

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF SOUTH DAKOTA

**IN THE MATTER OF THE
APPLICATION BY DEUEL HARVEST
WIND ENERGY SOUTH LLC FOR
ENERGY FACILITY PERMITS OF A
WIND ENERGY FACILITY AND A 345-
kV TRANSMISSION FACILITY IN
DEUEL COUNTY, SOUTH DAKOTA
FOR THE SOUTH DEUEL WIND
PROJECT**

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**DEUEL HARVEST WIND
ENERGY SOUTH LLC'S
RESPONSES TO STAFF'S FIRST
SET OF DATA REQUESTS**

EI 24-023

Deuel Harvest Wind Energy South LLC (“South Deuel Wind”) provides the following responses to Staff’s First Set of Data Requests in the above-captioned matter.

1-1) Please provide GIS shapefiles for the project.

Alexandra Thompson: Please see Exhibit 1-1 for the requested information.

1-2) Provide copies of all data requests submitted to you or by you and copies of all responses to those data requests. Provide this information to date and on an ongoing basis.

Monica Monterrosa: South Deuel Wind will provide copies of all data requests submitted to South Deuel Wind or by South Deuel Wind and copies of all responses to those data requests to the South Dakota Public Utilities Commission (“SDPUC”) on an ongoing basis.

1-3) Refer to Page 1 of the Application. The Applicant states “the Project will be located on privately-owned land within the 34,339-acre general Project Area, of which 29,258 acres are leased for the Project.”

a) How does the Applicant define the “general Project Area?” Please explain why approximately 5,081-acres that are not leased are considered part of the general Project Area.

Monica Monterrosa: The Project Area is defined as the 34,339-acre area identified in Figure 1 of Appendix A to the Application. The Project Area delineates the generalized area within which the Project will be located for referential and study purposes. The Project Area is not intended to delineate the extent to which South Deuel Wind has secured lease agreements. As such, both participating and non-participating property can be found within the Project Area.

b) Refer to Page 20. The Applicant states “the Project will be located on privately-owned land within the 48,730-acre general Project area, of which 29,258 acres are leased for the Project.” Please explain why general Project Area is defined as 34,339 acres on Page 1 and 48,730 acres on Page 20.



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Monica Monterrosa: The 48,730-acre figure was incorrectly presented on Page 20 of the Application. As described in response to SDPUC Data Request 1-3(a), the Project Area is 34,339 acres.

- 1-4) Is there an opportunity for South Deuel Wind to share facilities, such as the O&M facility or ADLS towers, or personnel with Deuel Harvest North Wind Farm? Please explain.

Monica Monterrosa: There are technically feasible opportunities for South Deuel Wind to share limited facilities and resources with the Deuel Harvest Wind Farm. However, business, physical, and operational challenges render resource sharing between the two projects impractical at this time. First, the majority interest in the Deuel Harvest Wind Farm is owned by Southern Power Company and there are no active discussions ongoing with Southern Power Company regarding potential ownership of, or partnership with, South Deuel Wind, which would be necessary to enable facility and resource sharing between the two projects. Second, the extremities of the two projects are approximately 6 miles apart at their closest adding to the distance that technicians would need to regularly travel to conduct fieldwork if dispatched from the Deuel Harvest Wind Farm O&M facility. Additionally, the Deuel Harvest Wind Farm O&M facility would likely need to undergo significant expansion to accommodate the additional technicians necessary to support South Deuel Wind. Third, technician training and operational performance monitoring differs between turbine manufacturers. If South Deuel Wind and Deuel Harvest Wind Farm utilize turbines supplied by different manufacturers, additional operational inefficiencies would be introduced. Fourth, utilizing the ADLS installed at the Deuel Harvest Wind Farm would require establishing a common link between the SCADA systems of the two projects, which from a security perspective, may not be allowed for projects under different ownership.

- 1-5) Refer to Page 1 of the Application. The Applicant states that “the wind energy facility will have a nameplate capacity of up to 260 megawatts (“MW”) and deliver up to 250 MW to the point of interconnection.” Please explain how the Applicant decided it would install approximately 10 MW of nameplate capacity above the amount requested through the interconnection.

Monica Monterrosa: The up to 10 MW of additional nameplate capacity beyond the 250 MW interconnection capacity is requested to provide flexibility during the turbine procurement process and account for system losses such as electrical collection system losses, wake losses, and turbine availability to ensure the Project can inject the full interconnection capacity into the transmission system.

- 1-6) Refer to Page 2 of the Application. The Applicant states that “South Deuel Wind has completed field surveys for 93 percent of the areas that would be temporarily and/or permanently impacted by Project Facilities as proposed in the Project Layout.”

- a) Why was South Deuel Wind unable to complete the field surveys on approximately 75 acres prior to filing the Application?

Michelle Phillips: South Deuel Wind has not field surveyed approximately 75 acres that are anticipated to be temporarily and/or permanently impacted by Project Facilities because of changes to the Project layout that occurred after the initial survey work was completed.

- b) Please list the field survey(s) that were not completed at the time the Application was filed.

Michelle Phillips: For the approximately 75 acres that are anticipated to be temporarily and/or permanently impacted by Project Facilities that have not yet been field surveyed, South Deuel Wind has not completed an update to the field wetland delineation, protected butterfly species habitat assessment, and archeological resources survey. The Project Layout considers desktop wetland data for all areas of proposed temporary and/or permanent impact that are outside of the initial survey area. South Deuel Wind will conduct additional field surveys prior to construction, as necessary, to ensure coverage of areas that will be temporarily and/or permanently impacted by Project Facilities in the final Project layout.

- c) Please identify any of the surveys identified in 1-2(a) that have been completed since the Application was filed. For the surveys that are not currently complete, please provide the anticipated completion date.

Michelle Phillips: South Deuel Wind has not completed any additional field surveys on the approximately 75 acres that are anticipated to be temporarily and/or permanently impacted by Project Facilities since the Application was filed. South Deuel Wind will complete the requisite surveys for any impacted areas prior to construction which is scheduled to begin September 2025.

- 1-7) Refer to Page 2 of the Application. The Applicant states that “there is one walk-in hunting area (“WIHA”) located on privately owned property participating in the Project that is anticipated to host Project Facilities. If Project Facilities are constructed on the property, the landowner has advised that the WIHA agreement will be modified or terminated as needed to accommodate the Project.” Has the Applicant verified with the South Dakota Game, Fish, and Parks that the WIHA agreement can be modified or terminated? Please explain.

Monica Monterrosa: Since filing the Application, South Deuel Wind continued to coordinate with the landowner of the property regarding the WIHA. He advised that he spoke with South Dakota Game, Fish, and Parks and has temporarily closed the WIHA effective 2024 and 2025, continuing through the completion of construction of the Project. Once construction is complete, the WIHA will be reopened. Subsequent to the landowner’s conversations, South Deuel Wind verified with the South Dakota Game, Fish, and Parks Hunting Access and Farm Bill Coordinator, Mark Norton, that this information is accurate. A copy of this correspondence with further details is provided as Exhibit 1-7.

- 1-8) Refer to Page 3 of the Application. The Applicant states that “South Deuel Wind may sell or assign the Project, or a portion thereof, to one or more public utilities or other qualified entity or entities at any time. Any future buyer or assignee will be required to meet all permit conditions and any power purchase agreement obligations associated with the Project or portion thereof.” Pursuant to SDCL 49-41B-29, please confirm that a permit may only be transferred subject to the approval of the SDPUC.

Monica Monterrosa: South Deuel Wind confirms that an Energy Facility Permit may only be transferred subject to the approval of the South Dakota Public Utilities Commission.

1-9) Refer to Page 3 of the Application. The Applicant states that the “noise from the Project during operations will be limited to 45 dBA at the perimeter of the existing non-participating residences.”

a) Is the 45 dBA referenced in this sentence an instantaneous maximum sound level or an average sound level? Please explain.

Michael Hankard: All noise levels described in the Application are a one-hour Leq (dBA). This is consistent with the applicable standard, ACP/ANSI 111-1 (2022), Wind Turbine Sound Modeling. Note that this is equivalent to the 10-minute measurement interval discussed in SDPUC Data Request 1-60. As discussed in the ACP/ANSI standard, these two time intervals are both considered valid for wind turbine noise predictions (and measurements).

b) How will the Applicant determine if it meets the 45 dBA limit?

Monica Monterrosa/Michael Hankard: South Deuel Wind is confident that the modeled (predicted) sound levels, which meet the 45 dBA limit at non-participating residences, are an over-estimation of the sound that will actually be produced by the Project. This confidence stems from Hankard Environmental’s expertise and prior validation of its methodologies. Hankard Environmental has validated the prediction method by comparing predicted noise levels at more than 15 operating wind energy facilities to measurement results conducted at each of those facilities. The method employed consistently over-predicts actual results by at least 1 to 2 dBA. The prediction method employed is that recommended by the ACP/ANSI standard, which states that “the methods proposed [by this standard] tend to overestimate, rather than underestimate, project sound levels”.

1-10) Refer to Page 3 of the Application. The Applicant states that the “Project will not exceed 30 hours of shadow flicker per year at existing residences.” Is 30 hours of shadow flicker referenced above the actual amount of shadow flicker a residence will experience in any given year or a modeled level of shadow flicker? Please explain.

JoAnne Blank: The Shadow Flicker Study provided as Appendix N to the Application was prepared using a conservative methodology intended to overpredict anticipated Project impacts. As a result, the modeled shadow flicker results provided in the Shadow Flicker Study are higher than can reasonably be anticipated during operations, i.e. actual shadow flicker is expected to be less than the modeled levels.

1-11) Refer to Page 16 of the Application. The Applicant states that “South Deuel Wind is actively submitting bids for power purchase agreements through various utility, commercial, and industrial opportunities.” Will the Applicant consider constructing the facility without a power purchase agreement? Please explain.

Monica Monterrosa: As described in Section 1.3 of the Application, South Deuel Wind may pursue other available options such as selling or assigning the Project, or a portion thereof, to one or more public utilities or other qualified entity or entities. South Deuel

Wind does not anticipate beginning construction on the Project without an executed agreement for the power produced by the Project or its ownership.

1-12) Refer to Page 18 of the Application. The Applicant states that “Wind energy generation is an inexhaustible source of clean electricity that *can help effectively address the identified capacity deficit* while avoiding the emission of particulate matter, heavy metals, and greenhouse gases caused by non-renewable combustion-based energy generation.” (*emphasis added*)

a) Is a wind energy facility generally considered more of an energy resource than a capacity resource? Please explain.

Monica Monterrosa: Intermittent resources in the MISO market, such as wind energy, qualify to provide both energy and capacity so long as they are registered with MISO and deliverable to load via Firm Transmission Service or Network Resource Interconnection Service (“NRIS”). Alternatively, intermittent resources can exclusively provide energy via Non-Firm Transmission Service or Energy Resource Interconnection Service (“ERIS”). During periods of grid congestion, generating facilities may be limited to delivering only the NRIS capacity allocated. As a general matter, wind energy facilities in the MISO market are considered more of a capacity resource.

b) Does the Applicant have an estimate for the capacity accreditation of South Deuel Wind? If yes, please provide supporting documentation for the calculation.

Monica Monterrosa: The Applicant anticipates that the capacity accreditation of South Deuel Wind will be consistent with MISO’s capacity values. MISO, in accordance with Federal Energy Regulatory Commission (“FERC”) acceptance of the Reliability Availability & Need seasonal capacity construct (ER22-495-000), developed four unique seasonal class average capacity values for wind for Planning Year 2024-2025, those being:

- 18.1% for Summer 2024
- 15.6% for Fall 2024
- 53.1% for Winter 2024-2025
- 18.0% for Spring 2025

Table 1-12b geographically illustrates the ten MISO Local Resource Zones (“LRZs”). The values shown in Table 1-12b have been combined for LRZs 5 & 6 so that proprietary information would not be revealed.

Table 1-12b: Distribution of Wind Capacity by LRZ

Planning Year 2024-2025 — Summer										
Metric	MISO	Zone 1	Zone 2	Zone 3	Zone 4	Zones 5 & 6	Zone 7	Zone 8	Zone 9	Zone 10
Registered Max (MW)	29,943	8,743	997	13,066	2,227	1,488	3,422	0	0	0
Total SAC (MW)	5,637	1,887	164	2,465	368	240	513	0	0	0
Average Credit %	18.0%	19.7%	15.1%	18.3%	16.2%	17.1%	14.6%	0%	0%	0%
Wind CPNode Count	273	102	13	98	16	9	35	0	0	0

Planning Year 2024-2025 — Fall										
Metric	MISO	Zone 1	Zone 2	Zone 3	Zone 4	Zones 5 & 6	Zone 7	Zone 8	Zone 9	Zone 10
Registered Max (MW)	28,796	8,320	906	12,796	1,977	1,488	3,310	0	0	0
Total SAC (MW)	4,726	1,573	134	2,136	241	185	457	0	0	0
Average Credit %	15.8%	17.4%	14.1%	15.7%	12.0%	14.0%	14.5%	0%	0%	0%
Wind CPNode Count	264	98	12	96	15	9	34	0	0	0

Planning Year 2024-2025 — Winter										
Metric	MISO	Zone 1	Zone 2	Zone 3	Zone 4	Zones 5 & 6	Zone 7	Zone 8	Zone 9	Zone 10
Registered Max (MW)	29,760	8,652	906	13,066	2,227	1,488	3,422	0	0	0
Total SAC (MW)	16,357	5,361	422	7,400	1,032	663	1,479	0	0	0
Average Credit %	52.2%	55.7%	43.7%	53.8%	46.2%	44.7%	45.3%	0%	0%	0%
Wind CPNode Count	271	101	12	98	16	9	35	0	0	0

Planning Year 2024-2025 — Spring										
Metric	MISO	Zone 1	Zone 2	Zone 3	Zone 4	Zones 5 & 6	Zone 7	Zone 8	Zone 9	Zone 10
Registered Max (MW)	29,943	8,743	997	13,066	2,227	1,488	3,422	0	0	0
Total SAC (MW)	5,736	1,831	144	2,594	353	243	571	0	0	0
Average Credit %	18.6%	19.8%	14.2%	19.1%	15.5%	16.9%	16.9%	0%	0%	0%
Wind CPNode Count	273	102	13	98	16	9	35	0	0	0

1-13) Refer to Page 19 of the Application. The Applicant states that “the development terms in the Project’s lease agreements are susceptible to expiration, jeopardizing the necessary property rights to site the Project.” Specifically, what is the soonest expiration date of any of the Project’s lease agreement? Do the lease agreements have renewal options? Please explain.

Monica Monterrosa: The earliest expiration date of the Project’s development term in its lease agreements is January 2026. The leases do not have any renewal options for the development term.

1-14) Refer to Page 19 of the Application. The Applicant states that “environmental and engineering studies may become outdated, necessitating duplicative efforts.”

a) Which specific engineering studies may become outdated and why? Is there a specific deadline for a decision associated with each engineering study?

Alexandra Thompson: While most engineering studies do not "expire", it is best practice to refresh certain studies every 2-3 years to ensure that the most up-to-date site information is being considered for the Project. For example, the communication and airspace studies provided as Appendix O, P, Q, R, and S to the Application are typically refreshed to identify any changes to infrastructure or usages and ensure any impacts identified continue to be avoided or mitigated accordingly. Similarly, noise and shadow

flicker studies can be updated to reflect changes to the Project layout or equipment selections.

Once the FAA completes its Aeronautical Study and issues a "Determination of No Hazard", the determinations will expire after 18 months if construction has not started. The determinations can be renewed once for an additional 18 months. If construction does not begin within 3 years of issuance, the turbine locations must be re-filed and re-studied by the FAA.

b) Which specific environmental studies may become outdated and why? Is there a specific deadline for a decision associated with each environmental study?

Michelle Phillips: No specific environmental studies have become outdated. While the Project’s environmental studies do not "expire", it is best practice to refresh surveys if there is potential that conditions have changed.

1-15) Refer to Page 19 of the Application. The Applicant states that “South Deuel Wind’s Generator Interconnection Agreement (“GIA”) will be, and Deuel County CUP is subject to expiry, adding further need to adhere to the Project schedule.”

a) When does the GIA expire?

Monica Monterrosa: South Deuel Wind anticipates executing a GIA for the Project before the end of 2024. The Commercial Operation Date (“COD”) defined in the GIA can be extended for a maximum of 3 years. South Deuel Wind anticipates executing the GIA with a COD of December 2026, meaning the COD can be extended to December 2029. After this timeframe, if the Project has not commenced construction, the GIA will expire. If the Project has commenced construction, the GIA will remain active throughout the life of the Project, until the Project is decommissioned.

b) When does the Deuel County CUP expire?

Monica Monterrosa: If the Project has not begun construction, the Deuel County CUP will expire in August 2026.

1-16) Refer to Page 19 of the Application. The Applicant states that the current estimated capital cost of the Project is approximately \$621 million. Please provide detailed cost breakdown to support that estimate.

Monica Monterrosa: Please see Table 1-16 for the requested information.

Table 1-16: Estimated Project Costs	
Cost Category	Cost (\$millions)
Turbine Supply	\$322
Construction & Procurement	\$223
POI Network Upgrades	\$4
Real Estate & Field Studies	\$12
Sales Tax	\$17
Financing Costs	\$43
Total Estimated Project Costs	\$621

- 1-17) Refer to Page 21 of the Application. The Applicant requests that “the Permit allow Gen-Tie transmission structures to be shifted within the 150-foot-wide Gen-Tie Line right-of-way.” Is there a minimum distance required between the transmission line and the edge of the Gen-Tie Line right-of-way? Please explain.

Monica Monterrosa: Yes, there is a minimum distance required between the Gen-Tie Line conductors and the edge of the Gen-Tie Line right-of-way (“ROW”). The minimum distance required is equal to the maximum blowout of the Gen-Tie Line conductors in an extreme wind loading case scenario, including a buffer that is reasonable by industry standards. South Deuel Wind will determine this distance for each span during final engineering and ensure that the Gen-Tie Line conductors will remain within the Gen-Tie Line ROW during extreme wind conditions with appropriate electrical clearance to the edge of the ROW.

- 1-18) Refer to Page 21 of the Application. The Applicant states that “South Deuel Wind developed this Application with a set of proposed turbine locations that can accommodate the turbine models identified in Table 4.2.1.” Would it be possible to identify the specific turbine model prior to the hearing in this permit proceeding? If no, please explain.

Monica Monterrosa: No. South Deuel Wind presents three specific turbine models in Table 4.2.1 of the Application for consideration by the SDPUC. The turbine models are relatively similar and thus South Deuel Wind respectfully requests that the Permit allow for the use of turbine models of comparable capacity and specifications, provided the Project meets county siting standards and Permit conditions. Limiting a project to installing a singular turbine model at a given turbine location adds risk and significantly reduces a project’s ability to negotiate cost-effective turbine supply agreements. If only one turbine model is permitted for a project, the vendor of that turbine model would hold substantial leverage during negotiations and may result in additional costs for the ultimate customer(s) of the project. Additionally, turbine supply agreements are typically executed after key permits are obtained because they require significant capital expenditure that would be at risk pending the necessary approvals.

- 1-19) Refer to Page 21 of the Application. The Applicant states that the “Project Layout shown in Figure 2 in Appendix A identifies 73 proposed turbine locations, of which up to 68 will be constructed.” Please identify how many locations will be constructed for each of the three models under consideration (GE, Siemens, Vestas).

Alexandra Thompson: South Deuel Wind will likely install turbines from one supplier but may elect to install turbines from multiple suppliers. If the final Project layout were comprised of only the General Electric 3.8-154 turbine, up to 68 turbine locations would be constructed. If the final Project layout were comprised of only the Siemens Gamesa 4.4-164 turbine, up to 59 turbine locations would be constructed. If the final Project layout were comprised of only the Vestas 163-4.5 turbine, up to 57 turbine locations would be constructed.

- 1-20) Refer to Page 21 and 22 of the Application. The Applicant states that “turbine locations were sited in accordance with industry standard spacing.” Pursuant to ARSD 20:10:22:33.01(1), please provide additional description regarding the distance between the turbines in the proposed layout.

Alexandra Thompson: Invenergy has extensive experience developing wind energy facilities and works closely with turbine manufacturers to evaluate suitability of turbine locations from a loading perspective to preserve the mechanical integrity of equipment for the project lifetime. Invenergy also works with third-party energy assessors to model the wind conditions at project sites and characterize the blockage and wake impacts to maximize energy production through turbine siting. Based on internal expertise and alignment with manufacturers and third-party energy assessors, Invenergy aims to maintain a distance of approximately three times the rotor diameter of the turbine between each turbine in the final Project layout. Larger spacing is utilized in the prevailing wind direction to minimize energy losses due to internal waking.

1-21) Refer to footnote 2 on Page 21 of the Application.

a) Can the Applicant identify what turbine locations are alternate sites? If not, please explain why not. If yes, please provide an updated turbine layout identifying the alternate turbine locations.

Alexandra Thompson: The final turbine locations will be dependent on the turbine model(s) ultimately employed, wind production analyses, and site-specific evaluations based on the model(s) selected. As such, it is not practically feasible to identify alternatives with certainty.

b) What are the mitigation methods to be implemented during project operations, should they be needed, to site the SG or Vestas turbines at locations 69 and 76?

Alexandra Thompson: If the SG 4.4-164 or V 163-4.5 turbine models are included in the final Project layout at turbine locations 69 and 76, other nearby turbine locations contributing to shadow flicker impacts at nearby receptors may not be included in the final Project layout. Alternatively, if turbine locations 69 and 76 are built alongside neighboring turbines, steps will be taken to limit the shadow flicker at the receptor to 30 hours per year. One option that may be employed is turbine curtailment.

1-22) Refer to Page 23, Section 4.2.6 of the Application. Will the lightning protection system prevent the blades from bursting and spreading fiberglass pieces across the ground in the event of a lightning strike? Please explain.

Alexandra Thompson: Yes, the lightning protection system (“LPS”) is designed to conduct lightning without significant damage to the turbine blades. The LPS works by conducting the strike through a cable which is grounded through the turbine foundation. In the unlikely event the LPS is damaged or a blade is struck multiple times within a storm event, damage to the blade is possible. Blades do not burst. Instead, damage may include cracks or peeling to the fiberglass coating. Operations personnel will repair the blade and check connectivity to the LPS cable after the repair. In very rare cases, blade damage could result in debris in the immediate area. In this situation, operations personnel would work with the landowner to remove the debris.

1-23) Refer to Page 24, Section 4.2.10 of the Application. The Applicant states that “[t]he Gen-Tie Line will be an overhead 345 kV transmission line of a three-phase, single-circuit, monopole design.” That section also states: “[t]ransmission structures will be single pole or H-frame structures, likely made of weathered steel.”

- a) Are H-frame structures considered a monopole design? If no, please clarify the discrepancy in the two statements noted above.

Monica Monterrosa: No, South Deuel Wind does not consider H-frame transmission structures as monopole transmission structures. Most of the transmission structures anticipated to be utilized for the Gen-Tie Line will be monopole transmission structures. Only in limited circumstances, when necessary, will the transmission structures deviate from a monopole design, i.e. use multi-pole structures. Figure 3 in Appendix A to the Application includes preliminary schematics of transmission structures that are anticipated to be used for the Gen-Tie Line. In limited circumstances, the Project may also require the use of a three-pole transmission structure. A preliminary schematic of a three-pole transmission structure design is provided in Exhibit 1-23.

- b) How will the Applicant determine if the transmission structures will be single pole or H-frame structures? Please explain in what circumstances an H-frame structure may be needed and why that structure is required.

Monica Monterrosa: Monopole transmission structures will be utilized for the Gen-Tie Line wherever possible. H-frame structures may be utilized where necessary to reduce the height of the structures and to meet code clearances at utility crossings.

- c) Can the Applicant identify the locations H-frame structures will be needed? If yes, please provide a map of the Gen-Tie Line that includes structure locations and type. If no, please explain why the location of H-frame structures cannot be identified.

Monica Monterrosa: Not at this time. The final Gen-Tie Line structure types and locations will be determined during final engineering and will be dependent on a variety of constraints including but not limited to crossing agreements, environmental constraints, landowner constraints, and geotechnical conditions.

- 1-24) Refer to Page 25, Section 4.2.11 of the Application regarding the Generator Interconnection Agreement.

- a) Has the Applicant executed a GIA with Otter Tail Power Company and MISO? Please provide an update.

Monica Monterrosa: No. South Deuel Wind anticipates executing a GIA for the Project by the end of 2024.

- b) Is there the potential for required upgrades to the transmission system being cost prohibitive for the project? Please explain.

Monica Monterrosa: Yes, this is a risk. Upgrades to the transmission system that are determined as part of the generator interconnection process may render the Project uneconomical. Final system upgrade costs are not known at this time.

- 1-25) Refer to Page 26, Section 4.2.15 of the Application. The Applicant states “[i]f approved by the FAA, an ADLS will be installed to minimize illumination time of the lights.”

- a) When does the Applicant expect the FAA review and approval of the ADLS to be completed by?

Alexandra Thompson: The Department of Defense is currently in the process of reviewing the project's request for ADLS. Once complete, the FAA will review the ADLS in conjunction with the turbine locations for the Project. Approval for the ADLS is expected shortly after receipt of Determinations of No Hazard for the turbine locations. At this time, it is unknown when the FAA will issue Determinations of No Hazard for the turbine locations. South Deuel Wind will coordinate with the FAA to finalize the marking and lighting plan for the Project prior to construction.

b) Does the Applicant expect ADLS to be installed and utilized prior to commercial operation of the Project? If no, please explain.

Alexandra Thompson: Yes, South Deuel Wind expects the ADLS to be installed and utilized prior to commercial operation of the Project.

1-26) Refer to Page 26, Section 4.3 of the Application. The Applicant states that "private land and public road ROW will be used for all Project Facilities."

a) Which Project Facilities will be located in the public road ROW?

Alexandra Thompson: Access road entrances, electrical collection and SCADA system crossings, Gen-Tie Line crossings, crane path crossings, and public road improvements are anticipated to be located in the public road ROW.

b) Approximately how many miles of transmission line will be placed in the public road ROW? Has the Applicant received approval from the appropriate governmental authority to place facilities in the public road ROW? Please explain.

Alexandra Thompson: Approximately 0.1 miles Gen-Tie Line will cross public road ROW. South Deuel Wind will obtain the necessary permits and crossing agreements for the Gen-Tie Line prior to construction.

1-27) Refer to Page 26, Section 4.4 of the Application. The Applicant states that "the construction schedule may be impacted by events outside of South Deuel Wind's control, such as unanticipated issues with equipment procurement, contracting, weather, or other scheduling factors." Is the Applicant aware of equipment procurement or contracting issues currently plaguing the wind energy industry? If yes, please describe the current challenges in the market.

Monica Monterrosa: South Deuel Wind is not aware of any industry-wide equipment procurement or contracting issues ongoing at this time.

1-28) Refer to Page 28 of the Application. The Applicant states that "public roads may require improvements to allow for the safe and efficient access of trailers carrying turbine components and construction equipment to the Project Area. South Deuel Wind is in the process of identifying the optimal haul route to the Project Area and where existing road improvements may be required." At the public input meeting in Clear Lake, SD on August 22, 2024, Mr. Josh Bekaert stated concern regarding a culvert near his home and the ability of South Deuel Wind to access a turbine location via that road. Is the Applicant aware of the culvert Mr. Bekaert is concerned about? Please explain the improvements that need to be made to that specific road, if any, or any further work the Applicant is performing to address Mr. Bekaert's concern.

Monica Monterrosa: Yes. South Deuel Wind is aware of the culvert near Mr. Bekaert's property. South Deuel Wind has spoken with Mr. Bekaert about his concerns and has received culvert specifications from Deuel County to further inform the evaluation of road improvements needed, if any. South Deuel Wind's review is currently in process.

- 1-29) Refer to Page 28, Section 4.4.3 of the Application. What restoration measures will be implemented to restore subgrade that required cement stabilization back to its original condition?

Monica Monterrosa: Temporary portions of access roads will not receive cement stabilization. If needed, permanent access roads will be cement stabilized. During the decommissioning of the Project, the subgrade for cement stabilized access roads will be restored by excavating four (4) feet below grade to remove the cement, decompacting the subsoil, replacing the topsoil, and seeding.

- 1-30) Refer to Page 31, Section 4.4.11 of the Application. The Applicant states "[s]hould any aspect of the Project construction or operations present unfamiliar situations for first responders, South Deuel Wind will arrange for adequate professional training to address those concerns."

- a) What situations does South Deuel Wind envision the first responders will need to train for?

Monica Monterrosa: South Deuel Wind does not anticipate any specialized training to be necessary for first responders to respond to an incident at the Project. In the event of an incident, South Deuel Wind envisions first responders will transport injured employees to the appropriate medical facility. First responders will not be required to climb and assist in a rescue effort. As part of the Emergency Response Plan, South Deuel Wind will coordinate an annual emergency response drill with first responders and request their participation to bolster their understanding of South Deuel Wind's incident response process and assist in site familiarization.

- b) Has Invenergy arranged for first responder training for other projects in its fleet? If yes, what were the types of training requested by first responders at other projects?

Monica Monterrosa: Invenergy coordinates annual emergency response drills with the first responders local to each project in its portfolio in accordance with the project's emergency response plan. Additional specialized training has not been necessary.

- 1-31) Refer to Page 33 of the Application. The Applicant states that "the transmission facility may remain in use or be repurposed after the operational life of the wind energy facility." Please elaborate why or how the gen tie may remain in use or be repurposed after the operational life of the wind energy facility.

Monica Monterrosa: South Deuel Wind included decommissioning of the Gen-Tie Line in the Decommissioning Plan provided as Appendix X to the Application. Transmission lines are designed to operate for decades, and typically require only moderate maintenance. It is likely that the transmission line will continue to have useful capacity beyond the operational life of the Project. As such, it is possible that the Gen-Tie Line may be able to be incorporated into the design of another project or use-case as opposed to being decommissioned.

- 1-32) Refer to Page 35 of the Application. The Applicant states that “the approximately 6-mile-long proposed Gen-Tie Line route is the most direct and feasible path between the Collector Substation and the Interconnection Switchyard.” Pursuant to ARSD 20:10:22:35(3), did the Applicant consider any other routes? If yes, please provide the alternatives as depicted on overhead photographs and land use cultural maps.

Alexandra Thompson: In developing a route for the Gen-Tie Line, South Deuel Wind considered multiple factors. First, land rights. South Deuel Wind only considered participants’ land for constructing the Gen-Tie Line, which narrowed the paths available for the Gen-Tie Line. South Deuel Wind also developed the route in the Application based on landowner input and review of cultural and environmental data and appropriate spacing between the wind turbines and the transmission line. During Project Development, South Deuel Wind considered alternative parcels and Project substation locations but did not fully develop end to end routes such as proposed in the Application. Rather, segments were evaluated and included or excluded based on the above factors.

- 1-33) Refer to Page 36 of the Application. The Applicant states that Project representatives have held meeting with the Lake Cochrane Improvement Association. Please summarize those discussions and identify actions taken by the Applicant to address their concerns.

Monica Monterrosa: South Deuel Wind has been aware of and receiving input from the Lake Cochrane Improvement Association (LCIA) since starting to develop the Deuel Harvest Wind Farm and South Deuel Wind Project in 2015. South Deuel Wind and LCIA both participated in the Wind Energy System permitting updates to the Deuel County Zoning Ordinance. One of the concerns LCIA raised during the county CUP process was whether three of the preliminary locations shown in the CUP application satisfied the 3-mile Lake Cochrane Park District setback requirement. Upon review, South Deuel Wind determined the turbine locations were non-compliant and removed the locations from further consideration.

- 1-34) Refer to Page 37, Section 5.2 of the Application. Please provide the legal citations to support the statement “[s]etbacks are measured from the center point of the turbine” when referring to state and local setback requirements. If there are no legal citations, please explain why measurements from the center point of the turbine is more appropriate than from the closest edge of the turbine foundation.

Lisa Agrimonti: South Deuel Wind objects to the request because it seeks legal analysis and conclusions. Subject to this objection, South Deuel Wind provides the response below.

Monica Monterrosa/Lisa Agrimonti: This statement in the Application was a typographical error. Setbacks from residences, businesses, and public buildings are measured from the outside wall of the turbine tower. This is the measuring point identified by the county zoning officer, Jodi Theisen, relying on Deuel County Zoning Ordinance, Article III Definitions:

Setback Between Uses. Unless specifically mentioned within this ordinance, the setback or separation distance between uses is the minimum horizontal distance measured from the wall line of a neighboring principal building to the wall line of the proposed

building/structure/use. In regard to concentrated animal feeding operations the separation distance shall be measured from the wall line of the neighboring principal building to the wall line of the feedlot or structure housing animals and/or manure management facility.”

Setbacks from property lines, as required by SDCL 43-13-24 are also measured from the outside wall of the turbine towers. SDCL 43-12-24 does not specify the part of the tower to measure from. Absent any specified legal requirement, measuring from the outside wall of the turbine tower is appropriate because it is consistent with the Deuel County Zoning Ordinance and because one of the primary reasons for setbacks is aesthetics (foundations are not visible from a distance). An email from Ms. Theisen regarding setbacks is provided as Exhibit 1-34 (highlighting in original).

- 1-35) Refer to Page 38, Table 5.2 of the Application. It is identified that Deuel County has a setback requirement that states “[d]istances from existing non-participating residences and businesses shall be not less than four time the height of the wind turbine.” Please provide the required setback distance (in feet) that Deuel Harvest must meet for its proposed turbines in order to comply with this requirement.

Alexandra Thomspson: For the GE 3.8-154 turbine model which has a tip height of 574 feet, the Deuel County non-participating residence and business setback is 2,296 feet from the outside wall of the turbine tower. For the SG 4.4-164 and V163-4.5 turbine models which have tip heights of 589 feet, the Deuel County non-participating residence and business setback is 2,356 feet from the outside wall of the turbine tower.

- 1-36) Refer to Page 39 of the Application and ARSD 20:10:22:13. Please explain why the Astoria Power Plant is not included in the cumulative environmental assessment in the Application.

Monica Monterrosa: The 245 MW Astoria Station owned by Otter Tail Power Company is a simple-cycle natural gas combustion turbine generating facility that began operating in May 2021 and consists of a single Mitsubishi Hitachi Power Systems Americas M501GAC combustion turbine that was permitted and constructed separately and prior to South Deuel Wind. The Astoria Station is located approximately 0.78 miles from the nearest turbine location (Turbine 72) in the Project. South Deuel Wind is unaware of any planned alterations to the Astoria Station. Because South Deuel Wind does not own or operate the Astoria Station, it can provide only a qualitative discussion of potential cumulative impacts. Because construction of the Astoria Station was completed several years before construction of this Project is anticipated to commence, the construction and operation of the Project is not anticipated to cause additional construction or operation impacts to natural resources, traffic, or construction noise of the immediate area when considered in combination with the Astoria Station. Likewise, construction and operation of the Project are not anticipated to contribute to cumulative emissions from the Astoria Station.

- 1-37) In section 7.1.1.6 of the Application it is stated that “[t]he potential for subsidence and slope instability within the Project Area is negligible and is not considered to be a risk.” In Figure 5 of Appendix A, the topographic map appears to indicate that turbines 4, 5, and 35 are sited near the edge of a ridge. Please provide further discussion on why slope instability is not considered to be a risk for those specific turbines.

Alexandra Thompson: South Deuel Wind will clear, grade, and develop an up to 250-foot radius construction workspace around each turbine site. However, this construction workspace does not have to be centered on the turbine location and allows for minor shifts to avoid complex terrain and sensitive areas, if necessary. Turbine locations 4, 5, and 35 are sited near more complex terrain. However, current designs have determined sufficient flat land exists for construction activities at these locations. South Deuel Wind has conducted geotechnical investigations at these turbine locations and concluded that based on the soil characteristics, the risk of slope instability is low.

- 1-38) Section 7.2.2 of the Application states “[a]djustments to Project Facilities will be made for unsuitable soils as needed.” Please identify the adjustments that may need to be made if geotechnical borings indicate the need for such and when South Deuel Wind will know if such adjustments need to be made.

Alexandra Thompson: As stated in Section 4.2 of the Application, South Deuel Wind respectfully requests that the Permit allow turbines to be shifted within 250 feet of their currently proposed locations, so long as they are located on leased land, specified noise and shadow flicker thresholds are not exceeded, county siting standards are complied with, cultural resource impacts and documented habitats for listed species are avoided, and wetland impacts are avoided or are in compliance with applicable USACE regulations. South Deuel Wind has completed geotechnical borings at 69 of the 73 proposed turbine locations and has determined that no adjustments are required due to geotechnical conditions at this time. Geotechnical borings for the remaining 4 turbine locations (23, 93, H, and J) will be completed prior to construction if included in the final Project layout.

- 1-39) Please identify what figure in Appendix A of the Application shows surface water drainage patterns as required by ARSD 20:10:22:15(1). If a figure does not include surface water drainage patterns, please provide a map that meets the requirement.

Michelle Phillips: Figures 1 and 9 in Appendix A to the Application show current surface water drainage patterns; the Project is not anticipated to impact surface water drainage patterns.

- 1-40) Referring to Section 8.1.1 of the Application and ARSD 20:10:22:15(4), please provide the specifications of the aquifer that may be used to supply the O&M facility, including the capacity of the aquifer to yield water, the estimated recharge rate, and the quality of the ground water.

Monica Monterrosa: The O&M Facility is located within the Prairie Couteau Aquifer. The storage capacity of this aquifer is 5,000,000 acre-ft (Kume 1985), can have a discharge rate of 1000 gallon/minute (Kume 1985), and has a recharge rate of 4.9 inches/year (Hedges et al. 1985). The closest public drinking water system is in Clear Lake, South Dakota. Clear Lake receives its water from the Brookings-Deuel Rural Water System (City of Clear Lake 2023). This system is within the Prairie Couteau Aquifer and Big Sioux Aquifer. The Big Sioux Aquifer has a storage capacity of 480,000 acre-ft (Kume 1985), can have a discharge rate of 1000 gallon/minute (Kume 1985), and has a recharge rate of 6.9 inches/year (Hedges et al. 1985). The Brookings-Deuel Rural Water System has met quality requirements from the South Dakota Department of Agriculture and Natural Resources for 18 consecutive years (Brookings-Deuel Rural Water System 2023).

New citations:

- Hedges, L., J. Allen, and D. Holly. (1985). Evaluation of Ground-Water Resources Eastern South Dakota and Upper Big Sioux River South Dakota and Iowa. Prepared for the Planning Division of U.S. Army Corps of Engineers. 40pp.
- City of Clear Lake (2023). Drinking Water Report. 5pp.
- Brookings-Deuel Rural Water System. (2023). Drinking Water Report. 6pp.

1-41) Please explain how Figure 9 of the Application meets the requirement in ARSD 20:10:22:15(2) that states “[u]sing plans filed with any local, state, or federal agencies, indication on a map drawn to scale of the current planned water uses by communities, agriculture, recreation, fish, and wildlife which may be affected by the location of the proposed facility [...].”

Monica Monterrosa: The location of the Project will not affect municipal or private water uses in the Project Area. As such, water usages are not identified in Figure 9 in Appendix A to the Application. Figure 14 in Appendix A to the Application identifies the locations of water wells and permitted water rights within the Project Area. As stated in Section 8.3.2 of the Application, surface water appropriation, permanent dewatering, deep well injection, and water storage, reprocessing, or cooling will not be required for construction or operation of the Project. Water use at the O&M Facility will be similar to household volume and is anticipated to be less than five gallons per minute.

1-42) Referring to Section 9.2.2 of the Application, please explain how temporary impacts to wetlands due to crane paths will be minimized.

Michelle Phillips: Temporary impacts associated with crane paths will be minimized by consolidating crane walking areas where possible, requiring crane travel within specified and marked routes, avoiding wetlands where possible, using matting or other best practices where crossing wetlands, and restoring wetlands to preconstruction conditions.

1-43) In Section 9.3.1.2 of the Application, it is identified that one geographical feature used by raptors during migration is ridgelines. That section goes on to conclude: 1) that “[t]he Project is located on flat to gently rolling land, lacking the defined topographical ridges or other features typically used by migrating raptors” and 2) “[t]here is a high potential for raptors to use [...] riparian corridors along streams and unnamed drainages in the Project Area.”

a) Looking at the topographical map in Figure A-2 (Page 2 of 22) of Appendix E, please explain why the topography on the north side of turbines 4, 5, and 35 is considered gently rolling without a defined topographical ridge.

Michelle Phillips: The overall topography of the Project Area is qualitatively assessed as gently rolling land without defined topographical ridges. The area to the north of turbine locations 4, 5, and 35 has a gradual slope towards Hidewood Creek with a topographic change of less than 15%. Areas to the south of these turbine locations are flatter. A topographical ridge is considered to be a continuous, narrow, long elevated landform separated from surrounding landforms by steep sides in multiple directions. Based on the Project Layout, these turbine locations are sited outside of the sloping areas toward Hidewood Creek. As stated in Section 9.3.1.2 of the Application, “No unique land

features, habitat types, or seasonal differences are known to occur in the Project Area relative to the overall landscape of the region...”

- b) Please explain why turbines 4, 5, and 35 do not pose a risk to raptors since they appear to be sited (1) next to a riparian corridor along Hidewood Creek and (2) on top of what appears to be a defined topographical ridgeline.

Michelle Phillips: As stated in Section 9.3.3 of the Application, “Bird species such as raptors (hawks, eagles, falcons, and owls) appear to be at higher risk of collisions with wind turbines, although the reason is not fully understood (National Wind Coordinating Collaborative [NWCC], 2004). Fatality rates of birds at wind energy facilities likely depend on amount of bird use, vegetation, and other physical and biological characteristics of the facility and surrounding area.” The overall topography of the Project Area is qualitatively assessed as gently rolling land without defined topographical ridges. A topographical ridge is considered to be a continuous, narrow, long elevated landform separated from surrounding landforms by steep sides in multiple directions. The area to the north of turbine locations 4, 5, and 35 has a gradual slope towards Hidewood Creek with a topographic change of less than 15%. Areas to the south of these turbine locations are flatter. Based on the Project Layout, these turbine locations are sited outside of the sloping areas toward Hidewood Creek. Hidewood Creek is approximately 1,230 feet from turbine location 4, 1,640 feet from turbine location 5, and 3,050 feet from turbine location 35, respectively. As stated in Section 9.3.1.2 of the Application, “No unique land features, habitat types, or seasonal differences are known to occur in the Project Area relative to the overall landscape of the region that could concentrate prey and potential use by raptors,” as well as, “potential for raptors to use open fields, wetland areas, Fox Lake, Cottonwood Slough, and riparian corridors along the streams and unnamed drainages in the Project Area.”

- 1-44) In Section 9.4.1 of the Application, it is stated: “[d]irect impacts to this species [osprey] include potential collision with wind turbines, although, as discussed in Section 9.3.3 above, bird fatalities due to collisions with wind energy facilities is unlikely [...]” Please provide support for the conclusion that bird fatalities due to collisions with wind energy facilities is unlikely.

Michelle Phillips: As stated in Section 9.3.2.2 of the Application “Ospreys have been recorded in the general vicinity of the Project Area, mostly during migration. There are several recent observations, including 2023 at Lake Poinsett (17 miles from the Project Area), 2021 at Oakwood Lakes (18 miles) and 2017 at Lake Hendricks (7 miles; eBird 2023).” Ospreys are not prevalent in the Project Area. As stated in Section 9.3.3 of the Application, “Bird species such as raptors (hawks, eagles, falcons, and owls) appear to be at higher risk of collisions with wind turbines, although the reason is not fully understood (National Wind Coordinating Collaborative [“NWCC”], 2004). Fatality rates of birds at wind energy facilities likely depend on amount of bird use, vegetation, and other physical and biological characteristics of the facility and surrounding area.” As stated in Section 9.3.1.2 of the Application, “No unique land features, habitat types, or seasonal differences are known to occur in the Project Area relative to the overall landscape of the region that could concentrate prey and potential use by raptors,” as well as, “potential for raptors to use open fields, wetland areas, Fox Lake, Cottonwood Slough, and riparian corridors along the streams and unnamed drainages in the Project Area.”

1-45) In Section 10.1.1 of the Application it is stated: “The Project Area is located in the [...] Middle Big Sioux Sub-basin of the Big Sioux Basin drainage system.” In Section 10.1.2 of the Application it is stated “[t]he current known distribution of the banded killifish in South Dakota is limited to the James, Vermillion, and Big Sioux River Basins [...].” Further, Section 10.1.2 of the Application concludes that the known distribution range for the banded killifish is outside the Project Area, making the potential occurrence for this species in the Project area unlikely.

a) Is the Big Sioux Basin drainage system different than the Big Sioux River Basin? Please explain.

Michelle Phillips: The Big Sioux Basin is the aquifer that the Project crosses. The aquifer is split into three sub-basins and the Project is within the Middle Big Sioux Sub-basin. The Big Sioux River Basin is the basin/watershed of the Big Sioux River.

b) If the Big Sioux Basin drainage system is part of the Big Sioux River Basin, please explain how the conclusion can be made that the banded killifish’s currently known distribution range is outside the Project Area.

Michelle Phillips: The currently known distribution of the banded killifish is limited to lakes and ponds within the James, Vermillion, and Big Sioux River Basins. The preferred habitat of the banded killifish within the Big Sioux River Basin is shallow lakes and ponds with abundant aquatic vegetation and sandy-gravel substrates. While the Big Sioux River Basin may contain suitable habitat for the banded killifish, the Project is not anticipated to cross or impact these areas as stated in Section 10.1.2 of the Application.

1-46) In Section 10.2.2 of the Application it is stated that “South Deuel Wind will avoid direct impacts to streams and BMPs will be implemented to control sedimentation and erosion during construction to prevent downstream water quality impacts.”

a) Does the statement mean that South Deuel Wind will bore or horizontally directional drill under all streams? Please explain.

Michelle Phillips: Yes. Directional boring will be used in locations where circuits and cables cross waterways. Project facilities that cannot be directionally drilled will include spanning waterways by the Gen-Tie Line and crossing streams with crane paths including consolidation of crane walking areas where possible, requiring crane travel within specified and marked routes, avoiding wetlands where possible, using matting or other best practices when crossing wetlands, and restoring wetlands to preconstruction conditions.

b) In its letter dated October 3, 2022, the South Dakota Game Fish and Parks recommended the Project horizontal directional drill any stream crossings on Cobb Creek. Does South Deuel Wind plan to adopt this recommendation? Please explain why or why not.

Michelle Phillips: Yes. Directional boring will be used in locations where circuits and cables cross Cobb Creek. Project facilities that cannot be directionally drilled will include spanning waterways by the Gen-Tie Line and crossing streams with crane paths including consolidation of crane walking areas where possible, requiring crane travel within specified and marked routes, avoiding wetlands where possible, using matting or other

best practices when crossing wetlands, and restoring wetlands to preconstruction conditions.

- c) Please provide a list of all streams and the crossing technique that will be used for project facilities, including both temporary (e.g. crane paths) and permanent facilities (e.g. collection lines).

Michelle Phillips: Please see Table 1-46(c) for a list of all streams and the crossing technique that will be used for Project Facilities.

Table 1-46(c)			
Stream ID	Stream Type	Infrastructure	Crossing Technique
S-A-3	Ephemeral	Crane Path	Matting
S-B-1	Intermittent	Collector Circuit	Directional Bore
S-B-2	Ephemeral	Collector Circuit	Directional Bore
S-B-3	Intermittent	Collector Circuit	Directional Bore
S-B-4	Intermittent	Collector Circuit	Directional Bore
S-B-5	Intermittent	Collector Circuit	Directional Bore
S-B-6	Ephemeral	Collector Circuit	Directional Bore
S-B-7	Ephemeral	Collector Circuit	Directional Bore
S-B-7	Ephemeral	Gen-Tie Line	Overhead Span
S-D-4	Intermittent	Collector Circuit	Directional Bore
S-D-5	Ephemeral	Collector Circuit	Directional Bore
S-D-5	Ephemeral	Gen-Tie Line	Overhead Span
S-G-1	Intermittent	Collector Circuit	Directional Bore
S-G-3	Intermittent	Collector Circuit	Directional Bore

- 1-47) Section 11.2.1.1 of the Application identifies that there is one parcel of the Dakota Tallgrass Prairie Wildlife Management Area 145 in the project area. Figure 13 of Appendix A shows two different parcels as part of the Dakota Tallgrass Prairie Wildlife Management Area being located within the project area. Please explain this discrepancy.

Michelle Phillips: Based on the information South Deuel Wind can identify for dates of database updates, the information provided by the United States Geological Survey Protected Areas Database-US has been updated recently. This dataset includes the National Conservation Easement Database. Using this data, the three parcels within the yellow polygons shown in Figure 13 of Appendix A to the Application should be classified as Dakota Tallgrass Prairie Wildlife Management Areas.

There seems to have been a change in classification in these parcels from when South Deuel Wind first received information from the USFWS in 2022 and the information gathered for the Application. In the files received on October 25, 2022 from the USFWS, the parcels were classified as Deuel County Waterfowl Production Areas. However, sometime between when the Project received the data from the USFWS and the Application submission, the parcels in question were reclassified to be Dakota Tallgrass Prairie Wildlife Management Area. There is no indication as to the date when the reclassification occurred. The Project meeting with the USFWS in 2023 indicated that these parcels were Deuel County Waterfowl Production Areas, and there was no discussion at that time of any error in that classification.

1-48) Referring to Section 11.4.2 of the Application regarding visual impacts and mitigation.

- a) Please explain how the setbacks in Table 5.2 are intended to minimize visual impacts of the Project.

Monica Monterrosa: South Deuel Wind incorporated the setbacks identified in Table 5.2 of the Application into the Project Layout. These separation distances were established, in part, by Deuel County to reduce aesthetic impacts—the impacts decrease with distance from residences.

- b) The section states “[after] decommissioning for the Project is complete, no visual impacts will remain except for aboveground Project Facilities that remain in use or can be repurposed.” Please provide a list of Project Facilities that could remain in use or are able to be repurposed.

Monica Monterrosa: The Project’s access roads, O&M Facility, Collector Substation, and Gen-Tie Line may remain in use or be repurposed after the useful life of the wind energy facility, subject to the applicable landowner and/or regulatory approvals.

1-49) Referring to Section 11.6.6 of the Application, what additional due diligence of NEXRAD impacts is South Deuel working on and, further, has NOAA identified any concerns? If NOAA has concerns, please identify what those concerns are and the types of mitigation measures that may be needed.

Alexandra Thompson: Since submission of the Application, South Deuel has referenced the NOAA NEXRAD Inventory, and the Project remains outside of the notification zones for the Aberdeen WSR-88D and Sioux Falls WSR-88D NEXRAD radars. Thus, as stated in the Application, South Deuel is located in the no impact zone for these radars and no additional coordination with the NOAA is required.

1-50) Referring to Section 11.6.7 of the Application, if a government agency has concerns with the Project as part of the NTIA review process, could that cause the proposed turbine layout to change? Please explain why or why not.

Alexandra Thompson: The NTIA circulates the Project Layout for review to multiple federal agencies. If any agency identifies concerns, South Deuel Wind will coordinate directly with that agency to mitigate their concerns. Mitigation could influence selection of the turbine locations included in the final Project layout. South Deuel Wind has procured multiple studies to ensure the Project avoids risk to telecommunication interests provided as Appendices O, P, Q, R, and S to the Application. South Deuel Wind expects to receive a response of “No Harmful Interference Anticipated” resulting from the NTIA review process.

1-51) In Section 15.1.2.2 of the Application, it is stated that “[w]orkers outside an 85-mile radius will likely require temporary housing in or near the Project Area but South Deuel Wind expects existing community facilities and services to be generally adequate to support the workforce during construction.” Please provide support for South Deuel Wind’s expectation that the community can support the temporary housing and community service needs of the temporary workforce.

Monica Monterrosa: Invenergy completed construction of the 300 MW Deuel Harvest Wind Farm in 2021 and is unaware of any reductions in facilities or services available that occurred during the construction process. Since commencement of operation, the Deuel Harvest Wind Farm has been providing significant tax revenue contributing to the enhancement of facilities and services available in Deuel County. The Project is slightly smaller (up to 260 MW) with a similar anticipated construction duration. Therefore, South Deuel Wind anticipates Deuel County and the surrounding communities will be able to accommodate the needs of the temporary workforce during construction of the Project.

- 1-52) In Section 15.4.2.2 of the Application, South Deuel Wind indicates there is “minimal crop-dusting activities within the Project Area.” Please explain why South Deuel Wind believes crop dusting activities are minimal within the project area.

Monica Monterrosa: South Deuel Wind is aware that crop-dusting activities will occur in the Project area. However, during the Project’s outreach with participants and other stakeholders, crop dusting was not raised as a major concern. The Project is designed with agricultural practices in mind so agricultural activities, like crop dusting, can continue. Additionally, as further discussed in response to SDPUC Data Request 1-54(b), South Deuel Wind is willing to agree to an order condition to accommodate reasonable requests to shut down turbines for crop-dusting activities.

- 1-53) Referring to Section 15.4.3.1 of the Application, please provide South Deuel Wind’s proposed amount for the SDCL 49-41B-38 indemnity bond and justification for that amount.

Monica Monterrosa: Pursuant to SDCL 49-41B-38, South Deuel Wind proposes to furnish an indemnity bond in the amount of \$1 million to secure the restoration and repair of roads after construction of the Gen-Tie Line. South Deuel Wind proposes this indemnity bond based on the length of the Gen-Tie Line (approximately 6 miles) and prior Commission decisions. This is the same amount that the Commission approved *in the Matter of the Application by Crocker Wind Farm, LLC for a Permit of a Wind Energy Facility and a 345 kV Transmission Line in Clark County, South Dakota, for Crocker Wind Farm*, Docket No. EL17-055. The transmission line in that permitting proceeding was a similar length (5.2 miles), and Staff recommended in pre-filed testimony that a \$1 million road indemnity bond was appropriate to satisfy SDCL 49-41B-38. *See Direct Testimony of Darren Kearney, at p. 11 (Mar. 28, 2018). In Crocker Wind, Mr. Kearney noted that he based his recommendation on prior dockets:*

the bonding requirements established in the two previous wind farm dockets. In Docket EL15-020 (Willow Creek Wind Farm) there was less than 1 mile of transmission proposed and a road repair bond set at \$500,000. In Docket EL09-028 (Prairie Winds SD1) there was 13 miles of transmission line proposed and a road repair bond set at \$1.5 million. Given that Crocker Wind Farm includes a 5.2 mile transmission line (a distance that falls in the middle of the two previous dockets), I felt that a \$1 million road repair bond would be reasonable for this project.

Id.

1-54) Referring to Section 15.4.3.2 of the Application, it is stated that “South Deuel Wind will also work with landowners to coordinate crop dusting activities to further reduce risks to crop dusters.”

a) What is meant by the statement above?

Monica Monterrosa: South Deuel Wind will cooperate with agricultural spray applicators as described in South Deuel Wind’s response to Data Request 1-54(b).

b) Would South Deuel Wind agree to the condition below? If not, please explain why.

Applicant will cooperate with agricultural spray applicators, who inquire, by shutting down wind turbines as needed in order to accommodate safe and effective spray operation and application when conditions allow for aerial spraying.

Monica Monterrosa: South Deuel Wind is willing to agree to the following amended condition:

Applicant will cooperate with agricultural spray applicators who request for South Deuel Wind to temporarily shut down wind turbines as needed to accommodate safe and effective spray operation and application when conditions allow for aerial spraying. South Deuel Wind shall accommodate reasonable requests provided the agricultural spray applicator provides notice of intent to spray 3 days prior, and subsequent notices 12 hours and 2 hours prior to spraying.

1-55) Referring to Section 16 of the Application, please explain how South Deuel Wind determined that 109 temporary construction jobs will be created for Deuel County. Further, in accordance with ARSD 20:10:22:24, please provide an assessment on the type of jobs included in the temporary construction job estimate for Deuel County and the ability of Deuel County’s workforce to meet that number of temporary jobs.

David Loomis: The 109 direct jobs during construction were determined through the use of the Jobs and Economic Impact (“JEDI”) model. The number of direct jobs during construction is an output from the model after providing detailed construction cost estimates and Deuel County IMPLAN multipliers as input into the model. Deuel County's workforce should be able to meet this number of jobs. As noted in Table 2 on page 11 of the Economic Impact Analysis (Exhibit C to the Application), there are 228 workers in the construction sector in 2021 (the latest year available at the time of the analysis). The existing number of workers in the workforce should not be viewed as static since workers can switch to the construction industry from other industries, and unemployed workers may fill these jobs. In addition, high-paying jobs such as these may attract people who are not currently in the labor force. The JEDI model does not provide any detail on the types of jobs included in this job estimate but we can utilize this output and obtain the occupational breakdown from IMPLAN. The output from IMPLAN is provided in Table 1-55.

Table 1-55 IMPLAN Output		
IMPLAN Occupation Code	Occupation	Wage and Salary Employment
47-2000	Construction Trades Workers	32.48
49-9000	Other Installation, Maintenance, and Repair Occupations	27.42
47-1000	Supervisors of Construction and Extraction Workers	7.67
49-1000	Supervisors of Installation, Maintenance, and Repair Workers	6.6
13-1000	Business Operations Specialists	4.84
11-9000	Other Management Occupations	4
11-1000	Top Executives	2.87
43-9000	Other Office and Administrative Support Workers	2.33
49-2000	Electrical and Electronic Equipment Mechanics, Installers, and Repairers	2.33
43-3000	Financial Clerks	2.1
53-3000	Motor Vehicle Operators	1.57
43-6000	Secretaries and Administrative Assistants	1.46
49-3000	Vehicle and Mobile Equipment Mechanics, Installers, and Repairers	1.42
53-7000	Material Moving Workers	1.31
17-2000	Engineers	1.11
13-2000	Financial Specialists	0.9
11-3000	Operations Specialties Managers	0.82
17-3000	Drafters, Engineering Technicians, and Mapping Technicians	0.75
51-4000	Metal Workers and Plastic Workers	0.67
19-5000	Occupational Health and Safety Specialists and Technicians	0.61
15-1200	Computer Occupations	0.61
43-5000	Material Recording, Scheduling, Dispatching, and Distributing Workers	0.6
43-1000	Supervisors of Office and Administrative Support Workers	0.56
47-5000	Extraction Workers	0.55
47-4000	Other Construction and Related Workers	0.55
47-3000	Helpers, Construction Trades	0.49
41-3000	Sales Representatives, Services	0.38
43-4000	Information and Record Clerks	0.37
37-3000	Grounds Maintenance Workers	0.25
53-1000	Supervisors of Transportation and Material Moving Workers	0.22
11-2000	Advertising, Marketing, Promotions, Public Relations, and Sales Managers	0.19
33-9000	Other Protective Service Workers	0.17
51-9000	Other Production Occupations	0.17
23-1000	Lawyers, Judges, and Related Workers	0.12

Table 1-55 IMPLAN Output		
IMPLAN Occupation Code	Occupation	Wage and Salary Employment
41-4000	Sales Representatives, Wholesale and Manufacturing	0.1
17-1000	Architects, Surveyors, and Cartographers	0.09
51-1000	Supervisors of Production Workers	0.07
53-2000	Air Transportation Workers	0.05
23-2000	Legal Support Workers	0.05
37-2000	Building Cleaning and Pest Control Workers	0.03
41-9000	Other Sales and Related Workers	0.03
41-1000	Supervisors of Sales Workers	0.02
37-1000	Supervisors of Building and Grounds Cleaning and Maintenance Workers	0.02
51-2000	Assemblers and Fabricators	0.02
19-1000	Life Scientists	0.02
15-2000	Mathematical Science Occupations	0.01

Monica Monterrosa: Additional information regarding Deuel County’s ability to meet the needs of South Deuel Wind is provided in response to SDPUC Data Request 1-51.

- 1-56) Referring to Table 22.1 of the Application, please identify when each permit application will be filed in accordance with ARSD 20:10:22:05.

Monica Monterrosa: Please see Table 1-56 for the requested information.

Table 1-56 Potentially Applicable Permits and Approvals				
Agency	Permit/Approval	Notes	Filing Date	Status
Federal				
Federal Aviation Administration	Notice of Proposed Construction or Alteration (Form 7460-1)	Required for any proposed construction over 200 feet above ground level.	Q3 2024 71 locations have been submitted. Remaining two expected to be filed Q4 2024	Pending FAA review
Federal Aviation Administration	Notice of Actual Construction or Alteration (Form 7460-2, Part 1 and/or 2)	Supplemental notice in advance of or after commencing construction of turbines.	Q3 2025	Not started

Table 1-56 Potentially Applicable Permits and Approvals				
Agency	Permit/Approval	Notes	Filing Date	Status
Federal Aviation Administration	Marking and Lighting Recommendations	Required for approval of light-mitigating technology.	Q2 2025	Not started
United States Department of Commerce – National Telecommunications and Information Administration	NTIA Letter of Concurrence	No interference with federal communication systems anticipated.	Q1 2025	Not started
United States Army Corps of Engineers	Section 404 Wetland Permit	The Project is designed to avoid impacts to jurisdictional water resources to the extent practicable. The final Project footprint will be evaluated to determine the appropriate authorization for impacts, if any.	N/A	Not required at this time
United States Fish and Wildlife Service	Coordination	Coordination on federally listed species or designated critical habitats.	N/A	In progress
United States Environmental Protection Agency	Spill Prevention, Control, and Countermeasure Plan	Required prior to storage of oil products greater than 10,000 gallons.	Q3 2025	Not started
State				
South Dakota Public Utilities Commission	Energy Facility Permit	Required for wind energy facility.	Q2 2024	In progress
South Dakota Public Utilities Commission	Energy Facility Permit	Required for transmission facility.	Q2 2024	In progress
South Dakota State Historic Preservation Office	SDCL 1-19A-11.1 Consultation	Determination of effect on archaeological	N/A	In progress

Table 1-56 Potentially Applicable Permits and Approvals				
Agency	Permit/Approval	Notes	Filing Date	Status
		and historical resources.		
South Dakota Department of Agriculture and Natural Resources	Section 401 Water Quality Certification	The Project is designed to avoid impacts to water resources to the extent practicable. The final Project footprint will be evaluated to determine the appropriate authorization for impacts, if any.	N/A	Not required at this time
South Dakota Department of Agriculture and Natural Resources	National Pollutant Discharge Elimination System General Permit for Storm Water Discharges Associated with Construction Activities	Required for land disturbance or construction activities that disturb one or more acres with a point source discharge to surface waters of the United States.	Q3 2025	Not started
South Dakota Department of Agriculture and Natural Resources	General Permit for Temporary Discharges	Temporary permit for the use of public water for construction dewatering.	Q3 2025	Not started
South Dakota Department of and Natural Resources	Temporary Water Use Permit for Construction Activities	Temporary permits for the use of public water for construction, testing, or drilling purposes; issuance of a temporary permit is not a grant of water right.	Q3 2025	Not started

Table 1-56 Potentially Applicable Permits and Approvals				
Agency	Permit/Approval	Notes	Filing Date	Status
South Dakota Department of and Natural Resources	Water Rights Permit for Non-irrigation Use	Required if water will be appropriated for O&M building.	Q4 2025	Not started
South Dakota Department of Agriculture and Natural Resources	Septic System Plan Approval	Review and approval required if O&M building septic system is not "conventional."	Q4 2025	Not started
South Dakota Electrical Commission	Electrical Inspection	Required for O&M building.	Q1 2026	Not started
South Dakota Game, Fish, and Parks	Coordination	Resource coordination.	N/A	In progress
South Dakota Department of Transportation	Aeronautical Hazard Permit	Permit lighting plan determined with FAA coordination.	Q2 2025	Not started
South Dakota Department of Transportation	Utility Permit	Permit required for any utility crossing or use within state road right-of-way.	Q2 2025	Not started
South Dakota Department of Transportation	Highway Access Permit	Permit required for any access roads abutting state roads.	Q2 2025	Not started
South Dakota Department of Transportation	Oversize/Overweight Permit	Permit required for heavy equipment transport over state roads during construction.	Q2 2025	Not started
Local				
Deuel County	Conditional Use Permit for a Wind Energy System	Permit required for construction of a wind energy system.	N/A	Complete
Deuel County	Individual Building Permits	Permit required for construction of each turbine and building.	Q1 2025	Not started

Table 1-56 Potentially Applicable Permits and Approvals				
Agency	Permit/Approval	Notes	Filing Date	Status
Deuel County	Utility Permits	Required for use and crossing of county roads.	Q2 2025	Not started
Deuel County	Occupancy Right of Way of County Highways Permit	Permit required for use of county highway rights-of-way.	Q2 2025	Not started
Deuel County	Driveway or Approach Construction Permits	Permit required for building any entrance off county highway.	Q2 2025	Not started
Deuel County	Overweight/Oversize Permit	Permit required for operating any vehicle above the maximum weight and/or size set in SDCL Chapter 32-22.	Q2 2025	Not started

1-57) Please provide South Deuel Wind’s plans for notifying telecommunications companies in accordance with SDCL 49-32.3.1.

Monica Monterrosa: South Deuel Wind will notify telecommunications companies in accordance with SDCL 49-32.3.1 after receiving Permits from the SDPUC, if issued, and prior to the conclusion of planning for construction of the Project.

1-58) Please refer to the testimony of Ms. JoAnne Blank and Appendix N (Shadow Flicker Analysis).

a) Does WindPRO have the ability to produce a shadow calendar for each receptor that shows the time of year and the turbines that cause flicker on that receptor? If yes, please provide the shadow calendar for each receptor.

JoAnne Blank: Yes, the WindPRO model has the ability to export shadow flicker calendars specific to each receptor. The responsive documents are provided in Exhibit 1-58.

b) The following questions are specific to participating receptors with modeled shadow flicker over 30 hours per year for any given wind turbine model.

i. For each of the receptors, please provide a detailed mitigation plan to limit the shadow flicker to comply with Deuel County’s ordinance.

JoAnne Blank: The Shadow Flicker Analysis includes three configurations for the Project, each based on the turbine type and size (Siemens Gamesa 4.4-164, Vestas 163-4.5, and General Electric 3.8-154). As described in response to SDPUC Data Request 1-19, if the final Project layout was comprised of only the General Electric 3.8-154 turbine, up to 68 turbines locations would be constructed. If the final Project layout was comprised of only the Siemens Gamesa 4.4-164 turbine, up to 59 turbines locations would be constructed. If the final Project layout was comprised of only the Vestas 163-4.5 turbine, up to 57 turbines locations would be constructed. As such, the analyses include turbine locations that will not be required to meet the Project's nameplate capacity. An updated analysis will be completed once the final turbine model is selected for the final Project layout. At that time, if an occupied residence is predicted to have greater than 30 annual hours of shadow flicker, South Deuel Wind will conduct additional site-specific analyses, taking into account potential existing screening on the receptor. If modeling continues to predict more than 30 hours of shadow flicker annually, steps will be taken to keep the shadow flicker below 30 hours. These steps may include the use of turbine control software.

- ii. Has South Deuel Wind informed the participants of the expected shadow flicker on their residences?

Monica Monterrosa: When questions about shadow flicker have been raised by participants, South Deuel Wind has communicated to the public and landowners alike that the Deuel County Zoning Ordinance requires shadow flicker at existing residences to be no more than 30 hours per year.

- iii. Has South Deuel Wind communicated the mitigation plan to each participant and received favorable approval of the mitigation plan? Please explain.

Monica Monterrosa: The shadow flicker levels are dependent on the final turbine models and locations selected. The specific method that will be used to ensure shadow flicker does not exceed 30 hours per year will be determined at that time. South Deuel Wind will contact landowners as appropriate to discuss any non-curtailement methods that may be employed.

- iv. Would South Deuel Wind agree to the following permit condition should the Commission issue a permit for the project? If no, please explain why not.

Shadow flicker at any receptor shall not exceed 30 hours per year unless the owner has signed a waiver.

Monica Monterrosa: South Deuel Wind does not object to this condition.

1-59) Refer to Section 18 of the Application and Table A-1 of Appendix X (Decommissioning Plan).

- a) In Section 18 it is stated “[t]he analysis assumed 57 Vestas 163-4.5 turbines with salvage value but no resale value.” Since South Deuel Wind is requesting a permit for up to 68 wind turbines, please provide an updated decommissioning cost estimate to reflect 68 wind turbines.

Monica Monterrosa: South Deuel Wind is currently in the process of preparing a Decommissioning Plan for the GE 3.8-154. Once complete, South Deuel Wind will supplement this discovery response with an Exhibit 1-59(a).

- b) For each cost category in Table A-1 of Appendix X, please provide all calculations used to determine the amounts listed.

Monica Monterrosa: Please see Confidential Exhibit 1-59(b) for the requested information.

- c) For each scrap value category in Table A-1 of Appendix X, please provide all calculations used to determine the amounts listed.

Monica Monterrosa: Please see Confidential Exhibit 1-59(b) for the requested information.

- d) Referring to Section 4.3, paragraph 2, of Appendix X, please provide the “[...] details and equipment defined through conversations with and documentation provided by South Deuel Wind in June of 2024.”

Monica Monterrosa: Please see Confidential Exhibit 1-59(b) for the requested information.

- e) Referring to Table 4-1 of Appendix X, please separate out the cost assumption for hauling and the cost assumption for the value of the scrap metal.

Monica Monterrosa: The cost assumptions for hauling the scrap metal are as follows:

1. Distance between Project and Brandt: 30 miles
2. Material hauling cost: \$0.50 per ton-mile
3. Rail tariff from Brandt to Chicago: \$46.97 per ton

The cost assumptions for the value of the scrap metal (not including transportation) are as follows:

1. Steel scrap value: \$306.54 per net ton
2. Copper scrap value: \$2.98 per pound
3. Aluminum scrap value: \$0.41 per pound

- f) Referring to Section 4.3, paragraph 5, of Appendix X, please provide the cost assumptions used for fluid removal and disposal.

Monica Monterrosa: The cost assumptions for fluid removal and disposal are as follows:

1. Approximately 407 CY of contaminated soil are assumed to be removed
2. Approximately 16,685 gallons of oil are assumed to be removed
3. Soil removal/disposal cost: \$152.13 per CY
4. Oil removal/disposal cost: \$1.00 per gallon

- g) Please explain how contractor mobilization expenses are included in the decommissioning cost estimate.

Monica Monterrosa: A cost of approximately \$307,000 is included in the subcategory “Removal” of the cost category “Wind Turbine Removal Cost” for the mobilization and demobilization of the demolition crew and the turbine crane.

1-60) Please refer to the testimony of Mr. Michael Hankard and Appendix M (Noise Analysis).

- a) In his testimony, Mr. Hankard states “[t]o ensure compliance with that requirement, my modeling was designed to assess the maximum sound level that could be generated by each turbine in any given hour (one-hour Leq).” Since the modeled sound levels are based on a one-hour Leq, would Mr. Hankard expect any project-only, 10-min Leq sound levels to exceed 45 dBA should a post-construction sound study be completed? Please explain why or why not.

Michael Hankard: Noise levels are not expected to exceed 45 dBA either on a one-hour or 10-minute interval basis. Our measurement validation work was carried out using both of these intervals, and in each case the prediction method used in the noise analysis was found to over-estimate actual noise levels. Furthermore, the ACP/ANSI wind turbine noise level prediction standard considers both intervals equivalent.

- b) Would South Deuel Wind agree to the following permit condition should the Commission issue a permit for the Project? If no, please explain why not.

Monica Monterrosa/Michael Hankard: South Deuel Wind is agreeable to a condition regarding sound. South Deuel Wind proposes several modifications as redlined below and described as follows:

- Clarify that the 45 dBA applies to non-participating residences in accordance with the Deuel County Zoning Ordinance.
- Revise e)i. to include the four nearest Project turbines to a residence. The four nearest turbines are typically creating almost all of the noise heard at any location; more distant turbines have little impact. The condition below requires turbines to be operating at 80% electric power or greater; if the 80% electric power provision applied to the entirety of the wind farm (rather than the four closest turbines), data could be invalidated if a distant turbine was operating at less than 80%. The four-turbine provision allows for as much valid data collection as possible while also ensuring that maximum noise conditions are captured.
- Confine shutdown testing to when post-filtered levels are greater than 45 dBA, and there is reason to suspect that there was contamination from background noise, then shut down testing should be employed.

The South Deuel Wind project, exclusive of all unrelated background noise except for that associated with pre-existing wind turbines, shall not generate a sound pressure level (10-minute equivalent continuous sound level, Leq) of more than 45.0 dBA at non-participating residences when ~~all wind turbines~~ the nearest four Project turbines are producing full acoustic output, as measured within 25 feet of any residence unless the owner of the residence has signed a waiver or the Commission otherwise orders. Applicant shall, upon Commission formal request, conduct valid field surveys or provide post-construction monitoring data verifying compliance with specified noise level limits. If the measured wind turbine noise level exceeds 45.0 dBA at any residence, then the Project Owner shall take whatever steps are necessary in accordance with prudent operating standards to rectify the situation. Sound monitoring will not be repeated in a representative area during any five-year period unless operational or maintenance changes result in a reasonable assumption of higher turbine sound levels.

If a field survey and monitoring data is requested by the Commission, the Project owner shall submit the test protocol to the Commission prior to conducting the survey and sound monitoring for approval. The test protocol shall include and be executed as follows:

- a) The post-construction monitoring survey shall follow the applicable portions of the American National Standards Institute (ANSI) standard S12.9 Part 3, and other acoustical standard relating to equipment and calibration specifications.
- b) Noise levels shall be measured continuously for at least two weeks, or until such time that a sufficient number of valid 10-minute Leq periods are acquired to determine compliance to a reasonable degree of scientific certainty. At a minimum, data must be collected for multiple 10-minute periods on at least two different nights when the nearest turbines are operating at full acoustic emissions. During the postconstruction monitoring survey, windscreens will be used to protect microphones and minimize effects from self-generated wind-induced noise.
- c) Measurements shall be conducted at a select number of non-participating and participating residences (where access can be arranged) with the highest expected noise levels based on acoustic modeling and/or at specific residences identified in the Commission's formal request. Typically, 4 to 6 measurement locations total.
- d) Measurements shall be conducted using sound level meters meeting ANSI Type 1 specifications. An anemometer shall be placed within 20 feet of each microphone, and at a height of approximately 2 meters above the ground.
- e) The measurement data shall be analyzed as follows:
 - i. Analyze those data acquired when the closest 4 ~~wind~~Project turbines to each measurement location ~~associated with South Deuel Wind and any pre-existing turbines within 2 miles of the measurement location~~ are operating at full capacity (80% electric power or more, which typically occurs at a hub-height wind speed of 10 m/s or greater).
 - ii. Discard those samples measured when the 10-minute average ground wind speed is 5 m/s or greater and samples measured during periods with precipitation.
 - iii. Remove transient background noise (i.e. occasional traffic, activities of residents, farming activities, and wind gusts) per ANSI S12.9 Part 3.
 - iv. If, after filtering out transient sounds, measured noise levels at a non participant's residence are greater than 45 dBA, and there is reason to suspect that there was contamination from background noise, then shut down testing should be employed. Remove continuous background noise by conducting turbine shut-downs, where the background noise is measured directly. Shut down testing will be conducted in a controlled manner and shall continue until enough data has been collected when ground wind speeds are between approximately 2 and 5 m/s that a repeatable pattern is observed in the measured background noise level. Deuel Harvest South's sound test consultant shall be present onsite for a portion of the shutdown tests, as deemed necessary by the consultant and Commission Staff, to observe and listen during the tests. Background noise levels will be subtracted from total noise levels measured during these wind conditions to calculate turbine-only noise levels.
 - v. Review of the frequency spectra of potential turbine-only samples to identify and remove outliers (spectral shape clearly differing from those samples measured under very low (less than 2 m/s) ground wind conditions, which are samples most representative of turbine-only noise).
- f) Compare the resulting turbine-only noise levels to the 45.0-dBA limit. Compliance shall be demonstrated if all samples are less than the limits.

Dated this 4th day of October 2024.

By s/ Lisa Agrimonti

Lisa M. Agrimonti

Haley Waller Pitts

FREDRIKSON & BYRON, P.A.

60 South 6th Street, Suite 1500

Minneapolis, Minnesota 55402

(612) 492-7344

lagrimonti@fredlaw.com

hwallerpitts@fredlaw.com

**Attorneys for Applicant Deuel Harvest Wind
Energy South LLC**

Iacopetti, Michael

From: Norton, Mark <Mark.Norton@state.sd.us>
Sent: Friday, September 27, 2024 2:28 PM
To: Iacopetti, Michael
Subject: [EXTERNAL] RE: Walk-In Hunting Area Closure Confirmation - (Contract # 23L-16-03) - Invenergy South Deuel Wind Project

Hello Michael,

I have reviewed your e-mail below and can confirm that this is all correct.

Thank you!

Mark Norton | *Hunting Access & Farm Bill Coordinator*
South Dakota Game, Fish and Parks
O:605-773-3096
C:605-295-4190

From: Iacopetti, Michael <MIacopetti@invenergy.com>
Sent: Friday, September 27, 2024 2:14 PM
To: Norton, Mark <Mark.Norton@state.sd.us>
Subject: [EXT] Walk-In Hunting Area Closure Confirmation - (Contract # 23L-16-03) - Invenergy South Deuel Wind Project

Hi Mark,

Thanks for speaking with me today! I'm following up our call with this email for future reference/documentation with our team.

I'm reaching out regarding a walk-in hunting area within the South Deuel Wind Project, and I was hoping to quickly discuss it with the SDGFP. Below is some applicable information and summary of what we've been able to find out thus far. Can you please review and confirm these details are correct and our understanding is accurate?

Hunting Access & Habitat Contract #: 23L-16-03 (Dated 5/6/16)
Parcel #: 1061
Legal Desc.: Section 24, Township 114, Range 49
Property Owner: PMP Capital Inc.
Owner Contact: Tom Gronseth

Summary of Our Understanding:

- Mr. Gronseth has spoken with Mark Norton, Hunting Access and Farm Bill Coordinator at the SDGFP, and confirmed that the SDGFP is okay with temporarily closing this walk-in hunting area in 2024 and 2025, during the construction of the South Deuel Wind Project. If the construction period extends beyond these windows, the hunting area will continue to be temporarily closed until construction of the project is completed.
- Some activities that have already begun to prevent public access during the time the walk in hunting area is temporarily closed, include signs on site being taken down and the area being removed from the plot map that gets distributed to the public.
- Once the construction period has been completed and the project is operational, the walk-in hunting area agreement between the property owner and the SDGFP will remain in effect during the operations term of the project if the landowner chooses to do so.

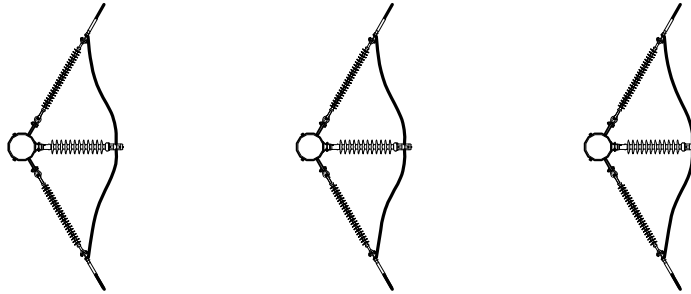
I appreciate your help with this!

Thank you,

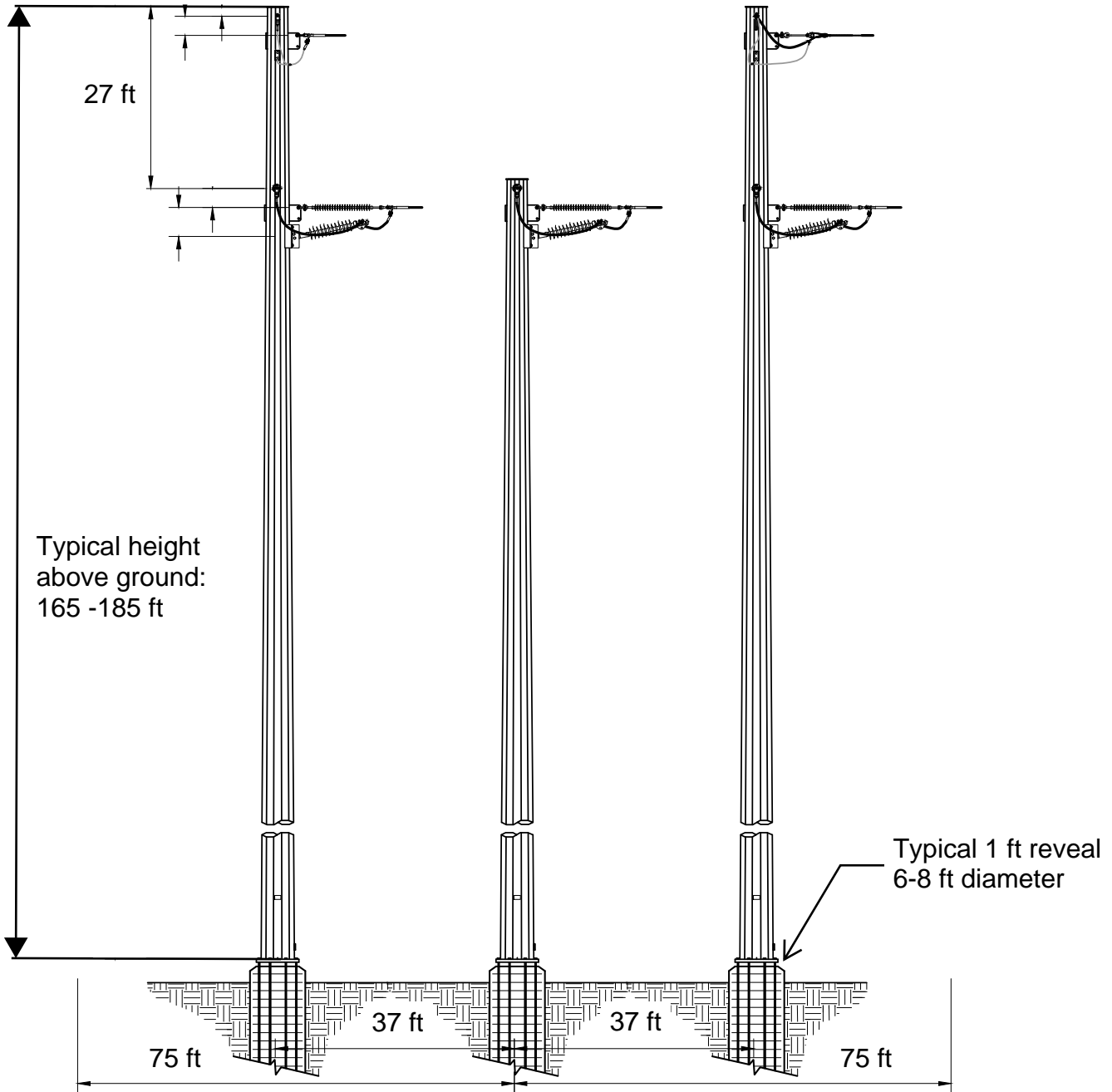
Michael Iacopetti | Associate, Renewable Development
Invenergy | One South Wacker Drive, Suite 1800, Chicago, IL 60606
miacopetti@invenergy.com | (708) 523-0049 | @InvenergyLLC

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ARE PRELIMINARY
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PURPOSES ONLY.



PLAN



Invenergy

ENGINEERING RECORD		DATE
DRAWN		
DESIGNED		
CHECKED		
APPROVED		
DWG SCALE:	PLT SCALE:	

345 kV - Typical Three Pole
Turning Structure

DWG. NAME: REVISION NO :

From: Deuel Zoning <dczoning@itctel.com>
Sent: Wednesday, July 19, 2023 1:40 PM
To: 'Young, Robert' <RYoung@invenergy.com>; Agrimonti, Lisa <LAgrimonti@fredlaw.com>
Cc: craigevenson@itctel.com
Subject: RE: [EXTERNAL] RE: 8/7 meeting info
Importance: High

CAUTION: EXTERNAL E-MAIL

Robert & Lisa

I noticed in the application page 2 section 2.5.1 3rd paragraph

In addition, the Ordinance requires a residence, business and public building setback of 1,500 feet. **The centers of all turbine sites** are at least 1,500 feet from the nearest participating residence, business building, or public building. Accordingly, the minimum setback requirement for all participating residences, businesses, and public buildings is satisfied.⁸ See Figure 6.

Deuel County Ordinance states:

Setback Between Uses. Unless specifically mentioned within this ordinance, the setback or separation distance between uses is the minimum horizontal distance measured from the wall line of a neighboring principal building to the wall line of the proposed building/structure/use. In regard to concentrated animal feeding operations the separation distance shall be measured from the wall line of the neighboring principal building to the wall line of the feedlot or structure housing animals and/or manure management facility.

Sincerely

Jodi Theisen
Deuel County Zoning Officer
Phone 605-874-8562

From: Young, Robert <RYoung@invenergy.com>
Sent: Wednesday, July 19, 2023 11:52 AM
To: Deuel Zoning <dczoning@itctel.com>
Cc: craigevenson@itctel.com
Subject: RE: [EXTERNAL] RE: 8/7 meeting info

Hi Jodi,

You bet. Working on making the change to the map today. Changing Figure 7 from a break up of four maps to six, per our discussion the other day. Hoping to have the updated figure to you either today or tomorrow.

Best,
Rob

From: Deuel Zoning <dczoning@itctel.com>
Sent: Wednesday, July 19, 2023 11:50 AM
To: Young, Robert <RYoung@invenergy.com>
Cc: craigevenson@itctel.com
Subject: RE: [EXTERNAL] RE: 8/7 meeting info
Importance: High

I was wondering if you could give the office a closer exhibit (figure 7) of the locations of the turbines and the setbacks.
The 4 maps are pretty condensed and it is hard to look at for review!!!

Sincerely

Jodi Theisen
Deuel County Zoning Officer
Phone 605-874-8562

From: Young, Robert <RYoung@invenergy.com>
Sent: Wednesday, July 19, 2023 8:33 AM
To: Deuel Zoning <dczoning@itctel.com>
Cc: craigevenson@itctel.com
Subject: Re: [EXTERNAL] RE: 8/7 meeting info

Great! Thanks Jodi

-Rob

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From: Deuel Zoning <dczoning@itctel.com>
Sent: Wednesday, July 19, 2023 8:31:57 AM
To: Young, Robert <RYoung@invenergy.com>

Cc: craigevenson@itctel.com <craigevenson@itctel.com>

Subject: [EXTERNAL] RE: 8/7 meeting info

Robert

Yes the next zoning meeting is Monday August 7, 2023 at the Clear Lake Community Center, 218 3rd Ave S Clear Lake SD 57226.

The meeting will start at 6:00 p.m. with a CUP and a Variance application . The WES hearing will be at 6:30 p.m.

I will send you the public notice when I send it to the paper later this week.

Sincerely

Jodi Theisen

Deuel County Zoning Officer

Phone 605-874-8562

From: Young, Robert <RYoung@invenenergy.com>

Sent: Tuesday, July 18, 2023 4:18 PM

To: Deuel Zoning <dczoning@itctel.com>

Subject: 8/7 meeting info

Hi Jodi,

Relaying the following info regarding the meeting to my managers. Can you confirm it is accurate?

Board meeting on August 7th at 6pm CST in Clear Lake, South Dakota. The meeting will be held at the Clear Lake Community Center, 218 3rd Ave S, Clear Lake, SD 57226. The board meeting will begin at 6pm with two regular agenda items, Lake Park variance and AG District essential services, and then we will be up to discuss South Deuel at 6:30pm.

Thanks,

Robert Young | Senior Analyst, Renewable Development
Invenenergy | One South Wacker Drive, Suite 1800, Chicago, IL 60606
ryoung@invenenergy.com | D: (312) 638-8499 | C: (216) 978-9153

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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-006 - R-006
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:47
6	08:05	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:59	06:10	05:43	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:38	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
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20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
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31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:05
	17:34		19:52	21:04			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-007 - R-007
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
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	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:04			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-021 - R-021
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	07:06 18:12	17:37 (T-90) 18:12	07:09 20:30	06:18 21:04	05:45 21:16	05:45 20:55	06:12 20:07	06:48 19:11	07:24 17:17	07:43 16:48
2	08:04 16:57	07:46 17:36	07:04 18:14	17:39 (T-90) 17:50 (T-90)	07:07 19:54	06:16 20:31	05:44 21:05	05:44 21:16	06:13 20:54	06:50 20:05	07:25 19:09	07:44 17:15
3	08:04 16:58	07:45 17:37	07:02 18:15	17:42 (T-90) 17:47 (T-90)	07:05 19:55	06:15 20:32	05:44 21:06	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	07:45 17:14
4	08:04 16:59	07:43 17:39	07:00 18:16	07:04 19:55	06:14 20:33	05:43 21:06	05:46 21:16	06:16 20:51	06:03 20:01	06:52 19:05	07:28 19:05	07:47 17:12
5	08:04 17:00	07:42 17:40	06:59 18:18	07:02 19:57	06:12 20:35	05:43 21:07	05:47 21:16	06:17 20:50	06:53 19:59	07:29 19:03	07:29 19:03	07:48 17:11
6	08:04 17:01	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:42 21:08	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:01	07:11 19:01	07:49 17:10
7	08:04 17:02	07:40 17:43	06:55 18:20	06:58 20:00	06:09 20:37	05:42 21:09	05:48 21:15	06:19 20:47	06:55 19:56	07:31 19:00	07:12 19:00	07:50 17:09
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12	08:02 17:08	07:33 17:50	07:46 19:27	07:46 20:06	06:03 20:43	05:41 21:12	05:52 21:13	06:25 20:40	07:01 19:46	07:38 18:49	18:12 (T-90) 17:03	07:19 07:54
13	08:02 17:09	07:31 17:52	07:44 19:28	07:44 20:07	06:02 20:44	05:41 21:13	05:53 21:12	06:26 20:38	07:02 19:45	07:39 18:47	18:10 (T-90) 17:02	07:20 07:56
14	08:02 17:10	07:30 17:53	07:42 19:30	07:42 20:09	06:01 20:45	05:41 21:13	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	18:09 (T-90) 17:00	07:22 07:47
15	08:01 17:12	07:28 17:54	07:41 19:31	07:41 20:10	05:59 20:47	05:41 21:14	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:43	18:08 (T-90) 16:59	07:23 07:57
16	08:01 17:13	07:27 17:56	07:39 19:32	07:39 20:11	05:58 20:48	05:41 21:14	05:56 21:10	06:29 20:34	07:06 19:39	07:43 18:42	18:07 (T-90) 16:58	07:24 07:58
17	08:00 17:14	07:25 17:57	07:37 19:33	07:37 20:12	05:57 20:49	05:41 21:14	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40	18:08 (T-90) 16:57	07:26 07:58
18	07:59 17:15	07:24 17:59	07:35 19:35	07:35 20:14	05:56 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:08 19:35	07:45 18:38	18:16 (T-90) 16:57	07:27 07:59
19	07:59 17:17	07:22 18:00	07:33 19:36	07:33 20:15	05:55 20:51	05:41 21:15	05:58 21:08	06:33 20:29	07:10 19:33	07:47 18:37	18:14 (T-90) 16:56	07:28 08:00
20	07:58 17:18	07:21 18:00	07:31 19:37	07:31 20:16	05:54 20:52	05:41 21:15	05:59 21:07	06:34 20:27	07:11 19:31	07:48 18:35	18:09 (T-90) 16:55	07:30 08:00
21	07:57 17:19	07:19 18:01	17:38 (T-90) 07:30	07:30 20:17	06:34 20:53	05:41 21:16	06:00 21:06	06:35 20:26	07:12 19:29	07:49 18:33	18:11 (T-90) 16:54	07:31 08:01
22	07:56 17:21	07:17 18:03	17:39 (T-90) 07:28	07:28 20:17	06:32 20:52	05:41 21:16	06:01 21:06	06:37 20:26	07:13 19:29	07:50 18:32	18:23 (T-90) 16:54	07:32 08:01
23	07:56 17:22	07:16 18:03	17:40 (T-90) 07:26	07:26 20:19	06:30 20:54	05:41 21:16	06:02 21:05	06:38 20:24	07:14 19:28	07:52 18:32	18:25 (T-90) 16:53	07:33 08:02
24	07:55 17:23	07:14 18:06	17:42 (T-90) 07:24	07:24 20:20	06:29 20:55	05:40 21:16	05:42 21:04	06:03 20:22	07:15 19:26	07:53 18:30	18:22 (T-90) 16:52	07:35 08:02
25	07:54 17:25	07:12 18:07	17:43 (T-90) 07:22	07:22 20:21	06:27 20:56	05:40 21:16	06:05 21:04	06:40 20:21	07:17 19:24	07:54 18:29	18:09 (T-90) 16:52	07:36 08:03
26	07:53 17:26	07:11 18:08	17:45 (T-90) 07:20	07:20 20:22	06:26 20:57	05:42 21:16	06:06 21:03	06:41 20:19	07:18 19:22	07:56 18:27	18:18 (T-90) 16:51	07:37 08:03
27	07:52 17:28	07:09 18:10	17:36 (T-90) 07:18	07:18 20:24	06:24 20:58	05:43 21:17	06:07 21:02	06:42 20:17	07:19 19:20	07:57 18:25	18:08 (T-90) 16:51	07:38 08:03
28	07:51 17:29	07:07 18:11	17:48 (T-90) 07:16	07:16 20:25	06:22 20:59	05:43 21:17	06:08 21:00	06:44 20:16	07:20 19:18	07:58 18:24	18:12 (T-90) 16:50	07:40 08:03
29	07:50 17:30		17:49 (T-90) 07:15	07:15 20:26	06:21 21:00	05:44 21:17	06:09 20:59	06:45 20:14	07:21 19:16	08:00 18:22	18:09 (T-90) 16:49	08:04 08:04
30	07:49 17:32			07:13 19:49	06:19 20:27	05:44 21:17	06:10 20:58	06:46 20:12	07:23 19:14	08:01 18:21	18:19 (T-90) 16:48	08:04 08:04
31	07:48 17:33			07:11 19:50	06:17 20:29	05:45 21:02	06:11 20:57	06:47 20:10	08:03 19:12	18:18 (T-90) 16:48	18:19 (T-90) 16:55	08:04 08:04
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case		62	29							91		
Sun reduction		0.58	0.59							0.56		
Oper. time red.		0.90	0.90							0.90		
Wind dir. red.		0.58	0.58							0.58		
Total reduction		0.30	0.31							0.29		
Total, real		19	9							27		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-022 - R-022
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	08:09 (T-90) 18:13	07:06 19:53	06:18 20:30	05:45 21:04	05:45 21:17	06:12 20:55	06:48 20:07	07:24 19:11	07:04 17:17	07:43 29 08:07 (T-90) 16:48
2	08:04 16:58	07:46 17:36	08:08 (T-90) 18:14	07:04 19:54	06:17 20:31	05:44 21:05	05:45 21:16	06:13 20:54	06:50 20:05	07:25 19:09	07:05 17:15	07:44 30 08:07 (T-90) 16:48
3	08:04 16:58	07:45 17:38	08:06 (T-90) 18:15	07:02 19:55	06:15 20:32	05:44 21:06	05:46 21:16	06:15 20:52	06:51 20:03	07:26 19:07	07:07 17:14	07:46 32 08:09 (T-90) 16:47
4	08:04 16:59	07:43 17:39	08:05 (T-90) 18:17	07:01 19:56	06:14 20:34	05:43 21:07	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	07:47 33 08:09 (T-90) 16:47
5	08:04 17:00	07:42 17:40	08:05 (T-90) 18:18	06:59 19:58	06:12 20:35	05:43 21:07	05:47 21:16	06:17 20:50	06:53 20:00	07:29 19:03	07:09 17:11	07:48 34 08:10 (T-90) 16:47
6	08:04 17:01	07:41 17:42	08:06 (T-90) 18:19	06:57 19:59	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:01	07:11 17:10	07:49 35 08:10 (T-90) 16:47
7	08:04 17:03	07:40 17:43	08:06 (T-90) 18:21	06:55 20:00	06:10 20:37	05:42 21:09	05:49 21:15	06:19 20:47	06:56 19:56	07:31 19:00	07:12 17:09	07:50 35 08:11 (T-90) 16:50
8	08:04 17:04	07:38 17:45	08:07 (T-90) 18:22	06:54 20:01	06:08 20:38	05:42 21:10	05:49 21:15	06:20 20:46	06:57 19:54	07:33 18:56	07:14 17:07	07:51 34 08:11 (T-90) 16:46
9	08:04 17:05	07:37 17:46	08:08 (T-90) 18:23	06:55 20:03	06:07 20:40	05:42 21:10	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	07:15 17:06	07:52 32 08:10 (T-90) 16:46
10	08:03 17:06	07:36 17:48	08:09 (T-90) 18:24	06:53 20:04	06:06 20:41	05:41 21:11	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:52	07:16 17:05	07:53 31 08:11 (T-90) 16:46
11	08:03 17:07	07:34 17:49	08:10 (T-90) 18:25	06:51 20:05	06:04 20:42	05:41 21:12	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51	07:18 17:04	07:54 30 08:11 (T-90) 16:46
12	08:03 17:08	07:33 17:50	08:11 (T-90) 18:26	06:49 20:06	06:03 20:43	05:41 21:12	05:52 21:13	06:25 20:40	07:01 19:47	07:38 18:49	07:19 17:03	07:54 28 08:11 (T-90) 16:46
13	08:02 17:09	07:31 17:52	08:14 (T-90) 18:28	06:47 20:08	06:02 20:44	05:41 21:13	05:53 21:12	06:26 20:38	07:03 19:45	07:39 18:47	07:20 17:02	07:55 27 08:11 (T-90) 16:46
14	08:02 17:11	07:30 17:53	08:16 (T-90) 18:30	06:43 20:09	06:01 20:46	05:41 21:13	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	07:22 17:01	07:56 25 08:11 (T-90) 16:47
15	08:01 17:12	07:28 17:55	08:21 (T-90) 18:31	06:41 20:10	06:00 20:47	05:41 21:14	05:55 21:11	06:28 20:35	07:05 19:41	07:42 18:44	07:23 17:00	07:57 23 08:10 (T-90) 16:47
16	08:01 17:13	07:27 17:56	08:25 (T-90) 18:32	06:39 20:11	05:58 20:48	05:41 21:14	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59	07:58 22 08:11 (T-90) 16:47
17	08:00 17:14	07:25 17:57	08:23 (T-90) 18:33	06:37 20:12	05:57 20:49	05:41 21:15	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40	07:26 16:58	07:58 20 08:10 (T-90) 16:47
18	07:59 17:16	07:23 17:59	08:23 (T-90) 18:34	06:35 20:14	05:56 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:08 19:35	07:45 18:38	07:27 16:57	07:59 18 08:10 (T-90) 16:48
19	07:59 17:17	07:22 18:00	08:22 (T-90) 18:35	06:33 20:15	05:55 20:51	05:41 21:15	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	07:28 16:56	08:00 16 08:09 (T-90) 16:48
20	07:58 17:18	07:21 18:00	08:21 (T-90) 18:36	06:31 20:16	05:54 20:52	05:41 21:16	06:00 21:07	06:34 20:27	07:11 19:31	07:48 18:35	07:30 16:55	08:00 14 08:08 (T-90) 16:48
21	07:57 17:20	07:19 18:02	08:20 (T-90) 18:37	06:30 20:17	05:53 20:53	05:41 21:16	06:01 21:06	06:35 20:26	07:12 19:30	07:49 18:34	07:31 16:54	08:01 12 08:08 (T-90) 16:49
22	07:57 17:21	07:18 18:03	08:19 (T-90) 18:38	06:28 20:19	05:52 20:54	05:41 21:16	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:53	08:01 10 08:07 (T-90) 16:49
23	07:56 17:22	07:16 18:04	08:18 (T-90) 18:39	06:26 20:20	05:51 20:55	05:42 21:16	06:03 21:05	06:38 20:22	07:14 19:26	07:52 18:30	07:34 16:53	08:02 8 08:06 (T-90) 16:50
24	07:55 17:24	07:14 18:06	08:18 (T-90) 18:40	06:24 20:21	05:51 20:56	05:42 21:16	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	08:02 6 08:06 (T-90) 16:50
25	07:54 17:25	07:13 18:07	08:17 (T-90) 18:41	06:22 20:22	05:50 20:57	05:42 21:17	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	07:36 16:51	08:03 3 08:04 (T-90) 16:51
26	07:53 17:26	07:11 18:08	08:16 (T-90) 18:42	06:20 20:24	05:49 20:59	05:43 21:17	06:06 21:02	06:41 20:17	07:18 19:20	07:56 18:26	07:37 16:51	08:03 1 08:03 (T-90) 16:52
27	07:52 17:28	07:09 18:10	08:15 (T-90) 18:43	06:18 20:25	05:48 20:59	05:43 21:17	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	07:39 16:50	08:03 8 08:57 (T-90) 16:50
28	07:51 17:29	07:08 18:11	08:13 (T-90) 18:44	06:17 20:26	05:47 21:00	05:43 21:17	06:08 21:00	06:44 20:14	07:20 19:16	07:59 18:23	07:40 15 09:00 (T-90) 16:50	08:04 08:42 (T-90) 16:50
29	07:50 17:31	07:07 18:12	08:38 (T-90) 18:45	06:15 20:27	05:47 21:01	05:44 21:17	06:09 20:58	06:45 20:12	07:22 19:14	08:00 18:21	07:41 20 09:02 (T-90) 16:49	08:04 08:41 (T-90) 16:49
30	07:49 17:32	07:06 18:11	08:39 (T-90) 18:46	06:13 20:28	05:46 21:02	05:44 21:17	06:10 20:57	06:46 20:10	07:23 19:13	08:01 18:20	07:42 23 09:04 (T-90) 16:49	08:04 08:41 (T-90) 16:49
31	07:48 17:33	07:05 18:10	08:10 (T-90) 18:47	06:11 20:29	05:46 21:03	05:44 21:18	06:11 20:56	06:47 20:09	08:03 18:18	07:42 26 09:05 (T-90) 16:49	07:42 16:56	08:04 16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case	262	410								92	588	
Sun reduction	0.58	0.58								0.56	0.48	
Oper. time red.	0.90	0.90								0.90	0.90	
Wind dir. red.	0.65	0.65								0.65	0.65	
Total reduction	0.34	0.34								0.33	0.28	
Total, real	88	138								30	164	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L085 73 GE3.8-154 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-023 - R-023 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum and values 561, 438, 311, 293, 309, 330, 363, 461, 788, 773, 462, 449, 509, 600, 629, 608, 7,884

Main calendar table with columns for months (January to December) and rows for each day of the month, including times and shadow reduction percentages.

Table layout: For each day in each month the following matrix apply

Matrix table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-024 - R-024

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	18:35 (T-90)	07:04	07:43	
	16:57	17:35	18:12	19:52	20:30	21:04	21:16	20:55	20:07	19:11	18:45 (T-90)	17:17	16:48	
2	08:04	07:46	07:04	07:07	06:16	05:44	05:45	06:13	06:50	07:25	18:33 (T-90)	07:05	07:44	
	16:57	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	18:43 (T-90)	17:15	16:48	
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	18:31 (T-90)	07:07	07:45	
	16:58	17:37	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	18:41 (T-90)	17:14	16:47	
4	08:04	07:43	07:00	07:04	06:14	05:43	05:46	06:16	06:52	07:28	18:31 (T-90)	07:08	07:47	
	16:59	17:39	18:16	19:56	20:33	21:06	21:16	20:51	20:01	19:05	18:40 (T-90)	17:12	16:47	
5	08:04	07:42	06:59	17:55 (T-90)	07:02	06:12	05:43	05:47	06:17	06:53	07:29	18:30 (T-90)	07:09	07:48
	17:00	17:40	18:18	17:56 (T-90)	19:57	20:35	21:07	21:16	20:50	19:59	19:03	18:38 (T-90)	17:11	16:47
6	08:04	07:41	06:57	17:54 (T-90)	07:00	06:11	05:42	05:48	06:18	06:54	07:30	18:29 (T-90)	07:11	07:49
	17:01	17:42	18:19	17:57 (T-90)	19:59	20:36	21:08	21:15	20:48	19:58	19:01	18:36 (T-90)	17:10	16:47
7	08:04	07:40	06:55	17:54 (T-90)	06:58	06:09	05:42	05:48	06:19	06:55	07:31	18:29 (T-90)	07:12	07:50
	17:02	17:43	18:20	17:59 (T-90)	20:00	20:37	21:09	21:15	20:47	19:56	19:00	18:34 (T-90)	17:09	16:46
8	08:04	07:38	07:53	18:53 (T-90)	06:56	06:08	05:42	05:49	06:20	06:57	07:33	18:30 (T-90)	07:13	07:51
	17:03	17:45	18:22	19:00 (T-90)	20:01	20:38	21:09	21:15	20:46	19:54	18:56	18:33 (T-90)	17:07	16:46
9	08:03	07:37	07:52	18:53 (T-90)	06:54	06:07	05:41	05:50	06:21	06:58	07:34	18:30 (T-90)	07:15	07:52
	17:05	17:46	19:23	19:02 (T-90)	20:02	20:39	21:10	21:14	20:44	19:52	18:54	18:33 (T-90)	17:06	16:46
10	08:03	07:35	07:50	18:53 (T-90)	06:53	06:05	05:41	05:51	06:22	06:59	07:35	18:30 (T-90)	07:16	07:53
	17:06	17:47	19:24	19:03 (T-90)	20:04	20:41	21:11	21:14	20:43	19:50	18:52	18:30 (T-90)	17:05	16:46
11	08:03	07:34	07:48	18:54 (T-90)	06:51	06:04	05:41	05:51	06:24	07:00	07:36	18:30 (T-90)	07:17	07:53
	17:07	17:49	19:26	19:04 (T-90)	20:05	20:42	21:11	21:13	20:41	19:48	18:50	18:30 (T-90)	17:04	16:46
12	08:02	07:33	07:46	18:56 (T-90)	06:49	06:03	05:41	05:52	06:25	07:01	07:38	18:30 (T-90)	07:19	07:54
	17:08	17:50	19:27	19:06 (T-90)	20:06	20:43	21:12	21:13	20:40	19:46	18:49	18:30 (T-90)	17:03	16:46
13	08:02	07:31	07:44	18:58 (T-90)	06:47	06:02	05:41	05:53	06:26	07:02	07:39	18:30 (T-90)	07:20	07:55
	17:09	17:52	19:28	19:04 (T-90)	20:07	20:44	21:13	21:12	20:38	19:45	18:47	18:30 (T-90)	17:02	16:46
14	08:02	07:30	07:42	06:46	06:01	05:41	05:41	05:54	06:27	07:04	07:40	18:30 (T-90)	07:22	07:56
	17:10	17:53	19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	18:30 (T-90)	17:00	16:46	
15	08:01	07:28	07:41	06:44	05:59	05:41	05:55	06:28	07:05	07:41	18:30 (T-90)	07:23	07:57	
	17:12	17:54	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:43	18:30 (T-90)	16:59	16:47	
16	08:01	07:27	07:39	06:42	05:58	05:41	05:56	06:29	07:06	07:43	18:30 (T-90)	07:24	07:57	
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	18:30 (T-90)	16:58	16:47	
17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	18:30 (T-90)	07:26	07:58	
	17:14	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	18:30 (T-90)	16:57	16:47	
18	07:59	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	18:30 (T-90)	07:27	07:59	
	17:15	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:38	18:30 (T-90)	16:57	16:48	
19	07:59	07:22	07:33	06:37	05:55	05:41	05:58	06:33	07:10	07:47	18:30 (T-90)	07:28	08:00	
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	18:30 (T-90)	16:56	16:48	
20	07:58	07:21	07:31	06:35	05:54	05:41	05:59	06:34	07:11	07:48	18:30 (T-90)	07:30	08:00	
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	18:30 (T-90)	16:55	16:48	
21	07:57	07:19	07:29	06:34	05:53	05:41	06:00	06:35	07:12	07:49	18:30 (T-90)	07:31	08:01	
	17:19	18:01	19:39	20:17	20:53	21:16	21:06	20:26	19:29	18:33	18:30 (T-90)	16:54	16:49	
22	07:56	07:17	07:28	06:32	05:52	05:41	06:01	06:37	07:13	07:50	18:30 (T-90)	07:32	08:01	
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	18:30 (T-90)	16:53	16:49	
23	07:56	07:16	07:26	06:30	05:51	05:41	06:02	06:38	07:14	07:52	18:30 (T-90)	07:33	08:02	
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	18:30 (T-90)	16:52	16:50	
24	07:55	07:14	07:24	06:29	05:50	05:42	06:03	06:39	07:15	07:53	18:30 (T-90)	07:35	08:02	
	17:23	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	18:30 (T-90)	16:52	16:50	
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	18:30 (T-90)	07:36	08:03	
	17:25	18:07	19:44	20:22	20:57	21:16	21:03	20:19	19:22	18:27	18:30 (T-90)	16:51	16:51	
26	07:53	07:11	07:20	06:26	05:49	05:42	06:06	06:41	07:18	07:56	18:30 (T-90)	07:37	08:03	
	17:26	18:08	19:45	20:24	20:58	21:17	21:01	20:17	19:20	18:25	18:30 (T-90)	16:50	16:52	
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	18:30 (T-90)	07:38	08:03	
	17:28	18:10	19:46	20:25	20:59	21:17	21:00	20:15	19:18	18:24	18:30 (T-90)	16:50	16:52	
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	18:30 (T-90)	07:40	08:03	
	17:29	18:11	19:47	20:26	21:00	21:17	20:59	20:14	19:16	18:22	18:30 (T-90)	16:49	16:53	
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:21	08:00	18:30 (T-90)	07:41	08:04	
	17:30		19:49	20:27	21:01	21:17	20:58	20:12	19:14	18:21	18:30 (T-90)	16:49	16:54	
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:23	08:01	18:30 (T-90)	07:42	08:04	
	17:32		19:50	20:28	21:02	21:17	20:57	20:10	19:12	18:19	18:30 (T-90)	16:48	16:55	
31	07:48		07:11		05:45		06:11	06:47		08:02	18:30 (T-90)		08:04	
	17:33		19:51		21:03		20:56	20:08		18:18	18:30 (T-90)		16:55	
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275		
Total, worst case														
Sun reduction			61								62			
Oper. time red.			0.59								0.56			
Wind dir. red.			0.90								0.90			
Total reduction			0.57								0.57			
Total, real			0.30								0.29			
			18								18			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-025 - R-025

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June				
1	08:04	07:47	17:00 (T-17)	07:06	07:09	19:27 (T-15)	06:18	06:39 (T-41)	05:45	06:08 (T-19)
	16:57	17:35	9 17:09 (T-17)	18:12	19:52	4 19:31 (T-15)	20:30	30 20:06 (T-16)	21:04	15 06:23 (T-19)
2	08:04	07:46	17:01 (T-17)	07:04	07:07	07:27 (T-20)	06:16	06:40 (T-41)	05:44	06:08 (T-19)
	16:58	17:36	10 17:11 (T-17)	18:14	19:54	9 19:32 (T-15)	20:31	29 20:08 (T-16)	21:05	16 06:24 (T-19)
3	08:04	07:45	17:01 (T-17)	07:02	07:05	07:26 (T-20)	06:15	06:41 (T-41)	05:44	06:07 (T-19)
	16:58	17:38	11 17:12 (T-17)	18:15	19:55	14 19:34 (T-15)	20:32	26 20:08 (T-16)	21:06	18 06:25 (T-19)
4	08:04	07:43	17:03 (T-17)	07:01	07:04	07:24 (T-20)	06:14	19:52 (T-16)	05:43	06:07 (T-19)
	16:59	17:39	9 17:12 (T-17)	18:16	19:56	18 19:35 (T-15)	20:33	18 20:10 (T-16)	21:06	19 06:26 (T-19)
5	08:04	07:42		06:59	07:02	07:22 (T-20)	06:12	19:53 (T-16)	05:43	06:07 (T-19)
	17:00	17:40		18:18	19:57	22 19:36 (T-15)	20:35	18 20:11 (T-16)	21:07	20 06:27 (T-19)
6	08:04	07:41		06:57	07:00	07:20 (T-20)	06:11	19:53 (T-16)	05:43	06:06 (T-19)
	17:01	17:42		18:19	19:59	25 19:37 (T-15)	20:36	18 20:11 (T-16)	21:08	22 06:28 (T-19)
7	08:04	07:40		06:55	06:58	07:18 (T-20)	06:09	19:55 (T-16)	05:42	06:06 (T-19)
	17:02	17:43		18:20	20:00	28 19:38 (T-15)	20:37	15 20:10 (T-16)	21:09	23 06:29 (T-19)
8	08:04	07:38		07:53	06:56	07:16 (T-20)	06:08	19:57 (T-16)	05:42	06:06 (T-19)
	17:04	17:45		18:22	20:01	28 19:38 (T-15)	20:38	12 20:09 (T-16)	21:09	23 06:29 (T-19)
9	08:03	07:37		07:52	06:55	07:15 (T-20)	06:07	19:58 (T-16)	05:42	06:05 (T-19)
	17:05	17:46		19:23	20:02	24 19:35 (T-15)	20:39	7 20:05 (T-16)	21:10	24 06:29 (T-19)
10	08:03	07:36		07:50	06:53	07:13 (T-20)	06:06		05:41	06:05 (T-19)
	17:06	17:47		19:24	20:04	21 07:34 (T-20)	20:41		21:11	25 06:30 (T-19)
11	08:03	07:34		07:48	06:51	07:11 (T-20)	06:04		05:41	06:05 (T-19)
	17:07	17:49		19:26	20:05	22 07:33 (T-20)	20:42		21:11	26 06:31 (T-19)
12	08:02	07:33		07:46	06:49	07:09 (T-20)	06:03		05:41	06:05 (T-19)
	17:08	17:50		19:27	20:06	24 07:33 (T-20)	20:43		21:12	26 06:31 (T-19)
13	08:02	07:31		07:44	06:47	07:08 (T-20)	06:02		05:41	06:05 (T-19)
	17:09	17:52		19:28	20:07	25 07:33 (T-20)	20:44		21:13	27 06:32 (T-19)
14	08:02	07:30		07:43	06:46	07:07 (T-20)	06:01		05:41	06:05 (T-19)
	17:11	17:53		19:30	20:09	24 07:31 (T-20)	20:45		21:13	27 06:32 (T-19)
15	08:01	07:28		07:41	06:44	07:08 (T-20)	06:00		05:41	06:05 (T-19)
	17:12	17:55		19:31	20:10	22 07:30 (T-20)	20:47		21:14	28 06:33 (T-19)
16	08:01	07:27		07:39	06:42	07:10 (T-20)	05:58		05:41	06:05 (T-19)
	17:13	17:56		19:32	20:11	19 07:29 (T-20)	20:48		21:14	28 06:33 (T-19)
17	08:00	07:25		07:37	06:40	07:11 (T-20)	05:57		05:41	06:05 (T-19)
	17:14	17:57		19:33	20:12	16 07:27 (T-20)	20:49		21:14	28 06:33 (T-19)
18	07:59	07:24		07:35	06:39	07:12 (T-20)	05:56		05:41	06:05 (T-19)
	17:16	17:59		19:35	20:14	12 07:24 (T-20)	20:50		21:15	29 06:34 (T-19)
19	07:59	07:22		07:33	06:37		05:55		05:41	06:05 (T-19)
	17:17	18:00		19:36	20:15		20:51		21:15	29 06:34 (T-19)
20	07:58	07:21		07:31	06:35		05:54		05:41	06:05 (T-19)
	17:18	18:00		19:37	20:16		20:52		21:15	29 06:34 (T-19)
21	07:57	07:19		07:30	06:34	06:54 (T-41)	05:53		05:41	06:06 (T-19)
	17:20	18:02		19:39	20:17	2 06:56 (T-41)	20:53		21:16	29 06:35 (T-19)
22	07:56	07:17	07:38 (T-21)	07:28	06:32	06:53 (T-41)	05:52		05:41	06:06 (T-19)
	17:21	18:03	2 07:40 (T-21)	19:40	20:19	5 06:58 (T-41)	20:54		21:16	29 06:35 (T-19)
23	07:56	07:16	07:37 (T-21)	07:26	06:30	06:51 (T-41)	05:51		05:42	06:06 (T-19)
	17:22	18:04	3 07:40 (T-21)	19:41	20:20	7 06:58 (T-41)	20:55		21:16	29 06:35 (T-19)
24	07:55	07:14	07:35 (T-21)	07:24	06:29	06:49 (T-41)	05:51		05:42	06:06 (T-19)
	17:24	18:06	5 07:40 (T-21)	19:42	20:21	12 19:58 (T-16)	20:56		21:16	29 06:35 (T-19)
25	07:54	16:57 (T-17)	07:13	07:22	06:27	06:48 (T-41)	05:50		05:42	06:07 (T-19)
	17:25	16:58 (T-17)	18:07	19:44	20:22	14 19:59 (T-16)	20:57		21:16	29 06:36 (T-19)
26	07:53	16:57 (T-17)	07:11	07:20	06:26	06:46 (T-41)	05:49		05:43	06:07 (T-19)
	17:26	16:59 (T-17)	18:08	19:45	20:24	18 20:00 (T-16)	20:58		21:17	28 06:35 (T-19)
27	07:52	16:57 (T-17)	07:09	07:18	06:24	06:45 (T-41)	05:48		05:43	06:07 (T-19)
	17:28	17:01 (T-17)	18:10	19:46	20:25	22 20:02 (T-16)	20:59		21:17	28 06:35 (T-19)
28	07:51	16:57 (T-17)	07:07	07:17	06:22	06:43 (T-41)	05:47	06:11 (T-19)	05:43	06:08 (T-19)
	17:29	17:02 (T-17)	18:11	19:47	20:26	24 20:02 (T-16)	21:00	4 06:15 (T-19)	21:17	28 06:36 (T-19)
29	07:50	16:58 (T-17)		07:15	06:21	06:42 (T-41)	05:47		05:44	06:08 (T-19)
	17:30	17:04 (T-17)		19:49	20:27	26 20:04 (T-16)	21:01	8 06:18 (T-19)	21:17	27 06:35 (T-19)
30	07:49	16:58 (T-17)		07:13	06:19	06:40 (T-41)	05:46		05:44	06:09 (T-19)
	17:32	17:06 (T-17)		19:50	20:29	29 20:05 (T-16)	21:02	10 06:19 (T-19)	21:17	27 06:36 (T-19)
31	07:48	16:59 (T-17)		07:11			05:45		06:09 (T-19)	
	17:33	17:07 (T-17)		19:51	2 19:30 (T-15)		21:03	13 06:22 (T-19)		
Potential sun hours	287	292	369	404	459				465	
Total, worst case	34	72	2	516	208				765	
Sun reduction	0.58	0.58	0.59	0.63	0.66				0.73	
Oper. time red.	0.90	0.90	0.90	0.90	0.90				0.90	
Wind dir. red.	0.59	0.60	0.60	0.59	0.60				0.59	
Total reduction	0.31	0.31	0.32	0.33	0.36				0.39	
Total, real	10	22	1	171	75				295	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-025 - R-025

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:09 (T-19) 20:55	06:12 20:07	06:48 20:07	07:10 (T-20) 19:11	07:24 16:48
2	05:45 21:16	06:10 (T-19) 20:54	06:13 20:05	06:50 20:05	07:11 (T-20) 19:09	07:25 16:48
3	05:46 21:16	06:10 (T-19) 20:52	06:14 20:03	06:51 20:03	07:13 (T-20) 19:07	07:26 16:47
4	05:47 21:16	06:11 (T-19) 20:51	06:16 20:01	06:52 20:01	07:14 (T-20) 19:05	07:28 16:47
5	05:47 21:16	06:12 (T-19) 20:50	06:17 20:05	06:53 20:19	07:15 (T-20) 19:03	07:29 16:47
6	05:48 21:15	06:12 (T-19) 20:48	06:18 20:04	06:54 20:16	07:16 (T-20) 19:01	07:30 16:47
7	05:48 21:15	06:13 (T-19) 20:47	06:19 20:03	06:55 20:18	07:17 (T-20) 19:00	07:31 16:46
8	05:49 21:15	06:14 (T-19) 20:46	06:20 20:02	06:57 20:19	07:18 (T-20) 18:56	07:33 16:46
9	05:50 21:14	06:14 (T-19) 20:44	06:21 20:18	06:58 20:18	07:19 (T-20) 18:54	07:34 16:46
10	05:51 21:14	06:15 (T-19) 20:43	06:22 20:18	06:59 20:18	07:20 (T-20) 18:52	07:35 16:46
11	05:52 21:13	06:16 (T-19) 20:41	06:24 20:16	07:00 20:16	07:21 (T-20) 18:51	07:36 16:46
12	05:52 21:13	06:17 (T-19) 20:40	06:25 20:15	07:01 20:15	07:22 (T-20) 18:49	07:38 16:46
13	05:53 21:12	06:17 (T-19) 20:38	06:26 20:13	07:02 20:13	07:23 (T-20) 18:47	07:39 16:46
14	05:54 21:12	06:18 (T-19) 20:37	06:27 20:11	07:04 20:11	07:24 (T-20) 18:45	07:40 16:46
15	05:55 21:11	06:19 (T-19) 20:35	06:28 20:10	07:05 20:10	07:25 (T-20) 18:44	07:41 16:47
16	05:56 21:10	06:20 (T-19) 20:34	06:29 20:08	07:06 20:08	07:26 (T-20) 18:42	07:42 16:47
17	05:57 21:09	06:21 (T-19) 20:32	06:30 20:06	07:07 20:06	07:27 (T-20) 18:40	07:43 16:47
18	05:58 21:09	06:22 (T-19) 20:31	06:31 20:06	07:08 20:06	07:28 (T-20) 18:38	07:44 16:48
19	05:59 21:08	06:23 (T-19) 20:29	06:32 20:04	07:09 20:04	07:29 (T-20) 18:37	07:45 16:48
20	06:00 21:07	06:24 (T-19) 20:27	06:33 20:03	07:10 20:03	07:30 (T-20) 18:35	07:46 16:48
21	06:01 21:06	06:25 (T-19) 20:26	06:34 20:02	07:11 20:02	07:31 (T-20) 18:33	07:47 16:49
22	06:02 21:05	06:26 (T-19) 20:24	06:35 20:01	07:12 20:01	07:32 (T-20) 18:32	07:48 16:49
23	06:03 21:04	06:27 (T-19) 20:22	06:36 20:00	07:13 20:00	07:33 (T-20) 18:30	07:49 16:50
24	06:04 21:04	06:28 (T-19) 20:21	06:37 20:00	07:14 20:00	07:34 (T-20) 18:29	07:50 16:50
25	06:05 21:03	06:29 (T-19) 20:19	06:38 20:00	07:15 20:00	07:35 (T-20) 18:27	07:51 16:51
26	06:06 21:02	06:30 (T-19) 20:17	06:39 20:00	07:16 20:00	07:36 (T-20) 18:25	07:52 16:52
27	06:07 21:00	06:31 (T-19) 20:16	06:40 20:00	07:17 20:00	07:37 (T-20) 18:24	07:53 16:52
28	06:08 20:59	06:32 (T-19) 20:14	06:41 20:00	07:18 20:00	07:38 (T-20) 18:22	07:54 16:53
29	06:09 20:58	06:33 (T-19) 20:12	06:42 20:00	07:19 20:00	07:39 (T-20) 18:21	07:55 16:54
30	06:10 20:57	06:34 (T-19) 20:10	06:43 20:00	07:20 20:00	07:40 (T-20) 18:20	07:56 16:54
31	06:11 20:56	06:35 (T-19) 20:08	06:44 20:00	07:21 20:00	07:41 (T-20) 18:18	07:57 16:55
Potential sun hours	471	436	377	341	288	275
Total, worst case		277	478	218	32	76
Sun reduction		0.75	0.72	0.67	0.56	0.48
Oper. time red.		0.90	0.90	0.90	0.90	0.90
Wind dir. red.		0.59	0.59	0.58	0.61	0.59
Total reduction		0.40	0.38	0.35	0.31	0.25
Total, real	110	184	77	10	19	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-026 - R-026

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June			
1	08:04	07:47	07:06	17:37 (T-30)	07:09	19:23 (T-29)	06:18	06:39 (T-18)	05:45
	16:57	17:35	18:13	14 17:51 (T-30)	19:53	5 19:28 (T-29)	20:30	12 06:51 (T-18)	21:04
2	08:04	07:46	07:04	07:04	07:07		06:17	06:38 (T-18)	05:45
	16:58	17:36	18:14	16 17:52 (T-30)	19:54		20:31	13 06:51 (T-18)	21:05
3	08:04	07:45	07:02	07:06	07:06		06:15	06:36 (T-18)	05:44
	16:59	17:38	18:15	18 17:54 (T-30)	19:55		20:32	13 06:49 (T-18)	21:06
4	08:04	07:43	07:01	07:37 (T-30)	07:04		06:14	06:35 (T-18)	05:44
	17:00	17:39	18:17	18 17:55 (T-30)	19:56		20:34	13 06:48 (T-18)	21:07
5	08:04	07:42	06:59	17:37 (T-30)	07:02		06:12	06:36 (T-18)	05:43
	17:01	17:41	18:18	19 17:56 (T-30)	19:58		20:35	11 06:47 (T-18)	21:07
6	08:04	07:41	06:57	17:39 (T-30)	07:00		06:11	06:39 (T-18)	05:43
	17:02	17:42	18:19	16 17:55 (T-30)	19:59		20:36	4 06:43 (T-18)	21:08
7	08:04	07:40	06:55	17:40 (T-30)	06:58		06:10		05:42
	17:03	17:43	18:21	13 17:53 (T-30)	20:00		20:37		21:09
8	08:04	07:38	07:54	18:44 (T-30)	06:56		06:08		05:42
	17:04	17:45	18:22	5 18:49 (T-30)	20:01		20:38		21:10
9	08:04	07:37	07:52		06:55		06:07		05:42
	17:05	17:46	19:23		20:03		20:40		21:10
10	08:03	07:36	07:50		06:53		06:06		05:41
	17:06	17:48	19:25		20:04		20:41		21:11
11	08:03	07:34	07:56 (T-42)	07:48	06:51		06:04		05:41
	17:07	17:49	1 07:57 (T-42)	19:26	20:05		20:42		21:11
12	08:03	07:33	07:54 (T-42)	07:46	06:49		06:03		05:41
	17:08	17:50	3 07:57 (T-42)	19:27	20:06	3 19:42 (T-13)	20:43		21:12
13	08:02	07:31	07:53 (T-42)	07:44	06:48		06:02		05:41
	17:09	17:52	4 07:57 (T-42)	19:28	20:08	5 19:45 (T-13)	20:44		21:13
14	08:02	07:30	07:51 (T-42)	07:43	06:46		06:01		05:41
	17:11	17:53	5 07:56 (T-42)	19:30	20:09	7 19:46 (T-13)	20:45		21:13
15	08:01	07:28	07:50 (T-42)	07:41	06:44		06:00		05:41
	17:12	17:55	6 07:56 (T-42)	19:31	20:10	9 19:47 (T-13)	20:47		21:14
16	08:01	07:27	07:48 (T-42)	07:39	06:42		05:59		05:41
	17:13	17:56	6 07:54 (T-42)	19:32	20:11	11 19:49 (T-13)	20:48		21:14
17	08:00	07:25	07:47 (T-42)	07:37	06:41		05:57		05:41
	17:14	17:57	5 07:52 (T-42)	19:34	20:12	12 19:50 (T-13)	20:49		21:14
18	07:59	07:24	07:35		06:39		05:56		05:41
	17:16	17:59	19:35		20:14	14 19:51 (T-13)	20:50		21:15
19	07:59	07:22	07:33		06:37		05:55		05:41
	17:17	18:00	19:36		20:15	15 19:53 (T-13)	20:51		21:15
20	07:58	07:21	07:32		06:36		05:54		05:41
	17:18	18:00	19:37		20:16	15 19:54 (T-13)	20:52		21:16
21	07:57	07:19	07:30		06:34		05:53		05:41
	17:20	18:02	19:39		20:17	13 19:52 (T-13)	20:53		21:16
22	07:57	07:18	07:28		06:32		05:53		05:42
	17:21	18:03	19:40		20:19	10 19:51 (T-13)	20:54		21:16
23	07:56	07:16	07:26		06:31		05:52		05:42
	17:22	18:04	19:41		20:20		20:55		21:16
24	07:55	07:14	17:40 (T-30)	07:24	06:29		05:51		05:42
	17:24	18:06	4 17:44 (T-30)	19:42	20:21	2 06:52 (T-18)	20:56		21:16
25	07:54	07:13	17:38 (T-30)	07:22	06:27		05:50		05:42
	17:25	18:07	7 17:45 (T-30)	19:44	1 19:22 (T-29)	20:22	20:57		21:17
26	07:53	07:11	17:38 (T-30)	07:20	19:21 (T-29)	06:26	06:47 (T-18)	05:49	05:43
	17:26	18:09	9 17:47 (T-30)	19:45	3 19:24 (T-29)	20:24	6 06:53 (T-18)	20:58	21:17
27	07:52	07:09	17:37 (T-30)	07:19	19:20 (T-29)	06:24	06:45 (T-18)	05:48	05:43
	17:28	18:10	11 17:48 (T-30)	19:46	5 19:25 (T-29)	20:25	8 06:53 (T-18)	20:59	21:17
28	07:51	07:08	17:36 (T-30)	07:17	19:20 (T-29)	06:23	06:44 (T-18)	05:48	05:44
	17:29	18:11	13 17:49 (T-30)	19:48	6 19:26 (T-29)	20:26	9 06:53 (T-18)	21:00	21:17
29	07:50		07:15	19:20 (T-29)	06:21		06:42 (T-18)	05:47	05:44
	17:31		19:49	7 19:27 (T-29)	20:27	10 06:52 (T-18)	21:01		21:17
30	07:49		07:13	19:20 (T-29)	06:20		06:41 (T-18)	05:46	05:44
	17:32		19:50	8 19:28 (T-29)	20:29	11 06:52 (T-18)	21:02		21:17
31	07:48		07:11	19:21 (T-29)			05:46		
	17:33		19:51	9 19:30 (T-29)			21:03		
Potential sun hours	287	292	369	403	459		465		
Total, worst case									
Sun reduction		74	158	169	66				
Oper. time red.		0.58	0.59	0.63	0.66				
Wind dir. red.		0.90	0.90	0.90	0.90				
Total reduction		0.60	0.58	0.59	0.58				
Total, real		0.31	0.31	0.34	0.35				
		23	49	57	23				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-026 - R-026
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December										
1	05:45 21:16	06:12 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:48										
2	05:45 21:16	06:14 20:54	06:50 20:05	07:25 19:09	07:05 17:15	07:44 16:48										
3	05:46 21:16	06:15 20:52	06:51 20:03	07:27 19:07	07:07 17:14	07:46 16:48										
4	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	07:47 16:47										
5	05:47 21:16	06:17 20:50	06:53 20:00	07:29 19:03	07:09 17:11	07:48 16:47										
6	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:02	18:17 (T-30) 18:27 (T-30)	07:11 17:10	07:49 16:47									
7	05:49 21:15	06:19 20:47	06:47 (T-18) 06:54 (T-18)	06:56 19:56	07:31 19:00	18:16 (T-30) 18:30 (T-30)	07:12 17:09	07:50 16:47								
8	05:49 21:15	06:20 20:46	06:45 (T-18) 06:57 (T-18)	06:57 19:54	07:33 18:56	18:13 (T-30) 18:31 (T-30)	07:14 17:08	07:51 16:47								
9	05:50 21:14	06:22 20:44	06:45 (T-18) 06:58 (T-18)	06:58 19:52	07:34 18:54	18:12 (T-30) 18:30 (T-30)	07:15 17:06	07:52 16:46								
10	05:51 21:14	06:23 20:43	06:46 (T-18) 06:59 (T-18)	06:59 19:50	07:35 18:52	18:11 (T-30) 18:28 (T-30)	07:16 17:05	07:53 16:46								
11	05:52 21:13	06:24 20:41	06:47 (T-18) 07:00 (T-18)	07:00 19:48	19:17 (T-29) 19:21 (T-29)	07:36 18:51	18:11 (T-30) 18:27 (T-30)	07:18 17:04	07:54 16:46							
12	05:52 21:13	06:25 20:40	06:48 (T-18) 07:00 (T-18)	07:01 19:47	19:13 (T-29) 19:22 (T-29)	07:38 18:49	18:10 (T-30) 18:25 (T-30)	07:19 17:03	07:54 16:47							
13	05:53 21:12	06:26 20:38	06:49 (T-18) 07:00 (T-18)	07:03 19:45	19:11 (T-29) 19:20 (T-29)	07:39 18:47	18:09 (T-30) 18:23 (T-30)	07:20 17:02	07:55 16:47							
14	05:54 21:12	06:27 20:37	06:50 (T-18) 07:00 (T-18)	07:04 19:43	19:10 (T-29) 19:18 (T-29)	07:40 18:45	18:10 (T-30) 18:22 (T-30)	07:22 17:01	07:56 16:47							
15	05:55 21:11	06:29 20:35	06:51 (T-18) 07:00 (T-18)	07:05 19:41	19:09 (T-29) 19:16 (T-29)	07:42 18:44	18:10 (T-30) 18:20 (T-30)	07:23 17:00	07:57 16:47							
16	05:56 21:10	06:30 20:34	06:52 (T-18) 06:59 (T-18)	07:06 19:39	19:08 (T-29) 19:14 (T-29)	07:43 18:42	18:10 (T-30) 18:18 (T-30)	07:24 16:59	07:58 16:47							
17	05:57 21:10	06:31 20:32	06:54 (T-18) 07:00 (T-18)	07:07 19:37	19:09 (T-29) 19:13 (T-29)	07:44 18:40	18:11 (T-30) 18:17 (T-30)	07:26 16:58	07:58 16:47							
18	05:58 21:09	06:32 20:31	06:55 (T-18) 06:59 (T-18)	07:09 19:35	19:09 (T-29) 19:11 (T-29)	07:45 18:39	18:12 (T-30) 18:14 (T-30)	07:27 16:57	07:59 16:48							
19	05:59 21:08	06:33 20:29	06:56 (T-18) 06:58 (T-18)	07:10 19:33	19:11 (T-29) 19:13 (T-29)	07:46 18:37	18:14 (T-30) 18:16 (T-30)	07:28 16:56	08:00 16:48							
20	06:00 21:07	06:34 20:27	19:50 (T-13) 19:53 (T-13)	07:11 19:31	19:14 (T-29) 19:17 (T-29)	07:48 18:35	18:18 (T-30) 18:20 (T-30)	07:30 16:55	08:00 16:49							
21	06:01 21:06	06:36 20:26	19:46 (T-13) 19:56 (T-13)	07:12 19:30	19:15 (T-29) 19:18 (T-29)	07:49 18:34	18:19 (T-30) 18:21 (T-30)	07:31 16:54	08:01 16:49							
22	06:02 21:05	06:37 20:24	19:44 (T-13) 19:57 (T-13)	07:13 19:28	19:16 (T-29) 19:19 (T-29)	07:51 18:32	18:22 (T-30) 18:24 (T-30)	07:32 16:53	08:01 16:49							
23	06:03 21:05	06:38 20:22	19:42 (T-13) 19:57 (T-13)	07:14 19:26	19:18 (T-29) 19:21 (T-29)	07:52 18:30	18:25 (T-30) 18:27 (T-30)	07:33 16:53	08:02 16:50							
24	06:04 21:04	06:39 20:21	19:41 (T-13) 19:55 (T-13)	07:16 19:24	19:20 (T-29) 19:23 (T-29)	07:53 18:29	18:28 (T-30) 18:30 (T-30)	07:35 16:52	08:02 16:51							
25	06:05 21:03	06:40 20:19	19:41 (T-13) 19:55 (T-13)	07:17 19:22	19:24 (T-29) 19:27 (T-29)	07:55 18:27	08:17 (T-42) 08:23 (T-42)	07:36 16:51	08:03 16:51							
26	06:06 21:02	06:41 20:17	19:41 (T-13) 19:53 (T-13)	07:18 19:20	19:28 (T-29) 19:31 (T-29)	07:56 18:26	08:18 (T-42) 08:24 (T-42)	07:37 16:51	08:03 16:52							
27	06:07 21:01	06:43 20:16	19:40 (T-13) 19:51 (T-13)	07:19 19:18	19:32 (T-29) 19:35 (T-29)	07:57 18:24	08:20 (T-42) 08:26 (T-42)	07:39 16:50	08:03 16:53							
28	06:08 20:59	06:44 20:14	19:40 (T-13) 19:49 (T-13)	07:20 19:16	19:36 (T-29) 19:39 (T-29)	07:59 18:23	08:21 (T-42) 08:26 (T-42)	07:40 16:50	08:04 16:53							
29	06:09 20:58	06:45 20:12	19:40 (T-13) 19:47 (T-13)	07:22 19:15	19:40 (T-29) 19:43 (T-29)	08:00 18:21	08:22 (T-42) 08:26 (T-42)	07:41 16:49	08:04 16:54							
30	06:10 20:57	06:46 20:10	19:40 (T-13) 19:45 (T-13)	07:23 19:13	19:44 (T-29) 19:47 (T-29)	08:01 18:20	08:24 (T-42) 08:26 (T-42)	07:42 16:49	08:04 16:55							
31	06:11 20:56	06:47 20:09	19:41 (T-13) 19:43 (T-13)	19:13	19:48 (T-29) 19:51 (T-29)	08:03 18:18	08:25 (T-42) 08:26 (T-42)	08:04 16:56	08:04 16:56							
Potential sun hours	471	436	377	341	288	275										
Total, worst case			234	49	190											
Sun reduction			0.72	0.67	0.56											
Oper. time red.			0.90	0.90	0.90											
Wind dir. red.			0.59	0.59	0.59											
Total reduction			0.38	0.36	0.30											
Total, real		90	18	56												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-028 - R-028
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	07:47	08:19 (T-45)	07:06	07:09	06:18
	16:57	17:35	17	08:36 (T-45)	18:12	19:52
2	08:04	07:46	08:21 (T-45)	07:04	07:07	20:30
	16:58	17:36	14	08:35 (T-45)	18:14	11
3	08:04	07:44	08:23 (T-45)	07:02	07:05	20:06 (T-17)
	16:58	17:38	8	08:31 (T-45)	18:15	9
4	08:04	07:43		07:00	07:04	20:00 (T-17)
	16:59	17:39		18:16	19:56	2
5	08:04	07:42		06:59	07:02	20:32
	17:00	17:40		18:18	19:57	20:02 (T-17)
6	08:04	07:41		06:57	07:00	06:14
	17:01	17:42		18:19	19:59	20:33
7	08:04	07:39		06:55	06:58	06:12
	17:03	17:43		18:20	20:00	20:35
8	08:04	07:38		07:53	06:56	06:08
	17:04	17:45		18:22	20:01	20:37
9	08:03	08:27 (T-45)	07:37	07:52	06:55	20:38
	17:05	1	08:28 (T-45)	17:46	19:23	06:07
10	08:03	08:27 (T-45)	07:35	07:50	06:53	20:39
	17:06	2	08:29 (T-45)	17:48	19:24	21:10
11	08:03	08:26 (T-45)	07:34	07:48	06:51	06:06
	17:07	4	08:30 (T-45)	17:49	19:26	20:41
12	08:02	08:26 (T-45)	07:33	07:46	06:49	06:04
	17:08	5	08:31 (T-45)	17:50	19:27	20:42
13	08:02	08:26 (T-45)	07:31	07:44	06:47	06:03
	17:09	7	08:33 (T-45)	17:52	19:28	1
14	08:02	08:25 (T-45)	07:30	07:42	06:46	06:25 (T-21)
	17:11	8	08:33 (T-45)	17:53	19:30	3
15	08:01	08:24 (T-45)	07:28	07:41	06:44	06:27 (T-21)
	17:12	10	08:34 (T-45)	17:55	19:31	4
16	08:01	08:24 (T-45)	07:27	07:39	06:42	06:27 (T-21)
	17:13	11	08:35 (T-45)	17:56	19:32	5
17	08:00	08:23 (T-45)	07:25	07:37	06:40	06:27 (T-21)
	17:14	13	08:36 (T-45)	17:57	19:33	3
18	07:59	08:22 (T-45)	07:24	07:35	06:39	06:23 (T-21)
	17:16	14	08:36 (T-45)	17:59	19:35	4
19	07:59	08:22 (T-45)	07:22	07:33	06:37	06:27 (T-21)
	17:17	15	08:37 (T-45)	18:00	19:36	7
20	07:58	08:21 (T-45)	07:21	07:31	06:35	06:19 (T-21)
	17:18	17	08:38 (T-45)	18:00	19:37	8
21	07:57	08:20 (T-45)	07:19	07:30	06:34	06:25 (T-21)
	17:20	18	08:38 (T-45)	18:02	19:39	8
22	07:56	08:19 (T-45)	07:17	07:28	06:32	06:16 (T-21)
	17:21	19	08:38 (T-45)	18:03	19:40	8
23	07:56	08:18 (T-45)	07:16	07:26	06:30	06:24 (T-21)
	17:22	20	08:38 (T-45)	18:04	19:41	1
24	07:55	08:17 (T-45)	07:14	07:24	06:29	06:27 (T-21)
	17:24	21	08:38 (T-45)	18:06	19:42	3
25	07:54	08:16 (T-45)	07:12	07:22	06:27	06:23 (T-21)
	17:25	23	08:39 (T-45)	18:07	19:44	4
26	07:53	08:15 (T-45)	07:11	07:20	06:26	06:22 (T-21)
	17:26	24	08:39 (T-45)	18:08	19:45	5
27	07:52	08:14 (T-45)	07:09	07:18	06:24	19:59 (T-17)
	17:28	24	08:38 (T-45)	18:10	19:46	7
28	07:51	08:14 (T-45)	07:07	07:17	06:23	20:00 (T-17)
	17:29	24	08:38 (T-45)	18:11	19:47	8
29	07:50	08:15 (T-45)		07:15	06:21	20:02 (T-17)
	17:31	23	08:38 (T-45)	18:09	19:49	9
30	07:49	08:16 (T-45)		07:13	06:19	19:54 (T-17)
	17:32	22	08:38 (T-45)	18:07	19:50	10
31	07:48	08:17 (T-45)		07:11	06:17	20:04 (T-17)
	17:33	20	08:37 (T-45)	18:05	19:51	11
Potential sun hours	287	292	369	403	459	21:02
Total, worst case	345	39		56	91	21:03
Sun reduction	0.58	0.58		0.63	0.66	21:16
Oper. time red.	0.90	0.90		0.90	0.90	05:42
Wind dir. red.	0.65	0.65		0.61	0.60	21:16
Total reduction	0.34	0.34		0.35	0.36	05:42
Total, real	117	13		19	32	21:16

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-028 - R-028
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	06:36 (T-21) 06:37 (T-21)	06:48 20:07	07:24 19:11	07:43 17:17
2	05:45 21:16	06:13 20:53		06:50 20:05	07:25 19:09	07:44 17:15
3	05:46 21:16	06:15 20:52		06:51 20:03	07:26 19:07	07:45 17:14
4	05:47 21:16	06:16 20:51		06:52 20:01	07:28 19:05	07:46 17:13
5	05:47 21:16	06:17 20:50		06:53 19:59	07:29 19:03	07:48 17:11
6	05:48 21:15	06:18 20:48		06:54 19:58	07:30 19:01	07:49 17:10
7	05:49 21:15	06:19 20:47		06:55 19:56	07:31 19:00	07:50 17:09
8	05:49 21:15	06:20 20:46		06:57 19:54	07:33 18:56	07:51 17:07
9	05:50 21:14	06:21 20:44		06:58 19:52	07:34 18:54	07:51 17:06
10	05:51 21:14	06:23 20:43	20:08 (T-17)	06:59 19:50	07:35 18:52	07:52 17:05
11	05:52 21:13	06:24 20:41	20:14 (T-17) 20:05 (T-17)	07:00 19:48	07:36 18:51	07:53 17:04
12	05:52 21:13	06:25 20:40	20:16 (T-17) 20:04 (T-17)	07:01 19:46	07:38 18:49	07:54 17:03
13	05:53 21:12	06:26 20:38	20:02 (T-17) 20:13 (T-17)	07:03 19:45	07:39 18:47	07:55 17:02
14	05:54 21:11	06:27 20:37	20:02 (T-17) 20:11 (T-17)	07:04 19:43	07:40 18:45	07:56 17:01
15	05:55 21:11	06:28 20:35	20:01 (T-17) 20:10 (T-17)	07:05 19:41	07:41 18:44	07:57 17:00
16	05:56 21:10	06:30 20:34	20:00 (T-17) 20:08 (T-17)	07:06 19:39	07:43 18:42	07:57 16:59
17	05:57 21:09	06:31 20:32	20:00 (T-17) 20:06 (T-17)	07:07 19:37	07:44 18:40	07:58 16:58
18	05:58 21:09	06:32 20:31	20:01 (T-17) 20:06 (T-17)	07:08 19:35	07:45 18:38	07:59 16:57
19	05:59 21:08	06:33 20:29	20:01 (T-17) 20:04 (T-17)	07:10 19:33	07:47 18:37	07:59 16:56
20	06:00 21:07	06:34 20:27	20:01 (T-17) 20:02 (T-17)	07:11 19:31	07:48 18:35	08:00 16:55
21	06:01 21:06	06:35 20:26	06:26 (T-21) 06:32 (T-21)	07:12 19:29	07:49 18:33	08:01 16:54
22	06:02 21:05	06:37 20:24	06:26 (T-21) 06:34 (T-21)	07:13 19:28	07:50 18:32	08:01 16:53
23	06:03 21:04	06:38 20:22	06:27 (T-21) 06:35 (T-21)	07:14 19:26	07:52 18:30	08:02 16:53
24	06:04 21:03	06:39 20:21	06:27 (T-21) 06:35 (T-21)	07:15 19:24	07:53 18:29	08:02 16:52
25	06:05 21:02	06:40 20:19	06:28 (T-21) 06:36 (T-21)	07:17 19:22	07:54 18:27	08:02 16:51
26	06:06 21:01	06:41 20:17	06:30 (T-21) 06:37 (T-21)	07:18 19:20	07:56 18:25	08:03 16:51
27	06:07 21:00	06:43 20:15	06:31 (T-21) 06:37 (T-21)	07:19 19:18	07:57 18:24	08:03 16:50
28	06:08 20:59	06:44 20:14	06:32 (T-21) 06:37 (T-21)	07:20 19:16	07:58 18:22	08:03 16:50
29	06:09 20:58	06:45 20:12	06:33 (T-21) 06:38 (T-21)	07:22 19:14	08:00 18:21	08:04 16:49
30	06:10 20:57	06:46 20:10	06:34 (T-21) 06:37 (T-21)	07:23 19:13	08:01 18:19	08:04 16:49
31	06:11 20:56	06:47 20:08	06:35 (T-21) 06:37 (T-21)	08:02 18:18	08:02 18:18	08:04 16:56
Potential sun hours	471	436		377	341	288
Total, worst case	66	80				379
Sun reduction	0.75	0.72				0.48
Oper. time red.	0.90	0.90				0.90
Wind dir. red.	0.59	0.61				0.65
Total reduction	0.40	0.40				0.28
Total, real	26	32				107

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-054 - R-054
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:56	17:34	18:12	19:52	20:30	21:04	21:16	20:55	20:06	19:10	17:16	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:57	17:36	18:14	19:53	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:47
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:13	05:43	05:46	06:15	06:52	07:27	07:08	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:12	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:42	05:48	06:18	06:54	07:30	07:10	07:48
	17:01	17:42	18:19	19:58	20:36	21:08	21:15	20:48	19:57	19:01	17:10	16:46
7	08:04	07:39	06:55	06:58	06:09	05:42	05:48	06:19	06:55	07:31	07:12	07:49
	17:02	17:43	18:20	20:00	20:37	21:09	21:15	20:47	19:56	18:58	17:08	16:46
8	08:04	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50
	17:03	17:44	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	06:07	05:41	05:50	06:21	06:58	07:34	07:15	07:51
	17:04	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:05	05:41	05:50	06:22	06:59	07:35	07:16	07:52
	17:06	17:47	19:24	20:03	20:40	21:11	21:14	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	05:51	06:23	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:50	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:19	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:02	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:01	16:46
14	08:01	07:30	07:42	06:45	06:00	05:40	05:54	06:27	07:03	07:40	07:21	07:56
	17:10	17:53	19:29	20:08	20:45	21:13	21:11	20:37	19:42	18:45	17:00	16:46
15	08:01	07:28	07:40	06:44	05:59	05:40	05:55	06:28	07:05	07:41	07:23	07:57
	17:12	17:54	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:43	16:59	16:47
16	08:00	07:27	07:39	06:42	05:58	05:40	05:56	06:29	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57	05:40	05:56	06:30	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:57	16:47
18	07:59	07:24	07:35	06:39	05:56	05:40	05:57	06:32	07:08	07:45	07:27	07:59
	17:15	17:59	19:35	20:13	20:50	21:15	21:09	20:30	19:35	18:38	16:56	16:47
19	07:59	07:22	07:33	06:37	05:55	05:41	05:58	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	05:59	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:33	05:53	05:41	06:00	06:35	07:12	07:49	07:31	08:00
	17:19	18:01	19:38	20:17	20:53	21:16	21:06	20:26	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:01	06:36	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:16	21:05	20:24	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	05:51	05:41	06:02	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:52	16:50
24	07:55	07:14	07:24	06:29	05:50	05:42	06:03	06:39	07:15	07:53	07:35	08:02
	17:23	18:05	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:28	16:52	16:50
25	07:54	07:12	07:22	06:27	05:49	05:42	06:04	06:40	07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:25	05:49	05:42	06:05	06:41	07:18	07:56	07:37	08:03
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:50	16:51
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:27	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:43	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:22	16:49	16:53
29	07:50		07:14	06:21	05:47	05:44	06:09	06:45	07:21	08:00	07:41	08:04
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:48	16:54
31	07:48		07:11		05:45		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:55
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christianajansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-055 - R-055
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	17:42 (T-21)	07:09	06:18	05:45	05:45	06:12	06:48	07:24	18:24 (T-22)	07:04	07:43
	16:56	17:34	18:12	8 17:50 (T-22)	19:52	20:30	21:04	21:16	20:55	20:06	19:10	19 18:43 (T-22)	17:16	16:48
2	08:04	07:45	07:04	17:43 (T-21)	07:07	06:16	05:44	05:45	06:13	06:49	07:25	18:22 (T-22)	07:05	07:44
	16:57	17:36	18:14	8 17:51 (T-22)	19:53	20:31	21:05	21:16	20:53	20:05	19:09	21 18:43 (T-22)	17:15	16:48
3	08:04	07:44	07:02	17:44 (T-21)	07:05	06:15	05:44	05:46	06:14	06:51	07:26	18:21 (T-22)	07:06	07:45
	16:58	17:37	18:15	10 17:54 (T-22)	19:55	20:32	21:05	21:16	20:52	20:03	19:07	20 18:41 (T-22)	17:14	16:47
4	08:04	07:43	07:00	17:45 (T-22)	07:03	06:13	05:43	05:46	06:15	06:52	07:27	18:21 (T-22)	07:08	07:46
	16:59	17:39	18:16	10 17:55 (T-22)	19:56	20:33	21:06	21:16	20:51	20:01	19:05	19 18:40 (T-22)	17:12	16:47
5	08:04	07:42	06:59	17:44 (T-22)	07:02	06:12	05:43	05:47	06:17	06:53	07:29	18:20 (T-22)	07:09	07:47
	17:00	17:40	18:18	12 17:56 (T-22)	19:57	20:34	21:07	21:15	20:49	19:59	19:03	18 18:38 (T-22)	17:11	16:47
6	08:04	07:41	06:57	17:43 (T-22)	07:00	06:11	05:42	05:48	06:18	06:54	07:30	18:19 (T-22)	07:10	07:48
	17:01	17:42	18:19	14 17:57 (T-22)	19:58	20:36	21:08	21:15	20:48	19:57	19:01	17 18:36 (T-22)	17:10	16:46
7	08:04	07:39	06:55	17:42 (T-22)	06:58	06:09	05:42	05:48	06:19	06:55	07:31	18:19 (T-22)	07:12	07:49
	17:02	17:43	18:20	16 17:58 (T-22)	20:00	20:37	21:09	21:15	20:47	19:56	19:01	15 18:34 (T-22)	17:08	16:46
8	08:03	07:38	07:53	18:43 (T-22)	06:56	06:08	05:42	05:49	06:20	06:56	07:32	18:19 (T-22)	07:13	07:50
	17:03	17:44	18:22	17 19:00 (T-22)	20:01	20:38	21:09	21:14	20:45	19:54	19:00	14 18:33 (T-22)	17:07	16:46
9	08:03	07:37	07:51	18:43 (T-22)	06:54	06:07	05:41	05:50	06:21	06:58	07:34	18:19 (T-22)	07:15	07:51
	17:04	17:46	19:23	19 19:02 (T-22)	20:02	20:39	21:10	21:14	20:44	19:52	19:00	11 18:30 (T-22)	17:06	16:46
10	08:03	07:35	07:50	18:43 (T-22)	06:53	06:05	05:41	05:51	06:22	06:59	07:35	18:19 (T-21)	07:16	07:52
	17:06	17:47	19:24	20 19:03 (T-22)	20:03	20:40	21:11	21:14	20:43	19:50	19:00	9 18:28 (T-22)	17:05	16:46
11	08:03	07:34	07:48	18:43 (T-22)	06:51	06:04	05:41	05:51	06:23	07:00	07:36	18:17 (T-21)	07:17	07:53
	17:07	17:49	19:26	21 19:04 (T-22)	20:05	20:42	21:11	21:13	20:41	19:48	19:00	9 18:26 (T-22)	17:04	16:46
12	08:02	07:33	07:46	18:43 (T-22)	06:49	06:03	05:41	05:52	06:25	07:01	07:37	18:16 (T-21)	07:19	07:54
	17:08	17:50	19:27	21 19:04 (T-22)	20:06	20:43	21:12	21:12	20:40	19:46	19:00	9 18:25 (T-22)	17:02	16:46
13	08:02	07:31	07:44	18:44 (T-22)	06:47	06:02	05:41	05:53	06:26	07:02	07:39	18:15 (T-21)	07:20	07:55
	17:09	17:52	19:28	18 19:02 (T-22)	20:07	20:44	21:12	21:12	20:38	19:44	19:00	8 18:23 (T-21)	17:01	16:46
14	08:01	07:30	07:42	18:47 (T-22)	06:45	06:00	05:41	05:54	06:27	07:03	07:40	18:14 (T-21)	07:21	07:56
	17:10	17:53	19:29	14 19:01 (T-22)	20:08	20:45	21:13	21:11	20:37	19:42	19:00	7 18:21 (T-21)	17:00	16:46
15	08:01	07:28	07:40	18:49 (T-22)	06:44	05:59	05:40	05:55	06:28	07:05	07:45	18:15 (T-21)	07:23	07:57
	17:12	17:54	19:31	8 18:57 (T-22)	20:10	20:46	21:13	21:11	20:35	19:41	19:00	5 18:20 (T-21)	16:59	16:47
16	08:00	07:27	07:39	06:42	05:58	05:40	05:56	06:29	07:06	07:42	07:42	18:15 (T-21)	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	19:42	18:42	3 18:18 (T-21)	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57	05:40	05:56	06:31	07:07	07:44	07:44	18:15 (T-21)	07:25	07:58
	17:14	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	19:40	18:40	1 18:16 (T-21)	16:57	16:47
18	07:59	07:24	07:35	06:39	05:56	05:41	05:57	06:32	07:08	07:45	07:45	18:16 (T-21)	07:27	07:59
	17:15	17:59	19:35	20:13	20:50	21:15	21:09	20:30	19:35	19:38	18:38	1 18:16 (T-21)	16:57	16:47
19	07:58	07:22	07:33	06:37	05:55	05:41	05:58	06:33	07:09	07:46	07:46	18:16 (T-21)	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	19:37	18:37	1 18:16 (T-21)	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	05:59	06:34	07:11	07:48	07:48	18:15 (T-21)	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	19:35	18:35	1 18:16 (T-21)	16:55	16:48
21	07:57	07:19	07:29	06:33	05:53	05:41	06:00	06:35	07:12	07:49	07:49	18:15 (T-21)	07:31	08:00
	17:19	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	19:33	18:33	1 18:16 (T-21)	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:01	06:36	07:13	07:50	07:50	18:14 (T-21)	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:16	21:05	20:24	19:27	19:31	18:32	1 18:14 (T-21)	16:53	16:49
23	07:55	07:16	07:26	06:30	05:51	05:41	06:02	06:38	07:14	07:52	07:52	18:13 (T-21)	07:33	08:01
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	19:30	18:30	1 18:13 (T-21)	16:52	16:50
24	07:55	07:14	07:24	06:29	05:50	05:42	06:03	06:39	07:15	07:53	07:53	18:12 (T-21)	07:34	08:02
	17:23	18:05	19:42	20:21	20:56	21:16	21:03	20:20	19:24	19:29	18:28	1 18:12 (T-21)	16:52	16:50
25	07:54	07:12	17:43 (T-21)	07:22	06:27	05:50	05:42	06:04	06:40	07:16	07:54	18:11 (T-21)	07:36	08:02
	17:25	18:07	2 17:45 (T-21)	19:43	20:22	20:57	21:16	21:02	20:19	19:22	19:22	18:11 (T-21)	16:51	16:51
26	07:53	07:11	17:42 (T-21)	07:20	06:25	05:49	05:42	06:05	06:41	07:18	07:56	18:10 (T-21)	07:37	08:03
	17:26	18:08	4 17:46 (T-21)	19:45	20:23	20:58	21:16	21:01	20:17	19:20	19:20	18:10 (T-21)	16:50	16:51
27	07:52	07:09	17:42 (T-21)	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	18:09 (T-21)	07:38	08:03
	17:27	18:10	6 17:48 (T-21)	19:46	20:25	20:59	21:16	21:00	20:15	19:18	19:18	18:09 (T-21)	16:50	16:52
28	07:51	07:07	17:42 (T-21)	07:16	06:22	05:47	05:43	06:08	06:43	07:20	07:58	18:08 (T-21)	07:39	08:03
	17:29	18:11	7 17:49 (T-21)	19:47	20:26	21:00	21:16	20:59	20:14	19:16	19:16	4 18:36 (T-22)	18:22	16:49
29	07:50	07:14	07:24	06:21	05:47	05:44	06:09	06:45	07:21	07:58	07:58	18:27 (T-22)	08:00	07:41
	17:30	18:12	19:48	20:27	21:01	21:16	20:58	20:12	19:14	12 18:39 (T-22)	18:21	18:27 (T-22)	18:21	16:49
30	07:49	07:13	07:23	06:19	05:46	05:44	06:10	06:46	07:23	07:59	07:59	18:26 (T-22)	08:01	07:42
	17:32	18:14	19:50	20:28	21:02	21:16	20:57	20:10	19:12	16 18:42 (T-22)	18:19	18:42 (T-22)	18:19	16:48
31	07:48	07:11	07:21	06:17	05:45	05:45	06:11	06:47	07:24	07:59	07:59	18:25 (T-22)	08:02	08:04
	17:33	18:15	19:51	21:03	21:03	21:03	20:56	20:08	19:12	16 18:42 (T-22)	18:19	18:42 (T-22)	18:19	16:48
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275	275	275
Total, worst case		19	216						32		205			
Sun reduction		0.58	0.59						0.67		0.56			
Oper. time red.		0.90	0.90						0.90		0.90			
Wind dir. red.		0.58	0.57						0.57		0.57			
Total reduction		0.30	0.30						0.35		0.29			
Total, real		6	66						11		59			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-061 - R-061
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December								
1	08:04	16:26 (T-53)	07:47	17:06 (T-52)	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04					07:43	16:10 (T-53)	
1	16:57	16:28 (T-53)	17:35	17:08 (T-52)	18:12	19:52	20:29	21:04	21:16	20:54	20:06	19:10	17:17					16:48	11 16:21 (T-53)	
2	08:04	16:26 (T-53)	07:45	17:06 (T-52)	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05			16:40 (T-52)		07:44	16:10 (T-53)	
2	16:58	16:29 (T-53)	17:36	17:10 (T-52)	18:14	19:53	20:31	21:04	21:16	20:53	20:05	19:09	17:15			9 16:40 (T-52)		16:48	10 16:20 (T-53)	
3	08:04	16:26 (T-53)	07:44	17:06 (T-52)	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06					16:38 (T-52)	07:45	16:12 (T-53)
3	16:58	16:30 (T-53)	17:37	17:12 (T-52)	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14			11 16:49 (T-52)		16:47	9 16:21 (T-53)	
4	08:04	16:27 (T-53)	07:43	17:07 (T-52)	07:00	07:03	06:14	05:43	05:47	06:16	06:52	07:27	07:08					16:38 (T-52)	07:46	16:12 (T-53)
4	16:59	16:31 (T-53)	17:39	17:14 (T-52)	18:16	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:12			10 16:48 (T-52)		16:47	8 16:20 (T-53)	
5	08:04	16:27 (T-53)	07:42	17:06 (T-52)	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09					16:37 (T-52)	07:47	16:13 (T-53)
5	17:00	16:32 (T-53)	17:40	17:14 (T-52)	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11			9 16:43 (T-52)		16:47	7 16:20 (T-53)	
6	08:04	16:27 (T-53)	07:41	17:07 (T-52)	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10					16:37 (T-52)	07:48	16:13 (T-53)
6	17:01	16:37 (T-53)	17:42	17:16 (T-52)	18:19	19:58	20:36	21:08	21:15	20:48	19:57	19:01	17:10			8 16:45 (T-52)		16:47	6 16:19 (T-53)	
7	08:04	16:28 (T-53)	07:39	17:08 (T-52)	06:55	06:58	06:09	05:42	05:48	06:19	06:55	07:31	07:12					16:36 (T-52)	07:49	16:14 (T-53)
7	17:02	16:35 (T-53)	17:43	17:18 (T-52)	18:20	20:00	20:37	21:08	21:15	20:47	19:56	18:58	17:09			7 16:43 (T-52)		16:46	5 16:19 (T-53)	
8	08:03	16:27 (T-53)	07:38	17:09 (T-52)	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13					16:37 (T-52)	07:50	16:15 (T-53)
8	17:04	16:35 (T-53)	17:45	17:19 (T-52)	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07			6 16:43 (T-52)		16:46	4 16:19 (T-53)	
9	08:03	16:28 (T-53)	07:37	17:11 (T-52)	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14					16:37 (T-52)	07:51	16:15 (T-53)
9	17:05	16:37 (T-53)	17:46	17:19 (T-52)	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06			4 16:41 (T-52)		16:46	4 16:19 (T-53)	
10	08:03	16:28 (T-53)	07:35	17:10 (T-52)	07:50	06:53	06:05	05:41	05:51	06:22	06:59	07:35	07:16					16:38 (T-52)	07:52	16:16 (T-53)
10	17:06	16:38 (T-53)	17:47	17:21 (T-52)	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05			2 16:40 (T-52)		16:46	3 16:19 (T-53)	
11	08:03	16:28 (T-53)	07:34	17:10 (T-52)	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17					16:36	07:47	16:17 (T-53)
11	17:07	16:39 (T-53)	17:49	17:22 (T-52)	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:50	17:04					16:46	2 16:19 (T-53)	
12	08:02	16:29 (T-53)	07:32	17:10 (T-52)	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:19					16:37	07:49	16:18 (T-53)
12	17:08	16:41 (T-53)	17:50	17:23 (T-52)	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03					16:48	1 16:19 (T-53)	
13	08:02	16:28 (T-53)	07:31	17:09 (T-52)	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20					16:37	07:47	16:18 (T-53)
13	17:09	16:41 (T-53)	17:52	17:24 (T-52)	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02					16:46		16:19 (T-53)
14	08:01	16:29 (T-53)	07:30	17:10 (T-52)	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21					16:37	07:48	16:19 (T-53)
14	17:11	16:43 (T-53)	17:53	17:25 (T-52)	19:29	20:08	20:45	21:13	21:11	20:37	19:42	18:45	17:00					16:47		16:19 (T-53)
15	08:01	16:29 (T-53)	07:28	17:10 (T-52)	07:40	06:44	05:59	05:41	05:55	06:28	07:05	07:41	07:23					16:37	07:49	16:19 (T-53)
15	17:12	16:44 (T-53)	17:54	17:26 (T-52)	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:43	16:59					16:47		16:19 (T-53)
16	08:00	16:29 (T-53)	07:27	17:10 (T-52)	07:39	06:42	05:58	05:41	05:56	06:29	07:06	07:42	07:24					16:13 (T-53)	07:57	16:19 (T-53)
16	17:13	16:45 (T-53)	17:56	17:27 (T-52)	19:32	20:11	20:47	21:14	21:10	20:33	19:39	18:42	16:58			8 16:21 (T-53)		16:47		16:19 (T-53)
17	08:00	16:30 (T-53)	07:25	17:10 (T-52)	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25					16:12 (T-53)	07:58	16:19 (T-53)
17	17:14	16:47 (T-53)	17:57	17:28 (T-52)	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:58			12 16:24 (T-53)		16:47		16:19 (T-53)
18	07:59	16:31 (T-53)	07:24	17:10 (T-52)	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27					16:10 (T-53)	07:59	16:19 (T-53)
18	17:16	16:48 (T-53)	17:59	17:29 (T-52)	19:35	20:13	20:50	21:14	21:08	20:30	19:35	18:38	16:57			15 16:25 (T-53)		16:48		16:19 (T-53)
19	07:58	16:31 (T-53)	07:22	17:10 (T-52)	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28					16:09 (T-53)	07:59	16:19 (T-53)
19	17:17	16:49 (T-53)	18:00	17:30 (T-52)	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56			17 16:26 (T-53)		16:48		16:19 (T-53)
20	07:58	16:33 (T-53)	07:20	17:10 (T-52)	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29					16:09 (T-53)	08:00	16:19 (T-53)
20	17:18	16:51 (T-53)	18:00	17:31 (T-52)	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55			19 16:28 (T-53)		16:48		16:19 (T-53)
21	07:57	16:33 (T-53)	07:19	17:10 (T-52)	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:31					16:08 (T-53)	08:00	16:19 (T-53)
21	17:19	16:53 (T-53)	18:01	17:32 (T-52)	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54			20 16:28 (T-53)		16:49		16:19 (T-53)
22	07:56	16:34 (T-53)	07:17	17:10 (T-52)	07:28	06:32	05:52	05:41	06:02	06:37	07:13	07:50	07:32					16:09 (T-53)	08:01	16:19 (T-53)
22	17:21	16:53 (T-53)	18:03	17:33 (T-52)	19:40	20:18	20:54	21:16	21:05	20:24	19:27	18:32	16:53			18 16:27 (T-53)		16:49		16:19 (T-53)
23	07:55	16:35 (T-53)	07:16	17:10 (T-52)	07:26	06:30	05:51	05:42	06:03	06:38	07:14	07:52	07:33					16:08 (T-53)	08:01	16:19 (T-53)
23	17:22	16:52 (T-53)	18:04	17:34 (T-52)	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53			18 16:26 (T-53)		16:50		16:19 (T-53)
24	07:55	16:36 (T-53)	07:14	17:10 (T-52)	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34					16:08 (T-53)	08:02	16:19 (T-53)
24	17:24	16:51 (T-53)	18:06	17:35 (T-52)	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52			17 16:25 (T-53)		16:50		16:19 (T-53)
25	07:54	16:38 (T-53)	07:12	17:10 (T-52)	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36					16:09 (T-53)	08:02	16:19 (T-53)
25	17:25	16:50 (T-53)	18:07	17:36 (T-52)	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51			16 16:25 (T-53)		16:51		16:19 (T-53)
26	07:53	16:40 (T-53)	07:11	17:10 (T-52)	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37					16:08 (T-53)	08:03	16:19 (T-53)
26	17:26	16:48 (T-53)	18:08	17:37 (T-52)	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51			16 16:24 (T-53)		16:52		16:19 (T-53)
27	07:52	16:39 (T-53)	07:10	17:10 (T-52)	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38					16:08 (T-53)	08:03	16:19 (T-53)
27	17:28	16:54 (T-53)	18:10	17:38 (T-52)	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50			15 16:23 (T-53)		16:52		16:19 (T-53)
28	07:51	16:39 (T-53)	07:07	17:10 (T-52)	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:39					16:08 (T-53)	08:03	16:19 (T-53)
28	17:29	16:55 (T-53)	18:11	17:39 (T-52)	19:47	20:26	21:00	21:16	21:09	20:14	19:16									

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-062 - R-062
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:46	07:05	07:09	06:18	19:58 (T-53)	05:45	05:45	06:12	06:48	07:24	07:04	07:43	
	16:57	17:35	18:12	19:52	20:29	3 20:01 (T-53)	21:04	21:16	20:54	20:06	19:10	17:17	16:48	
2	08:04	07:45	07:04	07:07	06:16		05:44	05:45	06:13	06:49	07:25	07:05	07:44	
	16:58	17:36	18:14	19:53	20:31		21:04	21:16	20:53	20:05	19:09	17:15	16:48	
3	08:04	07:44	07:02	07:05	06:15		05:44	05:46	06:14	06:51	07:26	07:06	07:45	
	16:58	17:37	18:15	19:55	20:32		21:05	21:16	20:52	20:03	19:07	17:14	16:47	
4	08:04	07:43	07:00	07:03	06:14		05:43	05:47	06:16	06:52	07:27	07:08	07:46	
	16:59	17:39	18:16	19:56	20:33		21:06	21:15	20:51	20:01	19:05	17:12	16:47	
5	08:04	07:42	06:58	07:02	06:12		05:43	05:47	06:17	06:53	07:29	07:09	07:47	
	17:00	17:40	18:18	19:57	20:34		21:07	21:15	20:49	19:59	19:03	17:11	16:47	
6	08:04	07:40	06:57	07:00	06:11		05:43	05:48	06:18	06:54	07:30	07:10	07:48	
	17:01	17:42	18:19	19:58	20:36		21:08	21:15	20:48	19:57	19:01	17:10	16:47	
7	08:03	07:39	06:55	06:58	06:09		05:42	05:49	06:19	06:55	07:31	07:12	07:49	
	17:02	17:43	18:20	20:00	20:37		21:08	21:15	20:47	19:55	18:58	17:09	16:46	
8	08:03	07:38	07:53	06:56	06:08		05:42	05:49	06:20	06:56	07:32	07:13	07:50	
	17:04	17:45	18:22	20:01	20:38		21:09	21:14	20:45	19:54	18:56	17:07	16:46	
9	08:03	07:37	07:51	06:54	06:07		05:42	05:50	06:21	06:58	07:34	07:14	07:51	
	17:05	17:46	19:23	20:02	20:39		21:10	21:14	20:44	19:52	18:54	17:06	16:46	
10	08:03	07:35	07:50	06:53	06:06		05:41	05:51	06:22	06:59	07:35	07:16	07:52	
	17:06	17:47	19:24	20:03	20:40		21:10	21:13	20:42	19:50	18:52	17:05	16:46	
11	08:02	07:34	07:48	06:51	06:04		05:41	05:52	06:24	07:00	07:36	07:17	07:53	
	17:07	17:49	19:26	20:05	20:41		21:11	21:13	20:41	19:48	18:50	17:04	16:46	
12	08:02	07:32	07:46	06:49	06:03		05:41	05:52	06:25	20:05 (T-53)	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:43		21:12	21:12	20:40	6 20:11 (T-53)	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02		05:41	05:53	06:26	20:02 (T-53)	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44		21:12	21:12	20:38	11 20:13 (T-53)	19:44	18:47	17:02	16:46
14	08:01	07:30	07:42	06:46	06:01		05:41	05:54	06:27	20:01 (T-53)	07:03	07:40	07:21	07:56
	17:11	17:53	19:29	20:08	20:45		21:13	21:11	20:36	10 20:11 (T-53)	19:42	18:45	17:00	16:47
15	08:01	07:28	07:40	06:44	06:00		05:41	05:55	06:28	19:59 (T-53)	07:05	07:41	07:23	07:56
	17:12	17:54	19:31	20:10	20:46		21:13	21:10	20:35	11 20:10 (T-53)	19:41	18:43	16:59	16:47
16	08:00	07:27	07:39	06:42	05:58		05:41	05:56	06:29	19:58 (T-53)	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47		21:14	21:10	20:33	10 20:08 (T-53)	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57		05:41	05:57	06:31	19:58 (T-53)	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48		21:14	21:09	20:32	8 20:06 (T-53)	19:37	18:40	16:58	16:47
18	07:59	07:23	07:35	06:39	05:56		05:41	05:58	06:32	19:57 (T-53)	07:08	07:45	07:27	07:58
	17:16	17:59	19:35	20:13	20:50		21:14	21:08	20:30	8 20:05 (T-53)	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55		05:41	05:59	06:33	19:58 (T-53)	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51		21:15	21:08	20:29	6 20:04 (T-53)	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54		05:41	06:00	06:34	19:58 (T-53)	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52		21:15	21:07	20:27	4 20:02 (T-53)	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	19:53 (T-53)	05:53	05:41	06:01	06:35	19:58 (T-53)	07:12	07:49	07:30	08:00
	17:19	18:01	19:38	20:17	1 19:54 (T-53)	20:53	21:15	21:06	20:25	3 20:01 (T-53)	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	19:53 (T-53)	05:52	05:41	06:02	06:37	19:58 (T-53)	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	3 19:56 (T-53)	20:54	21:16	21:05	20:24	1 19:59 (T-53)	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	19:52 (T-53)	05:51	05:42	06:03	06:38		07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:20	5 19:57 (T-53)	20:55	21:16	21:04	20:22		19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	19:51 (T-53)	05:51	05:42	06:04	06:39		07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	6 19:57 (T-53)	20:56	21:16	21:03	20:20		19:24	18:28	16:52	16:50
25	07:54	07:12	07:22	06:27	19:51 (T-53)	05:50	05:42	06:05	06:40		07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	8 19:59 (T-53)	20:57	21:16	21:02	20:19		19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	19:51 (T-53)	05:49	05:43	06:06	06:41		07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	9 20:00 (T-53)	20:58	21:16	21:01	20:17		19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	19:52 (T-53)	05:48	05:43	06:07	06:42		07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	10 20:02 (T-53)	20:59	21:16	21:00	20:15		19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	19:52 (T-53)	05:47	05:43	06:08	06:44		07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	10 20:02 (T-53)	21:00	21:16	20:59	20:13		19:16	18:22	16:49	16:53
29	07:50		07:14	06:21	19:53 (T-53)	05:47	05:44	06:09	06:45		07:21	07:59	07:40	08:03
	17:30		19:48	20:27	11 20:04 (T-53)	21:01	21:16	20:58	20:12		19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	19:54 (T-53)	05:46	05:44	06:10	06:46		07:23	08:01	07:42	08:03
	17:32		19:50	20:28	10 20:04 (T-53)	21:02	21:16	20:57	20:10		19:12	18:19	16:49	16:55
31	07:48		07:11		05:45			06:11	06:47			08:02		08:04
	17:33		19:51		21:03			20:56	20:08			18:18		16:55
Potential sun hours	287	292	369	403	458	465	471	436		377	341	289	275	
Total, worst case				73					78					
Sun reduction				0.63					0.72					
Oper. time red.				0.90					0.90					
Wind dir. red.				0.61					0.61					
Total reduction				0.34					0.39					
Total, real				25					31					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-064 - R-064
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:14	05:43	05:47	06:16	06:52	07:27	07:08	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:12	16:47
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
6	08:04	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48
	17:01	17:42	18:19	19:58	20:35	21:08	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:09	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:08	21:14	20:47	19:55	18:58	17:09	16:47
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:06	05:41	05:51	06:22	06:59	07:35	07:16	07:52
	17:06	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:41	21:11	21:13	20:41	19:48	18:50	17:04	16:46
12	08:02	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:43	21:11	21:12	20:39	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	16:46
14	08:01	07:29	07:42	06:46	06:01	05:41	05:54	06:27	07:03	07:40	07:21	07:56
	17:11	17:53	19:29	20:08	20:45	21:13	21:11	20:36	19:42	18:45	17:01	16:47
15	08:01	07:28	07:40	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:22	07:56
	17:12	17:54	19:31	20:10	20:46	21:13	21:10	20:35	19:41	18:43	16:59	16:47
16	08:00	07:27	07:39	06:42	05:58	05:41	05:56	06:29	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:13	21:10	20:33	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:58	16:47
18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:26	07:58
	17:16	17:59	19:35	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
	17:20	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:15	21:05	20:24	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	05:51	05:42	06:03	06:38	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52	16:50
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:13	19:16	18:22	16:49	16:53
29	07:50		07:14	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:22	08:01	07:42	08:03
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55
31	07:48		07:11	06:17	05:46		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-065 - R-065
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:29	21:04	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:14	05:43	05:47	06:16	06:52	07:27	07:08	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:12	16:47
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
6	08:04	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48
	17:01	17:42	18:19	19:58	20:35	21:08	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:09	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:08	21:14	20:47	19:55	18:58	17:09	16:47
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:06	05:41	05:51	06:22	06:59	07:35	07:16	07:52
	17:06	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:41	21:11	21:13	20:41	19:48	18:50	17:04	16:46
12	08:02	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:43	21:11	21:12	20:39	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	16:46
14	08:01	07:29	07:42	06:46	06:01	05:41	05:54	06:27	07:03	07:40	07:21	07:56
	17:11	17:53	19:29	20:08	20:45	21:13	21:11	20:36	19:42	18:45	17:01	16:47
15	08:01	07:28	07:40	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:22	07:56
	17:12	17:54	19:31	20:10	20:46	21:13	21:10	20:35	19:41	18:43	16:59	16:47
16	08:00	07:27	07:39	06:42	05:58	05:41	05:56	06:29	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:13	21:10	20:33	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:58	16:47
18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:26	07:58
	17:16	17:59	19:35	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
	17:20	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:15	21:05	20:24	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	05:51	05:42	06:03	06:38	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52	16:50
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:13	19:16	18:22	16:49	16:53
29	07:50		07:14	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:22	08:01	07:42	08:03
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-066 - R-066
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:04	07:47	07:05	07:09	19:12 (T-53)	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43		
	16:57	17:35	18:12	19:52	19	19:31 (T-53)	20:29	21:04	21:16	20:54	20:06	19:10	17:17	16:48	
2	08:04	07:45	07:04	07:07	19:11 (T-53)	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44		
	16:58	17:36	18:14	19:53	21	19:32 (T-53)	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48	
3	08:04	07:44	07:02	07:05	19:12 (T-53)	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45		
	16:58	17:37	18:15	19:55	21	19:33 (T-53)	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47	
4	08:04	07:43	07:00	07:03	19:13 (T-53)	06:14	05:43	05:47	06:16	06:52	07:27	07:08	07:46		
	16:59	17:39	18:16	19:56	21	19:34 (T-53)	20:33	21:06	21:15	20:51	20:01	19:05	17:12	16:47	
5	08:04	07:42	06:59	07:02	19:14 (T-53)	06:12	05:43	05:47	06:17	06:53	19:14 (T-53)	07:29	07:09	07:47	
	17:00	17:40	18:18	19:57	18	19:32 (T-53)	20:34	21:07	21:15	20:49	19:59	19:24	17:11	16:47	
6	08:04	07:41	06:57	07:00	19:15 (T-53)	06:11	05:43	05:48	06:18	06:54	19:11 (T-53)	07:30	07:10	07:48	
	17:01	17:42	18:19	19:58	15	19:30 (T-53)	20:36	21:08	21:15	20:48	19:57	15	19:26	17:10	16:47
7	08:04	07:39	06:55	06:58	19:17 (T-53)	06:09	05:42	05:49	06:19	06:55	19:09 (T-53)	07:31	07:12	07:49	
	17:03	17:43	18:20	20:00	10	19:27 (T-53)	20:37	21:08	21:15	20:47	19:56	18	19:27	17:09	16:47
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	19:07 (T-53)	07:32	07:13	07:50		
	17:04	17:45	18:22	20:01	21:09	21:14	20:45	21:14	20:45	19:54	21	19:28	17:07	16:46	
9	08:03	07:37	07:51	06:54	06:07	05:42	05:50	06:21	06:58	19:06 (T-53)	07:34	07:14	07:51		
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	21	19:27 (T-53)	18:54	17:06	16:46	
10	08:03	07:35	07:50	06:53	06:06	05:41	05:51	06:22	06:59	19:05 (T-53)	07:35	07:16	07:52		
	17:06	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	20	19:25 (T-53)	18:52	17:05	16:46	
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	19:04 (T-53)	07:36	07:17	07:53		
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	19	19:23 (T-53)	18:50	17:04	16:46	
12	08:02	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	19:04 (T-53)	07:37	07:19	07:54		
	17:08	17:50	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18	19:22 (T-53)	18:49	17:03	16:46	
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	19:03 (T-53)	07:39	07:20	07:55		
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	17	19:20 (T-53)	18:47	17:02	16:46	
14	08:01	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:04	19:03 (T-53)	07:40	07:21	07:56		
	17:11	17:53	19:29	20:08	20:45	21:13	21:11	20:37	19:42	15	19:18 (T-53)	18:45	17:00	16:47	
15	08:01	07:28	07:40	06:44	06:00	05:41	05:55	06:28	07:05	19:03 (T-53)	07:41	07:23	07:56		
	17:12	17:54	19:31	20:10	20:46	21:13	21:11	20:35	19:41	13	19:16 (T-53)	18:43	16:59	16:47	
16	08:00	07:27	07:39	06:42	05:58	05:41	05:56	06:29	07:06	19:03 (T-53)	07:42	07:24	07:57		
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:33	19:39	11	19:14 (T-53)	18:42	16:58	16:47	
17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	19:02 (T-52)	07:44	07:25	07:58		
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	10	19:12 (T-53)	18:40	16:58	16:47	
18	07:59	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	19:01 (T-52)	07:45	07:27	07:58		
	17:16	17:59	19:35	20:13	20:50	21:14	21:08	20:30	19:35	9	19:10 (T-53)	18:38	16:57	16:48	
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	19:02 (T-52)	07:46	07:28	07:59		
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	7	19:09 (T-53)	18:37	16:56	16:48	
20	07:58	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	19:01 (T-52)	07:48	07:29	08:00		
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	6	19:07 (T-52)	18:35	16:55	16:48	
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	19:01 (T-52)	07:49	07:30	08:00		
	17:20	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	3	19:04 (T-52)	18:33	16:54	16:49	
22	07:56	07:17	07:28	19:16 (T-52)	06:32	05:52	05:41	06:02	06:37	07:13	07:50	07:32	08:01		
	17:21	18:03	19:40	3	19:19 (T-52)	20:18	20:54	21:16	21:05	20:24	19:27	18:32	16:53	16:49	
23	07:55	07:16	07:26	19:15 (T-52)	06:30	05:51	05:42	06:03	06:38	07:14	07:52	07:33	08:01		
	17:22	18:04	19:41	5	19:20 (T-52)	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50	
24	07:54	07:14	07:24	19:14 (T-52)	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:02		
	17:24	18:06	19:42	7	19:21 (T-53)	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52	16:50	
25	07:54	07:12	07:22	19:14 (T-52)	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	08:02		
	17:25	18:07	19:43	8	19:22 (T-53)	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51	
26	07:53	07:11	07:20	19:14 (T-52)	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:02		
	17:26	18:08	19:45	9	19:23 (T-53)	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52	
27	07:52	07:09	07:18	19:14 (T-53)	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03		
	17:28	18:10	19:46	10	19:24 (T-53)	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52	
28	07:51	07:07	07:16	19:13 (T-53)	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:39	08:03		
	17:29	18:11	19:47	12	19:25 (T-53)	20:26	21:00	21:16	20:59	20:14	19:16	18:22	16:49	16:53	
29	07:50	07:15	07:25	19:13 (T-53)	06:21	05:47	05:44	06:09	06:45	07:21	08:00	07:40	08:03		
	17:30	18:12	19:48	14	19:27 (T-53)	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54	
30	07:49	07:13	07:23	19:12 (T-53)	06:19	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04		
	17:32	18:14	19:50	16	19:28 (T-53)	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55	
31	07:48	07:11	07:21	19:12 (T-53)	06:19	05:45	05:45	06:11	06:47	07:24	08:02	07:43	08:04		
	17:33	18:15	19:51	17	19:29 (T-53)	21:03	21:03	20:56	20:08	19:13	18:18	16:49	16:55	16:55	
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275			
Total, worst case			101	125					233						
Sun reduction			0.59	0.63					0.67						
Oper. time red.			0.90	0.90					0.90						
Wind dir. red.			0.59	0.59					0.59						
Total reduction			0.31	0.34					0.36						
Total, real			32	42					83						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-067 - R-067

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June			
1	08:04	16:16 (T-92)	07:47	07:06	17:46 (T-77)	07:09	06:18	05:45	20:26 (T-52)
	16:57	11 16:27 (T-92)	17:35	18:12	4 17:50 (T-77)	19:52	20:29	21:04	11 20:37 (T-52)
2	08:04	16:17 (T-92)	07:45	07:04	17:45 (T-77)	07:07	06:16	05:44	20:27 (T-52)
	16:58	10 16:27 (T-92)	17:36	18:14	7 17:52 (T-77)	19:53	20:31	21:04	11 20:38 (T-52)
3	08:04	16:18 (T-92)	07:44	07:02	17:46 (T-77)	07:05	06:15	05:44	20:26 (T-52)
	16:59	9 16:27 (T-92)	17:38	18:15	8 17:54 (T-77)	19:55	20:32	21:05	13 20:39 (T-52)
4	08:04	16:20 (T-92)	07:43	07:00	17:46 (T-77)	07:03	06:14	05:43	20:27 (T-52)
	16:59	7 16:27 (T-92)	17:39	18:16	9 17:55 (T-77)	19:56	20:33	21:06	13 20:40 (T-52)
5	08:04	16:22 (T-92)	07:42	06:59	17:46 (T-77)	07:02	06:12	05:43	20:27 (T-52)
	17:00	4 16:26 (T-92)	17:40	18:18	10 17:56 (T-77)	19:57	20:34	21:07	14 20:41 (T-52)
6	08:04	07:41	17:15 (T-58)	06:57	17:47 (T-77)	07:00	06:11	05:43	20:27 (T-52)
	17:02	17:42	1 17:16 (T-58)	18:19	10 17:57 (T-77)	19:58	20:36	21:08	14 20:41 (T-52)
7	08:04	07:39	17:14 (T-58)	06:55	17:49 (T-77)	06:58	06:09	05:42	20:27 (T-52)
	17:03	17:43	4 17:18 (T-58)	18:20	6 17:55 (T-77)	20:00	20:37	21:08	15 20:42 (T-52)
8	08:03	07:38	17:12 (T-58)	07:53	06:56	06:08	06:08	05:42	20:28 (T-52)
	17:04	17:45	7 17:19 (T-58)	18:22	20:01	20:38	21:09	21:09	15 20:43 (T-52)
9	08:03	07:37	17:12 (T-58)	07:51	06:54	06:07	06:07	05:42	20:28 (T-52)
	17:05	17:46	9 17:21 (T-58)	19:23	20:02	20:39	21:10	21:10	15 20:43 (T-52)
10	08:03	07:35	17:12 (T-58)	07:50	06:53	06:06	06:06	05:41	20:27 (T-52)
	17:06	17:47	11 17:23 (T-58)	19:24	20:03	20:40	21:10	21:10	16 20:43 (T-52)
11	08:02	07:34	17:11 (T-58)	07:48	06:51	06:04	06:04	05:41	20:28 (T-52)
	17:07	17:49	13 17:24 (T-58)	19:26	20:05	20:42	21:11	21:11	16 20:44 (T-52)
12	08:02	07:32	17:11 (T-58)	07:46	06:49	06:03	06:03	05:41	20:28 (T-52)
	17:08	17:50	15 17:26 (T-58)	19:27	20:06	20:43	21:12	21:12	17 20:45 (T-52)
13	08:02	07:31	17:10 (T-58)	07:44	06:47	06:02	06:02	05:41	20:29 (T-52)
	17:09	17:52	17 17:27 (T-58)	19:28	20:07	20:44	21:12	21:12	16 20:45 (T-52)
14	08:01	07:30	17:11 (T-58)	07:42	06:46	06:01	06:01	05:41	20:29 (T-52)
	17:11	17:53	18 17:29 (T-58)	19:29	20:08	20:45	21:13	21:13	17 20:46 (T-52)
15	08:01	07:28	17:11 (T-58)	07:40	06:44	06:00	06:00	05:41	20:29 (T-52)
	17:12	17:55	19 17:30 (T-58)	19:31	20:10	20:46	21:13	21:13	17 20:46 (T-52)
16	08:00	07:27	17:12 (T-58)	07:39	06:42	05:58	05:58	05:41	20:29 (T-52)
	17:13	17:56	20 17:32 (T-58)	19:32	20:11	20:47	21:14	21:14	18 20:47 (T-52)
17	08:00	07:25	17:12 (T-58)	07:37	06:40	05:57	05:57	05:41	20:30 (T-52)
	17:14	17:57	20 17:32 (T-58)	19:33	20:12	20:48	21:14	21:14	17 20:47 (T-52)
18	07:59	07:24	17:13 (T-58)	07:35	06:39	05:56	05:56	05:41	20:30 (T-52)
	17:16	17:59	19 17:32 (T-58)	19:35	20:13	20:50	21:14	21:14	17 20:47 (T-52)
19	07:58	07:22	17:14 (T-58)	07:33	06:37	05:55	05:55	05:41	20:30 (T-52)
	17:17	18:00	16 17:30 (T-58)	19:36	20:15	20:51	21:15	21:15	17 20:47 (T-52)
20	07:58	07:20	17:16 (T-58)	07:31	06:35	05:54	05:54	05:41	20:30 (T-52)
	17:18	18:00	12 17:28 (T-58)	19:37	20:16	20:52	21:15	21:15	17 20:47 (T-52)
21	07:57	07:19	17:20 (T-58)	07:29	06:34	05:53	05:53	05:41	20:31 (T-52)
	17:20	18:01	5 17:25 (T-58)	19:38	20:17	20:53	21:15	21:15	17 20:48 (T-52)
22	07:56	07:17	07:28	07:28	06:32	05:52	05:52	05:41	20:31 (T-52)
	17:21	18:03	19:40	19:40	20:18	20:54	21:16	21:16	17 20:48 (T-52)
23	07:55	07:16	07:26	07:26	06:30	05:51	05:51	05:42	20:31 (T-52)
	17:22	18:04	19:41	19:41	20:20	20:55	21:16	21:16	17 20:48 (T-52)
24	07:54	07:14	07:24	07:24	06:29	05:51	05:51	05:42	20:31 (T-52)
	17:24	18:06	19:42	19:42	20:21	20:56	2 20:30 (T-52)	21:16	17 20:48 (T-52)
25	07:54	07:12	07:22	07:22	06:27	05:50	05:50	05:42	20:32 (T-52)
	17:25	18:07	19:43	19:43	20:22	20:57	4 20:32 (T-52)	21:16	17 20:49 (T-52)
26	07:53	07:11	07:20	07:20	06:26	05:49	05:49	05:43	20:31 (T-52)
	17:26	18:08	19:45	19:45	20:23	20:58	4 20:32 (T-52)	21:16	18 20:49 (T-52)
27	07:52	07:09	07:18	07:18	06:24	05:48	05:48	05:43	20:31 (T-52)
	17:28	18:10	19:46	19:46	20:25	20:59	6 20:33 (T-52)	21:16	17 20:48 (T-52)
28	07:51	07:07	17:47 (T-77)	07:16	06:22	05:48	05:48	05:43	20:32 (T-52)
	17:29	18:11	2 17:49 (T-77)	19:47	20:26	21:00	8 20:35 (T-52)	21:16	17 20:49 (T-52)
29	07:50	07:15	07:15	07:15	06:21	05:47	05:47	05:44	20:32 (T-52)
	17:30	19:48	19:48	19:48	20:27	21:01	8 20:35 (T-52)	21:16	16 20:48 (T-52)
30	07:49	07:13	07:13	07:13	06:19	05:46	05:46	05:44	20:32 (T-52)
	17:32	19:50	07:11	07:11	20:28	21:02	9 20:35 (T-52)	21:16	17 20:49 (T-52)
31	07:48	07:11	07:11	07:11	06:17	05:46	05:46	05:44	20:32 (T-52)
	17:33	19:51	07:11	07:11	21:03	21:03	10 20:37 (T-52)	21:16	17 20:49 (T-52)
Potential sun hours	287	292	369	403	458	465	476	476	476
Total, worst case	41	208	54	59	66	73	73	73	73
Sun reduction	0.58	0.58	0.59	0.66	0.73	0.73	0.73	0.73	0.73
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Wind dir. red.	0.61	0.59	0.58	0.64	0.64	0.64	0.64	0.64	0.64
Total reduction	0.31	0.31	0.30	0.38	0.38	0.42	0.42	0.42	0.42
Total, real	13	64	16	19	19	200	200	200	200

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-067 - R-067

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45	20:32 (T-52)	06:12	06:48	07:24	07:04
	21:16	16 20:48 (T-52)	20:54	20:06	19:11	17:17
2	05:45	20:33 (T-52)	06:13	06:50	07:25	07:05
	21:16	16 20:49 (T-52)	20:53	20:05	19:09	17:15
3	05:46	20:32 (T-52)	06:15	06:51	07:26	07:06
	21:16	16 20:48 (T-52)	20:52	20:03	19:07	17:14
4	05:47	20:33 (T-52)	06:16	06:52	07:27	07:08
	21:15	15 20:48 (T-52)	20:51	20:01	19:05	17:12
5	05:47	20:33 (T-52)	06:17	06:53	07:29	07:09
	21:15	15 20:48 (T-52)	20:49	19:59	19:03	17:11
6	05:48	20:33 (T-52)	06:18	06:54	07:30	07:10
	21:15	14 20:47 (T-52)	20:48	19:57	19:01	17:10
7	05:49	20:33 (T-52)	06:19	06:55	07:31	18:24 (T-77)
	21:15	14 20:47 (T-52)	20:47	19:56	18:58	9 18:33 (T-77)
8	05:49	20:34 (T-52)	06:20	06:57	07:32	18:22 (T-77)
	21:14	13 20:47 (T-52)	20:45	19:54	18:56	11 18:33 (T-77)
9	05:50	20:33 (T-52)	06:21	06:58	07:34	18:21 (T-77)
	21:14	13 20:46 (T-52)	20:44	19:52	18:54	10 18:31 (T-77)
10	05:51	20:34 (T-52)	06:23	06:59	07:35	18:20 (T-77)
	21:13	12 20:46 (T-52)	20:42	19:50	18:52	8 18:28 (T-77)
11	05:52	20:34 (T-52)	06:24	07:00	07:36	18:19 (T-77)
	21:13	12 20:46 (T-52)	20:41	19:48	18:50	7 18:26 (T-77)
12	05:52	20:35 (T-52)	06:25	07:01	07:37	18:19 (T-77)
	21:12	10 20:45 (T-52)	20:40	19:46	18:49	6 18:25 (T-77)
13	05:53	20:34 (T-52)	06:26	07:02	07:39	18:19 (T-77)
	21:12	10 20:44 (T-52)	20:38	19:44	18:47	4 18:23 (T-77)
14	05:54	20:35 (T-52)	06:27	07:04	07:40	18:19 (T-77)
	21:11	9 20:44 (T-52)	20:37	19:43	18:45	2 18:21 (T-77)
15	05:55	20:35 (T-52)	06:28	07:05	07:41	07:23
	21:11	8 20:43 (T-52)	20:35	19:41	18:43	17:00
16	05:56	20:36 (T-52)	06:30	07:06	07:42	07:24
	21:10	7 20:43 (T-52)	20:33	19:39	18:42	16:59
17	05:57	20:37 (T-52)	06:31	07:07	07:44	07:25
	21:09	5 20:42 (T-52)	20:32	19:37	18:40	16:58
18	05:58	20:37 (T-52)	06:32	07:08	07:45	07:27
	21:08	5 20:42 (T-52)	20:30	19:35	18:38	16:57
19	05:59	20:38 (T-52)	06:33	07:09	07:46	07:28
	21:08	3 20:41 (T-52)	20:29	19:33	18:37	16:56
20	06:00	20:39 (T-52)	06:34	07:11	07:48	07:29
	21:07	1 20:40 (T-52)	20:27	19:31	18:35	16:55
21	06:01		06:35	07:12	07:49	17:49 (T-58)
	21:06		20:25	19:29	18:33	8 17:57 (T-58)
22	06:02		06:37	07:13	07:50	17:46 (T-58)
	21:05		20:24	19:27	18:32	13 17:59 (T-58)
23	06:03		06:38	07:14	07:52	17:44 (T-58)
	21:04		20:22	19:26	18:30	17 18:01 (T-58)
24	06:04		06:39	07:15	07:53	17:43 (T-58)
	21:03		20:20	19:24	18:29	19 18:02 (T-58)
25	06:05		06:40	07:17	07:54	17:41 (T-58)
	21:02		20:19	19:22	18:27	21 18:02 (T-58)
26	06:06		06:41	07:18	07:56	17:41 (T-58)
	21:01		20:17	19:20	18:25	20 18:01 (T-58)
27	06:07		06:42	07:19	07:57	17:40 (T-58)
	21:00		20:15	19:18	18:24	19 17:59 (T-58)
28	06:08		06:44	07:20	07:58	17:40 (T-58)
	20:59		20:14	19:16	18:22	18 17:58 (T-58)
29	06:09		06:45	07:21	08:00	17:40 (T-58)
	20:58		20:12	19:14	18:21	16 17:56 (T-58)
30	06:10		06:46	07:23	08:01	17:40 (T-58)
	20:57		20:10	19:12	18:19	14 17:54 (T-58)
31	06:11		06:47	07:24	08:02	17:40 (T-58)
	20:56		20:08	18:18	13 17:53 (T-58)	
Potential sun hours	471	436	377	341	289	275
Total, worst case				235		268
Sun reduction	0.75			0.56		0.52
Oper. time red.	0.90			0.90		0.90
Wind dir. red.	0.64			0.59		0.61
Total reduction	0.43			0.29		0.28
Total, real	92			69		76

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project: South Deuel Wind Project

Description: Invenery Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L085 73 GE3.8-154 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-068 - R-068 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Assumptions for shadow calculations Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum and values 561, 438, 311, 293, 309, 330, 363, 461, 788, 773, 462, 449, 509, 600, 629, 608, 7,884

Main shadow calculation table with columns for months (January-December) and rows for each day of the month, including start/end times and shadow reduction percentages.

Table layout: For each day in each month the following matrix apply

Matrix table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-070 - R-070

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	07:06 18:12	07:09 19:52	06:18 20:30	05:45 21:04	06:08 (T-51) 21:16	06:15 (T-51) 20:55	06:12 20:07	06:48 19:11	07:24 17:17	07:04 16:48
2	08:04 16:58	07:45 17:36	07:04 18:14	07:07 19:54	06:17 20:31	05:44 21:05	06:08 (T-51) 21:16	06:15 (T-51) 20:53	06:13 20:05	06:50 19:09	07:45 17:15	07:05 16:48
3	08:04 16:59	07:44 17:38	07:02 18:15	07:05 19:55	06:15 20:32	05:44 21:05	06:07 (T-51) 21:16	06:14 (T-51) 20:52	06:15 20:03	06:51 19:07	07:26 17:14	07:06 16:47
4	08:04 17:00	07:43 17:39	07:00 18:16	07:04 19:56	06:14 20:33	05:43 21:06	06:07 (T-51) 21:16	06:14 (T-51) 20:51	06:16 20:01	06:52 19:05	07:28 17:13	07:08 16:47
5	08:04 17:01	07:42 17:40	06:59 18:18	07:02 19:57	06:12 20:34	05:43 21:07	06:21 (T-51) 21:15	06:14 (T-51) 20:49	06:17 19:59	06:53 19:03	07:29 17:11	07:09 16:47
6	08:04 17:02	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	06:06 (T-51) 21:15	06:13 (T-51) 20:48	06:18 19:57	06:54 19:01	07:30 17:10	07:10 16:47
7	08:04 17:03	07:39 17:43	06:55 18:20	06:58 20:00	06:10 20:37	05:42 21:08	06:20 (T-51) 21:15	06:13 (T-51) 20:47	06:19 19:56	06:55 19:00	07:31 17:09	07:12 16:47
8	08:03 17:04	07:38 17:45	07:53 18:22	06:56 20:01	06:08 20:38	05:42 21:09	06:08 (T-51) 21:14	06:14 (T-51) 20:45	06:20 19:54	06:57 18:56	07:32 17:07	07:13 16:46
9	08:03 17:05	07:37 17:46	07:51 19:23	06:54 20:02	06:07 20:39	05:42 21:10	06:09 (T-51) 21:14	06:14 (T-51) 20:44	06:21 19:52	06:58 18:54	07:34 17:06	07:15 16:46
10	08:03 17:06	07:35 17:48	07:50 19:24	06:53 20:04	06:06 20:40	05:41 21:11	06:09 (T-51) 21:13	06:15 (T-51) 20:43	06:23 19:50	06:59 18:52	07:35 17:05	07:16 16:46
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:42	05:41 21:11	06:10 (T-51) 21:13	06:16 (T-51) 20:41	06:24 19:48	07:00 18:51	07:36 17:04	07:17 16:46
12	08:02 17:08	07:33 17:50	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	06:11 (T-51) 21:12	06:17 (T-51) 20:40	06:25 19:46	07:01 18:49	07:37 17:03	07:19 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	05:41 21:12	06:12 (T-51) 21:12	06:17 (T-51) 20:38	06:26 19:44	07:02 18:47	07:39 17:02	07:20 16:47
14	08:01 17:11	07:30 17:53	07:42 19:30	06:46 20:08	06:01 20:45	05:41 21:13	06:14 (T-51) 21:11	06:18 (T-51) 20:37	06:27 19:43	07:04 18:45	07:40 17:01	07:21 16:47
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	06:00 20:46	05:41 21:13	06:16 (T-51) 21:11	06:19 (T-51) 20:35	06:28 19:45	07:05 18:41	07:41 17:00	07:23 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:58 20:47	05:41 21:14	06:20 (T-51) 21:10	06:20 (T-51) 20:34	06:30 19:39	07:06 18:42	07:43 16:59	07:24 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:49	05:41 21:14	06:21 (T-51) 21:09	06:31 (T-51) 20:32	06:41 19:37	07:07 18:40	07:44 16:58	07:25 16:47
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:13	05:56 20:50	05:41 21:15	06:22 (T-51) 21:08	06:32 (T-51) 20:30	06:42 19:35	07:08 18:38	07:45 16:57	07:27 16:48
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	05:41 21:15	06:23 (T-51) 21:08	06:33 (T-51) 20:29	07:09 19:33	07:46 18:37	07:28 16:56	07:59 16:48
20	07:58 17:18	07:21 18:00	07:31 19:37	06:35 20:16	05:54 20:52	05:41 21:15	06:24 (T-51) 21:07	06:34 (T-51) 20:27	07:11 19:31	07:48 18:35	07:29 16:55	08:00 16:48
21	07:57 17:20	07:19 18:02	07:29 19:38	06:34 20:17	05:53 20:53	05:41 21:15	06:25 (T-51) 21:06	06:35 (T-51) 20:26	07:12 19:29	07:49 18:33	07:31 16:54	08:00 16:49
22	07:56 17:21	07:17 18:03	07:28 19:40	06:32 20:18	05:52 20:54	05:41 21:16	06:26 (T-51) 21:05	06:37 (T-51) 20:24	07:13 19:27	07:50 18:32	07:32 16:53	08:01 16:49
23	07:55 17:22	07:16 18:04	07:26 19:41	06:30 20:20	05:52 20:55	05:42 21:16	06:27 (T-51) 21:04	06:38 (T-51) 20:22	07:14 19:26	07:52 18:30	07:33 16:53	08:01 16:50
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	05:51 20:56	05:42 21:16	06:28 (T-51) 21:03	06:39 (T-51) 20:21	07:15 19:24	07:53 18:29	07:34 16:52	08:02 16:51
25	07:54 17:25	07:12 18:07	07:22 19:44	06:27 20:22	05:50 20:57	05:42 21:16	06:29 (T-51) 21:02	06:40 (T-51) 20:19	07:17 19:22	07:54 18:27	07:36 16:51	08:02 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:23	05:49 20:58	05:43 21:16	06:30 (T-51) 21:01	06:41 (T-51) 20:17	07:18 19:20	07:56 18:25	07:37 16:51	08:03 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	05:48 20:59	05:43 21:16	06:31 (T-51) 21:00	06:43 (T-51) 20:15	07:19 19:18	07:57 18:24	07:38 16:50	08:03 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47	06:23 20:26	05:48 21:00	05:43 21:16	06:32 (T-51) 20:59	06:44 (T-51) 20:14	07:20 19:16	07:58 18:22	07:39 16:50	08:03 16:53
29	07:50 17:31	07:05 19:49	07:15 19:49	06:21 20:27	05:47 21:01	05:44 21:16	06:33 (T-51) 20:58	06:45 (T-51) 20:12	07:21 19:14	08:00 18:21	07:41 16:49	08:03 16:54
30	07:49 17:32	07:13 19:50	07:19 20:28	06:19 21:02	05:46 21:02	05:44 21:16	06:34 (T-51) 20:57	06:46 (T-51) 20:10	07:23 19:12	08:01 18:19	07:42 16:49	08:04 16:55
31	07:48 17:33	07:11 19:51	07:11 21:03	06:19 21:03	05:46 21:03	05:44 21:16	06:35 (T-51) 20:56	06:47 (T-51) 20:08	07:24 18:18	08:02 17:08	07:43 16:48	08:04 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case					118	161	254					
Sun reduction					0.66	0.73	0.75					
Oper. time red.					0.90	0.90	0.90					
Wind dir. red.					0.59	0.59	0.59					
Total reduction					0.35	0.39	0.40					
Total, real					41	62	101					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-071 - R-071
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	07:47 17:35	07:06 18:12	07:09 19:52	06:18 20:30	05:45 21:04	05:45 21:16	06:12 20:55	06:48 20:07	07:10 (T-51) 07:19 (T-51)	07:24 19:11	07:04 17:17	07:43 16:48
2	08:04 16:58	07:46 17:36	07:04 18:14	07:07 19:54	06:17 20:31	05:44 21:05	05:45 21:16	06:13 20:53	06:50 20:05	07:11 (T-51) 07:18 (T-51)	07:25 19:09	07:05 17:15	07:44 16:48
3	08:04 16:59	07:44 17:38	07:02 18:15	07:05 19:55	06:15 20:32	05:44 21:05	05:46 21:16	06:15 20:52	06:51 20:03	07:13 (T-51) 07:19 (T-51)	07:26 19:07	07:06 17:14	07:45 16:47
4	08:04 17:00	07:43 17:39	07:00 18:16	07:04 19:56	06:14 20:33	05:43 21:06	05:47 21:16	06:16 20:51	06:52 20:01	07:14 (T-51) 07:18 (T-51)	07:28 19:05	07:08 17:13	07:46 16:47
5	08:04 17:01	07:42 17:40	06:59 18:18	07:02 19:57	06:12 20:34	05:43 21:07	05:47 21:15	06:17 20:50	06:53 19:59	07:15 (T-51) 07:17 (T-51)	07:29 19:03	07:09 17:11	07:47 16:47
6	08:04 17:02	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:54 19:57	07:16 (T-51) 07:19 (T-51)	07:30 19:01	07:11 17:10	07:48 16:47
7	08:04 17:03	07:39 17:43	06:55 18:20	06:58 20:00	07:18 (T-51) 07:20 (T-51)	06:10 20:37	05:42 21:09	05:49 21:15	06:19 20:47	06:55 19:56	07:31 19:00	07:12 17:09	07:49 16:47
8	08:04 17:04	07:38 17:45	07:53 18:22	06:56 20:01	07:16 (T-51) 07:20 (T-51)	06:08 20:38	05:42 21:09	05:49 21:14	06:20 20:45	06:57 19:54	07:32 18:56	07:13 17:07	07:50 16:46
9	08:03 17:05	07:37 17:46	07:52 19:23	06:55 20:02	07:15 (T-51) 07:21 (T-51)	06:07 20:39	05:42 21:10	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	07:15 17:06	07:51 16:46
10	08:03 17:06	07:35 17:48	07:50 19:24	06:53 20:04	07:13 (T-51) 07:20 (T-51)	06:06 20:40	05:41 21:11	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:52	07:16 17:05	07:52 16:46
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	07:11 (T-51) 07:20 (T-51)	06:04 20:42	05:41 21:11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51	07:17 17:04	07:53 16:46
12	08:02 17:08	07:33 17:50	07:46 19:27	06:49 20:06	07:09 (T-51) 07:19 (T-51)	06:03 20:43	05:41 21:12	05:52 21:12	06:25 20:40	07:01 19:46	07:37 18:49	07:19 17:03	07:54 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	07:08 (T-51) 07:19 (T-51)	06:02 20:44	05:41 21:12	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	07:20 17:02	07:55 16:47
14	08:01 17:11	07:30 17:53	07:42 19:30	06:46 20:09	07:06 (T-51) 07:17 (T-51)	06:01 20:45	05:41 21:13	05:54 21:11	06:27 20:37	07:04 19:43	07:40 18:45	07:21 17:01	07:56 16:47
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	07:04 (T-51) 07:15 (T-51)	06:00 20:46	05:41 21:13	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:44	07:23 17:00	07:57 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	07:08 (T-51) 07:13 (T-51)	05:58 20:47	05:41 21:14	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59	07:57 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:49	05:41 21:14	05:57 21:09	06:31 20:52	07:07 19:37	07:07 18:40	07:44 16:58	07:25 16:58	07:58 16:47
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:13	05:56 20:50	05:41 21:15	05:58 21:09	06:32 20:30	07:08 19:35	07:08 18:38	07:45 16:57	07:27 16:48	07:59 16:48
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	05:41 21:15	05:59 21:08	06:33 20:29	07:10 19:33	07:10 18:37	07:46 16:56	07:28 16:48	07:59 16:48
20	07:58 17:18	07:21 18:00	07:31 19:37	06:35 20:16	05:54 20:52	05:41 21:15	06:00 21:07	06:34 20:27	07:11 19:31	07:11 18:35	07:48 16:55	07:29 16:48	08:00 16:48
21	07:57 17:20	07:19 18:02	07:29 19:39	06:34 20:17	05:53 20:53	05:41 21:15	06:01 21:06	06:35 20:26	07:12 19:29	07:12 18:33	07:49 16:54	07:31 16:49	08:00 16:49
22	07:56 17:21	07:17 18:03	07:28 19:40	06:32 20:18	05:52 20:54	05:41 21:16	06:02 21:05	06:37 20:24	07:13 19:28	07:13 18:32	07:50 16:53	07:32 16:49	08:01 16:49
23	07:55 17:22	07:16 18:04	07:26 19:41	06:30 20:20	05:52 20:55	05:42 21:16	06:03 21:04	06:38 20:22	07:14 19:26	07:14 18:30	07:52 16:53	07:33 16:50	08:01 16:50
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	05:51 20:56	05:42 21:16	06:04 21:03	06:39 20:21	07:15 19:24	07:15 18:29	07:53 16:52	07:34 16:51	08:02 16:51
25	07:54 17:25	07:12 18:07	07:22 19:44	06:27 20:22	05:50 20:57	05:42 21:16	06:05 21:02	06:40 20:19	07:17 19:22	07:17 18:27	07:54 16:51	07:36 16:51	08:02 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:23	05:49 20:58	05:43 21:16	06:06 21:01	06:41 20:17	07:18 19:20	07:18 18:25	07:56 16:51	07:37 16:51	08:03 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	05:48 20:59	05:43 21:16	06:07 21:00	06:43 20:15	07:19 19:18	07:19 18:24	07:57 16:50	07:38 16:50	08:03 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47	06:23 20:26	05:48 21:00	05:43 21:16	06:08 20:59	06:44 20:14	07:20 19:16	07:20 18:22	07:58 16:50	07:39 16:53	08:03 16:53
29	07:50 17:31	07:15 19:49	06:21 20:27	06:21 20:27	05:47 21:01	05:44 21:16	06:09 20:58	06:45 20:12	07:21 19:14	07:21 18:21	08:00 16:49	07:41 16:54	08:04 16:54
30	07:49 17:32	07:13 19:50	06:19 20:28	06:19 20:28	05:46 21:02	05:44 21:16	06:10 20:57	06:46 20:10	07:23 19:12	07:23 18:19	08:01 16:49	07:42 16:55	08:04 16:55
31	07:48 17:33	07:11 19:51	06:11 20:28	06:11 20:28	05:46 21:03	05:44 21:16	06:11 20:56	06:47 20:08	07:24 19:12	07:24 18:18	08:02 16:49	07:43 16:56	08:04 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	
Total, worst case				76									
Sun reduction				0.63				49	28				
Oper. time red.				0.90				0.72	0.67				
Wind dir. red.				0.57				0.90	0.90				
Total reduction				0.32				0.57	0.57				
Total, real				25				0.37	0.34				
								18	10				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-072 - R-072
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04	07:47	16:38 (T-52)	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	26 17:04 (T-52)	18:12	19:52	20:30	21:04	21:16	20:54	20:06	19:11	17:17	16:48
2	08:04	07:45	16:38 (T-52)	07:04	07:07	06:16	05:44	05:45	06:13	06:50	07:25	07:05	07:44
	16:58	17:36	25 17:03 (T-52)	18:14	19:53	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	16:39 (T-52)	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:38	24 17:03 (T-52)	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	16:41 (T-52)	07:00	07:04	06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:16 (T-52)
	16:59	17:39	21 17:02 (T-52)	18:16	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:12	11 16:27 (T-52)
5	08:04	07:42	16:42 (T-52)	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	16:13 (T-52)
	17:00	17:40	19 17:01 (T-52)	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16 16:29 (T-52)
6	08:04	07:41	16:43 (T-52)	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	16:12 (T-52)
	17:01	17:42	16 16:59 (T-52)	18:19	19:58	20:36	21:08	21:15	20:48	19:57	19:01	17:10	19 16:31 (T-52)
7	08:04	07:39	16:46 (T-52)	06:55	06:58	06:09	05:42	05:49	06:19	06:55	07:31	07:12	16:10 (T-52)
	17:03	17:43	11 16:57 (T-52)	18:20	20:00	20:37	21:08	21:15	20:47	19:56	18:58	17:09	22 16:32 (T-52)
8	08:03	07:38		07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:32	07:13	16:10 (T-52)
	17:04	17:45		18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	24 16:34 (T-52)
9	08:03	07:37		07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:15	16:09 (T-52)
	17:05	17:46		19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	25 16:34 (T-52)
10	08:03	07:35		07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16	16:09 (T-52)
	17:06	17:47		19:24	20:03	20:40	21:10	21:13	20:43	19:50	18:52	17:05	26 16:35 (T-52)
11	08:03	07:34		07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	16:08 (T-52)
	17:07	17:49		19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:50	17:04	27 16:35 (T-52)
12	08:02	16:39 (T-52)	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:19	16:07 (T-52)
	17:08	2 16:41 (T-52)	17:50	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	28 16:35 (T-52)
13	08:02	16:38 (T-52)	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	16:08 (T-52)
	17:09	3 16:41 (T-52)	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	28 16:36 (T-52)
14	08:01	16:38 (T-52)	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	16:07 (T-52)
	17:11	5 16:43 (T-52)	17:53	19:29	20:08	20:45	21:13	21:11	20:37	19:43	18:45	17:01	28 16:35 (T-52)
15	08:01	16:37 (T-52)	07:28	07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:23	16:08 (T-52)
	17:12	7 16:44 (T-52)	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:43	17:00	26 16:34 (T-52)
16	08:00	16:36 (T-52)	07:27	07:39	06:42	05:58	05:41	05:56	06:30	07:06	07:42	07:24	16:08 (T-52)
	17:13	9 16:45 (T-52)	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:59	25 16:33 (T-52)
17	08:00	16:36 (T-52)	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	16:09 (T-52)
	17:14	11 16:47 (T-52)	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	23 16:32 (T-52)
18	07:59	16:35 (T-52)	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	16:09 (T-52)
	17:16	13 16:48 (T-52)	17:59	19:35	20:13	20:50	21:14	21:08	20:30	19:35	18:38	16:57	22 16:31 (T-52)
19	07:58	16:35 (T-52)	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	16:09 (T-52)
	17:17	14 16:49 (T-52)	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	20 16:29 (T-52)
20	07:58	16:35 (T-52)	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	16:10 (T-52)
	17:18	16 16:51 (T-52)	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	19 16:29 (T-52)
21	07:57	16:35 (T-52)	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:31	16:10 (T-52)
	17:20	18 16:53 (T-52)	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	18 16:28 (T-52)
22	07:56	16:35 (T-52)	07:17	07:28	06:32	05:52	05:41	06:02	06:37	07:13	07:50	07:32	16:11 (T-52)
	17:21	19 16:54 (T-52)	18:03	19:40	20:18	20:54	21:16	21:05	20:24	19:27	18:32	16:53	16 16:27 (T-52)
23	07:55	16:35 (T-52)	07:16	07:26	06:30	05:51	05:42	06:03	06:38	07:14	07:52	07:33	16:12 (T-52)
	17:22	20 16:55 (T-52)	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	14 16:26 (T-52)
24	07:55	16:35 (T-52)	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	16:12 (T-52)
	17:24	22 16:57 (T-52)	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52	13 16:25 (T-52)
25	07:54	16:35 (T-52)	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	16:14 (T-52)
	17:25	23 16:58 (T-52)	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	11 16:25 (T-52)
26	07:53	16:35 (T-52)	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	16:15 (T-52)
	17:26	25 17:00 (T-52)	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	9 16:24 (T-52)
27	07:52	16:35 (T-52)	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	16:16 (T-52)
	17:28	26 17:01 (T-52)	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	7 16:23 (T-52)
28	07:51	16:35 (T-52)	07:07	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:39	16:18 (T-52)
	17:29	28 17:03 (T-52)	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:22	16:50	5 16:23 (T-52)
29	07:50	16:36 (T-52)		07:15	06:21	05:47	05:44	06:09	06:45	07:21	08:00	07:41	16:19 (T-52)
	17:30	28 17:04 (T-52)		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	3 16:22 (T-52)
30	07:49	16:36 (T-52)		07:13	06:19	05:46	05:44	06:10	06:46	07:23	08:01	07:42	16:20 (T-52)
	17:32	29 17:05 (T-52)		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	2 16:22 (T-52)
31	07:48	16:37 (T-52)		07:11		05:46		06:11	06:47		08:02		08:04
	17:33	28 17:05 (T-52)		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	487	275
Total, worst case	346	142										487	
Sun reduction	0.58	0.58										0.48	
Oper. time red.	0.90	0.90										0.90	
Wind dir. red.	0.59	0.59										0.59	
Total reduction	0.31	0.31										0.25	
Total, real	106	43										123	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-073 - R-073
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	07:06 18:12	07:09 19:52	06:18 20:30	06:39 (T-51) 20:30	05:45 21:04	05:45 21:16	06:12 20:55	06:42 (T-51) 20:07	07:24 19:11	07:04 17:17
2	08:04 16:58	07:45 17:36	07:04 18:14	07:07 19:54	06:16 20:31	06:38 (T-51) 21:05	05:44 21:16	05:45 21:16	06:13 20:53	06:42 (T-51) 20:05	07:25 19:09	07:05 17:15
3	08:04 16:58	07:44 17:38	07:02 18:15	07:05 19:55	06:15 20:32	06:36 (T-51) 21:05	05:44 21:16	05:46 21:16	06:14 20:52	06:41 (T-51) 20:03	07:26 19:07	07:06 17:14
4	08:04 16:59	07:43 17:39	07:00 18:16	07:04 19:56	06:14 20:33	06:35 (T-51) 21:06	05:43 21:16	05:47 21:16	06:16 20:51	06:41 (T-51) 20:01	07:27 19:05	07:08 17:12
5	08:04 17:00	07:42 17:40	06:59 18:18	07:02 19:57	06:12 20:34	06:34 (T-51) 21:07	05:43 21:15	05:47 21:15	06:17 20:49	06:40 (T-51) 19:59	07:29 19:03	07:09 17:11
6	08:04 17:01	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	06:32 (T-51) 21:08	05:43 21:15	05:48 21:15	06:18 20:48	06:41 (T-51) 19:57	07:30 19:01	07:10 17:10
7	08:04 17:03	07:39 17:43	06:55 18:20	06:58 20:00	06:09 20:37	06:31 (T-51) 21:08	05:42 21:15	05:49 21:15	06:19 20:47	06:42 (T-51) 19:56	07:31 18:58	07:12 17:09
8	08:03 17:04	07:38 17:45	07:53 18:22	06:56 20:01	06:08 20:38	06:31 (T-51) 21:09	05:42 21:14	05:49 21:14	06:20 20:45	06:43 (T-51) 19:54	07:32 18:56	07:13 17:07
9	08:03 17:05	07:37 17:46	07:51 19:23	06:54 20:02	06:07 20:39	06:30 (T-51) 21:10	05:42 21:14	05:50 21:14	06:21 20:44	06:44 (T-51) 19:52	07:34 18:54	07:15 17:06
10	08:03 17:06	07:35 17:47	07:50 19:24	06:53 20:03	06:06 20:40	06:31 (T-51) 21:10	05:41 21:13	05:51 21:13	06:23 20:43	06:46 (T-51) 19:50	07:35 18:52	07:16 17:05
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:42	06:31 (T-51) 21:11	05:41 21:13	05:52 21:13	06:24 20:41	06:47 (T-51) 19:48	07:36 18:50	07:17 17:04
12	08:02 17:08	07:33 17:50	07:46 19:27	06:49 20:06	06:03 20:43	06:32 (T-51) 21:12	05:41 21:12	05:52 21:12	06:25 20:40	06:48 (T-51) 19:46	07:37 18:49	07:19 17:03
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	06:32 (T-51) 21:12	05:41 21:12	05:53 21:12	06:26 20:38	06:49 (T-51) 19:44	07:39 18:47	07:20 17:02
14	08:01 17:11	07:30 17:53	07:42 19:30	06:46 20:08	06:01 20:45	06:33 (T-51) 21:13	05:41 21:11	05:54 21:11	06:27 20:37	06:50 (T-51) 19:43	07:40 18:45	07:21 17:01
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	06:00 20:46	06:34 (T-51) 21:13	05:41 21:11	05:55 21:11	06:28 20:35	06:51 (T-51) 19:41	07:41 18:43	07:23 17:00
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:58 20:47	06:35 (T-51) 21:14	05:41 21:10	05:56 21:10	06:30 20:34	06:52 (T-51) 19:39	07:43 18:42	07:24 16:59
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:49	06:36 (T-51) 21:14	05:41 21:09	05:57 21:09	06:31 20:32	06:53 (T-51) 19:37	07:44 18:40	07:25 16:58
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:13	05:56 20:50	06:37 (T-51) 21:14	05:41 21:08	05:58 21:08	06:32 20:30	06:54 (T-51) 19:35	07:45 18:38	07:27 16:57
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	06:38 (T-51) 21:15	05:41 21:08	05:59 21:08	06:33 20:29	06:56 (T-51) 19:33	07:46 18:37	07:28 16:56
20	07:58 17:18	07:20 18:00	07:31 19:37	06:35 20:16	05:54 20:52	06:40 (T-51) 21:15	05:41 21:07	06:00 21:07	06:34 20:27	06:57 (T-51) 19:31	07:48 18:35	07:29 16:55
21	07:57 17:20	07:19 18:01	07:29 19:38	06:34 20:17	05:53 20:53	06:41 (T-51) 21:15	05:41 21:06	06:01 21:06	06:35 20:26	06:58 (T-51) 19:29	07:49 18:33	07:31 16:54
22	07:56 17:21	07:17 18:03	07:28 19:40	06:32 20:18	05:52 20:54	06:44 (T-51) 21:16	05:41 21:05	06:02 21:05	06:37 20:24	06:59 (T-51) 19:27	07:50 18:32	07:32 16:53
23	07:55 17:22	07:16 18:04	07:26 19:41	06:30 20:20	05:51 20:55	06:51 (T-51) 21:16	05:41 21:04	06:03 21:04	06:38 20:22	07:14 (T-51) 19:26	07:52 18:30	07:33 16:53
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	05:51 20:56	06:49 (T-51) 21:16	05:41 21:03	06:04 21:03	06:39 20:20	07:15 (T-51) 19:24	07:53 18:29	07:34 16:52
25	07:54 17:25	07:12 18:07	07:22 19:43	06:27 20:22	05:50 20:57	06:48 (T-51) 21:17	05:40 21:02	06:05 21:02	06:40 20:19	07:17 (T-51) 19:22	07:54 18:27	07:36 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:23	05:49 20:58	06:46 (T-51) 21:18	05:41 21:01	06:06 21:01	06:41 (T-51) 20:17	07:18 (T-51) 19:20	07:56 18:25	07:37 16:51
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	05:48 20:59	06:45 (T-51) 21:19	05:40 21:00	06:07 21:00	06:42 (T-51) 20:15	07:19 (T-51) 19:18	07:57 18:24	07:38 16:50
28	07:51 17:29	07:07 18:11	07:16 19:47	06:22 20:26	05:47 21:00	06:43 (T-51) 21:20	05:40 21:00	06:08 20:59	06:45 (T-51) 20:14	07:20 (T-51) 19:16	07:58 18:22	07:39 16:49
29	07:50 17:30	07:05 18:15	07:15 19:49	06:21 20:27	05:47 21:01	06:42 (T-51) 21:21	05:40 21:01	06:09 20:58	06:44 (T-51) 20:12	07:21 (T-51) 19:14	07:59 18:21	07:41 16:49
30	07:49 17:32	07:04 18:19	07:13 19:50	06:19 20:28	05:46 21:02	06:40 (T-51) 21:22	05:40 21:02	06:10 20:57	06:44 (T-51) 20:10	07:23 (T-51) 19:12	08:01 18:19	07:42 16:49
31	07:48 17:33	07:01 18:11	07:11 19:51	06:15 20:29	05:46 21:03	06:43 (T-51) 21:23	05:40 21:03	06:11 20:56	06:43 (T-51) 20:08	07:24 (T-51) 18:18	08:02 18:18	07:43 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case				169	630							
Sun reduction				0.63	0.66							
Oper. time red.				0.90	0.90							
Wind dir. red.				0.58	0.58							
Total reduction				0.33	0.35							
Total, real				56	219							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-074 - R-074

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:09	06:18	05:45
	16:57	17:35	18:12	19:52	20:30	21:04
2	08:04	07:46	07:04	07:07	06:16	05:44
	16:58	17:36	18:14	19:54	20:31	21:05
3	08:04	07:44	07:02	07:05	06:15	05:44
	16:58	17:38	18:15	19:55	20:32	21:05
4	08:04	07:43	07:00	07:04	06:14	05:43
	16:59	17:39	18:16	19:56	20:33	21:06
5	08:04	07:42	06:59	07:02	06:12	05:43
	17:00	17:40	18:18	19:57	20:35	21:07
6	08:04	07:41	06:57	07:00	06:11	05:43
	17:01	17:42	18:19	19:59	20:36	21:08
7	08:04	07:39	06:55	06:58	06:09	05:42
	17:03	17:43	18:20	20:00	20:37	21:09
8	08:04	07:38	07:53	06:56	06:08	05:42
	17:04	17:45	18:22	20:01	20:38	21:09
9	08:03	07:37	07:52	06:54	06:07	05:42
	17:05	17:46	19:23	20:02	20:39	21:10
10	08:03	07:35	07:50	06:53	06:06	05:41
	17:06	17:47	19:24	20:04	20:41	21:11
11	08:03	07:34	07:48	06:51	06:04	05:41
	17:07	17:49	19:26	20:05	20:42	21:11
12	08:02	07:33	07:46	06:49	06:03	05:41
	17:08	17:50	19:27	20:06	20:43	21:12
13	08:02	07:31	07:44	06:47	06:02	05:41
	17:09	17:52	19:28	20:07	20:44	21:12
14	08:01	07:30	07:42	06:46	06:01	05:41
	17:11	17:53	19:30	20:09	20:45	21:13
15	08:01	07:28	07:41	06:44	06:00	05:41
	17:12	17:55	19:31	20:10	20:46	21:13
16	08:00	07:27	07:39	06:42	05:58	05:41
	17:13	17:56	19:32	20:11	20:48	21:14
17	08:00	07:25	07:37	06:40	05:57	05:41
	17:14	17:57	19:33	20:12	20:49	21:14
18	07:59	08:22 (T-51)	07:24	07:35	06:39	05:41
	17:16	1 08:23 (T-51)	17:59	19:35	20:14	20:50
19	07:59	08:21 (T-51)	07:22	07:33	06:37	05:41
	17:17	3 08:24 (T-51)	18:00	19:36	20:15	20:51
20	07:58	08:21 (T-51)	07:21	07:31	06:35	05:41
	17:18	4 08:25 (T-51)	18:00	19:37	20:16	20:52
21	07:57	08:20 (T-51)	07:19	07:29	06:34	05:41
	17:20	5 08:25 (T-51)	18:02	19:39	20:17	20:53
22	07:56	08:19 (T-51)	07:17	07:28	06:32	05:41
	17:21	6 08:25 (T-51)	18:03	19:40	20:18	20:54
23	07:56	08:18 (T-51)	07:16	07:26	06:30	05:41
	17:22	7 08:25 (T-51)	18:04	19:41	20:20	20:55
24	07:55	08:17 (T-51)	07:14	07:24	06:29	05:41
	17:24	8 08:25 (T-51)	18:06	19:42	20:21	20:56
25	07:54	08:16 (T-51)	07:12	07:22	06:27	05:41
	17:25	8 08:24 (T-51)	18:07	19:44	20:22	20:57
26	07:53	08:15 (T-51)	07:11	07:20	06:26	05:41
	17:26	9 08:24 (T-51)	18:08	19:45	20:23	20:58
27	07:52	08:14 (T-51)	07:09	07:18	06:24	05:41
	17:28	9 08:23 (T-51)	18:10	19:46	20:25	20:59
28	07:51	08:16 (T-51)	07:07	07:16	06:22	05:41
	17:29	5 08:21 (T-51)	18:11	19:47	20:26	21:00
29	07:50			07:15	06:21	05:41
	17:30			19:49	20:27	21:01
30	07:49			07:13	06:19	05:41
	17:32			19:50	20:28	21:02
31	07:48			07:11	05:46	05:41
	17:33			19:51	21:03	21:03
Potential sun hours	287	292	369	403	459	465
Total, worst case	65				554	82
Sun reduction	0.58				0.66	0.73
Oper. time red.	0.90				0.90	0.90
Wind dir. red.	0.65				0.59	0.64
Total reduction	0.34				0.35	0.42
Total, real	22				194	34

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-074 - R-074
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	20:47 (T-42) 20:48 (T-42)	06:12 20:55	06:36 (T-48) 20:07	06:48 19:11	07:24 17:17
2	05:45 21:16	20:48 (T-42) 20:49 (T-42)	06:13 20:53	06:37 (T-48) 20:05	06:50 19:09	07:25 17:15
3	05:46 21:16		06:15 20:52	06:38 (T-48) 20:03	06:51 19:07	07:06 17:14
4	05:47 21:16		06:16 20:51	06:39 (T-48) 20:01	06:52 19:05	07:08 17:12
5	05:47 21:15		06:17 20:50	06:40 (T-48) 19:59	06:53 19:03	07:09 17:11
6	05:48 21:15		06:18 20:48	06:41 (T-48) 19:58	06:54 19:01	07:11 17:10
7	05:49 21:15		06:19 20:47	06:42 (T-48) 19:56	06:55 19:00	07:12 17:09
8	05:49 21:14		06:20 20:45	06:43 (T-48) 19:54	06:57 18:56	07:13 17:07
9	05:50 21:14		06:21 20:44	06:44 (T-48) 19:52	06:58 18:54	07:15 17:06
10	05:51 21:14		06:23 20:43	06:46 (T-48) 19:50	06:59 18:52	07:16 17:05
11	05:52 21:13	06:37 (T-48) 06:44 (T-48)	06:24 20:41	07:00 19:48	07:36 18:51	07:17 17:04
12	05:52 21:13	06:35 (T-48) 06:46 (T-48)	06:25 20:40	07:01 19:46	07:37 18:49	07:19 17:03
13	05:53 21:12	06:33 (T-48) 06:47 (T-48)	06:26 20:38	07:02 19:44	07:39 18:47	07:20 17:02
14	05:54 21:11	06:32 (T-48) 06:48 (T-48)	06:27 20:37	07:04 19:43	07:40 18:45	07:21 17:01
15	05:55 21:11	06:32 (T-48) 06:49 (T-48)	06:28 20:35	07:05 19:41	07:41 18:44	07:23 17:00
16	05:56 21:10	06:31 (T-48) 06:50 (T-48)	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59
17	05:57 21:09	06:31 (T-48) 06:51 (T-48)	06:31 20:32	07:07 19:37	07:44 18:40	07:25 16:58
18	05:58 21:09	06:30 (T-48) 06:52 (T-48)	06:32 20:30	07:08 19:35	07:45 18:38	07:27 16:57
19	05:59 21:08	06:30 (T-48) 06:53 (T-48)	06:33 20:29	07:10 19:33	07:46 18:37	07:28 16:56
20	06:00 21:07	06:29 (T-48) 06:54 (T-48)	06:34 20:27	07:11 19:31	07:48 18:35	07:29 16:55
21	06:01 21:06	06:29 (T-48) 06:54 (T-48)	06:35 20:26	07:12 19:29	07:49 18:33	07:31 16:54
22	06:02 21:05	06:29 (T-48) 06:55 (T-48)	06:37 20:24	07:13 19:28	07:50 18:32	07:32 16:53
23	06:03 21:04	06:27 (T-48) 06:54 (T-48)	06:38 20:22	07:14 19:26	07:52 18:30	07:33 16:53
24	06:04 21:03	06:27 (T-48) 06:55 (T-48)	06:39 20:21	07:15 19:24	07:53 18:29	07:35 16:52
25	06:05 21:02	06:28 (T-48) 06:55 (T-48)	06:40 20:19	07:17 19:22	07:54 18:27	07:36 16:51
26	06:06 21:01	06:29 (T-48) 06:55 (T-48)	06:41 20:17	07:18 19:20	07:56 18:25	07:37 16:51
27	06:07 21:00	06:31 (T-48) 06:57 (T-48)	06:42 20:15	07:19 19:18	07:57 18:24	07:38 16:50
28	06:08 20:59	06:32 (T-48) 06:57 (T-48)	06:44 20:14	07:20 19:16	07:58 18:22	07:39 16:50
29	06:09 20:58	06:33 (T-48) 06:57 (T-48)	06:45 20:12	07:21 19:14	08:00 18:21	07:41 16:49
30	06:10 20:57	06:34 (T-48) 06:57 (T-48)	06:46 20:10	07:23 19:12	08:01 18:19	07:42 16:49
31	06:11 20:56	06:35 (T-48) 06:56 (T-48)	06:47 20:08	08:02 18:18	08:02 18:18	08:04 16:56
Potential sun hours	471		436	377	341	289
Total, worst case	454		121			66
Sun reduction	0.75		0.72			0.48
Oper. time red.	0.90		0.90			0.90
Wind dir. red.	0.59		0.59			0.65
Total reduction	0.40		0.38			0.28
Total, real	181		46			18

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project: South Deuel Wind Project
Description: Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024
Licensed user: Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated: 6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-076 - R-076
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns for months (January-December) and wind directions (N, NNE, NE, etc.) and a detailed row-by-row time schedule.

Table layout: For each day in each month the following matrix apply

Matrix for table layout with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-077 - R-077
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum		
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

January		February		March		April		May		June			
1	08:04	16:07 (T-45)	07:47	16:14 (T-45)	07:06		07:09	06:18		06:39 (T-49)	05:45		
	16:57	22	16:29 (T-45)	17:35	55	17:09 (T-43)	18:12		19:52	20:30	2	06:41 (T-49)	21:04
2	08:04	16:07 (T-45)	07:46	16:14 (T-45)	07:04		07:07	06:16		06:38 (T-49)	05:44		
	16:57	22	16:29 (T-45)	17:36	55	17:10 (T-43)	18:14		19:54	20:31	5	06:43 (T-49)	21:05
3	08:04	16:07 (T-45)	07:44	16:15 (T-45)	07:02		07:05	06:15		06:36 (T-49)	05:44		
	16:58	24	16:31 (T-45)	17:37	52	17:10 (T-43)	18:15		19:52	20:30	8	06:44 (T-49)	21:06
4	08:04	16:06 (T-45)	07:43	16:16 (T-45)	07:00		07:04	06:14		06:35 (T-49)	05:43		
	16:59	25	16:31 (T-45)	17:39	48	17:09 (T-43)	18:16		19:56	20:33	11	06:46 (T-49)	21:06
5	08:04	16:07 (T-45)	07:42	16:18 (T-45)	06:59		07:02	06:12		06:33 (T-49)	05:43		
	17:00	25	16:32 (T-45)	17:40	42	17:15 (T-44)	18:18		19:57	20:35	13	06:46 (T-49)	21:07
6	08:04	16:07 (T-45)	07:41	16:18 (T-45)	06:57		07:00	06:11		06:32 (T-49)	05:42		
	17:01	26	16:33 (T-45)	17:42	37	17:16 (T-44)	18:19		19:59	20:36	15	06:47 (T-49)	21:08
7	08:04	16:07 (T-45)	07:39	16:20 (T-45)	06:55		06:58	06:09		06:31 (T-49)	05:42		
	17:02	27	16:34 (T-45)	17:43	37	17:18 (T-44)	18:20		20:00	20:37	16	06:47 (T-49)	21:09
8	08:04	16:08 (T-45)	07:38	16:23 (T-45)	07:53		06:56	06:08		06:30 (T-49)	05:42		
	17:04	28	16:36 (T-45)	17:45	34	17:20 (T-44)	18:22		20:01	20:38	18	06:48 (T-49)	21:09
9	08:03	16:07 (T-45)	07:37	16:24 (T-45)	07:51		06:54	06:07		06:28 (T-49)	05:42		
	17:05	29	16:36 (T-45)	17:46	34	17:21 (T-44)	19:23		20:02	20:39	20	06:48 (T-49)	21:10
10	08:03	16:07 (T-45)	07:35	16:28 (T-45)	07:50		06:53	06:05		06:27 (T-49)	05:41		
	17:06	31	16:38 (T-45)	17:47	29	17:23 (T-44)	19:24		20:04	20:41	21	06:48 (T-49)	21:11
11	08:03	16:07 (T-45)	07:34	17:07 (T-44)	07:48		06:51	06:04		06:26 (T-49)	05:41		
	17:07	32	16:39 (T-45)	17:49	17	17:24 (T-44)	19:26		20:05	20:42	22	06:48 (T-49)	21:11
12	08:02	16:07 (T-45)	07:33	17:07 (T-44)	07:46		06:49	06:03		06:25 (T-49)	05:41		
	17:08	33	16:40 (T-45)	17:50	19	17:26 (T-44)	19:27		20:06	20:43	24	06:49 (T-49)	21:12
13	08:02	16:07 (T-45)	07:31	17:07 (T-44)	07:44		06:47	06:02		06:24 (T-49)	05:41		
	17:09	34	16:41 (T-45)	17:52	20	17:27 (T-44)	19:28		20:07	20:44	25	06:49 (T-49)	21:12
14	08:01	16:08 (T-45)	07:30	17:07 (T-44)	07:42		06:46	06:01		06:23 (T-49)	05:41		
	17:10	35	16:43 (T-45)	17:53	22	17:29 (T-44)	19:30		20:09	20:45	26	06:49 (T-49)	21:13
15	08:01	16:07 (T-45)	07:28	17:07 (T-44)	07:41		06:44	05:59		06:22 (T-49)	05:41		
	17:12	37	16:44 (T-45)	17:54	23	17:30 (T-44)	19:31		20:10	20:46	27	06:49 (T-49)	21:13
16	08:00	16:08 (T-45)	07:27	17:07 (T-44)	07:39		06:42	05:58		06:21 (T-49)	05:41		
	17:13	38	16:46 (T-45)	17:56	25	17:32 (T-44)	19:32		20:11	20:48	27	06:48 (T-49)	21:14
17	08:00	16:08 (T-45)	07:25	17:07 (T-44)	07:37		06:40	05:57		06:19 (T-49)	05:41		
	17:14	39	16:47 (T-45)	17:57	26	17:33 (T-44)	19:33		20:12	20:49	28	06:47 (T-49)	21:14
18	07:59	16:08 (T-45)	07:24	17:08 (T-44)	07:35		06:39	05:56		06:20 (T-49)	05:41		
	17:16	40	16:48 (T-45)	17:59	27	17:35 (T-44)	19:35		20:14	20:50	28	06:48 (T-49)	21:15
19	07:59	16:08 (T-45)	07:22	17:09 (T-44)	07:33		06:37	05:55		06:20 (T-49)	05:41		
	17:17	42	16:50 (T-45)	18:00	25	17:34 (T-44)	19:36		20:15	20:51	27	06:47 (T-49)	21:15
20	07:58	16:08 (T-45)	07:21	17:10 (T-44)	07:31		06:35	05:54		06:20 (T-49)	05:41		
	17:18	43	16:51 (T-45)	18:00	23	17:33 (T-44)	19:37		20:16	20:52	27	06:47 (T-49)	21:15
21	07:57	16:08 (T-45)	07:19	17:11 (T-44)	07:29		06:34	05:53		06:21 (T-49)	05:41		
	17:19	44	16:52 (T-45)	18:01	21	17:32 (T-44)	19:38		20:17	20:53	25	06:46 (T-49)	21:16
22	07:56	16:09 (T-45)	07:17	17:12 (T-44)	07:28		06:32	05:52		06:21 (T-49)	05:41		
	17:21	45	16:54 (T-43)	18:03	17	17:29 (T-44)	19:40		20:18	20:54	25	06:46 (T-49)	21:16
23	07:56	16:09 (T-45)	07:16	17:15 (T-44)	07:26		06:30	05:51		06:22 (T-49)	05:42		
	17:22	46	16:55 (T-43)	18:04	13	17:28 (T-44)	19:41		20:20	20:55	23	06:45 (T-49)	21:16
24	07:55	16:09 (T-45)	07:14		07:24		06:29	05:51		06:23 (T-49)	05:42		
	17:24	47	16:56 (T-43)	18:06		19:42	20:21	20:56	21	06:44 (T-49)	21:16		
25	07:54	16:09 (T-45)	07:12		07:22		06:27	05:50		06:24 (T-49)	05:42		
	17:25	49	16:58 (T-43)	18:07		19:44	20:22	20:57	20	06:44 (T-49)	21:16		
26	07:53	16:10 (T-45)	07:11		07:20		06:26	05:49		06:25 (T-49)	05:42		
	17:26	49	16:59 (T-43)	18:08		19:45	20:23	20:58	18	06:43 (T-49)	21:16		
27	07:52	16:10 (T-45)	07:09		07:18		06:24	05:48		06:26 (T-49)	05:43		
	17:28	51	17:01 (T-43)	18:10		19:46	20:25	20:59	16	06:42 (T-49)	21:16		
28	07:51	16:11 (T-45)	07:07		07:16		06:22	05:47		06:28 (T-49)	05:43		
	17:29	51	17:02 (T-43)	18:11		19:47	20:26	21:00	13	06:41 (T-49)	21:16		
29	07:50	16:11 (T-45)			07:15		06:21	05:47		06:29 (T-49)	05:44		
	17:30	53	17:04 (T-43)		19:49		20:27	21:01	10	06:39 (T-49)	21:16		
30	07:49	16:12 (T-45)			07:13		06:19	05:46		06:31 (T-49)	05:44		
	17:32	54	17:06 (T-43)		19:50		20:28	21:02	6	06:37 (T-49)	21:16		
31	07:48	16:13 (T-45)			07:11			05:45					
	17:33	54	17:07 (T-43)		19:51			21:03					
Potential sun hours	287		292		369		403	459			465		
Total, worst case	1175		701		29			567					
Sun reduction	0.58		0.58		0.59			0.66					
Oper. time red.	0.90		0.90		0.90			0.90					
Wind dir. red.	0.60		0.59		0.57			0.59					
Total reduction	0.31		0.31		0.31			0.35					
Total, real	367		217		9			199					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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L085 73 GE3.8-154 WTGs on 98m HH
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-077 - R-077
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time													N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884													

	July	August	September	October	November	December
1	05:45	06:12	06:36 (T-49)	06:48	07:24	07:04
	21:16	20:55	23 06:59 (T-49)	20:07	19:11	17:17
2	05:45	06:13	06:37 (T-49)	06:49	07:25	07:05
	21:16	20:53	22 06:59 (T-49)	20:05	19:09	17:15
3	05:46	06:14	06:38 (T-49)	06:51	07:26	07:06
	21:16	20:52	21 06:59 (T-49)	20:03	19:07	17:14
4	05:46	06:16	06:39 (T-49)	06:52	07:28	07:08
	21:16	20:51	19 06:58 (T-49)	20:01	19:05	17:12
5	05:47	06:17	06:40 (T-49)	06:53	07:29	07:09
	21:15	20:50	18 06:58 (T-49)	19:59	19:03	17:11
6	05:48	06:18	06:41 (T-49)	06:54	07:30	07:11
	21:15	20:48	16 06:57 (T-49)	19:57	19:01	6 18:30 (T-42)
7	05:48	06:19	06:42 (T-49)	06:55	07:31	07:12
	21:15	20:47	14 06:56 (T-49)	19:56	18:58	7 18:34 (T-42)
8	05:49	06:20	06:43 (T-49)	06:57	07:32	07:13
	21:14	20:45	12 06:55 (T-49)	19:54	18:56	6 18:33 (T-42)
9	05:50	06:21	06:44 (T-49)	06:58	07:34	07:15
	21:14	20:44	10 06:54 (T-49)	19:52	18:54	4 18:30 (T-42)
10	05:51	06:22	06:46 (T-49)	06:59	07:35	07:16
	21:14	20:43	7 06:53 (T-49)	19:50	18:52	3 18:28 (T-42)
11	05:51	06:24	06:47 (T-49)	07:00	07:36	07:17
	21:13	20:41	5 06:52 (T-49)	19:48	18:50	2 18:27 (T-42)
12	05:52	06:25	06:48 (T-49)	07:01	07:37	07:19
	21:13	20:40	1 06:49 (T-49)	19:46	18:49	17:03
13	05:53	06:26		07:02	07:39	07:20
	21:12	20:38		19:44	18:47	17:02
14	05:54	06:38 (T-49)	06:27	07:04	07:40	07:21
	21:11	9 06:47 (T-49)	20:37	19:43	18:45	17:00
15	05:55	06:37 (T-49)	06:28	07:05	07:41	07:23
	21:11	12 06:49 (T-49)	20:35	19:41	18:43	16:59
16	05:56	06:36 (T-49)	06:29	07:06	07:43	07:24
	21:10	14 06:50 (T-49)	20:34	19:39	18:42	16:58
17	05:57	06:35 (T-49)	06:31	07:07	07:44	07:25
	21:09	17 06:52 (T-49)	20:32	19:37	18:40	16:58
18	05:58	06:34 (T-49)	06:32	07:08	07:45	07:27
	21:09	19 06:53 (T-49)	20:30	19:35	18:38	7 17:49 (T-44)
19	05:59	06:33 (T-49)	06:33	07:09	07:46	07:28
	21:08	21 06:54 (T-49)	20:29	19:33	18:37	14 17:59 (T-44)
20	06:00	06:33 (T-49)	06:34	07:11	07:48	07:29
	21:07	22 06:55 (T-49)	20:27	19:31	18:35	19 18:02 (T-44)
21	06:00	06:31 (T-49)	06:35	07:12	07:49	07:31
	21:06	24 06:55 (T-49)	20:26	19:29	18:33	21 18:02 (T-44)
22	06:01	06:31 (T-49)	06:37	07:13	07:50	07:32
	21:05	25 06:56 (T-49)	20:24	19:27	18:32	24 18:03 (T-44)
23	06:03	06:30 (T-49)	06:38	07:14	07:52	07:33
	21:04	26 06:56 (T-49)	20:22	19:26	18:30	25 18:04 (T-44)
24	06:04	06:30 (T-49)	06:39	07:15	07:53	07:35
	21:03	27 06:57 (T-49)	20:21	19:24	18:29	26 18:04 (T-44)
25	06:05	06:29 (T-49)	06:40	07:17	07:54	07:36
	21:02	28 06:57 (T-49)	20:19	19:22	18:27	25 18:03 (T-44)
26	06:06	06:29 (T-49)	06:41	07:18	07:56	07:37
	21:01	29 06:58 (T-49)	20:17	19:20	18:25	24 18:01 (T-44)
27	06:07	06:30 (T-49)	06:42	07:19	07:57	07:38
	21:00	28 06:58 (T-49)	20:15	19:18	18:24	23 17:59 (T-44)
28	06:08	06:31 (T-49)	06:44	07:20	07:58	07:39
	20:59	27 06:58 (T-49)	20:14	19:16	18:22	21 17:58 (T-44)
29	06:09	06:33 (T-49)	06:45	07:21	08:00	07:41
	20:58	26 06:59 (T-49)	20:12	19:14	18:21	20 17:56 (T-44)
30	06:10	06:34 (T-49)	06:46	07:23	08:01	07:42
	20:57	25 06:59 (T-49)	20:10	19:12	18:19	18 17:55 (T-44)
31	06:11	06:35 (T-49)	06:47	08:02	08:02	17:02 (T-45)
	20:56	24 06:59 (T-49)	20:08	18:18	20 17:53 (T-44)	08:04
Potential sun hours	471	436		377	341	289
Total, worst case			168		315	1306
Sun reduction	0.75		0.72		0.56	0.48
Oper. time red.	0.90		0.90		0.90	0.90
Wind dir. red.	0.59		0.59		0.59	0.60
Total reduction	0.40		0.38		0.30	0.26
Total, real	160		64		94	337

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-078 - R-078

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:41 (T-22)	07:09	06:18
	16:57	17:35	18:12	43 08:24 (T-22)	19:52	20:30
2	08:04	07:46	07:04	07:42 (T-22)	07:07	06:16
	16:57	17:36	18:14	42 08:24 (T-22)	19:54	20:31
3	08:04	07:44	07:02	07:43 (T-22)	07:05	06:15
	16:58	17:37	18:15	39 08:22 (T-22)	19:55	20:32
4	08:04	07:43	07:00	07:43 (T-22)	07:03	06:14
	16:59	17:39	18:16	38 08:21 (T-22)	19:56	20:33
5	08:04	07:42	06:59	07:44 (T-22)	07:02	06:12
	17:00	17:40	18:18	35 08:19 (T-22)	19:57	20:35
6	08:04	07:41	08:02 (T-22)	06:57	07:45 (T-22)	07:00
	17:01	17:42	6 08:08 (T-22)	18:19	32 08:17 (T-22)	19:59
7	08:04	07:39	08:01 (T-22)	06:55	07:48 (T-22)	06:58
	17:02	17:43	12 08:13 (T-22)	18:20	28 08:16 (T-22)	20:00
8	08:04	07:38	08:00 (T-22)	07:53	08:49 (T-22)	06:56
	17:03	17:45	16 08:16 (T-22)	18:22	24 09:13 (T-22)	20:01
9	08:03	07:37	07:58 (T-22)	07:51	08:52 (T-22)	06:54
	17:05	17:46	20 08:18 (T-22)	19:23	17 09:09 (T-22)	20:02
10	08:03	07:35	07:57 (T-22)	07:50	08:58 (T-22)	06:53
	17:06	17:47	23 08:20 (T-22)	19:24	4 09:02 (T-22)	20:04
11	08:03	07:34	07:55 (T-22)	07:48	06:51	06:04
	17:07	17:49	26 08:21 (T-22)	19:26	20:05	20:42
12	08:02	07:33	07:54 (T-22)	07:46	06:49	06:03
	17:08	17:50	29 08:23 (T-22)	19:27	20:06	20:43
13	08:02	07:31	07:52 (T-22)	07:44	06:47	06:02
	17:09	17:52	31 08:23 (T-22)	19:28	20:07	20:44
14	08:01	07:30	07:51 (T-22)	07:42	06:46	06:01
	17:10	17:53	34 08:25 (T-22)	19:30	20:09	20:45
15	08:01	07:28	07:49 (T-22)	07:41	06:44	05:59
	17:12	17:54	36 08:25 (T-22)	19:31	20:10	20:46
16	08:00	07:27	07:48 (T-22)	07:39	06:42	05:58
	17:13	17:56	38 08:26 (T-22)	19:32	20:11	20:48
17	08:00	07:25	07:46 (T-22)	07:37	06:40	05:57
	17:14	17:57	40 08:26 (T-22)	19:33	20:12	20:49
18	07:59	07:24	07:45 (T-22)	07:35	06:39	05:56
	17:15	17:59	42 08:27 (T-22)	19:35	20:14	20:50
19	07:59	07:22	07:43 (T-22)	07:33	06:37	05:55
	17:17	18:00	44 08:27 (T-22)	19:36	20:15	20:51
20	07:58	07:21	07:42 (T-22)	07:31	06:35	05:54
	17:18	18:00	46 08:28 (T-22)	19:37	2 19:54 (T-20)	20:52
21	07:57	07:19	07:40 (T-22)	07:29	06:34	05:53
	17:19	18:01	48 08:28 (T-22)	19:38	7 19:54 (T-20)	20:53
22	07:56	07:17	07:40 (T-22)	07:28	06:32	05:52
	17:21	18:03	47 08:27 (T-22)	19:40	11 19:56 (T-20)	20:54
23	07:56	07:16	07:40 (T-22)	07:26	06:30	05:51
	17:22	18:04	48 08:28 (T-22)	19:41	15 19:57 (T-20)	20:55
24	07:55	07:14	07:40 (T-22)	07:24	06:29	05:50
	17:23	18:06	47 08:27 (T-22)	19:42	20:21	18 19:58 (T-20)
25	07:54	07:12	07:40 (T-22)	07:22	06:27	05:49
	17:25	18:07	47 08:27 (T-22)	19:44	20:22	20 19:59 (T-20)
26	07:53	07:11	07:41 (T-22)	07:20	06:26	05:49
	17:26	18:08	46 08:27 (T-22)	19:45	20:23	22 20:00 (T-20)
27	07:52	07:09	07:41 (T-22)	07:18	06:24	05:48
	17:28	18:10	45 08:26 (T-22)	19:46	20:25	25 20:02 (T-20)
28	07:51	07:07	07:41 (T-22)	07:16	06:22	05:47
	17:29	18:11	44 08:25 (T-22)	19:47	20:26	26 20:02 (T-20)
29	07:50		07:15		06:21	05:47
	17:30		19:49		20:27	28 20:04 (T-20)
30	07:49		07:13		06:19	05:46
	17:32		19:50		20:28	31 20:05 (T-20)
31	07:48		07:11			05:45
	17:33		19:51			21:03
Potential sun hours	287	292	369	404	459	465
Total, worst case		815	302	205	705	
Sun reduction		0.58	0.59	0.63	0.66	
Oper. time red.		0.90	0.90	0.90	0.90	
Wind dir. red.		0.63	0.63	0.61	0.61	
Total reduction		0.33	0.33	0.35	0.36	
Total, real		268	101	71	257	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-078 - R-078
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time													N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884													

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	19:46 (T-20) 20:21 (T-20)	06:48 20:07	07:24 19:11	07:04 17:16
2	05:45 21:16	06:13 20:53	19:45 (T-20) 20:21 (T-20)	06:49 20:05	07:25 19:09	07:05 17:15
3	05:46 21:16	06:14 20:52	19:44 (T-20) 20:21 (T-20)	06:51 20:03	07:26 19:07	07:06 17:14
4	05:46 21:16	06:16 20:51	19:44 (T-20) 20:22 (T-20)	06:52 20:01	07:28 19:05	07:08 17:12
5	05:47 21:15	06:17 20:50	19:44 (T-20) 20:23 (T-19)	06:53 19:59	07:29 19:03	07:09 17:11
6	05:48 21:15	06:18 20:48	19:43 (T-20) 20:22 (T-20)	06:54 19:57	07:30 19:01	07:11 17:10
7	05:48 21:15	06:19 20:47	19:43 (T-20) 20:21 (T-20)	06:55 19:56	07:31 18:58	07:12 17:08
8	05:49 21:14	06:20 20:46	19:43 (T-20) 20:19 (T-20)	06:57 19:54	07:32 18:56	07:13 17:07
9	05:50 21:14	06:21 20:44	19:42 (T-20) 20:18 (T-20)	06:58 19:52	07:34 18:54	07:15 17:06
10	05:51 21:14	06:22 20:43	19:42 (T-20) 20:17 (T-20)	06:59 19:50	07:35 18:52	07:16 17:05
11	05:51 21:13	06:24 20:41	19:43 (T-20) 20:16 (T-20)	07:00 19:48	07:36 18:50	07:17 17:04
12	05:52 21:13	06:25 20:40	19:43 (T-20) 20:14 (T-20)	07:01 19:46	07:37 18:49	07:19 17:03
13	05:53 21:12	06:26 20:38	19:43 (T-20) 20:13 (T-20)	07:02 19:44	07:39 18:47	07:20 17:01
14	05:54 21:11	06:27 20:37	19:43 (T-20) 20:11 (T-20)	07:04 19:43	07:40 18:45	07:21 17:00
15	05:55 21:11	06:28 20:35	19:44 (T-20) 20:10 (T-20)	07:05 19:41	07:41 18:43	07:23 16:59
16	05:56 21:10	06:29 20:34	19:44 (T-20) 20:08 (T-20)	07:06 19:39	07:43 18:42	07:24 16:58
17	05:57 21:09	06:31 20:32	19:45 (T-20) 20:06 (T-20)	07:07 19:37	07:44 18:40	07:25 16:57
18	05:58 21:09	06:32 20:30	19:45 (T-20) 20:05 (T-20)	07:08 19:35	07:45 18:38	07:27 16:57
19	05:58 21:08	06:33 20:29	19:47 (T-20) 20:04 (T-20)	07:09 19:33	07:46 18:37	07:28 16:56
20	05:59 21:07	19:59 (T-20) 20:06 (T-20)	06:34 20:27	19:48 (T-20) 20:02 (T-20)	07:11 19:31	07:29 16:55
21	06:00 21:06	19:56 (T-20) 20:09 (T-20)	06:35 20:26	19:50 (T-20) 20:01 (T-20)	07:12 19:29	07:31 16:54
22	06:01 21:05	19:54 (T-20) 20:11 (T-20)	06:36 20:24	19:52 (T-20) 19:59 (T-20)	07:13 19:27	07:32 16:53
23	06:02 21:04	19:53 (T-20) 20:13 (T-20)	06:38 20:22	19:51 (T-20) 19:26	07:14 18:30	07:33 16:52
24	06:03 21:03	19:51 (T-20) 20:14 (T-20)	06:39 20:21	19:50 (T-20) 19:24	07:15 18:28	07:35 16:52
25	06:05 21:02	19:50 (T-20) 20:15 (T-20)	06:40 20:19	19:49 (T-20) 19:22	07:17 18:27	07:36 16:51
26	06:06 21:01	19:49 (T-20) 20:16 (T-20)	06:41 20:17	19:48 (T-20) 19:20	07:18 18:25	07:37 16:50
27	06:07 21:00	19:48 (T-20) 20:17 (T-20)	06:42 20:15	19:47 (T-20) 19:18	07:19 18:24	07:38 16:50
28	06:08 20:59	19:47 (T-20) 20:18 (T-20)	06:44 20:14	19:46 (T-20) 19:16	07:20 18:22	07:40 16:49
29	06:09 20:58	19:47 (T-20) 20:18 (T-20)	06:45 20:12	19:45 (T-20) 19:14	07:21 18:21	07:41 16:49
30	06:10 20:57	19:47 (T-20) 20:20 (T-20)	06:46 20:10	19:44 (T-20) 19:12	07:22 18:19	07:42 16:48
31	06:11 20:56	19:46 (T-20) 20:20 (T-20)	06:47 20:08	19:43 (T-20)	07:23 18:18	07:43 16:48
Potential sun hours	471	436	377	341	288	275
Total, worst case	290	631	1058	73		
Sun reduction	0.75	0.72	0.56	0.48		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.61	0.61	0.63	0.63		
Total reduction	0.41	0.40	0.32	0.27		
Total, real	120	251	336	20		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
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1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-079 - R-079

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June			
1	08:04	15:54 (T-21)	07:47	07:06	07:09	06:18	05:45		
	16:56	13 16:07 (T-21)	17:35	18:12	19:52	20:30	21:04		
2	08:04	15:55 (T-21)	07:46	07:04	07:07	06:16	05:44		
	16:57	12 16:07 (T-21)	17:36	18:14	19:53	20:31	21:05		
3	08:04	15:57 (T-21)	07:44	07:02	07:05	06:15	05:44		
	16:58	9 16:06 (T-21)	17:37	18:15	19:55	20:32	21:06		
4	08:04	15:58 (T-21)	07:43	07:00	07:03	06:13	05:43		
	16:59	6 16:04 (T-21)	17:39	18:16	19:56	20:33	21:06		
5	08:04		07:42	06:59	07:02	06:12	05:43		
	17:00		17:40	18:18	19:57	20:35	21:07		
6	08:04		07:41	06:57	07:00	06:11	05:42		
	17:01		17:42	18:19	19:58	20:36	21:08		
7	08:04		07:39	06:55	06:58	19:36 (T-41)	06:09	05:42	
	17:02		17:43	18:20	20:00	2 19:38 (T-41)	20:37	21:09	
8	08:04		07:38	07:53	06:56	19:34 (T-41)	06:08	05:42	
	17:03		17:44	18:22	20:01	5 19:39 (T-41)	20:38	21:09	
9	08:03		07:37	07:51	06:54	19:34 (T-41)	06:07	05:41	
	17:05		17:46	19:23	20:02	7 19:41 (T-41)	20:39	21:10	
10	08:03		07:35	07:50	06:53	19:32 (T-41)	06:05	05:41	
	17:06		17:47	19:24	20:03	10 19:42 (T-41)	20:41	21:11	
11	08:03		07:34	07:48	06:51	19:31 (T-41)	06:04	05:41	
	17:07		17:49	19:26	20:05	12 19:43 (T-41)	20:42	21:11	
12	08:02		07:33	07:46	06:49	19:31 (T-41)	06:03	05:41	
	17:08		17:50	19:27	20:06	13 19:44 (T-41)	20:43	21:12	
13	08:02		07:31	07:44	06:47	19:31 (T-41)	06:02	05:41	
	17:09		17:52	19:28	20:07	15 19:46 (T-41)	20:44	21:12	
14	08:01		07:30	07:42	06:45	19:30 (T-41)	06:01	05:41	
	17:10		17:53	19:29	20:08	16 19:46 (T-41)	20:45	21:13	
15	08:01		07:28	07:41	06:44	19:30 (T-41)	05:59	05:41	
	17:12		17:54	19:31	20:10	17 19:47 (T-41)	20:46	21:13	
16	08:00		07:27	07:39	06:42	19:30 (T-41)	05:58	05:40	
	17:13		17:56	19:32	20:11	18 19:48 (T-41)	20:48	21:14	
17	08:00		07:25	07:37	06:40	19:31 (T-41)	05:57	05:41	
	17:14		17:57	19:33	20:12	19 19:50 (T-41)	20:49	21:14	
18	07:59		07:24	07:35	06:39	19:32 (T-41)	05:56	05:41	
	17:15		17:59	19:35	20:13	18 19:50 (T-41)	20:50	21:15	
19	07:59		07:22	07:33	06:37	19:32 (T-41)	05:55	05:41	
	17:17		18:00	19:36	4 19:14 (T-20)	20:15	16 19:48 (T-41)	20:51	21:15
20	07:58		07:20	07:31	06:35	19:09 (T-20)	05:54	05:41	
	17:18		18:00	19:37	6 19:15 (T-20)	20:16	12 19:47 (T-41)	20:52	21:15
21	07:57		07:19	07:29	06:34	19:10 (T-20)	05:53	05:41	
	17:19		18:01	19:38	7 19:17 (T-20)	20:17	6 19:43 (T-41)	20:53	21:16
22	07:56		07:17	07:28	06:32	19:09 (T-20)	05:52	05:41	
	17:21		18:03	19:40	10 19:19 (T-20)	20:18		20:54	21:16
23	07:56		07:16	07:26	06:30	19:09 (T-20)	05:51	05:41	
	17:22		18:04	19:41	11 19:20 (T-20)	20:20		20:55	21:16
24	07:55		07:14	07:24	06:29	19:09 (T-20)	05:50	05:42	
	17:23		18:05	19:42	12 19:21 (T-20)	20:21		20:56	21:16
25	07:54		07:12	07:22	06:27	19:09 (T-20)	05:50	05:42	
	17:25		18:07	19:43	13 19:22 (T-20)	20:22		20:57	21:16
26	07:53		07:11	07:20	06:25	19:10 (T-20)	05:49	05:42	
	17:26		18:08	19:45	13 19:23 (T-20)	20:23		20:58	21:16
27	07:52		07:09	07:18	06:24	19:12 (T-20)	05:48	05:43	
	17:28		18:10	19:46	9 19:21 (T-20)	20:25		20:59	21:16
28	07:51		07:07	07:16	06:22		05:47	05:43	
	17:29		18:11	19:47	20:26		21:00	21:16	
29	07:50			07:14	06:21		05:47	05:44	
	17:30			19:48	20:27		21:01	21:16	
30	07:49			07:13	06:19		05:46	05:44	
	17:32			19:50	20:28		21:02	21:16	
31	07:48			07:11			05:45		
	17:33			19:51			21:03		
Potential sun hours	287	292	369	404	459	465			
Total, worst case	40		86	186					
Sun reduction	0.58		0.59	0.63					
Oper. time red.	0.90		0.90	0.90					
Wind dir. red.	0.62		0.59	0.60					
Total reduction	0.32		0.31	0.34					
Total, real	13		27	63					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-079 - R-079
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	06:48 20:07	19:30 (T-41) 19:10	07:24 17:16	07:43 16:48
2	05:45 21:16	06:13 20:53	06:49 20:05	19:30 (T-41) 19:09	07:25 17:15	07:44 16:48
3	05:46 21:16	06:14 20:52	06:51 20:03	19:31 (T-41) 19:07	07:26 17:14	07:45 16:47
4	05:46 21:16	06:15 20:51	06:52 20:01	19:32 (T-41) 19:05	07:27 17:12	07:46 16:47
5	05:47 21:15	06:17 20:50	06:53 19:59	19:33 (T-41) 19:35 (T-41)	07:29 19:03	07:47 17:11
6	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	07:11 17:10	07:48 16:46
7	05:48 21:15	06:19 20:47	06:55 19:56	07:31 18:58	07:12 17:08	07:49 16:46
8	05:49 21:14	06:20 20:45	06:56 19:54	07:32 18:56	07:13 17:07	07:50 16:46
9	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	07:15 17:06	07:51 16:46
10	05:51 21:14	06:22 20:43	06:59 19:50	07:35 18:52	07:16 17:05	07:52 16:46
11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:50	07:17 17:04	07:53 16:46
12	05:52 21:13	06:25 20:40	07:01 19:46	07:37 18:49	07:19 17:03	07:54 16:46
13	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	07:20 17:01	07:55 16:46
14	05:54 21:11	06:27 20:37	07:04 19:43	07:40 18:45	07:21 17:00	07:56 16:46
15	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:43	07:23 16:59	07:57 16:47
16	05:56 21:10	06:29 20:34	07:06 19:39	19:02 (T-20) 19:10 (T-20)	07:24 18:42	07:57 16:47
17	05:57 21:09	06:31 20:32	07:07 19:37	18:59 (T-20) 19:11 (T-20)	07:44 18:40	07:58 16:57
18	05:57 21:09	06:32 20:30	07:08 19:35	18:57 (T-20) 19:10 (T-20)	07:45 18:38	07:59 16:56
19	05:58 21:08	06:33 20:29	07:09 19:33	18:56 (T-20) 19:09 (T-20)	07:46 18:37	07:59 16:56
20	05:59 21:07	06:34 20:27	07:11 19:31	18:55 (T-20) 19:07 (T-20)	07:48 18:35	08:00 16:55
21	06:00 21:06	06:35 20:26	07:12 19:29	18:54 (T-20) 19:04 (T-20)	07:49 18:33	08:01 16:54
22	06:01 21:05	06:36 20:24	19:41 (T-41) 19:48 (T-41)	07:13 19:27	18:54 (T-20) 19:02 (T-20)	07:50 18:32
23	06:02 21:04	06:38 20:22	19:38 (T-41) 19:51 (T-41)	07:14 19:26	18:54 (T-20) 19:00 (T-20)	07:52 18:30
24	06:03 21:03	06:39 20:21	19:36 (T-41) 19:52 (T-41)	07:15 19:24	18:54 (T-20) 18:58 (T-20)	07:53 18:28
25	06:04 21:02	06:40 20:19	19:34 (T-41) 19:53 (T-41)	07:17 19:22	18:55 (T-20) 18:57 (T-20)	07:54 18:27
26	06:06 21:01	06:41 20:17	19:33 (T-41) 19:52 (T-41)	07:18 19:20	18:57 (T-20) 18:25	07:56 16:50
27	06:07 21:00	06:42 20:15	19:32 (T-41) 19:50 (T-41)	07:19 19:18	18:54 (T-20) 18:24	07:57 16:50
28	06:08 20:59	06:44 20:14	19:32 (T-41) 19:49 (T-41)	07:20 19:16	18:53 (T-20) 18:22	07:58 16:49
29	06:09 20:58	06:45 20:12	19:31 (T-41) 19:47 (T-41)	07:21 19:14	18:52 (T-20) 18:21	07:59 16:49
30	06:10 20:57	06:46 20:10	19:31 (T-41) 19:45 (T-41)	07:23 19:12	18:21 18:19	16:54 16:48
31	06:11 20:56	06:47 20:08	19:30 (T-41) 19:43 (T-41)	07:23 19:12	18:19 18:18	16:48 16:55
Potential sun hours	471	436	377	341	288	275
Total, worst case						400
Sun reduction		152	124			0.52
Oper. time red.		0.72	0.67			0.90
Wind dir. red.		0.90	0.90			0.62
Total reduction		0.60	0.59			0.29
Total, real		0.39	0.36			115

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-080 - R-080
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	07:06 18:12	07:09 19:52	07:29 (T-20) 20:30	06:39 (T-19) 21:04	05:45 21:16	06:12 20:55	06:48 20:07	19:26 (T-15) 19:42 (T-15)	07:24 19:11	07:43 17:17
2	08:04 16:58	07:46 17:36	07:04 18:14	07:07 19:54	07:27 (T-20) 20:31	06:39 (T-19) 21:05	05:44 21:16	06:13 20:54	06:50 20:05	19:27 (T-15) 19:40 (T-15)	07:25 19:09	07:44 17:15
3	08:04 16:58	07:45 17:38	07:02 18:15	07:05 19:55	07:26 (T-20) 20:32	06:39 (T-19) 21:06	05:44 21:16	06:15 20:52	06:51 20:03	19:29 (T-15) 19:39 (T-15)	07:26 19:07	07:45 17:14
4	08:04 16:59	07:43 17:39	07:01 18:17	07:04 19:56	07:24 (T-20) 20:33	06:41 (T-19) 21:07	05:43 21:16	06:16 20:51	06:52 20:01	07:17 (T-20) 19:35 (T-15)	07:28 19:05	07:47 17:13
5	08:04 17:00	07:42 17:40	06:59 18:18	07:02 19:57	07:22 (T-20) 20:35	06:43 (T-19) 21:07	05:43 21:16	06:17 20:50	06:53 19:59	07:15 (T-20) 07:25 (T-20)	07:29 19:03	07:49 17:11
6	08:04 17:01	07:41 17:42	06:57 18:19	07:00 19:59	07:20 (T-20) 20:36	06:52 (T-19) 21:08	05:43 21:15	06:18 20:48	06:54 19:58	07:16 (T-20) 07:25 (T-20)	07:30 19:01	07:11 17:10
7	08:04 17:03	07:40 17:43	06:55 18:21	06:58 20:00	07:18 (T-20) 20:37	06:58 (T-19) 21:09	05:49 21:15	06:19 20:47	06:55 (T-19) 19:56	07:17 (T-20) 07:25 (T-20)	07:31 19:00	07:12 17:09
8	08:04 17:04	07:38 17:45	07:53 18:22	06:56 20:01	07:20 (T-20) 20:38	06:52 (T-19) 21:10	05:49 21:15	06:20 20:46	06:51 (T-19) 19:54	07:18 (T-20) 07:25 (T-20)	07:33 18:56	07:13 17:07
9	08:04 17:05	07:37 17:46	07:52 19:23	06:55 20:02	07:19 (T-15) 20:40	06:52 (T-19) 21:10	05:50 21:14	06:21 20:44	06:50 (T-19) 19:52	07:19 (T-20) 07:25 (T-20)	07:34 18:54	07:15 17:06
10	08:03 17:06	07:36 17:48	07:50 19:24	06:53 20:04	07:19 (T-15) 20:41	06:51 (T-19) 21:11	05:51 21:14	06:23 20:43	06:48 (T-19) 19:50	07:20 (T-20) 07:24 (T-20)	07:35 18:52	07:16 17:05
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	07:17 (T-15) 20:42	06:52 (T-19) 21:11	05:52 21:13	06:24 20:41	06:47 (T-19) 19:48	07:22 (T-20) 07:24 (T-20)	07:36 18:51	07:18 17:04
12	08:03 17:08	07:33 17:50	07:46 19:27	06:49 20:06	07:16 (T-15) 20:43	06:51 (T-19) 21:12	05:52 21:13	06:25 20:40	06:48 (T-19) 19:47	07:21 (T-20) 07:25 (T-20)	07:38 18:49	07:19 17:03
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	07:15 (T-15) 20:44	06:47 (T-19) 21:13	05:53 21:12	06:26 20:38	06:49 (T-19) 19:45	07:03 (T-19) 07:15 (T-19)	07:39 18:47	07:55 17:02
14	08:02 17:11	07:30 17:53	07:43 19:30	06:46 20:09	07:14 (T-15) 20:45	06:46 (T-19) 21:13	05:54 21:12	06:27 20:37	06:50 (T-19) 19:43	07:04 (T-19) 07:15 (T-19)	07:40 18:45	07:22 17:01
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	07:13 (T-15) 20:47	06:45 (T-19) 21:14	05:55 21:11	06:28 20:35	06:51 (T-19) 19:41	07:05 (T-19) 07:15 (T-19)	07:41 18:44	07:23 17:00
16	08:01 17:13	07:27 17:56	07:39 19:32	06:42 20:11	07:12 (T-15) 20:48	06:44 (T-19) 21:14	05:56 21:10	06:30 20:34	06:52 (T-19) 19:39	07:06 (T-19) 07:15 (T-19)	07:43 18:42	07:24 16:59
17	08:00 17:14	07:25 17:57	07:37 19:34	06:41 20:12	07:11 (T-15) 20:49	06:43 (T-19) 21:14	05:57 21:10	06:31 20:32	06:53 (T-19) 19:37	07:07 (T-19) 07:15 (T-19)	07:44 18:40	07:26 16:58
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:14	07:10 (T-15) 20:50	06:42 (T-19) 21:15	05:58 21:09	06:32 20:31	06:55 (T-19) 19:35	07:08 (T-19) 07:15 (T-19)	07:45 18:38	07:27 16:57
19	07:59 17:17	07:22 18:00	07:33 19:36	06:37 20:15	07:09 (T-15) 20:51	06:41 (T-19) 21:15	05:59 21:08	06:33 20:29	06:56 (T-19) 19:33	07:10 (T-19) 07:15 (T-19)	07:47 18:37	07:28 16:56
20	07:58 17:18	07:21 18:00	07:31 19:37	06:35 20:16	07:08 (T-15) 20:52	06:40 (T-19) 21:15	06:00 21:07	06:34 20:27	06:57 (T-19) 19:31	07:11 (T-19) 07:15 (T-19)	07:48 18:35	07:30 16:55
21	07:57 17:20	07:19 18:02	07:30 19:39	06:34 20:17	07:07 (T-15) 20:53	06:39 (T-19) 21:16	06:01 21:06	06:35 20:26	06:58 (T-19) 19:30	07:12 (T-19) 07:15 (T-19)	07:49 18:33	07:31 16:54
22	07:57 17:21	07:17 18:03	07:28 19:40	06:32 20:19	07:06 (T-15) 20:54	06:38 (T-19) 21:16	06:02 21:05	06:37 20:24	06:59 (T-19) 19:28	07:13 (T-19) 07:15 (T-19)	07:51 18:32	07:32 16:53
23	07:56 17:22	07:16 18:04	07:26 19:41	06:30 20:20	07:05 (T-15) 20:55	06:37 (T-19) 21:16	06:03 21:05	06:38 20:22	07:00 (T-19) 19:26	07:14 (T-19) 07:15 (T-19)	07:52 18:30	07:33 16:53
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	07:04 (T-15) 20:56	06:36 (T-19) 21:16	06:04 21:04	06:39 20:21	06:52 (T-19) 19:24	07:16 (T-19) 07:15 (T-19)	07:53 18:29	07:35 16:52
25	07:54 17:25	07:13 18:07	07:22 19:44	06:27 20:22	07:03 (T-15) 20:57	06:35 (T-19) 21:16	06:05 21:03	06:40 20:19	06:55 (T-19) 19:22	07:17 (T-19) 07:15 (T-19)	07:54 18:27	07:36 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:24	07:02 (T-15) 20:58	06:34 (T-19) 21:17	06:06 21:02	06:41 20:17	06:56 (T-19) 19:20	07:18 (T-19) 07:15 (T-19)	07:56 18:26	07:37 16:51
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	07:01 (T-15) 20:59	06:33 (T-19) 21:17	06:07 21:00	06:43 20:16	06:57 (T-19) 19:18	07:19 (T-19) 07:15 (T-19)	07:57 18:24	07:38 16:50
28	07:51 17:29	07:07 18:11	07:17 19:47	06:23 20:26	07:00 (T-15) 21:00	06:32 (T-19) 21:17	06:08 20:59	06:44 20:14	06:58 (T-19) 19:16	07:20 (T-19) 07:15 (T-19)	07:59 18:22	07:40 16:50
29	07:50 17:31	07:05 18:13	07:15 19:42	06:21 20:27	07:00 (T-15) 21:01	06:31 (T-19) 21:17	06:09 20:58	06:45 20:12	06:59 (T-19) 19:14	07:22 (T-19) 07:15 (T-19)	08:00 18:21	07:41 16:49
30	07:49 17:32	07:03 18:00	07:13 19:40	06:19 20:29	07:00 (T-15) 21:02	06:30 (T-19) 21:17	06:10 20:57	06:46 20:10	06:58 (T-19) 19:13	07:23 (T-19) 07:15 (T-19)	08:01 18:20	07:42 16:49
31	07:48 17:33	07:01 18:01	07:11 19:51	06:18 21:03	07:00 (T-15) 21:03	06:29 (T-19) 21:16	06:11 20:56	06:47 20:09	06:59 (T-19) 19:43	07:24 (T-19) 07:15 (T-19)	08:03 18:18	07:43 16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case				674	75			663	98			
Sun reduction				0.63	0.66			0.72	0.67			
Oper. time red.				0.90	0.90			0.90	0.90			
Wind dir. red.				0.59	0.58			0.59	0.59			
Total reduction				0.34	0.35			0.38	0.36			
Total, real				227	26			255	35			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-081 - R-081
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	08:09 (T-42)	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04
	16:57	17:35	31 08:40 (T-42)	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17
2	08:04	07:46	08:08 (T-43)	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05
	16:58	17:36	32 08:40 (T-42)	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15
3	08:04	07:45	08:06 (T-43)	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07
	16:59	17:38	33 08:39 (T-42)	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14
4	08:04	07:43	08:07 (T-43)	07:01	07:04	06:14	05:43	05:47	06:16	06:52	07:28	07:08
	17:00	17:39	31 08:38 (T-42)	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13
5	08:04	07:42	08:12 (T-42)	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09
	17:01	17:40	26 08:38 (T-42)	18:18	19:57	20:35	21:07	21:16	20:50	19:59	19:03	17:11
6	08:04	07:41	08:13 (T-42)	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11
	17:02	17:42	24 08:37 (T-42)	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10
7	08:04	07:40	08:14 (T-42)	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12
	17:03	17:43	22 08:36 (T-42)	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09
8	08:04	07:38	08:16 (T-42)	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13
	17:04	17:45	19 08:35 (T-42)	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:07
9	08:03	07:37	08:17 (T-42)	07:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15
	17:05	17:46	15 08:32 (T-42)	19:23	20:02	20:40	21:10	21:14	20:44	19:52	18:54	17:06
10	08:03	07:36	08:21 (T-42)	07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16
	17:06	17:48	8 08:29 (T-42)	19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05
11	08:03	07:34		07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:18
	17:07	17:49		19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04
12	08:02	07:33		07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19
	17:08	17:50		19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03
13	08:02	07:31		07:44	06:47	06:02	05:41	05:53	06:26	07:03	07:39	07:20
	17:09	17:52		19:28	20:07	20:44	21:13	21:12	20:38	19:45	18:47	17:02
14	08:02	08:25 (T-42)	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22
	17:11	3 08:28 (T-42)	17:53	19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	17:01
15	08:01	08:24 (T-42)	07:28	07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	08:03 (T-44)
	17:12	5 08:29 (T-42)	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00
16	08:01	08:24 (T-42)	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	08:04 (T-44)
	17:13	7 08:31 (T-42)	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	17:01
17	08:00	08:23 (T-42)	07:25	07:37	06:41	05:57	05:41	05:57	06:31	07:07	07:44	08:06 (T-44)
	17:14	9 08:32 (T-42)	17:57	19:34	20:12	20:49	21:14	21:10	20:32	19:37	18:40	17:00
18	07:59	08:22 (T-42)	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	08:07 (T-44)
	17:16	10 08:32 (T-42)	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	17:00
19	07:59	08:22 (T-42)	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	08:08 (T-44)
	17:17	12 08:34 (T-42)	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	17:00
20	07:58	08:21 (T-42)	07:21	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	08:10 (T-44)
	17:18	14 08:35 (T-42)	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	17:00
21	07:57	08:20 (T-42)	07:19	07:30	06:34	05:53	05:41	06:01	06:36	07:12	07:49	08:11 (T-44)
	17:20	16 08:36 (T-42)	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	17:00
22	07:57	08:19 (T-42)	07:17		07:38 (T-44)	07:28	06:32	05:52	05:41	06:02	06:37	07:13
	17:21	17 08:36 (T-42)	18:03	2 07:40 (T-44)	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32
23	07:56	08:18 (T-42)	07:16		07:37 (T-44)	07:26	06:31	05:52	05:42	06:03	06:38	07:14
	17:22	19 08:37 (T-42)	18:04	4 07:41 (T-44)	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30
24	07:55	08:17 (T-42)	07:14		07:35 (T-44)	07:24	06:29	05:51	05:42	06:04	06:39	07:16
	17:24	20 08:37 (T-42)	18:06	5 07:40 (T-44)	19:42	20:21	20:56	21:16	21:04	20:21	19:24	18:29
25	07:54	08:16 (T-42)	07:13		07:33 (T-44)	07:22	06:27	05:50	05:42	06:05	06:40	07:17
	17:25	22 08:38 (T-42)	18:07	7 07:40 (T-44)	19:44	20:22	20:57	21:16	21:03	20:19	19:22	18:27
26	07:53	08:15 (T-42)	07:11		07:32 (T-44)	07:20	06:26	05:49	05:43	06:06	06:41	07:18
	17:26	23 08:38 (T-42)	18:08	8 07:40 (T-44)	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26
27	07:52	08:14 (T-42)	07:09		07:30 (T-44)	07:18	06:24	05:48	05:43	06:07	06:43	07:19
	17:28	25 08:39 (T-42)	18:10	8 07:38 (T-44)	19:46	20:25	20:59	21:17	21:00	20:16	19:18	18:24
28	07:51	08:13 (T-42)	07:07		07:28 (T-44)	07:17	06:23	05:48	05:43	06:08	06:44	07:20
	17:29	26 08:39 (T-42)	18:11	8 07:36 (T-44)	19:47	20:26	21:00	21:17	20:59	20:14	19:16	18:23
29	07:50	08:12 (T-42)			07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00
	17:31	27 08:39 (T-42)			19:49	20:27	21:01	21:17	20:58	20:12	19:14	18:21
30	07:49	08:11 (T-42)			07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01
	17:32	29 08:40 (T-42)			19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20
31	07:48	08:10 (T-42)			07:11		05:46		06:11	06:47		08:03
	17:33	30 08:40 (T-42)			19:51	21:03			20:56	20:09		18:18
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275
Total, worst case	314	283								44	561	
Sun reduction	0.58	0.58								0.56	0.48	
Oper. time red.	0.90	0.90								0.90	0.90	
Wind dir. red.	0.65	0.64								0.61	0.65	
Total reduction	0.34	0.33								0.31	0.28	
Total, real	106	95								14	157	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-082 - R-082

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December					
1	08:04	08:29 (T-42)	07:47	08:37 (T-42)	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:17	16:48	28	08:09 (T-42)
2	08:04	08:29 (T-42)	07:46	08:43 (T-42)	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05	07:44	16:48	27	08:10 (T-42)
3	08:04	08:29 (T-42)	07:45	08:44 (T-42)	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05	07:44	16:48	27	08:11 (T-42)
4	08:04	08:29 (T-42)	07:43		07:01	07:04	06:14	05:43	05:47	06:16	06:52	07:28	07:08	07:47	16:48	26	08:12 (T-42)
5	08:04	08:28 (T-42)	07:42		07:01	07:04	06:14	05:43	05:47	06:16	06:52	07:28	07:08	07:47	16:48	25	08:13 (T-42)
6	08:04	08:28 (T-42)	07:41		06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49	16:47	24	08:14 (T-42)
7	08:04	08:28 (T-42)	07:40		06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:10	07:48	16:47	24	08:15 (T-42)
8	08:04	08:28 (T-42)	07:38		06:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:51	16:47	23	08:16 (T-42)
9	08:03	08:27 (T-42)	07:37		06:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15	07:53	16:46	22	08:17 (T-42)
10	08:03	08:27 (T-42)	07:36		06:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16	07:54	16:46	21	08:18 (T-42)
11	08:03	08:27 (T-42)	07:34		06:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:18	07:56	16:46	20	08:19 (T-42)
12	08:02	08:26 (T-42)	07:33		06:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19	07:57	16:46	19	08:20 (T-42)
13	08:02	08:26 (T-42)	07:31		06:44	06:47	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:58	16:46	18	08:21 (T-42)
14	08:02	08:25 (T-42)	07:30		06:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:60	16:46	18	08:22 (T-42)
15	08:01	08:24 (T-42)	07:28		06:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:23	07:61	16:46	17	08:23 (T-42)
16	08:01	08:24 (T-42)	07:27		06:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:62	16:46	17	08:24 (T-42)
17	08:00	08:23 (T-42)	07:25		06:37	06:41	06:05	05:41	05:57	06:31	07:07	07:44	07:26	07:63	16:46	17	08:25 (T-42)
18	07:59	08:22 (T-42)	07:24		06:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:64	16:46	16	08:26 (T-42)
19	07:59	08:22 (T-42)	07:22		06:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28	07:65	16:46	16	08:27 (T-42)
20	07:58	08:21 (T-42)	07:21		06:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:30	07:66	16:46	15	08:28 (T-42)
21	07:57	08:20 (T-42)	07:19		06:29	06:33	05:53	05:41	06:01	06:35	07:12	07:49	07:31	07:67	16:46	15	08:29 (T-42)
22	07:56	08:19 (T-42)	07:17		06:27	06:31	05:52	05:41	06:02	06:36	07:13	07:50	07:32	07:68	16:46	14	08:30 (T-42)
23	07:56	08:18 (T-42)	07:16		06:25	06:29	05:51	05:41	06:03	06:37	07:14	07:51	07:33	07:69	16:46	14	08:31 (T-42)
24	07:55	08:17 (T-42)	07:14		06:23	06:27	05:50	05:41	06:04	06:38	07:15	07:52	07:34	07:70	16:46	13	08:32 (T-42)
25	07:54	08:16 (T-42)	07:13		06:21	06:25	05:49	05:41	06:05	06:39	07:16	07:53	07:35	07:71	16:46	13	08:33 (T-42)
26	07:53	08:15 (T-42)	07:11		06:19	06:23	05:48	05:41	06:06	06:40	07:17	07:54	07:36	07:72	16:46	12	08:34 (T-42)
27	07:52	08:14 (T-42)	07:09		06:17	06:21	05:47	05:41	06:07	06:41	07:18	07:55	07:37	07:73	16:46	12	08:35 (T-42)
28	07:51	08:13 (T-42)	07:07		06:15	06:19	05:46	05:41	06:08	06:42	07:19	07:56	07:38	07:74	16:46	11	08:36 (T-42)
29	07:50	08:12 (T-42)	07:05		06:13	06:17	05:45	05:41	06:09	06:43	07:20	07:57	07:39	07:75	16:46	11	08:37 (T-42)
30	07:49	08:11 (T-42)	07:03		06:11	06:15	05:44	05:41	06:10	06:44	07:21	07:58	07:40	07:76	16:46	10	08:38 (T-42)
31	07:48	08:10 (T-42)	07:01		06:09	06:13	05:43	05:41	06:11	06:45	07:22	07:59	07:41	07:77	16:46	10	08:39 (T-42)
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275	61	716	600	600	600
Total, worst case	955	74	58	58	58	58	58	58	58	58	58	58	58	58	58	58	58
Sun reduction	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Wind dir. red.	0.65	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Total reduction	0.34	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Total, real	325	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-084 - R-084
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:00	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:01	17:40	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:07	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:03	16:47
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:01	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	08:24 (T-53)	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24
	17:13	1	08:25 (T-53)	17:56	19:32	20:11	20:48	21:14	20:34	19:39	18:42	16:59
17	08:00	08:23 (T-53)	07:25	07:37	06:41	05:57	05:41	05:57	06:31	07:07	07:44	07:25
	17:14	2	08:25 (T-53)	17:57	19:33	20:12	20:49	21:14	20:32	19:37	18:40	16:58
18	07:59	08:22 (T-53)	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27
	17:16	3	08:25 (T-53)	17:59	19:35	20:14	20:50	21:15	20:30	19:35	18:38	16:57
19	07:59	08:22 (T-53)	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:46	07:28
	17:17	4	08:26 (T-53)	18:00	19:36	20:15	20:51	21:15	20:29	19:33	18:37	16:56
20	07:58	08:21 (T-53)	07:21	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29
	17:18	5	08:26 (T-53)	18:00	19:37	20:16	20:52	21:15	20:27	19:31	18:35	16:55
21	07:57	08:20 (T-53)	07:19	07:30	06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31
	17:20	5	08:25 (T-53)	18:02	19:39	20:17	20:53	21:16	20:26	19:29	18:33	16:54
22	07:56	08:19 (T-53)	07:17	07:28	06:32	05:52	05:42	06:02	06:37	07:13	07:50	07:32
	17:21	5	08:24 (T-53)	18:03	19:40	20:19	20:54	21:16	20:24	19:28	18:32	16:53
23	07:56	08:18 (T-53)	07:16	07:26	06:30	05:52	05:42	06:03	06:38	07:14	07:52	07:33
	17:22	5	08:23 (T-53)	18:04	19:41	20:20	20:55	21:16	20:22	19:26	18:30	16:53
24	07:55	08:19 (T-53)	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35
	17:24	1	08:20 (T-53)	18:06	19:42	20:21	20:56	21:16	20:21	19:24	18:29	16:52
25	07:54	08:20 (T-53)	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36
	17:25		18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:02 (T-53)
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	1
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03 (T-53)
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	05:48	05:43	06:08	06:44	07:20	07:58	07:39	08:03 (T-53)
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50	07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	07:41	08:04 (T-53)
	17:31	19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:49	16:54
30	07:49	07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42	07:42	08:04 (T-53)
	17:32	19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:49	16:55
31	07:48	07:11	06:17	05:46	05:46	06:11	06:47	07:24	08:02	07:42	07:42	08:04 (T-53)
	17:33	19:51	21:03	21:03	20:56	20:56	20:08	18:18	18:18	16:49	16:49	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case	31											
Sun reduction	0.58											0.48
Oper. time red.	0.90											0.90
Wind dir. red.	0.65											0.65
Total reduction	0.34											0.28
Total, real	10											9

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-085 - R-085
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:45 (T-52)	07:04	07:43	
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	9 07:54 (T-52)	17:17	16:48	
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:46 (T-52)	07:05	07:44	
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	8 07:54 (T-52)	17:15	16:48	
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:47 (T-52)	07:07	07:45	
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	7 07:54 (T-52)	17:14	16:48	
4	08:04	07:43	07:00	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:49 (T-52)	07:08	07:46	
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	6 07:55 (T-52)	17:13	16:47	
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:49 (T-52)	07:09	07:47	
	17:01	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	4 07:54 (T-52)	17:11	16:47	
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:51 (T-52)	07:11	07:48	
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	2 07:53 (T-52)	17:10	16:47	
7	08:04	07:39	06:55	07:16 (T-52)	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:49	
	17:03	17:43	18:21	1 07:17 (T-52)	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47	
8	08:04	07:38	07:53	08:14 (T-52)	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:50	
	17:04	17:45	18:22	3 08:17 (T-52)	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:08	16:47	
9	08:03	07:37	07:52	08:12 (T-52)	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:51	
	17:05	17:46	19:23	5 08:17 (T-52)	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47	
10	08:03	07:35	07:50	08:10 (T-52)	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52	
	17:06	17:48	19:24	7 08:17 (T-52)	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:46	
11	08:03	07:34	07:48	08:08 (T-52)	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53	
	17:07	17:49	19:26	8 08:16 (T-52)	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47	
12	08:02	07:33	07:46	08:07 (T-52)	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54	
	17:08	17:50	19:27	9 08:16 (T-52)	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:03	16:47	
13	08:02	07:31	07:44	08:05 (T-52)	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55	
	17:10	17:52	19:28	10 08:15 (T-52)	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47	
14	08:01	07:30	07:43	08:03 (T-52)	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56	
	17:11	17:53	19:30	9 08:12 (T-52)	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47	
15	08:01	07:28	07:41	08:05 (T-52)	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57	
	17:12	17:55	19:31	3 08:08 (T-52)	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47	
16	08:00	07:27	07:39		06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57	
	17:13	17:56	19:32		20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47	
17	08:00	07:25	07:37		06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58	
	17:14	17:57	19:34		20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48	
18	07:59	07:24	07:35		06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:59	
	17:16	17:59	19:35		20:14	20:50	21:15	21:09	20:30	19:35	18:39	16:57	16:48	
19	07:59	07:22	07:33		06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28	07:59	
	17:17	18:00	19:36		20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48	
20	07:58	07:21	07:31		06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00	
	17:18	18:00	19:37		20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49	
21	07:57	07:19	07:30		06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31	08:00	
	17:20	18:02	19:39		20:17	20:53	21:16	21:06	20:26	19:29	18:34	16:54	16:49	
22	07:56	07:17	07:28		06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01	
	17:21	18:03	19:40		20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:53	16:50	
23	07:56	07:16	07:26		06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02	
	17:22	18:04	19:41		20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50	
24	07:55	07:14	07:24		06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02	
	17:24	18:06	19:42		20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51	
25	07:54	07:12	07:22		06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	08:02	
	17:25	18:07	19:44		20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51	
26	07:53	07:11	07:20		06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:03	
	17:26	18:08	19:45		20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52	
27	07:52	07:09	07:18		06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03	
	17:28	18:10	19:46		20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53	
28	07:51	07:07	07:17		06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03	
	17:29	18:11	19:47		20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53	
29	07:50		07:15		06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04	
	17:31		19:49		20:27	21:01	21:16	20:58	20:12	19:14	8 07:52 (T-52)	18:21	16:49	16:54
30	07:49		07:13		06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04	
	17:32		19:50		20:28	21:02	21:16	20:57	20:10	19:13	10 07:54 (T-52)	18:20	16:49	16:55
31	07:48		07:11			05:46		06:11	06:47		08:02		08:04	
	17:33		19:51			21:03		20:56	20:08		18:18		16:56	
Potential sun hours	287	292	369	403	458	465	471	436	377	341		289	275	
Total, worst case			55						18		36			
Sun reduction			0.59						0.67		0.56			
Oper. time red.			0.90						0.90		0.90			
Wind dir. red.			0.60						0.60		0.60			
Total reduction			0.32						0.36		0.30			
Total, real			17					6			11			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
 Invenergy Deuel Harvest Wind in Deuel County, SD
 Greenhouse Shadow Flicker Study
 Project Turbines Only
 L085 73 GE3.8-154 WTGs on 98m HH
 June 14, 2024

Licensed user:
 Stantec Consulting Services Inc.
 1165 Scheuring Road
 US-DE PERE WI 54115
 920 278 3215
 Christiana Jansen / christiana.jansen@stantec.com
 Calculated:
 6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
 Assumptions for shadow calculations

Shadow receptor: R-086 - R-086

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January			February			March			April			May			June			July			August			September			October			November			December		
	1	08:04	07:47	07:06	19:52	17:35	18:12	07:09	07:29 (T-52)	06:18	05:45	05:45	06:12	06:48	07:10 (T-53)	07:24	07:04	07:17	07:43	07:09	07:37 (T-52)	20:30	21:04	21:16	20:55	20:07	34	07:44 (T-52)	19:11	17:17	16:48					
31	07:48	07:11	07:00	07:11	07:11	07:00	20:28	21:02	21:16	21:16	21:16	20:57	20:08	20:08	20:12	18:20	16:49	16:55	18:29	18:29	20:12	21:03	20:56	20:08	36	37	07:45 (T-52)	18:18	18:18	16:56						
Potential sun hours	287			292			369			403			458			465			471			436			377			341			289			275		
Total, worst case						3		764					515		260			125					0.72		0.67								0.52			
Sun reduction						0.59		0.63					0.72		0.67			0.52					0.90		0.90								0.90			
Oper. time red.						0.90		0.90					0.90		0.90			0.90					0.58		0.58								0.61			
Wind dir. red.						0.58		0.58					0.58		0.58			0.61					0.37		0.35								0.28			
Total reduction						0.31		0.33					0.37		0.35			0.28					0.193		0.91								0.36			
Total, real						1		250					193		91			36																		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-087 - R-087

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	08:31 (T-58)	07:47	07:06	07:09	06:18
	16:57	30 16:29 (T-54)	17:35	18:12	19:52	9 06:48 (T-53)
2	08:04	08:32 (T-58)	07:46	07:04	07:07	06:17
	16:58	29 16:30 (T-54)	17:36	18:14	19:54	9 06:47 (T-52)
3	08:04	08:32 (T-58)	07:44	07:02	07:05	06:15
	16:59	29 16:30 (T-54)	17:38	18:15	19:55	11 06:47 (T-52)
4	08:04	08:32 (T-58)	07:43	07:00	07:04	06:14
	17:00	29 16:31 (T-54)	17:39	18:17	19:56	13 06:35 (T-52)
5	08:04	08:33 (T-58)	07:42	06:59	07:02	06:12
	17:01	30 16:32 (T-54)	17:41	18:18	19:57	15 06:48 (T-52)
6	08:04	08:35 (T-58)	07:41	06:57	07:00	06:11
	17:02	28 16:33 (T-54)	17:42	18:19	19:59	17 06:32 (T-52)
7	08:04	08:36 (T-58)	07:39	06:55	06:58	06:10
	17:03	28 16:35 (T-54)	17:43	18:20	20:00	19 06:31 (T-52)
8	08:03	08:36 (T-58)	07:38	07:53	06:56	06:08
	17:04	27 16:35 (T-54)	17:45	18:22	20:01	19 06:50 (T-52)
9	08:03	08:38 (T-58)	07:37	07:52	06:55	06:07
	17:05	26 16:37 (T-54)	17:46	19:23	20:02	21 06:29 (T-52)
10	08:03	08:40 (T-58)	07:35	07:50	06:53	06:06
	17:06	23 16:38 (T-54)	17:48	19:24	20:04	23 06:27 (T-52)
11	08:03	08:42 (T-58)	07:34	07:48	06:51	06:04
	17:07	20 16:39 (T-54)	17:49	19:26	20:05	24 06:26 (T-52)
12	08:02	16:27 (T-54)	07:33	07:46	06:49	06:03
	17:08	14 16:41 (T-54)	17:50	19:27	20:06	25 06:25 (T-52)
13	08:02	16:27 (T-54)	07:31	07:44	06:47	06:02
	17:10	14 16:41 (T-54)	17:52	19:28	20:07	26 06:24 (T-52)
14	08:01	16:29 (T-54)	07:30	07:42	06:46	06:01
	17:11	12 16:41 (T-54)	17:53	19:30	20:09	27 06:23 (T-52)
15	08:01	16:30 (T-54)	07:28	07:41	06:44	06:00
	17:12	10 16:40 (T-54)	17:55	19:31	20:10	27 06:50 (T-52)
16	08:00	16:33 (T-54)	07:27	07:39	06:42	05:59
	17:13	6 16:39 (T-54)	17:56	19:32	20:11	28 06:21 (T-52)
17	08:00		07:25	07:37	06:41	05:57
	17:14		17:57	19:33	20:12	28 06:21 (T-52)
18	07:59		07:24	07:35	06:39	05:56
	17:16		17:59	19:35	20:14	27 06:49 (T-52)
19	07:58		07:22	07:33	06:37	05:55
	17:17		18:00	19:36	20:15	27 06:22 (T-52)
20	07:58		07:21	07:31	06:35	05:54
	17:18		18:00	19:37	20:16	26 06:48 (T-52)
21	07:57		07:19	07:30	06:34	05:53
	17:20		18:02	19:39	20:17	25 06:47 (T-52)
22	07:56		07:17	07:28	06:32	05:53
	17:21		18:03	19:40	20:18	23 06:46 (T-52)
23	07:55		07:16	07:26	06:31	05:52
	17:22		18:04	19:41	20:20	22 06:24 (T-52)
24	07:55		07:14	07:24	06:29	05:51
	17:24		18:06	19:42	20:21	21 06:45 (T-52)
25	07:54		07:12	07:22	06:27	05:50
	17:25		18:07	19:44	20:22	18 06:26 (T-52)
26	07:53		07:11	07:20	06:26	05:49
	17:26		18:08	19:45	20:23	16 06:43 (T-52)
27	07:52		07:09	07:18	06:24	05:48
	17:28		18:10	19:46	20:25	14 06:42 (T-52)
28	07:51		07:07	07:17	06:23	05:48
	17:29		18:11	19:47	20:26	10 06:30 (T-52)
29	07:50			07:15	06:21	05:47
	17:31			19:49	20:27	3 06:37 (T-52)
30	07:49			07:13	06:20	05:46
	17:32			19:50	20:28	11 06:53 (T-53)
31	07:48			07:11		05:46
	17:33			19:51		21:02
Potential sun hours	287	292	369	403	458	465
Total, worst case	355			86		548
Sun reduction	0.58			0.63		0.66
Oper. time red.	0.90			0.90		0.90
Wind dir. red.	0.63			0.58		0.59
Total reduction	0.33			0.33		0.35
Total, real	118			29		193

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-087 - R-087
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:12	06:36 (T-52)	06:48	07:24	07:04
	21:16	20:55	25 07:01 (T-52)	20:07	19:11	17:17
2	05:46	06:14	06:37 (T-52)	06:50	07:25	07:05
	21:16	20:53	23 07:00 (T-52)	20:05	19:09	17:15
3	05:46	06:15	06:38 (T-52)	06:51	07:26	07:06
	21:16	20:52	22 07:00 (T-52)	20:03	19:07	17:14
4	05:47	06:16	06:39 (T-52)	06:52	07:28	07:08
	21:16	20:51	21 07:00 (T-52)	20:01	19:05	17:13
5	05:47	06:17	06:40 (T-52)	06:53	07:29	07:09
	21:15	20:50	20 07:00 (T-52)	19:59	19:03	17:11
6	05:48	06:18	06:41 (T-52)	06:54	07:30	07:11
	21:15	20:48	18 06:59 (T-52)	19:58	19:01	17:10
7	05:49	06:19	06:42 (T-52)	06:55	07:31	07:12
	21:15	20:47	16 06:58 (T-52)	19:56	19:00	17:09
8	05:49	06:20	06:43 (T-52)	06:57	07:32	07:13
	21:14	20:45	15 06:58 (T-52)	19:54	18:56	17:07
9	05:50	06:22	06:45 (T-52)	06:58	07:34	07:15
	21:14	20:44	13 06:58 (T-52)	19:52	18:54	17:06
10	05:51	06:23	06:46 (T-52)	06:59	07:35	07:16
	21:13	20:43	11 06:57 (T-52)	19:50	18:52	17:05
11	05:52	06:24	06:47 (T-52)	07:00	07:36	07:17
	21:13	20:41	8 06:55 (T-52)	19:48	18:51	17:04
12	05:53	06:25	06:48 (T-52)	07:01	07:38	07:19
	21:12	20:40	10 06:58 (T-53)	19:46	18:49	17:03
13	05:53	06:26	06:49 (T-53)	07:03	07:39	07:20
	21:12	20:38	11 07:00 (T-53)	19:45	18:47	17:02
14	05:54	06:27	06:50 (T-53)	07:04	07:40	07:21
	21:11	20:37	11 07:01 (T-53)	19:43	18:45	17:01
15	05:55	06:28	06:51 (T-53)	07:05	07:41	07:23
	21:11	20:35	11 07:02 (T-53)	19:41	18:44	17:00
16	05:56	06:41 (T-52)	06:30	06:52 (T-53)	07:06	07:43
	21:10	7 06:48 (T-52)	20:34	11 07:03 (T-53)	19:39	18:42
17	05:57	06:39 (T-52)	06:31	06:53 (T-53)	07:07	07:44
	21:09	11 06:50 (T-52)	20:32	10 07:03 (T-53)	19:37	18:40
18	05:58	06:37 (T-52)	06:32	06:55 (T-53)	07:08	07:45
	21:09	15 06:52 (T-52)	20:30	9 07:04 (T-53)	19:35	18:38
19	05:59	06:36 (T-52)	06:33	06:56 (T-53)	07:10	07:46
	21:08	17 06:53 (T-52)	20:29	7 07:03 (T-53)	19:33	18:37
20	06:00	06:35 (T-52)	06:34	06:57 (T-53)	07:11	07:48
	21:07	20 06:55 (T-52)	20:27	6 07:03 (T-53)	19:31	18:35
21	06:01	06:35 (T-52)	06:36	06:58 (T-53)	07:12	07:49
	21:06	21 06:56 (T-52)	20:26	4 07:02 (T-53)	19:29	18:34
22	06:02	06:34 (T-52)	06:37	06:59 (T-53)	07:13	07:50
	21:05	23 06:57 (T-52)	20:24	3 07:02 (T-53)	19:28	18:32
23	06:03	06:33 (T-52)	06:38		07:14	07:52
	21:04	24 06:57 (T-52)	20:22		19:26	18:30
24	06:04	06:33 (T-52)	06:39		07:15	07:53
	21:03	25 06:58 (T-52)	20:21		19:24	18:29
25	06:05	06:32 (T-52)	06:40		07:17	07:54
	21:02	27 06:59 (T-52)	20:19		19:22	18:27
26	06:06	06:32 (T-52)	06:41		07:18	07:56
	21:01	27 06:59 (T-52)	20:17		19:20	18:26
27	06:07	06:31 (T-52)	06:43		07:19	07:57
	21:00	29 07:00 (T-52)	20:15		19:18	18:24
28	06:08	06:32 (T-52)	06:44		07:20	07:58
	20:59	28 07:00 (T-52)	20:14		19:16	18:23
29	06:09	06:33 (T-52)	06:45		07:21	08:00
	20:58	27 07:00 (T-52)	20:12		19:14	18:21
30	06:10	06:34 (T-52)	06:46		07:23	08:01
	20:57	26 07:00 (T-52)	20:10		19:13	18:20
31	06:11	06:35 (T-52)	06:47			08:02
	20:56	26 07:01 (T-52)	20:08			18:18
Potential sun hours	471	436		377	341	289
Total, worst case	353	285			56	869
Sun reduction	0.75	0.72			0.48	0.52
Oper. time red.	0.90	0.90			0.90	0.90
Wind dir. red.	0.59	0.59			0.60	0.65
Total reduction	0.40	0.38			0.26	0.30
Total, real	141	109			15	264

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-088 - R-088
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum		
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	08:29 (T-57)	07:47	08:09 (T-77)	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:43
1	16:57	08:44 (T-57)	17:35	17:09 (T-89)	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	08:29 (T-57)	07:46	08:07 (T-77)	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
2	16:58	08:45 (T-57)	17:36	17:10 (T-89)	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	08:29 (T-57)	07:44	08:06 (T-77)	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45
3	16:59	08:45 (T-57)	17:38	17:12 (T-89)	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	08:28 (T-57)	07:43	08:07 (T-77)	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
4	17:00	08:44 (T-57)	17:39	17:14 (T-89)	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	08:29 (T-57)	07:42	17:04 (T-89)	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
5	17:01	08:44 (T-57)	17:41	17:13 (T-89)	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	08:30 (T-57)	07:41	17:07 (T-89)	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
6	17:02	08:44 (T-57)	17:42	17:09 (T-89)	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10	16:47
7	08:04	08:31 (T-57)	07:39		06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:49
7	17:03	08:44 (T-57)	17:43		18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	08:33 (T-57)	07:38		07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:50
8	17:04	08:44 (T-57)	17:45		18:22	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:08	16:47
9	08:03	08:33 (T-57)	07:37		07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:51
9	17:05	08:43 (T-57)	17:46		19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	08:36 (T-57)	07:35		07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
10	17:06	08:42 (T-57)	17:48		19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:47
11	08:03		07:34		07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:17	07:53
11	17:07		17:49		19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02		07:33		07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54
12	17:08		17:50		19:27	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:03	16:47
13	08:02		07:31		07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55
13	17:10		17:52		19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:01		07:30		07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
14	17:11		17:53		19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01		07:28		07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
15	17:12		17:55		19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00		07:27		07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
16	17:13		17:56		19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00		07:25		07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58
17	17:15		17:58		19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59		07:24		07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:59
18	17:16		17:59		19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59		07:22		07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28	07:59
19	17:17		18:00		19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58		07:21		07:31	06:36	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
20	17:18		18:00		19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57		07:19		07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01
21	17:20		18:02		19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56		07:17		07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
22	17:21		18:03		19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56		07:16		07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02
23	17:22		18:04		19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55		07:14		07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
24	17:24		18:06		19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54		08:16 (T-77)		07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	08:02
25	17:25		18:07		19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53		08:15 (T-77)		07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:03
26	17:27		17:00 (T-89)		19:45	20:24	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52		08:14 (T-77)		07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03
27	17:28		17:01 (T-89)		19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51		08:13 (T-77)		07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
28	17:29		17:03 (T-89)		19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		08:12 (T-77)		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
29	17:31		17:04 (T-89)		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		08:11 (T-77)		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
30	17:32		17:06 (T-89)		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		08:10 (T-77)		07:11		05:46		06:11	06:47		08:02		08:04
31	17:33		17:08 (T-89)		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	153	275	419
Total, worst case	196	91										153		419
Sun reduction	0.58	0.58										0.48		0.52
Oper. time red.	0.90	0.90										0.90		0.90
Wind dir. red.	0.65	0.61										0.61		0.66
Total reduction	0.34	0.32										0.27		0.31
Total, real	66	29										41		130

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-089 - R-089

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-57)	07:47	08:09 (T-77)	07:06	07:09
	16:57	27 08:56 (T-57)	17:35	8 08:17 (T-77)	18:13	19:52
2	08:04	08:30 (T-57)	07:46	08:07 (T-77)	07:04	07:07
	16:58	27 08:57 (T-57)	17:36	9 08:16 (T-77)	18:14	19:54
3	08:04	08:30 (T-57)	07:44	08:06 (T-77)	07:02	07:06
	16:59	27 08:57 (T-57)	17:38	11 08:17 (T-77)	18:15	19:55
4	08:04	08:30 (T-57)	07:43	08:05 (T-77)	07:00	07:04
	17:00	26 08:56 (T-57)	17:39	13 08:18 (T-77)	18:17	19:56
5	08:04	08:31 (T-57)	07:42	08:04 (T-77)	06:59	07:02
	17:01	26 08:57 (T-57)	17:41	14 08:18 (T-77)	18:18	19:57
6	08:04	08:32 (T-57)	07:41	08:02 (T-77)	06:57	07:00
	17:02	25 08:57 (T-57)	17:42	15 08:17 (T-77)	18:19	19:59
7	08:04	08:33 (T-57)	07:39	08:01 (T-77)	06:55	06:58
	17:03	25 08:58 (T-57)	17:43	16 08:17 (T-77)	18:21	20:00
8	08:04	08:33 (T-57)	07:38	08:00 (T-77)	07:53	06:56
	17:04	24 08:57 (T-57)	17:45	17 08:17 (T-77)	18:22	20:01
9	08:03	08:34 (T-57)	07:37	07:58 (T-77)	07:52	06:55
	17:05	23 08:57 (T-57)	17:46	18 08:16 (T-77)	19:23	20:02
10	08:03	08:35 (T-57)	07:35	07:59 (T-77)	07:50	06:53
	17:06	22 08:57 (T-57)	17:48	17 08:16 (T-77)	19:24	20:04
11	08:03	08:36 (T-57)	07:34	07:55 (T-58)	07:48	06:51
	17:07	21 08:57 (T-57)	17:49	15 08:14 (T-77)	19:26	20:05
12	08:02	08:37 (T-57)	07:33	07:54 (T-58)	07:46	06:49
	17:08	20 08:57 (T-57)	17:50	13 08:12 (T-77)	19:27	20:06
13	08:02	08:38 (T-57)	07:31	07:52 (T-58)	07:44	06:48
	17:10	18 08:56 (T-57)	17:52	4 07:56 (T-58)	19:28	20:07
14	08:01	08:40 (T-57)	07:30	07:51 (T-58)	07:43	06:46
	17:11	16 08:56 (T-57)	17:53	5 07:56 (T-58)	19:30	20:09
15	08:01	08:41 (T-57)	07:28	07:49 (T-58)	07:41	06:44
	17:12	13 08:54 (T-57)	17:55	6 07:55 (T-58)	19:31	20:10
16	08:00	08:44 (T-57)	07:27	07:48 (T-58)	07:39	06:42
	17:13	9 08:53 (T-57)	17:56	7 07:55 (T-58)	19:32	20:11
17	08:00		07:25	07:46 (T-58)	07:37	06:41
	17:15		17:57	7 07:53 (T-58)	19:34	20:12
18	07:59		07:24	07:48 (T-58)	07:35	06:39
	17:16		17:59	3 07:51 (T-58)	19:35	20:14
19	07:59		07:22		07:33	06:37
	17:17		18:00		19:36	20:15
20	07:58		07:21		07:31	06:36
	17:18		18:00		19:37	20:16
21	07:57		07:19		07:30	06:34
	17:20		18:02		19:39	20:17
22	07:56		07:17		07:28	06:32
	17:21		18:03		19:40	20:19
23	07:56		07:16		07:26	06:31
	17:22		18:04		19:41	20:20
24	07:55		07:14		07:24	06:29
	17:24		18:06		19:42	20:21
25	07:54		07:12		07:22	06:27
	17:25		18:07		19:44	20:22
26	07:53		07:11		07:20	06:26
	17:27		18:08		19:45	20:23
27	07:52		07:09		07:18	06:24
	17:28		18:10		19:46	20:25
28	07:51		07:07		07:17	06:23
	17:29		18:11		19:47	20:26
29	07:50	08:12 (T-77)			07:15	06:21
	17:31	1 08:13 (T-77)			19:49	20:27
30	07:49	08:11 (T-77)			07:13	06:20
	17:32	4 08:15 (T-77)			19:50	20:28
31	07:48	08:10 (T-77)			07:11	06:19
	17:33	6 08:16 (T-77)			19:51	20:29
Potential sun hours	287	292	369	403	458	465
Total, worst case	360	198		51		
Sun reduction	0.58	0.58		0.63		
Oper. time red.	0.90	0.90		0.90		
Wind dir. red.	0.66	0.64		0.58		
Total reduction	0.35	0.33		0.33		
Total, real	125	66		17		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-089 - R-089

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December				
1	05:45	06:12	06:49	07:24	07:04	07:28 (T-77) 07:43	08:18 (T-57)			
	21:16	20:55	20:07	19:11	17:17	17:45 (T-77) 16:48	21 08:39 (T-57)			
2	05:46	06:14	06:50	07:25	07:05	07:28 (T-77) 07:44	08:18 (T-57)			
	21:16	20:53	20:05	19:09	17:15	17:46 (T-77) 16:48	22 08:40 (T-57)			
3	05:46	06:15	06:51	07:26	07:06	07:29 (T-77) 07:45	08:18 (T-57)			
	21:16	20:52	20:03	19:07	17:14	17:46 (T-77) 16:48	23 08:41 (T-57)			
4	05:47	06:16	06:52	07:28	07:08	07:31 (T-77) 07:46	08:18 (T-57)			
	21:16	20:51	20:01	19:05	17:13	17:47 (T-77) 16:47	24 08:42 (T-57)			
5	05:47	06:17	06:53	07:29	07:09	07:32 (T-77) 07:47	08:18 (T-57)			
	21:15	20:50	19:59	19:03	17:11	17:47 (T-77) 16:47	25 08:43 (T-57)			
6	05:48	06:18	06:54	07:30	07:11	07:34 (T-77) 07:48	08:18 (T-57)			
	21:15	20:48	19:58	19:01	17:10	17:48 (T-77) 16:47	25 08:43 (T-57)			
7	05:49	06:19	06:56	07:31	07:12	07:35 (T-77) 07:49	08:18 (T-57)			
	21:15	20:47	19:56	19:00	17:09	17:47 (T-77) 16:47	26 08:44 (T-57)			
8	05:49	06:20	06:57	07:33	07:13	07:37 (T-77) 07:50	08:18 (T-57)			
	21:14	20:45	19:54	18:56	17:08	17:48 (T-77) 16:47	26 08:44 (T-57)			
9	05:50	06:22	06:58	07:34	07:15	07:38 (T-77) 07:51	08:18 (T-57)			
	21:14	20:44	19:52	18:54	17:06	17:47 (T-77) 16:47	27 08:45 (T-57)			
10	05:51	06:23	06:59	07:35	07:16	07:40 (T-77) 07:52	08:19 (T-57)			
	21:14	20:43	19:50	18:52	17:05	17:47 (T-77) 16:47	27 08:46 (T-57)			
11	05:52	06:24	07:00	07:36	07:17	07:41 (T-77) 07:53	08:19 (T-57)			
	21:13	20:41	19:48	18:51	17:04	17:47 (T-77) 16:47	27 08:46 (T-57)			
12	05:53	06:25	07:01	07:38	07:19	07:43 (T-77) 07:54	08:20 (T-57)			
	21:13	20:40	19:46	18:49	17:03	17:46 (T-77) 16:47	27 08:47 (T-57)			
13	05:53	06:26	07:03	07:39	07:20	07:44 (T-77) 07:55	08:21 (T-57)			
	21:12	20:38	19:45	18:47	17:02	1 07:45 (T-77) 16:47	27 08:48 (T-57)			
14	05:54	06:27	07:04	07:40	07:21	07:46 (T-77) 07:56	08:21 (T-57)			
	21:11	20:37	19:43	18:45	17:01	16:47	27 08:48 (T-57)			
15	05:55	06:29	06:53 (T-52)	07:05	07:23	07:47	07:57	08:22 (T-57)		
	21:11	20:35	5 06:58 (T-52)	19:41	18:44	17:00	16:47	26 08:48 (T-57)		
16	05:56	06:30	06:52 (T-52)	07:06	07:24	07:48	07:57	08:23 (T-57)		
	21:10	20:34	8 07:00 (T-52)	19:39	18:42	16:59	16:47	26 08:49 (T-57)		
17	05:57	06:31	06:54 (T-52)	07:07	07:25	07:58	08:24	(T-57)		
	21:09	20:32	8 07:02 (T-52)	19:37	18:40	16:58	16:48	26 08:50 (T-57)		
18	05:58	06:32	06:55 (T-52)	07:08	07:27	07:59	08:24	(T-57)		
	21:09	20:30	8 07:03 (T-52)	19:35	18:39	16:57	16:48	26 08:50 (T-57)		
19	05:59	06:33	06:56 (T-52)	07:10	07:28	07:59	08:25	(T-57)		
	21:08	20:29	7 07:03 (T-52)	19:33	18:37	16:56	16:48	26 08:51 (T-57)		
20	06:00	06:34	06:57 (T-52)	07:11	07:29	08:00	08:25	(T-57)		
	21:07	20:27	6 07:03 (T-52)	19:31	18:35	16:55	16:49	26 08:51 (T-57)		
21	06:01	06:36	06:58 (T-52)	07:12	07:49	07:31	08:00	08:26	(T-57)	
	21:06	20:26	5 07:03 (T-52)	19:29	18:34	16:54	16:49	26 08:52 (T-57)		
22	06:02	06:37	06:59 (T-52)	07:13	07:50	07:32	08:01	08:26	(T-57)	
	21:05	20:24	3 07:02 (T-52)	19:28	18:32	16:54	16:50	26 08:52 (T-57)		
23	06:03	06:38	07:00 (T-52)	07:14	07:52	07:33	08:01	08:27	(T-57)	
	21:04	20:22	1 07:01 (T-52)	19:26	18:30	16:53	16:50	26 08:53 (T-57)		
24	06:04	06:39	07:16	07:53	08:16 (T-58)	07:35	08:02	08:27	(T-57)	
	21:03	20:21	19:24	18:29	5 08:21 (T-58)	16:52	16:51	26 08:53 (T-57)		
25	06:05	06:40	07:17	07:54	08:17 (T-58)	07:36	08:02	08:27	(T-57)	
	21:02	20:19	19:22	18:27	7 08:24 (T-58)	16:51	16:51	26 08:53 (T-57)		
26	06:06	06:41	07:18	07:56	08:18 (T-58)	07:37	08:22 (T-57)	08:03	08:28	(T-57)
	21:01	20:17	19:20	18:26	7 08:25 (T-58)	16:51	9 08:31 (T-57)	16:52	26 08:54 (T-57)	
27	06:07	06:43	07:19	07:57	08:19 (T-58)	07:38	08:20 (T-57)	08:03	08:28	(T-57)
	21:00	20:15	19:18	18:24	6 08:25 (T-58)	16:50	13 08:33 (T-57)	16:53	26 08:54 (T-57)	
28	06:08	06:44	07:20	07:58	08:21 (T-58)	07:39	08:20 (T-57)	08:03	08:28	(T-57)
	20:59	20:14	19:16	18:23	5 08:26 (T-58)	16:50	16 08:36 (T-57)	16:53	26 08:54 (T-57)	
29	06:09	06:45	07:22	08:00	08:22 (T-58)	07:41	08:19 (T-57)	08:04	08:28	(T-57)
	20:58	20:12	19:14	18:21	6 08:37 (T-77)	16:49	18 08:37 (T-57)	16:54	26 08:54 (T-57)	
30	06:10	06:46	07:23	08:01	08:24 (T-58)	07:42	08:18 (T-57)	08:04	08:29	(T-57)
	20:57	20:10	19:13	18:20	12 08:42 (T-77)	16:49	20 08:38 (T-57)	16:55	27 08:56 (T-57)	
31	06:11	06:47	08:02	08:25 (T-58)	08:04	08:04	08:04	08:29	(T-57)	
	20:56	20:08	18:18	16 08:44 (T-77)	16:56	27 08:56 (T-57)				
Potential sun hours	471	436	377	341	289	275				
Total, worst case				64		222		798		
Sun reduction		0.72		0.56		0.48		0.52		
Oper. time red.		0.90		0.90		0.90		0.90		
Wind dir. red.		0.58		0.63		0.65		0.66		
Total reduction		0.38		0.32		0.28		0.31		
Total, real		19		20		62		248		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-090 - R-090

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04 16:57	07:47 17:35		07:06 18:13	07:09 19:52	05:45 21:04
2	08:04 16:58	07:46 17:36	08:07 (T-61) 08:09 (T-61)	07:04 18:14	07:07 19:54	05:45 21:05
3	08:04 16:59	07:44 17:38	08:06 (T-61) 08:10 (T-61)	07:02 18:15	07:06 19:55	05:44 21:05
4	08:04 17:00	07:43 17:39	08:05 (T-61) 08:10 (T-61)	07:00 18:17	07:04 19:56	05:44 21:06
5	08:04 17:01	07:42 17:41	08:04 (T-61) 08:11 (T-61)	06:59 18:18	07:02 19:57	05:43 21:07
6	08:04 17:02	07:41 17:42	08:02 (T-61) 08:10 (T-61)	06:57 18:19	07:00 19:59	05:43 21:08
7	08:04 17:03	07:39 17:43	08:01 (T-61) 08:10 (T-61)	06:55 18:21	06:58 20:00	05:43 21:08
8	08:03 17:04	07:38 17:45	08:00 (T-61) 08:10 (T-61)	07:53 18:22	06:56 20:01	05:42 21:09
9	08:03 17:05	07:37 17:46	07:58 (T-61) 08:09 (T-61)	07:52 19:23	06:55 20:02	05:42 21:10
10	08:03 17:06	07:35 17:48	07:57 (T-61) 08:08 (T-61)	07:50 19:24	06:53 20:04	05:42 21:10
11	08:03 17:07	07:34 17:49	07:55 (T-61) 08:06 (T-61)	07:48 19:26	06:51 20:05	05:41 21:11
12	08:02 17:08	07:33 17:51	07:59 (T-61) 08:04 (T-61)	07:46 19:27	06:49 20:06	05:41 21:12
13	08:02 17:10	07:31 17:52		07:44 19:28	06:48 20:07	05:41 21:12
14	08:01 17:11	07:30 17:53		07:42 19:30	06:46 20:09	05:41 21:13
15	08:01 17:12	07:28 17:55		07:41 19:31	06:44 20:10	05:41 21:13
16	08:00 17:13	07:27 17:56		07:39 19:32	06:42 20:11	05:41 21:14
17	08:00 17:15	07:25 17:58		07:37 19:34	06:41 20:12	05:41 21:14
18	07:59 17:16	07:24 17:59		07:35 19:35	06:39 20:14	05:41 21:14
19	07:58 17:17	07:22 18:00		07:33 19:36	06:37 20:15	05:41 21:15
20	07:58 17:18	07:21 18:00		07:31 19:37	06:36 20:16	05:41 21:15
21	07:57 17:20	07:19 18:02		07:30 19:39	06:34 20:17	05:41 21:15
22	07:56 17:21	07:17 18:03		07:28 19:40	06:32 20:18	05:42 21:16
23	07:55 17:22	07:16 18:04		07:26 19:41	06:31 20:20	05:42 21:16
24	07:55 17:24	07:14 18:06		07:24 19:42	06:29 20:21	05:42 21:16
25	07:54 17:25	07:12 18:07		07:22 19:44	06:27 20:22	05:43 21:16
26	07:53 17:27	07:11 18:09		07:20 19:45	06:26 20:23	05:43 21:16
27	07:52 17:28	07:09 18:10		07:18 19:46	06:24 20:25	05:43 21:16
28	07:51 17:29	07:07 18:11		07:17 19:47	06:23 20:26	05:44 21:16
29	07:50 17:31			07:15 19:49	06:21 20:27	05:44 21:16
30	07:49 17:32			07:13 19:50	06:20 20:28	05:45 21:16
31	07:48 17:34			07:11 19:51	06:19 20:29	05:46 21:16
Potential sun hours	287	292	369	403	458	465
Total, worst case		83	25	228	115	43
Sun reduction		0.58	0.59	0.63	0.66	0.73
Oper. time red.		0.90	0.90	0.90	0.90	0.90
Wind dir. red.		0.64	0.58	0.58	0.59	0.65
Total reduction		0.33	0.31	0.33	0.35	0.43
Total, real		28	8	76	40	18

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-090 - R-090

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	06:36 (T-92) 20:07	06:49 20:07	07:15 (T-60) 19:11	07:04 17:17
2	05:46 21:16	06:14 20:53	06:37 (T-92) 20:05	06:50 20:05	07:13 (T-60) 19:09	07:05 17:15
3	05:46 21:16	06:15 20:52	06:38 (T-92) 20:03	06:51 20:03	07:13 (T-60) 19:07	07:06 17:14
4	05:47 21:16	06:16 20:51	06:52 20:01	06:52 20:01	07:14 (T-60) 19:05	07:08 17:13
5	05:47 21:15	06:17 20:49	06:53 19:59	06:53 19:59	07:15 (T-60) 19:03	07:09 17:11
6	05:48 21:15	06:18 20:48	06:54 19:58	06:54 19:58	07:16 (T-60) 19:01	07:11 17:10
7	05:49 21:15	06:19 20:47	06:56 19:56	06:56 19:56	07:17 (T-60) 19:00	07:12 17:09
8	05:50 21:14	06:20 20:45	06:57 19:54	06:57 19:54	07:18 (T-60) 18:56	07:13 17:08
9	05:50 21:14	06:22 20:44	06:58 19:52	06:58 19:52	07:19 (T-60) 18:54	07:15 17:06
10	05:51 21:13	06:23 20:43	06:59 19:50	06:59 19:50	07:21 (T-60) 18:52	07:16 17:05
11	05:52 21:13	06:24 20:41	07:00 19:48	07:00 19:48	07:22 (T-60) 18:51	07:17 17:04
12	05:53 21:12	06:25 20:40	07:01 19:46	07:01 19:46	07:23 (T-60) 18:49	07:19 17:03
13	05:53 21:12	06:26 20:38	07:03 19:45	07:03 19:45	07:24 (T-60) 18:47	07:20 17:02
14	05:54 21:11	06:27 20:37	07:04 19:43	07:04 19:43	07:25 (T-60) 18:45	07:21 17:01
15	05:55 21:11	06:29 20:35	07:05 19:41	07:05 19:41	07:26 (T-60) 18:44	07:23 17:00
16	05:56 21:10	06:30 20:34	07:06 19:39	07:06 19:39	07:27 (T-60) 18:42	07:24 16:59
17	05:57 21:09	06:31 20:32	07:07 19:37	07:07 19:37	07:28 (T-60) 18:40	07:25 16:58
18	05:58 21:08	06:32 20:30	07:08 19:35	07:08 19:35	07:29 (T-60) 18:39	07:26 16:57
19	05:59 21:08	06:33 20:29	07:10 19:33	07:10 19:33	07:30 (T-60) 18:37	07:28 16:56
20	06:00 21:07	06:28 (T-92) 06:33 (T-92)	06:34 20:27	06:34 20:27	07:11 18:35	07:29 16:55
21	06:01 21:06	06:26 (T-92) 06:36 (T-92)	06:36 20:26	06:36 20:26	07:12 18:34	07:31 16:54
22	06:02 21:05	06:26 (T-92) 06:37 (T-92)	06:37 20:24	06:37 20:24	07:13 18:32	07:32 16:54
23	06:03 21:04	06:27 (T-92) 06:38 (T-92)	06:38 20:22	06:38 20:22	07:14 18:30	07:33 16:53
24	06:04 21:03	06:28 (T-92) 06:39 (T-92)	06:39 20:21	06:39 20:21	07:16 18:29	07:34 16:52
25	06:05 21:02	06:29 (T-92) 06:40 (T-92)	06:40 20:19	06:40 20:19	07:17 18:27	07:36 16:51
26	06:06 21:01	06:30 (T-92) 06:41 (T-92)	06:41 20:17	06:41 20:17	07:18 18:26	07:37 16:51
27	06:07 21:00	06:31 (T-92) 06:41 (T-92)	06:43 20:15	06:43 20:15	07:19 18:24	07:38 16:50
28	06:08 20:59	06:32 (T-92) 06:41 (T-92)	06:44 20:14	06:44 20:14	07:20 18:23	07:39 16:50
29	06:09 20:58	06:33 (T-92) 06:41 (T-92)	06:45 20:12	06:45 20:12	07:22 18:21	07:41 16:49
30	06:10 20:57	06:34 (T-92) 06:41 (T-92)	06:46 20:10	06:46 20:10	08:01 18:20	07:42 16:49
31	06:11 20:56	06:35 (T-92) 06:41 (T-92)	06:47 20:08	06:47 20:08	08:02 18:18	07:42 16:48
Potential sun hours	471	436	377	341	289	275
Total, worst case	109	30	236	17	66	
Sun reduction	0.75	0.72	0.67	0.56	0.48	
Oper. time red.	0.90	0.90	0.90	0.90	0.90	
Wind dir. red.	0.59	0.59	0.58	0.64	0.64	
Total reduction	0.40	0.38	0.35	0.32	0.28	
Total, real	44	11	83	5	18	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-091 - R-091
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June				
1	08:04	07:47	08:21 (T-J)	07:06	07:09	07:29 (T-55)	06:18	19:29 (T-89)	05:45	
	16:57	17:35	20 08:41 (T-J)	18:13	19:52	45 08:21 (T-54)	20:30	16 19:45 (T-89)	21:04	
2	08:04	08:29 (T-J)	07:46	08:22 (T-J)	07:04	07:07	07:28 (T-56)	06:17	19:32 (T-89)	05:45
	16:58	1 08:30 (T-J)	17:36	17 08:39 (T-J)	18:14	19:54	37 08:17 (T-54)	20:31	11 19:43 (T-89)	21:05
3	08:04	08:29 (T-J)	07:44	08:25 (T-J)	07:02	07:06	07:26 (T-56)	06:15	05:44	
	16:59	2 08:31 (T-J)	17:38	12 08:37 (T-J)	18:15	19:55	26 07:52 (T-55)	20:32	21:06	
4	08:04	08:28 (T-J)	07:43	08:31 (T-J)	07:01	07:21 (T-54)	07:04	07:24 (T-56)	06:14	05:44
	17:00	3 08:31 (T-J)	17:39	1 08:32 (T-J)	18:17	4 07:25 (T-54)	07:04	19:56	26 07:50 (T-55)	20:33
5	08:04	08:28 (T-J)	07:42	06:59	07:19 (T-54)	07:02	07:22 (T-56)	06:12	05:43	
	17:01	4 08:32 (T-J)	17:41	18:18	10 07:29 (T-54)	19:57	24 07:48 (T-55)	20:35	21:07	
6	08:04	08:28 (T-J)	07:41	06:57	07:18 (T-54)	07:00	07:20 (T-56)	06:11	05:43	
	17:02	6 08:34 (T-J)	17:42	18:19	15 07:33 (T-54)	19:59	21 07:45 (T-55)	20:36	21:08	
7	08:04	08:28 (T-J)	07:39	06:55	07:16 (T-54)	06:58	07:18 (T-56)	06:10	05:43	
	17:03	7 08:35 (T-J)	17:43	18:21	18 07:34 (T-54)	20:00	11 07:29 (T-56)	20:37	21:09	
8	08:04	08:28 (T-J)	07:38	07:53	08:14 (T-54)	06:56	07:17 (T-56)	06:08	05:42	
	17:04	8 08:36 (T-J)	17:45	18:22	22 08:36 (T-54)	20:01	12 07:29 (T-56)	20:38	21:09	
9	08:03	08:27 (T-J)	07:37	07:52	08:12 (T-54)	06:55	07:15 (T-56)	06:07	05:42	
	17:05	9 08:36 (T-J)	17:46	19:23	25 08:37 (T-54)	20:02	18 19:41 (T-89)	20:39	21:10	
10	08:03	08:27 (T-J)	07:35	07:50	08:10 (T-54)	06:53	07:13 (T-56)	06:06	05:42	
	17:06	10 08:37 (T-J)	17:48	19:25	27 08:37 (T-54)	20:04	22 19:42 (T-89)	20:41	21:11	
11	08:03	08:26 (T-J)	07:34	07:48	08:08 (T-54)	06:51	07:12 (T-56)	06:05	05:41	
	17:07	12 08:38 (T-J)	17:49	19:26	30 08:38 (T-54)	20:05	25 19:43 (T-89)	20:42	21:11	
12	08:02	08:26 (T-J)	07:33	07:46	08:07 (T-54)	06:49	07:16 (T-56)	06:03	05:41	
	17:08	13 08:39 (T-J)	17:51	19:27	32 08:39 (T-54)	20:06	20 19:44 (T-89)	20:43	21:12	
13	08:02	08:25 (T-J)	07:31	07:44	08:05 (T-54)	06:48	19:28 (T-89)	06:02	05:41	
	17:10	14 08:39 (T-J)	17:52	19:28	35 08:40 (T-54)	20:07	17 19:45 (T-89)	20:44	21:12	
14	08:01	08:25 (T-J)	07:30	07:43	08:03 (T-54)	06:46	19:26 (T-89)	06:01	05:41	
	17:11	16 08:41 (T-J)	17:53	19:30	37 08:40 (T-54)	20:09	20 19:46 (T-89)	20:45	21:13	
15	08:01	08:24 (T-J)	07:28	07:41	08:01 (T-54)	06:44	19:25 (T-89)	06:00	05:41	
	17:12	17 08:41 (T-J)	17:55	19:31	39 08:40 (T-54)	20:10	22 19:47 (T-89)	20:46	21:13	
16	08:00	08:24 (T-J)	07:27	07:39	07:59 (T-54)	06:42	19:25 (T-89)	05:59	05:41	
	17:13	18 08:42 (T-J)	17:56	19:32	41 08:40 (T-54)	20:11	24 19:49 (T-89)	20:48	21:14	
17	08:00	08:23 (T-J)	07:25	07:37	07:57 (T-54)	06:41	19:24 (T-89)	05:58	05:41	
	17:15	19 08:42 (T-J)	17:58	19:34	43 08:40 (T-54)	20:12	26 19:50 (T-89)	20:49	21:14	
18	07:59	08:22 (T-J)	07:24	07:35	07:55 (T-54)	06:39	19:23 (T-89)	05:57	05:41	
	17:16	20 08:42 (T-J)	17:59	19:35	44 08:39 (T-54)	20:14	28 19:51 (T-89)	20:50	21:15	
19	07:59	08:22 (T-J)	07:22	07:33	07:54 (T-54)	06:37	19:23 (T-89)	05:56	05:41	
	17:17	22 08:44 (T-J)	18:00	19:36	46 08:40 (T-54)	20:15	30 19:53 (T-89)	20:51	21:15	
20	07:58	08:21 (T-J)	07:21	07:32	07:53 (T-54)	06:36	19:22 (T-89)	05:55	05:41	
	17:18	23 08:44 (T-J)	18:00	19:37	46 08:39 (T-54)	20:16	31 19:53 (T-89)	20:52	21:15	
21	07:57	08:20 (T-J)	07:19	07:30	07:50 (T-55)	06:34	19:22 (T-89)	05:54	05:42	
	17:20	24 08:44 (T-J)	18:02	19:39	48 08:38 (T-54)	20:17	32 19:54 (T-89)	20:53	21:16	
22	07:56	08:19 (T-J)	07:17	07:28	07:48 (T-55)	06:32	19:23 (T-89)	05:53	05:42	
	17:21	25 08:44 (T-J)	18:03	19:40	50 08:38 (T-54)	20:19	33 19:56 (T-89)	20:54	21:16	
23	07:56	08:18 (T-J)	07:16	07:26	07:46 (T-55)	06:31	19:22 (T-89)	05:52	05:42	
	17:23	26 08:44 (T-J)	18:04	19:41	51 08:37 (T-54)	20:20	33 19:55 (T-89)	20:55	21:16	
24	07:55	08:17 (T-J)	07:14	07:24	07:44 (T-55)	06:29	19:23 (T-89)	05:51	05:42	
	17:24	27 08:44 (T-J)	18:06	19:42	52 08:36 (T-54)	20:21	32 19:55 (T-89)	20:56	21:16	
25	07:54	08:16 (T-J)	07:13	07:22	07:42 (T-55)	06:27	19:23 (T-89)	05:50	05:43	
	17:25	28 08:44 (T-J)	18:07	19:44	52 08:34 (T-54)	20:22	31 19:54 (T-89)	20:57	21:16	
26	07:53	08:15 (T-J)	07:11	07:20	07:41 (T-55)	06:26	19:24 (T-89)	05:49	05:43	
	17:27	29 08:44 (T-J)	18:09	19:45	53 08:34 (T-54)	20:24	29 19:53 (T-89)	20:58	21:16	
27	07:52	08:16 (T-J)	07:09	07:19	07:39 (T-55)	06:24	19:24 (T-89)	05:49	05:43	
	17:28	28 08:44 (T-J)	18:10	19:46	54 08:33 (T-54)	20:25	28 19:52 (T-89)	20:59	21:16	
28	07:51	08:16 (T-J)	07:07	07:17	07:37 (T-55)	06:23	19:26 (T-89)	05:48	05:44	
	17:29	28 08:44 (T-J)	18:11	19:47	54 08:31 (T-54)	20:26	25 19:51 (T-89)	21:00	21:16	
29	07:50	08:17 (T-J)		07:15	07:35 (T-55)	06:21	19:26 (T-89)	05:47	05:44	
	17:31	26 08:43 (T-J)		19:49	54 08:29 (T-54)	20:27	23 19:49 (T-89)	21:01	21:16	
30	07:49	08:19 (T-J)		07:13	07:33 (T-55)	06:20	19:28 (T-89)	05:46	05:45	
	17:32	24 08:43 (T-J)		19:50	52 08:27 (T-54)	20:28	20 19:48 (T-89)	21:02	21:16	
31	07:48	08:20 (T-J)		07:11	07:31 (T-55)			05:46		
	17:34	22 08:42 (T-J)		19:51	49 08:24 (T-54)			21:03		
Potential sun hours	287	292	369	403	458	465				
Total, worst case	511	50	1083	771	27					
Sun reduction	0.58	0.58	0.59	0.63	0.66					
Oper. time red.	0.90	0.90	0.90	0.90	0.90					
Wind dir. red.	0.65	0.65	0.60	0.59	0.60					
Total reduction	0.34	0.34	0.32	0.34	0.36					
Total, real	173	17	344	260	10					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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South Deuel Wind Project

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Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-091 - R-091

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December	
1	05:45 21:16	06:13 20:55	06:49 20:07	07:11 (T-56) 19:11	07:24 17:17	07:45 (T-54) 16:48	08:08 (T-J) 12
2	05:46 21:16	06:14 20:53	06:50 20:05	07:12 (T-56) 19:09	07:25 17:15	07:46 (T-54) 16:48	08:10 (T-J) 11
3	05:46 21:16	06:15 20:52	06:51 20:03	07:13 (T-56) 19:07	07:26 17:14	07:48 (T-54) 16:48	08:11 (T-J) 9
4	05:47 21:16	06:16 20:51	06:52 20:01	07:14 (T-56) 19:05	07:28 17:13	07:49 (T-54) 16:47	08:12 (T-J) 8
5	05:48 21:15	06:17 20:50	06:53 19:59	07:15 (T-56) 19:03	07:29 17:11	07:50 (T-54) 16:47	08:13 (T-J) 7
6	05:48 21:15	06:18 20:48	06:54 19:58	07:16 (T-56) 19:02	07:30 17:10	07:51 (T-54) 16:47	08:14 (T-J) 6
7	05:49 21:15	06:19 20:47	06:56 19:56	07:17 (T-56) 19:00	07:31 17:09	07:53 (T-54) 16:47	08:15 (T-J) 4
8	05:50 21:14	06:20 20:46	06:57 19:54	07:18 (T-56) 18:56	07:33 17:08	07:54 (T-54) 16:47	08:16 (T-J) 3
9	05:50 21:14	06:22 20:44	06:58 19:52	07:19 (T-56) 18:54	07:34 17:06	07:55 (T-54) 16:47	08:17 (T-J) 2
10	05:51 21:14	06:23 20:43	06:59 19:50	07:21 (T-56) 18:52	07:35 17:05	07:56 (T-54) 16:47	08:18 (T-J) 1
11	05:52 21:13	06:24 20:41	07:00 19:48	07:22 (T-55) 18:51	07:36 17:04	07:57 (T-54) 16:47	
12	05:53 21:13	06:25 20:40	07:01 19:47	07:23 (T-55) 18:49	07:38 17:03	07:58 (T-54) 16:47	
13	05:54 21:12	06:26 20:38	07:03 19:45	07:24 (T-55) 18:47	07:39 17:02	07:59 (T-54) 16:47	
14	05:54 21:11	06:27 20:37	07:04 19:43	07:25 (T-54) 18:45	07:40 17:01	08:00 (T-54) 16:47	
15	05:55 21:11	06:29 20:35	07:05 19:41	07:26 (T-55) 18:44	07:41 17:00	08:01 (T-54) 16:47	
16	05:56 21:10	06:30 20:34	07:06 19:39	07:27 (T-55) 18:42	07:42 16:59	08:02 (T-54) 16:47	
17	05:57 21:09	06:31 20:32	07:07 19:37	07:29 (T-55) 18:40	07:43 16:58	08:03 (T-54) 16:47	
18	05:58 21:09	06:32 20:31	07:09 19:35	07:30 (T-55) 18:39	07:44 16:57	08:04 (T-54) 16:47	
19	05:59 21:08	06:33 20:29	07:10 19:33	07:31 (T-55) 18:37	07:45 16:56	08:05 (T-54) 16:47	
20	06:00 21:07	06:34 20:27	07:11 19:31	07:32 (T-55) 18:35	07:46 16:55	08:06 (T-54) 16:47	
21	06:01 21:06	06:36 20:26	07:12 19:29	07:33 (T-55) 18:34	07:47 16:54	08:07 (T-54) 16:47	
22	06:02 21:05	06:37 20:24	07:13 19:28	07:34 (T-55) 18:32	07:48 16:53	08:08 (T-54) 16:47	
23	06:03 21:04	06:38 20:22	07:14 19:26	07:35 (T-55) 18:30	07:49 16:52	08:09 (T-54) 16:47	
24	06:04 21:03	06:39 20:21	07:16 19:24	07:37 (T-54) 18:29	07:50 16:51	08:10 (T-54) 16:47	
25	06:05 21:02	06:40 20:19	07:17 19:22	07:38 (T-54) 18:27	07:51 16:50	08:11 (T-54) 16:47	
26	06:06 21:01	06:42 20:17	07:18 19:20	07:39 (T-54) 18:26	07:52 16:49	08:12 (T-54) 16:47	
27	06:07 21:00	06:43 20:16	07:19 19:18	07:40 (T-54) 18:24	07:53 16:48	08:13 (T-54) 16:47	
28	06:08 20:59	06:44 20:14	07:20 19:16	07:41 (T-54) 18:23	07:54 16:47	08:14 (T-54) 16:47	
29	06:09 20:58	06:45 20:12	07:22 19:15	07:43 (T-54) 18:21	07:55 16:46	08:15 (T-54) 16:47	
30	06:10 20:57	06:46 20:10	07:23 19:13	07:44 (T-54) 18:20	07:56 16:45	08:16 (T-54) 16:47	
31	06:11 20:56	06:47 20:08	07:15 (T-56) 19:13	08:20 (T-54) 18:18	08:02 16:44	08:17 (T-54) 16:47	
Potential sun hours	471	436	377	341	289	275	
Total, worst case			533	1170	197	504	63
Sun reduction			0.72	0.67	0.56	0.48	0.52
Oper. time red.			0.90	0.90	0.90	0.90	0.90
Wind dir. red.			0.60	0.59	0.60	0.65	0.65
Total reduction			0.39	0.36	0.30	0.28	0.30
Total, real		207		420	59	142	19

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-093 - R-093
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:13	07:51
	17:04	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:18	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02
	17:23	18:05	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:55	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:00	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40	08:03
	17:29	18:11	19:48	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:17	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11	06:17	05:46		06:11	06:47		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-096 - R-096
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04	08:29 (T-56)	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:43
	16:57	7 08:36 (T-56)	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	08:29 (T-56)	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	7 08:36 (T-56)	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	08:29 (T-56)	07:44	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45
	16:59	7 08:36 (T-56)	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	08:28 (T-56)	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	7 08:35 (T-56)	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	08:28 (T-56)	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:01	7 08:35 (T-56)	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	08:28 (T-56)	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49
	17:02	7 08:35 (T-56)	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	08:29 (T-56)	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	6 08:35 (T-56)	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:56	06:08	05:42	05:50	06:20	06:57	07:33	07:13	07:51	08:22 (T-56)
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:08	16:47	7 08:23 (T-56)
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52	08:17 (T-56)
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47	7 08:24 (T-56)
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52	08:18 (T-56)
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:47	7 08:25 (T-56)
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:17	07:53	08:19 (T-56)
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47	7 08:26 (T-56)
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54	08:20 (T-56)
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47	7 08:27 (T-56)
13	08:02	07:31	07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55	08:21 (T-56)
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47	7 08:28 (T-56)
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56	08:21 (T-56)
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47	7 08:28 (T-56)
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57	08:22 (T-56)
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47	6 08:28 (T-56)
16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57	08:23 (T-56)
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47	6 08:29 (T-56)
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58	08:24 (T-56)
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48	6 08:30 (T-56)
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59	08:24 (T-56)
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48	6 08:30 (T-56)
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59	08:25 (T-56)
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48	6 08:31 (T-56)
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:34	07:11	07:48	07:29	08:00	08:25 (T-56)
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49	6 08:31 (T-56)
21	07:57	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01	08:26 (T-56)
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49	6 08:32 (T-56)
22	07:56	07:17	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01	08:26 (T-56)
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50	6 08:32 (T-56)
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02	08:27 (T-56)
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50	6 08:33 (T-56)
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02	08:27 (T-56)
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51	6 08:33 (T-56)
25	07:54	07:13	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36	08:02	08:28 (T-56)
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51	6 08:34 (T-56)
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03	08:28 (T-56)
	17:27	18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52	6 08:34 (T-56)
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03	08:28 (T-56)
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:16	19:18	18:24	16:50	16:53	6 08:34 (T-56)
28	07:51	07:07	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:40	08:03	08:28 (T-56)
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53	6 08:34 (T-56)
29	07:50	07:15	07:25	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04	08:28 (T-56)
	17:31	18:13	19:49	20:27	21:01	21:16	20:58	20:12	19:15	18:21	16:49	16:54	6 08:34 (T-56)
30	07:49	07:13	07:23	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04	08:29 (T-56)
	17:32	18:14	19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55	7 08:36 (T-56)
31	07:48	07:11	07:21	06:18	05:44	05:43	06:11	06:47	07:24	08:03	07:44	08:04	08:29 (T-56)
	17:34	18:16	19:51	21:03	20:56	20:56	20:09	20:09	18:18	18:18	16:56	16:56	7 08:36 (T-56)
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	
Total, worst case													172
Sun reduction	48												0.52
Oper. time red.	0.58												0.90
Wind dir. red.	0.90												0.66
Total reduction	0.66												0.31
Total, real	0.34												53

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-099 - R-099
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:08	05:42	05:50	06:20	06:57	07:33	07:13	07:51
	17:04	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:18	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:13	21:12	20:38	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:34	07:11	07:48	07:30	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:22	20:57	21:16	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:00	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40	08:03
	17:29	18:11	19:48	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:17	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-100 - R-100
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:09	06:18	05:45
	16:57	17:35	18:13	19:52	20:30	21:04
2	08:04	07:46	07:04	07:07	06:17	05:45
	16:58	17:36	18:14	19:54	20:31	21:05
3	08:04	07:45	07:02	07:06	06:15	05:44
	16:59	17:38	18:15	19:55	20:32	21:06
4	08:04	07:43	07:01	07:04	06:14	05:44
	17:00	17:39	18:17	19:56	20:33	21:06
5	08:04	07:42	06:59	07:02	06:12	05:43
	17:01	17:41	18:18	19:57	20:35	21:07
6	08:04	07:41	06:57	07:00	06:11	05:43
	17:02	17:42	18:19	19:59	20:36	21:08
7	08:04	07:40	06:55	06:58	06:10	05:42
	17:03	17:43	18:21	20:00	20:37	21:09
8	08:04	07:38	07:53	06:56	06:08	05:42
	17:04	17:45	18:22	20:01	20:38	21:09
9	08:03	07:37	07:52	06:55	06:07	05:42
	17:05	17:46	19:23	20:02	20:40	21:10
10	08:03	07:36	07:50	06:53	19:40 (T-32)	06:06
	17:06	17:48	19:25	20:04	20:42 (T-32)	20:41
11	08:03	07:34	07:48	06:51	19:39 (T-32)	06:04
	17:07	17:49	19:26	20:05	4 19:43 (T-32)	20:42
12	08:02	07:33	07:46	06:49	19:38 (T-32)	06:03
	17:08	17:50	19:27	20:06	7 19:45 (T-32)	20:43
13	08:02	07:31	07:44	06:48	19:37 (T-32)	06:02
	17:10	17:52	19:28	20:07	8 19:45 (T-32)	20:44
14	08:02	07:30	07:43	06:46	19:37 (T-32)	06:01
	17:11	17:53	19:30	20:09	9 19:46 (T-32)	20:45
15	08:01	07:28	07:41	06:44	19:36 (T-32)	06:00
	17:12	17:55	19:31	20:10	11 19:47 (T-32)	20:47
16	08:01	07:27	07:39	06:42	19:37 (T-32)	05:59
	17:13	17:56	19:32	20:11	12 19:49 (T-32)	20:48
17	08:00	07:25	07:37	19:11 (T-31)	06:41	19:37 (T-32)
	17:15	17:58	19:34	1 19:12 (T-31)	20:12	13 19:50 (T-32)
18	07:59	07:24	07:35	19:10 (T-31)	06:39	19:38 (T-32)
	17:16	17:59	19:35	3 19:13 (T-31)	20:14	13 19:51 (T-32)
19	07:59	07:22	07:33	19:10 (T-31)	06:37	19:39 (T-32)
	17:17	18:00	19:36	5 19:15 (T-31)	20:15	12 19:51 (T-32)
20	07:58	07:21	07:32	19:10 (T-31)	06:36	19:41 (T-32)
	17:18	18:00	19:37	6 19:16 (T-31)	20:16	7 19:48 (T-32)
21	07:57	07:19	07:30	19:10 (T-31)	06:34	05:53
	17:20	18:02	19:39	8 19:18 (T-31)	20:17	20:53
22	07:57	07:18	07:28	19:10 (T-31)	06:32	05:53
	17:21	18:03	19:40	9 19:19 (T-31)	20:19	20:54
23	07:56	07:16	07:26	19:11 (T-31)	06:31	05:52
	17:22	18:04	19:41	9 19:20 (T-31)	20:20	20:55
24	07:55	07:14	07:24	19:14 (T-31)	06:29	05:51
	17:24	18:06	19:42	2 19:16 (T-31)	20:21	20:56
25	07:54	07:13	07:22	06:27	05:50	05:42
	17:25	18:07	19:44	20:22	20:57	21:16
26	07:53	07:11	07:20	06:26	20:58	05:43
	17:27	18:09	19:45	20:24	20:58	21:17
27	07:52	07:09	07:18	06:24	05:48	06:11 (T-42)
	17:28	18:10	19:46	20:25	20:59	1 06:12 (T-42)
28	07:51	07:08	07:17	06:23	05:48	06:11 (T-42)
	17:29	18:11	19:47	20:26	21:00	2 06:13 (T-42)
29	07:50		07:15	06:21	05:47	06:10 (T-42)
	17:31		19:49	20:27	21:01	3 06:13 (T-42)
30	07:49		07:13	06:20	05:46	06:10 (T-42)
	17:32		19:50	20:29	21:02	4 06:14 (T-42)
31	07:48		07:11		05:46	06:09 (T-42)
	17:33		19:51		21:03	4 06:13 (T-42)
Potential sun hours	287	292	369	403	459	465
Total, worst case				98	14	225
Sun reduction			0.59	0.63	0.66	0.73
Oper. time red.			0.90	0.90	0.90	0.90
Wind dir. red.			0.59	0.60	0.59	0.59
Total reduction			0.31	0.34	0.35	0.39
Total, real			13	33	5	87

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
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Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
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Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December			
1	05:45	06:09 (T-42)	06:12	06:49	19:38 (T-32)	07:24	07:04	07:43	
	21:16	8 06:17 (T-42)	20:55	20:07	4 19:42 (T-32)	19:11	17:17	16:48	
2	05:46	06:10 (T-42)	06:14	06:50	19:39 (T-32)	07:25	07:05	07:44	
	21:16	8 06:18 (T-42)	20:54	20:05	2 19:41 (T-32)	19:09	17:15	16:48	
3	05:46	06:11 (T-42)	06:15	06:51		07:26	07:07	07:45	
	21:16	8 06:19 (T-42)	20:52	20:03		19:07	17:14	16:48	
4	05:47	06:11 (T-42)	06:16	06:52		07:28	07:08	07:47	
	21:16	7 06:18 (T-42)	20:51	20:01		19:05	17:13	16:47	
5	05:47	06:12 (T-42)	06:17	06:53		07:29	07:09	07:48	
	21:16	7 06:19 (T-42)	20:50	20:00		19:03	17:11	16:47	
6	05:48	06:12 (T-42)	06:18	06:54		07:30	07:11	07:49	
	21:15	7 06:19 (T-42)	20:48	19:58		19:02	17:10	16:47	
7	05:49	06:13 (T-42)	06:19	06:56		07:31	07:12	07:50	
	21:15	7 06:20 (T-42)	20:47	19:56		19:00	17:09	16:47	
8	05:49	06:14 (T-42)	06:20	06:57		07:33	07:13	07:51	
	21:15	6 06:20 (T-42)	20:46	19:54		18:56	17:08	16:47	
9	05:50	06:15 (T-42)	06:22	06:58		07:34	07:15	07:52	
	21:14	6 06:21 (T-42)	20:44	19:52		18:54	17:06	16:47	
10	05:51	06:15 (T-42)	06:23	06:59		07:35	07:16	07:53	
	21:14	6 06:21 (T-42)	20:43	19:50		18:52	17:05	16:46	
11	05:52	06:16 (T-42)	06:24	07:00		07:36	07:18	07:53	
	21:13	5 06:21 (T-42)	20:41	19:48		18:51	17:04	16:47	
12	05:53	06:17 (T-42)	06:25	07:01		07:38	07:19	07:54	
	21:13	4 06:21 (T-42)	20:40	19:47		18:49	17:03	16:47	
13	05:53	06:18 (T-42)	06:26	07:03		07:39	07:20	07:55	
	21:12	4 06:22 (T-42)	20:38	19:45		18:47	17:02	16:47	
14	05:54	06:18 (T-42)	06:27	07:04		07:40	07:22	07:56	
	21:12	3 06:21 (T-42)	20:37	19:43		18:45	17:01	16:47	
15	05:55	06:19 (T-42)	06:29	07:05		07:41	07:23	07:57	
	21:11	2 06:21 (T-42)	20:35	19:41		18:44	17:00	16:47	
16	05:56	06:20 (T-42)	06:30	07:06		07:43	07:24	07:57	
	21:10	2 06:22 (T-42)	20:34	19:39		18:42	16:59	16:47	
17	05:57	06:21 (T-42)	06:31	07:07		07:44	07:26	07:58	
	21:09	1 06:22 (T-42)	20:32	19:37		18:40	16:58	16:48	
18	05:58		06:32	07:09		07:45	07:27	07:59	
	21:09		20:31	19:35		18:39	16:57	16:48	
19	05:59		06:33	07:10		07:47	07:28	08:00	
	21:08		20:29	19:33		18:37	16:56	16:48	
20	06:00		06:34	07:11		18:58 (T-31)	07:48	07:30	08:00
	21:07		20:27	19:31	8	19:06 (T-31)	18:35	16:55	16:49
21	06:01		06:36	07:12		18:56 (T-31)	07:49	07:31	08:01
	21:06		20:26	19:30	8	19:04 (T-31)	18:34	16:54	16:49
22	06:02		06:37	07:13		18:54 (T-31)	07:51	07:32	08:01
	21:05		20:24	19:28	8	19:02 (T-31)	18:32	16:54	16:50
23	06:03		06:38	19:45 (T-32)	07:14	18:54 (T-31)	07:52	07:33	08:02
	21:04		20:22	7 19:52 (T-32)	19:26	7 19:01 (T-31)	18:30	16:53	16:50
24	06:04		06:39	19:42 (T-32)	07:16	18:54 (T-31)	07:53	07:35	08:02
	21:04		20:21	12 19:54 (T-32)	19:24	5 18:59 (T-31)	18:29	16:52	16:51
25	06:05		06:40	19:41 (T-32)	07:17	18:53 (T-31)	07:55	07:36	08:03
	21:03		20:19	14 19:55 (T-32)	19:22	4 18:57 (T-31)	18:27	16:51	16:51
26	06:06		06:41	19:40 (T-32)	07:18	18:53 (T-31)	07:56	07:37	08:03
	21:02		20:17	13 19:53 (T-32)	19:20	2 18:55 (T-31)	18:26	16:51	16:52
27	06:07		06:43	19:39 (T-32)	07:19		07:57	07:38	08:03
	21:00		20:16	12 19:51 (T-32)	19:18		18:24	16:50	16:53
28	06:08		06:44	19:38 (T-32)	07:20		07:59	07:40	08:03
	20:59		20:14	11 19:49 (T-32)	19:16		18:23	16:50	16:53
29	06:09		06:45	19:38 (T-32)	07:22		08:00	07:41	08:04
	20:58		20:12	9 19:47 (T-32)	19:15		18:21	16:49	16:54
30	06:10		06:46	19:37 (T-32)	07:23		08:01	07:42	08:04
	20:57		20:10	8 19:45 (T-32)	19:13		18:20	16:49	16:55
31	06:11		06:47	19:37 (T-32)			08:03		08:04
	20:56		20:09	6 19:43 (T-32)			18:18		16:56
Potential sun hours	471	436	377	341	289	275			
Total, worst case	91	92	48						
Sun reduction	0.75	0.72	0.67						
Oper. time red.	0.90	0.90	0.90						
Wind dir. red.	0.59	0.60	0.59						
Total reduction	0.40	0.39	0.35						
Total, real	36	36	17						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-101 - R-101

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:09	19:28 (T-32)	06:18
	16:57	17:35	18:13	19:52	3 19:31 (T-32)	20:30
2	08:04	07:46	07:04	07:07	19:28 (T-32)	06:17
	16:58	17:36	18:14	19:54	5 19:33 (T-32)	20:31
3	08:04	07:45	07:02	07:06	19:27 (T-32)	06:15
	16:59	17:38	18:15	19:55	7 19:34 (T-32)	20:32
4	08:04	07:43	07:01	07:04	19:27 (T-32)	06:14
	17:00	17:39	18:17	19:56	8 19:35 (T-32)	20:33
5	08:04	07:42	06:59	07:02	19:27 (T-32)	06:12
	17:01	17:41	18:18	19:57	9 19:36 (T-32)	20:35
6	08:04	07:41	06:57	07:00	19:27 (T-32)	06:11
	17:02	17:42	18:19	19:59	10 19:37 (T-32)	20:36
7	08:04	07:40	06:55	06:58	19:28 (T-32)	06:10
	17:03	17:43	18:21	20:00	10 19:38 (T-32)	20:37
8	08:04	07:38	07:53	06:56	19:31 (T-32)	06:08
	17:04	17:45	18:22	20:01	6 19:37 (T-32)	20:38
9	08:03	07:37	07:52	06:55	06:07	06:07
	17:05	17:46	19:23	20:02	06:40	21:10
10	08:03	07:36	07:50	06:53	06:06	05:42
	17:06	17:48	19:25	20:04	20:41	21:11
11	08:03	07:34	07:48	06:51	06:04	05:41
	17:07	17:49	19:26	20:05	20:42	21:11
12	08:02	07:33	07:46	06:49	06:03	05:41
	17:08	17:50	19:27	20:06	20:43	21:12
13	08:02	07:31	07:44	06:48	06:02	05:41
	17:10	17:52	19:28	20:07	20:44	21:13
14	08:02	07:30	07:43	06:46	07:06 (T-43)	06:01
	17:11	17:53	19:30	20:09	1 07:07 (T-43)	20:45
15	08:01	07:28	07:41	06:44	07:04 (T-43)	06:00
	17:12	17:55	19:31	20:10	2 07:06 (T-43)	20:47
16	08:01	07:27	07:39	06:42	07:03 (T-43)	05:59
	17:13	17:56	19:32	20:11	3 07:06 (T-43)	20:48
17	08:00	07:25	07:37	06:41	07:01 (T-43)	05:58
	17:14	17:57	19:34	20:12	4 07:05 (T-43)	20:49
18	07:59	07:24	07:35	06:39	06:59 (T-43)	05:56
	17:16	17:59	19:35	20:14	4 07:03 (T-43)	20:50
19	07:59	07:22	07:33	06:37	06:58 (T-43)	05:55
	17:17	18:00	19:36	20:15	2 07:00 (T-43)	20:51
20	07:58	07:21	07:32	06:36	05:54	05:54
	17:18	18:00	19:37	20:16	20:52	21:15
21	07:57	07:19	07:30	06:34	05:53	05:41
	17:20	18:02	19:39	20:17	20:53	21:16
22	07:56	07:18	07:28	06:32	05:53	06:15 (T-42)
	17:21	18:03	19:40	20:19	20:54	1 06:16 (T-42)
23	07:56	07:16	07:26	06:31	05:52	06:14 (T-42)
	17:22	18:04	19:41	20:20	20:55	2 06:16 (T-42)
24	07:55	07:14	07:24	06:29	05:51	06:14 (T-42)
	17:24	18:06	19:42	20:21	20:56	3 06:17 (T-42)
25	07:54	07:13	07:22	06:27	05:50	06:13 (T-42)
	17:25	18:07	19:44	20:22	20:57	4 06:17 (T-42)
26	07:53	07:11	07:20	06:26	05:49	06:12 (T-42)
	17:26	18:09	19:45	20:24	20:58	5 06:17 (T-42)
27	07:52	07:09	07:18	06:24	05:48	06:11 (T-42)
	17:28	18:10	19:46	20:25	20:59	6 06:17 (T-42)
28	07:51	07:08	07:17	06:23	05:48	06:11 (T-42)
	17:29	18:11	19:47	20:26	21:00	7 06:18 (T-42)
29	07:50		07:15	06:21	05:47	06:10 (T-42)
	17:31		19:49	20:27	21:01	8 06:18 (T-42)
30	07:49		07:13	06:20	05:46	06:10 (T-42)
	17:32		19:50	20:29	21:02	8 06:18 (T-42)
31	07:48		07:11		05:46	06:09 (T-42)
	17:33		19:51		21:03	9 06:18 (T-42)
Potential sun hours	287	292	369	403	459	465
Total, worst case				74	53	349
Sun reduction				0.63	0.66	0.73
Oper. time red.				0.90	0.90	0.90
Wind dir. red.				0.59	0.59	0.59
Total reduction				0.34	0.35	0.39
Total, real				25	19	135

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-101 - R-101
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:09 (T-42)	06:12	06:49	07:24	07:43
	21:16	12 06:21 (T-42)	20:55	20:07	19:11	17:17
2	05:46	06:10 (T-42)	06:14	06:50	07:25	07:44
	21:16	12 06:22 (T-42)	20:54	20:05	19:09	17:15
3	05:46	06:11 (T-42)	06:15	06:51	07:26	07:45
	21:16	12 06:23 (T-42)	20:52	20:03	19:07	17:14
4	05:47	06:11 (T-42)	06:16	06:52	19:28 (T-32)	07:28
	21:16	12 06:23 (T-42)	20:51	20:01	6 19:34 (T-32)	19:05
5	05:47	06:12 (T-42)	06:17	06:53	19:25 (T-32)	07:29
	21:16	11 06:23 (T-42)	20:50	20:00	10 19:35 (T-32)	19:03
6	05:48	06:12 (T-42)	06:18	06:54	19:23 (T-32)	07:30
	21:15	11 06:23 (T-42)	20:48	19:58	10 19:33 (T-32)	19:02
7	05:49	06:13 (T-42)	06:19	06:56	19:22 (T-32)	07:31
	21:15	11 06:24 (T-42)	20:47	19:56	9 19:31 (T-32)	19:00
8	05:49	06:14 (T-42)	06:20	06:57	19:21 (T-32)	07:33
	21:15	11 06:25 (T-42)	20:46	19:54	8 19:29 (T-32)	18:56
9	05:50	06:14 (T-42)	06:22	06:58	19:20 (T-32)	07:34
	21:14	10 06:24 (T-42)	20:44	19:52	7 19:27 (T-32)	18:54
10	05:51	06:15 (T-42)	06:23	06:59	19:21 (T-32)	07:35
	21:14	10 06:25 (T-42)	20:43	19:50	5 19:26 (T-32)	18:52
11	05:52	06:16 (T-42)	06:24	07:00	19:21 (T-32)	07:36
	21:13	10 06:26 (T-42)	20:41	19:48	3 19:24 (T-32)	18:51
12	05:53	06:17 (T-42)	06:25	07:01	19:21 (T-32)	07:38
	21:13	9 06:26 (T-42)	20:40	19:47	1 19:22 (T-32)	18:49
13	05:53	06:18 (T-42)	06:26	07:03	07:39	07:20
	21:12	8 06:26 (T-42)	20:38	19:45	18:47	17:02
14	05:54	06:18 (T-42)	06:27	07:04	07:40	07:22
	21:12	8 06:26 (T-42)	20:37	19:43	18:45	17:01
15	05:55	06:19 (T-42)	06:29	07:05	07:41	07:23
	21:11	7 06:26 (T-42)	20:35	19:41	18:44	17:00
16	05:56	06:20 (T-42)	06:30	07:06	07:43	07:24
	21:10	6 06:26 (T-42)	20:34	19:39	18:42	16:59
17	05:57	06:21 (T-42)	06:31	07:07	07:44	07:26
	21:09	6 06:27 (T-42)	20:32	19:37	18:40	16:58
18	05:58	06:22 (T-42)	06:32	07:08	07:45	07:27
	21:09	5 06:27 (T-42)	20:31	19:35	18:39	16:57
19	05:59	06:23 (T-42)	06:33	07:10	07:47	07:28
	21:08	4 06:27 (T-42)	20:29	19:33	18:37	16:56
20	06:00	06:24 (T-42)	06:34	07:11	07:48	07:30
	21:07	3 06:27 (T-42)	20:27	19:31	18:35	16:55
21	06:01	06:25 (T-42)	06:36	07:12	07:49	07:31
	21:06	1 06:26 (T-42)	20:26	19:30	18:34	16:54
22	06:02		06:37	07:13	07:51	07:32
	21:05		20:24	19:28	18:32	16:53
23	06:03		06:38	07:14	07:52	07:33
	21:04		20:22	19:26	18:30	16:53
24	06:04		06:39	07:16	07:53	07:35
	21:04		20:21	2 07:03 (T-43)	19:24	18:29
25	06:05		06:40	07:17	07:55	07:36
	21:03		20:19	4 07:07 (T-43)	19:22	18:27
26	06:06		06:41	07:18	07:56	07:37
	21:02		20:17	3 07:07 (T-43)	19:20	18:26
27	06:07		06:43	07:19	07:57	07:38
	21:00		20:16	3 07:08 (T-43)	19:18	18:24
28	06:08		06:44	07:20	07:59	07:40
	20:59		20:14	2 07:08 (T-43)	19:16	18:23
29	06:09		06:45	07:22	08:00	07:41
	20:58		20:12	1 07:08 (T-43)	19:14	18:21
30	06:10		06:46	07:23	08:01	07:42
	20:57		20:10	19:13	18:20	16:49
31	06:11		06:47		08:03	08:04
	20:56		20:09		18:18	16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case	179	15	59			
Sun reduction	0.75	0.72	0.67			
Oper. time red.	0.90	0.90	0.90			
Wind dir. red.	0.59	0.57	0.60			
Total reduction	0.40	0.37	0.36			
Total, real	71	6	21			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



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L085 73 GE3.8-154 WTGs on 98m HH
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-155 - R-155
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	
1	08:04 16:57 46 08:04 16:58 46 08:04 16:59 46 08:04 17:00 46 08:04 17:01 46 08:04 17:02 46 08:04 17:03 46 08:04 17:04 45 08:04 17:05 45 08:03 17:06 44 08:03 17:07 44 08:03 17:08 44 08:02 17:10 43 08:02 17:11 43 08:01 17:12 43 08:01 17:13 41 08:00 17:15 41 07:59 17:16 40 07:59 17:17 39 07:58 17:18 38 07:57 17:20 36 07:57 17:21 34 07:56 17:22 33 07:55 17:24 32 07:54 17:25 30 07:53 17:27 29 07:52 17:28 27 07:51 17:29 23 07:50 17:31 16 07:49 17:32 7 07:48 17:34 7	15:38 (T-32) 16:24 (T-32) 15:39 (T-32) 16:25 (T-32) 15:39 (T-32) 16:26 (T-32) 15:40 (T-32) 16:26 (T-32) 15:40 (T-32) 16:26 (T-32) 15:40 (T-32) 16:26 (T-32) 15:41 (T-32) 16:27 (T-32) 15:42 (T-32) 16:27 (T-32) 15:42 (T-32) 16:27 (T-32) 15:43 (T-32) 16:27 (T-32) 15:44 (T-32) 16:28 (T-32) 15:44 (T-32) 16:28 (T-32) 15:45 (T-32) 16:28 (T-32) 15:45 (T-32) 16:28 (T-32) 15:47 (T-32) 16:28 (T-32) 15:51 (T-32) 16:27 (T-32) 15:52 (T-32) 16:26 (T-32) 15:53 (T-32) 16:26 (T-32) 15:54 (T-32) 16:57 (T-82) 15:57 (T-32) 16:59 (T-82) 15:58 (T-32) 17:00 (T-82) 16:00 (T-32) 17:02 (T-82) 16:02 (T-32) 17:03 (T-82) 16:06 (T-32) 17:04 (T-82) 16:59 (T-82) 17:06 (T-82) 17:00 (T-82) 17:07 (T-82)	07:47 17:09 (T-82) 07:46 07:45 17:38 17:39 07:42 17:41 07:41 07:40 17:43 07:38 07:37 17:46 07:36 17:48 07:34 17:49 07:33 17:51 07:31 17:52 07:30 07:28 17:55 07:27 17:56 07:25 17:58 07:24 17:59 07:22 18:00 07:21 18:00 07:19 18:02 07:18 18:03 07:16 18:04 07:14 18:06 07:13 18:07 07:11 18:09 07:09 18:10 07:08 18:11 07:15 18:07 07:13 19:50 07:11 19:51	17:02 (T-82) 17:09 (T-82) 18:13 07:04 18:14 07:02 18:15 07:01 18:17 06:59 18:18 06:57 18:19 06:55 18:21 07:54 18:22 07:52 19:23 07:50 19:25 07:48 19:26 07:46 19:27 07:45 19:29 07:43 19:30 07:41 19:31 07:39 19:32 07:37 19:34 07:35 19:35 07:33 19:36 07:32 19:37 07:30 19:39 07:28 19:40 07:26 19:41 07:24 19:43 07:22 19:44 07:20 19:45 07:19 19:46 07:17 19:48 07:15 19:49 07:13 19:50 07:11 19:51	17:45 (T-93) 17:51 (T-93) 17:44 (T-93) 17:52 (T-93) 17:44 (T-93) 17:54 (T-93) 17:45 (T-93) 17:55 (T-93) 17:45 (T-93) 17:56 (T-93) 17:48 (T-93) 17:57 (T-93) 06:58 20:00 06:57 20:01 06:55 20:03 06:53 20:04 06:51 20:05 06:49 20:06 06:48 20:08 06:46 20:09 06:44 20:10 06:42 20:11 06:41 20:13 06:39 20:14 06:37 20:15 06:36 20:16 06:34 20:17 06:32 20:19 06:31 20:20 06:29 20:21 06:27 20:22 06:26 20:24 06:24 20:25 06:23 20:26 06:21 20:27 06:20 20:29 05:46 21:03	07:09 19:53 07:07 19:54 07:06 19:55 07:04 19:56 07:02 19:58 07:00 19:59 06:58 20:37 06:57 20:38 20:07 20:40 06:06 20:41 06:05 20:42 06:03 20:43 06:02 20:44 06:01 20:45 06:00 20:47 05:59 20:48 05:58 20:49 05:57 20:50 05:55 20:51 05:54 20:52 05:54 20:53 05:53 20:54 05:52 20:55 05:51 20:56 05:50 20:57 05:49 20:58 05:48 20:59 05:48 21:00 05:47 21:01 05:46 21:02 05:46 21:03	05:45 21:04 05:45 21:05 05:44 21:06 05:44 21:07 05:43 21:07 05:43 21:08 05:42 21:09 05:42 21:10 05:42 21:11 05:41 21:11 05:41 21:12 05:41 21:13 05:41 21:13 05:41 21:14 05:41 21:14 05:41 21:15 05:41 21:15 05:41 21:16 05:41 21:16 05:42 21:16 05:42 21:17 05:43 21:17 05:44 21:17 05:44 21:17 05:44 21:17 05:45 21:17 05:45 21:17
Potential sun hours	287	292	369	403	459	465	
Total, worst case	1146	16	54				
Sun reduction	0.58	0.58	0.59				
Oper. time red.	0.90	0.90	0.90				
Wind dir. red.	0.61	0.58	0.58				
Total reduction	0.32	0.30	0.31				
Total, real	366	5	17				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-155 - R-155

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45	06:12	06:49	07:24	07:04	07:43
	21:17	20:55	20:07	19:11	17:17	16:48
2	05:46	06:14	06:50	07:25	07:05	07:44
	21:16	20:54	20:05	19:09	17:15	16:48
3	05:46	06:15	06:51	07:27	07:07	07:46
	21:16	20:52	20:03	19:07	17:14	16:48
4	05:47	06:16	06:52	07:28	07:08	07:47
	21:16	20:51	20:01	19:05	17:13	16:47
5	05:47	06:17	06:53	07:29	07:09	07:48
	21:16	20:50	20:00	19:03	17:11	16:47
6	05:48	06:18	06:54	07:30	07:11	07:49
	21:15	20:48	19:58	19:02	17:10	16:47
7	05:49	06:19	06:56	07:31	18:25 (T-93)	07:12
	21:15	20:47	19:56	19:00	18:31 (T-93)	17:09
8	05:49	06:20	06:57	07:33	18:22 (T-93)	07:14
	21:15	20:46	19:54	18:56	11 18:33 (T-93)	17:08
9	05:50	06:22	06:58	07:34	18:20 (T-93)	07:15
	21:14	20:44	19:52	18:54	10 18:30 (T-93)	17:06
10	05:51	06:23	06:59	07:35	18:19 (T-93)	07:16
	21:14	20:43	19:50	18:53	9 18:28 (T-93)	17:05
11	05:52	06:24	07:00	07:36	18:18 (T-93)	07:18
	21:13	20:41	19:48	18:51	9 18:27 (T-93)	17:04
12	05:53	06:25	07:02	07:38	18:18 (T-93)	07:19
	21:13	20:40	19:47	18:49	7 18:25 (T-93)	17:03
13	05:53	06:26	07:03	07:39	18:17 (T-93)	07:20
	21:12	20:38	19:45	18:47	6 18:23 (T-93)	17:02
14	05:54	06:27	07:04	07:40	18:18 (T-93)	07:22
	21:12	20:37	19:43	18:45	4 18:22 (T-93)	17:01
15	05:55	06:29	07:05	07:42	18:18 (T-93)	07:23
	21:11	20:35	19:41	18:44	2 18:20 (T-93)	17:00
16	05:56	06:30	07:06	07:43	07:24	15:31 (T-32)
	21:10	20:34	19:39	18:42	16:59	29 16:33 (T-82)
17	05:57	06:31	07:07	07:44	07:26	15:30 (T-32)
	21:10	20:32	19:37	18:40	16:58	30 16:32 (T-82)
18	05:58	06:32	07:09	07:45	07:27	15:28 (T-32)
	21:09	20:31	19:35	18:39	16:57	32 16:31 (T-82)
19	05:59	06:33	07:10	07:47	07:28	15:28 (T-32)
	21:08	20:29	19:33	18:37	16:56	33 16:01 (T-32)
20	06:00	06:34	07:11	07:48	07:30	15:27 (T-32)
	21:07	20:27	19:32	18:35	16:55	34 16:01 (T-32)
21	06:01	06:36	07:12	07:49	07:31	15:27 (T-32)
	21:06	20:26	19:30	18:34	16:54	36 16:03 (T-32)
22	06:02	06:37	07:13	07:51	07:32	15:26 (T-32)
	21:05	20:24	19:28	18:32	16:54	38 16:04 (T-32)
23	06:03	06:38	07:14	07:52	07:34	15:25 (T-32)
	21:05	20:23	19:26	18:30	16:53	39 16:04 (T-32)
24	06:04	06:39	07:16	07:53	07:35	15:26 (T-32)
	21:04	20:21	19:24	18:29	16:52	40 16:06 (T-32)
25	06:05	06:40	07:17	07:55	07:36	15:25 (T-32)
	21:03	20:19	19:22	18:27	16:51	41 16:06 (T-32)
26	06:06	06:42	07:18	07:56	07:37	15:25 (T-32)
	21:02	20:17	19:20	18:26	16:51	41 16:06 (T-32)
27	06:07	06:43	07:19	07:57	07:39	15:25 (T-32)
	21:01	20:16	19:18	18:24	16:50	43 16:08 (T-32)
28	06:08	06:44	07:20	07:59	07:40	15:25 (T-32)
	20:59	20:14	19:16	18:23	16:50	43 16:08 (T-32)
29	06:09	06:45	07:22	08:00	07:41	15:25 (T-32)
	20:58	20:12	19:15	18:21	16:49	44 16:09 (T-32)
30	06:10	06:46	07:23	08:01	07:42	15:25 (T-32)
	20:57	20:10	19:13	18:20	16:49	44 16:09 (T-32)
31	06:11	06:47	08:03			08:04
	20:56	20:09	18:18			16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case				64	655	1423
Sun reduction				0.56	0.48	0.52
Oper. time red.				0.90	0.90	0.90
Wind dir. red.				0.58	0.61	0.61
Total reduction				0.29	0.26	0.29
Total, real				19	173	408

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-156 - R-156
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	
1	08:04	07:47	08:09 (T-42)	07:06	07:09	06:18	05:45
	16:57	17:35	7 08:16 (T-42)	18:13	19:52	20:30	21:04
2	08:04	07:46	08:08 (T-42)	07:04	07:07	06:17	05:44
	16:58	17:36	9 08:17 (T-42)	18:14	19:54	20:31	21:05
3	08:04	07:45	08:06 (T-42)	07:02	07:06	06:15	05:44
	16:59	17:38	10 08:16 (T-42)	18:15	19:55	20:32	21:06
4	08:04	07:43	08:05 (T-42)	07:01	07:04	06:14	05:44
	17:00	17:39	12 08:17 (T-42)	18:17	19:56	20:33	21:07
5	08:04	07:42	08:04 (T-42)	06:59	07:02	06:12	05:43
	17:01	17:41	13 08:17 (T-42)	18:18	19:57	20:35	21:07
6	08:04	07:41	08:03 (T-42)	06:57	07:00	06:11	05:43
	17:02	17:42	14 08:17 (T-42)	18:19	19:59	20:36	21:08
7	08:04	07:40	08:01 (T-42)	06:55	06:58	06:10	05:42
	17:03	17:43	16 08:17 (T-42)	18:21	20:00	20:37	21:09
8	08:04	07:38	08:00 (T-42)	07:53	06:56	06:08	05:42
	17:04	17:45	17 08:17 (T-42)	18:22	20:01	20:38	21:09
9	08:04	07:37	07:58 (T-42)	07:52	06:55	06:07	05:42
	17:05	17:46	17 08:15 (T-42)	19:23	20:02	20:40	21:10
10	08:03	07:36	07:57 (T-42)	07:50	19:02 (T-30)	06:53	06:06
	17:06	17:48	18 08:15 (T-42)	19:25	1 19:03 (T-30)	20:04	20:41
11	08:03	07:34	07:59 (T-42)	07:48	19:01 (T-30)	06:51	06:04
	17:07	17:49	15 08:14 (T-42)	19:26	3 19:04 (T-30)	20:05	20:42
12	08:03	07:33	08:00 (T-42)	07:46	19:01 (T-30)	06:49	06:03
	17:08	17:50	12 08:12 (T-42)	19:27	5 19:06 (T-30)	20:06	20:43
13	08:02	07:31	08:04 (T-42)	07:44	19:00 (T-30)	06:48	06:02
	17:09	17:52	5 08:09 (T-42)	19:28	7 19:07 (T-30)	20:07	20:44
14	08:02	07:30	07:43	07:43	19:00 (T-30)	06:46	06:01
	17:11	17:53	19:30	8 19:08 (T-30)	20:09	20:45	21:13
15	08:01	07:28	07:41	07:41	19:00 (T-30)	06:44	06:00
	17:12	17:55	19:31	10 19:10 (T-30)	20:10	20:47	21:14
16	08:01	07:27	07:39	07:39	19:01 (T-30)	06:42	05:59
	17:13	17:56	19:32	10 19:11 (T-30)	20:11	20:48	21:14
17	08:00	07:25	07:37	07:37	19:02 (T-30)	06:41	05:57
	17:14	17:57	19:34	9 19:11 (T-30)	20:12	20:49	21:14
18	07:59	07:24	07:35	07:35	06:39	05:56	05:41
	17:16	17:59	19:35	20:14	20:50	21:15	21:15
19	07:59	07:22	07:33	07:33	06:37	05:55	05:41
	17:17	18:00	19:36	20:15	20:51	21:15	21:15
20	07:58	07:21	07:31	07:31	06:35	05:54	05:41
	17:18	18:00	19:37	20:16	20:52	21:15	21:15
21	07:57	07:19	07:30	07:30	06:34	05:53	05:41
	17:20	18:02	19:39	20:17	20:53	21:16	21:16
22	07:57	07:18	07:28	07:28	06:32	05:52	05:41
	17:21	18:03	19:40	20:19	20:54	21:16	21:16
23	07:56	07:16	07:26	07:26	06:31	05:52	05:42
	17:22	18:04	19:41	20:20	20:55	21:16	21:16
24	07:55	07:14	07:24	07:24	06:29	05:51	05:42
	17:24	18:06	19:42	20:21	20:56	21:16	21:16
25	07:54	07:13	07:22	07:22	06:27	05:50	05:42
	17:25	18:07	19:44	20:22	20:57	21:16	21:16
26	07:53	07:11	07:20	07:20	06:26	05:49	05:43
	17:26	18:08	19:45	20:24	20:58	21:17	21:17
27	07:52	07:09	07:18	07:18	06:24	05:48	05:43
	17:28	18:10	19:46	20:25	20:59	21:17	21:17
28	07:51	07:08	07:17	07:17	06:23	05:48	05:43
	17:29	18:11	19:47	20:26	21:00	21:17	21:17
29	07:50		07:15	07:15	06:21	05:47	05:44
	17:31		19:49	20:27	21:01	21:17	21:17
30	07:49	08:11 (T-42)	07:13	07:13	06:20	05:46	05:44
	17:32	3 08:14 (T-42)	19:50	20:29	21:02	21:17	21:17
31	07:48	08:10 (T-42)	07:11	07:11	06:19	05:45	05:43
	17:33	5 08:15 (T-42)	19:51	21:03			
Potential sun hours	287	292	369	403	459	465	211
Total, worst case	8	165	53				0.73
Sun reduction	0.58	0.58	0.59				0.90
Oper. time red.	0.90	0.90	0.90				0.59
Wind dir. red.	0.64	0.64	0.58				0.39
Total reduction	0.34	0.34	0.31				0.39
Total, real	3	55	16				82

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-156 - R-156
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:09 (T-18) 06:16 (T-18)	06:12 20:55	06:49 20:07	07:24 19:11	07:43 16:48
2	05:45 21:16	06:10 (T-18) 06:17 (T-18)	06:13 20:54	06:50 20:05	07:25 19:09	07:44 16:48
3	05:46 21:16	06:10 (T-18) 06:16 (T-18)	06:15 20:52	06:51 20:03	07:26 19:07	07:45 16:48
4	05:47 21:16	06:11 (T-18) 06:16 (T-18)	06:16 20:51	06:52 20:01	07:28 19:05	07:47 16:47
5	05:47 21:16	06:12 (T-18) 06:16 (T-18)	06:17 20:50	06:53 20:00	07:29 19:03	07:48 16:47
6	05:48 21:15	06:12 (T-18) 06:15 (T-18)	06:18 20:48	06:54 19:58	07:30 19:01	07:49 16:47
7	05:49 21:15	06:13 (T-18) 06:15 (T-18)	06:19 20:47	06:56 19:56	07:31 19:00	07:50 16:47
8	05:49 21:15	06:13 (T-18) 06:15 (T-18)	06:19 20:47	06:56 19:56	07:31 19:00	07:50 16:47
9	05:50 21:14	06:15 (T-18) 06:21	06:20 19:54	06:57 18:56	07:33 17:07	07:51 16:47
10	05:51 21:14	06:15 (T-18) 06:23	06:20 19:52	06:57 18:54	07:33 17:06	07:51 16:46
11	05:52 21:13	06:15 (T-18) 06:24	06:21 19:50	06:58 18:52	07:34 17:05	07:52 16:46
12	05:52 21:13	06:15 (T-18) 06:24	06:21 19:48	06:58 18:51	07:34 17:04	07:52 16:46
13	05:53 21:12	06:15 (T-18) 06:26	06:22 19:47	06:59 18:49	07:35 17:03	07:53 16:46
14	05:54 21:12	06:15 (T-18) 06:27	06:23 19:45	07:00 18:47	07:36 17:02	07:54 16:47
15	05:55 21:11	06:15 (T-18) 06:28	06:24 19:43	07:01 18:45	07:37 17:01	07:55 16:47
16	05:56 21:10	06:15 (T-18) 06:30	06:25 19:41	07:02 18:44	07:38 17:00	07:56 16:47
17	05:57 21:10	06:15 (T-18) 06:31	06:26 19:39	07:03 18:42	07:39 16:59	07:57 16:47
18	05:58 21:09	06:15 (T-18) 06:32	06:27 19:37	07:04 18:40	07:40 16:58	07:58 16:47
19	05:59 21:08	06:15 (T-18) 06:33	06:28 19:35	07:05 18:39	07:41 16:57	07:59 16:48
20	06:00 21:07	06:15 (T-18) 06:34	06:29 19:33	07:06 18:37	07:42 16:56	08:00 16:48
21	06:01 21:06	06:15 (T-18) 06:36	06:30 19:31	07:07 18:35	07:43 16:55	08:01 16:49
22	06:02 21:05	06:15 (T-18) 06:37	06:31 19:30	07:08 18:34	07:44 16:54	08:02 16:49
23	06:03 21:05	06:15 (T-18) 06:38	06:32 19:28	07:09 18:32	07:45 16:53	08:03 16:49
24	06:04 21:04	06:15 (T-18) 06:39	06:33 19:26	07:10 18:30	07:46 16:53	08:04 16:50
25	06:05 21:03	06:15 (T-18) 06:40	06:34 19:24	07:11 18:29	07:47 16:52	08:05 16:51
26	06:06 21:02	06:15 (T-18) 06:41	06:35 19:22	07:12 18:27	07:48 16:51	08:06 16:51
27	06:07 21:00	06:15 (T-18) 06:43	06:36 19:20	07:13 18:25	07:49 16:51	08:07 16:52
28	06:08 20:59	06:15 (T-18) 06:44	06:37 19:18	07:14 18:23	07:50 16:50	08:08 16:53
29	06:09 20:58	06:15 (T-18) 06:45	06:38 19:16	07:15 18:21	07:51 16:50	08:09 16:54
30	06:10 20:57	06:15 (T-18) 06:46	06:39 19:14	07:16 18:20	07:52 16:49	08:10 16:55
31	06:11 20:56	06:15 (T-18) 06:47	06:40 19:13	07:17 18:18	07:53 16:48	08:11 16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case						
Sun reduction	34		45	49	138	
Oper. time red.	0.75		0.67	0.56	0.48	
Wind dir. red.	0.90		0.90	0.90	0.90	
Total reduction	0.59		0.58	0.62	0.64	
Total, real	0.40		0.35	0.32	0.28	
Total, real	14		16	15	38	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-157 - R-157
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June					
1	08:04	07:47	16:46 (T-30)	07:06	07:09	19:16 (T-29)	06:18	06:39 (T-17)	05:45		20:01 (T-13)
	16:57	17:35	23 17:09 (T-30)	18:13	19:53	15 19:31 (T-29)	20:30	9 20:06 (T-13)	21:04	12	20:13 (T-13)
2	08:04	07:46	16:45 (T-30)	07:04	07:07	19:16 (T-29)	06:17	06:38 (T-17)	05:45		20:03 (T-13)
	16:58	17:36	26 17:11 (T-30)	18:14	19:54	17 19:33 (T-29)	20:31	15 20:08 (T-13)	21:05	8	20:11 (T-13)
3	08:04	07:45	16:44 (T-30)	07:02	07:06	19:16 (T-29)	06:15	06:36 (T-17)	05:44		
	16:59	17:38	28 17:12 (T-30)	18:15	19:55	18 19:34 (T-29)	20:32	19 20:08 (T-13)	21:06		
4	08:04	07:43	16:43 (T-30)	07:01	07:04	19:15 (T-29)	06:14	06:35 (T-17)	05:44		
	17:00	17:39	30 17:13 (T-30)	18:17	19:56	20 19:35 (T-29)	20:34	24 20:10 (T-13)	21:07		
5	08:04	07:42	16:43 (T-30)	06:59	07:02	19:15 (T-29)	06:12	06:34 (T-17)	05:43		
	17:01	17:41	32 17:15 (T-30)	18:18	19:58	21 19:36 (T-29)	20:35	28 20:11 (T-13)	21:07		
6	08:04	07:41	16:43 (T-30)	06:57	07:00	19:15 (T-29)	06:11	06:32 (T-17)	05:43		
	17:02	17:42	34 17:17 (T-30)	18:19	19:59	22 19:37 (T-29)	20:36	31 20:12 (T-13)	21:08		
7	08:04	07:40	16:42 (T-30)	06:55	06:58	19:16 (T-29)	06:10	06:31 (T-17)	05:42		
	17:03	17:43	36 17:18 (T-30)	18:21	20:00	19 19:35 (T-29)	20:37	34 20:13 (T-13)	21:09		
8	08:04	07:38	16:42 (T-30)	07:54	06:57	19:18 (T-29)	06:08	06:30 (T-17)	05:42		
	17:04	17:45	38 17:20 (T-30)	18:22	20:01	16 19:34 (T-29)	20:38	37 20:14 (T-13)	21:10		
9	08:04	07:37	16:42 (T-30)	07:52	06:55	19:19 (T-29)	06:07	06:29 (T-17)	05:42		
	17:05	17:46	40 17:22 (T-30)	19:23	20:03	13 19:32 (T-29)	20:40	40 20:16 (T-13)	21:10		
10	08:03	07:36	16:41 (T-30)	07:50	06:53	19:22 (T-29)	06:06	06:27 (T-17)	05:42		
	17:06	17:48	42 17:23 (T-30)	19:25	20:04	7 19:29 (T-29)	20:41	43 20:16 (T-13)	21:11		
11	08:03	07:34	16:41 (T-30)	07:48	06:51		06:04	06:26 (T-17)	05:41		
	17:07	17:49	44 17:25 (T-30)	19:26	20:05		20:42	45 20:17 (T-13)	21:12		
12	08:03	07:33	16:41 (T-30)	07:46	06:49		06:03	06:25 (T-17)	05:41		
	17:08	17:51	45 17:26 (T-30)	19:27	20:06		20:43	47 20:19 (T-13)	21:12		
13	08:02	07:31	16:41 (T-30)	07:44	06:48		06:02	06:24 (T-17)	05:41		
	17:10	17:52	45 17:26 (T-30)	19:28	20:08		20:44	49 20:20 (T-13)	21:13		
14	08:02	07:30	16:41 (T-30)	07:43	06:46		06:01	06:23 (T-17)	05:41		
	17:11	17:53	45 17:26 (T-30)	19:30	20:09		20:45	50 20:21 (T-13)	21:13		
15	08:01	07:28	16:42 (T-30)	07:41	06:44		06:00	06:22 (T-17)	05:41		
	17:12	17:55	44 17:26 (T-30)	19:31	20:10		20:47	51 20:21 (T-13)	21:14		
16	08:01	07:27	16:41 (T-30)	07:39	06:42		05:59	06:22 (T-17)	05:41		
	17:13	17:56	44 17:25 (T-30)	19:32	20:11		20:48	49 20:21 (T-13)	21:14		
17	08:00	07:25	16:42 (T-30)	07:37	06:41		05:58	06:23 (T-17)	05:41		
	17:15	17:58	43 17:25 (T-30)	19:34	20:13		20:49	47 20:21 (T-13)	21:15		
18	07:59	07:24	16:42 (T-30)	07:35	06:39		05:56	06:25 (T-17)	05:41		
	17:16	17:59	42 17:24 (T-30)	19:35	20:14		20:50	43 20:21 (T-13)	21:15		
19	07:59	07:22	16:43 (T-30)	07:33	06:37		05:55	06:27 (T-17)	05:41		
	17:17	18:00	40 17:23 (T-30)	19:36	20:15		20:51	39 20:21 (T-13)	21:15		
20	07:58	07:21	16:44 (T-30)	07:32	06:36		05:54	19:51 (T-13)	05:41		
	17:18	18:00	39 17:23 (T-30)	19:37	20:16		20:52	29 20:20 (T-13)	21:16		
21	07:57	07:19	16:44 (T-30)	07:30	06:34		05:53	19:51 (T-13)	05:41		
	17:20	18:02	38 17:22 (T-30)	19:39	20:18		20:53	29 20:20 (T-13)	21:16		
22	07:57	07:18	16:46 (T-30)	07:28	06:32		05:53	19:51 (T-13)	05:42		
	17:21	18:03	36 17:22 (T-30)	19:40	20:19		20:54	28 20:19 (T-13)	21:16		
23	07:56	07:16	16:47 (T-30)	07:26	06:31		05:52	19:52 (T-13)	05:42		
	17:22	18:04	33 17:20 (T-30)	19:41	20:20		20:55	27 20:19 (T-13)	21:16		
24	07:55	07:14	16:48 (T-30)	07:24	06:29		05:51	19:53 (T-13)	05:42		
	17:24	18:06	30 17:18 (T-30)	19:43	20:21		20:56	26 20:19 (T-13)	21:16		
25	07:54	07:13	16:49 (T-30)	07:22	06:27		05:50	19:54 (T-13)	05:42		
	17:25	18:07	27 17:16 (T-30)	19:44	20:22		20:57	24 20:18 (T-13)	21:17		
26	07:53	16:57 (T-30)	07:11	07:20	06:26		05:49	19:54 (T-13)	05:43		
	17:27	3 17:00 (T-30)	18:09	22 17:14 (T-30)	19:45		20:58	23 20:17 (T-13)	21:17		
27	07:52	16:54 (T-30)	07:09	07:19	06:24	19:24 (T-29)	05:48	19:55 (T-13)	05:43		
	17:28	8 17:02 (T-30)	18:10	16 17:11 (T-30)	19:46	1 19:25 (T-29)	20:25	20:59	22 20:17 (T-13)	21:17	
28	07:51	16:50 (T-30)	07:08	07:17	06:23	19:21 (T-29)	05:48	19:56 (T-13)	05:44		
	17:29	12 17:02 (T-30)	18:11	19:48	5 19:26 (T-29)	20:26	21:00	21 20:17 (T-13)	21:17		
29	07:50	16:49 (T-30)		07:15	06:21	19:19 (T-29)	05:47	19:57 (T-13)	05:44		
	17:31	15 17:04 (T-30)		19:49	8 19:27 (T-29)	20:27	21:01	18 20:15 (T-13)	21:17		
30	07:49	16:48 (T-30)		07:13	06:20	20:04 (T-13)	05:46	19:59 (T-13)	05:44		
	17:32	18 17:06 (T-30)		19:50	10 19:28 (T-29)	20:29	21:02	16 20:15 (T-13)	21:17		
31	07:48	16:47 (T-30)		07:11	05:46	19:17 (T-29)	05:46	19:59 (T-13)			
	17:33	20 17:07 (T-30)		19:51	13 19:30 (T-29)		21:03	15 20:14 (T-13)			
Potential sun hours	287	292	369	403	459			465			
Total, worst case	76	962	37	170	978			20			
Sun reduction	0.58	0.58	0.59	0.63	0.66			0.73			
Oper. time red.	0.90	0.90	0.90	0.90	0.90			0.90			
Wind dir. red.	0.59	0.59	0.60	0.60	0.62			0.62			
Total reduction	0.31	0.31	0.32	0.34	0.37			0.41			
Total, real	23	296	12	57	357			8			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-157 - R-157
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum		
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December	
1	05:45	06:12	06:36 (T-17)	06:49	07:24	07:04	
	21:17	20:55	46 20:29 (T-13)	20:07	19:11	17:17	
2	05:46	06:14	06:37 (T-17)	06:50	19:20 (T-29)	07:25	
	21:16	20:54	44 20:28 (T-13)	20:05	8 19:28 (T-29)	19:09	
3	05:46	06:15	06:38 (T-17)	06:51	19:17 (T-29)	07:27	
	21:16	20:52	41 20:26 (T-13)	20:03	13 19:30 (T-29)	19:07	
4	05:47	06:16	06:39 (T-17)	06:52	19:15 (T-29)	07:28	
	21:16	20:51	39 20:25 (T-13)	20:01	16 19:31 (T-29)	19:05	
5	05:47	06:17	06:40 (T-17)	06:53	19:13 (T-29)	07:29	
	21:16	20:50	36 20:24 (T-13)	20:00	19 19:32 (T-29)	19:03	
6	05:48	06:18	06:41 (T-17)	06:54	19:12 (T-29)	07:30	
	21:15	20:48	33 20:22 (T-13)	19:58	21 19:33 (T-29)	19:02	
7	05:49	06:19	06:42 (T-17)	06:56	19:10 (T-29)	07:31	
	21:15	20:47	31 20:21 (T-13)	19:56	21 19:31 (T-29)	19:00	
8	05:49	06:20	06:44 (T-17)	06:57	19:09 (T-29)	07:33	
	21:15	20:46	26 20:20 (T-13)	19:54	20 19:29 (T-29)	18:56	
9	05:50	06:22	06:45 (T-17)	06:58	19:09 (T-29)	07:34	
	21:14	20:44	23 20:19 (T-13)	19:52	18 19:27 (T-29)	18:54	
10	05:51	20:11 (T-13)	06:23	06:46 (T-17)	06:59	19:09 (T-29)	07:35
	21:14	6 20:17 (T-13)	20:43	18 20:17 (T-13)	19:50	17 19:26 (T-29)	18:53
11	05:52	20:10 (T-13)	06:24	06:47 (T-17)	07:00	19:09 (T-29)	07:36
	21:13	10 20:20 (T-13)	20:41	14 20:16 (T-13)	19:48	15 19:24 (T-29)	18:51
12	05:53	20:08 (T-13)	06:25	06:48 (T-17)	07:01	19:09 (T-29)	07:38
	21:13	13 20:21 (T-13)	20:40	6 20:14 (T-13)	19:47	13 19:22 (T-29)	18:49
13	05:53	20:08 (T-13)	06:26	07:03	19:09 (T-29)	07:39	07:20
	21:12	15 20:23 (T-13)	20:38	11 19:45	19:20 (T-29)	18:47	17:02
14	05:54	20:06 (T-13)	06:27	07:04	19:09 (T-29)	07:40	17:22
	21:12	17 20:23 (T-13)	20:37	9 19:43	19:18 (T-29)	18:45	10 17:41 (T-30)
15	05:55	20:05 (T-13)	06:29	07:05	19:10 (T-29)	07:42	17:26 (T-30)
	21:11	20 20:25 (T-13)	20:35	19:41	6 19:16 (T-29)	18:44	19 17:45 (T-30)
16	05:56	20:05 (T-13)	06:30	07:06	19:11 (T-29)	07:43	17:23 (T-30)
	21:10	21 20:26 (T-13)	20:34	19:39	3 19:14 (T-29)	18:42	24 17:47 (T-30)
17	05:57	20:04 (T-13)	06:31	07:07	07:44	17:21 (T-30)	07:26
	21:10	23 20:27 (T-13)	20:32	19:37	18:40	28 17:49 (T-30)	16:58
18	05:58	20:03 (T-13)	06:32	07:09	07:45	17:19 (T-30)	07:27
	21:09	24 20:27 (T-13)	20:31	19:35	18:39	31 17:50 (T-30)	16:57
19	05:59	20:03 (T-13)	06:33	07:10	07:47	17:17 (T-30)	07:28
	21:08	25 20:28 (T-13)	20:29	19:33	18:37	34 17:51 (T-30)	16:56
20	06:00	20:03 (T-13)	06:34	07:11	07:48	17:16 (T-30)	07:30
	21:07	26 20:29 (T-13)	20:27	19:32	18:35	36 17:52 (T-30)	16:55
21	06:01	20:02 (T-13)	06:36	07:12	07:49	17:15 (T-30)	07:31
	21:06	28 20:30 (T-13)	20:26	19:30	18:34	38 17:53 (T-30)	16:54
22	06:02	20:02 (T-13)	06:37	07:13	07:51	17:14 (T-30)	07:32
	21:06	28 20:30 (T-13)	20:24	19:28	18:32	40 17:54 (T-30)	16:54
23	06:03	20:01 (T-13)	06:38	07:14	07:52	17:13 (T-30)	07:34
	21:05	30 20:31 (T-13)	20:23	19:26	18:30	41 17:54 (T-30)	16:53
24	06:04	06:39 (T-17)	06:39	07:16	07:53	17:12 (T-30)	07:35
	21:04	35 20:31 (T-13)	20:21	19:24	18:29	42 17:54 (T-30)	16:52
25	06:05	06:36 (T-17)	06:40	07:17	07:55	17:12 (T-30)	07:36
	21:03	41 20:31 (T-13)	20:19	19:22	18:27	43 17:55 (T-30)	16:51
26	06:06	06:35 (T-17)	06:42	07:18	07:56	17:11 (T-30)	07:37
	21:02	45 20:32 (T-13)	20:17	19:20	18:26	44 17:55 (T-30)	16:51
27	06:07	06:34 (T-17)	06:43	07:19	07:57	17:11 (T-30)	07:39
	21:01	48 20:32 (T-13)	20:16	19:18	18:24	45 17:56 (T-30)	16:50
28	06:08	06:33 (T-17)	06:44	07:20	07:59	17:11 (T-30)	07:40
	20:59	50 20:32 (T-13)	20:14	19:16	18:23	44 17:55 (T-30)	16:50
29	06:09	06:33 (T-17)	06:45	07:22	08:00	17:10 (T-30)	07:41
	20:58	51 20:32 (T-13)	20:12	19:15	18:21	45 17:55 (T-30)	16:49
30	06:10	06:34 (T-17)	06:46	07:23	08:01	17:11 (T-30)	07:42
	20:57	49 20:31 (T-13)	20:10	19:13	18:20	44 17:55 (T-30)	16:49
31	06:11	06:35 (T-17)	06:47	07:24	08:03	17:10 (T-30)	07:43
	20:56	48 20:30 (T-13)	20:09	19:12	18:18	43 17:53 (T-30)	16:48
Potential sun hours	471	436	377	341	288	275	
Total, worst case	653	357	210	651	401		
Sun reduction	0.75	0.72	0.67	0.56	0.48		
Oper. time red.	0.90	0.90	0.90	0.90	0.90		
Wind dir. red.	0.62	0.61	0.60	0.59	0.59		
Total reduction	0.42	0.40	0.36	0.30	0.25		
Total, real	272	141	75	193	102		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
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Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-158 - R-158
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:15	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:49	06:20	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:12	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:32	20:11	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:54	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:18	18:00	19:38	20:16	20:52	21:16	21:07	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:22	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39	08:04
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:57	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46	05:45	06:11	06:48	08:03	08:03	08:03	08:04
	17:34		19:51	21:03	21:03	21:17	20:56	20:09	18:18	18:18	16:56	16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-160 - R-160

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June		
1	08:04	07:47	07:06	07:09	07:29 (T-16)	06:18	05:45	
	16:57	17:35	18:13	19:53	2 07:31 (T-16)	20:30	21:04	
2	08:04	08:29 (T-17)	07:46	07:04	07:07	07:28 (T-16)	06:17	05:45
	16:58	1 08:30 (T-17)	17:36	18:14	19:54	4 07:32 (T-16)	20:31	21:05
3	08:05	08:29 (T-17)	07:45	07:02	07:06	07:26 (T-16)	06:15	05:44
	16:59	1 08:30 (T-17)	17:38	18:15	19:55	5 07:31 (T-16)	20:32	21:06
4	08:04	08:29 (T-17)	07:44	07:01	07:04	07:24 (T-16)	06:14	05:44
	17:00	2 08:31 (T-17)	17:39	18:17	19:56	6 07:30 (T-16)	20:34	21:07
5	08:04	08:29 (T-17)	07:42	06:59	07:02	07:22 (T-16)	06:12	05:43
	17:01	3 08:32 (T-17)	17:41	18:18	19:58	7 07:29 (T-16)	20:35	21:07
6	08:04	08:28 (T-17)	07:41	06:57	07:00	07:20 (T-16)	06:11	05:43
	17:02	3 08:31 (T-17)	17:42	18:19	19:59	7 07:27 (T-16)	20:36	21:08
7	08:04	08:28 (T-17)	07:40	06:55	06:58	07:20 (T-16)	06:10	05:42
	17:03	4 08:32 (T-17)	17:43	18:21	20:00	3 07:23 (T-16)	20:37	21:09
8	08:04	08:28 (T-17)	07:38	07:54	06:57		06:08	05:42
	17:04	4 08:32 (T-17)	17:45	18:22	20:01		20:38	21:10
9	08:04	08:28 (T-17)	07:37	07:52	06:55		06:07	05:42
	17:05	5 08:33 (T-17)	17:46	19:23	20:03		20:40	21:10
10	08:03	08:27 (T-17)	07:36	07:50	06:53		06:06	05:42
	17:06	6 08:33 (T-17)	17:48	19:25	20:04		20:41	21:11
11	08:03	08:27 (T-17)	07:34	07:48	06:51		06:04	05:41
	17:07	6 08:33 (T-17)	17:49	19:26	20:05		20:42	21:12
12	08:03	08:26 (T-17)	07:33	07:46	06:49		06:03	05:41
	17:08	7 08:33 (T-17)	17:51	19:27	20:06		20:43	21:12
13	08:02	08:26 (T-17)	07:31	07:45	06:48		06:02	05:41
	17:10	7 08:33 (T-17)	17:52	19:29	20:08		20:44	21:13
14	08:02	08:25 (T-17)	07:30	07:43	08:03 (T-15)	06:46	06:01	05:41
	17:11	7 08:32 (T-17)	17:53	19:30	2 08:05 (T-15)	20:09	20:46	21:13
15	08:01	08:25 (T-17)	07:29	07:41	08:01 (T-15)	06:44	06:00	05:41
	17:12	7 08:32 (T-17)	17:55	19:31	4 08:05 (T-15)	20:10	20:47	21:14
16	08:01	08:24 (T-17)	07:27	07:39	07:59 (T-15)	06:42	05:59	05:41
	17:13	7 08:31 (T-17)	17:56	19:32	6 08:05 (T-15)	20:11	20:48	21:14
17	08:00	08:25 (T-17)	07:26	07:37	07:57 (T-15)	06:41	05:58	05:41
	17:14	4 08:29 (T-17)	17:58	19:34	7 08:04 (T-15)	20:13	20:49	21:15
18	08:00		07:24	07:35	07:56 (T-15)	06:39	05:56	05:41
	17:16		17:59	19:35	9 08:05 (T-15)	20:14	20:50	21:15
19	07:59		07:22	07:33	07:54 (T-15)	06:37	05:55	05:41
	17:17		18:00	19:36	10 08:04 (T-15)	20:15	20:51	21:15
20	07:58		07:21	07:32	07:52 (T-15)	06:36	05:54	05:41
	17:18		18:00	19:37	11 08:03 (T-15)	20:16	20:52	21:16
21	07:57		07:19	07:30	07:50 (T-15)	06:34	05:53	05:41
	17:20		18:02	19:39	11 08:01 (T-15)	20:18	20:53	21:16
22	07:57		07:18	07:28	07:49 (T-15)	06:32	05:53	05:42
	17:21		18:03	19:40	10 07:59 (T-15)	20:19	20:54	21:16
23	07:56		07:16	07:26	06:31		05:52	05:42
	17:22		18:04	19:41	20:20		20:55	21:16
24	07:55		07:14	07:24	06:29		05:51	05:42
	17:24		18:06	19:43	20:21		20:57	21:17
25	07:54		07:13	07:22	06:27		05:50	05:42
	17:25		18:07	19:44	20:23		20:58	21:17
26	07:53		07:11	07:20	06:26		05:49	05:43
	17:26		18:09	19:45	20:24		20:59	21:17
27	07:52		07:09	07:19	06:24		05:48	05:43
	17:28		18:10	19:46	20:25		21:00	21:17
28	07:51		07:08	07:17	06:23		05:48	05:44
	17:29		18:11	19:48	20:26		21:01	21:17
29	07:50			07:15	06:21		05:47	05:44
	17:31			19:49	20:27		21:01	21:17
30	07:49			07:13	06:20		05:46	05:44
	17:32			19:50	20:29		21:02	21:17
31	07:48			07:11			05:46	
	17:33			19:51			21:03	
Potential sun hours	287	292	369	404	459	465		
Total, worst case	74		70	34				
Sun reduction	0.58		0.59	0.63				
Oper. time red.	0.90		0.90	0.90				
Wind dir. red.	0.65		0.60	0.58				
Total reduction	0.34		0.32	0.33				
Total, real	25		22	11				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

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Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-160 - R-160
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:12 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:48
2	05:46 21:16	06:14 20:54	06:50 20:05	07:25 19:09	07:05 17:15	6 16:48
3	05:46 21:16	06:15 20:52	06:51 20:03	07:27 19:07	07:07 17:14	6 16:48
4	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	5 16:47
5	05:47 21:16	06:17 20:50	06:53 20:00	07:29 19:03	07:10 17:11	4 16:47
6	05:48 21:16	06:18 20:49	06:54 19:58	07:30 19:02	07:11 17:10	3 16:47
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	07:12 17:09	3 16:47
8	05:49 21:15	06:20 20:46	06:57 19:54	07:33 18:56	07:14 17:08	2 16:47
9	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54	07:15 17:06	1 16:46
10	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:53	07:16 17:05	1 16:46
11	05:52 21:13	06:24 20:42	07:00 19:49	07:37 18:51	07:18 17:04	08:18 (T-17)
12	05:52 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	08:18 (T-17)
13	05:53 21:12	06:26 20:39	07:03 19:45	07:39 18:47	07:20 17:02	08:19 (T-17)
14	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	07:22 17:01	08:19 (T-17)
15	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	08:19 (T-17)
16	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59	08:19 (T-17)
17	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40	07:26 16:58	08:19 (T-17)
18	05:58 21:09	06:32 20:31	07:09 19:35	07:45 18:39	07:27 16:57	08:19 (T-17)
19	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	07:28 16:56	08:19 (T-17)
20	06:00 21:07	06:34 20:28	07:11 19:32	07:48 18:35	07:30 16:55	08:19 (T-17)
21	06:01 21:06	06:36 20:26	07:12 19:30	07:49 18:34	07:31 16:54	08:19 (T-17)
22	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:53	08:19 (T-17)
23	06:03 21:05	06:38 20:23	07:14 19:26	07:52 18:30	07:34 16:53	08:19 (T-17)
24	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	08:19 (T-17)
25	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	07:36 16:51	08:03 (T-17)
26	06:06 21:02	06:42 20:17	07:18 19:20	07:56 18:26	07:37 16:51	4 08:03 (T-17)
27	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	07:39 16:50	7 08:04 (T-17)
28	06:08 21:00	06:44 20:14	07:20 19:16	07:59 18:23	07:40 16:50	7 08:05 (T-17)
29	06:09 20:58	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	7 08:06 (T-17)
30	06:10 20:57	06:46 20:10	07:23 19:13	08:01 18:20	07:42 16:49	7 08:07 (T-17)
31	06:11 20:56	06:47 20:09	07:23 19:13	08:03 18:18	07:42 16:49	7 08:08 (T-17)
Potential sun hours	471	436	377	341	288	275
Total, worst case			104		39	35
Sun reduction			0.67		0.48	0.52
Oper. time red.			0.90		0.90	0.90
Wind dir. red.			0.59		0.65	0.65
Total reduction			0.36		0.28	0.30
Total, real			37		11	11

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-161 - R-161
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:47	07:06	07:09	19:20 (T-11)	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:43			
	16:57	17:35	18:13	19:53	11	19:31 (T-11)	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48		
2	08:05	07:46	07:04	07:08	19:20 (T-11)	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:45			
	16:58	17:36	18:14	19:54	13	19:33 (T-11)	20:31	21:05	21:17	20:54	20:05	19:09	17:15	16:48		
3	08:05	07:45	07:03	07:06	19:20 (T-11)	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46			
	16:59	17:38	18:15	19:55	14	19:34 (T-11)	20:32	21:06	21:16	20:53	20:03	19:07	17:14	16:48		
4	08:05	07:44	07:01	07:04	19:20 (T-11)	06:14	05:44	05:47	06:16	06:52	19:21 (T-11)	07:28	07:08	07:47		
	17:00	17:39	18:17	19:56	15	19:35 (T-11)	20:34	21:07	21:16	20:51	20:02	19:32 (T-11)	19:05	17:13	16:47	
5	08:04	07:42	06:59	07:02	19:20 (T-11)	06:12	05:43	05:47	06:17	06:53	19:19 (T-11)	07:29	07:10	07:48		
	17:01	17:41	18:18	19:58	16	19:36 (T-11)	20:35	21:08	21:16	20:50	20:00	14	19:33 (T-11)	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	19:21 (T-11)	06:11	05:43	05:48	06:18	06:55	19:17 (T-11)	07:30	07:11	07:49		
	17:02	17:42	18:19	19:59	16	19:37 (T-11)	20:36	21:08	21:16	20:49	19:58	16	19:33 (T-11)	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	19:22 (T-11)	06:10	05:42	05:49	06:19	06:56	19:15 (T-11)	07:32	07:12	07:50		
	17:03	17:43	18:21	20:00	15	19:37 (T-11)	20:37	21:09	21:15	20:47	19:56	16	19:31 (T-11)	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	19:24 (T-11)	06:08	05:42	05:49	06:20	06:57	19:14 (T-11)	07:33	07:14	07:51		
	17:04	17:45	18:22	20:01	11	19:35 (T-11)	20:39	21:10	21:15	20:46	19:54	15	19:29 (T-11)	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	20:03	06:07	05:42	05:50	06:22	06:58	19:14 (T-11)	07:34	07:15	07:52		
	17:05	17:46	19:23	20:03	20:40	21:10	21:10	21:14	20:44	19:52	14	19:28 (T-11)	18:54	17:06	16:47	
10	08:03	07:36	07:50	06:53	20:04	06:06	05:42	05:51	06:23	06:59	19:14 (T-11)	07:35	07:16	07:53		
	17:06	17:48	19:25	20:04	20:41	21:11	21:11	21:14	20:43	19:50	12	19:26 (T-11)	18:53	17:05	16:47	
11	08:03	07:34	07:48	06:51	20:05	06:05	05:41	05:52	06:24	07:00	19:13 (T-11)	07:37	07:18	07:54		
	17:07	17:49	19:26	20:05	20:42	21:12	21:12	21:13	20:42	19:49	11	19:24 (T-11)	18:51	17:04	16:47	
12	08:03	07:33	07:46	06:49	20:06	06:03	05:41	05:53	06:25	07:02	19:13 (T-11)	07:38	07:19	07:55		
	17:08	17:51	19:27	20:06	20:43	21:12	21:12	21:13	20:40	19:47	9	19:22 (T-11)	18:49	17:03	16:47	
13	08:02	07:32	07:45	06:48	20:08	06:02	05:41	05:53	06:26	07:03	19:13 (T-11)	07:39	07:20	07:55		
	17:10	17:52	19:29	20:08	20:44	21:13	21:12	21:12	20:39	19:45	7	19:20 (T-11)	18:47	17:02	16:47	
14	08:02	07:30	07:43	06:46	20:09	06:01	05:41	05:54	06:27	07:04	19:13 (T-11)	07:40	07:22	07:56		
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	21:12	20:37	19:43	5	19:18 (T-11)	18:46	17:01	16:47	
15	08:01	07:29	07:41	06:44	20:10	06:00	05:41	05:55	06:29	07:05	19:14 (T-11)	07:42	07:23	07:57		
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	21:11	20:36	19:41	2	19:16 (T-11)	18:44	17:00	16:47	
16	08:01	07:27	07:39	06:42	20:11	05:59	05:41	05:56	06:30	07:06	19:16 (T-11)	07:43	07:24	07:58		
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	21:10	20:34	19:39	18:42	16:59	16:47			
17	08:00	07:26	07:37	06:41	20:13	05:58	05:41	05:57	06:31	07:07	18:40	16:58	16:48			
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	21:10	20:32	19:37	18:40	16:58	16:48			
18	08:00	07:24	07:35	06:39	20:14	05:57	05:41	05:58	06:32	07:09	18:39	16:57	16:48			
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	21:09	20:31	19:35	18:39	16:57	16:48			
19	07:59	07:22	07:34	06:37	20:15	05:55	05:41	05:59	06:33	07:10	18:37	16:56	16:48			
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	21:08	20:29	19:34	18:37	16:56	16:48			
20	07:58	07:21	07:32	06:36	20:16	05:54	05:41	06:00	06:34	07:11	18:35	16:55	16:49			
	17:18	18:00	19:38	20:16	20:52	21:16	21:07	21:07	20:28	19:32	18:35	16:55	16:49			
21	07:58	07:19	07:30	06:34	20:17	05:54	05:41	06:01	06:36	07:12	18:34	16:54	16:49			
	17:20	18:02	19:39	20:18	20:53	21:16	21:07	21:07	20:26	19:30	18:34	16:54	16:49			
22	07:57	07:18	07:28	06:32	20:19	05:53	05:42	06:02	06:37	07:13	18:32	16:53	16:50			
	17:21	18:03	19:40	20:19	20:54	21:16	21:06	21:06	20:24	19:28	18:32	16:54	16:50			
23	07:56	07:16	07:26	06:31	20:20	05:52	05:42	06:03	06:38	07:15	18:31	16:53	16:50			
	17:22	18:05	19:41	20:20	20:56	21:16	21:05	21:05	20:23	19:26	18:30	16:53	16:50			
24	07:55	07:14	07:24	06:29	20:21	05:51	05:42	06:04	06:39	07:16	18:29	16:52	16:51			
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	21:04	20:21	19:24	18:29	16:52	16:51			
25	07:54	07:13	07:22	06:27	20:22	05:50	05:42	06:05	06:40	07:17	18:28	16:51	16:51			
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	21:03	20:19	19:22	18:27	16:51	16:51			
26	07:53	07:11	07:20	06:26	20:24	05:49	05:43	06:06	06:42	07:18	18:26	16:51	16:52			
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	21:02	20:17	19:20	18:26	16:51	16:52			
27	07:52	07:09	07:19	06:24	20:25	05:48	05:43	06:07	06:43	07:19	18:25	16:50	16:53			
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	21:01	20:16	19:18	18:24	16:50	16:53			
28	07:51	07:08	07:17	06:23	20:26	05:48	05:44	06:08	06:44	07:21	18:23	16:50	16:53			
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	21:00	20:14	19:17	18:23	16:50	16:53			
29	07:50	07:15	07:25	06:21	20:27	05:47	05:44	06:09	06:45	07:22	18:22	16:49	16:54			
	17:31	18:13	19:49	20:28	21:02	21:17	21:09	21:09	20:12	19:15	18:21	16:49	16:54			
30	07:49	07:13	07:23	06:20	20:29	05:46	05:45	06:10	06:46	07:23	18:20	16:49	16:54			
	17:32	18:15	19:50	20:29	21:02	21:17	21:05	21:05	20:11	19:13	18:20	16:49	16:55			
31	07:48	07:11	07:21	06:19	20:30	05:46	05:41	06:11	06:47	07:24	18:19	16:49	16:55			
	17:34	18:17	19:51	20:30	21:03	21:18	21:06	21:06	20:09	07:25	18:18	16:49	16:56			
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275				
Total, worst case			20	111					132							
Sun reduction			0.59	0.63					0.67							
Oper. time red.			0.90	0.90					0.90							
Wind dir. red.			0.60	0.60					0.60							
Total reduction			0.32	0.34					0.36							
Total, real			6	37					47							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-162 - R-162
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January			February			March			April			May			June		
1	08:04		16:19 (T-29)	07:47			16:14 (T-13)	07:06			07:09	06:18					05:45	
	16:57	9	16:28 (T-29)	17:35	48		17:02 (T-13)	18:13			19:53	20:30					21:04	
2	08:04		16:19 (T-29)	07:46			16:14 (T-13)	07:04			07:07	06:17					05:45	
	16:58	10	16:29 (T-29)	17:36	49		17:03 (T-13)	18:14			19:54	20:31					21:05	
3	08:04		16:19 (T-29)	07:45			16:14 (T-13)	07:02			07:06	06:15					05:44	
	16:59	11	16:30 (T-29)	17:38	49		17:03 (T-13)	18:15			19:55	20:32					21:06	
4	08:04		16:20 (T-29)	07:43			16:14 (T-13)	07:01			07:04	06:14					05:44	
	17:00	12	16:32 (T-29)	17:39	48		17:02 (T-13)	18:17			19:56	20:34					21:07	
5	08:04		16:20 (T-29)	07:42			16:14 (T-13)	06:59			07:02	06:12					05:43	
	17:01	13	16:33 (T-29)	17:41	49		17:03 (T-13)	18:18			19:58	20:35					21:07	
6	08:04		16:19 (T-29)	07:41			16:15 (T-13)	06:57			07:00	06:11					05:43	
	17:02	14	16:33 (T-29)	17:42	48		17:03 (T-13)	18:19			19:59	20:36					21:08	
7	08:04		16:20 (T-29)	07:40			16:15 (T-13)	06:55		07:16 (T-17)	06:58	06:10					05:42	
	17:03	14	16:34 (T-29)	17:43	47		17:02 (T-13)	18:21	3	07:19 (T-17)	20:00	20:37					21:09	
8	08:04		16:20 (T-29)	07:38			16:16 (T-13)	07:54		08:14 (T-17)	06:57	06:08					05:42	
	17:04	16	16:36 (T-29)	17:45	46		17:02 (T-13)	18:22	5	08:19 (T-17)	20:01	20:38					21:10	
9	08:04		16:20 (T-29)	07:37			16:17 (T-13)	07:52		08:12 (T-17)	06:55	06:07					05:42	
	17:05	17	16:37 (T-29)	17:46	45		17:02 (T-13)	19:23	6	08:18 (T-17)	20:03	20:40					21:10	
10	08:03		16:20 (T-29)	07:36			16:17 (T-13)	07:50		08:10 (T-17)	06:53	06:06					05:42	
	17:06	18	16:38 (T-29)	17:48	44		17:01 (T-13)	19:25	8	08:18 (T-17)	20:04	20:41					21:11	
11	08:03		16:21 (T-29)	07:34			16:18 (T-13)	07:48		08:09 (T-17)	06:51	06:04					05:41	
	17:07	19	16:40 (T-29)	17:49	43		17:01 (T-13)	19:26	9	08:18 (T-17)	20:05	20:42					21:12	
12	08:03		16:20 (T-29)	07:33			16:18 (T-13)	07:46		08:07 (T-17)	06:49	06:03					05:41	
	17:08	20	16:40 (T-29)	17:51	42		17:00 (T-13)	19:27	9	08:16 (T-17)	20:06	20:43					21:12	
13	08:02		16:19 (T-13)	07:31			16:20 (T-13)	07:45		08:05 (T-17)	06:48	06:02					05:41	
	17:10	23	16:42 (T-29)	17:52	39		16:59 (T-13)	19:29	10	08:15 (T-17)	20:08	20:44					21:13	
14	08:02		16:18 (T-13)	07:30			16:20 (T-13)	07:43		08:03 (T-17)	06:46	06:01					05:41	
	17:11	25	16:43 (T-29)	17:53	38		16:58 (T-13)	19:30	9	08:12 (T-17)	20:09	20:46					21:13	
15	08:01		16:18 (T-13)	07:29			16:22 (T-13)	07:41			06:44	06:00					05:41	
	17:12	27	16:45 (T-29)	17:55	35		16:57 (T-13)	19:31			20:10	20:47					21:14	
16	08:01		16:17 (T-13)	07:27			16:23 (T-13)	07:39			06:42	05:59					05:41	
	17:13	29	16:46 (T-29)	17:56	32		16:55 (T-13)	19:32			20:11	20:48					21:14	
17	08:00		16:16 (T-13)	07:26			16:25 (T-13)	07:37			06:41	05:58			06:20 (T-15)		05:41	
	17:15	31	16:47 (T-29)	17:58	29		16:54 (T-13)	19:34			20:13	20:49	1	06:21 (T-15)			21:15	
18	08:00		16:17 (T-13)	07:24			16:27 (T-13)	07:35			06:39	05:56			06:19 (T-15)		05:41	
	17:16	32	16:49 (T-29)	17:59	25		16:52 (T-13)	19:35			20:14	20:50	2	06:21 (T-15)			21:15	
19	07:59		16:16 (T-13)	07:22			16:29 (T-13)	07:33			06:37	05:55			06:18 (T-15)		05:41	
	17:17	34	16:50 (T-29)	18:00	20		16:49 (T-13)	19:36			20:15	20:51	3	06:21 (T-15)			21:15	
20	07:58		16:15 (T-13)	07:21			16:35 (T-13)	07:32			06:36	05:54			06:17 (T-15)		05:41	
	17:18	36	16:51 (T-29)	18:00	10		16:45 (T-13)	19:37			20:16	20:52	4	06:21 (T-15)			21:16	
21	07:57		16:15 (T-13)	07:19				07:30			06:34	05:53			06:16 (T-15)		05:41	
	17:20	37	16:52 (T-29)	18:02				19:39			20:18	20:53	5	06:21 (T-15)			21:16	
22	07:57		16:14 (T-13)	07:18				07:28			06:32	05:53			06:15 (T-15)		05:42	
	17:21	40	16:54 (T-13)	18:03				19:40			20:19	20:54	6	06:21 (T-15)			21:16	
23	07:56		16:14 (T-13)	07:16				07:26			06:31	05:52			06:14 (T-15)		05:42	
	17:22	41	16:55 (T-13)	18:04				19:41			20:20	20:55	6	06:20 (T-15)			21:16	
24	07:55		16:15 (T-13)	07:14				07:24			06:29	05:51			06:14 (T-15)		05:42	
	17:24	42	16:57 (T-13)	18:06				19:43			20:21	20:57	7	06:21 (T-15)			21:16	
25	07:54		16:14 (T-13)	07:13				07:22			06:27	05:50			06:13 (T-15)		05:42	
	17:25	45	16:59 (T-13)	18:07				19:44			20:23	20:58	7	06:20 (T-15)			21:17	
26	07:53		16:14 (T-13)	07:11				07:20			06:26	05:49			06:12 (T-15)		05:43	
	17:27	46	17:00 (T-13)	18:09				19:45			20:24	20:59	8	06:20 (T-15)			21:17	
27	07:52		16:14 (T-13)	07:09				07:19			06:24	05:48			06:11 (T-15)		05:43	
	17:28	47	17:01 (T-13)	18:10				19:46			20:25	21:00	8	06:19 (T-15)			21:17	
28	07:51		16:14 (T-13)	07:08				07:17			06:23	05:48			06:11 (T-15)		05:44	
	17:29	47	17:01 (T-13)	18:11				19:48			20:26	21:00	8	06:19 (T-15)			21:17	
29	07:50		16:13 (T-13)					07:15			06:21	05:47			06:10 (T-15)		05:44	
	17:31	48	17:01 (T-13)					19:49			20:27	21:01	8	06:18 (T-15)			21:17	
30	07:49		16:13 (T-13)					07:13			06:20	05:46			06:10 (T-15)		05:44	
	17:32	48	17:01 (T-13)					19:50			20:29	21:02	8	06:18 (T-15)			21:17	
31	07:48		16:13 (T-13)					07:11				05:46			06:10 (T-15)			
	17:34	49	17:02 (T-13)					19:51				21:03	6	06:16 (T-15)				
Potential sun hours		287			292			369			403	459					465	
Total, worst case		900			786			59				87						
Sun reduction		0.58			0.58			0.59				0.66						
Oper. time red.		0.90			0.90			0.90				0.90						
Wind dir. red.		0.59			0.59			0.60				0.59						
Total reduction		0.31			0.31			0.32				0.35						
Total, real		279			242			19				31						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-162 - R-162
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:12 20:55	06:49 20:07	07:24 19:11		
2	05:46 21:16	06:14 20:54	06:50 20:05	07:25 19:09	10 9	
3	05:46 21:16	06:15 20:52	06:51 20:03	07:27 19:07		
4	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	8 7	
5	05:47 21:16	06:17 20:50	06:53 20:00	07:29 19:03		
6	05:48 21:15	06:18 20:49	06:54 19:58	07:30 19:02	4	
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00		
8	05:49 21:15	06:20 20:46	06:57 19:54	07:33 18:56	1	
9	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54		
10	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:53		
11	05:52 21:13	06:24 20:42	07:00 19:49	07:37 18:51		
12	05:53 21:13	06:19 (T-15) 06:23 (T-15)	07:02 19:47	07:38 18:49		
13	05:53 21:12	06:18 (T-15) 06:25 (T-15)	07:03 19:45	07:39 18:47		
14	05:54 21:12	06:18 (T-15) 06:26 (T-15)	07:04 19:43	07:40 18:45		
15	05:55 21:11	06:19 (T-15) 06:27 (T-15)	07:05 19:41	07:42 18:44		
16	05:56 21:10	06:20 (T-15) 06:28 (T-15)	07:06 19:39	07:43 18:42		
17	05:57 21:10	06:21 (T-15) 06:29 (T-15)	07:07 19:37	07:44 18:40		
18	05:58 21:09	06:22 (T-15) 06:29 (T-15)	07:09 19:35	07:45 18:39		
19	05:59 21:08	06:23 (T-15) 06:30 (T-15)	07:10 19:33	07:47 18:37		
20	06:00 21:07	06:24 (T-15) 06:31 (T-15)	07:11 19:32	07:48 18:35		
21	06:01 21:06	06:25 (T-15) 06:31 (T-15)	07:12 19:30	07:49 18:34		
22	06:02 21:06	06:26 (T-15) 06:31 (T-15)	07:13 19:28	07:51 18:32		
23	06:03 21:05	06:27 (T-15) 06:32 (T-15)	07:14 19:26	07:52 18:30		
24	06:04 21:04	06:28 (T-15) 06:32 (T-15)	07:16 19:24	07:53 18:29		
25	06:05 21:03	06:29 (T-15) 06:32 (T-15)	07:17 19:22	07:55 18:27		
26	06:06 21:02	06:30 (T-15) 06:32 (T-15)	07:18 19:20	07:56 18:26		
27	06:07 21:01		07:19 19:18	07:57 18:24		
28	06:08 21:00		07:20 19:16	07:59 18:23		
29	06:09 20:58		07:22 19:15	08:00 18:21		
30	06:10 20:57		07:23 19:13	08:01 18:20		
31	06:11 20:56		07:24 20:09	08:03 18:18		
Potential sun hours	471	436	377	341	288	275
Total, worst case						
Sun reduction	89		18	368	1223	293
Oper. time red.	0.75		0.67	0.56	0.48	0.52
Wind dir. red.	0.90		0.90	0.90	0.90	0.90
Total reduction	0.59		0.60	0.59	0.59	0.60
Total, real	0.40		0.36	0.30	0.26	0.28
	35		6	110	313	82

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-163 - R-163
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	ENE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June			
1	08:04	07:47	16:35 (T-29)	07:06	16:32 (T-13)	07:09	06:18	05:45	06:09 (T-15)
	16:57	17:35	34 17:09 (T-13)	18:13	45 17:17 (T-13)	19:53	20:30	21:04	5 06:14 (T-15)
2	08:04	07:46	16:36 (T-29)	07:04	16:33 (T-13)	07:07	06:17	05:45	06:08 (T-15)
	16:58	17:36	35 17:11 (T-13)	18:14	43 17:16 (T-13)	19:54	20:31	21:05	6 06:14 (T-15)
3	08:04	07:45	16:35 (T-13)	07:02	16:34 (T-13)	07:06	06:15	05:44	06:08 (T-15)
	16:59	17:38	38 17:13 (T-13)	18:15	40 17:14 (T-13)	19:55	20:32	21:06	6 06:14 (T-15)
4	08:04	07:43	16:33 (T-13)	07:01	16:35 (T-13)	07:04	06:14	05:44	06:07 (T-15)
	17:00	17:39	40 17:13 (T-13)	18:17	37 17:12 (T-13)	19:56	20:34	21:07	6 06:13 (T-15)
5	08:04	07:42	16:32 (T-13)	06:59	16:38 (T-13)	07:02	06:12	05:43	06:07 (T-15)
	17:01	17:41	43 17:15 (T-13)	18:18	33 17:11 (T-13)	19:58	20:35	21:07	6 06:13 (T-15)
6	08:04	07:41	16:32 (T-13)	06:57	16:40 (T-13)	07:00	06:11	05:43	06:06 (T-15)
	17:02	17:42	45 17:17 (T-13)	18:19	28 17:08 (T-13)	19:59	20:36	21:08	6 06:12 (T-15)
7	08:04	07:40	16:30 (T-13)	06:55	16:42 (T-13)	06:58	06:10	05:42	06:06 (T-15)
	17:03	17:43	48 17:18 (T-13)	18:21	23 17:05 (T-13)	20:00	20:37	21:09	6 06:12 (T-15)
8	08:04	07:38	16:30 (T-13)	07:54	17:46 (T-13)	06:57	06:08	05:42	06:06 (T-15)
	17:04	17:45	49 17:19 (T-13)	18:22	15 18:01 (T-13)	20:01	20:38	21:10	6 06:12 (T-15)
9	08:04	07:37	16:30 (T-13)	07:52	16:55	06:07	06:07	05:42	06:06 (T-15)
	17:05	17:46	51 17:21 (T-13)	19:23	20:03	20:40	21:10	6 06:12 (T-15)	
10	08:03	16:37 (T-29)	07:36	16:29 (T-13)	07:50	06:53	06:06	05:42	06:05 (T-15)
	17:06	1 16:38 (T-29)	17:48	52 17:21 (T-13)	19:25	20:04	20:41	21:11	6 06:11 (T-15)
11	08:03	16:37 (T-29)	07:34	16:29 (T-13)	07:48	06:51	06:05	05:41	06:05 (T-15)
	17:07	3 16:40 (T-29)	17:49	53 17:22 (T-13)	19:26	20:05	20:42	21:12	6 06:11 (T-15)
12	08:03	16:35 (T-29)	07:33	16:28 (T-13)	07:46	06:49	06:03	05:41	06:05 (T-15)
	17:08	5 16:40 (T-29)	17:51	54 17:22 (T-13)	19:27	20:06	20:43	21:12	6 06:11 (T-15)
13	08:02	16:35 (T-29)	07:31	16:28 (T-13)	07:45	06:48	06:02	05:41	06:05 (T-15)
	17:10	7 16:42 (T-29)	17:52	55 17:23 (T-13)	19:29	20:08	20:44	21:13	6 06:11 (T-15)
14	08:02	16:34 (T-29)	07:30	16:27 (T-13)	07:43	08:03 (T-17)	06:46	06:01	05:41
	17:11	9 16:43 (T-29)	17:53	55 17:22 (T-13)	19:30	2 08:05 (T-17)	20:09	20:46	21:13
15	08:01	16:34 (T-29)	07:29	16:27 (T-13)	07:41	08:01 (T-17)	06:44	06:00	5 06:10 (T-15)
	17:12	11 16:45 (T-29)	17:55	56 17:23 (T-13)	19:31	4 08:05 (T-17)	20:10	20:47	21:14
16	08:01	16:34 (T-29)	07:27	16:27 (T-13)	07:39	07:59 (T-17)	06:42	05:59	3 06:09 (T-15)
	17:13	12 16:46 (T-29)	17:56	56 17:23 (T-13)	19:32	5 08:04 (T-17)	20:11	20:48	21:14
17	08:00	16:33 (T-29)	07:26	16:27 (T-13)	07:37	07:57 (T-17)	06:41	05:58	05:41
	17:15	14 16:47 (T-29)	17:58	57 17:24 (T-13)	19:34	7 08:04 (T-17)	20:13	20:49	21:15
18	08:00	16:33 (T-29)	07:24	16:27 (T-13)	07:35	07:56 (T-17)	06:39	05:56	05:41
	17:16	16 16:49 (T-29)	17:59	56 17:23 (T-13)	19:35	8 08:04 (T-17)	20:14	20:50	21:15
19	07:59	16:33 (T-29)	07:22	16:26 (T-13)	07:33	07:54 (T-17)	06:37	05:55	05:41
	17:17	17 16:50 (T-29)	18:00	57 17:23 (T-13)	19:36	9 08:03 (T-17)	20:15	20:51	21:15
20	07:58	16:32 (T-29)	07:21	16:27 (T-13)	07:32	07:52 (T-17)	06:36	05:54	05:41
	17:18	19 16:51 (T-29)	18:00	56 17:23 (T-13)	19:37	9 08:01 (T-17)	20:16	20:52	21:16
21	07:57	16:32 (T-29)	07:19	16:27 (T-13)	07:30	07:50 (T-17)	06:34	05:53	05:41
	17:20	20 16:52 (T-29)	18:02	56 17:23 (T-13)	19:39	8 07:58 (T-17)	20:18	20:53	21:16
22	07:57	16:32 (T-29)	07:18	16:28 (T-13)	07:28	06:32	05:53	05:42	05:42
	17:21	22 16:54 (T-29)	18:03	55 17:23 (T-13)	19:40	20:19	20:54	21:16	05:42
23	07:56	16:32 (T-29)	07:16	16:28 (T-13)	07:26	06:31	05:52	05:42	05:42
	17:22	23 16:55 (T-29)	18:04	54 17:22 (T-13)	19:41	20:20	20:55	21:16	05:42
24	07:55	16:33 (T-29)	07:14	16:28 (T-13)	07:24	06:29	05:51	05:42	05:42
	17:24	24 16:57 (T-29)	18:06	53 17:21 (T-13)	19:43	20:21	20:57	21:16	05:42
25	07:54	16:33 (T-29)	07:13	16:29 (T-13)	07:22	06:27	05:50	05:42	05:42
	17:25	26 16:59 (T-29)	18:07	52 17:21 (T-13)	19:44	20:23	20:58	21:17	06:13 (T-15)
26	07:53	16:33 (T-29)	07:11	16:29 (T-13)	07:20	06:26	05:49	05:43	06:12 (T-15)
	17:27	27 17:00 (T-29)	18:09	51 17:20 (T-13)	19:45	20:24	20:59	21:17	1 06:13 (T-15)
27	07:52	16:33 (T-29)	07:09	16:30 (T-13)	07:19	06:24	05:48	05:43	06:11 (T-15)
	17:28	29 17:02 (T-29)	18:10	49 17:19 (T-13)	19:46	20:25	21:00	21:17	2 06:13 (T-15)
28	07:51	16:33 (T-29)	07:08	16:30 (T-13)	07:17	06:23	05:48	05:44	06:11 (T-15)
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29	07:50	16:33 (T-29)	07:07	16:30 (T-13)	07:15	06:21	05:47	05:44	06:10 (T-15)
	17:31	31 17:04 (T-29)	18:12	47 17:19 (T-13)	19:49	20:27	21:01	21:17	4 06:14 (T-15)
30	07:49	16:33 (T-29)	07:06	16:30 (T-13)	07:14	06:20	05:46	05:44	06:10 (T-15)
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	17:34	33 17:07 (T-13)	18:15	45 17:19 (T-13)	19:51	21:03	21:03	21:17	5 06:14 (T-15)
Potential sun hours	287	292	369	403	459	465			
Total, worst case	412	1408	316		20			102	
Sun reduction	0.58	0.58	0.59		0.66			0.73	
Oper. time red.	0.90	0.90	0.90		0.90			0.90	
Wind dir. red.	0.59	0.59	0.59		0.59			0.59	
Total reduction	0.31	0.31	0.31		0.35			0.39	
Total, real	126	433	99		7			40	

Table layout: For each day in each month the following matrix apply

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Calculated:
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1	05:45	06:09 (T-15)	06:12	06:49	07:24	07:04
	21:17	6 06:15 (T-15)	20:55	20:07	19:11	17:17
2	05:46	06:10 (T-15)	06:14	06:50	07:25	51 16:50 (T-13)
	21:16	6 06:16 (T-15)	20:54	20:05	19:09	17:15
3	05:46	06:11 (T-15)	06:15	06:51	07:27	50 16:49 (T-13)
	21:16	6 06:17 (T-15)	20:52	20:03	19:07	17:14
4	05:47	06:11 (T-15)	06:16	06:52	07:28	49 16:49 (T-13)
	21:16	6 06:17 (T-15)	20:51	20:01	19:05	17:13
5	05:47	06:12 (T-15)	06:17	06:53	07:29	48 16:48 (T-13)
	21:16	6 06:18 (T-15)	20:50	20:00	19:03	17:11
6	05:48	06:12 (T-15)	06:18	06:54	07:30	45 16:47 (T-13)
	21:15	6 06:18 (T-15)	20:49	19:58	19:02	17:10
7	05:49	06:13 (T-15)	06:19	06:56	07:32	43 16:45 (T-13)
	21:15	6 06:19 (T-15)	20:47	19:56	19:00	17:09
8	05:49	06:14 (T-15)	06:20	06:57	07:33	40 16:44 (T-13)
	21:15	6 06:20 (T-15)	20:46	19:54	19:00	17:09
9	05:50	06:15 (T-15)	06:22	06:58	07:34	37 16:42 (T-13)
	21:14	6 06:21 (T-15)	20:44	19:52	18:56	17:08
10	05:51	06:15 (T-15)	06:23	06:59	07:35	31 17:45 (T-13)
	21:14	6 06:21 (T-15)	20:43	19:50	18:54	17:06
11	05:52	06:16 (T-15)	06:24	07:00	07:37	35 17:46 (T-13)
	21:13	5 06:21 (T-15)	20:42	19:49	18:53	17:05
12	05:53	06:17 (T-15)	06:25	07:02	07:38	34 17:47 (T-13)
	21:13	5 06:22 (T-15)	20:40	19:47	18:52	17:04
13	05:53	06:18 (T-15)	06:26	07:03	07:39	33 17:48 (T-13)
	21:12	4 06:22 (T-15)	20:39	19:45	18:49	17:03
14	05:54	06:18 (T-15)	06:27	07:04	07:40	31 17:49 (T-13)
	21:12	4 06:22 (T-15)	20:37	19:43	18:48	17:02
15	05:55	06:19 (T-15)	06:29	07:05	07:42	30 17:50 (T-13)
	21:11	3 06:22 (T-15)	20:35	19:41	18:47	17:01
16	05:56	06:20 (T-15)	06:30	07:06	07:43	29 17:51 (T-13)
	21:10	3 06:23 (T-15)	20:34	19:39	18:46	17:00
17	05:57	06:21 (T-15)	06:31	07:07	07:44	27 17:52 (T-13)
	21:10	2 06:23 (T-15)	20:32	19:37	18:45	17:00
18	05:58	06:22 (T-15)	06:32	07:09	07:45	26 17:53 (T-13)
	21:09	1 06:23 (T-15)	20:31	19:35	18:44	17:00
19	05:59		06:33	07:10	07:47	25 17:54 (T-13)
	21:08		20:29	19:33	18:43	17:00
20	06:00		06:34	07:11	07:48	24 17:55 (T-13)
	21:07		20:28	19:32	18:42	17:00
21	06:01		06:36	07:12	07:49	23 17:56 (T-13)
	21:06		20:26	19:30	18:41	17:00
22	06:02		06:37	07:13	07:51	22 17:57 (T-13)
	21:06		20:24	19:28	18:39	17:00
23	06:03		06:38	07:15	07:52	21 17:58 (T-13)
	21:05		20:23	19:26	18:38	17:00
24	06:04		06:39	07:16	07:53	20 17:59 (T-13)
	21:04		20:21	19:24	18:29	17:00
25	06:05		06:40	07:17	07:55	19 17:59 (T-13)
	21:03		20:19	19:22	18:27	17:00
26	06:06		06:42	07:18	07:56	18 17:59 (T-13)
	21:02		20:17	19:20	18:26	17:00
27	06:07		06:43	07:19	07:57	17 17:59 (T-13)
	21:01		20:16	19:18	18:24	17:00
28	06:08		06:44	07:20	07:59	16 17:59 (T-13)
	21:00		20:14	19:16	18:23	17:00
29	06:09		06:45	07:22	08:00	15 17:59 (T-13)
	20:58		20:12	19:15	18:21	17:00
30	06:10		06:46	07:23	08:01	14 17:59 (T-13)
	20:57		20:10	19:13	18:20	17:00
31	06:11		06:47		08:03	13 17:59 (T-13)
	20:56		20:09		18:18	17:00
Potential sun hours	471	436	377	341	288	275
Total, worst case				52	1269	840
Sun reduction	0.75			0.67	0.56	0.48
Oper. time red.	0.90			0.90	0.90	0.90
Wind dir. red.	0.59			0.60	0.59	0.59
Total reduction	0.40			0.36	0.30	0.25
Total, real	35		19	377	213	1

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-164 - R-164
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June			
1	08:04	07:47	07:06	07:27 (T-30)	07:09	07:30 (T-29)	06:18	06:40 (T-13)	05:45
	16:57	17:35	18:13	10 07:37 (T-30)	19:53	30 08:00 (T-29)	20:30	24 07:04 (T-13)	21:04
2	08:05	07:46	07:04	07:25 (T-30)	07:08	07:28 (T-29)	06:17	06:40 (T-13)	05:45
	16:58	17:36	18:14	11 07:36 (T-30)	19:54	32 08:00 (T-29)	20:31	24 07:04 (T-13)	21:05
3	08:05	07:45	07:03	07:23 (T-30)	07:06	07:26 (T-29)	06:15	06:41 (T-13)	05:44
	16:59	17:38	18:15	13 07:36 (T-30)	19:55	34 08:00 (T-29)	20:32	23 07:04 (T-13)	21:06
4	08:05	07:44	07:01	07:21 (T-30)	07:04	07:24 (T-29)	06:14	06:41 (T-13)	05:44
	17:00	17:39	18:17	14 07:35 (T-30)	19:56	36 08:00 (T-29)	20:34	21 07:02 (T-13)	21:07
5	08:04	07:42	06:59	07:20 (T-30)	07:02	07:22 (T-29)	06:13	06:43 (T-13)	05:43
	17:01	17:41	18:18	15 07:35 (T-30)	19:58	37 07:59 (T-29)	20:35	18 07:01 (T-13)	21:08
6	08:04	07:41	06:57	07:18 (T-30)	07:00	07:20 (T-29)	06:11	06:44 (T-13)	05:43
	17:02	17:42	18:19	15 07:33 (T-30)	19:59	39 07:59 (T-29)	20:36	16 07:00 (T-13)	21:08
7	08:04	07:40	06:55	07:19 (T-30)	06:58	07:21 (T-29)	06:10	06:45 (T-13)	05:43
	17:03	17:44	18:21	12 07:31 (T-30)	20:00	38 07:59 (T-29)	20:37	13 06:58 (T-13)	21:09
8	08:04	07:38	07:54	08:22 (T-30)	06:57	07:21 (T-29)	06:08	06:48 (T-13)	05:42
	17:04	17:45	18:22	5 08:27 (T-30)	20:01	37 07:58 (T-29)	20:39	7 06:55 (T-13)	21:10
9	08:04	07:37	07:52	06:55	06:55	07:21 (T-29)	06:07		05:42
	17:05	17:46	19:23		20:03	36 07:57 (T-29)	20:40		21:10
10	08:03	07:36	07:50	06:53	07:21 (T-29)	06:06			05:42
	17:06	17:48	19:25		20:04	35 07:56 (T-29)	20:41		21:11
11	08:03	07:34	07:48	06:51	07:21 (T-29)	06:05			05:41
	17:07	17:49	19:26		20:05	34 07:55 (T-29)	20:42		21:12
12	08:03	07:33	07:46	06:49	07:22 (T-29)	06:03			05:41
	17:08	17:51	19:27		20:06	33 07:55 (T-29)	20:43		21:12
13	08:02	07:32	07:45	06:48	07:23 (T-29)	06:02			05:41
	17:10	17:52	19:29		20:08	30 07:53 (T-29)	20:44		21:13
14	08:02	07:30	07:43	06:46	07:23 (T-29)	06:01			05:41
	17:11	17:53	19:30		20:09	28 07:51 (T-29)	20:46		21:13
15	08:01	07:29	07:41	06:44	07:25 (T-29)	06:00			05:41
	17:12	17:55	19:31		20:10	25 07:50 (T-29)	20:47		21:14
16	08:01	16:44 (T-28)	07:27	06:42	07:27 (T-29)	05:59			05:41
	17:13	2 16:46 (T-28)	17:56	19:32	20:11	21 07:48 (T-29)	20:48		21:14
17	08:00	16:44 (T-28)	07:26	07:37	06:41	07:29 (T-29)	05:58		05:41
	17:15	3 16:47 (T-28)	17:58	19:34	20:13	15 07:44 (T-29)	20:49		21:15
18	08:00	16:44 (T-28)	07:24	07:35	06:39	07:32 (T-29)	05:57		05:41
	17:16	5 16:49 (T-28)	17:59	19:35	20:14	7 07:39 (T-29)	20:50		21:15
19	07:59	16:44 (T-28)	07:22	07:34	06:37	06:58 (T-13)	05:56		05:41
	17:17	6 16:50 (T-28)	18:00	19:36	20:15	3 07:01 (T-13)	20:51		21:15
20	07:58	16:44 (T-28)	07:21	07:32	06:36	06:56 (T-13)	05:55		05:41
	17:19	7 16:51 (T-28)	18:00	19:38	20:16	6 07:02 (T-13)	20:52		21:16
21	07:58	16:44 (T-28)	07:19	07:30	06:34	06:55 (T-13)	05:54		05:41
	17:20	8 16:52 (T-28)	18:02	19:39	20:18	9 07:04 (T-13)	20:53		21:16
22	07:57	16:45 (T-28)	07:18	07:28	06:32	06:53 (T-13)	05:53		05:42
	17:21	9 16:54 (T-28)	18:03	19:40	20:19	12 07:05 (T-13)	20:54		21:16
23	07:56	16:46 (T-28)	07:16	07:26	06:31	06:51 (T-13)	05:52		05:42
	17:23	10 16:56 (T-28)	18:05	19:41	20:20	14 07:05 (T-13)	20:56		21:16
24	07:55	16:47 (T-28)	07:14	07:24	06:29	06:50 (T-13)	05:51		05:42
	17:24	10 16:57 (T-28)	18:06	19:43	3 07:47 (T-29)	20:21	16 07:06 (T-13)	20:57	21:17
25	07:54	16:47 (T-28)	07:13	07:22	07:43 (T-29)	06:28	06:48 (T-13)	05:50	05:43
	17:25	12 16:59 (T-28)	18:07	1 07:35 (T-30)	19:44	10 07:53 (T-29)	20:23	18 07:06 (T-13)	20:58
26	07:53	16:48 (T-28)	07:11	07:32 (T-30)	07:21	07:41 (T-29)	06:26	06:47 (T-13)	05:49
	17:27	12 17:00 (T-28)	18:09	3 07:35 (T-30)	19:45	14 07:55 (T-29)	20:24	20 07:07 (T-13)	20:59
27	07:52	16:50 (T-28)	07:09	07:30 (T-30)	07:19	07:39 (T-29)	06:24	06:45 (T-13)	05:49
	17:28	10 17:00 (T-28)	18:10	6 07:36 (T-30)	19:46	17 07:56 (T-29)	20:25	21 07:06 (T-13)	21:00
28	07:51	16:52 (T-28)	07:08	07:28 (T-30)	07:17	07:37 (T-29)	06:23	06:44 (T-13)	05:48
	17:29	7 16:59 (T-28)	18:11	8 07:36 (T-30)	19:48	20 07:57 (T-29)	20:26	22 07:06 (T-13)	21:01
29	07:50			07:15	07:35 (T-29)	06:21	06:42 (T-13)	05:47	05:44
	17:31			19:49	23 07:58 (T-29)	20:28	24 07:06 (T-13)	21:01	21:17
30	07:49			07:13	07:33 (T-29)	06:20	06:41 (T-13)	05:46	05:45
	17:32			19:50	26 07:59 (T-29)	20:29	25 07:06 (T-13)	21:02	21:17
31	07:48			07:11	07:31 (T-29)			05:46	
	17:34			19:51	28 07:59 (T-29)			21:03	
Potential sun hours	287	292	369		403		459		465
Total, worst case				236	737		146		
Sun reduction	0.58		0.58	0.59		0.63	0.66		
Oper. time red.	0.90		0.90	0.90		0.90	0.90		
Wind dir. red.	0.59		0.60	0.59		0.59	0.58		
Total reduction	0.31		0.31	0.31		0.33	0.35		
Total, real	31	6	74		245		50		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-164 - R-164

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:21 (T-29) 19:11	07:24 17:17	07:43 16:48
2	05:46 21:17	06:14 20:54	06:50 20:05	07:20 (T-29) 19:09	07:25 17:16	07:45 16:48
3	05:46 21:16	06:15 20:53	06:51 20:03	07:19 (T-29) 19:07	07:27 17:14	07:46 16:48
4	05:47 21:16	06:16 20:51	06:52 20:02	07:18 (T-29) 19:05	07:28 17:13	07:47 16:47
5	05:47 21:16	06:17 20:50	06:56 (T-13) 07:06 (T-13)	06:53 20:00	07:17 (T-29) 19:04	07:29 17:11
6	05:48 21:16	06:18 20:49	06:54 (T-13) 07:08 (T-13)	06:55 19:58	07:16 (T-29) 19:02	07:30 17:10
7	05:49 21:15	06:19 20:47	06:53 (T-13) 07:10 (T-13)	06:56 19:56	07:17 (T-29) 19:00	07:32 17:09
8	05:50 21:15	06:21 20:46	06:52 (T-13) 07:11 (T-13)	06:57 19:54	07:18 (T-29) 18:56	07:33 17:08
9	05:50 21:14	06:22 20:44	06:51 (T-13) 07:12 (T-13)	06:58 19:52	07:20 (T-29) 18:54	07:34 17:06
10	05:51 21:14	06:23 20:43	06:50 (T-13) 07:13 (T-13)	06:59 19:50	07:21 (T-29) 18:53	07:35 17:05
11	05:52 21:13	06:24 20:42	06:49 (T-13) 07:13 (T-13)	07:00 19:49	07:22 (T-29) 18:51	07:37 17:04
12	05:53 21:13	06:25 20:40	06:48 (T-13) 07:13 (T-13)	07:02 19:47	07:23 (T-29) 18:49	07:38 17:03
13	05:53 21:12	06:26 20:39	06:49 (T-13) 07:13 (T-13)	07:03 19:45	07:24 (T-29) 18:47	07:39 17:02
14	05:54 21:12	06:28 20:37	06:50 (T-13) 07:13 (T-13)	07:04 19:43	07:25 (T-29) 18:46	07:40 17:01
15	05:55 21:11	06:29 20:36	06:51 (T-13) 07:13 (T-13)	07:05 19:41	07:26 (T-29) 18:44	07:42 17:00
16	05:56 21:10	06:30 20:34	06:53 (T-13) 07:14 (T-13)	07:06 19:39	07:28 (T-29) 18:42	07:43 16:59
17	05:57 21:10	06:31 20:32	06:54 (T-13) 07:13 (T-13)	07:07 19:37	07:29 (T-29) 18:40	07:44 16:58
18	05:58 21:09	06:32 20:31	06:55 (T-13) 07:13 (T-13)	07:09 19:35	07:30 (T-29) 18:39	07:46 16:57
19	05:59 21:08	06:33 20:29	06:56 (T-13) 07:12 (T-13)	07:10 19:34	07:31 (T-29) 18:37	07:47 16:56
20	06:00 21:07	06:35 20:28	06:57 (T-13) 07:11 (T-13)	07:11 19:32	07:32 (T-29) 18:35	07:48 16:55
21	06:01 21:07	06:36 20:26	06:58 (T-13) 07:09 (T-13)	07:12 19:30	07:33 (T-29) 18:34	07:49 16:54
22	06:02 21:06	06:37 20:24	06:59 (T-13) 07:08 (T-13)	07:13 19:28	07:34 (T-29) 18:32	07:51 16:53
23	06:03 21:05	06:38 20:23	07:00 (T-13) 07:06 (T-13)	07:15 19:26	07:35 (T-29) 18:31	07:52 16:52
24	06:04 21:04	06:39 20:21	07:02 (T-13) 07:04 (T-13)	07:16 19:24	07:36 (T-29) 18:29	07:53 16:51
25	06:05 21:03	06:40 20:19	07:35 (T-29) 07:44 (T-29)	07:17 19:22	07:37 (T-29) 18:27	07:54 16:50
26	06:06 21:02	06:42 20:18	07:31 (T-29) 07:48 (T-29)	07:18 19:20	07:38 (T-29) 18:26	07:55 16:49
27	06:07 21:01	06:43 20:16	07:28 (T-29) 07:50 (T-29)	07:19 19:18	07:39 (T-29) 18:24	07:56 16:48
28	06:08 21:00	06:44 20:14	07:26 (T-29) 07:51 (T-29)	07:21 19:17	07:40 (T-29) 18:23	07:57 16:47
29	06:09 20:59	06:45 20:12	07:24 (T-29) 07:52 (T-29)	07:22 19:15	07:41 (T-29) 18:21	07:58 16:46
30	06:10 20:57	06:46 20:11	07:22 (T-29) 07:53 (T-29)	07:23 19:13	07:42 (T-29) 18:20	07:59 16:45
31	06:11 20:56	06:48 20:09	07:21 (T-29) 07:54 (T-29)	07:24 19:11	07:43 (T-29) 18:18	08:00 16:44
Potential sun hours	471	436	377	341	288	275
Total, worst case		503	536	111	101	
Sun reduction		0.72	0.67	0.56	0.48	
Oper. time red.		0.90	0.90	0.90	0.90	
Wind dir. red.		0.58	0.59	0.60	0.59	
Total reduction		0.38	0.35	0.30	0.25	
Total, real		190	190	33	26	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-165 - R-165

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June			
1	08:04	07:47	07:06	17:46 (T-38)	07:09	19:17 (T-82)	06:18	19:16 (T-31)	05:45
	16:57	17:35	18:13	5 17:51 (T-38)	19:53	13 19:30 (T-82)	20:30	39 19:55 (T-31)	21:04
2	08:04	07:46	07:04	17:45 (T-38)	07:07	19:21 (T-82)	06:17	19:17 (T-31)	05:45
	16:58	17:36	18:14	8 17:53 (T-38)	19:54	7 19:28 (T-82)	20:31	38 19:55 (T-31)	21:05
3	08:04	07:45	07:02	17:45 (T-38)	07:06		06:15	19:17 (T-31)	05:44
	16:59	17:38	18:15	9 17:54 (T-38)	19:55		20:32	36 19:53 (T-31)	21:06
4	08:04	07:43	07:01	17:46 (T-38)	07:04		06:14	19:18 (T-31)	05:44
	17:00	17:39	18:17	9 17:55 (T-38)	19:56		20:34	35 19:53 (T-31)	21:07
5	08:04	07:42	06:59	17:47 (T-38)	07:02		06:12	19:19 (T-31)	05:43
	17:01	17:41	18:18	9 17:56 (T-38)	19:58		20:35	33 19:52 (T-31)	21:07
6	08:04	07:41	06:57	17:50 (T-38)	07:00		06:11	19:19 (T-31)	05:43
	17:02	17:42	18:19	6 17:56 (T-38)	19:59		20:36	31 19:50 (T-31)	21:08
7	08:04	07:40	06:55		06:58		06:10	19:21 (T-31)	05:42
	17:03	17:43	18:21		20:00		20:37	31 20:13 (T-93)	21:09
8	08:04	07:38	07:54		06:57		06:08	19:22 (T-31)	05:42
	17:04	17:45	18:22		20:01		20:38	30 20:14 (T-93)	21:10
9	08:04	07:37	07:52		06:55		06:07	19:24 (T-31)	05:42
	17:05	17:46	19:23		20:03		20:40	28 20:16 (T-93)	21:10
10	08:03	07:36	07:50		06:53		06:06	19:25 (T-31)	05:42
	17:06	17:48	19:25		20:04		20:41	27 20:16 (T-93)	21:11
11	08:03	07:34	07:48		06:51	19:32 (T-31)	06:05	19:27 (T-31)	05:41
	17:07	17:49	19:26		20:05	11 19:43 (T-31)	20:42	23 20:17 (T-93)	21:11
12	08:03	07:33	07:46		06:49	19:29 (T-31)	06:03	19:31 (T-31)	05:41
	17:08	17:51	19:27		20:06	16 19:45 (T-31)	20:43	18 20:19 (T-93)	21:12
13	08:02	07:31	07:45		06:48	19:27 (T-31)	06:02	20:10 (T-93)	05:41
	17:10	17:52	19:29		20:08	18 19:45 (T-31)	20:44	10 20:20 (T-93)	21:13
14	08:02	07:30	07:43		06:46	19:24 (T-31)	06:01	20:10 (T-93)	05:41
	17:11	17:53	19:30		20:09	22 19:46 (T-31)	20:45	11 20:21 (T-93)	21:13
15	08:01	07:28	07:41		06:44	19:22 (T-31)	06:00	20:10 (T-93)	05:41
	17:12	17:55	19:31		20:10	25 19:47 (T-31)	20:47	12 20:22 (T-93)	21:14
16	08:01	07:27	07:39		06:42	19:22 (T-31)	05:59	20:11 (T-93)	05:41
	17:13	17:56	19:32		20:11	27 19:49 (T-31)	20:48	12 20:23 (T-93)	21:14
17	08:00	07:25	07:37		06:41	19:20 (T-31)	05:58	20:11 (T-93)	05:41
	17:15	17:58	19:34		20:13	30 19:50 (T-31)	20:49	13 20:24 (T-93)	21:14
18	07:59	07:24	07:35		06:39	19:19 (T-31)	05:57	20:12 (T-93)	05:41
	17:16	17:59	19:35		20:14	32 19:51 (T-31)	20:50	13 20:25 (T-93)	21:15
19	07:59	07:22	07:33		06:37	19:19 (T-31)	05:56	20:13 (T-93)	05:41
	17:17	18:00	19:36		20:15	34 19:53 (T-31)	20:51	13 20:26 (T-93)	21:15
20	07:58	07:21	07:32		06:36	19:17 (T-31)	05:55	20:14 (T-93)	05:41
	17:18	18:00	19:37		20:16	36 19:53 (T-31)	20:52	11 20:25 (T-93)	21:15
21	07:57	07:19	07:30		06:34	19:16 (T-31)	05:54	20:15 (T-93)	05:41
	17:20	18:02	19:39		20:17	38 19:54 (T-31)	20:53	9 20:24 (T-93)	21:16
22	07:57	07:18	07:28		06:32	19:17 (T-31)	05:53	20:18 (T-93)	05:42
	17:21	18:03	19:40		20:19	39 19:56 (T-31)	20:54	3 20:21 (T-93)	21:16
23	07:56	07:16	07:26		06:31	19:16 (T-31)	05:52		05:42
	17:22	18:05	19:41		20:20	41 19:57 (T-31)	20:55		21:16
24	07:55	07:14	07:24	19:18 (T-82)	06:29	19:16 (T-31)	05:51		05:42
	17:24	18:06	19:43	3 19:21 (T-82)	20:21	42 19:58 (T-31)	20:56		21:16
25	07:54	07:13	07:22	19:17 (T-82)	06:27	19:15 (T-31)	05:50		05:42
	17:25	18:07	19:44	5 19:22 (T-82)	20:22	43 19:58 (T-31)	20:57		21:17
26	07:53	07:11	07:20	19:17 (T-82)	06:26	19:16 (T-31)	05:49		05:43
	17:27	18:09	19:45	7 19:24 (T-82)	20:24	42 19:58 (T-31)	20:58		21:17
27	07:52	07:09	07:19	19:16 (T-82)	06:24	19:15 (T-31)	05:48		05:43
	17:28	18:10	1 17:48 (T-38)	19:46	9 19:25 (T-82)	20:25	42 19:57 (T-31)	20:59	21:17
28	07:51	07:08	07:17	19:16 (T-82)	06:23	19:16 (T-31)	05:48		05:44
	17:29	18:11	3 17:49 (T-38)	19:48	10 19:26 (T-82)	20:26	41 19:57 (T-31)	21:00	21:17
29	07:50		07:15	19:16 (T-82)	06:21	19:16 (T-31)	05:47		05:44
	17:31		19:49	11 19:27 (T-82)	20:27	40 19:56 (T-31)	21:01		21:17
30	07:49		07:13	19:16 (T-82)	06:20	19:16 (T-31)	05:46		05:45
	17:32		19:50	12 19:28 (T-82)	20:29	40 19:56 (T-31)	21:02		21:17
31	07:48		07:11	19:16 (T-82)			05:46		
	17:34		19:51	13 19:29 (T-82)			21:03		
Potential sun hours	287	292	369	403	459	465			
Total, worst case			116	679	476				
Sun reduction		0.58	0.59	0.63	0.66				
Oper. time red.		0.90	0.90	0.90	0.90				
Wind dir. red.		0.58	0.59	0.60	0.61				
Total reduction		0.30	0.31	0.34	0.36				
Total, real		1	36	229	171				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-165 - R-165
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:13 20:55	19:40 (T-31) 20:29 (T-93)	06:49 20:07	19:32 (T-31) 19:11	07:24 17:17
2	05:46 21:16	06:14 20:54	19:37 (T-31) 20:27 (T-93)	06:50 20:05	19:43 (T-31) 19:09	07:25 17:15
3	05:46 21:16	06:15 20:52	19:35 (T-31) 20:26 (T-93)	06:51 20:03	19:07 19:07	07:27 17:14
4	05:47 21:16	06:16 20:51	19:33 (T-31) 20:25 (T-93)	06:52 20:01	19:08 19:05	07:28 17:13
5	05:47 21:16	06:17 20:50	19:31 (T-31) 20:24 (T-93)	06:53 20:00	19:09 19:03	07:29 17:11
6	05:48 21:15	06:18 20:48	19:30 (T-31) 20:22 (T-93)	06:55 19:58	19:02 19:02	07:30 17:10
7	05:49 21:15	06:19 20:47	19:30 (T-31) 20:01 (T-31)	06:56 19:56	19:01 19:00	07:31 17:09
8	05:50 21:15	06:20 20:46	19:28 (T-31) 20:02 (T-31)	06:57 19:54	18:23 (T-38) 18:33 (T-38)	07:14 17:08
9	05:50 21:14	06:22 20:44	19:27 (T-31) 20:03 (T-31)	06:58 19:52	18:21 (T-38) 18:30 (T-38)	07:15 17:06
10	05:51 21:14	06:23 20:43	19:26 (T-31) 20:03 (T-31)	06:59 19:50	18:20 (T-38) 18:28 (T-38)	07:16 17:05
11	05:52 21:13	06:24 20:41	19:25 (T-31) 20:04 (T-31)	07:00 19:48	18:20 (T-38) 18:27 (T-38)	07:18 17:04
12	05:53 21:13	06:25 20:40	19:25 (T-31) 20:04 (T-31)	07:02 19:47	18:19 (T-38) 18:25 (T-38)	07:19 17:03
13	05:53 21:12	06:26 20:38	19:24 (T-31) 20:04 (T-31)	07:03 19:45	18:18 (T-38) 18:23 (T-38)	07:20 17:02
14	05:54 21:12	06:27 20:37	19:23 (T-31) 20:04 (T-31)	07:04 19:43	18:19 (T-38) 18:22 (T-38)	07:22 17:01
15	05:55 21:11	06:29 20:35	19:23 (T-31) 20:04 (T-31)	07:05 19:41	18:19 (T-38) 18:20 (T-38)	07:23 17:00
16	05:56 21:10	06:30 20:34	19:23 (T-31) 20:05 (T-31)	07:06 19:39	18:20 (T-38) 19:14 (T-82)	07:24 16:59
17	05:57 21:10	06:31 20:32	19:23 (T-31) 20:05 (T-31)	07:07 19:37	18:44 18:40	07:44 16:58
18	05:58 21:09	06:32 20:31	19:22 (T-31) 20:04 (T-31)	07:09 19:35	18:46 19:11 (T-82)	17:01 16:57
19	05:59 21:08	06:33 20:29	19:22 (T-31) 20:04 (T-31)	07:10 19:33	18:39 19:05 (T-82)	16:48 16:56
20	06:00 21:07	06:35 20:27	19:22 (T-31) 20:02 (T-31)	07:11 19:32	18:37 19:07 (T-82)	16:48 16:55
21	06:01 21:06	06:36 20:26	19:21 (T-31) 20:01 (T-31)	07:12 19:30	18:35 18:34	16:49 16:54
22	06:02 21:05	20:27 (T-93) 6 20:33 (T-93)	06:37 20:24	07:13 19:28	18:33 18:32	16:50 16:50
23	06:03 21:05	20:25 (T-93) 10 20:35 (T-93)	06:38 20:22	07:15 19:26	18:32 18:30	16:51 16:50
24	06:04 21:04	20:24 (T-93) 12 20:36 (T-93)	06:39 20:21	07:16 19:24	18:29 18:29	16:52 16:51
25	06:05 21:03	20:23 (T-93) 13 20:36 (T-93)	06:40 20:19	07:17 19:22	18:29 18:27	16:53 16:51
26	06:06 21:02	20:22 (T-93) 13 20:35 (T-93)	06:42 20:17	07:18 19:20	18:27 18:26	16:52 16:52
27	06:07 21:01	20:22 (T-93) 12 20:34 (T-93)	06:43 20:16	07:19 19:18	18:26 18:24	16:53 16:50
28	06:08 20:59	20:21 (T-93) 12 20:33 (T-93)	06:44 20:14	07:20 19:16	18:24 18:23	16:51 16:50
29	06:09 20:58	20:21 (T-93) 11 20:32 (T-93)	06:45 20:12	07:22 19:15	18:23 18:21	16:50 16:49
30	06:10 20:57	20:20 (T-93) 11 20:31 (T-93)	06:46 20:10	07:23 19:13	18:21 18:20	16:49 16:48
31	06:11 20:56	20:20 (T-93) 10 20:30 (T-93)	06:47 20:09	19:13 19:43 (T-31)	18:20 18:18	16:48 16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case	110	1025	106	49		
Sun reduction	0.75	0.72	0.67	0.56		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.63	0.60	0.59	0.58		
Total reduction	0.43	0.39	0.36	0.29		
Total, real	47	397	38	14		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-166 - R-166
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	19:35 (T-37)	05:45					
	16:57	17:35	18:13	19:53	20:30	19:51 (T-37)	21:04					
2	08:04	07:46	07:04	07:08	06:17	19:38 (T-37)	05:45					
	16:58	17:36	18:14	19:54	20:31	19:49 (T-37)	21:05					
3	08:04	07:45	07:02	07:06	06:15		05:44					
	16:59	17:38	18:15	19:55	20:32	21:06	13 20:40 (T-38)	21:16	20 20:49 (T-38)	20:52		
4	08:04	07:43	07:01	07:04	06:14		05:44					
	17:00	17:39	18:17	19:56	20:34	21:07	14 20:40 (T-38)	21:16	19 20:48 (T-38)	20:51		
5	08:04	07:42	06:59	07:02	06:13		05:43					
	17:01	17:41	18:18	19:58	20:35	21:07	15 20:41 (T-38)	21:16	18 20:48 (T-38)	20:50		
6	08:04	07:41	06:57	07:00	06:11		05:43					
	17:02	17:42	18:19	19:59	20:36	21:08	17 20:42 (T-38)	21:15	17 20:48 (T-38)	20:49		
7	08:04	07:40	06:55	06:58	06:10		05:43					
	17:03	17:44	18:21	20:00	20:37	21:09	18 20:42 (T-38)	21:15	16 20:47 (T-38)	20:47		
8	08:04	07:38	07:54	06:57	06:09		05:42					
	17:04	17:45	18:22	20:01	20:38	21:10	19 20:43 (T-38)	21:15	14 20:47 (T-38)	20:46		
9	08:04	07:37	07:52	06:55	06:07		05:42					
	17:05	17:46	19:23	20:03	20:40	21:10	20 20:44 (T-38)	21:14	13 20:47 (T-38)	20:44		
10	08:03	07:36	07:50	06:53	06:06		05:42					
	17:06	17:48	19:25	20:04	20:41	21:11	20 20:44 (T-38)	21:14	11 20:46 (T-38)	20:43		
11	08:03	07:34	07:48	06:51	06:05		05:42					
	17:07	17:49	19:26	20:05	20:42	21:12	21 20:45 (T-38)	21:13	10 20:46 (T-38)	20:41		
12	08:03	07:33	07:46	06:49	19:40 (T-37)	06:03	05:41					
	17:09	17:51	19:27	20:06	5 19:45 (T-37)	20:43	21:12	22 20:45 (T-38)	21:13	8 20:46 (T-38)	20:40	17 20:00 (T-37)
13	08:02	07:31	07:45	06:48	19:37 (T-37)	06:02	05:41					
	17:10	17:52	19:29	20:08	8 19:45 (T-37)	20:44	21:13	22 20:45 (T-38)	21:12	4 20:41 (T-38)	20:26	19 20:02 (T-37)
14	08:02	07:30	07:43	06:46	19:35 (T-37)	06:01	05:41					
	17:11	17:53	19:30	20:09	11 19:46 (T-37)	20:46	21:13	23 20:46 (T-38)	21:12	20:37	23 20:03 (T-37)	19:43
15	08:01	07:29	07:41	06:44	19:35 (T-37)	06:00	05:41					
	17:12	17:55	19:31	20:10	13 19:48 (T-37)	20:47	21:14	23 20:46 (T-38)	21:11	20:35	24 20:04 (T-37)	19:41
16	08:01	07:27	07:39	06:43	19:33 (T-37)	05:59	05:41					
	17:13	17:56	19:32	20:11	16 19:49 (T-37)	20:48	21:14	24 20:47 (T-38)	21:10	20:34	27 20:05 (T-37)	19:39
17	08:00	07:26	07:37	06:41	19:32 (T-37)	05:58	05:41					
	17:15	17:58	19:34	20:13	18 19:50 (T-37)	20:49	21:15	24 20:47 (T-38)	21:10	20:32	28 20:05 (T-37)	19:37
18	07:59	07:24	07:35	06:39	19:31 (T-37)	05:57	05:41					
	17:16	17:59	19:35	20:14	20 19:51 (T-37)	20:50	21:15	24 20:47 (T-38)	21:09	20:31	28 20:05 (T-37)	19:35
19	07:59	07:22	07:34	06:37	19:31 (T-37)	05:56	05:41					
	17:17	18:00	19:36	20:15	22 19:53 (T-37)	20:51	21:15	24 20:48 (T-38)	21:08	20:29	28 20:04 (T-37)	19:34
20	07:58	07:21	07:32	06:36	19:30 (T-37)	05:55	05:41					
	17:19	18:00	19:38	20:16	23 19:53 (T-37)	20:52	21:16	25 20:49 (T-38)	21:07	20:28	27 20:02 (T-37)	19:32
21	07:57	07:19	07:30	06:34	19:30 (T-37)	05:54	05:42					
	17:20	18:02	19:39	20:18	25 19:55 (T-37)	20:53	21:16	25 20:49 (T-38)	21:06	20:26	26 20:01 (T-37)	19:30
22	07:57	07:18	07:28	06:32	19:30 (T-37)	05:53	05:42					
	17:21	18:03	19:40	20:19	26 19:56 (T-37)	20:54	21:16	25 20:49 (T-38)	21:06	20:24	25 19:59 (T-37)	19:28
23	07:56	07:16	07:26	06:31	19:29 (T-37)	05:52	05:42					
	17:23	18:05	19:41	20:20	28 19:57 (T-37)	20:55	21:16	24 20:48 (T-38)	21:05	20:23	23 19:57 (T-37)	19:26
24	07:55	07:14	07:24	06:29	19:30 (T-37)	05:51	05:42					
	17:24	18:06	19:43	20:21	29 19:59 (T-37)	20:56	21:16	24 20:49 (T-38)	21:04	20:21	21 19:56 (T-37)	19:24
25	07:54	07:13	07:22	06:28	19:30 (T-37)	05:50	05:43					
	17:25	18:07	19:44	20:23	29 19:59 (T-37)	20:57	21:17	24 20:49 (T-38)	21:03	20:19	19 19:54 (T-37)	19:22
26	07:53	07:11	07:21	06:26	19:31 (T-37)	05:49	05:43					
	17:27	18:09	19:45	20:24	27 19:58 (T-37)	20:58	21:17	24 20:49 (T-38)	21:02	20:17	18 19:53 (T-37)	19:20
27	07:52	07:09	07:19	06:24	19:31 (T-37)	05:49	05:43					
	17:28	18:10	19:46	20:25	26 19:57 (T-37)	20:59	21:17	23 20:49 (T-38)	21:01	20:16	16 19:51 (T-37)	19:18
28	07:51	07:08	07:17	06:23	19:32 (T-37)	05:48	05:44					
	17:29	18:11	19:48	20:26	24 19:56 (T-37)	21:00	21:17	23 20:48 (T-38)	21:00	20:14	13 19:49 (T-37)	19:17
29	07:50		07:15	06:21	19:33 (T-37)	05:47	05:44					
	17:31		19:49	20:27	22 19:55 (T-37)	21:01	21:17	23 20:50 (T-38)	20:58	20:12	11 19:47 (T-37)	19:15
30	07:49		07:13	06:20	19:34 (T-37)	05:47	05:45					
	17:32		19:50	20:29	20 19:54 (T-37)	21:02	3 20:34 (T-38)	21:17	22 20:49 (T-38)	20:57	8 19:45 (T-37)	19:13
31	07:48		07:11		05:46		20:31 (T-38)			06:12	06:48	
	17:34		19:51		21:03	6 20:37 (T-38)				20:56	20:09	4 19:43 (T-37)
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case				392	36	623		421				
Sun reduction				0.63	0.66	0.73		0.72				
Oper. time red.				0.90	0.90	0.90		0.90				
Wind dir. red.				0.60	0.61	0.65		0.60				
Total reduction				0.34	0.36	0.42		0.39				
Total, real				132	13	265		162				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
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1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-167 - R-167
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:37	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:01	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:07	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:45	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:08	20:44	21:13	21:12	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:54	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:58
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:58
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:19	18:00	19:38	20:16	20:52	21:16	21:07	20:28	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:18	20:53	21:16	21:06	20:26	19:30	18:34	16:55	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:55	21:16	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:41	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:57	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:39	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:00	21:17	21:00	20:14	19:17	18:23	16:50	16:54
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:17	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:47	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:12	06:48		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-169 - R-169

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:09	07:29 (T-89)	05:45
	16:57	17:35	18:13	19:53	50 08:19 (T-89)	20:30 24 07:53 (T-89)
2	08:04	07:46	07:04	07:07	07:28 (T-89)	06:17
	16:58	17:36	18:14	19:54	52 08:20 (T-89)	20:31 18 07:50 (T-89)
3	08:04	07:45	07:02	07:06	07:26 (T-89)	06:15
	16:59	17:38	18:15	19:55	54 08:20 (T-89)	20:32 5 07:44 (T-89)
4	08:04	07:43	07:01	07:04	07:24 (T-89)	06:14
	17:00	17:39	18:17	19:56	56 08:20 (T-89)	20:33
5	08:04	07:42	06:59	07:02	07:22 (T-89)	06:13
	17:01	17:41	18:18	19:58	58 08:20 (T-89)	20:35
6	08:04	07:41	06:57	07:00	07:20 (T-89)	06:11
	17:02	17:42	18:19	19:59	59 08:19 (T-89)	20:36
7	08:04	07:40	08:01 (T-H)	06:55	06:58	07:19 (T-89)
	17:03	17:44	1 08:02 (T-H)	18:21	20:00	61 08:20 (T-89)
8	08:04	07:38	08:00 (T-H)	07:54	06:57	07:17 (T-89)
	17:04	17:45	3 08:03 (T-H)	18:22	20:01	63 08:20 (T-89)
9	08:03	07:37	07:58 (T-H)	07:52	06:55	07:15 (T-89)
	17:05	17:46	4 08:02 (T-H)	19:23	20:03	64 08:19 (T-89)
10	08:03	07:36	07:57 (T-H)	07:50	06:53	07:15 (T-89)
	17:06	17:48	5 08:02 (T-H)	19:25	20:04	64 08:19 (T-89)
11	08:03	07:34	07:56 (T-H)	07:48	06:51	07:14 (T-89)
	17:07	17:49	6 08:02 (T-H)	19:26	20:05	64 08:18 (T-89)
12	08:02	07:33	07:54 (T-H)	07:46	08:07 (T-54)	06:49
	17:09	17:51	7 08:01 (T-H)	19:27	2 08:09 (T-54)	20:06
13	08:02	07:31	07:53 (T-H)	07:44	08:05 (T-54)	06:48
	17:10	17:52	7 08:00 (T-H)	19:29	3 08:08 (T-54)	20:07
14	08:02	07:30	07:51 (T-H)	07:43	08:03 (T-54)	06:46
	17:11	17:53	6 07:57 (T-H)	19:30	4 08:07 (T-54)	20:09
15	08:01	07:28	07:41	06:44	08:01 (T-54)	06:44
	17:12	17:55	19:31	4 08:05 (T-54)	20:10	62 08:16 (T-89)
16	08:01	07:27	07:39	06:42	07:59 (T-54)	06:42
	17:13	17:56	19:32	3 08:02 (T-54)	20:11	61 08:16 (T-89)
17	08:00	07:25	07:37	06:41	07:15 (T-89)	05:58
	17:15	17:58	19:34	20:12	60 08:15 (T-89)	20:49
18	07:59	07:24	07:35	06:39	07:15 (T-89)	05:57
	17:16	17:59	19:35	20:14	58 08:13 (T-89)	20:50
19	07:59	07:22	07:33	06:37	07:16 (T-89)	05:56
	17:17	18:00	19:36	20:15	57 08:13 (T-89)	20:51
20	07:58	07:21	07:32	06:36	07:16 (T-89)	05:55
	17:19	18:00	19:37	20:16	56 08:12 (T-89)	20:52
21	07:57	07:19	07:30	06:34	07:17 (T-89)	05:54
	17:20	18:02	19:39	13 08:03 (T-89)	20:17	54 08:11 (T-89)
22	07:56	07:18	07:28	06:32	07:48 (T-89)	06:32
	17:21	18:03	19:40	19 08:07 (T-89)	20:19	53 08:10 (T-89)
23	07:56	07:16	07:26	06:31	07:17 (T-89)	05:52
	17:23	18:05	19:41	23 08:09 (T-89)	20:20	51 08:08 (T-89)
24	07:55	07:14	07:24	06:29	07:44 (T-89)	06:29
	17:24	18:06	19:43	27 08:11 (T-89)	20:21	48 08:07 (T-89)
25	07:54	07:13	07:22	06:28	07:42 (T-89)	06:28
	17:25	18:07	19:44	31 08:13 (T-89)	20:22	46 08:05 (T-89)
26	07:53	07:11	07:20	06:26	07:41 (T-89)	06:26
	17:27	18:09	19:45	34 08:15 (T-89)	20:24	43 08:04 (T-89)
27	07:52	07:09	07:19	06:24	07:39 (T-89)	06:24
	17:28	18:10	19:46	37 08:16 (T-89)	20:25	40 08:02 (T-89)
28	07:51	07:08	07:17	06:23	07:37 (T-89)	06:23
	17:29	18:11	19:48	40 08:17 (T-89)	20:26	37 08:01 (T-89)
29	07:50		07:15	06:21	07:35 (T-89)	06:21
	17:31		19:49	42 08:17 (T-89)	20:27	33 07:58 (T-89)
30	07:49		07:13	06:20	07:33 (T-89)	06:20
	17:32		19:50	45 08:18 (T-89)	20:29	29 07:56 (T-89)
31	07:48		07:11	06:19	07:31 (T-89)	06:19
	17:34		19:51	47 08:18 (T-89)	20:30	21:03
Potential sun hours	287	292	369	403	458	465
Total, worst case					1621	47
Sun reduction		0.58	0.59	0.63	0.66	
Oper. time red.		0.90	0.90	0.90	0.90	
Wind dir. red.		0.63	0.59	0.59	0.59	
Total reduction		0.33	0.31	0.33	0.35	
Total, real		13	117	540	16	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-169 - R-169
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December			
1	05:45	06:13	06:49	07:14 (T-89)	07:24	07:45 (T-54)	07:04	07:27 (T-H)	07:43
	21:16	20:55	20:07	64 08:18 (T-89)	19:11	2 07:47 (T-54)	17:17	5 07:32 (T-H)	16:49
2	05:46	06:14	06:50	07:14 (T-89)	07:25	07:46 (T-54)	07:05	07:28 (T-H)	07:44
	21:16	20:54	20:05	64 08:18 (T-89)	19:09	1 07:47 (T-54)	17:16	4 07:32 (T-H)	16:48
3	05:46	06:15	06:51	07:13 (T-89)	07:27		07:07	07:30 (T-H)	07:45
	21:16	20:52	20:03	64 08:17 (T-89)	19:07		17:14	3 07:33 (T-H)	16:48
4	05:47	06:16	06:52	07:14 (T-89)	07:28		07:08	07:31 (T-H)	07:46
	21:16	20:51	20:01	63 08:17 (T-89)	19:05		17:13	1 07:32 (T-H)	16:48
5	05:48	06:17	06:53	07:15 (T-89)	07:29		07:09		07:48
	21:16	20:50	20:00	61 08:16 (T-89)	19:03		17:11		16:47
6	05:48	06:18	06:55	07:16 (T-89)	07:30		07:11		07:49
	21:15	20:48	19:58	59 08:15 (T-89)	19:02		17:10		16:47
7	05:49	06:19	06:56	07:17 (T-89)	07:31		07:12		07:50
	21:15	20:47	19:56	58 08:15 (T-89)	19:00		17:09		16:47
8	05:50	06:21	06:57	07:18 (T-89)	07:33		07:13		07:51
	21:15	20:46	19:54	56 08:14 (T-89)	18:56		17:08		16:47
9	05:50	06:22	06:58	07:20 (T-89)	07:34		07:15		07:52
	21:14	20:44	19:52	54 08:14 (T-89)	18:54		17:06		16:47
10	05:51	06:23	07:45 (T-89)	06:59	07:21 (T-89)	07:35	07:16		07:52
	21:14	20:43	10 07:55 (T-89)	19:50	52 08:13 (T-89)	18:53	17:05		16:47
11	05:52	06:24	07:40 (T-89)	07:00	07:22 (T-89)	07:36	07:18		07:53
	21:13	20:41	20 08:00 (T-89)	19:48	50 08:12 (T-89)	18:51	17:04		16:47
12	05:53	06:25	07:37 (T-89)	07:02	07:23 (T-89)	07:38	07:19		07:54
	21:13	20:40	26 08:03 (T-89)	19:47	48 08:11 (T-89)	18:49	17:03		16:47
13	05:54	06:26	07:34 (T-89)	07:03	07:24 (T-89)	07:39	07:20		07:55
	21:12	20:38	31 08:05 (T-89)	19:45	45 08:09 (T-89)	18:47	17:02		16:47
14	05:54	06:28	07:32 (T-89)	07:04	07:25 (T-89)	07:40	07:22		07:56
	21:11	20:37	34 08:06 (T-89)	19:43	43 08:08 (T-89)	18:46	17:01		16:47
15	05:55	06:29	07:30 (T-89)	07:05	07:26 (T-89)	07:41	07:23		07:57
	21:11	20:35	38 08:08 (T-89)	19:41	40 08:06 (T-89)	18:44	17:00		16:47
16	05:56	06:30	07:29 (T-89)	07:06	07:27 (T-89)	07:43	07:24		07:57
	21:10	20:34	41 08:10 (T-89)	19:39	37 08:04 (T-89)	18:42	16:59		16:47
17	05:57	06:31	07:27 (T-89)	07:07	07:29 (T-89)	07:44	07:26		07:58
	21:09	20:32	44 08:11 (T-89)	19:37	34 08:03 (T-89)	18:40	16:58		16:48
18	05:58	06:32	07:26 (T-89)	07:09	07:30 (T-89)	07:45	07:27		07:59
	21:09	20:31	46 08:12 (T-89)	19:35	31 08:01 (T-89)	18:39	16:57		16:48
19	05:59	06:33	07:24 (T-89)	07:10	07:31 (T-89)	07:47	07:28		07:59
	21:08	20:29	49 08:13 (T-89)	19:33	28 07:59 (T-89)	18:37	16:56		16:48
20	06:00	06:35	07:23 (T-89)	07:11	07:32 (T-89)	07:48	07:30		08:00
	21:07	20:27	51 08:14 (T-89)	19:32	24 07:56 (T-89)	18:35	16:55		16:49
21	06:01	06:36	07:22 (T-89)	07:12	07:33 (T-89)	07:49	07:31		08:01
	21:06	20:26	53 08:15 (T-89)	19:30	20 07:53 (T-89)	18:34	16:54		16:49
22	06:02	06:37	07:21 (T-89)	07:13	07:34 (T-89)	07:51	07:32		08:01
	21:05	20:24	54 08:15 (T-89)	19:28	15 07:49 (T-89)	18:32	16:54		16:50
23	06:03	06:38	07:19 (T-89)	07:14	07:36 (T-89)	07:52	07:33		08:02
	21:04	20:22	57 08:16 (T-89)	19:26	7 07:43 (T-89)	18:30	16:53		16:50
24	06:04	06:39	07:19 (T-89)	07:16		07:53	07:35		08:02
	21:03	20:21	58 08:17 (T-89)	19:24		18:29	16:52		16:51
25	06:05	06:40	07:18 (T-89)	07:17		07:55	07:36		08:02
	21:02	20:19	59 08:17 (T-89)	19:22		18:27	16:52		16:51
26	06:06	06:42	07:18 (T-89)	07:18		07:56	07:37		08:03
	21:01	20:17	59 08:17 (T-89)	19:20		18:26	16:51		16:52
27	06:07	06:43	07:17 (T-89)	07:19		07:57	07:38		08:03
	21:00	20:16	61 08:18 (T-89)	19:18		18:24	16:50		16:53
28	06:08	06:44	07:16 (T-89)	07:20	07:42 (T-54)	07:59	08:21 (T-H)		08:03
	20:59	20:14	62 08:18 (T-89)	19:16	4 07:46 (T-54)	18:23	7 08:28 (T-H)		16:54
29	06:09	06:45	07:15 (T-89)	07:22	07:43 (T-54)	08:00	08:22 (T-H)		08:04
	20:58	20:12	63 08:18 (T-89)	19:15	4 07:47 (T-54)	18:21	7 08:29 (T-H)		16:54
30	06:10	06:46	07:14 (T-89)	07:23	07:44 (T-54)	08:01	08:24 (T-H)		08:04
	20:57	20:10	63 08:17 (T-89)	19:13	3 07:47 (T-54)	18:20	7 08:31 (T-H)		16:55
31	06:11	06:47	07:14 (T-89)			08:03	08:25 (T-H)		08:04
	20:56	20:09	63 08:17 (T-89)			18:18	6 08:31 (T-H)		16:56
Potential sun hours	471	436	377	341	289	275			
Total, worst case			1042	1028	30	13			
Sun reduction			0.72	0.67	0.56	0.48			
Oper. time red.			0.90	0.90	0.90	0.90			
Wind dir. red.			0.59	0.59	0.63	0.63			
Total reduction			0.38	0.35	0.32	0.27			
Total, real		397	364	10	4				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-171 - R-171
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	07:06 18:13	07:10 19:53	06:19 20:30	05:46 21:04	20:10 (T-39) 21:17	06:13 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:49
2	08:05 16:58	07:46 17:37	07:04 18:14	07:08 19:54	06:17 20:31	05:45 21:05	20:09 (T-39) 20:38 (T-39)	06:14 20:54	06:50 20:05	07:26 19:09	07:06 17:16	07:45 16:48
3	08:05 16:59	07:45 17:38	07:03 18:16	07:06 19:55	06:16 20:33	05:44 21:06	20:10 (T-39) 20:40 (T-39)	06:15 20:53	06:51 20:03	07:27 19:07	07:07 17:14	07:46 16:48
4	08:04 17:00	07:44 17:40	07:01 18:17	07:04 19:57	06:14 20:34	05:44 21:07	20:10 (T-39) 20:41 (T-39)	06:16 20:51	06:52 20:02	07:28 19:06	07:08 17:13	07:47 16:48
5	08:04 17:01	07:42 17:41	06:59 18:18	07:02 19:58	06:13 20:35	05:44 21:07	20:10 (T-39) 20:41 (T-39)	06:17 20:50	06:54 20:00	07:29 19:04	07:10 17:12	07:48 16:47
6	08:04 17:02	07:41 17:42	06:57 18:20	07:00 19:59	06:11 20:36	05:43 21:08	20:10 (T-39) 20:42 (T-39)	06:19 20:49	06:55 19:58	07:30 19:02	07:11 17:10	07:49 16:47
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	06:10 20:37	05:43 21:09	20:11 (T-39) 20:43 (T-39)	06:20 20:47	06:56 19:56	07:32 19:00	07:12 17:09	07:50 16:47
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	06:09 20:39	05:43 21:10	20:10 (T-39) 20:43 (T-39)	06:21 20:46	06:57 19:54	07:33 18:56	07:14 17:08	07:51 16:47
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 20:03	06:07 20:40	05:42 21:10	20:11 (T-39) 20:44 (T-39)	06:22 20:44	06:58 19:52	07:34 18:55	07:15 17:07	07:52 16:47
10	08:03 17:06	07:36 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11	20:11 (T-39) 20:44 (T-39)	06:23 20:43	06:59 19:51	07:35 18:53	07:16 17:06	07:53 16:47
11	08:03 17:08	07:34 17:49	07:48 19:26	06:51 20:05	06:05 20:42	05:42 21:12	20:12 (T-39) 20:45 (T-39)	06:24 20:42	07:01 19:49	07:37 18:51	07:18 17:04	07:54 16:47
12	08:03 17:09	07:33 17:51	07:47 19:27	06:50 20:07	06:04 20:43	05:42 21:12	20:12 (T-39) 20:46 (T-39)	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:55 16:47
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	06:02 20:44	05:41 21:13	20:12 (T-39) 20:46 (T-39)	06:27 20:39	07:03 19:45	07:39 18:48	07:20 17:02	07:55 16:47
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	06:01 20:46	05:41 21:13	20:12 (T-39) 20:46 (T-39)	06:28 20:37	07:04 19:43	07:40 18:46	07:22 17:01	07:56 16:47
15	08:01 17:12	07:29 17:55	07:41 19:31	06:44 20:10	06:00 20:47	05:41 21:14	20:12 (T-39) 20:46 (T-39)	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	07:57 16:47
16	08:01 17:14	07:27 17:56	07:39 19:33	06:43 20:11	05:59 20:48	05:41 21:14	20:13 (T-39) 20:48 (T-39)	06:30 20:34	07:06 19:39	07:43 18:42	07:25 16:59	07:58 16:48
17	08:00 17:15	07:26 17:58	07:37 19:34	06:41 20:13	05:58 20:49	05:41 21:15	20:13 (T-39) 20:48 (T-39)	06:31 20:32	07:08 19:37	07:44 18:41	07:26 16:58	07:58 16:48
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 20:14	05:57 20:50	05:41 21:15	20:13 (T-39) 20:48 (T-39)	06:32 20:31	07:09 19:36	07:46 18:39	07:27 16:57	07:59 16:48
19	07:59 17:17	07:23 18:01	07:34 19:36	06:38 20:15	05:56 20:51	05:42 21:15	20:12 (T-39) 20:48 (T-39)	06:34 20:29	07:10 19:34	07:47 18:37	07:28 16:56	08:00 16:49
20	07:58 17:19	07:21 18:01	07:32 19:38	06:36 20:16	05:55 20:52	05:42 21:16	20:11 (T-39) 20:48 (T-39)	06:35 20:28	07:11 19:32	07:48 18:36	07:30 16:56	08:00 16:49
21	07:58 17:20	07:19 18:02	07:30 19:39	06:34 20:18	05:54 20:53	05:42 21:16	20:10 (T-39) 20:48 (T-39)	06:36 20:26	07:12 19:30	07:49 18:34	07:31 16:55	08:01 16:49
22	07:57 17:21	07:18 18:03	07:28 19:40	06:33 20:19	05:53 20:54	05:42 21:16	20:11 (T-39) 20:48 (T-39)	06:37 20:24	07:14 19:28	07:51 18:32	07:32 16:54	08:01 16:50
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 20:20	05:52 20:56	05:42 21:16	20:10 (T-39) 20:49 (T-39)	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53	08:02 16:51
24	07:55 17:24	07:15 18:06	07:24 19:43	06:29 20:21	05:51 20:57	05:43 21:17	20:10 (T-39) 20:49 (T-39)	06:40 20:21	07:16 19:24	07:53 18:29	07:35 16:52	08:02 16:51
25	07:54 17:26	07:13 18:08	07:23 19:44	06:28 20:23	05:50 20:58	05:43 21:17	20:09 (T-39) 20:49 (T-39)	06:41 20:19	07:17 19:22	07:55 18:28	07:36 16:52	08:03 16:52
26	07:53 17:27	07:11 18:09	07:21 19:45	06:26 20:24	05:50 20:59	05:43 21:17	20:10 (T-39) 20:50 (T-39)	06:42 20:18	07:18 19:20	07:56 18:26	07:37 16:51	08:03 16:52
27	07:52 17:28	07:10 18:10	07:19 19:47	06:25 20:25	05:49 21:00	05:44 21:17	20:09 (T-39) 20:34 (T-39)	06:43 20:16	07:20 19:19	07:57 18:24	07:39 16:51	08:03 16:53
28	07:51 17:30	07:08 18:12	07:17 19:48	06:23 20:26	05:48 21:01	05:44 21:17	20:09 (T-39) 20:35 (T-39)	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50	08:04 16:54
29	07:50 17:31	07:15 18:19	07:15 19:49	06:22 20:28	05:47 21:01	05:44 21:17	20:10 (T-39) 20:36 (T-39)	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:50	08:04 16:55
30	07:49 17:32	07:13 18:10	07:13 19:50	06:20 20:29	05:47 21:02	05:45 21:17	20:09 (T-39) 20:36 (T-39)	06:47 20:11	07:23 19:13	08:01 18:20	07:42 16:49	08:04 16:55
31	07:48 17:34	07:11 19:52	07:11 20:09	05:46 21:03	05:46 20:37	05:46 21:17	20:09 (T-39) 20:37 (T-39)	06:48 20:09	07:24 18:19	08:03 18:19	07:43 16:49	08:04 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case						328	993					
Sun reduction						0.66	0.73					
Oper. time red.						0.90	0.90					
Wind dir. red.						0.64	0.64					
Total reduction						0.38	0.42					
Total, real						125	418					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-172 - R-172
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:10	06:18	05:45	05:45	06:13	06:49	19:34 (T-39)	07:24	07:04	07:43	
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	8 19:42 (T-39)	19:11	17:17	16:49	
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	19:34 (T-39)	07:26	07:06	07:45	
	16:58	17:37	18:14	19:54	20:31	21:05	21:16	20:54	20:05	7 19:41 (T-39)	19:09	17:16	16:48	
3	08:04	07:45	07:03	07:06	06:16	05:44	05:47	06:15	06:51	19:34 (T-39)	07:27	07:07	07:46	
	16:59	17:38	18:16	19:55	20:32	21:06	21:16	20:53	20:03	5 19:39 (T-39)	19:07	17:14	16:48	
4	08:04	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	19:34 (T-39)	07:28	07:08	07:47	
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	3 19:37 (T-39)	19:05	17:13	16:48	
5	08:04	07:42	06:59	07:02	06:13	05:44	05:48	06:17	06:54	19:34 (T-39)	07:29	07:10	07:48	
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	1 19:35 (T-39)	19:04	17:12	16:47	
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55		07:30	07:11	07:49	
	17:02	17:42	18:20	19:59	20:36	21:08	21:15	20:49	19:58		19:02	17:10	16:47	
7	08:04	07:40	06:56	06:59	19:38 (T-39)	06:10	05:43	05:49	06:20	06:56	07:32	07:12	07:50	
	17:03	17:44	18:21	20:00	1 19:39 (T-39)	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47	
8	08:04	07:38	07:54	06:57	19:37 (T-39)	06:09	05:42	05:50	06:21	06:57	07:33	07:14	07:51	
	17:04	17:45	18:22	20:01	3 19:40 (T-39)	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47	
9	08:04	07:37	07:52	06:55	19:36 (T-39)	06:07	05:42	05:51	06:22	06:58	07:34	07:15	07:52	
	17:05	17:47	19:24	20:03	5 19:41 (T-39)	20:40	21:10	21:14	20:44	19:52	18:55	17:07	16:47	
10	08:03	07:36	07:50	06:53	19:35 (T-39)	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53	
	17:06	17:48	19:25	20:04	7 19:42 (T-39)	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47	
11	08:03	07:34	07:48	06:51	19:35 (T-39)	06:05	05:42	05:52	06:24	07:01	07:37	07:18	07:54	
	17:08	17:49	19:26	20:05	9 19:44 (T-39)	20:42	21:12	21:13	20:42	19:49	18:51	17:04	16:47	
12	08:03	07:33	07:47	06:50	19:34 (T-39)	06:04	05:42	05:53	06:25	07:02	07:38	07:19	07:55	
	17:09	17:51	19:27	20:06	10 19:44 (T-39)	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47	
13	08:02	07:32	07:45	06:48	19:34 (T-39)	06:02	05:41	05:54	06:27	07:03	07:39	07:20	07:55	
	17:10	17:52	19:29	20:08	11 19:45 (T-39)	20:44	21:13	21:12	20:39	19:45	18:47	17:02	16:47	
14	08:02	07:30	07:43	06:46	19:34 (T-39)	06:01	05:41	05:55	06:28	07:04	07:40	07:22	07:56	
	17:11	17:54	19:30	20:09	12 19:46 (T-39)	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47	
15	08:01	07:29	07:41	06:44	19:35 (T-39)	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57	
	17:12	17:55	19:31	20:10	13 19:48 (T-39)	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47	
16	08:01	07:27	07:39	06:43	19:36 (T-39)	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:58	
	17:14	17:56	19:33	20:11	13 19:49 (T-39)	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:48	
17	08:00	07:26	07:37	06:41	19:37 (T-39)	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:58	
	17:15	17:58	19:34	20:13	11 19:48 (T-39)	20:49	21:15	21:10	20:32	19:37	18:41	16:58	16:48	
18	08:00	07:24	07:36	06:39	19:41 (T-39)	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59	
	17:16	17:59	19:35	20:14	3 19:44 (T-39)	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48	
19	07:59	07:23	07:34	06:38		05:56	05:41	05:59	06:34	07:10	07:47	07:28	08:00	
	17:17	18:01	19:36	20:15		20:51	21:15	21:08	20:29	19:34	18:37	16:56	16:49	
20	07:58	07:21	07:32	06:36		05:55	05:42	06:00	06:35	07:11	07:48	07:30	08:00	
	17:19	18:01	19:38	20:16		20:52	21:16	21:07	20:28	19:32	18:36	16:55	16:49	
21	07:57	07:19	07:30	06:34		05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01	
	17:20	18:02	19:39	20:18		20:53	21:16	21:06	20:26	19:30	18:34	16:55	16:49	
22	07:57	07:18	07:28	06:33		05:53	05:42	06:02	06:37	07:14	07:51	07:32	08:01	
	17:21	18:03	19:40	20:19		20:54	21:16	21:06	20:24	19:28	18:32	16:54	16:50	
23	07:56	07:16	07:26	06:31		05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02	
	17:23	18:05	19:41	20:20		20:56	21:16	21:05	20:23	19:26	18:31	16:53	16:50	
24	07:55	07:14	07:24	06:29		05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02	
	17:24	18:06	19:43	20:21		20:57	21:16	21:04	20:21	19:24	18:29	16:52	16:51	
25	07:54	07:13	07:23	06:28		05:50	05:43	06:05	06:41	19:44 (T-39)	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23		20:58	21:17	21:03	20:19	4 19:48 (T-39)	19:22	18:28	16:52	16:52
26	07:53	07:11	07:21	06:26		05:50	05:43	06:06	06:42	19:40 (T-39)	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24		20:59	21:17	21:02	20:18	11 19:51 (T-39)	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:25		05:49	05:44	06:07	06:43	19:38 (T-39)	07:19	07:57	07:39	08:03
	17:28	18:10	19:47	20:25		21:00	21:17	21:01	20:16	13 19:51 (T-39)	19:19	18:24	16:51	16:53
28	07:51	07:08	07:17	06:23		05:48	05:44	06:08	06:44	19:36 (T-39)	07:21	07:59	07:40	08:04
	17:30	18:12	19:48	20:26		21:00	21:17	21:00	20:14	13 19:49 (T-39)	19:17	18:23	16:50	16:54
29	07:50		07:15	06:21		05:47	05:44	06:09	06:45	19:35 (T-39)	07:22	08:00	07:41	08:04
	17:31		19:49	20:28		21:01	21:17	20:58	20:12	12 19:47 (T-39)	19:15	18:21	16:50	16:54
30	07:49		07:13	06:20		05:47	05:45	06:11	06:47	19:34 (T-39)	07:23	08:01	07:42	08:04
	17:32		19:50	20:29		21:02	21:17	20:57	20:11	11 19:45 (T-39)	19:13	18:20	16:49	16:55
31	07:48		07:11			05:46		06:12	06:48	19:34 (T-39)		08:03	07:43	08:04
	17:34		19:52			21:03		20:56	20:09	10 19:44 (T-39)		18:19	16:49	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377		341	289	275	
Total, worst case				98					74	24				
Sun reduction				0.63					0.72	0.67				
Oper. time red.				0.90					0.90	0.90				
Wind dir. red.				0.60					0.60	0.60				
Total reduction				0.34					0.39	0.36				
Total, real				33				29		9				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-173 - R-173

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June		
1	08:04	07:47	07:06	17:35 (T-39)	07:10	19:07 (T-40)	06:18	05:45
	16:57	17:35	18:13	8 17:43 (T-39)	19:53	25 19:32 (T-40)	20:30	21:04
2	08:05	07:46	07:04		07:08	19:06 (T-40)	06:17	05:45
	16:58	17:37	18:14		19:54	27 19:33 (T-40)	20:31	21:05
3	08:05	07:45	07:03		07:06	19:05 (T-40)	06:16	05:44
	16:59	17:38	18:16		19:55	29 19:34 (T-40)	20:32	21:06
4	08:04	07:44	07:01		07:04	19:04 (T-40)	06:14	05:44
	17:00	17:39	18:17		19:57	31 19:35 (T-40)	20:34	21:07
5	08:04	07:42	06:59		07:02	19:04 (T-40)	06:13	05:44
	17:01	17:41	18:18		19:58	32 19:36 (T-40)	20:35	21:07
6	08:04	07:41	06:57		07:00	19:04 (T-40)	06:11	05:43
	17:02	17:42	18:20		19:59	34 19:38 (T-40)	20:36	21:08
7	08:04	07:40	06:56		06:59	19:04 (T-40)	06:10	05:43
	17:03	17:44	18:21		20:00	35 19:39 (T-40)	20:37	21:09
8	08:04	07:39	07:54		06:57	19:04 (T-40)	06:09	05:42
	17:04	17:45	18:22		20:02	36 19:40 (T-40)	20:39	21:10
9	08:04	07:37	07:52		06:55	19:04 (T-40)	06:07	05:42
	17:05	17:47	19:24		20:03	35 19:39 (T-40)	20:40	21:10
10	08:03	07:36	07:50		06:53	19:04 (T-40)	06:06	05:42
	17:06	17:48	19:25		20:04	34 19:38 (T-40)	20:41	21:11
11	08:03	07:34	07:48		06:51	19:05 (T-40)	06:05	05:42
	17:08	17:49	19:26		20:05	33 19:38 (T-40)	20:42	21:12
12	08:03	07:33	07:47		06:50	19:05 (T-40)	06:04	05:42
	17:09	17:51	19:27		20:06	32 19:37 (T-40)	20:43	21:12
13	08:02	07:32	07:45		06:48	19:06 (T-40)	06:02	05:41
	17:10	17:52	19:29		20:08	29 19:35 (T-40)	20:44	21:13
14	08:02	07:30	07:43		06:46	19:06 (T-40)	06:01	05:41
	17:11	17:54	19:30		20:09	28 19:34 (T-40)	20:46	21:13
15	08:01	07:29	07:41		06:44	19:08 (T-40)	06:00	05:41
	17:12	17:55	19:31		20:10	25 19:33 (T-40)	20:47	21:14
16	08:01	07:27	07:39		06:43	19:10 (T-40)	05:59	05:41
	17:14	17:56	19:33		20:11	20 19:30 (T-40)	20:48	21:14
17	08:00	07:26	17:32 (T-39)	07:37	06:41	19:12 (T-40)	05:58	05:41
	17:15	17:58	2 17:34 (T-39)	19:34	20:13	15 19:27 (T-40)	20:49	21:15
18	08:00	07:24	17:31 (T-39)	07:36	06:39	19:17 (T-40)	05:57	05:41
	17:16	17:59	4 17:35 (T-39)	19:35	20:14	6 19:23 (T-40)	20:50	21:15
19	07:59	07:23	17:30 (T-39)	07:34	06:38		05:56	05:41
	17:17	18:01	7 17:37 (T-39)	19:36	20:15		20:51	21:15
20	07:58	07:21	17:29 (T-39)	07:32	06:36		05:55	05:42
	17:19	18:01	9 17:38 (T-39)	19:38	20:16		20:52	21:16
21	07:58	07:19	17:29 (T-39)	07:30	06:34		05:54	05:42
	17:20	18:02	10 17:39 (T-39)	19:39	20:18		20:53	21:16
22	07:57	07:18	17:29 (T-39)	07:28	06:33		05:53	05:42
	17:21	18:03	12 17:41 (T-39)	19:40	20:19		20:54	21:16
23	07:56	07:16	17:29 (T-39)	07:26	06:31		05:52	05:42
	17:23	18:05	14 17:43 (T-39)	19:41	20:20		20:56	21:16
24	07:55	07:15	17:28 (T-39)	07:24	06:29		05:51	05:42
	17:24	18:06	16 17:44 (T-39)	19:43	20:21		20:57	21:17
25	07:54	07:13	17:30 (T-39)	07:23	19:21 (T-40)	06:28	05:50	05:43
	17:25	18:07	16 17:46 (T-39)	19:44	2 19:23 (T-40)	20:23	20:58	21:17
26	07:53	07:11	17:30 (T-39)	07:21	19:17 (T-40)	06:26	05:50	05:43
	17:27	18:09	17 17:47 (T-39)	19:45	7 19:24 (T-40)	20:24	20:59	21:17
27	07:52	07:09	17:31 (T-39)	07:19	19:14 (T-40)	06:25	05:49	05:44
	17:28	18:10	16 17:47 (T-39)	19:47	11 19:25 (T-40)	20:25	21:00	21:17
28	07:51	07:08	17:32 (T-39)	07:17	19:12 (T-40)	06:23	05:48	05:44
	17:30	18:12	13 17:45 (T-39)	19:48	14 19:26 (T-40)	20:26	21:01	21:17
29	07:50		07:15	19:10 (T-40)	06:21		05:47	05:44
	17:31		17 19:27 (T-40)	20:28	17 19:27 (T-40)	20:28	21:01	21:17
30	07:49		07:13	19:09 (T-40)	06:20		05:47	05:45
	17:32		19:50	19:28 (T-40)	20:29		21:02	21:17
31	07:48		07:11	19:08 (T-40)			05:46	
	17:34		19:52	22 19:30 (T-40)			21:03	
Potential sun hours	287	292	369	403	458	465		
Total, worst case			100	506				
Sun reduction		0.58	0.59	0.63				
Oper. time red.		0.90	0.90	0.90				
Wind dir. red.		0.59	0.59	0.60				
Total reduction		0.31	0.32	0.34				
Total, real		42	32	171				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-173 - R-173

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	19:04 (T-40) 19:11	07:04 17:17	07:43 16:49
2	05:46 21:16	06:14 20:54	06:50 20:05	19:03 (T-40) 19:09	07:06 17:16	07:45 16:48
3	05:46 21:16	06:15 20:53	06:51 20:03	19:02 (T-40) 19:07	07:07 17:14	07:46 16:48
4	05:47 21:16	06:16 20:51	06:52 20:02	19:01 (T-40) 19:06	07:08 17:13	07:47 16:48
5	05:48 21:16	06:17 20:50	06:54 20:00	19:00 (T-40) 19:04	07:10 17:12	07:48 16:47
6	05:48 21:16	06:18 20:49	06:55 19:58	18:59 (T-40) 19:02	07:11 17:10	07:49 16:47
7	05:49 21:15	06:20 20:47	06:56 19:56	18:59 (T-40) 19:00	07:12 17:09	07:50 16:47
8	05:50 21:15	06:21 20:46	06:57 19:54	19:00 (T-40) 18:56	07:14 17:08	07:51 16:47
9	05:51 21:14	06:22 20:44	06:58 19:52	18:59 (T-40) 18:55	07:15 17:07	07:52 16:47
10	05:51 21:14	06:23 20:43	06:59 19:51	18:59 (T-40) 18:53	07:16 17:05	07:53 16:47
11	05:52 21:13	06:24 20:42	07:01 19:49	18:59 (T-40) 18:51	07:18 17:04	07:54 16:47
12	05:53 21:13	06:25 20:40	07:02 19:47	18:59 (T-40) 18:49	07:19 17:03	07:55 16:47
13	05:54 21:12	06:27 20:39	07:03 19:45	19:00 (T-40) 18:47	18:07 (T-39) 17:02	07:55 16:47
14	05:55 21:12	06:28 20:37	07:04 19:43	19:00 (T-40) 18:46	18:18 (T-39) 17:01	07:56 16:47
15	05:55 21:11	06:29 20:36	07:05 19:41	19:02 (T-40) 18:44	18:04 (T-39) 17:00	07:57 16:47
16	05:56 21:10	06:30 20:34	07:06 19:39	19:17 (T-40) 18:42	18:20 (T-39) 16:59	07:58 16:48
17	05:57 21:10	06:31 20:32	07:08 19:37	19:03 (T-40) 18:41	18:02 (T-39) 16:58	07:58 16:48
18	05:58 21:09	06:32 20:31	07:09 19:36	19:05 (T-40) 18:39	18:17 (T-39) 16:57	07:59 16:48
19	05:59 21:08	06:34 20:29	07:10 19:34	19:08 (T-40) 18:37	18:15 (T-39) 16:56	08:00 16:49
20	06:00 21:07	06:35 20:28	07:11 19:32	19:11 (T-40) 18:36	18:00 (T-39) 16:55	08:00 16:49
21	06:01 21:07	06:36 20:26	07:12 19:30	19:14 (T-40) 18:34	18:11 (T-39) 16:54	08:01 16:49
22	06:02 21:06	06:37 20:24	07:14 19:28	19:11 (T-40) 18:32	17:59 (T-39) 16:53	08:01 16:50
23	06:03 21:05	06:38 20:23	07:15 19:26	19:28 (T-40) 18:31	18:09 (T-39) 16:52	08:02 16:50
24	06:04 21:04	06:39 20:21	07:16 19:24	19:30 (T-40) 18:29	18:06 (T-39) 16:51	08:02 16:51
25	06:05 21:03	06:41 20:19	07:17 19:22	19:32 (T-40) 18:28	18:05 (T-39) 16:50	08:03 16:52
26	06:06 21:02	06:42 20:18	07:18 19:20	19:34 (T-40) 18:27	18:04 (T-39) 16:49	08:03 16:52
27	06:07 21:01	06:43 20:16	07:19 19:19	19:36 (T-40) 18:26	18:03 (T-39) 16:48	08:03 16:53
28	06:08 21:00	06:44 20:14	07:21 19:17	19:11 (T-40) 18:24	19:30 (T-40) 16:47	08:04 16:53
29	06:09 20:59	06:45 20:12	07:22 19:15	19:09 (T-40) 18:23	19:32 (T-40) 16:46	08:04 16:54
30	06:11 20:57	06:47 20:11	07:23 19:13	19:07 (T-40) 18:21	19:34 (T-40) 16:45	08:04 16:54
31	06:12 20:56	06:48 20:09	07:24 19:11	19:05 (T-40) 18:20	19:35 (T-40) 16:44	08:04 16:55
Potential sun hours	471	436	377	341	289	275
Total, worst case			159	449	145	
Sun reduction			0.72	0.67	0.56	
Oper. time red.			0.90	0.90	0.90	
Wind dir. red.			0.60	0.60	0.59	
Total reduction			0.39	0.36	0.29	
Total, real		61	161	43		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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L085 73 GE3.8-154 WTGs on 98m HH
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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-174 - R-174
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	07:47 17:35	07:06 18:13	07:09 19:53	06:18 20:30	05:45 21:04	05:45 21:17	20:40 (T-83) 20:55	06:13 20:55	06:49 20:07	19:36 (T-40) 19:11	07:24 17:17	07:43 16:49
2	08:04 16:58	07:46 17:37	07:04 18:14	07:08 19:54	06:17 20:31	05:45 21:05	05:46 21:16	20:40 (T-83) 20:54	06:14 20:54	06:50 20:05	19:37 (T-40) 19:09	07:25 17:16	07:44 16:48
3	08:04 16:59	07:45 17:38	07:03 18:16	07:06 19:55	06:16 20:32	05:44 21:06	20:37 (T-83) 21:16	20:41 (T-83) 20:52	06:15 20:51	06:51 20:03	19:37 (T-40) 19:07	07:27 17:14	07:46 16:48
4	08:04 17:00	07:44 17:39	07:01 18:17	07:04 19:56	06:14 20:34	05:44 21:07	20:36 (T-83) 21:16	20:40 (T-83) 20:51	06:16 20:51	06:52 20:02	19:37 (T-40) 19:05	07:28 17:13	07:47 16:48
5	08:04 17:01	07:42 17:41	06:59 18:18	07:02 19:58	06:13 20:35	05:43 21:07	20:36 (T-83) 21:16	20:41 (T-83) 21:16	06:17 20:50	06:54 20:00	19:41 (T-40) 19:04	07:29 17:12	07:48 16:47
6	08:04 17:02	07:41 17:42	06:57 18:20	07:00 19:59	06:11 20:36	05:43 21:08	20:36 (T-83) 21:15	20:42 (T-83) 20:49	06:18 20:49	06:55 19:58	19:30 (T-40) 19:02	07:30 17:10	07:49 16:47
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	06:10 20:37	05:43 21:09	20:35 (T-83) 21:15	20:42 (T-83) 21:15	06:20 20:47	06:56 19:56	19:32 (T-40) 19:00	07:12 17:09	07:50 16:47
8	08:04 17:04	07:38 17:45	06:54 18:22	06:57 20:01	06:09 20:39	05:42 21:10	20:35 (T-83) 21:15	20:43 (T-83) 20:46	06:21 20:46	06:57 19:54	19:33 (T-40) 18:56	07:14 17:08	07:51 16:47
9	08:04 17:05	07:37 17:47	06:52 18:23	06:55 20:03	19:39 (T-40) 19:41 (T-40)	06:07 20:40	20:36 (T-83) 21:14	20:44 (T-83) 20:44	06:22 20:44	06:58 19:52	18:47 (T-40) 18:55	07:15 17:07	07:52 16:47
10	08:03 17:06	07:36 17:48	06:50 18:25	06:53 20:04	19:38 (T-40) 19:42 (T-40)	06:06 20:41	20:36 (T-83) 21:11	20:44 (T-83) 21:14	06:23 20:43	06:59 19:51	18:53 (T-40) 18:53	07:16 17:05	07:53 16:47
11	08:03 17:07	07:34 17:49	06:48 18:26	06:51 20:05	19:37 (T-40) 19:44 (T-40)	06:05 20:42	20:36 (T-83) 21:12	20:45 (T-83) 21:13	06:24 20:42	07:01 19:49	18:51 (T-40) 18:51	07:18 17:04	07:54 16:47
12	08:03 17:09	07:33 17:51	06:46 18:27	06:50 20:06	19:36 (T-40) 19:44 (T-40)	06:04 20:43	20:36 (T-83) 21:12	20:46 (T-83) 21:13	06:25 20:40	07:02 19:47	18:49 (T-40) 18:49	07:19 17:03	07:54 16:47
13	08:02 17:10	07:32 17:52	06:45 18:29	06:48 20:08	19:36 (T-40) 19:45 (T-40)	06:02 20:44	20:35 (T-83) 21:13	20:47 (T-83) 21:12	06:27 20:39	07:03 19:45	18:47 (T-40) 18:47	07:20 17:02	07:55 16:47
14	08:02 17:11	07:30 17:54	06:43 18:30	06:46 20:09	19:35 (T-40) 19:46 (T-40)	06:01 20:46	20:35 (T-83) 21:13	20:48 (T-83) 21:12	06:28 20:37	07:04 19:43	18:46 (T-40) 18:46	07:22 17:01	07:56 16:47
15	08:01 17:12	07:29 17:55	06:41 18:31	06:44 20:10	19:36 (T-40) 19:48 (T-40)	06:00 20:47	20:35 (T-83) 21:11	20:49 (T-83) 21:11	06:29 20:36	07:05 19:41	18:45 (T-40) 18:44	07:23 17:00	07:57 16:47
16	08:01 17:14	07:27 17:56	06:39 18:33	06:43 20:11	19:36 (T-40) 19:49 (T-40)	05:59 20:48	20:35 (T-83) 21:10	20:50 (T-83) 21:10	06:30 20:34	07:06 19:39	18:44 (T-40) 18:42	07:24 16:59	07:58 16:48
17	08:00 17:15	07:26 17:58	06:37 18:34	06:41 20:13	19:36 (T-40) 19:50 (T-40)	05:58 20:49	20:35 (T-83) 21:10	20:51 (T-83) 21:10	06:31 20:32	07:08 19:37	18:42 (T-40) 18:41	07:26 16:58	07:58 16:48
18	08:00 17:16	07:24 17:59	06:35 18:35	06:39 20:14	19:38 (T-40) 19:51 (T-40)	05:57 20:50	20:36 (T-83) 21:10	20:52 (T-83) 21:09	06:32 20:31	07:09 19:35	18:46 (T-40) 18:39	07:27 16:57	07:59 16:48
19	07:59 17:17	07:23 18:01	06:34 18:36	06:37 20:15	19:39 (T-40) 19:48 (T-40)	05:56 20:51	20:36 (T-83) 21:10	20:53 (T-83) 21:08	06:34 20:29	07:10 19:34	18:37 (T-40) 18:37	07:28 16:56	08:00 16:49
20	07:58 17:19	07:21 18:01	06:32 18:38	06:36 20:16	19:40 (T-40) 19:55	05:55 20:52	20:36 (T-83) 21:07	20:54 (T-83) 21:07	06:35 20:28	07:11 19:32	18:36 (T-40) 18:36	07:30 16:55	08:00 16:49
21	07:57 17:20	07:19 18:02	06:30 18:39	06:34 20:18	19:41 (T-40) 19:56	05:54 20:53	20:37 (T-83) 21:06	20:55 (T-83) 21:06	06:36 20:26	07:12 19:30	18:35 (T-40) 18:34	07:31 16:55	08:01 16:49
22	07:57 17:21	07:18 18:03	06:28 18:40	06:33 20:19	19:42 (T-40) 19:57	05:53 20:54	20:37 (T-83) 21:06	20:56 (T-83) 21:06	06:37 20:24	07:13 19:28	18:34 (T-40) 18:32	07:32 16:54	08:01 16:50
23	07:56 17:23	07:16 18:05	06:26 18:41	06:31 20:20	19:43 (T-40) 19:58	05:52 20:55	20:37 (T-83) 21:05	20:57 (T-83) 21:05	06:38 20:23	07:15 19:26	18:33 (T-40) 18:31	07:34 16:53	08:02 16:50
24	07:55 17:24	07:14 18:06	06:24 18:43	06:29 20:21	19:44 (T-40) 19:59	05:51 20:57	20:37 (T-83) 21:04	20:58 (T-83) 21:04	06:39 20:21	07:16 19:24	18:32 (T-40) 18:29	07:35 16:52	08:02 16:51
25	07:54 17:25	07:13 18:07	06:22 18:44	06:28 20:23	19:45 (T-40) 19:60	05:50 20:58	20:37 (T-83) 21:03	20:59 (T-83) 21:03	06:41 20:19	07:17 19:22	18:31 (T-40) 18:27	07:36 16:52	08:03 16:52
26	07:53 17:27	07:11 18:09	06:21 18:45	06:26 20:24	19:46 (T-40) 19:61	05:49 20:59	20:38 (T-83) 21:02	20:60 (T-83) 21:02	06:42 20:18	07:18 19:20	18:30 (T-40) 18:26	07:37 16:51	08:03 16:52
27	07:52 17:28	07:09 18:10	06:19 18:46	06:25 20:25	19:47 (T-40) 19:62	05:49 21:00	20:38 (T-83) 21:01	20:61 (T-83) 21:01	06:43 20:16	07:19 19:23	18:29 (T-40) 18:24	07:39 16:51	08:03 16:53
28	07:51 17:30	07:08 18:12	06:17 18:48	06:23 20:26	19:48 (T-40) 19:63	05:48 21:00	20:38 (T-83) 21:00	20:62 (T-83) 21:00	06:44 20:14	07:21 19:24	18:28 (T-40) 18:23	07:40 16:50	08:04 16:54
29	07:50 17:31	07:05 18:13	06:15 18:49	06:21 20:27	19:49 (T-40) 19:64	05:47 21:01	20:39 (T-83) 20:58	20:63 (T-83) 20:58	06:45 20:12	07:22 19:25	18:27 (T-40) 18:21	07:41 16:50	08:04 16:54
30	07:49 17:32	07:03 18:14	06:13 18:50	06:20 20:29	19:50 (T-40) 19:65	05:47 21:02	20:39 (T-83) 20:57	20:64 (T-83) 20:57	06:46 20:11	07:23 19:26	18:26 (T-40) 18:20	07:42 16:49	08:04 16:55
31	07:48 17:34	07:11 18:15	06:11 18:51	06:18 20:30	19:51 (T-40) 19:66	05:46 21:03	20:40 (T-83) 20:56	20:65 (T-83) 20:56	06:48 20:09	07:24 19:27	18:25 (T-40) 18:18	07:43 16:48	08:04 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	
Total, worst case				102		272	60	89	12				
Sun reduction				0.63		0.73	0.75	0.72	0.67				
Oper. time red.				0.90		0.90	0.90	0.90	0.90				
Wind dir. red.				0.60		0.65	0.65	0.60	0.60				
Total reduction				0.34		0.42	0.44	0.39	0.36				
Total, real				34		115	26	34	4				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-175 - R-175
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June				
1	08:04	07:47	07:06	07:09	19:28 (T-40)	06:18	20:00 (T-83)	05:45		
	16:57	17:35	18:13	19:53	4	19:32 (T-40)	20:30	6	20:06 (T-83)	21:04
2	08:04	07:46	07:04	07:08	19:28 (T-40)	06:17	20:00 (T-83)	05:45		
	16:58	17:37	18:14	19:54	5	19:33 (T-40)	20:31	8	20:08 (T-83)	21:05
3	08:04	07:45	07:03	07:06	19:28 (T-40)	06:15	20:00 (T-83)	05:44		
	16:59	17:38	18:16	19:55	6	19:34 (T-40)	20:32	9	20:09 (T-83)	21:06
4	08:04	07:44	07:01	07:04	19:28 (T-40)	06:14	19:59 (T-83)	05:44		
	17:00	17:39	18:17	19:56	7	19:35 (T-40)	20:34	11	20:10 (T-83)	21:07
5	08:04	07:42	06:59	07:02	19:28 (T-40)	06:13	20:00 (T-83)	05:43		
	17:01	17:41	18:18	19:58	8	19:36 (T-40)	20:35	11	20:11 (T-83)	21:07
6	08:04	07:41	06:57	07:00	19:30 (T-40)	06:11	20:00 (T-83)	05:43		
	17:02	17:42	18:20	19:59	6	19:36 (T-40)	20:36	12	20:12 (T-83)	21:08
7	08:04	07:40	06:55	06:59	06:10	20:37	19:59 (T-83)	05:43		
	17:03	17:44	18:21	20:00	20:37	14	20:13 (T-83)	21:09		
8	08:04	07:38	07:54	06:57	06:09	20:38	20:00 (T-83)	05:42		
	17:04	17:45	18:22	20:01	20:38	14	20:14 (T-83)	21:10		
9	08:04	07:37	07:52	06:55	06:07	20:37	20:01 (T-83)	05:42		
	17:05	17:47	19:23	20:03	20:40	15	20:16 (T-83)	21:10		
10	08:03	07:36	07:50	06:53	06:06	20:41	20:02 (T-83)	05:42		
	17:06	17:48	19:25	20:04	20:41	15	20:17 (T-83)	21:11		
11	08:03	07:34	07:48	06:51	06:05	20:42	20:02 (T-83)	05:42		
	17:07	17:49	19:26	20:05	20:42	13	20:15 (T-83)	21:12		
12	08:03	07:33	07:46	06:50	06:04	20:43	20:04 (T-83)	05:41		
	17:09	17:51	19:27	20:06	20:43	10	20:14 (T-83)	21:12		
13	08:02	07:32	07:45	06:48	06:02	20:44	20:06 (T-83)	05:41		
	17:10	17:52	19:29	20:08	20:44	6	20:12 (T-83)	21:13		
14	08:02	07:30	07:43	06:46	06:01	20:45	20:07 (T-83)	05:41		
	17:11	17:54	19:30	20:09	20:46			21:13		
15	08:01	07:29	07:41	06:44	06:00	20:47	20:08 (T-83)	05:41		
	17:12	17:55	19:31	20:10	20:47			21:14		
16	08:01	07:27	07:39	06:43	05:59	20:48	20:09 (T-83)	05:41		
	17:14	17:56	19:33	20:11	20:48			21:14		
17	08:00	07:26	07:37	06:41	05:58	20:49	20:10 (T-83)	05:41		
	17:15	17:58	19:34	20:13	20:49			21:15		
18	08:00	07:24	07:35	06:39	05:57	20:50	20:11 (T-83)	05:41		
	17:16	17:59	19:35	20:14	20:50			21:15		
19	07:59	07:22	07:34	06:37	05:56	20:51	20:12 (T-83)	05:41		
	17:17	18:01	19:36	20:15	20:51			21:15		
20	07:58	07:21	07:32	06:36	05:55	20:52	20:13 (T-83)	05:42		
	17:19	18:01	19:38	20:16	20:52			21:16		
21	07:57	07:19	07:30	06:34	05:54	20:53	20:14 (T-83)	05:42		
	17:20	18:02	19:39	20:18	20:53			21:16		
22	07:57	07:18	07:28	06:32	05:53	20:54	20:15 (T-83)	05:42		
	17:21	18:03	19:40	20:19	20:54			21:16		
23	07:56	07:16	07:26	06:31	05:52	20:55	20:16 (T-83)	05:42		
	17:23	18:05	19:41	20:20	20:55			21:16		
24	07:55	07:14	07:24	06:29	05:51	20:56	20:17 (T-83)	05:42		
	17:24	18:06	19:43	20:21	20:56			21:16		
25	07:54	07:13	07:22	06:28	05:50	20:58	20:18 (T-83)	05:43		
	17:25	18:07	19:44	20:23	20:58			21:17		
26	07:53	07:11	07:21	06:26	05:49	20:59	20:19 (T-83)	05:43		
	17:27	18:09	19:45	20:24	20:59			21:17		
27	07:52	07:09	07:19	06:24	05:49	21:00	20:20 (T-83)	05:43		
	17:28	18:10	19:46	20:25	20:59			21:17		
28	07:51	07:08	07:17	06:23	05:48	21:01	20:21 (T-83)	05:44		
	17:30	18:11	19:48	20:26	21:00			21:17		
29	07:50		07:15	06:21	20:02 (T-83)	05:47	20:22 (T-83)	05:44		
	17:31		19:49	20:28	2	20:04 (T-83)	21:01	21:17		
30	07:49		07:13	06:20	20:02 (T-83)	05:47	20:23 (T-83)	05:45		
	17:32		19:50	20:29	3	20:05 (T-83)	21:02	21:17		
31	07:48		07:11	19:28 (T-40)		05:46				
	17:34		19:51	19:29 (T-40)		21:03				
Potential sun hours	287	292	369	403	458	465				
Total, worst case			1	41	144					
Sun reduction			0.59	0.63	0.66					
Oper. time red.			0.90	0.90	0.90					
Wind dir. red.			0.60	0.60	0.62					
Total reduction			0.32	0.34	0.37					
Total, real			0	14	53					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-175 - R-175
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December	
1	05:45 21:17	06:13 20:55	20:14 (T-83) 20:25 (T-83)	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:49
2	05:46 21:16	06:14 20:54	20:12 (T-83) 20:26 (T-83)	06:50 20:05	07:25 19:09	07:05 17:16	07:44 16:48
3	05:46 21:16	06:15 20:52	20:11 (T-83) 20:26 (T-83)	06:51 20:03	07:27 19:07	07:07 17:14	07:46 16:48
4	05:47 21:16	06:16 20:51	20:10 (T-83) 20:25 (T-83)	06:52 20:02	07:28 19:05	07:08 17:13	07:47 16:48
5	05:48 21:16	06:17 20:50	20:10 (T-83) 20:24 (T-83)	06:53 20:00	07:29 19:04	07:10 17:12	07:48 16:47
6	05:48 21:15	06:18 20:49	20:10 (T-83) 20:23 (T-83)	06:55 19:58	19:26 (T-40) 19:32 (T-40)	07:30 19:02	07:49 16:47
7	05:49 21:15	06:20 20:47	20:09 (T-83) 20:22 (T-83)	06:56 19:56	19:24 (T-40) 19:31 (T-40)	07:32 19:00	07:50 16:47
8	05:50 21:15	06:21 20:46	20:09 (T-83) 20:20 (T-83)	06:57 19:54	19:23 (T-40) 19:30 (T-40)	07:33 18:56	07:51 16:47
9	05:50 21:14	06:22 20:44	20:09 (T-83) 20:19 (T-83)	06:58 19:52	19:22 (T-40) 19:28 (T-40)	07:34 18:55	07:52 16:47
10	05:51 21:14	06:23 20:43	20:09 (T-83) 20:17 (T-83)	06:59 19:50	19:21 (T-40) 19:26 (T-40)	07:35 18:53	07:53 16:47
11	05:52 21:13	06:24 20:42	20:09 (T-83) 20:16 (T-83)	07:01 19:49	19:20 (T-40) 19:24 (T-40)	07:37 18:51	07:54 16:47
12	05:53 21:13	06:25 20:40	20:09 (T-83) 20:14 (T-83)	07:02 19:47	19:20 (T-40) 19:22 (T-40)	07:38 18:49	07:54 16:47
13	05:54 21:12	06:26 20:39	20:10 (T-83) 20:13 (T-83)	07:03 19:45	07:39 18:47	07:20 17:02	07:55 16:47
14	05:55 21:12	06:28 20:37	20:10 (T-83) 20:11 (T-83)	07:04 19:43	07:40 18:46	07:22 17:01	07:56 16:47
15	05:55 21:11	06:29 20:36	07:05 19:41	07:05 19:41	07:42 18:44	07:23 17:00	07:57 16:47
16	05:56 21:10	06:30 20:34	07:06 19:39	07:06 19:39	07:43 18:42	07:24 16:59	07:58 16:48
17	05:57 21:10	06:31 20:32	07:08 19:37	07:08 19:37	07:44 18:41	07:26 16:58	07:58 16:48
18	05:58 21:09	06:32 20:31	07:09 19:35	07:09 19:35	07:46 18:39	07:27 16:57	07:59 16:48
19	05:59 21:08	06:34 20:29	07:10 19:34	07:10 19:34	07:47 18:37	07:28 16:56	08:00 16:49
20	06:00 21:07	06:35 20:28	07:11 19:32	07:11 19:32	07:48 18:35	07:30 16:55	08:00 16:49
21	06:01 21:06	06:36 20:26	07:12 19:30	07:12 19:30	07:49 18:34	07:31 16:55	08:01 16:49
22	06:02 21:06	06:37 20:24	07:13 19:28	07:13 19:28	07:51 18:32	07:32 16:54	08:01 16:50
23	06:03 21:05	06:38 20:23	07:15 19:26	07:15 19:26	07:52 18:31	07:34 16:53	08:02 16:50
24	06:04 21:04	06:39 20:21	07:16 19:24	07:16 19:24	07:53 18:29	07:35 16:52	08:02 16:51
25	06:05 21:03	06:41 20:19	07:17 19:22	07:17 19:22	07:55 18:27	07:36 16:52	08:03 16:52
26	06:06 21:02	06:42 20:17	07:18 19:20	07:18 19:20	07:56 18:26	07:37 16:51	08:03 16:52
27	06:07 21:01	06:43 20:16	07:19 19:18	07:19 19:18	07:57 18:24	07:39 16:51	08:03 16:53
28	06:08 21:00	06:44 20:14	07:21 19:17	07:21 19:17	07:59 18:23	07:40 16:50	08:04 16:54
29	06:09 20:58	06:45 20:12	07:22 19:15	07:22 19:15	08:00 18:21	07:41 16:49	08:04 16:54
30	06:10 20:57	06:46 20:11	07:23 19:13	07:23 19:13	08:01 18:20	07:42 16:49	08:04 16:55
31	06:12 20:56	20:16 (T-83) 20:23 (T-83)	06:48 20:09	06:48 20:09	08:03 18:18	07:44 16:49	08:04 16:56
Potential sun hours	471	436	377	341	289	275	
Total, worst case	7	140	37				
Sun reduction	0.75	0.72	0.67				
Oper. time red.	0.90	0.90	0.90				
Wind dir. red.	0.62	0.62	0.60				
Total reduction	0.42	0.40	0.36				
Total, real	3	56	13				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



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Calculated:
6/14/2024 3:01 PM/3.6.366

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Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-176 - R-176

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:37	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48
3	08:04	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:15	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:20	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:07	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:13	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:50	06:04	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:08	20:44	21:13	21:12	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	19:07 (T-83)	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22
	17:11	17:54	19:30	2	19:09 (T-83)	20:09	20:46	21:13	21:12	20:37	19:43	18:46
15	08:01	07:29	07:41	19:06 (T-83)	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23
	17:12	17:55	19:31	4	19:10 (T-83)	20:10	20:47	21:14	21:11	20:36	19:41	18:44
16	08:01	07:27	07:39	19:05 (T-83)	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:24
	17:13	17:56	19:33	6	19:11 (T-83)	20:11	20:48	21:14	21:10	20:34	19:39	18:42
17	08:00	07:26	07:37	19:05 (T-83)	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26
	17:15	17:58	19:34	8	19:13 (T-83)	20:13	20:49	21:15	21:10	20:32	19:37	18:40
18	08:00	07:24	07:35	19:05 (T-83)	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27
	17:16	17:59	19:35	9	19:14 (T-83)	20:14	20:50	21:15	21:09	20:31	19:35	18:39
19	07:59	07:22	07:34	19:04 (T-83)	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28
	17:17	18:01	19:36	11	19:15 (T-83)	20:15	20:51	21:15	21:08	20:29	19:34	18:37
20	07:58	07:21	07:32	19:04 (T-83)	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30
	17:19	18:01	19:38	12	19:16 (T-83)	20:16	20:52	21:16	21:07	20:28	19:32	7
21	07:57	07:19	07:30	19:05 (T-83)	06:34	05:54	05:42	06:01	06:36	07:12	18:52 (T-83)	18:35
	17:20	18:02	19:39	13	19:18 (T-83)	20:18	20:53	21:16	21:06	20:26	19:30	12
22	07:57	07:18	07:28	19:06 (T-83)	06:32	05:53	05:42	06:02	06:37	07:13	18:51 (T-83)	18:34
	17:21	18:03	19:40	13	19:19 (T-83)	20:19	20:54	21:16	21:06	20:24	19:28	12
23	07:56	07:16	07:26	19:07 (T-83)	06:31	05:52	05:42	06:03	06:38	07:15	18:49 (T-83)	18:32
	17:23	18:05	19:41	9	19:16 (T-83)	20:20	20:55	21:16	21:05	20:23	19:26	12
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	18:48 (T-83)	18:31	18:35
	17:24	18:06	19:43	20:21	20:57	21:16	21:04	20:21	19:24	11	18:59 (T-83)	18:29
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:41	07:17	18:47 (T-83)	18:27	18:36
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	10	18:57 (T-83)	18:27
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	18:47 (T-83)	18:26	18:35
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	8	18:55 (T-83)	18:26
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	18:46 (T-83)	18:25	18:34
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	7	18:53 (T-83)	18:24
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	18:47 (T-83)	18:24	18:33
	17:30	18:11	19:48	20:26	21:00	21:17	21:00	20:14	19:17	5	18:52 (T-83)	18:23
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	18:47 (T-83)	18:23	18:32
	17:31		19:49	20:28	21:01	21:17	20:58	20:12	19:15	3	18:50 (T-83)	18:21
30	07:49		07:13	06:20	05:47	05:45	06:10	06:46	07:23		08:01	07:42
	17:32		19:50	20:29	21:02	21:17	20:57	20:11	19:13		18:20	16:49
31	07:48		07:11		05:46		06:12	06:48			08:03	08:04
	17:34		19:51		21:03		20:56	20:09			18:18	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction			87						87			
Oper. time red.			0.59						0.67			
Wind dir. red.			0.90						0.90			
Total reduction			0.58						0.58			
Total, real			0.31						0.35			
			27						31			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-177 - R-177
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June										
1	08:05	07:47	07:06	07:10	19:12 (T-34)	06:18	05:45	20:00 (T-24)								
	16:57	17:35	18:13	19:53	20	19:32 (T-34)	20:30	21:04	38	20:38 (T-24)						
2	08:05	07:46	07:04	07:08	19:12 (T-34)	06:17	05:45	20:00 (T-24)								
	16:58	17:37	18:14	19:54	21	19:33 (T-34)	20:31	21:05	38	20:38 (T-24)						
3	08:05	07:45	07:03	07:06	19:11 (T-34)	06:16	05:44	20:01 (T-24)								
	16:59	17:38	18:16	19:55	23	19:34 (T-34)	20:33	21:06	38	20:39 (T-24)						
4	08:05	07:44	07:01	07:04	19:12 (T-34)	06:14	05:44	20:01 (T-24)								
	17:00	17:39	18:17	19:57	23	19:35 (T-34)	20:34	21:07	38	20:39 (T-24)						
5	08:04	07:42	06:59	07:02	19:12 (T-34)	06:13	05:44	20:01 (T-24)								
	17:01	17:41	18:18	19:58	22	19:34 (T-34)	20:35	21:08	38	20:39 (T-24)						
6	08:04	07:41	06:57	07:00	19:14 (T-34)	06:11	05:43	20:02 (T-24)								
	17:02	17:42	18:20	19:59	20	19:34 (T-34)	20:36	21:08	37	20:39 (T-24)						
7	08:04	07:40	06:56	06:59	19:15 (T-34)	06:10	05:43	20:02 (T-24)								
	17:03	17:44	18:21	20:00	17	19:32 (T-34)	20:37	21:09	37	20:39 (T-24)						
8	08:04	07:39	07:54	06:57	19:16 (T-34)	06:09	05:42	20:02 (T-24)								
	17:04	17:45	18:22	20:02	13	19:29 (T-34)	20:39	21:10	36	20:38 (T-24)						
9	08:04	07:37	07:52	06:55	19:20 (T-34)	06:07	05:42	20:03 (T-24)								
	17:05	17:47	19:24	20:03	5	19:25 (T-34)	20:40	21:10	36	20:39 (T-24)						
10	08:03	07:36	07:50	06:53	06:06	06:06	05:42	20:03 (T-24)								
	17:06	17:48	19:25	20:04	20:41	14	20:17 (T-24)	21:11	36	20:39 (T-24)						
11	08:03	07:34	07:48	06:51	06:05	20:02 (T-24)	05:42	20:04 (T-24)								
	17:08	17:49	19:26	20:05	20:42	16	20:18 (T-24)	21:12	35	20:39 (T-24)						
12	08:03	07:33	07:47	06:50	06:04	20:01 (T-24)	05:42	20:04 (T-24)								
	17:09	17:51	19:27	20:07	20:43	17	20:18 (T-24)	21:12	35	20:39 (T-24)						
13	08:02	07:32	07:45	06:48	06:02	20:00 (T-24)	05:41	20:04 (T-24)								
	17:10	17:52	19:29	20:08	20:45	20	20:20 (T-24)	21:13	34	20:38 (T-24)						
14	08:02	07:30	07:43	06:46	06:01	19:59 (T-24)	05:41	20:04 (T-24)								
	17:11	17:54	19:30	20:09	20:46	22	20:21 (T-24)	21:13	34	20:38 (T-24)						
15	08:01	07:29	07:41	06:44	06:00	19:59 (T-24)	05:41	20:05 (T-24)								
	17:12	17:55	19:31	20:10	20:47	23	20:22 (T-24)	21:14	33	20:38 (T-24)						
16	08:01	07:27	07:39	08:00 (T-37)	06:43	05:59	19:59 (T-24)	05:41	20:05 (T-24)							
	17:14	17:56	19:33	1	08:01 (T-37)	20:12	20:48	24	20:23 (T-24)	21:14	34	20:39 (T-24)				
17	08:00	07:26	07:37	07:58 (T-37)	06:41	05:58	19:58 (T-24)	05:41	20:05 (T-24)							
	17:15	17:58	19:34	3	08:01 (T-37)	20:13	20:49	26	20:24 (T-24)	21:15	34	20:39 (T-24)				
18	08:00	07:24	07:36	07:56 (T-37)	06:39	05:57	19:58 (T-24)	05:41	20:06 (T-24)							
	17:16	17:59	19:35	5	08:01 (T-37)	20:14	20:50	27	20:25 (T-24)	21:15	34	20:40 (T-24)				
19	07:59	07:23	07:34	07:54 (T-37)	06:38	05:56	19:58 (T-24)	05:41	20:06 (T-24)							
	17:17	18:01	19:36	6	08:00 (T-37)	20:15	20:51	28	20:26 (T-24)	21:15	34	20:40 (T-24)				
20	07:58	07:21	07:32	07:52 (T-37)	06:36	05:55	19:58 (T-24)	05:42	20:07 (T-24)							
	17:19	18:01	19:38	10	19:16 (T-33)	20:16	20:52	29	20:27 (T-24)	21:16	33	20:40 (T-24)				
21	07:58	07:19	07:30	07:50 (T-37)	06:34	05:54	19:58 (T-24)	05:42	20:07 (T-24)							
	17:20	18:02	19:39	13	19:18 (T-33)	20:18	20:53	30	20:28 (T-24)	21:16	33	20:40 (T-24)				
22	07:57	07:18	07:28	07:48 (T-37)	06:33	05:53	19:58 (T-24)	05:42	20:07 (T-24)							
	17:21	18:03	19:40	15	19:19 (T-33)	20:19	20:55	32	20:30 (T-24)	21:16	33	20:40 (T-24)				
23	07:56	07:16	07:26	07:47 (T-37)	06:31	05:52	19:58 (T-24)	05:42	20:07 (T-24)							
	17:23	18:05	19:42	14	19:20 (T-33)	20:20	20:56	33	20:31 (T-24)	21:16	34	20:41 (T-24)				
24	07:55	07:15	07:24	19:13 (T-33)	06:29	05:51	19:58 (T-24)	05:42	20:07 (T-24)							
	17:24	18:06	19:43	9	19:22 (T-33)	20:21	20:57	33	20:31 (T-24)	21:17	34	20:41 (T-24)				
25	07:54	07:13	07:23	19:13 (T-33)	06:28	05:50	19:58 (T-24)	05:43	20:07 (T-24)							
	17:25	18:08	19:44	10	19:23 (T-33)	20:23	20:58	34	20:32 (T-24)	21:17	34	20:41 (T-24)				
26	07:53	07:11	07:21	19:14 (T-33)	06:26	05:49	19:58 (T-24)	05:43	20:08 (T-24)							
	17:27	18:09	19:45	10	19:24 (T-33)	20:24	20:59	35	20:33 (T-24)	21:17	34	20:42 (T-24)				
27	07:52	07:10	07:19	19:15 (T-34)	06:25	05:49	19:59 (T-24)	05:43	20:08 (T-24)							
	17:28	18:10	19:47	10	19:25 (T-34)	20:25	21:00	35	20:34 (T-24)	21:17	34	20:42 (T-24)				
28	07:51	07:08	07:17	19:14 (T-34)	06:23	05:48	19:59 (T-24)	05:44	20:07 (T-24)							
	17:30	18:12	19:48	12	19:26 (T-34)	20:26	21:01	36	20:35 (T-24)	21:17	34	20:41 (T-24)				
29	07:50		07:15	19:13 (T-34)	06:21	05:47	19:58 (T-24)	05:44	20:08 (T-24)							
	17:31		19:49	14	19:27 (T-34)	20:28	21:02	37	20:35 (T-24)	21:17	34	20:42 (T-24)				
30	07:49		07:13	19:12 (T-34)	06:20	05:47	19:59 (T-24)	05:45	20:08 (T-24)							
	17:32		19:50	16	19:28 (T-34)	20:29	21:02	38	20:37 (T-24)	21:17	34	20:42 (T-24)				
31	07:48		07:11	19:12 (T-34)		05:46	19:59 (T-24)									
	17:34		19:52	18	19:30 (T-34)		21:03	38	20:37 (T-24)							
Potential sun hours	287	292	369	403	458	465	1050									
Total, worst case			166	164	659	1050										
Sun reduction			0.59	0.63	0.66	0.73										
Oper. time red.			0.90	0.90	0.90	0.90										
Wind dir. red.			0.59	0.59	0.63	0.63										
Total reduction			0.31	0.34	0.38	0.42										
Total, real			52	55	248	437										

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-177 - R-177
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December			
1	05:45	20:08 (T-24)	06:13	20:11 (T-24)	06:49	07:24	07:04	07:43	
	21:17	35 20:43 (T-24)	20:55	18 20:29 (T-24)	20:07	19:11	17:17	16:49	
2	05:46	20:08 (T-24)	06:14	20:12 (T-24)	06:50	07:26	07:06	07:45	
	21:17	35 20:43 (T-24)	20:54	15 20:27 (T-24)	20:05	19:09	17:16	16:48	
3	05:46	20:08 (T-24)	06:15	20:13 (T-24)	06:51	19:18 (T-34)	07:27	07:07	07:46
	21:16	36 20:44 (T-24)	20:53	13 20:26 (T-24)	20:03	4 19:22 (T-34)	19:07	17:14	16:48
4	05:47	20:07 (T-24)	06:16	20:14 (T-24)	06:52	19:13 (T-34)	07:28	07:08	07:47
	21:16	36 20:43 (T-24)	20:51	11 20:25 (T-24)	20:02	13 19:26 (T-34)	19:06	17:13	16:48
5	05:48	20:08 (T-24)	06:17	20:16 (T-24)	06:54	19:11 (T-34)	07:29	07:10	07:48
	21:16	36 20:44 (T-24)	20:50	8 20:24 (T-24)	20:00	17 19:28 (T-34)	19:04	17:12	16:47
6	05:48	20:08 (T-24)	06:18	20:17 (T-24)	06:55	19:09 (T-34)	07:30	07:11	07:49
	21:16	37 20:45 (T-24)	20:49	6 20:23 (T-24)	19:58	20 19:29 (T-34)	19:02	17:10	16:47
7	05:49	20:07 (T-24)	06:20	20:19 (T-24)	06:56	19:08 (T-34)	07:32	07:12	07:50
	21:15	38 20:45 (T-24)	20:47	3 20:22 (T-24)	19:56	22 19:30 (T-34)	19:00	17:09	16:47
8	05:50	20:08 (T-24)	06:21		06:57	19:07 (T-34)	07:33	07:14	07:51
	21:15	37 20:45 (T-24)	20:46		19:54	23 19:30 (T-34)	18:56	17:08	16:47
9	05:51	20:08 (T-24)	06:22		06:58	19:06 (T-34)	07:34	07:15	07:52
	21:14	38 20:46 (T-24)	20:45		19:52	22 19:28 (T-34)	18:55	17:07	16:47
10	05:51	20:08 (T-24)	06:23		06:59	19:05 (T-34)	07:35	07:16	07:53
	21:14	39 20:47 (T-24)	20:43		19:51	21 19:26 (T-34)	18:53	17:05	16:47
11	05:52	20:07 (T-24)	06:24		07:01	19:04 (T-34)	07:37	07:18	07:54
	21:14	39 20:46 (T-24)	20:42		19:49	20 19:24 (T-34)	18:51	17:04	16:47
12	05:53	20:07 (T-24)	06:25		07:02	19:03 (T-34)	07:38	07:19	07:55
	21:13	39 20:46 (T-24)	20:40		19:47	19 19:22 (T-34)	18:49	17:03	16:47
13	05:54	20:08 (T-24)	06:27		07:03	19:03 (T-34)	07:39	07:21	07:55
	21:12	37 20:45 (T-24)	20:39		19:45	17 19:20 (T-34)	18:47	17:02	16:47
14	05:55	20:08 (T-24)	06:28		07:04	19:03 (T-34)	07:41	07:22	07:56
	21:12	37 20:45 (T-24)	20:37		19:43	15 19:18 (T-34)	18:46	17:01	16:47
15	05:55	20:08 (T-24)	06:29		07:05	19:04 (T-34)	07:42	07:23	07:57
	21:11	36 20:44 (T-24)	20:36		19:41	13 19:17 (T-34)	18:44	17:00	16:47
16	05:56	20:08 (T-24)	06:30		07:06	19:04 (T-34)	07:43	07:25	07:58
	21:11	36 20:44 (T-24)	20:34		19:39	11 19:15 (T-34)	18:42	16:59	16:48
17	05:57	20:07 (T-24)	06:31		07:08	19:03 (T-33)	07:44	07:26	07:58
	21:10	35 20:42 (T-24)	20:33		19:37	10 19:13 (T-33)	18:41	16:58	16:48
18	05:58	20:07 (T-24)	06:32		07:09	19:01 (T-33)	07:46	07:27	07:59
	21:09	35 20:42 (T-24)	20:31		19:36	10 19:11 (T-33)	18:39	16:57	16:48
19	05:59	20:08 (T-24)	06:34		07:10	18:59 (T-33)	07:47	07:29	08:00
	21:08	33 20:41 (T-24)	20:29		19:34	10 19:09 (T-33)	18:37	16:56	16:49
20	06:00	20:08 (T-24)	06:35		07:11	07:35 (T-37)	07:48	07:30	08:00
	21:07	32 20:40 (T-24)	20:28		19:32	12 19:07 (T-33)	18:36	16:55	16:49
21	06:01	20:08 (T-24)	06:36		07:12	07:34 (T-37)	07:50	07:31	08:01
	21:07	32 20:40 (T-24)	20:26		19:30	15 19:05 (T-33)	18:34	16:55	16:49
22	06:02	20:08 (T-24)	06:37		07:14	07:35 (T-37)	07:51	07:32	08:01
	21:06	31 20:39 (T-24)	20:24		19:28	13 19:03 (T-33)	18:32	16:54	16:50
23	06:03	20:08 (T-24)	06:38		07:15	07:36 (T-37)	07:52	07:34	08:02
	21:05	30 20:38 (T-24)	20:23		19:26	10 19:01 (T-33)	18:31	16:53	16:50
24	06:04	20:08 (T-24)	06:39		07:16	07:37 (T-37)	07:53	07:35	08:02
	21:04	29 20:37 (T-24)	20:21		19:24	7 18:59 (T-33)	18:29	16:52	16:51
25	06:05	20:09 (T-24)	06:41		07:17	07:38 (T-37)	07:55	07:36	08:03
	21:03	27 20:36 (T-24)	20:19		19:22	5 07:43 (T-37)	18:28	16:52	16:52
26	06:06	20:09 (T-24)	06:42		07:18	07:39 (T-37)	07:56	07:38	08:03
	21:02	26 20:35 (T-24)	20:18		19:20	3 07:42 (T-37)	18:26	16:51	16:52
27	06:07	20:09 (T-24)	06:43		07:20	07:41 (T-37)	07:57	07:39	08:03
	21:01	25 20:34 (T-24)	20:16		19:19	2 07:43 (T-37)	18:24	16:51	16:53
28	06:08	20:09 (T-24)	06:44		07:21		07:59	07:40	08:04
	21:00	24 20:33 (T-24)	20:14		19:17		18:23	16:50	16:54
29	06:09	20:10 (T-24)	06:45		07:22		08:00	07:41	08:04
	20:59	22 20:32 (T-24)	20:12		19:15		18:21	16:50	16:54
30	06:11	20:10 (T-24)	06:47		07:23		08:02	07:42	08:04
	20:57	21 20:31 (T-24)	20:11		19:13		18:20	16:49	16:55
31	06:12	20:11 (T-24)	06:48				08:03		08:04
	20:56	19 20:30 (T-24)	20:09				18:19		16:56
Potential sun hours	471	436		377		341	289	275	
Total, worst case	1012		74	334					
Sun reduction	0.75		0.72	0.67					
Oper. time red.	0.90		0.90	0.90					
Wind dir. red.	0.63		0.63	0.59					
Total reduction	0.43		0.41	0.36					
Total, real	433	30		119					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-178 - R-178

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June				
1	08:04	07:47	07:06	17:42 (T-83)	07:09	06:18	05:45	20:33 (T-25)		
	16:57	17:35	18:13	9	17:51 (T-83)	19:53	20:30	21:04	5	20:38 (T-25)
2	08:04	07:46	07:04	07:04	17:41 (T-83)	07:08	06:17	05:45	20:33 (T-25)	
	16:58	17:37	18:14	12	17:53 (T-83)	19:54	20:31	21:05	5	20:38 (T-25)
3	08:04	07:45	07:03	07:03	17:41 (T-83)	07:06	06:15	05:44	20:34 (T-25)	
	16:59	17:38	18:16	13	17:54 (T-83)	19:55	20:32	21:06	6	20:40 (T-25)
4	08:04	07:44	07:01	07:01	17:40 (T-83)	07:04	06:14	05:44	20:34 (T-25)	
	17:00	17:39	18:17	15	17:55 (T-83)	19:56	20:34	21:07	6	20:40 (T-25)
5	08:04	07:42	06:59	06:59	17:41 (T-83)	07:02	06:13	05:43	20:36 (T-25)	
	17:01	17:41	18:18	16	17:57 (T-83)	19:58	20:35	21:07	5	20:41 (T-25)
6	08:04	07:41	06:57	06:57	17:41 (T-83)	07:00	06:11	05:43	20:37 (T-25)	
	17:02	17:42	18:20	17	17:58 (T-83)	19:59	20:36	21:08	5	20:42 (T-25)
7	08:04	07:40	06:56	06:56	17:41 (T-83)	06:59	06:10	05:43	20:38 (T-25)	
	17:03	17:44	18:21	18	17:59 (T-83)	20:00	20:37	21:09	3	20:41 (T-25)
8	08:04	07:38	07:54	07:54	18:42 (T-83)	06:57	06:09	05:42		
	17:04	17:45	18:22	18	19:00 (T-83)	20:01	20:39	21:10		
9	08:04	07:37	07:52	07:52	18:43 (T-83)	06:55	06:07	05:42		
	17:05	17:47	19:23	15	18:58 (T-83)	20:03	20:40	21:10		
10	08:03	07:36	07:50	07:50	18:46 (T-83)	06:53	06:06	05:42		
	17:06	17:48	19:25	11	18:57 (T-83)	20:04	20:41	21:11		
11	08:03	07:34	07:48	07:48		06:51	06:05	05:42		
	17:07	17:49	19:26			20:05	20:42	21:12		
12	08:03	07:33	07:46	07:46		06:50	06:04	05:41		
	17:09	17:51	19:27			20:06	20:43	21:12		
13	08:02	07:32	07:45	07:45		06:48	06:02	05:41		
	17:10	17:52	19:29			20:08	20:44	21:13		
14	08:02	07:30	07:43	07:43		06:46	06:01	05:41		
	17:11	17:54	19:30			20:09	20:46	21:13		
15	08:01	07:29	17:29 (T-40)	07:41		06:44	06:00	05:41		
	17:12	17:55	2	17:31 (T-40)	19:31	20:10	20:47	21:14		
16	08:01	07:27	17:28 (T-40)	07:39		06:43	05:59	05:41		
	17:14	17:56	4	17:32 (T-40)	19:33	20:11	20:48	21:14		
17	08:00	07:26	17:29 (T-40)	07:37		06:41	05:58	05:41		
	17:15	17:58	5	17:34 (T-40)	19:34	20:13	20:49	21:15		
18	08:00	07:24	17:29 (T-40)	07:35		06:39	05:57	05:41		
	17:16	17:59	6	17:35 (T-40)	19:35	20:14	20:50	21:15		
19	07:59	07:23	17:30 (T-40)	07:34		06:37	05:56	05:41		
	17:17	18:01	7	17:37 (T-40)	19:36	20:15	20:51	21:15		
20	07:58	07:21	17:31 (T-40)	07:32		06:36	05:55	05:41		
	17:19	18:01	7	17:38 (T-40)	19:38	20:16	20:52	21:16		
21	07:57	07:19	17:32 (T-40)	07:30		06:34	05:54	05:42		
	17:20	18:02	7	17:39 (T-40)	19:39	20:18	20:53	21:16		
22	07:57	07:18		07:28		06:32	05:53	05:42		
	17:21	18:03		19:40		20:19	20:54	21:16		
23	07:56	07:16		07:26		06:31	05:52	05:42		
	17:23	18:05		19:41		20:20	20:55	21:16		
24	07:55	07:14		07:24		06:29	05:51	05:42		
	17:24	18:06		19:43		20:21	20:57	21:16		
25	07:54	07:13		07:22		06:28	05:50	05:43		
	17:25	18:07		19:44		20:23	20:58	2	20:32 (T-25)	21:17
26	07:53	07:11	17:46 (T-83)	07:21		06:26	05:49	2	20:30 (T-25)	05:43
	17:27	18:09	1	17:47 (T-83)	19:45	20:24	20:59	3	20:33 (T-25)	21:17
27	07:52	07:09	17:44 (T-83)	07:19		06:24	05:49	3	20:31 (T-25)	05:43
	17:28	18:10	4	17:48 (T-83)	19:46	20:25	21:00	3	20:34 (T-25)	21:17
28	07:51	07:08	17:42 (T-83)	07:17		06:23	05:48	20:31 (T-25)	05:44	
	17:30	18:11	7	17:49 (T-83)	19:48	20:26	21:00	4	20:35 (T-25)	21:17
29	07:50			07:15		06:21	05:47	20:31 (T-25)	05:44	
	17:31			19:49		20:28	21:01	4	20:35 (T-25)	21:17
30	07:49			07:13		06:20	05:47	20:32 (T-25)	05:45	
	17:32			19:50		20:29	21:02	5	20:37 (T-25)	21:17
31	07:48			07:11			05:46	20:32 (T-25)		
	17:34			19:51			21:03	5	20:37 (T-25)	
Potential sun hours	287	292	369	403	458	465				
Total, worst case			144				26		35	
Sun reduction		0.58	0.59				0.66		0.73	
Oper. time red.		0.90	0.90				0.90		0.90	
Wind dir. red.		0.59	0.58				0.64		0.64	
Total reduction		0.30	0.30				0.38		0.42	
Total, real		15	44				10		15	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-178 - R-178

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:49
2	05:46 21:16	06:14 20:54	06:50 20:05	07:25 19:09	07:05 17:16	07:45 16:48
3	05:46 21:16	06:15 20:52	06:51 20:03	07:27 19:07	18:25 (T-83) 18:33 (T-83)	07:07 17:14
4	05:47 21:16	06:16 20:51	06:52 20:02	07:28 19:05	18:21 (T-83) 18:35 (T-83)	07:08 17:13
5	05:48 21:16	20:45 (T-25) 20:47 (T-25)	06:17 20:50	06:53 20:00	07:29 19:04	18:19 (T-83) 18:36 (T-83)
6	05:48 21:15	20:44 (T-25) 20:48 (T-25)	06:18 20:49	06:55 19:58	07:30 19:02	18:18 (T-83) 18:37 (T-83)
7	05:49 21:15	20:42 (T-25) 20:47 (T-25)	06:20 20:47	06:56 19:56	07:32 19:00	18:17 (T-83) 18:35 (T-83)
8	05:50 21:15	20:42 (T-25) 20:47 (T-25)	06:21 20:46	06:57 19:54	07:33 18:56	18:16 (T-83) 18:33 (T-83)
9	05:50 21:14	20:42 (T-25) 20:47 (T-25)	06:22 20:44	06:58 19:52	07:34 18:55	18:15 (T-83) 18:31 (T-83)
10	05:51 21:14	20:42 (T-25) 20:47 (T-25)	06:23 20:43	06:59 19:51	07:35 18:53	18:15 (T-83) 18:29 (T-83)
11	05:52 21:13	20:41 (T-25) 20:46 (T-25)	06:24 20:42	07:01 19:49	07:37 18:51	18:15 (T-83) 18:27 (T-83)
12	05:53 21:13	20:40 (T-25) 20:46 (T-25)	06:25 20:40	07:02 19:47	07:38 18:49	18:15 (T-83) 18:25 (T-83)
13	05:54 21:12	20:40 (T-25) 20:45 (T-25)	06:26 20:39	07:03 19:45	07:39 18:47	18:16 (T-83) 18:24 (T-83)
14	05:55 21:12	20:40 (T-25) 20:45 (T-25)	06:28 20:37	07:04 19:43	07:40 18:46	18:16 (T-83) 18:22 (T-83)
15	05:55 21:11	20:40 (T-25) 20:44 (T-25)	06:29 20:36	07:05 19:41	07:42 18:44	18:17 (T-83) 18:20 (T-83)
16	05:56 21:10	20:40 (T-25) 20:43 (T-25)	06:30 20:34	07:06 19:39	07:43 18:42	17:00 16:59
17	05:57 21:10	20:40 (T-25) 20:42 (T-25)	06:31 20:32	07:08 19:37	07:44 18:41	07:26 16:58
18	05:58 21:09	20:40 (T-25) 20:42 (T-25)	06:32 20:31	07:09 19:35	07:46 18:39	07:27 16:57
19	05:59 21:08	20:40 (T-25) 20:41 (T-25)	06:34 20:29	07:10 19:34	07:47 18:37	07:28 16:56
20	06:00 21:07	06:35 20:28	07:11 19:32	07:48 18:35	07:30 16:55	08:00 16:49
21	06:01 21:06	06:36 20:26	07:12 19:30	07:49 18:34	18:02 (T-40) 18:09 (T-40)	07:31 16:55
22	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	18:01 (T-40) 18:08 (T-40)	07:32 16:54
23	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:31	17:59 (T-40) 18:06 (T-40)	07:34 16:53
24	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	17:58 (T-40) 18:04 (T-40)	07:35 16:52
25	06:05 21:03	06:41 20:19	07:17 19:22	07:55 18:27	17:58 (T-40) 18:03 (T-40)	07:36 16:52
26	06:06 21:02	06:42 20:18	07:18 19:20	07:56 18:26	17:58 (T-40) 18:01 (T-40)	07:37 16:51
27	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	17:59 (T-40) 18:00 (T-40)	07:39 16:50
28	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50	08:04 16:54
29	06:09 20:58	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	08:04 16:54
30	06:10 20:57	06:46 20:11	07:23 19:13	08:01 18:20	07:42 16:49	08:04 16:55
31	06:12 20:56	06:48 20:09	08:03 18:18	08:03 18:18	08:04 16:56	08:04 16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case				198		
Sun reduction	0.75				0.56	
Oper. time red.	0.90				0.90	
Wind dir. red.	0.64				0.58	
Total reduction	0.43				0.29	
Total, real	25			57		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
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Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-179 - R-179

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June		
1	08:04	07:47	07:06	07:09	06:18	05:45		06:09 (T-37)
	16:57	17:35		18:13	19:53	20:30		21:04 34 20:38 (T-25)
2	08:05	07:46	17:09 (T-40)	07:04	07:08	06:17		05:45 06:08 (T-37)
	16:58	17:37	2	17:11 (T-40)	18:14	19:54		21:05 36 20:38 (T-25)
3	08:05	07:45	17:09 (T-40)	07:03	07:06	06:16		05:44 06:08 (T-37)
	16:59	17:38	4	17:13 (T-40)	18:16	19:55		21:06 38 20:40 (T-25)
4	08:04	07:44	17:08 (T-40)	07:01	07:04	06:14		05:44 06:07 (T-37)
	17:00	17:39	6	17:14 (T-40)	18:17	19:56		20:34 21:07 40 20:40 (T-25)
5	08:04	07:42	17:08 (T-40)	06:59	07:02	06:13		20:10 (T-24) 05:43 06:07 (T-37)
	17:01	17:41	7	17:15 (T-40)	18:18	19:58		20:35 1 20:11 (T-24) 21:07 41 20:41 (T-25)
6	08:04	07:41	17:09 (T-40)	06:57	07:00	06:11		20:11 (T-24) 05:43 06:07 (T-37)
	17:02	17:42	8	17:17 (T-40)	18:20	19:59		20:36 2 20:13 (T-24) 21:08 42 20:42 (T-25)
7	08:04	07:40	17:09 (T-40)	06:56	06:59	06:10		20:10 (T-24) 05:43 06:06 (T-37)
	17:03	17:44	9	17:18 (T-40)	18:21	20:00		20:37 3 20:13 (T-24) 21:09 43 20:42 (T-25)
8	08:04	07:38	17:10 (T-40)	07:54	06:57	06:09		06:30 (T-38) 05:42 06:06 (T-37)
	17:04	17:45	10	17:20 (T-40)	18:22	20:01		20:39 6 20:14 (T-24) 21:10 45 20:43 (T-25)
9	08:04	07:37	17:11 (T-40)	07:52	06:55	06:07		06:29 (T-38) 05:42 06:06 (T-37)
	17:05	17:47	11	17:22 (T-40)	19:23	20:03		20:40 9 20:16 (T-24) 21:10 45 20:44 (T-25)
10	08:03	07:36	17:12 (T-40)	07:50	06:53	06:06		06:28 (T-38) 05:42 06:06 (T-37)
	17:06	17:48	11	17:23 (T-40)	19:25	20:04		20:41 11 20:17 (T-24) 21:11 46 20:44 (T-25)
11	08:03	07:34	17:14 (T-40)	07:48	06:51	06:05		06:27 (T-38) 05:42 06:06 (T-37)
	17:07	17:49	11	17:25 (T-83)	19:26	20:05		20:42 11 20:18 (T-24) 21:12 47 20:45 (T-25)
12	08:03	07:33	17:18 (T-83)	07:47	06:50	06:04		06:25 (T-38) 05:41 06:05 (T-37)
	17:09	17:51	8	17:26 (T-83)	19:27	20:06		20:43 10 06:35 (T-38) 21:12 47 20:45 (T-25)
13	08:02	07:32	17:18 (T-83)	07:45	06:48	06:02		06:24 (T-38) 05:41 06:05 (T-37)
	17:10	17:52	10	17:28 (T-83)	19:29	20:08		20:44 12 06:36 (T-38) 21:13 48 20:45 (T-25)
14	08:02	07:30	17:16 (T-83)	07:43	06:46	06:01		06:23 (T-38) 05:41 06:05 (T-37)
	17:11	17:54	13	17:29 (T-83)	19:30	20:09		20:46 13 06:36 (T-38) 21:13 48 20:46 (T-25)
15	08:01	07:29	17:16 (T-83)	07:41	06:44	06:00		06:22 (T-38) 05:41 06:05 (T-37)
	17:12	17:55	15	17:31 (T-83)	19:31	20:10		20:47 15 06:37 (T-38) 21:14 48 20:46 (T-25)
16	08:01	07:27	17:15 (T-83)	07:39	06:43	05:59		06:21 (T-38) 05:41 06:05 (T-37)
	17:14	17:56	17	17:32 (T-83)	19:33	20:11		20:48 16 06:37 (T-38) 21:14 49 20:47 (T-25)
17	08:00	07:26	17:15 (T-83)	07:37	06:41	05:58		06:20 (T-38) 05:41 06:05 (T-37)
	17:15	17:58	19	17:34 (T-83)	19:34	20:13		20:49 17 06:37 (T-38) 21:15 50 20:47 (T-25)
18	08:00	07:24	17:15 (T-83)	07:35	06:39	05:57		06:19 (T-38) 05:41 06:06 (T-37)
	17:16	17:59	20	17:35 (T-83)	19:35	20:14		20:50 18 06:37 (T-38) 21:15 50 20:48 (T-25)
19	07:59	07:23	17:15 (T-83)	07:34	06:37	05:56		06:18 (T-38) 05:41 06:06 (T-37)
	17:17	18:01	22	17:37 (T-83)	19:36	20:15		20:51 19 06:37 (T-38) 21:15 49 20:48 (T-25)
20	07:58	07:21	17:15 (T-83)	07:32	06:36	05:55		06:17 (T-38) 05:41 06:06 (T-37)
	17:19	18:01	23	17:38 (T-83)	19:38	20:16		20:52 20 06:37 (T-38) 21:16 50 20:49 (T-25)
21	07:57	07:19	17:15 (T-83)	07:30	06:34	05:54		06:16 (T-38) 05:42 06:06 (T-37)
	17:20	18:02	24	17:39 (T-83)	19:39	20:18		20:53 21 06:37 (T-38) 21:16 50 20:49 (T-25)
22	07:57	07:18	17:16 (T-83)	07:28	06:32	05:53		06:15 (T-38) 05:42 06:06 (T-37)
	17:21	18:03	25	17:41 (T-83)	19:40	20:19		20:54 22 06:37 (T-38) 21:16 50 20:49 (T-25)
23	07:56	07:16	17:16 (T-83)	07:26	06:31	05:52		06:15 (T-38) 05:42 06:06 (T-37)
	17:23	18:05	26	17:42 (T-83)	19:41	20:20		20:56 22 06:37 (T-38) 21:16 49 20:48 (T-25)
24	07:55	07:14	17:16 (T-83)	07:24	06:29	05:51		06:14 (T-38) 05:42 06:07 (T-37)
	17:24	18:06	25	17:41 (T-83)	19:43	20:21		20:57 24 06:38 (T-37) 21:17 50 20:49 (T-25)
25	07:54	07:13	17:18 (T-83)	07:22	06:28	05:50		06:13 (T-38) 05:43 06:07 (T-37)
	17:25	18:07	22	17:40 (T-83)	19:44	20:23		20:58 25 06:38 (T-37) 21:17 50 20:49 (T-25)
26	07:53	07:11	17:19 (T-83)	07:21	06:26	05:49		06:12 (T-38) 05:43 06:07 (T-37)
	17:27	18:09	19	17:38 (T-83)	19:45	20:24		20:59 27 06:39 (T-37) 21:17 50 20:49 (T-25)
27	07:52	07:09	17:21 (T-83)	07:19	06:24	05:49		06:12 (T-38) 05:43 06:08 (T-37)
	17:28	18:10	15	17:36 (T-83)	19:46	20:25		21:00 28 06:40 (T-37) 21:17 48 20:49 (T-25)
28	07:51	07:08	17:24 (T-83)	07:17	06:23	05:48		06:11 (T-38) 05:44 06:08 (T-37)
	17:30	18:12	8	17:32 (T-83)	19:48	20:26		21:01 29 06:40 (T-37) 21:17 48 20:49 (T-25)
29	07:50			07:15	06:21	05:47		06:10 (T-37) 05:44 06:09 (T-37)
	17:31			19:49	20:28	21:01		06:40 (T-37) 21:17 49 20:50 (T-25)
30	07:49			07:13	06:20	05:47		06:10 (T-37) 05:45 06:09 (T-37)
	17:32			19:50	20:29	21:02		06:42 (T-37) 21:17 47 20:49 (T-25)
31	07:48			07:11	05:46	05:46		06:09 (T-37)
	17:34			19:51	21:03	21:03		20:37 (T-25) 34
Potential sun hours	287	292	369	403	458	465		
Total, worst case			390		477		1387	
Sun reduction			0.58		0.66		0.73	
Oper. time red.			0.90		0.90		0.90	
Wind dir. red.			0.59		0.59		0.60	
Total reduction			0.31		0.35		0.39	
Total, real		120			168		544	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

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6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-179 - R-179
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:10 (T-37)	06:13	06:36 (T-38)	06:49	07:24
	21:17	46 20:49 (T-25)	20:55	10 06:46 (T-38)	20:07	19:11
2	05:46	06:10 (T-37)	06:14	06:37 (T-38)	06:50	07:26
	21:16	47 20:49 (T-25)	20:54	11 20:27 (T-24)	20:05	19:09
3	05:46	06:11 (T-37)	06:15	06:38 (T-38)	06:51	07:27
	21:16	45 20:49 (T-25)	20:53	10 20:26 (T-24)	20:03	19:07
4	05:47	06:11 (T-37)	06:16	06:39 (T-38)	06:52	07:28
	21:16	45 20:48 (T-25)	20:51	8 20:25 (T-24)	20:02	19:05
5	05:48	06:12 (T-37)	06:17	06:41 (T-38)	06:54	07:29
	21:16	43 20:48 (T-25)	20:50	5 20:24 (T-24)	20:00	19:04
6	05:48	06:13 (T-37)	06:18	20:21 (T-24)	06:55	07:30
	21:16	43 20:48 (T-25)	20:49	2 20:23 (T-24)	19:58	19:02
7	05:49	06:13 (T-37)	06:20	20:20 (T-24)	06:56	07:32
	21:15	41 20:47 (T-25)	20:47	2 20:22 (T-24)	19:56	19:00
8	05:50	06:14 (T-37)	06:21	06:57	07:33	
	21:15	40 20:47 (T-25)	20:46	19:54	18:56	
9	05:50	06:15 (T-37)	06:22	06:58	07:34	
	21:14	39 20:47 (T-25)	20:44	19:52	18:55	
10	05:51	06:16 (T-37)	06:23	06:59	07:35	
	21:14	38 20:47 (T-25)	20:43	19:51	18:53	
11	05:52	06:16 (T-37)	06:24	07:01	07:37	
	21:13	36 20:46 (T-25)	20:42	19:49	18:51	
12	05:53	06:17 (T-37)	06:25	07:02	07:38	
	21:13	34 20:46 (T-25)	20:40	19:47	18:49	
13	05:54	06:18 (T-37)	06:26	07:03	07:39	
	21:12	32 06:50 (T-37)	20:39	19:45	18:47	
14	05:55	06:19 (T-37)	06:28	07:04	07:40	
	21:12	31 06:50 (T-37)	20:37	19:43	18:46	12 18:07 (T-83)
15	05:55	06:20 (T-37)	06:29	07:05	07:42	17:52 (T-83)
	21:11	30 06:50 (T-37)	20:36	19:41	18:44	17 18:09 (T-83)
16	05:56	06:20 (T-38)	06:30	07:06	07:43	17:51 (T-83)
	21:10	29 06:49 (T-37)	20:34	19:39	18:42	20 18:11 (T-83)
17	05:57	06:21 (T-38)	06:31	07:08	07:44	17:49 (T-83)
	21:10	28 06:49 (T-37)	20:32	19:37	18:41	23 18:12 (T-83)
18	05:58	06:22 (T-38)	06:32	07:09	07:46	17:48 (T-83)
	21:09	26 06:48 (T-37)	20:31	19:35	18:39	24 18:12 (T-83)
19	05:59	06:23 (T-38)	06:34	07:10	07:47	17:47 (T-83)
	21:08	25 06:48 (T-37)	20:29	19:34	18:37	26 18:13 (T-83)
20	06:00	06:24 (T-38)	06:35	07:11	07:48	17:46 (T-83)
	21:07	23 06:47 (T-38)	20:28	19:32	18:35	25 18:11 (T-83)
21	06:01	06:25 (T-38)	06:36	07:12	07:49	17:45 (T-83)
	21:06	22 06:47 (T-38)	20:26	19:30	18:34	24 18:09 (T-83)
22	06:02	06:26 (T-38)	06:37	07:13	07:51	17:45 (T-83)
	21:06	21 06:47 (T-38)	20:24	19:28	18:32	23 18:08 (T-83)
23	06:03	06:27 (T-38)	06:38	07:15	07:52	17:45 (T-83)
	21:05	20 06:47 (T-38)	20:23	19:26	18:31	21 18:06 (T-83)
24	06:04	06:28 (T-38)	06:39	07:16	07:53	17:45 (T-83)
	21:04	20 06:48 (T-38)	20:21	19:24	18:29	20 18:05 (T-83)
25	06:05	06:29 (T-38)	06:41	07:17	07:55	17:45 (T-83)
	21:03	19 06:48 (T-38)	20:19	19:22	18:27	18 18:03 (T-83)
26	06:06	06:30 (T-38)	06:42	07:18	07:56	17:45 (T-83)
	21:02	18 06:48 (T-38)	20:18	19:20	18:26	16 18:01 (T-83)
27	06:07	06:31 (T-38)	06:43	07:19	07:57	17:46 (T-83)
	21:01	17 06:48 (T-38)	20:16	19:19	18:24	14 18:00 (T-83)
28	06:08	06:32 (T-38)	06:44	07:21	07:59	17:46 (T-83)
	21:00	15 06:47 (T-38)	20:14	19:17	18:23	12 17:58 (T-83)
29	06:09	06:33 (T-38)	06:45	07:22	08:00	17:48 (T-83)
	20:58	14 06:47 (T-38)	20:12	19:15	18:21	9 17:57 (T-83)
30	06:10	06:34 (T-38)	06:46	07:23	08:01	17:48 (T-83)
	20:57	13 06:47 (T-38)	20:11	19:13	18:20	7 17:55 (T-83)
31	06:12	06:35 (T-38)	06:48	08:03	17:42 (T-40)	
	20:56	11 06:46 (T-38)	20:09	18:18	11 17:53 (T-83)	
Potential sun hours	471	436	377	341	289	275
Total, worst case	911	48	322	68		
Sun reduction	0.75	0.72	0.56	0.48		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.59	0.60	0.59	0.59		
Total reduction	0.40	0.39	0.30	0.25		
Total, real	364	19	95	17		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-180 - R-180

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June						
1	08:05	07:47	07:06	07:10	19:09 (T-24)	06:18	19:20 (T-25)	05:45				
	16:57	17:35	18:13	19:53	21	19:30 (T-24)	20:30	41	20:01 (T-25)	21:04		
2	08:05	07:46	07:04	07:08	17:50 (T-34)	07:08	19:10 (T-24)	06:17	19:20 (T-25)	05:45		
	16:58	17:37	18:14	3	17:53 (T-34)	19:54	18	19:28 (T-24)	20:31	40	20:00 (T-25)	21:05
3	08:05	07:45	07:03	07:06	17:49 (T-34)	07:06	19:12 (T-24)	06:16	19:21 (T-25)	05:44		
	16:59	17:38	18:16	5	17:54 (T-34)	19:55	13	19:25 (T-24)	20:33	39	20:00 (T-25)	21:06
4	08:05	07:44	07:01	07:04	17:48 (T-34)	07:04	19:15 (T-24)	06:14	19:21 (T-25)	05:44		
	17:00	17:39	18:17	7	17:55 (T-34)	19:57	6	19:21 (T-24)	20:34	37	19:58 (T-25)	21:07
5	08:04	07:42	06:59	07:02	17:48 (T-34)	07:02		06:13	19:22 (T-25)	05:43		
	17:01	17:41	18:18	9	17:57 (T-33)	19:58		20:35	19:58 (T-25)	21:08		
6	08:04	07:41	06:57	07:00	17:48 (T-34)	07:00		06:11	19:23 (T-25)	05:43		
	17:02	17:42	18:20	10	17:58 (T-33)	19:59		20:36	19:57 (T-25)	21:08		
7	08:04	07:40	06:56	06:59	07:16 (T-38)	06:59		06:10	19:24 (T-25)	05:43		
	17:03	17:44	18:21	13	17:59 (T-33)	20:00		20:37	19:55 (T-25)	21:09		
8	08:04	07:39	07:54	06:57	08:14 (T-38)	06:57		06:09	19:25 (T-25)	05:42		
	17:04	17:45	18:22	16	19:01 (T-33)	20:02		20:39	19:54 (T-25)	21:10		
9	08:04	07:37	07:52	06:55	08:12 (T-38)	06:55		06:07	19:27 (T-25)	05:42		
	17:05	17:47	19:24	17	19:02 (T-33)	20:03		20:40	19:53 (T-25)	21:10		
10	08:03	07:36	07:50	06:53	08:11 (T-38)	06:53		06:06	19:29 (T-25)	05:42		
	17:06	17:48	19:25	19	19:04 (T-34)	20:04	6	19:42 (T-25)	20:41	22	19:51 (T-25)	21:11
11	08:03	07:34	07:48	06:51	08:09 (T-38)	06:51		06:05	19:34 (T-25)	05:42		
	17:07	17:49	19:26	16	19:02 (T-34)	20:05	10	19:44 (T-25)	20:42	19	19:50 (T-25)	21:12
12	08:03	07:33	07:47	06:50	08:07 (T-38)	06:50		06:04	19:31 (T-25)	05:41		
	17:09	17:51	19:27	5	08:12 (T-38)	20:07	14	19:45 (T-25)	20:43	13	19:46 (T-25)	21:12
13	08:02	07:32	07:45	06:48		06:48		06:02	19:29 (T-25)	05:41		
	17:10	17:52	19:29	16	19:45 (T-25)	20:45	3	19:41 (T-25)	21:13			
14	08:02	07:30	07:43	06:46		06:46		06:01	19:27 (T-25)	05:41		
	17:11	17:54	19:30	19	19:46 (T-25)	20:46		20:46	19:46 (T-25)	21:13		
15	08:01	07:29	07:41	06:44		06:44		06:00	19:26 (T-25)	05:41		
	17:12	17:55	19:31	22	19:48 (T-25)	20:47		20:47	19:48 (T-25)	21:14		
16	08:01	07:27	07:39	06:43		06:43		05:59	19:24 (T-25)	05:41		
	17:14	17:56	19:33	25	19:49 (T-25)	20:48		20:48	19:49 (T-25)	21:14		
17	08:00	07:26	07:37	06:41		06:41		05:58	19:23 (T-25)	05:41		
	17:15	17:58	19:34	27	19:50 (T-25)	20:49		20:49	19:50 (T-25)	21:15		
18	08:00	07:24	07:36	06:39		06:39		05:57	19:23 (T-25)	05:41		
	17:16	17:59	19:35	29	19:52 (T-25)	20:50		20:50	19:52 (T-25)	21:15		
19	07:59	07:23	07:44 (T-37)	07:34	19:14 (T-24)	06:38		05:56	19:22 (T-25)	05:41		
	17:17	18:01	2	07:46 (T-37)	19:36	1	19:15 (T-24)	20:15	31	19:53 (T-25)	20:51	
20	07:58	07:21	07:42 (T-37)	07:32	19:12 (T-24)	06:36		05:55	19:21 (T-25)	05:42		
	17:19	18:01	4	07:46 (T-37)	19:38	4	19:16 (T-24)	20:16	32	19:53 (T-25)	20:52	
21	07:58	07:19	07:40 (T-37)	07:30	19:11 (T-24)	06:34		05:54	19:21 (T-25)	05:42		
	17:20	18:02	6	07:46 (T-37)	19:39	7	19:18 (T-24)	20:18	34	19:55 (T-25)	20:53	
22	07:57	07:18	07:39 (T-37)	07:28	19:09 (T-24)	06:33		05:53	19:20 (T-25)	05:42		
	17:21	18:03	8	07:47 (T-37)	19:40	10	19:19 (T-24)	20:19	36	19:56 (T-25)	20:55	
23	07:56	07:16	07:37 (T-37)	07:26	19:08 (T-24)	06:31		05:52	19:20 (T-25)	05:42		
	17:23	18:05	9	07:46 (T-37)	19:42	12	19:20 (T-24)	20:20	38	19:58 (T-25)	20:56	
24	07:55	07:15	07:35 (T-37)	07:24	19:08 (T-24)	06:29		05:51	19:19 (T-25)	05:42		
	17:24	18:06	10	07:45 (T-37)	19:43	14	19:22 (T-24)	20:21	40	19:59 (T-25)	20:57	
25	07:54	07:13	07:34 (T-37)	07:23	19:08 (T-24)	06:28		05:50	19:19 (T-25)	05:43		
	17:25	18:07	11	07:45 (T-37)	19:44	15	19:23 (T-24)	20:23	40	19:59 (T-25)	20:58	
26	07:53	07:11	07:32 (T-37)	07:21	19:07 (T-24)	06:26		05:49	19:19 (T-25)	05:43		
	17:27	18:09	12	07:44 (T-37)	19:45	17	19:24 (T-24)	20:24	42	20:01 (T-25)	20:59	
27	07:52	07:10	07:30 (T-37)	07:19	19:07 (T-24)	06:25		05:49	19:19 (T-25)	05:43		
	17:28	18:10	12	07:42 (T-37)	19:47	18	19:25 (T-24)	20:25	43	20:02 (T-25)	21:00	
28	07:51	07:08	07:31 (T-37)	07:17	19:06 (T-24)	06:23		05:48	19:19 (T-25)	05:44		
	17:30	18:12	10	07:41 (T-37)	19:48	20	19:26 (T-24)	20:26	44	20:03 (T-25)	21:01	
29	07:50		07:15	07:15	19:06 (T-24)	06:21		05:47	19:19 (T-25)	05:44		
	17:31		19:49	21	19:27 (T-24)	20:28	43	20:02 (T-25)	21:02			
30	07:49		07:13	07:13	19:07 (T-24)	06:20		05:47	19:20 (T-25)	05:45		
	17:32		19:50	21	19:28 (T-24)	20:29	41	20:01 (T-25)	21:02			
31	07:48		07:11	07:11	19:08 (T-24)			05:46		21:17		
	17:34		19:52	22	19:30 (T-24)			21:03				
Potential sun hours	287	292	369	403	459	465						
Total, worst case												
Sun reduction		84	302	690	370							
Oper. time red.		0.58	0.59	0.63	0.66							
Wind dir. red.		0.90	0.90	0.90	0.90							
Total reduction		0.61	0.59	0.60	0.60							
Total, real		0.32	0.31	0.34	0.35							
		27	94	233	131							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-180 - R-180
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	19:42 (T-25) 20:07	06:49 20:07	19:33 (T-25) 19:11	07:24 17:17
2	05:46 21:17	06:14 20:54	19:39 (T-25) 20:00 (T-25)	06:50 20:05	19:35 (T-25) 19:09	07:26 17:16
3	05:46 21:16	06:15 20:53	19:38 (T-25) 20:02 (T-25)	06:51 20:03	19:07 19:07	07:27 17:14
4	05:47 21:16	06:16 20:51	19:36 (T-25) 20:03 (T-25)	06:52 20:02	19:06 19:06	07:28 17:13
5	05:48 21:16	06:17 20:50	19:35 (T-25) 20:05 (T-25)	06:54 20:00	19:04 19:04	07:29 17:12
6	05:48 21:16	06:18 20:49	19:34 (T-25) 20:06 (T-25)	06:55 19:58	19:02 19:02	07:30 17:10
7	05:49 21:15	06:20 20:47	19:33 (T-25) 20:07 (T-25)	06:56 19:56	19:00 19:00	07:32 17:09
8	05:50 21:15	06:21 20:46	19:32 (T-25) 20:07 (T-25)	06:57 19:54	19:11 (T-24) 19:15 (T-24)	07:33 18:56
9	05:50 21:14	06:22 20:45	19:31 (T-25) 20:08 (T-25)	06:58 19:52	19:06 (T-24) 19:19 (T-24)	07:34 18:55
10	05:51 21:14	06:23 20:43	19:30 (T-25) 20:08 (T-25)	06:59 19:51	19:03 (T-24) 19:21 (T-24)	07:35 18:53
11	05:52 21:14	06:24 20:42	19:29 (T-25) 20:09 (T-25)	07:01 19:49	19:01 (T-24) 19:22 (T-24)	07:37 18:51
12	05:53 21:13	06:25 20:40	19:28 (T-25) 20:09 (T-25)	07:02 19:47	18:59 (T-24) 19:22 (T-24)	07:38 18:49
13	05:54 21:12	06:27 20:39	19:27 (T-25) 20:09 (T-25)	07:03 19:45	18:58 (T-24) 19:20 (T-24)	07:39 18:47
14	05:55 21:12	06:28 20:37	19:27 (T-25) 20:10 (T-25)	07:04 19:43	18:57 (T-24) 19:18 (T-24)	07:40 18:46
15	05:55 21:11	06:29 20:36	19:27 (T-25) 20:10 (T-25)	07:05 19:41	18:57 (T-24) 19:17 (T-24)	07:42 18:44
16	05:56 21:11	06:30 20:34	19:26 (T-25) 20:09 (T-25)	07:06 19:39	18:56 (T-24) 19:15 (T-24)	07:43 18:42
17	05:57 21:10	06:31 20:33	19:26 (T-25) 20:07 (T-25)	07:08 19:37	18:55 (T-24) 19:13 (T-24)	07:44 18:41
18	05:58 21:09	06:32 20:31	19:25 (T-25) 20:06 (T-25)	07:09 19:36	18:55 (T-24) 19:11 (T-24)	07:46 18:39
19	05:59 21:08	06:34 20:29	19:25 (T-25) 20:04 (T-25)	07:10 19:34	18:55 (T-24) 19:09 (T-24)	07:47 18:37
20	06:00 21:07	06:35 20:28	19:25 (T-25) 20:02 (T-25)	07:11 19:32	18:54 (T-24) 19:07 (T-24)	07:48 18:36
21	06:01 21:07	06:36 20:26	19:25 (T-25) 20:01 (T-25)	07:12 19:30	18:54 (T-24) 19:04 (T-24)	07:50 18:34
22	06:02 21:06	06:37 20:24	19:24 (T-25) 19:59 (T-25)	07:14 19:28	18:56 (T-24) 19:03 (T-24)	07:51 18:32
23	06:03 21:05	06:38 20:23	19:25 (T-25) 19:58 (T-25)	07:15 19:26	18:56 (T-24) 19:01 (T-24)	07:52 18:31
24	06:04 21:04	06:39 20:21	19:25 (T-25) 19:56 (T-25)	07:16 19:24	18:57 (T-24) 18:59 (T-24)	07:53 18:29
25	06:05 21:03	06:41 20:19	19:26 (T-25) 19:55 (T-25)	07:17 19:22	18:59 (T-24)	07:55 18:28
26	06:06 21:02	06:42 20:18	19:26 (T-25) 19:53 (T-25)	07:18 19:20	18:26	07:56 16:51
27	06:07 21:01	06:43 20:16	19:26 (T-25) 19:51 (T-25)	07:20 19:19	07:57 18:24	16:52 16:53
28	06:08 21:00	06:44 20:14	19:27 (T-25) 19:49 (T-25)	07:21 19:17	07:59 18:23	16:54 16:54
29	06:09 20:59	06:45 20:12	19:28 (T-25) 19:47 (T-25)	07:22 19:15	08:00 18:21	16:55 16:54
30	06:11 20:57	06:47 20:11	19:29 (T-25) 19:45 (T-25)	07:23 19:13	08:02 18:20	16:56 16:55
31	06:12 20:56	19:46 (T-25) 19:54 (T-25)	06:48 20:09	19:31 (T-25) 19:44 (T-25)	08:03 18:19	16:56 16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case	8	990	262	202		
Sun reduction	0.75	0.72	0.67	0.56		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.60	0.60	0.59	0.59		
Total reduction	0.40	0.39	0.36	0.30		
Total, real	3	382	93	60		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-181 - R-181
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	08:30 (T-37)	07:47	07:06	07:09	06:18
	16:57	33 09:03 (T-37)	17:35	18:13	19:53	20:30
2	08:05	08:31 (T-37)	07:46	07:04	07:08	06:17
	16:58	33 09:04 (T-37)	17:37	18:14	19:54	20:31
3	08:05	08:31 (T-37)	07:45	07:03	07:06	06:15
	16:59	33 09:04 (T-37)	17:38	18:16	19:55	20:33
4	08:05	08:32 (T-37)	07:44	07:01	07:04	06:14
	17:00	32 09:04 (T-37)	17:39	18:17	19:56	20:34
5	08:04	08:33 (T-37)	07:42	06:59	07:02	06:13
	17:01	32 09:05 (T-37)	17:41	18:18	19:58	20:35
6	08:04	08:33 (T-37)	07:41	08:03 (T-38)	06:57	07:00
	17:02	31 09:04 (T-37)	17:42	2 08:05 (T-38)	18:20	19:59
7	08:04	08:34 (T-37)	07:40	08:01 (T-38)	06:56	06:59
	17:03	31 09:05 (T-37)	17:44	5 08:06 (T-38)	18:21	20:00
8	08:04	08:35 (T-37)	07:39	08:00 (T-38)	07:54	06:57
	17:04	30 09:05 (T-37)	17:45	7 08:07 (T-38)	18:22	20:01
9	08:04	08:36 (T-37)	07:37	07:59 (T-38)	07:52	06:55
	17:05	29 09:05 (T-37)	17:47	9 08:08 (T-38)	19:23	20:03
10	08:03	08:36 (T-37)	07:36	07:57 (T-38)	07:50	06:53
	17:06	29 09:05 (T-37)	17:48	11 08:08 (T-38)	19:25	20:04
11	08:03	08:37 (T-37)	07:34	07:56 (T-38)	07:48	06:51
	17:07	28 09:05 (T-37)	17:49	13 08:09 (T-38)	19:26	20:05
12	08:03	08:38 (T-37)	07:33	07:54 (T-38)	07:47	06:50
	17:09	26 09:04 (T-37)	17:51	14 08:08 (T-38)	19:27	20:06
13	08:02	08:39 (T-37)	07:32	07:53 (T-38)	07:45	19:05 (T-24)
	17:10	26 09:05 (T-37)	17:52	16 08:09 (T-38)	19:29	2 19:07 (T-24)
14	08:02	08:40 (T-37)	07:30	07:51 (T-38)	07:43	19:05 (T-24)
	17:11	24 09:04 (T-37)	17:54	17 08:08 (T-38)	19:30	3 19:08 (T-24)
15	08:01	08:42 (T-37)	07:29	07:50 (T-38)	07:41	19:04 (T-24)
	17:12	22 09:04 (T-37)	17:55	18 08:08 (T-38)	19:31	6 19:10 (T-24)
16	08:01	08:42 (T-37)	07:27	07:48 (T-38)	07:39	19:04 (T-24)
	17:13	21 09:03 (T-37)	17:56	19 08:07 (T-38)	19:33	7 19:11 (T-24)
17	08:00	08:44 (T-37)	07:26	07:47 (T-38)	07:37	19:06 (T-24)
	17:15	18 09:02 (T-37)	17:58	20 08:07 (T-38)	19:34	7 19:13 (T-24)
18	08:00	08:46 (T-37)	07:24	07:47 (T-38)	07:35	19:07 (T-24)
	17:16	15 09:01 (T-37)	17:59	18 08:05 (T-38)	19:35	7 19:14 (T-24)
19	07:59	08:49 (T-37)	07:23	07:49 (T-38)	07:34	19:09 (T-24)
	17:17	10 08:59 (T-37)	18:01	15 08:04 (T-38)	19:36	6 19:15 (T-24)
20	07:58		07:21	07:50 (T-38)	07:32	07:52 (T-82)
	17:19		18:01	12 08:02 (T-38)	19:38	4 19:16 (T-25)
21	07:58		07:19	07:30	07:30	07:50 (T-82)
	17:20		18:02		19:39	10 19:18 (T-25)
22	07:57		07:18	07:28	07:28	07:48 (T-82)
	17:21		18:03		19:40	14 19:19 (T-25)
23	07:56		07:16	07:26	07:26	07:46 (T-82)
	17:23		18:05		19:41	18 19:20 (T-25)
24	07:55		07:14	07:24	07:24	07:45 (T-82)
	17:24		18:06		19:43	22 19:22 (T-25)
25	07:54		07:13	07:22	07:22	07:43 (T-82)
	17:25		18:07		19:44	24 19:23 (T-25)
26	07:53		07:11	07:21	07:21	07:41 (T-82)
	17:27		18:09		19:45	26 19:24 (T-25)
27	07:52		07:09	07:19	07:19	07:39 (T-82)
	17:28		18:10		19:46	28 19:25 (T-25)
28	07:51		07:08	07:17	07:17	07:37 (T-82)
	17:30		18:12		19:48	28 19:26 (T-25)
29	07:50			07:15	07:15	07:36 (T-82)
	17:31			26 19:26 (T-25)	20:28	21:02
30	07:49			07:13	07:13	07:38 (T-82)
	17:32			17 19:50	20:29	21:02
31	07:48			07:11	07:11	07:46
	17:34			19:51	20:29	21:03
Potential sun hours	287	292	369	403	459	465
Total, worst case	503	196	255	86		
Sun reduction	0.58	0.58	0.59	0.66		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.67	0.63	0.59	0.59		
Total reduction	0.35	0.33	0.31	0.35		
Total, real	176	65	80	30		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

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South Deuel Wind Project

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Invernergy Deuel Harvest Wind in Deuel County, SD
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Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-181 - R-181
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December					
1	05:45	06:13	06:36 (T-93)	06:49	07:24	07:04	07:27 (T-38)	07:43	08:19 (T-37)		
	21:17	20:55	10 06:46 (T-93)	20:07	19:11	17:17	11 07:38 (T-38)	16:49	28 08:47 (T-37)		
2	05:46	06:14	06:37 (T-93)	06:50	07:26	07:06	07:28 (T-38)	07:45	08:19 (T-37)		
	21:17	20:54	10 06:47 (T-93)	20:05	19:09	17:16	9 07:37 (T-38)	16:48	29 08:48 (T-37)		
3	05:46	06:15	06:38 (T-93)	06:51	07:27	07:07	07:30 (T-38)	07:46	08:19 (T-37)		
	21:16	20:53	9 06:47 (T-93)	20:03	19:07	17:14	7 07:37 (T-38)	16:48	29 08:48 (T-37)		
4	05:47	06:16	06:39 (T-93)	06:52	07:28	07:08	07:31 (T-38)	07:47	08:19 (T-37)		
	21:16	20:51	8 06:47 (T-93)	20:02	19:05	17:13	4 07:35 (T-38)	16:48	30 08:49 (T-37)		
5	05:48	06:17	06:41 (T-93)	06:54	07:29	07:10	07:33 (T-38)	07:48	08:19 (T-37)		
	21:16	20:50	8 06:49 (T-93)	20:00	19:04	17:12	2 07:35 (T-38)	16:47	31 08:50 (T-37)		
6	05:48	06:18	06:42 (T-93)	06:55	07:30	07:11		07:49	08:19 (T-37)		
	21:16	20:49	7 06:49 (T-93)	19:58	19:02	17:10		16:47	31 08:50 (T-37)		
7	05:49	06:20	06:43 (T-93)	06:56	07:32	07:12		07:50	08:19 (T-37)		
	21:15	20:47	5 06:48 (T-93)	19:56	19:00	17:09		16:47	32 08:51 (T-37)		
8	05:50	06:21	06:44 (T-93)	06:57	07:33	07:14		07:51	08:19 (T-37)		
	21:15	20:46	4 06:48 (T-93)	19:54	18:56	17:08		16:47	32 08:51 (T-37)		
9	05:50	06:22	06:45 (T-93)	06:58	07:34	07:15		07:52	08:19 (T-37)		
	21:14	20:44	3 06:48 (T-93)	19:52	18:55	17:07		16:47	33 08:52 (T-37)		
10	05:51	06:23	06:46 (T-93)	06:59	07:35	07:16		07:53	08:20 (T-37)		
	21:14	20:43	1 06:47 (T-93)	19:51	18:53	17:05		16:47	33 08:53 (T-37)		
11	05:52	06:24		07:01	07:37	07:18		07:54	08:20 (T-37)		
	21:13	20:42		19:49	18:51	17:04		16:47	33 08:53 (T-37)		
12	05:53	06:25		07:02	07:38	07:19		07:55	08:21 (T-37)		
	21:13	20:40		19:47	18:49	17:03		16:47	33 08:54 (T-37)		
13	05:54	06:26		07:03	07:39	07:20		07:55	08:21 (T-37)		
	21:12	20:39		19:45	14 19:15 (T-25)	18:47		17:02	16:47	34 08:55 (T-37)	
14	05:54	06:28		07:04	07:26 (T-82)	07:40		07:22	07:56	08:22 (T-37)	
	21:12	20:37		19:43	26 19:16 (T-25)	18:46		17:01	16:47	33 08:55 (T-37)	
15	05:55	06:29		07:05	07:27 (T-82)	07:42		07:23	07:57	08:23 (T-37)	
	21:11	20:36		19:41	29 19:17 (T-25)	18:44		17:00	16:47	33 08:56 (T-37)	
16	05:56	06:30		07:06	07:28 (T-82)	07:43		07:25	07:58	08:23 (T-37)	
	21:10	20:34		19:39	28 19:15 (T-25)	18:42		16:59	16:48	33 08:56 (T-37)	
17	05:57	06:31		07:08	07:29 (T-82)	07:44		07:26	07:58	08:24 (T-37)	
	21:10	20:32		19:37	27 19:13 (T-25)	18:41		16:58	16:48	33 08:57 (T-37)	
18	05:58	06:32		07:09	07:30 (T-82)	07:46		07:27	07:59	08:25 (T-37)	
	21:09	20:31		19:36	24 19:11 (T-25)	18:39		16:57	16:48	33 08:58 (T-37)	
19	05:59	06:34		07:10	07:31 (T-82)	07:47		07:28	08:00	08:25 (T-37)	
	21:08	20:29		19:34	22 19:09 (T-25)	18:37		16:56	16:48	32 08:57 (T-37)	
20	06:00	06:35		07:11	07:32 (T-82)	07:48		07:30	08:00	08:26 (T-37)	
	21:07	20:28		19:32	19 19:07 (T-25)	18:35		16:55	16:49	32 08:58 (T-37)	
21	06:01	06:36		07:12	07:33 (T-82)	07:49		07:31	08:01	08:26 (T-37)	
	21:07	20:26		19:30	15 19:04 (T-25)	18:34	6 08:23 (T-38)	16:55	16:49	32 08:58 (T-37)	
22	06:02	06:37		07:13	07:35 (T-82)	07:51		07:32	08:01	08:27 (T-37)	
	21:06	20:24		19:28	11 19:03 (T-25)	18:32	13 08:33 (T-38)	16:54	16:50	32 08:59 (T-37)	
23	06:03	06:38		07:15	07:36 (T-82)	07:52		07:34	08:02	08:27 (T-37)	
	21:05	20:23		19:26	5 19:01 (T-25)	18:31	16 08:34 (T-38)	16:53	10 08:36 (T-37)	16:50	32 08:59 (T-37)
24	06:04	06:39		07:16	08:17 (T-38)	07:53		07:35	08:02	08:28 (T-37)	
	21:04	20:21		19:24	4 18:59 (T-25)	18:29	19 08:36 (T-38)	16:52	15 08:38 (T-37)	16:51	32 09:00 (T-37)
25	06:05	06:41		07:17	18:50 (T-24)	07:55		07:36	08:03	08:28 (T-37)	
	21:03	20:19		19:22	7 18:57 (T-24)	18:27	20 08:37 (T-38)	16:52	18 08:40 (T-37)	16:52	32 09:00 (T-37)
26	06:06	06:42		07:18	18:48 (T-24)	07:56		07:37	08:03	08:28 (T-37)	
	21:02	20:18		19:20	7 18:55 (T-24)	18:26	19 08:37 (T-38)	16:51	20 08:42 (T-37)	16:52	33 09:01 (T-37)
27	06:07	06:43		07:19	18:47 (T-24)	07:57		07:39	08:03	08:28 (T-37)	
	21:01	20:16		19:19	7 18:54 (T-24)	18:24	18 08:38 (T-38)	16:50	22 08:43 (T-37)	16:53	33 09:01 (T-37)
28	06:08	06:44		07:21	18:46 (T-24)	07:59		07:40	08:04	08:29 (T-37)	
	21:00	20:14		19:17	6 18:52 (T-24)	18:23	17 08:38 (T-38)	16:50	24 08:44 (T-37)	16:54	33 09:02 (T-37)
29	06:09	06:45	06:38 (T-93)	07:22	18:45 (T-24)	08:00		07:41	08:04	08:29 (T-37)	
	20:59	2 06:40 (T-93)	20:12	19:15	5 18:50 (T-24)	18:21	15 08:38 (T-38)	16:49	26 08:45 (T-37)	16:54	33 09:02 (T-37)
30	06:10	06:34 (T-93)	06:46	07:23	18:45 (T-24)	08:01		07:42	08:04	08:29 (T-37)	
	20:57	9 06:43 (T-93)	20:11	19:13	3 18:48 (T-24)	18:20	14 08:38 (T-38)	16:49	26 08:46 (T-37)	16:55	34 09:03 (T-37)
31	06:12	06:35 (T-93)	06:48			08:03		07:43	08:04	08:30 (T-37)	
	20:56	10 06:45 (T-93)	20:09			18:18	12 08:38 (T-38)		16:56	33 09:03 (T-37)	
Potential sun hours	471	436		377		341		289		275	
Total, worst case	21	65		259		169		194		996	
Sun reduction	0.75	0.72		0.67		0.56		0.48		0.52	
Oper. time red.	0.90	0.90		0.90		0.90		0.90		0.90	
Wind dir. red.	0.59	0.59		0.59		0.63		0.66		0.67	
Total reduction	0.40	0.38		0.36		0.32		0.29		0.31	
Total, real	8	25		92		54		56		312	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-182 - R-182
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:05 16:57	08:29 (T-37) 08:37 (T-37)	07:47 17:35	17:07 (T-25) 18:13	07:10 19:53	06:18 20:30
2	08:05 16:58	08:29 (T-37) 08:38 (T-37)	07:46 17:37	08:08 (T-38) 17:11 (T-25)	07:08 19:54	21:04 20:31
3	08:05 16:59	08:29 (T-37) 08:38 (T-37)	07:45 17:38	08:07 (T-38) 17:13 (T-25)	07:06 19:55	21:05 20:33
4	08:05 17:00	08:29 (T-37) 08:38 (T-37)	07:44 17:39	08:05 (T-38) 17:13 (T-25)	07:04 19:57	05:44 21:07
5	08:04 17:01	08:29 (T-37) 08:39 (T-37)	07:42 17:41	08:04 (T-38) 17:15 (T-24)	07:02 19:58	05:43 21:08
6	08:04 17:02	08:29 (T-37) 08:39 (T-37)	07:41 17:42	08:03 (T-38) 17:17 (T-24)	07:00 19:59	05:43 21:08
7	08:04 17:03	08:28 (T-37) 08:39 (T-37)	07:40 17:44	08:01 (T-38) 17:18 (T-24)	06:59 20:00	05:43 21:09
8	08:04 17:04	08:28 (T-37) 08:39 (T-37)	07:39 17:45	08:00 (T-38) 17:20 (T-24)	06:57 20:02	05:42 21:10
9	08:04 17:05	08:28 (T-37) 08:40 (T-37)	07:37 17:47	07:59 (T-38) 17:22 (T-24)	06:55 20:03	05:42 21:10
10	08:03 17:06	08:27 (T-37) 08:39 (T-37)	07:36 17:48	17:00 (T-25) 17:23 (T-24)	07:50 20:04	05:42 21:11
11	08:03 17:07	08:27 (T-37) 08:39 (T-37)	07:34 17:49	17:01 (T-25) 17:25 (T-24)	07:48 20:05	05:42 21:12
12	08:03 17:09	08:26 (T-37) 08:38 (T-37)	07:33 17:51	17:00 (T-25) 17:26 (T-24)	07:47 20:07	05:41 21:12
13	08:02 17:10	08:26 (T-37) 08:38 (T-37)	07:32 17:52	17:01 (T-25) 17:28 (T-24)	07:45 20:08	05:41 21:13
14	08:02 17:11	08:28 (T-37) 08:37 (T-37)	07:30 17:54	17:00 (T-25) 17:29 (T-24)	07:43 20:09	05:41 21:13
15	08:01 17:12	08:30 (T-37) 08:36 (T-37)	07:29 17:55	17:01 (T-25) 17:31 (T-24)	07:41 19:31	05:41 21:14
16	08:01 17:14	07:27 17:56	07:39 17:32 (T-24)	17:01 (T-25) 17:32 (T-24)	07:39 19:33	05:41 21:14
17	08:00 17:15	07:26 17:58	07:37 17:33 (T-25)	17:02 (T-25) 17:33 (T-25)	07:37 19:34	05:41 21:15
18	08:00 17:16	07:24 17:59	07:36 17:32 (T-25)	17:02 (T-25) 17:32 (T-25)	07:36 19:35	05:41 21:15
19	07:59 17:17	07:23 18:01	07:34 17:31 (T-25)	17:04 (T-25) 17:31 (T-25)	07:34 19:36	05:41 21:15
20	07:58 17:19	07:21 18:01	07:32 17:29 (T-25)	17:05 (T-25) 17:29 (T-25)	07:32 19:38	05:41 21:16
21	07:58 17:20	07:19 18:02	07:30 17:28 (T-25)	17:06 (T-25) 17:28 (T-25)	07:30 19:39	05:42 21:16
22	07:57 17:21	07:18 18:03	07:28 17:26 (T-25)	17:08 (T-25) 17:26 (T-25)	07:28 19:40	05:42 21:16
23	07:56 17:23	07:16 18:05	07:26 17:23 (T-25)	17:11 (T-25) 17:23 (T-25)	07:26 19:41	05:42 21:16
24	07:55 17:24	07:15 18:06	07:24 19:43	17:24 19:43	19:41 20:21	05:42 21:17
25	07:54 17:25	07:13 18:07	07:23 19:44	17:23 19:44	20:21 20:23	05:42 21:17
26	07:53 17:27	07:11 18:09	07:21 19:45	17:21 19:45	20:23 20:24	05:43 21:17
27	07:52 17:28	07:10 18:10	07:19 19:47	17:19 19:47	20:25 20:25	05:43 21:17
28	07:51 17:30	07:08 18:12	07:17 19:48	17:08 (T-25) 19:48	07:28 20:26	05:44 21:17
29	07:50 17:31	07:15 19:49	07:15 19:49	17:15 19:49	07:15 20:28	05:44 21:17
30	07:49 17:32	07:13 19:50	07:13 19:50	17:13 19:50	07:13 20:29	05:45 21:17
31	07:48 17:34	07:11 19:52	07:11 19:52	17:11 19:52	07:11 20:29	05:46 21:17
Potential sun hours	287	292	369	403	459	465
Total, worst case	152	495	10	7		
Sun reduction	0.58	0.58	0.59	0.63		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.65	0.59	0.60	0.58		
Total reduction	0.34	0.31	0.32	0.33		
Total, real	52	153	3	2		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-182 - R-182
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:13	06:49	07:24	07:04	07:43
	21:17	20:55	20:07	19:11	17:17	16:52 (T-24)
2	05:46	06:14	06:50	07:26	07:06	07:28 (T-38)
	21:17	20:54	20:05	19:09	17:16	16:50 (T-24)
3	05:46	06:15	06:51	07:27	07:07	07:30 (T-38)
	21:16	20:53	20:03	19:07	17:14	16:49 (T-24)
4	05:47	06:16	06:52	07:14 (T-93)	07:28	07:31 (T-38)
	21:16	20:51	20:02	19:05	17:13	16:48 (T-24)
5	05:48	06:17	06:54	07:15 (T-93)	07:29	07:33 (T-38)
	21:16	20:50	20:00	19:04	17:12	16:47 (T-24)
6	05:48	06:18	06:55	07:16 (T-93)	07:30	07:34 (T-38)
	21:16	20:49	19:58	19:02	17:10	16:45 (T-24)
7	05:49	06:20	06:56	07:17 (T-93)	07:32	07:36 (T-38)
	21:15	20:47	19:56	19:00	17:09	16:44 (T-25)
8	05:50	06:21	06:57	07:17 (T-93)	07:33	07:37 (T-38)
	21:15	20:46	19:54	18:56	17:08	16:42 (T-25)
9	05:50	06:22	06:58	07:18 (T-93)	07:34	07:39 (T-38)
	21:14	20:45	19:52	18:55	17:07	16:42 (T-25)
10	05:51	06:23	06:59	07:35	07:16	16:38 (T-25)
	21:14	20:43	19:51	18:53	17:05	16:40 (T-25)
11	05:52	06:24	07:01	07:37	07:18	16:38 (T-34)
	21:14	20:42	19:49	18:51	17:04	16:39 (T-34)
12	05:53	06:25	07:02	07:38	07:19	07:55
	21:13	20:40	19:47	18:49	17:03	16:47
13	05:54	06:27	07:03	07:39	07:21	07:55
	21:12	20:39	19:45	18:47	17:02	16:47
14	05:55	06:28	07:04	07:40	07:22	07:56
	21:12	20:37	19:43	18:46	17:01	16:47
15	05:55	06:29	07:05	07:42	07:23	07:57
	21:11	20:36	19:41	18:44	17:00	16:47
16	05:56	06:30	07:06	07:43	07:25	07:58
	21:11	20:34	19:39	18:42	16:59	16:48
17	05:57	06:31	07:08	07:44	07:26	07:58
	21:10	20:33	19:37	18:41	16:58	16:48
18	05:58	06:32	07:09	07:46	17:46 (T-25)	07:27
	21:09	20:31	19:36	18:39	17:50 (T-25)	16:57
19	05:59	06:34	07:10	07:47	17:41 (T-25)	07:29
	21:08	20:29	19:34	18:37	17:55 (T-25)	16:56
20	06:00	06:35	07:11	07:48	17:38 (T-25)	07:30
	21:07	20:28	19:32	18:36	17:57 (T-25)	16:55
21	06:01	06:36	07:12	07:50	17:36 (T-25)	07:31
	21:07	20:26	19:30	18:34	17:59 (T-25)	16:55
22	06:02	06:37	07:14	07:51	17:35 (T-25)	07:32
	21:06	20:24	19:28	18:32	18:00 (T-25)	16:54
23	06:03	06:38	07:15	07:52	17:33 (T-25)	07:34
	21:05	20:23	19:26	18:31	18:01 (T-25)	16:53
24	06:04	06:39	07:16	07:53	17:33 (T-25)	07:35
	21:04	20:21	19:24	18:29	18:02 (T-25)	16:52
25	06:05	06:41	07:17	07:55	17:32 (T-25)	07:36
	21:03	20:19	19:22	18:27	18:02 (T-25)	16:52
26	06:06	06:42	07:18	07:56	17:31 (T-25)	07:38
	21:02	20:18	19:20	18:26	18:01 (T-24)	16:51
27	06:07	06:43	07:19	07:57	17:31 (T-25)	07:39
	21:01	20:16	19:19	18:24	18:00 (T-24)	16:51
28	06:08	06:44	07:21	07:59	17:30 (T-25)	07:40
	21:00	20:14	19:17	18:23	17:58 (T-24)	16:50
29	06:09	06:45	07:22	08:00	17:30 (T-25)	07:41
	20:59	20:12	19:15	18:21	17:57 (T-24)	16:49
30	06:11	06:46	07:23	08:02	17:30 (T-25)	07:42
	20:57	20:11	19:13	18:20	17:55 (T-24)	16:49
31	06:12	06:48		08:03	17:30 (T-25)	07:43
	20:56	20:09		18:18	17:54 (T-24)	16:48
Potential sun hours	471	436	377	341	289	275
Total, worst case				345	198	244
Sun reduction			0.67	0.56	0.48	0.52
Oper. time red.			0.90	0.90	0.90	0.90
Wind dir. red.			0.58	0.59	0.61	0.65
Total reduction			0.35	0.30	0.26	0.31
Total, real			2	103	52	75

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
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1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-183 - R-183
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:05	08:29 (T-93)	07:47	16:45 (T-27)	07:06	07:09
	16:57	13 08:42 (T-93)	17:35	14 16:59 (T-27)	18:13	19:53
2	08:05	08:29 (T-93)	07:46	16:48 (T-27)	07:04	07:08
	16:58	13 08:42 (T-93)	17:37	9 16:57 (T-27)	18:14	19:54
3	08:05	08:29 (T-93)	07:45		07:03	07:06
	16:59	13 08:42 (T-93)	17:38		18:16	19:55
4	08:05	08:30 (T-93)	07:44		07:01	07:04
	17:00	12 08:42 (T-93)	17:39		18:17	19:56
5	08:04	08:32 (T-93)	07:42		06:59	07:02
	17:01	10 08:42 (T-93)	17:41		18:18	19:58
6	08:04	08:34 (T-93)	07:41		06:57	07:00
	17:02	7 08:41 (T-93)	17:42		18:20	19:59
7	08:04	08:35 (T-93)	07:40		06:56	06:58
	17:03	4 08:39 (T-93)	17:44		18:21	20:00
8	08:04		07:39		07:54	06:57
	17:04		17:45		18:22	20:01
9	08:04		07:37		07:52	06:55
	17:05		17:46		19:23	20:03
10	08:03		07:36		07:50	06:53
	17:06		17:48		19:25	20:04
11	08:03		07:34		07:48	06:51
	17:07		17:49		19:26	20:05
12	08:03	16:39 (T-27)	07:33		07:47	06:50
	17:09	1 16:40 (T-27)	17:51		19:27	20:06
13	08:02	16:39 (T-27)	07:32		07:45	06:48
	17:10	3 16:42 (T-27)	17:52		19:29	20:08
14	08:02	16:38 (T-27)	07:30		07:43	06:46
	17:11	5 16:43 (T-27)	17:54		19:30	20:09
15	08:01	16:38 (T-27)	07:29		07:41	06:44
	17:12	7 16:45 (T-27)	17:55		19:31	20:10
16	08:01	16:38 (T-27)	07:27		07:39	06:43
	17:13	8 16:46 (T-27)	17:56		19:33	20:11
17	08:00	16:37 (T-27)	07:26		07:37	06:41
	17:15	10 16:47 (T-27)	17:58		19:34	20:13
18	08:00	16:38 (T-27)	07:24		07:35	06:39
	17:16	11 16:49 (T-27)	17:59		19:35	20:14
19	07:59	16:38 (T-27)	07:23		07:34	06:37
	17:17	12 16:50 (T-27)	18:01		19:36	20:15
20	07:58	16:37 (T-27)	07:21		07:32	06:36
	17:19	14 16:51 (T-27)	18:01		19:38	20:16
21	07:58	16:37 (T-27)	07:19		07:30	06:34
	17:20	15 16:52 (T-27)	18:02		19:39	20:18
22	07:57	16:38 (T-27)	07:18		07:28	06:32
	17:21	17 16:55 (T-27)	18:03		19:40	20:19
23	07:56	16:38 (T-27)	07:16		07:26	06:31
	17:23	18 16:56 (T-27)	18:05		19:41	20:20
24	07:55	16:39 (T-27)	07:14		07:24	06:29
	17:24	18 16:57 (T-27)	18:06		19:43	20:21
25	07:54	16:39 (T-27)	07:13		07:22	06:28
	17:25	20 16:59 (T-27)	18:07		19:44	20:23
26	07:53	16:40 (T-27)	07:11		07:21	06:26
	17:27	20 17:00 (T-27)	18:09		19:45	20:24
27	07:52	16:40 (T-27)	07:09		07:19	06:24
	17:28	22 17:02 (T-27)	18:10		19:46	20:25
28	07:51	16:41 (T-27)	07:08		07:17	06:23
	17:29	22 17:03 (T-27)	18:11		19:48	20:26
29	07:50	16:42 (T-27)			07:15	06:21
	17:31	20 17:02 (T-27)			19:49	20:28
30	07:49	16:42 (T-27)			07:13	06:20
	17:32	19 17:01 (T-27)			19:50	20:29
31	07:48	16:43 (T-27)			07:11	
	17:34	17 17:00 (T-27)			19:51	
Potential sun hours	287	292	369	403	459	465
Total, worst case	351	23		31		
Sun reduction	0.58	0.58		0.63		
Oper. time red.	0.90	0.90		0.90		
Wind dir. red.	0.60	0.59		0.57		
Total reduction	0.31	0.31		0.33		
Total, real	110	7		10		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-183 - R-183
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-29) 19:11	07:24 17:17	07:43 16:49
2	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-29) 19:09	07:26 17:16	07:45 16:48
3	05:46 21:16	06:15 20:53	06:51 20:03	07:13 (T-29) 19:07	07:27 17:14	07:46 16:48
4	05:47 21:16	06:16 20:51	06:52 20:02	07:14 (T-29) 19:05	07:28 17:13	07:47 16:48
5	05:48 21:16	06:17 20:50	06:53 20:00	07:15 (T-29) 19:04	07:29 17:12	07:48 16:47
6	05:48 21:16	06:18 20:49	06:55 19:58	07:16 (T-29) 19:02	07:30 17:10	07:49 16:47
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	07:12 17:09	07:50 16:47
8	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	07:14 17:08	07:51 16:47
9	05:50 21:14	06:22 20:45	06:58 19:52	07:34 18:54	07:15 17:07	07:52 16:47
10	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:16 17:05	07:53 16:47
11	05:52 21:14	06:24 20:42	07:01 19:49	07:37 18:51	07:18 17:04	07:54 16:47
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:55 16:47
13	05:54 21:12	06:26 20:39	07:03 19:45	07:39 18:47	07:21 17:02	07:55 16:47
14	05:54 21:12	06:28 20:37	07:04 19:43	07:40 18:46	07:22 17:01	07:56 16:47
15	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	07:57 16:47
16	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42	07:25 16:59	07:58 16:47
17	05:57 21:10	06:31 20:32	07:08 19:37	07:44 18:40	07:26 16:58	07:58 16:48
18	05:58 21:09	06:32 20:31	07:09 19:35	07:46 18:39	07:27 16:57	07:59 16:48
19	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37	07:29 16:56	08:00 16:48
20	06:00 21:07	06:35 20:28	07:11 19:32	07:48 18:35	07:30 16:55	08:00 16:49
21	06:01 21:07	06:36 20:26	07:12 19:30	07:49 18:34	07:31 16:54	08:01 16:49
22	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:54	08:01 16:50
23	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53	08:02 16:50
24	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	08:02 16:51
25	06:05 21:03	06:41 20:19	07:17 19:22	07:55 18:27	07:36 16:52	08:03 16:51
26	06:06 21:02	06:42 20:18	07:18 19:20	07:56 18:26	07:37 16:51	08:03 16:52
27	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	07:39 16:50	08:03 16:53
28	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50	08:04 16:54
29	06:09 20:59	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	08:04 16:54
30	06:10 20:57	06:46 20:11	07:23 19:13	08:01 18:20	07:42 16:49	08:04 16:55
31	06:12 20:56	06:48 20:09	07:24 19:11	08:03 18:18	07:43 16:48	08:04 16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case					304	317
Sun reduction		0.72	0.67		0.48	0.52
Oper. time red.		0.90	0.90		0.90	0.90
Wind dir. red.		0.57	0.57		0.59	0.66
Total reduction		0.37	0.35		0.25	0.31
Total, real		4	7		77	98

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-184 - R-184
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NE	E	SE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum				
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June									
1	08:04	08:29 (T-82)	07:47	08:22 (T-82)	07:06	07:27 (T-31)	07:09	07:30 (T-32)	06:18	06:47 (T-93)	05:45				
16:57	15	08:44 (T-82)	17:35	32	08:54 (T-82)	18:13	4	07:31 (T-31)	19:53	6	07:36 (T-32)	20:30	47	20:06 (T-28)	21:04
2	08:05	08:29 (T-82)	07:46	08:23 (T-82)	07:04	07:25 (T-31)	07:08	07:28 (T-32)	06:17	06:48 (T-93)	05:45				
16:58	16	08:45 (T-82)	17:37	30	08:53 (T-82)	18:14	6	07:31 (T-31)	19:54	6	07:34 (T-32)	20:31	45	20:08 (T-28)	21:05
3	08:05	08:29 (T-82)	07:45	08:25 (T-82)	07:03	07:23 (T-31)	07:06	07:26 (T-32)	06:15	06:49 (T-93)	05:44				
16:59	16	08:45 (T-82)	17:38	27	08:52 (T-82)	18:15	8	07:31 (T-31)	19:55	8	07:31 (T-31)	20:32	45	20:09 (T-28)	21:06
4	08:04	08:29 (T-82)	07:44	08:26 (T-82)	07:01	07:21 (T-31)	07:04	07:24 (T-32)	06:14	06:50 (T-93)	05:44				
17:00	17	08:46 (T-82)	17:39	24	08:50 (T-82)	18:17	9	07:30 (T-31)	19:56	9	07:30 (T-31)	20:34	44	20:10 (T-28)	21:07
5	08:04	08:29 (T-82)	07:42	08:28 (T-82)	06:59	07:20 (T-31)	07:02	07:23 (T-32)	06:13	06:52 (T-93)	05:43				
17:01	18	08:47 (T-82)	17:41	21	08:49 (T-82)	18:18	11	07:31 (T-31)	19:58	11	07:31 (T-31)	20:35	41	20:11 (T-28)	21:07
6	08:04	08:28 (T-82)	07:41	08:31 (T-82)	06:57	07:18 (T-31)	07:00	07:21 (T-32)	06:11	06:53 (T-93)	05:43				
17:02	19	08:47 (T-82)	17:42	16	08:47 (T-82)	18:19	12	07:30 (T-31)	19:59	12	07:30 (T-31)	20:36	41	20:13 (T-28)	21:08
7	08:04	08:28 (T-82)	07:40	08:34 (T-82)	06:55	07:16 (T-31)	06:58	07:19 (T-32)	06:10	06:55 (T-93)	05:43				
17:03	20	08:48 (T-82)	17:44	8	08:42 (T-82)	18:21	12	07:28 (T-31)	20:00	12	07:28 (T-31)	20:37	37	20:13 (T-28)	21:09
8	08:04	08:28 (T-82)	07:38	07:54	06:57	08:14 (T-31)	06:57	07:17 (T-32)	06:09	06:58 (T-93)	05:42				
17:04	21	08:49 (T-82)	17:45	18:22	13	08:27 (T-31)	20:01	07:15 (T-93)	06:07	06:59 (T-93)	05:42				
9	08:04	08:28 (T-82)	07:37	07:52	06:55	08:14 (T-31)	06:55	07:17 (T-32)	06:07	06:57 (T-93)	05:42				
17:05	22	08:50 (T-82)	17:46	19:23	10	08:24 (T-31)	20:03	2	07:17 (T-93)	20:40	23	20:16 (T-28)	21:10		
10	08:03	08:27 (T-82)	07:36	07:50	06:53	07:13 (T-93)	06:06	07:13 (T-93)	06:06	06:57 (T-93)	05:42				
17:06	23	08:50 (T-82)	17:48	19:25	20:04	6	07:19 (T-93)	20:41	24	20:17 (T-28)	21:11				
11	08:03	08:27 (T-82)	07:34	07:48	06:51	07:12 (T-93)	06:05	07:12 (T-93)	06:05	06:57 (T-93)	05:42				
17:07	24	08:51 (T-82)	17:49	19:26	20:05	10	07:22 (T-93)	20:42	24	20:17 (T-28)	21:12				
12	08:03	08:26 (T-82)	07:33	07:46	06:50	07:10 (T-93)	06:03	07:10 (T-93)	06:03	06:57 (T-93)	05:41				
17:09	26	08:52 (T-82)	17:51	19:27	20:06	13	07:23 (T-93)	20:43	26	20:19 (T-28)	21:12				
13	08:02	08:26 (T-82)	07:32	07:45	06:48	07:08 (T-93)	06:02	07:08 (T-93)	06:02	06:57 (T-93)	05:41				
17:10	27	08:53 (T-82)	17:52	19:29	20:08	16	07:24 (T-93)	20:44	26	20:20 (T-28)	21:13				
14	08:02	08:25 (T-82)	07:30	07:43	06:46	07:06 (T-93)	06:01	07:06 (T-93)	06:01	06:56 (T-93)	05:41				
17:11	28	08:53 (T-82)	17:54	19:30	20:09	19	07:25 (T-93)	20:46	25	20:19 (T-28)	21:13				
15	08:01	08:25 (T-82)	07:29	07:41	06:44	07:05 (T-93)	06:00	07:05 (T-93)	06:00	06:55 (T-93)	05:41				
17:12	29	08:54 (T-82)	17:55	19:31	20:10	21	07:26 (T-93)	20:47	24	20:19 (T-28)	21:14				
16	08:01	08:24 (T-82)	07:27	07:39	06:43	07:03 (T-93)	05:59	07:03 (T-93)	05:59	06:54 (T-93)	05:41				
17:13	30	08:54 (T-82)	17:56	19:33	20:11	23	07:26 (T-93)	20:48	22	20:18 (T-28)	21:14				
17	08:00	08:23 (T-82)	07:26	07:37	06:41	07:01 (T-93)	05:58	07:01 (T-93)	05:58	06:53 (T-93)	05:41				
17:15	31	08:54 (T-82)	17:58	19:34	20:13	25	07:26 (T-93)	20:49	21	20:17 (T-28)	21:15				
18	08:00	08:23 (T-82)	07:24	07:35	06:39	07:00 (T-93)	05:57	07:00 (T-93)	05:57	06:52 (T-93)	05:41				
17:16	32	08:55 (T-82)	17:59	19:35	20:14	27	07:27 (T-93)	20:50	19	20:16 (T-28)	21:15				
19	07:59	08:22 (T-82)	07:23	07:34	06:37	06:58 (T-93)	05:56	06:58 (T-93)	05:56	06:51 (T-93)	05:41				
17:17	33	08:55 (T-82)	18:01	19:36	20:15	29	07:27 (T-93)	20:51	17	20:15 (T-28)	21:15				
20	07:58	08:21 (T-82)	07:21	07:32	06:36	06:56 (T-93)	05:55	06:56 (T-93)	05:55	06:50 (T-93)	05:41				
17:19	35	08:56 (T-82)	18:01	19:38	20:16	31	07:27 (T-93)	20:52	14	20:14 (T-28)	21:16				
21	07:57	08:20 (T-82)	07:19	07:30	06:34	06:55 (T-93)	05:54	06:55 (T-93)	05:54	06:49 (T-93)	05:42				
17:20	36	08:56 (T-82)	18:02	19:39	20:18	32	07:27 (T-93)	20:53	11	20:12 (T-28)	21:16				
22	07:57	08:19 (T-82)	07:18	07:28	06:32	06:53 (T-93)	05:53	06:53 (T-93)	05:53	06:48 (T-93)	05:42				
17:21	37	08:56 (T-82)	18:03	19:40	20:19	37	19:56 (T-27)	20:54	5	20:09 (T-28)	21:16				
23	07:56	08:19 (T-82)	07:16	07:26	06:31	06:51 (T-93)	05:52	06:51 (T-93)	05:52	06:46 (T-93)	05:42				
17:23	38	08:57 (T-82)	18:05	19:41	20:20	40	19:57 (T-27)	20:56	2	20:11 (T-28)	21:16				
24	07:55	08:18 (T-82)	07:14	07:24	06:29	06:50 (T-93)	05:51	06:50 (T-93)	05:51	06:45 (T-93)	05:42				
17:24	39	08:57 (T-82)	18:06	19:43	20:21	43	19:59 (T-27)	20:57	1	20:10 (T-28)	21:17				
25	07:54	08:17 (T-82)	07:13	07:22	06:28	06:48 (T-93)	05:50	06:48 (T-93)	05:50	06:43 (T-93)	05:43				
17:25	40	08:57 (T-82)	18:07	19:44	20:23	45	19:59 (T-27)	20:58	1	20:10 (T-28)	21:17				
26	07:53	08:18 (T-82)	07:11	07:21	06:26	06:47 (T-93)	05:49	06:47 (T-93)	05:49	06:42 (T-93)	05:43				
17:27	39	08:57 (T-82)	18:09	19:45	20:24	49	20:01 (T-27)	20:59	1	20:10 (T-28)	21:17				
27	07:52	08:18 (T-82)	07:09	07:19	06:24	06:45 (T-93)	05:49	06:45 (T-93)	05:49	06:40 (T-93)	05:43				
17:28	39	08:57 (T-82)	18:10	19:46	20:25	50	20:02 (T-27)	21:00	1	20:10 (T-28)	21:17				
28	07:51	08:19 (T-82)	07:08	07:17	06:23	06:46 (T-93)	05:48	06:46 (T-93)	05:48	06:40 (T-93)	05:44				
17:29	37	08:56 (T-82)	18:11	1	07:29 (T-31)	19:48	1	07:38 (T-32)	20:26	49	20:03 (T-28)	21:01	21:17		
29	07:50	08:19 (T-82)	07:15	07:25	06:21	06:46 (T-93)	05:47	06:46 (T-93)	05:47	06:39 (T-93)	05:44				
17:31	36	08:55 (T-82)	18:11	19:49	3	07:38 (T-32)	20:28	49	20:04 (T-28)	21:01	21:17				
30	07:49	08:20 (T-82)	07:13	07:23	06:20	07:33 (T-32)	06:20	06:47 (T-93)	05:47	06:39 (T-93)	05:45				
17:32	35	08:55 (T-82)	18:11	19:50	4	07:37 (T-32)	20:29	49	20:06 (T-28)	21:02	21:17				
31	07:48	08:21 (T-82)	07:11	07:21	06:19	07:31 (T-32)	06:19	07:31 (T-32)	06:19	06:39 (T-93)	05:45				
17:34	34	08:55 (T-82)	18:11	19:51	5	07:36 (T-32)	20:30	49	20:06 (T-28)	21:03	21:17				
Potential sun hours	287	292	369	403	459	465									
Total, worst case	892	159	98	677	613										
Sun reduction	0.58	0.58	0.59	0.63	0.66										
Oper. time red.	0.90	0.90	0.90	0.90	0.90										
Wind dir. red.	0.65	0.65	0.59	0.58	0.61										
Total reduction	0.34	0.34	0.32	0.33	0.36										
Total, real	304	54	31	224	222										

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-184 - R-184
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	20:04 (T-28) 20:29 (T-28)	06:49 20:07	07:11 (T-93) 07:21 (T-93)	07:24 19:11
2	05:46 21:16	06:14 20:54	20:03 (T-28) 20:27 (T-28)	06:50 20:05	07:12 (T-93) 07:18 (T-93)	07:25 19:09
3	05:46 21:16	06:15 20:53	20:03 (T-28) 20:26 (T-28)	06:51 20:03	07:13 (T-93) 07:15 (T-93)	07:27 19:07
4	05:47 21:16	06:16 20:51	07:11 (T-93) 20:25 (T-28)	06:52 20:02	07:28 19:05	07:08 17:13
5	05:48 21:16	06:17 20:50	07:06 (T-93) 20:24 (T-28)	06:53 20:00	07:29 19:04	07:10 17:12
6	05:48 21:16	06:18 20:49	07:04 (T-93) 20:23 (T-28)	06:55 19:58	07:30 19:02	07:11 17:10
7	05:49 21:15	06:19 20:47	07:02 (T-93) 20:22 (T-28)	06:56 19:56	07:32 19:00	07:12 17:09
8	05:50 21:15	06:21 20:46	07:01 (T-93) 20:20 (T-28)	06:57 19:54	07:33 18:56	07:14 17:08
9	05:50 21:14	06:22 20:44	06:59 (T-93) 20:19 (T-28)	06:58 19:52	07:34 18:54	07:15 17:07
10	05:51 21:14	06:23 20:43	06:58 (T-93) 20:17 (T-28)	06:59 19:50	07:35 18:53	07:16 17:05
11	05:52 21:13	06:24 20:42	06:57 (T-93) 20:16 (T-28)	07:00 19:49	07:37 18:51	07:18 17:04
12	05:53 21:13	06:25 20:40	06:55 (T-93) 20:14 (T-28)	07:02 19:47	07:38 18:49	07:19 17:03
13	05:54 21:12	06:26 20:39	06:54 (T-93) 20:13 (T-28)	07:03 19:45	07:39 18:47	07:20 17:02
14	05:54 21:12	06:28 20:37	06:53 (T-93) 20:11 (T-28)	07:04 19:43	07:40 18:46	07:22 17:01
15	05:55 21:11	06:29 20:36	06:54 (T-93) 20:11 (T-28)	07:05 19:41	07:42 18:44	07:23 17:00
16	05:56 21:10	06:30 20:34	06:53 (T-93) 20:09 (T-27)	07:06 19:39	07:43 18:42	07:24 16:59
17	05:57 21:10	06:31 20:32	06:54 (T-93) 20:07 (T-27)	07:08 19:37	07:44 18:40	07:26 16:58
18	05:58 21:09	06:32 20:31	06:55 (T-93) 20:06 (T-27)	07:09 19:35	07:46 18:39	07:27 16:57
19	05:59 21:08	06:33 20:29	06:56 (T-93) 20:04 (T-27)	07:10 19:34	07:47 18:37	07:28 16:56
20	06:00 21:07	06:35 20:28	06:57 (T-93) 20:02 (T-27)	07:11 19:32	07:48 18:35	07:30 16:55
21	06:01 21:07	06:36 20:26	06:58 (T-93) 20:01 (T-27)	07:12 19:30	07:49 18:34	07:31 16:54
22	06:02 21:06	20:13 (T-28) 20:21 (T-28)	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:54
23	06:03 21:05	20:11 (T-28) 20:24 (T-28)	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53
24	06:04 21:04	20:10 (T-28) 20:25 (T-28)	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52
25	06:05 21:03	20:08 (T-28) 20:26 (T-28)	06:41 20:19	07:17 19:22	07:55 18:27	07:36 16:52
26	06:06 21:02	20:07 (T-28) 20:27 (T-28)	06:42 20:18	07:18 19:20	07:56 18:26	07:37 16:51
27	06:07 21:01	20:27 (T-28) 20:28 (T-28)	06:43 20:16	07:19 19:18	07:57 18:24	07:39 16:50
28	06:08 21:00	20:06 (T-28) 20:29 (T-28)	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50
29	06:09 20:58	20:05 (T-28) 20:29 (T-28)	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49
30	06:10 20:57	20:05 (T-28) 20:30 (T-28)	06:46 20:11	07:23 19:13	08:01 18:20	07:42 16:49
31	06:12 20:56	20:04 (T-28) 20:30 (T-28)	06:48 20:09	07:23 (T-93)	08:03 18:18	08:04 16:56
Potential sun hours	471	436		377	341	275
Total, worst case	193	1083		44	91	452
Sun reduction	0.75	0.72		0.67	0.56	0.48
Oper. time red.	0.90	0.90		0.90	0.90	0.90
Wind dir. red.	0.62	0.59		0.58	0.60	0.65
Total reduction	0.42	0.38		0.35	0.30	0.31
Total, real	82	414		16	27	138

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-185 - R-185
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January		February		March		April		May		June					
1	08:05	08:36 (T-82)	07:47	17:05 (T-25)	07:06	07:27 (T-93)	07:09	18:32 (T-28)	06:18		05:45	06:09 (T-29)				
	16:57	14	08:50 (T-82)	17:35	4	17:09 (T-25)	18:13	18:29 (T-27)	20:30		21:04	4	06:13 (T-29)			
2	08:05	08:37 (T-82)	07:46	17:05 (T-25)	07:04	07:25 (T-93)	07:08	18:33 (T-28)	06:17		05:45	06:08 (T-29)				
	16:58	13	08:50 (T-82)	17:37	6	17:11 (T-25)	18:14	19:28 (T-27)	20:31		21:05	5	06:13 (T-29)			
3	08:05	08:38 (T-82)	07:45	17:06 (T-25)	07:03	07:23 (T-93)	07:06	18:35 (T-28)	06:15		05:44	06:08 (T-29)				
	16:59	12	08:50 (T-82)	17:38	7	17:13 (T-25)	18:16	19:26 (T-27)	20:33		21:06	5	06:13 (T-29)			
4	08:05	08:39 (T-82)	07:44	17:06 (T-25)	07:01	07:21 (T-93)	07:04	18:38 (T-28)	06:14		05:44	06:07 (T-29)				
	17:00	10	08:49 (T-82)	17:39	7	17:13 (T-25)	18:17	19:24 (T-27)	20:34		21:07	6	06:13 (T-29)			
5	08:04	08:41 (T-82)	07:42	17:07 (T-25)	06:59	07:22 (T-93)	07:02	18:44 (T-28)	06:13		05:43	06:07 (T-29)				
	17:01	8	08:49 (T-82)	17:41	8	17:15 (T-25)	18:18	19:20 (T-27)	20:35		21:08	6	06:13 (T-29)			
6	08:04	08:43 (T-82)	07:41	17:08 (T-25)	06:57	07:23 (T-93)	07:00		06:11		05:43	06:07 (T-29)				
	17:02	3	08:46 (T-82)	17:42	9	17:17 (T-25)	18:20	17:40 (T-93)	19:59		20:36	21:08	6	06:13 (T-29)		
7	08:04		07:40	17:10 (T-25)	06:56	07:25 (T-93)	06:58		06:10		05:43	06:06 (T-29)				
	17:03		17:44	7	17:17 (T-25)	18:21	24	17:59 (T-28)	20:00		20:37	21:09	6	06:12 (T-29)		
8	08:04		07:39		07:54	08:28 (T-93)	06:57		06:09		05:42	06:06 (T-29)				
	17:04		17:45		18:22	21	19:00 (T-28)	20:01	20:39		21:10	6	06:12 (T-29)			
9	08:04		07:37		07:52	18:40 (T-28)	06:55		06:07		05:42	06:06 (T-29)				
	17:05		17:46		19:23	22	19:02 (T-28)	20:03	20:40		21:10	7	06:13 (T-29)			
10	08:03		07:36	07:57 (T-31)	07:50	18:39 (T-28)	06:53		06:06		05:42	06:06 (T-29)				
	17:06		17:48	1	07:58 (T-31)	19:25	25	19:04 (T-28)	20:04		21:11	7	06:13 (T-29)			
11	08:03		07:34	07:56 (T-31)	07:48	18:37 (T-28)	06:51		06:05		05:42	06:06 (T-29)				
	17:07		17:49	3	07:59 (T-31)	19:26	28	19:05 (T-28)	20:05		21:12	7	06:13 (T-29)			
12	08:03		07:33	07:54 (T-31)	07:46	18:35 (T-28)	06:50		06:03		05:41	06:05 (T-29)				
	17:09		17:51	4	07:58 (T-31)	19:27	31	19:06 (T-28)	20:06		21:12	7	06:12 (T-29)			
13	08:02		07:32	07:53 (T-31)	07:45	18:33 (T-28)	06:48		06:02		05:41	06:05 (T-29)				
	17:10		17:52	5	07:58 (T-31)	19:29	34	19:07 (T-28)	20:08		21:13	6	06:11 (T-29)			
14	08:02		07:30	07:51 (T-31)	07:43	18:32 (T-28)	06:46		06:01		05:41	06:05 (T-29)				
	17:11		17:54	6	07:57 (T-31)	19:30	36	19:08 (T-28)	20:09		21:13	6	06:11 (T-29)			
15	08:01		07:29	07:50 (T-31)	07:41	18:31 (T-28)	06:44		06:00		05:41	06:05 (T-29)				
	17:12		17:55	6	07:56 (T-31)	19:31	39	19:10 (T-28)	20:10		21:14	6	06:11 (T-29)			
16	08:01		07:27	07:48 (T-31)	07:39	18:30 (T-28)	06:43		05:59		05:41	06:05 (T-29)				
	17:13		17:56	6	07:54 (T-31)	19:33	41	19:11 (T-28)	20:11		21:14	6	06:11 (T-29)			
17	08:00		07:26		07:37	18:30 (T-28)	06:41		05:58		05:41	06:05 (T-29)				
	17:15		17:58		19:34	43	19:13 (T-28)	20:13	20:49		21:15	6	06:11 (T-29)			
18	08:00		07:24		07:35	18:29 (T-28)	06:39		05:57		05:41	06:05 (T-29)				
	17:16		17:59		19:35	45	19:14 (T-28)	20:14	20:50		21:15	6	06:11 (T-29)			
19	07:59		07:23		07:34	18:28 (T-28)	06:37		05:56		05:41	06:06 (T-29)				
	17:17		18:01		19:36	46	19:14 (T-28)	20:15	20:51		21:15	6	06:12 (T-29)			
20	07:58		07:21		07:32	18:28 (T-28)	06:36		05:55		05:41	06:07 (T-29)				
	17:19		18:01		19:38	46	19:14 (T-28)	20:16	20:52		21:16	5	06:12 (T-29)			
21	07:58		07:19	07:40 (T-93)	07:30	18:27 (T-28)	06:34		05:54		05:42	06:07 (T-29)				
	17:20		18:02	1	07:41 (T-93)	19:39	46	18:23 (T-28)	20:18		21:16	5	06:12 (T-29)			
22	07:57		07:18	07:39 (T-93)	07:28	18:27 (T-28)	06:32		05:53		05:42	06:07 (T-29)				
	17:21		18:03	4	07:43 (T-93)	19:40	51	19:19 (T-27)	20:19		21:16	5	06:12 (T-29)			
23	07:56		07:16	07:37 (T-93)	07:26	18:27 (T-28)	06:31		05:52		05:42	06:06 (T-29)				
	17:23		18:05	7	07:44 (T-93)	19:41	53	19:20 (T-27)	20:20		21:16	6	06:12 (T-29)			
24	07:55		07:14	07:35 (T-93)	07:24	18:26 (T-28)	06:29		05:51		05:42	06:07 (T-29)				
	17:24		18:06	9	07:44 (T-93)	19:43	55	19:21 (T-27)	20:21		21:17	6	06:13 (T-29)			
25	07:54		07:13	07:34 (T-93)	07:22	18:27 (T-28)	06:28		05:50		05:43	06:07 (T-29)				
	17:25		18:07	12	07:46 (T-93)	19:44	56	19:23 (T-27)	20:23		21:17	6	06:13 (T-29)			
26	07:53		07:11	07:32 (T-93)	07:21	18:27 (T-28)	06:26		05:49		05:43	06:07 (T-29)				
	17:27		18:09	14	07:46 (T-93)	19:45	57	19:24 (T-27)	20:24		21:17	6	06:13 (T-29)			
27	07:52		07:09	07:30 (T-93)	07:19	18:28 (T-28)	06:24		05:49		05:43	06:08 (T-29)				
	17:28		18:10	15	07:45 (T-93)	19:46	57	19:25 (T-27)	20:25	1	06:13 (T-29)	21:17	6	06:14 (T-29)		
28	07:51		07:08	07:28 (T-93)	07:17	18:28 (T-28)	06:23		05:48		06:11 (T-29)	05:44	06:08 (T-29)			
	17:29		18:11	17	07:45 (T-93)	19:48	58	19:26 (T-27)	20:26	2	06:13 (T-29)	21:17	6	06:14 (T-29)		
29	07:50				07:15	18:28 (T-28)	06:21		05:47		06:10 (T-29)	05:44	06:09 (T-29)			
	17:31				19:49	59	19:27 (T-27)	20:28	21:02	2	06:12 (T-29)	21:17	6	06:15 (T-29)		
30	07:49		17:05 (T-25)		07:13	18:29 (T-28)	06:20		05:47		06:10 (T-29)	05:45	06:09 (T-29)			
	17:32	1	17:06 (T-25)		19:50	59	19:28 (T-27)	20:29	21:02	3	06:13 (T-29)	21:17	7	06:16 (T-29)		
31	07:48		17:05 (T-25)		07:11	18:30 (T-28)			05:46		06:09 (T-29)					
	17:34	2	17:07 (T-25)		19:51	57	19:29 (T-27)		21:03	4	06:13 (T-29)					
Potential sun hours		287		292		369		403		459		465				
Total, worst case		63		158		1207		184		12		178				
Sun reduction		0.58		0.58		0.59		0.63		0.66		0.73				
Oper. time red.		0.90		0.90		0.90		0.90		0.90		0.90				
Wind dir. red.		0.66		0.61		0.58		0.58		0.59		0.59				
Total reduction		0.35		0.32		0.31		0.33		0.35		0.39				
Total, real		22		50		373		61		4		69				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-185 - R-185
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time													N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	629	7,884												

	July	August	September	October	November	December											
1	05:45	06:10 (T-29)	06:13	06:49	07:24	18:13 (T-28)	07:04	07:27 (T-31)	07:43								
	21:17	7 06:17 (T-29)	20:55	20:07	19:11	32 18:45 (T-28)	17:17	1 07:28 (T-31)	16:49								
2	05:46	06:10 (T-29)	06:14	06:50	07:26	18:15 (T-28)	07:06		07:45								
	21:17	7 06:17 (T-29)	20:54	20:05	19:09	29 18:44 (T-28)	17:16		16:48								
3	05:48	06:11 (T-29)	06:15	06:51	07:27	18:16 (T-28)	07:07		07:46								
	21:16	7 06:18 (T-29)	20:53	20:03	19:07	26 18:42 (T-28)	17:14		16:48								
4	05:47	06:11 (T-29)	06:16	06:52	07:28	18:17 (T-28)	07:08		16:39 (T-25)	07:47							
	21:16	6 06:17 (T-29)	20:51	20:02	19:05	23 18:40 (T-28)	17:13	8	16:47 (T-25)	16:48							
5	05:48	06:12 (T-29)	06:17	06:53	07:29	18:19 (T-28)	07:10		16:38 (T-25)	07:48							
	21:16	6 06:18 (T-29)	20:50	20:00	19:04	19 18:38 (T-28)	17:12	9	16:47 (T-25)	16:47							
6	05:48	06:13 (T-29)	06:18	06:55	07:30	08:03 (T-93)	07:11		16:36 (T-25)	07:49			08:29 (T-82)				
	21:16	6 06:19 (T-29)	20:49	19:58	19:02	24 18:37 (T-28)	17:10	9	16:45 (T-25)	16:47	3		08:32 (T-82)				
7	05:49	06:13 (T-29)	06:19	06:56		18:40 (T-28)	07:32		08:00 (T-93)	07:12			16:36 (T-25)	07:50			08:27 (T-82)
	21:15	6 06:19 (T-29)	20:47	19:56	9	19:15 (T-27)	19:00	15	08:15 (T-93)	17:09	8		16:44 (T-25)	16:47	8		08:35 (T-82)
8	05:50	06:14 (T-29)	06:21	06:57		18:33 (T-28)	07:33		07:57 (T-93)	07:14			16:36 (T-25)	07:51			08:27 (T-82)
	21:15	6 06:20 (T-29)	20:46	19:54	31	19:19 (T-27)	18:56	19	08:16 (T-93)	17:08	6		16:42 (T-25)	16:47	9		08:36 (T-82)
9	05:50	06:15 (T-29)	06:22	06:58		18:30 (T-28)	07:34		07:56 (T-93)	07:15			16:36 (T-25)	07:52			08:26 (T-82)
	21:14	5 06:20 (T-29)	20:44	19:52	39	19:20 (T-27)	18:54	21	08:17 (T-93)	17:07	6		16:42 (T-25)	16:47	12		08:38 (T-82)
10	05:51	06:15 (T-29)	06:23	06:59		18:27 (T-28)	07:35		07:57 (T-93)	07:16			16:36 (T-25)	07:53			08:26 (T-82)
	21:14	5 06:20 (T-29)	20:43	19:51	47	19:21 (T-27)	18:53	21	08:18 (T-93)	17:05	4		16:40 (T-25)	16:47	13		08:39 (T-82)
11	05:52	06:16 (T-29)	06:24	07:01		18:24 (T-28)	07:37		07:58 (T-93)	07:18			16:37 (T-25)	07:54			08:26 (T-82)
	21:13	5 06:21 (T-29)	20:42	19:49	53	19:21 (T-27)	18:51	20	08:18 (T-93)	17:04	2		16:39 (T-25)	16:47	14		08:40 (T-82)
12	05:53	06:17 (T-29)	06:25	07:02		18:22 (T-28)	07:38		07:59 (T-93)	07:19			16:37 (T-25)	07:55			08:26 (T-82)
	21:13	4 06:21 (T-29)	20:40	19:47	57	19:21 (T-27)	18:49	19	08:18 (T-93)	17:03	1		16:38 (T-25)	16:47	15		08:41 (T-82)
13	05:54	06:18 (T-29)	06:26	07:03		18:21 (T-28)	07:39		08:01 (T-93)	07:20			07:55				08:26 (T-82)
	21:12	3 06:21 (T-29)	20:39	19:45	59	19:20 (T-27)	18:47	18	08:19 (T-93)	17:02			16:47	16			08:42 (T-82)
14	05:54	06:19 (T-29)	06:28	07:04		18:19 (T-28)	07:40		08:02 (T-93)	07:22			07:56				08:27 (T-82)
	21:12	3 06:22 (T-29)	20:37	19:43	59	19:18 (T-27)	18:46	16	08:18 (T-93)	17:01			16:47	16			08:43 (T-82)
15	05:55	06:20 (T-29)	06:29	07:05		18:17 (T-28)	07:42		08:03 (T-93)	07:23			07:57				08:27 (T-82)
	21:11	2 06:22 (T-29)	20:36	19:41	59	19:16 (T-27)	18:44	15	08:18 (T-93)	17:00			16:47	17			08:44 (T-82)
16	05:56	06:20 (T-29)	06:30	07:06		18:17 (T-28)	07:43		08:05 (T-93)	07:25			07:58				08:27 (T-82)
	21:10	1 06:21 (T-29)	20:34	19:39	58	19:15 (T-27)	18:42	13	08:18 (T-93)	16:59			16:47	17			08:44 (T-82)
17	05:57		06:31	07:08		18:16 (T-28)	07:44		08:06 (T-93)	07:26			07:58				08:27 (T-82)
	21:10		20:32	19:37	57	19:13 (T-27)	18:40	11	08:17 (T-93)	16:58			16:48	18			08:45 (T-82)
18	05:58		06:32	07:09		18:15 (T-28)	07:46		08:07 (T-93)	07:27			07:59				08:28 (T-82)
	21:09		20:31	19:35	56	19:11 (T-27)	18:39	9	08:16 (T-93)	16:57			16:48	18			08:46 (T-82)
19	05:59		06:33	07:10		18:14 (T-28)	07:47		08:09 (T-93)	07:29			08:00				08:28 (T-82)
	21:08		20:29	19:34	55	19:09 (T-27)	18:37	6	08:15 (T-93)	16:56			16:48	17			08:45 (T-82)
20	06:00		06:35	07:11		18:13 (T-28)	07:48		08:10 (T-93)	07:30			08:00				08:28 (T-82)
	21:07		20:28	19:32	54	19:07 (T-27)	18:35	3	08:13 (T-93)	16:55			16:49	18			08:46 (T-82)
21	06:01		06:36	07:12		18:12 (T-28)	07:49			07:31			08:01				08:28 (T-82)
	21:07		20:26	19:30	51	19:04 (T-27)	18:34			16:54			16:49	18			08:46 (T-82)
22	06:02		06:37	07:13		18:13 (T-28)	07:51			07:32			08:01				08:29 (T-82)
	21:06		20:24	19:28	47	19:03 (T-27)	18:32			16:54			16:50	18			08:47 (T-82)
23	06:03		06:38	07:15		18:12 (T-28)	07:52			07:34			08:02				08:29 (T-82)
	21:05		20:23	19:26	46	18:58 (T-28)	18:31			16:53			16:50	18			08:47 (T-82)
24	06:04		06:39	07:16		18:12 (T-28)	07:53			07:35			08:02				08:30 (T-82)
	21:04		20:21	19:24	46	18:58 (T-28)	18:29			16:52			16:51	18			08:48 (T-82)
25	06:05		06:41	07:17		18:11 (T-28)	07:55			07:36			08:03				08:31 (T-82)
	21:03		20:19	19:22	46	18:57 (T-28)	18:27			16:52			16:51	18			08:49 (T-82)
26	06:06		06:42	07:18		18:11 (T-28)	07:56		08:18 (T-31)	07:37			08:03				08:31 (T-82)
	21:02		20:18	19:20	44	18:55 (T-28)	18:26	6	08:24 (T-31)	16:51			16:52	18			08:49 (T-82)
27	06:07		06:43	07:19		18:12 (T-28)	07:57		08:20 (T-31)	07:39			08:03				08:32 (T-82)
	21:01		20:16	19:18	42	18:54 (T-28)	18:24	6	08:26 (T-31)	16:50			16:53	18			08:50 (T-82)
28	06:08		06:44	07:21		18:12 (T-28)	07:59		08:21 (T-31)	07:40			08:04				08:33 (T-82)
	21:00		20:14	19:17	40	18:52 (T-28)	18:23	6	08:27 (T-31)	16:50			16:54	17			08:50 (T-82)
29	06:09		06:45	07:22		18:12 (T-28)	08:00		08:23 (T-31)	07:41			08:04				08:33 (T-82)
	20:59		20:12	19:15	38	18:50 (T-28)	18:21	5	08:28 (T-31)	16:49			16:54	17			08:50 (T-82)
30	06:10		06:46	07:23		18:13 (T-28)	08:01		08:24 (T-31)	07:42			08:04				08:34 (T-82)
	20:57		20:11	19:13	35	18:48 (T-28)	18:20	4	08:28 (T-31)	16:49			16:55	16			08:50 (T-82)
31	06:12		06:48				08:03		08:26 (T-31)				08:04				08:35 (T-82)
	20:56		20:09				18:18	2	08:28 (T-31)				16:56	15			08:50 (T-82)
Potential sun hours	471	436	377	341	289								275				
Total, worst case				1128		388		54					402				
Sun reduction	0.79			0.67		0.56		0.48					0.52				
Oper. time red.	0.90			0.90		0.90		0.90					0.90				
Wind dir. red.	0.59			0.58		0.60		0.59					0.67				
Total reduction	0.40			0.35		0.30		0.26					0.31				
Total, real	32			395		117		14					126				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-186 - R-186
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:05	15:56 (T-28) 07:47	17:03 (T-27) 07:06	07:09	06:18	05:45
	16:57	15 16:11 (T-28) 17:35	6 17:09 (T-27) 18:13	19:53	20:30	21:04
2	08:05	15:57 (T-28) 07:46	17:03 (T-27) 07:04	07:08	06:17	05:45
	16:58	14 16:11 (T-28) 17:36	8 17:11 (T-27) 18:14	19:54	20:31	21:05
3	08:05	15:59 (T-28) 07:45	17:03 (T-27) 07:03	07:06	06:15	05:44
	16:59	11 16:10 (T-28) 17:38	10 17:13 (T-27) 18:15	19:55	20:33	21:06
4	08:05	16:00 (T-28) 07:44	17:02 (T-27) 07:01	07:04	06:14	05:44
	17:00	10 16:10 (T-28) 17:39	11 17:13 (T-27) 18:17	19:56	20:34	21:07
5	08:04	16:03 (T-28) 07:42	17:03 (T-27) 06:59	07:02	06:13	05:43
	17:01	6 16:09 (T-28) 17:41	12 17:15 (T-27) 18:18	19:58	20:35	21:08
6	08:04	07:41	17:03 (T-27) 06:57	07:00	06:11	05:43
	17:02	17:42	14 17:17 (T-27) 18:19	19:59	20:36	21:08
7	08:04	07:40	17:03 (T-27) 06:56	06:58	06:10	05:43
	17:03	17:44	15 17:18 (T-27) 18:21	20:00	20:37	21:09
8	08:04	07:39	17:04 (T-27) 07:54	06:57	07:17 (T-29) 06:09	05:42
	17:04	17:45	16 17:20 (T-27) 18:22	20:01	3 07:20 (T-29) 20:39	21:10
9	08:04	07:37	17:06 (T-27) 07:52	06:55	07:15 (T-29) 06:07	05:42
	17:05	17:46	14 17:20 (T-27) 19:23	20:03	5 07:20 (T-29) 20:40	21:10
10	08:03	07:36	17:07 (T-27) 07:50	06:53	07:13 (T-29) 06:06	05:42
	17:06	17:48	12 17:19 (T-27) 19:25	20:04	7 07:20 (T-29) 20:41	21:11
11	08:03	07:34	17:09 (T-27) 07:48	06:51	07:12 (T-29) 06:05	05:42
	17:07	17:49	8 17:17 (T-27) 19:26	20:05	8 07:20 (T-29) 20:42	21:12
12	08:03	07:33	07:46	06:50	07:10 (T-29) 06:03	05:41
	17:09	17:51	19:27	20:06	10 07:20 (T-29) 20:43	21:12
13	08:02	07:32	07:45	06:48	07:08 (T-29) 06:02	05:41
	17:10	17:52	19:29	20:08	11 07:19 (T-29) 20:44	21:13
14	08:02	07:30	07:43	06:46	07:06 (T-29) 06:01	05:41
	17:11	17:54	19:30	20:09	12 07:18 (T-29) 20:46	21:13
15	08:01	07:29	07:41	06:44	07:05 (T-29) 06:00	05:41
	17:12	17:55	19:31	20:10	12 07:17 (T-29) 20:47	21:14
16	08:01	07:27	07:39	06:43	07:03 (T-29) 05:59	05:41
	17:13	17:56	19:33	20:11	12 07:15 (T-29) 20:48	21:14
17	08:00	07:26	07:37	06:41	07:04 (T-29) 05:58	05:41
	17:15	17:58	19:34	20:13	9 07:13 (T-29) 20:49	21:15
18	08:00	07:24	07:35	06:39	05:57	05:41
	17:16	17:59	19:35	20:14	20:50	21:15
19	07:59	07:23	07:34	06:37	05:56	05:41
	17:17	18:00	19:36	20:15	20:51	21:15
20	07:58	07:21	07:32	06:36	05:55	05:41
	17:19	18:00	19:38	20:16	20:52	21:16
21	07:58	07:19	07:30	06:34	06:55 (T-13) 05:54	05:42
	17:20	18:02	19:39	20:18	1 06:56 (T-13) 20:53	21:16
22	07:57	07:18	07:28	06:32	06:53 (T-13) 05:53	05:42
	17:21	18:03	19:40	20:19	3 06:56 (T-13) 20:55	21:16
23	07:56	07:16	07:26	06:31	06:51 (T-13) 05:52	05:42
	17:23	18:05	19:41	20:20	4 06:55 (T-13) 20:56	21:16
24	07:55	07:14	07:24	06:29	06:50 (T-13) 05:51	05:42
	17:24	18:06	19:43	20:21	5 06:55 (T-13) 20:57	21:17
25	07:54	07:13	07:22	06:28	06:48 (T-13) 05:50	05:43
	17:25	18:07	19:44	20:23	6 06:54 (T-13) 20:58	21:17
26	07:53	07:11	07:21	06:26	06:47 (T-13) 05:49	05:43
	17:27	18:09	19:45	20:24	7 06:54 (T-13) 20:59	21:17
27	07:52	07:09	07:19	06:24	06:45 (T-13) 05:49	05:43
	17:28	18:10	19:46	20:25	8 06:53 (T-13) 21:00	21:17
28	07:51	07:08	07:17	06:23	06:44 (T-13) 05:48	05:44
	17:29	18:11	19:48	20:26	7 06:51 (T-13) 21:01	21:17
29	07:50		07:15	06:21	06:45 (T-13) 05:47	05:44
	17:31		19:49	20:28	2 06:47 (T-13) 21:02	21:17
30	07:49	17:04 (T-27)	07:13	06:20	05:46	05:45
	17:32	2 17:06 (T-27)	19:50	20:29	21:02	21:17
31	07:48	17:03 (T-27)	07:11		05:46	
	17:34	4 17:07 (T-27)	19:51		21:03	
Potential sun hours	287	292	369	403	459	465
Total, worst case	62	126		132		
Sun reduction	0.58	0.58		0.63		
Oper. time red.	0.90	0.90		0.90		
Wind dir. red.	0.61	0.59		0.57		
Total reduction	0.32	0.31		0.33		
Total, real	20	39		43		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-187 - R-187
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:05	07:47	07:06	07:10	06:18	20:00 (T-06)	05:45	05:45	06:13	06:49	07:24	07:04	07:44	
	16:57	17:35	18:13	19:53	20:30	6 20:06 (T-06)	21:04	21:17	20:55	20:07	19:11	17:17	16:49	
2	08:05	07:46	07:04	07:08	06:17	20:00 (T-06)	05:45	05:46	06:14	06:50	07:26	07:06	07:45	
	16:58	17:37	18:14	19:54	20:31	8 20:08 (T-06)	21:05	21:17	20:54	20:05	19:09	17:16	16:48	
3	08:05	07:45	07:03	07:06	06:15	20:01 (T-06)	05:44	05:46	06:15	06:51	07:27	07:07	07:46	
	16:59	17:38	18:16	19:55	20:33	8 20:09 (T-06)	21:06	21:16	20:53	20:03	19:07	17:14	16:48	
4	08:05	07:44	07:01	07:04	06:14	20:00 (T-06)	05:44	05:47	06:16	06:52	07:28	07:08	07:47	
	17:00	17:39	18:17	19:57	20:34	10 20:10 (T-06)	21:07	21:16	20:51	4 20:20 (T-06)	20:02	19:05	17:13	16:48
5	08:05	07:42	06:59	07:02	06:13	20:01 (T-06)	05:43	05:48	06:17	06:54	07:29	07:10	07:48	
	17:01	17:41	18:18	19:58	20:35	10 20:11 (T-06)	21:08	21:16	20:50	10 20:24 (T-06)	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	20:02 (T-06)	05:43	05:48	06:18	06:55	07:30	07:11	07:49	
	17:02	17:42	18:20	19:59	20:36	11 20:13 (T-06)	21:08	21:16	20:49	10 20:23 (T-06)	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:59	06:10	20:03 (T-06)	05:43	05:49	06:19	06:56	07:32	07:12	07:50	
	17:03	17:44	18:21	20:00	20:37	10 20:13 (T-06)	21:09	21:15	20:47	10 20:22 (T-06)	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:09	20:05 (T-06)	05:42	05:50	06:21	20:11 (T-06)	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	7 20:12 (T-06)	21:10	21:15	20:46	9 20:20 (T-06)	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	20:06	05:42	05:50	06:22	20:10 (T-06)	06:58	07:34	07:15	07:52
	17:05	17:47	18:24	20:03	20:40	21:10	21:15	20:45	9 20:19 (T-06)	19:52	18:55	17:07	16:47	
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	20:09 (T-06)	06:59	07:35	07:16	07:53	
	17:06	17:48	18:25	20:04	20:41	21:11	21:14	20:43	8 20:17 (T-06)	19:51	18:53	17:05	16:47	
11	08:03	07:35	07:48	06:51	06:05	05:42	05:52	06:24	20:09 (T-06)	07:01	07:37	07:18	07:54	
	17:07	17:49	18:26	20:05	20:42	21:12	21:14	20:42	7 20:16 (T-06)	19:49	18:51	17:04	16:47	
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	20:09 (T-06)	07:02	07:38	07:19	07:55	
	17:09	17:51	18:27	20:07	20:43	21:12	21:13	20:40	5 20:14 (T-06)	19:47	18:49	17:03	16:47	
13	08:02	07:32	07:45	06:48	06:02	05:41	05:54	06:26	20:09 (T-06)	07:03	07:39	07:21	07:56	
	17:10	17:52	18:29	20:08	20:45	21:13	21:12	20:39	4 20:13 (T-06)	19:45	18:47	17:02	16:47	
14	08:02	07:30	07:43	19:07 (T-23)	06:46	06:01	05:41	05:54	06:28	20:09 (T-06)	07:04	07:41	07:22	07:56
	17:11	17:54	18:30	1 19:08 (T-23)	20:09	20:46	21:13	21:12	20:37	2 20:11 (T-06)	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	19:07 (T-23)	06:44	06:00	05:41	05:55	06:29	20:10 (T-06)	07:05	07:42	07:23	07:57
	17:12	17:55	18:31	3 19:10 (T-23)	20:10	20:47	21:14	21:11	20:36	1 20:11 (T-06)	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	19:08 (T-23)	06:43	06:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58	
	17:13	17:56	18:33	4 19:12 (T-23)	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47	
17	08:00	07:26	07:37	19:09 (T-23)	06:41	06:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59	
	17:15	17:58	18:34	4 19:13 (T-23)	20:13	20:49	21:15	21:10	20:33	19:37	18:41	16:58	16:48	
18	08:00	07:24	07:36	19:11 (T-23)	06:39	06:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59	
	17:16	17:59	18:35	3 19:14 (T-23)	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48	
19	07:59	07:23	07:34	06:37	06:56	06:51	05:49	06:34	07:10	07:47	07:29	08:00		
	17:17	18:01	18:36	20:15	20:51	21:15	21:08	20:29	19:30	18:37	16:56	16:48		
20	07:58	07:21	07:32	06:36	06:55	06:51	06:00	06:35	07:11	07:48	07:30	08:00		
	17:19	18:01	18:38	20:16	20:52	21:16	21:07	20:28	19:32	18:36	16:55	16:49		
21	07:58	07:19	07:30	06:34	06:54	06:52	06:01	06:36	07:12	07:50	07:31	08:01		
	17:20	18:02	18:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:55	16:49		
22	07:57	07:18	07:28	06:32	06:53	06:52	06:02	06:37	07:14	07:51	07:32	08:02		
	17:21	18:03	18:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50		
23	07:56	07:16	07:26	06:31	06:52	06:52	06:03	06:38	07:15	07:52	07:34	08:02		
	17:23	18:05	18:41	20:20	20:56	21:16	21:05	20:23	19:26	18:31	16:53	16:50		
24	07:55	07:15	07:24	06:29	06:51	06:52	06:04	06:39	07:16	07:53	07:35	08:02		
	17:24	18:06	18:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51		
25	07:54	07:13	07:23	06:28	06:50	06:53	06:05	06:41	07:17	07:55	07:36	08:03		
	17:25	18:07	18:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51		
26	07:53	07:11	07:21	06:26	06:49	06:53	06:06	06:42	07:18	18:51 (T-23)	07:56	07:38	08:03	
	17:27	18:09	18:45	20:24	20:59	21:17	21:02	20:18	19:20	4 18:55 (T-23)	18:26	16:51	16:52	
27	07:52	07:10	07:19	06:24	06:49	06:53	06:07	06:43	07:19	18:50 (T-23)	07:57	07:39	08:04	
	17:28	18:10	18:47	20:25	21:00	21:17	21:01	20:16	19:19	4 18:54 (T-23)	18:24	16:50	16:53	
28	07:51	07:08	07:17	06:23	20:02 (T-06)	05:48	05:44	06:08	06:44	07:21	18:49 (T-23)	07:59	07:40	08:04
	17:30	18:12	18:48	20:26	1 20:03 (T-06)	21:01	21:17	21:00	20:14	19:17	3 18:52 (T-23)	18:23	16:50	16:54
29	07:50	07:15	07:24	06:21	20:01 (T-06)	05:47	05:44	06:09	06:45	07:22	18:48 (T-23)	08:00	07:41	08:04
	17:31	18:13	18:49	20:28	3 20:04 (T-06)	21:02	21:17	20:59	20:12	19:15	2 18:50 (T-23)	18:21	16:49	16:54
30	07:49	07:13	07:22	06:20	20:01 (T-06)	05:47	05:45	06:10	06:46	07:23	18:47 (T-23)	08:02	07:42	08:04
	17:32	18:14	18:50	20:29	5 20:06 (T-06)	21:03	21:17	20:57	20:11	19:13	1 18:48 (T-23)	18:20	16:49	16:55
31	07:48	07:11	07:20	06:19	06:46	06:51	06:12	06:48	07:15	08:03	08:03	08:03	08:04	
	17:34	18:16	18:52	21:03	21:03	21:03	20:56	20:09	19:13	18:18	18:18	16:56	16:56	
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275		
Total, worst case			15	9	70			79		14				
Sun reduction			0.59	0.63	0.66			0.72		0.67				
Oper. time red.			0.90	0.90	0.90			0.90		0.90				
Wind dir. red.			0.58	0.62	0.62			0.62		0.58				
Total reduction			0.31	0.35	0.37			0.40		0.35				
Total, real			5	3	26			32		5				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-188 - R-188
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:05 16:57	07:47 17:35	07:06 18:13	17:41 (T-23) 17:51 (T-23)	07:10 19:53	06:18 19:58 (T-06)
2	08:05 16:58	07:46 17:37	07:04 18:14	17:41 (T-23) 17:52 (T-23)	07:08 19:54	06:17 20:31
3	08:05 16:59	07:45 17:38	07:03 18:16	17:42 (T-23) 17:54 (T-23)	07:06 19:55	06:16 20:33
4	08:05 17:00	07:44 17:39	07:01 18:17	17:44 (T-23) 17:56 (T-23)	07:04 19:57	06:14 20:34
5	08:05 17:01	07:42 17:41	06:59 18:18	17:46 (T-23) 17:54 (T-23)	07:02 19:58	06:13 20:35
6	08:04 17:02	07:41 17:42	06:57 18:20	07:00 19:59	06:11 20:36	19:55 (T-06) 20:13 (T-06)
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	06:10 20:37	19:54 (T-06) 20:13 (T-06)
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	06:09 20:39	19:55 (T-06) 20:14 (T-06)
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 20:03	06:07 20:40	19:55 (T-06) 20:16 (T-06)
10	08:04 17:06	07:36 17:48	07:50 19:25	06:53 20:04	06:06 20:41	19:55 (T-06) 20:17 (T-06)
11	08:03 17:07	07:35 17:49	07:48 19:26	06:51 20:05	06:05 20:42	19:55 (T-06) 20:18 (T-06)
12	08:03 17:09	07:33 17:51	07:47 19:27	06:50 20:07	06:04 20:43	19:55 (T-06) 20:19 (T-06)
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	06:02 20:45	19:55 (T-06) 20:20 (T-06)
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	06:01 20:46	19:56 (T-06) 20:20 (T-06)
15	08:01 17:12	07:29 17:55	07:41 19:31	06:44 20:10	06:00 20:47	19:57 (T-06) 20:19 (T-06)
16	08:01 17:14	07:27 17:56	07:39 19:33	06:43 20:12	05:59 20:48	19:57 (T-06) 20:19 (T-06)
17	08:00 17:15	07:26 17:58	07:37 19:34	06:41 20:13	05:58 20:49	19:58 (T-06) 20:18 (T-06)
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 20:14	05:57 20:50	19:59 (T-06) 20:17 (T-06)
19	07:59 17:17	07:23 18:01	07:34 19:36	06:38 20:15	05:56 20:51	20:00 (T-06) 20:16 (T-06)
20	07:58 17:19	07:21 18:01	07:32 19:38	06:36 20:17	05:55 20:52	20:02 (T-06) 20:14 (T-06)
21	07:58 17:20	07:19 18:02	07:30 19:39	06:34 20:18	05:54 20:54	20:04 (T-06) 20:12 (T-06)
22	07:57 17:21	07:18 18:03	07:28 19:40	06:33 20:19	05:53 20:55	05:42 21:16
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 20:20	05:52 20:56	05:42 21:17
24	07:55 17:24	07:15 18:06	17:42 (T-23) 19:43	06:29 20:21	05:51 20:57	05:42 21:17
25	07:54 17:25	07:13 18:07	17:42 (T-23) 19:44	06:28 20:23	05:50 20:58	05:43 21:17
26	07:53 17:27	07:11 18:09	17:46 (T-23) 19:45	06:26 20:24	05:49 20:59	05:43 21:17
27	07:52 17:28	07:10 18:10	17:41 (T-23) 19:47	06:25 20:25	05:49 21:00	05:43 21:17
28	07:51 17:30	07:08 18:12	17:41 (T-23) 19:48	06:23 20:26	05:48 21:01	05:44 21:17
29	07:50 17:31		07:15 19:49	06:21 20:28	20:01 (T-06) 20:04 (T-06)	05:47 21:02
30	07:49 17:32		07:13 19:50	06:20 20:29	20:00 (T-06) 20:06 (T-06)	05:47 21:03
31	07:48 17:34		07:11 19:52	06:19 20:30	05:46 21:04	05:46 21:03
Potential sun hours	287	292	369	403	459	465
Total, worst case						
Sun reduction		28	53	9	374	
Oper. time red.		0.58	0.59	0.63	0.66	
Wind dir. red.		0.90	0.90	0.90	0.90	
Total reduction		0.58	0.58	0.62	0.62	
Total, real		0.30	0.31	0.35	0.37	
		8	16	3	138	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-188 - R-188
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	20:05 (T-06) 20:29 (T-06)	06:49 20:07	07:24 19:11	07:04 17:17
2	05:46 21:17	06:14 20:54	20:05 (T-06) 20:28 (T-06)	06:50 20:05	07:26 19:09	07:06 17:16
3	05:46 21:16	06:15 20:53	20:05 (T-06) 20:26 (T-06)	06:51 20:04	07:27 19:07	07:07 17:14
4	05:47 21:16	06:16 20:51	20:04 (T-06) 20:25 (T-06)	06:52 20:02	07:28 19:06	07:08 17:13
5	05:48 21:16	06:17 20:50	20:05 (T-06) 20:25 (T-06)	06:54 20:00	07:29 19:04	07:10 17:12
6	05:48 21:16	06:18 20:49	20:05 (T-06) 20:23 (T-06)	06:55 19:58	07:31 19:02	07:11 17:10
7	05:49 21:15	06:20 20:47	20:05 (T-06) 20:22 (T-06)	06:56 19:56	07:32 19:00	07:12 17:09
8	05:50 21:15	06:21 20:46	20:05 (T-06) 20:20 (T-06)	06:57 19:54	07:33 18:56	18:23 (T-23) 18:26 (T-23)
9	05:50 21:15	06:22 20:45	20:05 (T-06) 20:19 (T-06)	06:58 19:52	07:34 18:55	18:19 (T-23) 18:30 (T-23)
10	05:51 21:14	06:23 20:43	20:06 (T-06) 20:17 (T-06)	06:59 19:51	07:35 18:53	18:17 (T-23) 18:29 (T-23)
11	05:52 21:14	06:24 20:42	20:06 (T-06) 20:16 (T-06)	07:01 19:49	07:37 18:51	18:16 (T-23) 18:27 (T-23)
12	05:53 21:13	06:25 20:40	20:07 (T-06) 20:14 (T-06)	07:02 19:47	07:38 18:49	18:14 (T-23) 18:25 (T-23)
13	05:54 21:13	06:26 20:39	20:08 (T-06) 20:13 (T-06)	07:03 19:45	07:39 18:47	18:14 (T-23) 18:24 (T-23)
14	05:54 21:12	06:28 20:37	20:10 (T-06) 20:12 (T-06)	07:04 19:43	07:41 18:46	18:14 (T-23) 18:22 (T-23)
15	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	8 18:22 (T-23)	17:01 17:01
16	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42	7 18:20 (T-23)	17:00 17:00
17	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:41	5 18:19 (T-23)	17:00 16:59
18	05:58 21:09	06:32 20:31	07:09 19:36	07:46 18:39	3 18:17 (T-23)	17:00 16:58
19	05:59 21:08	06:34 20:29	07:10 19:34	07:47 18:37		17:00 16:56
20	06:00 21:08	06:35 20:28	07:11 19:32	07:48 18:36		17:00 16:55
21	06:01 21:07	06:36 20:26	07:12 19:30	07:50 18:34		17:00 16:55
22	06:02 21:06	20:16 (T-06) 20:21 (T-06)	06:37 20:24	07:14 19:28		17:00 16:54
23	06:03 21:05	20:13 (T-06) 20:24 (T-06)	06:38 20:23	07:15 19:26		17:00 16:53
24	06:04 21:04	20:12 (T-06) 20:26 (T-06)	06:39 20:21	07:16 19:24		17:00 16:52
25	06:05 21:03	20:10 (T-06) 20:27 (T-06)	06:41 20:19	07:17 19:22		17:00 16:52
26	06:06 21:02	20:09 (T-06) 20:28 (T-06)	06:42 20:18	07:18 19:20		17:00 16:51
27	06:07 21:01	20:08 (T-06) 20:29 (T-06)	06:43 20:16	07:20 19:19		17:00 16:50
28	06:08 21:00	20:08 (T-06) 20:30 (T-06)	06:44 20:14	07:21 19:17		17:00 16:50
29	06:09 20:59	20:07 (T-06) 20:30 (T-06)	06:45 20:12	07:22 19:15		17:00 16:49
30	06:10 20:58	20:06 (T-06) 20:31 (T-06)	06:46 20:11	07:23 19:13		17:00 16:49
31	06:12 20:56	20:06 (T-06) 20:30 (T-06)	06:48 20:09	08:03 18:18		17:00 16:56
Potential sun hours	471	436	377	341	288	275
Total, worst case	181	208		81		
Sun reduction	0.75	0.72		0.56		
Oper. time red.	0.90	0.90		0.90		
Wind dir. red.	0.62	0.62		0.58		
Total reduction	0.42	0.40		0.29		
Total, real	76	84		24		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-189 - R-189

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05	07:47	07:06	07:10	06:18	05:45
	16:57	17:35	18:13	19:53	20:30	21:04
2	08:05	07:46	07:04	07:08	06:17	05:45
	16:58	17:37	18:14	19:54	20:31	21:05
3	08:05	07:45	07:03	07:06	06:15	05:44
	16:59	17:38	18:16	19:55	20:33	21:06
4	08:05	07:44	17:11 (T-06) 07:01	07:04	06:14	05:44
	17:00	17:39	2 17:13 (T-06) 18:17	19:57	20:34	21:07
5	08:05	07:42	17:11 (T-06) 06:59	07:02	06:13	05:43
	17:01	17:41	4 17:15 (T-06) 18:18	19:58	20:35	21:08
6	08:04	07:41	17:11 (T-06) 06:57	07:00	06:11	05:43
	17:02	17:42	6 17:17 (T-06) 18:20	19:59	20:36	21:08
7	08:04	07:40	17:11 (T-06) 06:56	06:59	06:10	05:43
	17:03	17:44	8 17:19 (T-06) 18:21	20:00	20:37	21:09
8	08:04	07:39	17:11 (T-06) 07:54	06:57	06:09	05:42
	17:04	17:45	9 17:20 (T-06) 18:22	20:02	20:39	21:10
9	08:04	07:37	17:11 (T-06) 07:52	18:59 (T-07) 06:55	06:07	05:42
	17:05	17:46	11 17:22 (T-06) 19:24	3 19:02 (T-07) 20:03	20:40	21:11
10	08:04	07:36	17:11 (T-06) 07:50	18:57 (T-07) 06:53	19:41 (T-35) 06:06	05:42
	17:06	17:48	12 17:23 (T-06) 19:25	7 19:04 (T-07) 20:04	1 19:42 (T-35) 20:41	21:11
11	08:03	07:35	17:12 (T-06) 07:48	18:56 (T-07) 06:51	07:12 (T-11) 06:05	05:42
	17:07	17:49	13 17:25 (T-06) 19:26	9 19:05 (T-07) 20:05	6 19:44 (T-35) 20:42	21:12
12	08:03	07:33	17:13 (T-06) 07:47	18:54 (T-07) 06:50	07:10 (T-11) 06:03	05:41
	17:09	17:51	13 17:26 (T-06) 19:27	12 19:06 (T-07) 20:07	9 19:45 (T-35) 20:43	21:12
13	08:02	07:32	17:15 (T-06) 07:45	18:53 (T-07) 06:48	07:08 (T-11) 06:02	05:41
	17:10	17:52	11 17:26 (T-06) 19:29	14 19:07 (T-07) 20:08	13 19:46 (T-35) 20:45	21:13
14	08:02	07:30	17:16 (T-06) 07:43	18:52 (T-07) 06:46	07:06 (T-11) 06:01	05:41
	17:11	17:54	8 17:24 (T-06) 19:30	16 19:08 (T-07) 20:09	14 19:46 (T-35) 20:46	21:13
15	08:01	07:29	07:41	18:52 (T-07) 06:44	07:05 (T-11) 06:00	05:41
	17:12	17:55	19:31	18 19:10 (T-07) 20:10	16 19:48 (T-35) 20:47	21:14
16	08:01	07:27	07:39	18:52 (T-07) 06:43	07:03 (T-11) 05:59	05:41
	17:13	17:56	19:33	20 19:12 (T-07) 20:12	16 19:49 (T-35) 20:48	21:14
17	08:00	07:26	07:37	18:52 (T-07) 06:41	07:01 (T-11) 05:58	05:41
	17:15	17:58	19:34	21 19:13 (T-07) 20:13	12 07:13 (T-11) 20:49	21:15
18	08:00	07:24	07:36	18:52 (T-07) 06:39	07:00 (T-11) 05:57	05:41
	17:16	17:59	19:35	22 19:14 (T-07) 20:14	13 07:13 (T-11) 20:50	21:15
19	07:59	07:23	07:34	18:53 (T-07) 06:37	06:58 (T-11) 05:56	05:41
	17:17	18:01	19:36	22 19:15 (T-07) 20:15	14 07:12 (T-11) 20:51	21:16
20	07:58	07:21	07:32	18:53 (T-07) 06:36	06:56 (T-11) 05:55	05:41
	17:19	18:01	19:38	20 19:13 (T-07) 20:17	14 07:10 (T-11) 20:53	21:16
21	07:58	07:19	07:30	18:54 (T-07) 06:34	06:57 (T-11) 05:54	05:42
	17:20	18:02	19:39	18 19:12 (T-07) 20:18	11 07:08 (T-11) 20:54	21:16
22	07:57	07:18	07:28	18:56 (T-07) 06:32	06:59 (T-11) 05:53	05:42
	17:21	18:03	19:40	13 19:09 (T-07) 20:19	6 07:05 (T-11) 20:55	21:16
23	07:56	07:16	07:26	18:58 (T-07) 06:31	05:52	05:42
	17:23	18:05	19:42	7 19:05 (T-07) 20:20	20:56	21:17
24	07:55	07:15	07:24	06:29	05:51	05:42
	17:24	18:06	19:43	20:21	20:57	21:17
25	07:54	07:13	07:23	06:28	05:50	05:43
	17:25	18:07	19:44	20:23	20:58	21:17
26	07:53	07:11	07:21	06:26	05:49	05:43
	17:27	18:09	19:45	20:24	20:59	21:17
27	07:52	07:10	07:19	06:24	05:49	05:43
	17:28	18:10	19:47	20:25	21:00	21:17
28	07:51	07:08	07:17	06:23	05:48	05:44
	17:29	18:12	19:48	20:26	21:01	21:17
29	07:50		07:15	06:21	05:47	05:44
	17:31		19:49	20:28	21:02	21:17
30	07:49		07:13	06:20	05:47	05:45
	17:32		19:50	20:29	21:03	21:17
31	07:48		07:11		05:46	
	17:34		19:52		21:03	
Potential sun hours	287	292	369	404	459	465
Total, worst case		97	222	145		
Sun reduction		0.58	0.59	0.63		
Oper. time red.		0.90	0.90	0.90		
Wind dir. red.		0.59	0.58	0.58		
Total reduction		0.31	0.31	0.33		
Total, real		30	68	47		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-189 - R-189
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-11) 20:07	07:24 18:33 (T-07)	07:44 16:41 (T-06)
2	05:46 21:17	06:14 20:54	06:50 20:05	19:40 (T-35) 19:41 (T-35)	07:26 19:09	11 16:51 (T-06)
3	05:46 21:16	06:15 20:53	06:51 20:03	07:27 19:07	10 18:34 (T-07)	10 16:40 (T-06)
4	05:47 21:16	06:16 20:51	06:52 20:02	07:28 19:05	8 18:35 (T-07)	9 16:49 (T-06)
5	05:48 21:16	06:17 20:50	06:54 20:00	07:29 19:04	7 18:37 (T-07)	7 16:47 (T-06)
6	05:48 21:16	06:18 20:49	06:55 19:58	07:30 19:02	1 18:38 (T-07)	6 16:47 (T-06)
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	4 17:10	4 16:45 (T-06)
8	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	2 17:09	2 16:44 (T-06)
9	05:50 21:15	06:22 20:45	06:58 19:52	07:34 18:55		
10	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53		
11	05:52 21:14	06:24 20:42	07:01 19:49	07:37 18:51		
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49		
13	05:54 21:13	06:26 20:39	07:03 19:45	07:39 18:47		
14	05:54 21:12	06:28 20:37	07:04 19:43	07:41 18:46		
15	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44		
16	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42		
17	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:41		
18	05:58 21:09	06:32 20:31	07:09 19:36	07:46 18:39		
19	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37		
20	06:00 21:08	06:35 20:28	07:11 19:32	18:47 (T-07) 18:50 (T-07)	07:48 18:35	08:01 16:49
21	06:01 21:07	06:36 20:26	07:12 19:30	18:42 (T-07) 18:54 (T-07)	07:50 18:34	08:01 16:49
22	06:02 21:06	06:37 20:24	07:14 19:28	18:40 (T-07) 18:57 (T-07)	07:51 18:32	08:02 16:50
23	06:03 21:05	06:38 20:23	07:15 19:26	18:38 (T-07) 18:57 (T-07)	07:52 18:31	08:02 16:50
24	06:04 21:04	06:39 20:21	07:16 19:24	18:36 (T-07) 18:58 (T-07)	07:54 18:29	08:03 16:51
25	06:05 21:03	06:41 20:19	07:17 19:22	18:35 (T-07) 18:57 (T-07)	07:55 18:27	08:03 16:51
26	06:06 21:02	06:42 20:18	07:18 19:20	18:34 (T-07) 18:55 (T-07)	07:56 18:26	08:03 16:52
27	06:07 21:01	06:43 20:16	07:20 19:19	18:34 (T-07) 18:54 (T-07)	07:58 18:24	08:04 16:53
28	06:08 21:00	06:44 20:14	07:21 19:17	18:33 (T-07) 18:52 (T-07)	07:59 18:23	08:04 16:54
29	06:09 20:59	06:45 20:12	07:22 19:15	18:33 (T-07) 18:50 (T-07)	08:00 18:21	08:04 16:54
30	06:10 20:58	06:46 20:11	07:23 19:13	18:33 (T-07) 18:48 (T-07)	08:02 18:20	08:04 16:55
31	06:12 20:56	06:48 20:09	07:10 (T-11) 19:44 (T-35)	08:03 18:18	12 17:54 (T-06)	08:04 16:56
Potential sun hours	471	436	377	341	288	275
Total, worst case						
Sun reduction		142	194	82	49	
Oper. time red.		0.72	0.67	0.56	0.48	
Wind dir. red.		0.90	0.90	0.90	0.90	
Total reduction		0.58	0.58	0.58	0.59	
Total, real		0.37	0.35	0.29	0.26	
		53	68	24	13	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-190 - R-190
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January		February		March		April		May		June	
1	08:05	16:20 (T-06)	07:47		07:06	17:26 (T-07)	07:10		06:18	05:45		
	16:57	8 16:28 (T-06)	17:35		18:13	25 17:51 (T-07)	19:53		20:30	21:04		
2	08:05	16:20 (T-06)	07:46		07:04	17:25 (T-07)	07:08		06:17	05:45		
	16:58	9 16:29 (T-06)	17:37		18:14	27 17:52 (T-07)	19:54		20:31	21:05		
3	08:05	16:21 (T-06)	07:45		07:03	17:23 (T-07)	07:06		06:15	05:44		
	16:59	9 16:30 (T-06)	17:38		18:16	31 17:54 (T-07)	19:55		20:33	21:06		
4	08:05	16:21 (T-06)	07:44		07:01	17:23 (T-07)	07:04		06:14	05:44		
	17:00	11 16:32 (T-06)	17:39		18:17	33 17:56 (T-07)	19:57		20:34	21:07		
5	08:05	16:21 (T-06)	07:43		06:59	17:22 (T-07)	07:02		06:13	05:43		
	17:01	12 16:33 (T-06)	17:41		18:18	35 17:57 (T-07)	19:58		20:35	21:08		
6	08:05	16:22 (T-06)	07:41		06:57	17:21 (T-07)	07:00		06:11	05:43		
	17:02	12 16:34 (T-06)	17:42		18:20	37 17:58 (T-07)	19:59	1	07:22 (T-11)	20:36	21:08	
7	08:04	16:21 (T-06)	07:40		06:56	17:20 (T-07)	06:59		07:19 (T-11)	06:10	05:43	
	17:03	13 16:34 (T-06)	17:44		18:21	39 17:59 (T-07)	20:00	2	07:21 (T-11)	20:38	21:09	
8	08:04	16:22 (T-06)	07:39		07:54	18:20 (T-07)	06:57		07:17 (T-11)	06:09	05:42	
	17:04	14 16:36 (T-06)	17:45		18:22	40 19:00 (T-07)	20:02	4	07:21 (T-11)	20:39	21:10	
9	08:04	16:22 (T-06)	07:37		07:52	18:20 (T-07)	06:55		07:15 (T-11)	06:07	05:42	
	17:05	15 16:37 (T-06)	17:47		19:24	43 19:03 (T-07)	20:03	5	07:20 (T-11)	20:40	21:11	
10	08:04	16:22 (T-06)	07:36		07:50	18:20 (T-07)	06:53		07:13 (T-11)	06:06	05:42	
	17:06	16 16:38 (T-06)	17:48		19:25	42 19:02 (T-07)	20:04	5	07:18 (T-11)	20:41	21:11	
11	08:03	16:23 (T-06)	07:35		07:48	18:19 (T-07)	06:51		07:12 (T-11)	06:05	05:42	
	17:07	16 16:39 (T-06)	17:49		19:26	43 19:02 (T-07)	20:05	7	19:44 (T-05)	20:42	21:12	
12	08:03	16:24 (T-06)	07:33		07:47	18:19 (T-07)	06:50		07:11 (T-11)	06:04	05:41	
	17:09	17 16:41 (T-06)	17:51		19:27	42 19:01 (T-07)	20:07	6	19:45 (T-05)	20:43	21:12	
13	08:02	16:23 (T-06)	07:32		07:45	18:19 (T-07)	06:48		19:41 (T-05)	06:02	05:41	
	17:10	19 16:42 (T-06)	17:52		19:29	41 19:00 (T-07)	20:08	5	19:46 (T-05)	20:45	21:13	
14	08:02	16:23 (T-06)	07:30		07:43	18:19 (T-07)	06:46		19:41 (T-05)	06:01	05:41	
	17:11	20 16:43 (T-06)	17:54		19:30	41 19:00 (T-07)	20:09	5	19:46 (T-05)	20:46	21:13	
15	08:02	16:24 (T-06)	07:29		07:41	18:20 (T-07)	06:44		19:42 (T-05)	06:00	05:41	
	17:12	21 16:45 (T-06)	17:55		19:31	39 18:59 (T-07)	20:10	6	19:48 (T-05)	20:47	21:14	
16	08:01	16:24 (T-06)	07:27		07:39	18:21 (T-07)	06:43		19:43 (T-05)	05:59	05:41	
	17:13	22 16:46 (T-06)	17:56		19:33	37 18:58 (T-07)	20:12	6	19:49 (T-05)	20:48	21:14	
17	08:00	16:26 (T-06)	07:26		07:37	18:22 (T-07)	06:41		19:42 (T-35)	05:58	05:41	
	17:15	22 16:48 (T-06)	17:58		19:34	35 18:57 (T-07)	20:13	8	19:50 (T-05)	20:49	21:15	
18	08:00	16:26 (T-06)	07:24		07:36	18:22 (T-07)	06:39		19:42 (T-35)	05:57	05:41	
	17:16	23 16:49 (T-06)	17:59		19:35	34 18:56 (T-07)	20:14	10	19:52 (T-35)	20:50	21:15	
19	07:59	16:26 (T-06)	07:23		07:34	18:23 (T-07)	06:37		19:42 (T-35)	05:56	05:41	
	17:17	24 16:50 (T-06)	18:01		19:36	31 18:54 (T-07)	20:15	11	19:53 (T-35)	20:51	21:16	
20	07:58	16:27 (T-06)	07:21		07:32	18:25 (T-07)	06:36		19:42 (T-35)	05:55	05:41	
	17:19	24 16:51 (T-06)	18:01		19:38	27 18:52 (T-07)	20:17	12	19:54 (T-35)	20:53	21:16	
21	07:58	16:27 (T-06)	07:19		07:30	18:26 (T-07)	06:34		19:42 (T-35)	05:54	05:42	
	17:20	24 16:51 (T-06)	18:02		19:39	23 18:49 (T-07)	20:18	13	19:55 (T-35)	20:54	21:16	
22	07:57	16:29 (T-06)	07:18		07:28	18:29 (T-07)	06:32		19:43 (T-35)	05:53	05:42	
	17:21	22 16:51 (T-06)	18:03		19:40	17 18:46 (T-07)	20:19	13	19:56 (T-35)	20:55	21:16	
23	07:56	16:30 (T-06)	07:16		07:26	18:33 (T-07)	06:31		19:43 (T-35)	05:52	05:42	
	17:23	21 16:51 (T-06)	18:05		19:42	8 18:41 (T-07)	20:20	14	19:57 (T-35)	20:56	21:17	
24	07:55	16:31 (T-06)	07:15	17:40 (T-07)	07:24		06:29		19:45 (T-35)	05:51	05:42	
	17:24	19 16:50 (T-06)	18:06	4 17:44 (T-07)	19:43		20:22	12	19:57 (T-35)	20:57	21:17	
25	07:54	16:32 (T-06)	07:13	17:35 (T-07)	07:23		06:28		19:47 (T-35)	05:50	05:43	
	17:25	17 16:49 (T-06)	18:07	11 17:46 (T-07)	19:44		20:23	7	19:54 (T-35)	20:58	21:17	
26	07:53	16:34 (T-06)	07:11	17:32 (T-07)	07:21		06:26			05:49	05:43	
	17:27	14 16:48 (T-06)	18:09	15 17:47 (T-07)	19:45		20:24			20:59	21:17	
27	07:53	16:37 (T-06)	07:10	17:29 (T-07)	07:19		06:24			05:49	05:43	
	17:28	9 16:46 (T-06)	18:10	19 17:48 (T-07)	19:47		20:25			21:00	21:17	
28	07:52		07:08	17:28 (T-07)	07:17		06:23			05:48	05:44	
	17:30		18:12	22 17:50 (T-07)	19:48		20:26			21:01	21:17	
29	07:51				07:15		06:21			05:47	05:44	
	17:31				19:49		20:28			21:02	21:17	
30	07:49				07:13		06:20			05:47	05:45	
	17:32				19:50		20:29			21:03	21:17	
31	07:48				07:11					05:46		
	17:34				19:52					21:04		
Potential sun hours	287		292		369		404		459	465		
Total, worst case	453		71		770		152					
Sun reduction	0.58		0.58		0.59		0.63					
Oper. time red.	0.90		0.90		0.90		0.90					
Wind dir. red.	0.60		0.58		0.58		0.59					
Total reduction	0.31		0.30		0.31		0.34					
Total, real	141		21		236		51					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-191 - R-191
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June			
1	08:05	07:47	07:06	17:37 (T-07)	07:10	06:18	05:45		
	16:57	17:35	18:13	14 17:51 (T-07)	19:53	20:30	21:04		
2	08:05	07:46	07:04	17:35 (T-07)	07:08	06:17	05:45		
	16:58	17:37	18:14	17 17:52 (T-07)	19:54	20:31	21:05		
3	08:05	07:45	07:03	17:33 (T-07)	07:06	06:15	05:44		
	16:59	17:38	18:16	21 17:54 (T-07)	19:55	20:33	21:06		
4	08:05	07:44	07:01	17:33 (T-07)	07:04	06:14	05:44		
	17:00	17:39	18:17	23 17:56 (T-07)	19:57	20:34	21:07		
5	08:05	07:43	06:59	17:31 (T-07)	07:02	06:13	05:43		
	17:01	17:41	18:18	26 17:57 (T-07)	19:58	20:35	21:08		
6	08:05	07:41	06:57	17:30 (T-07)	07:00	06:11	05:43		
	17:02	17:42	18:20	28 17:58 (T-07)	19:59	1 07:22 (T-11)	20:36	21:08	
7	08:04	07:40	06:56	17:29 (T-07)	06:59	07:19 (T-11)	06:10	05:43	
	17:03	17:44	18:21	30 17:59 (T-07)	20:00	2 07:21 (T-11)	20:38	21:09	
8	08:04	16:34 (T-06)	07:39	17:54 (T-07)	06:57	07:17 (T-11)	06:09	05:42	
	17:04	2 16:36 (T-06)	17:45	18:22	32 19:00 (T-07)	20:02	4 07:21 (T-11)	20:39	21:10
9	08:04	16:35 (T-06)	07:37	17:52 (T-07)	06:55	07:15 (T-11)	06:07	05:42	
	17:05	2 16:37 (T-06)	17:47	19:24	35 19:03 (T-07)	20:03	5 07:20 (T-11)	20:40	21:11
10	08:04	16:34 (T-06)	07:36	17:50 (T-07)	06:53	07:13 (T-11)	06:06	05:42	
	17:06	4 16:38 (T-06)	17:48	19:25	36 19:04 (T-07)	20:04	7 19:42 (T-05)	20:41	21:11
11	08:03	16:34 (T-06)	07:35	17:48 (T-07)	06:51	07:12 (T-11)	06:05	05:42	
	17:07	5 16:39 (T-06)	17:49	19:26	38 19:05 (T-07)	20:05	10 19:44 (T-05)	20:42	21:12
12	08:03	16:34 (T-06)	07:33	17:47 (T-07)	06:50	07:10 (T-11)	06:03	05:41	
	17:09	7 16:41 (T-06)	17:51	19:27	38 19:05 (T-07)	20:07	11 19:45 (T-05)	20:43	21:12
13	08:02	16:34 (T-06)	07:32	17:45 (T-07)	06:48	07:09 (T-11)	06:02	05:41	
	17:10	8 16:42 (T-06)	17:52	19:29	37 19:04 (T-07)	20:08	10 19:46 (T-05)	20:45	21:13
14	08:02	16:33 (T-06)	07:30	17:43 (T-07)	06:46	19:41 (T-05)	06:01	05:41	
	17:11	10 16:43 (T-06)	17:54	19:30	36 19:03 (T-07)	20:09	5 19:46 (T-05)	20:46	21:13
15	08:02	16:34 (T-06)	07:29	17:41 (T-07)	06:44	19:42 (T-35)	06:00	05:41	
	17:12	11 16:45 (T-06)	17:55	19:31	35 19:02 (T-07)	20:10	6 19:48 (T-05)	20:47	21:14
16	08:01	16:34 (T-06)	07:27	17:39 (T-07)	06:43	19:41 (T-35)	05:59	05:41	
	17:13	12 16:46 (T-06)	17:56	19:33	34 19:02 (T-07)	20:12	8 19:49 (T-35)	20:48	21:14
17	08:00	16:35 (T-06)	07:26	17:37 (T-07)	06:41	19:41 (T-35)	05:58	05:41	
	17:15	13 16:48 (T-06)	17:58	19:34	32 19:01 (T-07)	20:13	9 19:50 (T-35)	20:49	21:15
18	08:00	16:34 (T-06)	07:24	17:36 (T-07)	06:39	19:41 (T-35)	05:57	05:41	
	17:16	15 16:49 (T-06)	17:59	19:35	30 19:00 (T-07)	20:14	11 19:52 (T-35)	20:50	21:15
19	07:59	16:34 (T-06)	07:23	17:34 (T-07)	06:37	19:41 (T-35)	05:56	05:41	
	17:17	16 16:50 (T-06)	18:01	19:36	27 18:58 (T-07)	20:15	12 19:53 (T-35)	20:51	21:16
20	07:58	16:34 (T-06)	07:21	17:32 (T-07)	06:36	19:41 (T-35)	05:55	05:41	
	17:19	17 16:51 (T-06)	18:01	19:38	24 18:56 (T-07)	20:17	13 19:54 (T-35)	20:53	21:16
21	07:58	16:35 (T-06)	07:19	17:30 (T-07)	06:34	19:43 (T-35)	05:54	05:42	
	17:20	17 16:52 (T-06)	18:02	19:39	19 18:53 (T-07)	20:18	12 19:55 (T-35)	20:54	21:16
22	07:57	16:36 (T-06)	07:18	17:28 (T-07)	06:32	19:44 (T-35)	05:53	05:42	
	17:21	19 16:55 (T-06)	18:03	19:40	14 18:50 (T-07)	20:19	10 19:54 (T-35)	20:55	21:16
23	07:56	16:36 (T-06)	07:16	17:26 (T-07)	06:31	19:47 (T-35)	05:52	05:42	
	17:23	20 16:56 (T-06)	18:05	19:42	20:20	4 19:51 (T-35)	20:56	21:17	
24	07:55	16:37 (T-06)	07:15	17:24 (T-07)	06:29	19:47 (T-35)	05:51	05:42	
	17:24	20 16:57 (T-06)	18:06	19:43	20:22	20:57	21:17	21:17	
25	07:54	16:37 (T-06)	07:13	17:23 (T-07)	06:28	19:47 (T-35)	05:50	05:43	
	17:25	22 16:59 (T-06)	18:07	19:44	20:23	20:58	21:17	21:17	
26	07:53	16:38 (T-06)	07:11	17:21 (T-07)	06:26	19:47 (T-35)	05:49	05:43	
	17:27	22 17:00 (T-06)	18:09	19:45	20:24	20:59	21:17	21:17	
27	07:53	16:39 (T-06)	07:10	17:44 (T-07)	07:19	19:47 (T-35)	05:49	05:43	
	17:28	21 17:00 (T-06)	18:10	4 17:48 (T-07)	19:47	20:25	21:00	21:17	
28	07:52	16:40 (T-06)	07:08	17:40 (T-07)	07:17	19:47 (T-35)	05:48	05:44	
	17:30	19 16:59 (T-06)	18:12	10 17:50 (T-07)	19:48	20:26	21:01	21:17	
29	07:51	16:42 (T-06)	07:07	17:15 (T-07)	06:21	19:47 (T-35)	05:47	05:44	
	17:31	16 16:58 (T-06)	18:07	19:49	20:28	21:02	21:17	21:17	
30	07:49	16:43 (T-06)	07:06	17:13 (T-07)	06:20	19:47 (T-35)	05:47	05:45	
	17:32	14 16:57 (T-06)	18:06	19:50	20:29	21:03	21:17	21:17	
31	07:48	16:45 (T-06)	07:05	17:11 (T-07)	06:19	19:47 (T-35)	05:46	05:45	
	17:34	9 16:54 (T-06)	18:05	19:52	20:30	21:04	21:17	21:17	
Potential sun hours	287	292	369	404	459	465			
Total, worst case	321	14	626	140					
Sun reduction	0.58	0.58	0.59	0.63					
Oper. time red.	0.90	0.90	0.90	0.90					
Wind dir. red.	0.59	0.57	0.57	0.59					
Total reduction	0.31	0.30	0.30	0.34					
Total, real	99	4	191	47					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



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South Deuel Wind Project

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Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
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6/14/2024 3:01 PM/3.6.366

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Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-191 - R-191
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-11) 19:43 (T-05)	07:24 19:11	18:06 (T-07) 17:17
2	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-11) 19:41 (T-05)	07:26 19:09	18:06 (T-07) 17:16
3	05:46 21:17	06:15 20:53	06:51 20:04	07:13 (T-11) 19:42 (T-05)	07:27 19:07	18:06 (T-07) 17:14
4	05:47 21:16	06:16 20:51	06:52 20:02	07:14 (T-11) 19:43 (T-05)	07:28 19:06	18:05 (T-07) 17:13
5	05:48 21:16	06:17 20:50	06:54 20:00	07:15 (T-11) 19:44 (T-05)	07:29 19:04	18:05 (T-07) 17:12
6	05:48 21:16	06:18 20:49	06:55 19:58	07:16 (T-11) 19:45 (T-05)	07:31 19:02	18:06 (T-07) 17:11
7	05:49 21:15	06:19 20:47	06:56 19:56	07:17 (T-11) 19:46 (T-05)	07:32 19:00	18:05 (T-07) 17:09
8	05:50 21:15	06:21 20:46	06:57 19:54	07:18 (T-11) 19:47 (T-05)	07:33 18:56	18:06 (T-07) 17:08
9	05:50 21:15	06:22 20:45	06:58 19:52	07:19 (T-11) 19:48 (T-05)	07:34 18:55	18:06 (T-07) 17:07
10	05:51 21:14	06:23 20:43	06:59 19:51	07:20 (T-11) 19:49 (T-05)	07:35 18:53	18:07 (T-07) 17:05
11	05:52 21:14	06:24 20:42	07:01 19:49	07:21 (T-11) 19:50 (T-05)	07:36 18:51	18:08 (T-07) 17:04
12	05:53 21:13	06:25 20:40	07:02 19:47	07:22 (T-11) 19:51 (T-05)	07:37 18:49	18:09 (T-07) 17:03
13	05:54 21:13	06:26 20:39	07:03 19:45	07:23 (T-11) 19:52 (T-05)	07:38 18:47	18:10 (T-07) 17:02
14	05:54 21:12	06:28 20:37	07:04 19:43	07:24 (T-11) 19:53 (T-05)	07:39 18:46	18:11 (T-07) 17:01
15	05:55 21:11	06:29 20:36	07:05 19:41	07:25 (T-11) 19:54 (T-05)	07:40 18:44	18:12 (T-07) 17:00
16	05:56 21:11	06:30 20:34	07:06 19:39	07:26 (T-11) 19:55 (T-05)	07:41 18:42	18:13 (T-07) 16:59
17	05:57 21:10	06:31 20:33	07:07 19:37	07:27 (T-11) 19:56 (T-05)	07:42 18:41	18:14 (T-07) 16:58
18	05:58 21:09	06:32 20:31	07:09 19:36	07:28 (T-11) 19:57 (T-05)	07:43 18:39	18:15 (T-07) 16:57
19	05:59 21:08	06:34 20:29	07:10 19:34	07:29 (T-11) 19:58 (T-05)	07:44 18:37	18:16 (T-07) 16:56
20	06:00 21:08	06:35 20:28	07:11 19:32	07:30 (T-11) 19:59 (T-05)	07:45 18:36	18:17 (T-07) 16:55
21	06:01 21:07	06:36 20:26	07:12 19:30	07:31 (T-11) 20:00 (T-35)	07:46 18:35	18:18 (T-07) 16:54
22	06:02 21:06	06:37 20:24	07:14 19:28	07:32 (T-11) 20:01 (T-35)	07:47 18:34	18:19 (T-07) 16:53
23	06:03 21:05	06:38 20:23	07:15 19:26	07:33 (T-11) 20:02 (T-35)	07:48 18:33	18:20 (T-07) 16:52
24	06:04 21:04	06:39 20:21	07:16 19:24	07:34 (T-11) 20:03 (T-35)	07:49 18:32	18:21 (T-07) 16:51
25	06:05 21:03	06:41 20:19	07:17 19:22	07:35 (T-11) 20:04 (T-35)	07:50 18:31	18:22 (T-07) 16:50
26	06:06 21:02	06:42 20:18	07:18 19:20	07:36 (T-11) 20:05 (T-35)	07:51 18:30	18:23 (T-07) 16:49
27	06:07 21:01	06:43 20:16	07:20 19:19	07:37 (T-11) 20:06 (T-35)	07:52 18:29	18:24 (T-07) 16:48
28	06:08 21:00	06:44 20:14	07:21 19:17	07:38 (T-11) 20:07 (T-35)	07:53 18:28	18:25 (T-07) 16:47
29	06:09 20:59	06:45 20:12	07:22 19:15	07:39 (T-11) 20:08 (T-35)	07:54 18:27	18:26 (T-07) 16:46
30	06:10 20:58	06:46 20:11	07:23 19:13	07:40 (T-11) 20:09 (T-35)	07:55 18:26	18:27 (T-07) 16:45
31	06:12 20:56	06:48 20:09	07:24 19:11	07:41 (T-11) 20:10 (T-35)	07:56 18:25	18:28 (T-07) 16:44
Potential sun hours	471	436	377	341	288	275
Total, worst case						
Sun reduction		112	309	368	310	14
Oper. time red.		0.72	0.67	0.56	0.48	0.52
Wind dir. red.		0.90	0.90	0.90	0.90	0.90
Total reduction		0.59	0.57	0.57	0.59	0.59
Total, real		0.39	0.35	0.29	0.25	0.28
Total, real		43	107	106	79	4

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	January	February	March	April	May	June		
1	08:05	15:59 (T-07)	07:47	07:06	07:27 (T-11)	07:10	06:18	05:45
	16:57	22 16:21 (T-07)	17:35	18:13	6 07:33 (T-11)	19:53	20:30	21:04
2	08:05	16:00 (T-07)	07:46	07:04	07:25 (T-11)	07:08	06:17	05:45
	16:58	22 16:22 (T-07)	17:37	18:14	8 07:33 (T-11)	19:54	20:31	21:05
3	08:05	16:00 (T-07)	07:45	07:03	07:23 (T-11)	07:06	06:15	05:44
	16:59	22 16:22 (T-07)	17:38	18:16	10 17:54 (T-35)	19:55	20:33	21:06
4	08:05	16:01 (T-07)	07:44	07:01	07:22 (T-11)	07:04	06:14	05:44
	17:00	21 16:22 (T-07)	17:39	18:17	13 17:56 (T-35)	19:57	20:34	21:07
5	08:05	16:02 (T-07)	07:43	06:59	07:20 (T-11)	07:02	06:13	05:43
	17:01	20 16:22 (T-07)	17:41	18:18	14 17:57 (T-35)	19:58	20:35	21:08
6	08:05	16:04 (T-07)	07:41	06:57	17:51 (T-35)	07:00	06:11	05:43
	17:02	18 16:22 (T-07)	17:42	18:20	7 17:58 (T-35)	19:59	20:36	21:08
7	08:04	16:04 (T-07)	07:40	06:56	17:51 (T-35)	06:59	06:10	05:43
	17:03	17 16:21 (T-07)	17:44	18:21	8 17:59 (T-35)	20:00	20:38	21:09
8	08:04	16:05 (T-07)	07:39	07:54	18:51 (T-35)	06:57	06:09	05:42
	17:04	17 16:22 (T-07)	17:45	18:22	9 19:00 (T-35)	20:02	20:39	21:10
9	08:04	16:07 (T-07)	07:37	07:52	18:52 (T-35)	06:55	06:07	05:42
	17:05	14 16:21 (T-07)	17:46	19:24	11 19:03 (T-35)	20:03	20:40	21:11
10	08:04	16:08 (T-07)	07:36	07:50	18:53 (T-35)	06:53	06:06	05:42
	17:06	12 16:20 (T-07)	17:48	19:25	11 19:04 (T-35)	20:04	20:41	21:11
11	08:03	16:10 (T-07)	07:35	07:48	18:55 (T-35)	06:51	06:05	05:42
	17:07	10 16:20 (T-07)	17:49	19:26	7 19:02 (T-35)	20:05	20:42	21:12
12	08:03	16:13 (T-07)	07:33	07:47		06:50	06:03	05:41
	17:09	5 16:18 (T-07)	17:51	19:27		20:07	20:43	21:12
13	08:02		07:32	07:45		06:48	06:02	05:41
	17:10		17:52	19:29		20:08	20:45	21:13
14	08:02		07:30	07:43		06:46	06:01	05:41
	17:11		17:54	19:30		20:09	20:46	21:13
15	08:02		07:29	07:41		06:44	06:00	05:41
	17:12		17:55	19:31		20:10	20:47	21:14
16	08:01		07:27	07:39		06:43	05:59	05:41
	17:13		17:56	19:33		20:12	20:48	21:14
17	08:00		07:26	07:37		06:41	05:58	05:41
	17:15		17:58	19:34		20:13	20:49	21:15
18	08:00		07:24	07:36		06:39	05:57	05:41
	17:16		17:59	19:35		20:14	20:50	21:15
19	07:59		07:23	07:34		06:37	05:56	05:41
	17:17		18:01	19:36		20:15	20:51	21:16
20	07:58		07:21	07:32		06:36	05:55	05:41
	17:19		18:01	19:38		20:17	20:53	21:16
21	07:58		07:19	07:30		06:34	05:54	05:42
	17:20		18:02	19:39		20:18	20:54	21:16
22	07:57		07:18	07:28		06:32	05:53	05:42
	17:21		18:03	19:40		20:19	20:55	21:16
23	07:56		07:16	07:26		06:31	05:52	05:42
	17:23		18:05	19:42		20:20	20:56	21:17
24	07:55		07:15	07:24		06:29	05:51	05:42
	17:24		18:06	19:43		20:22	20:57	21:17
25	07:54		07:13	07:23		06:28	05:50	05:43
	17:25		18:07	19:44		20:23	20:58	21:17
26	07:53		07:11	07:32 (T-11)	07:21	06:26	05:49	05:43
	17:27		18:09	1 07:33 (T-11)	19:45	20:24	20:59	21:17
27	07:53		07:10	07:30 (T-11)	07:19	06:24	05:49	05:43
	17:28		18:10	3 07:33 (T-11)	19:47	20:25	21:00	21:17
28	07:52		07:08	07:29 (T-11)	07:17	06:23	05:48	05:44
	17:29		18:12	5 07:34 (T-11)	19:48	20:26	21:01	21:17
29	07:51			07:15		06:21	05:47	05:44
	17:31			19:49		20:28	21:02	21:17
30	07:49			07:13		06:20	05:47	05:45
	17:32			19:50		20:29	21:03	21:17
31	07:48			07:11			05:46	
	17:34			19:52			21:04	
Potential sun hours	287	292	369		404	459	465	
Total, worst case	200	9	104					
Sun reduction	0.58	0.58	0.59					
Oper. time red.	0.90	0.90	0.90					
Wind dir. red.	0.61	0.60	0.58					
Total reduction	0.32	0.31	0.31					
Total, real	64	3	32					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-192 - R-192

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:44 16:49
2	05:46 21:17	06:14 20:54	06:50 20:05	07:26 19:09	07:06 17:16	9 16:01
3	05:46 21:17	06:15 20:53	06:51 20:04	07:27 19:07	18:32 (T-35) 18:42 (T-35)	12 16:03
4	05:47 21:16	06:16 20:51	06:52 20:02	07:28 19:06	18:30 (T-35) 18:40 (T-35)	14 16:04
5	05:48 21:16	06:17 20:50	06:54 20:00	07:29 19:04	18:28 (T-35) 18:38 (T-35)	17 16:06
6	05:48 21:16	06:18 20:49	06:55 19:58	07:31 19:02	18:28 (T-35) 18:37 (T-35)	18 16:08
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	18:27 (T-35) 18:35 (T-35)	20 16:09
8	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	07:56 (T-11) 18:33 (T-35)	21 16:10
9	05:50 21:15	06:22 20:45	06:58 19:52	07:34 18:55	07:55 (T-11) 18:30 (T-35)	21 16:11
10	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:57 (T-11) 18:29 (T-35)	22 16:12
11	05:52 21:14	06:24 20:42	07:01 19:49	07:37 18:51	07:58 (T-11) 08:06 (T-11)	22 16:12
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:59 (T-11) 08:06 (T-11)	23 16:12
13	05:54 21:13	06:26 20:39	07:03 19:45	07:39 18:47	08:01 (T-11) 08:07 (T-11)	23 16:13
14	05:54 21:12	06:28 20:37	07:04 19:43	07:41 18:46	08:02 (T-11) 08:06 (T-11)	24 16:14
15	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	08:03 (T-11) 08:05 (T-11)	24 16:15
16	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42	07:25 16:59	24 16:15
17	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:41	07:26 16:58	24 16:15
18	05:58 21:09	06:32 20:31	07:09 19:36	07:46 18:39	07:27 16:57	24 16:16
19	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37	07:29 16:56	24 16:16
20	06:00 21:08	06:35 20:28	07:11 19:32	07:48 18:36	07:30 16:55	25 16:17
21	06:01 21:07	06:36 20:26	07:12 19:30	07:50 18:34	07:31 16:54	25 16:18
22	06:02 21:06	06:37 20:24	07:14 19:28	07:51 18:32	07:33 16:54	25 16:18
23	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53	25 16:18
24	06:04 21:04	06:39 20:21	07:16 19:24	07:54 18:29	07:35 16:52	24 16:19
25	06:05 21:03	06:41 20:19	07:17 19:22	07:55 18:27	07:36 16:52	24 16:19
26	06:06 21:02	06:42 20:18	07:18 19:20	07:56 18:26	07:38 16:51	24 16:19
27	06:07 21:01	06:43 20:16	07:20 19:19	07:58 18:24	07:39 16:50	24 16:20
28	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50	24 16:21
29	06:09 20:59	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	24 16:21
30	06:10 20:58	06:46 20:11	07:23 19:13	08:02 18:20	07:42 16:49	4 15:55 (T-07)
31	06:12 20:56	06:48 20:09	08:03 18:18	08:03 18:18	07:42 16:49	4 15:59 (T-07)
Potential sun hours	471	436	377	341	288	275
Total, worst case				111	4	674
Sun reduction				0.56	0.48	0.52
Oper. time red.				0.90	0.90	0.90
Wind dir. red.				0.58	0.61	0.61
Total reduction				0.29	0.26	0.29
Total, real				33	1	193

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-193 - R-193
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:05	09:28 (T-11)	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44	09:22 (T-11)	
	16:57	43 10:11 (T-11)	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48	27 09:49 (T-11)	
2	08:05	09:29 (T-11)	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45	09:21 (T-11)	
	16:58	42 10:11 (T-11)	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48	30 09:51 (T-11)	
3	08:05	09:30 (T-11)	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46	09:20 (T-11)	
	16:59	41 10:11 (T-11)	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48	32 09:52 (T-11)	
4	08:05	09:31 (T-11)	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47	09:19 (T-11)	
	17:00	40 10:11 (T-11)	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47	35 09:54 (T-11)	
5	08:05	09:32 (T-11)	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48	09:19 (T-11)	
	17:01	39 10:11 (T-11)	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47	36 09:55 (T-11)	
6	08:04	09:33 (T-11)	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49	09:19 (T-11)	
	17:02	38 10:11 (T-11)	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47	38 09:57 (T-11)	
7	08:04	09:34 (T-11)	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50	09:19 (T-11)	
	17:03	36 10:10 (T-11)	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47	39 09:58 (T-11)	
8	08:04	09:35 (T-11)	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51	09:19 (T-11)	
	17:04	35 10:10 (T-11)	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47	40 09:59 (T-11)	
9	08:04	09:37 (T-11)	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52	09:19 (T-11)	
	17:05	32 10:09 (T-11)	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47	41 10:00 (T-11)	
10	08:04	09:38 (T-11)	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53	09:19 (T-11)	
	17:06	30 10:08 (T-11)	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47	42 10:01 (T-11)	
11	08:03	09:40 (T-11)	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54	09:18 (T-11)	
	17:07	28 10:08 (T-11)	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47	43 10:01 (T-11)	
12	08:03	09:41 (T-11)	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55	09:18 (T-11)	
	17:08	25 10:06 (T-11)	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47	44 10:02 (T-11)	
13	08:02	09:44 (T-11)	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56	09:18 (T-11)	
	17:10	21 10:05 (T-11)	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47	45 10:03 (T-11)	
14	08:02	09:46 (T-11)	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56	09:19 (T-11)	
	17:11	16 10:02 (T-11)	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47	45 10:04 (T-11)	
15	08:01	09:51 (T-11)	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57	09:19 (T-11)	
	17:12	8 09:59 (T-11)	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47	46 10:05 (T-11)	
16	08:01		07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58	09:19 (T-11)	
	17:13		17:56	19:33	20:11	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47	46 10:05 (T-11)	
17	08:00		07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59	09:19 (T-11)	
	17:15		17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48	47 10:06 (T-11)	
18	08:00		07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59	09:20 (T-11)	
	17:16		17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48	47 10:07 (T-11)	
19	07:59		07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00	09:20 (T-11)	
	17:17		18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48	47 10:07 (T-11)	
20	07:58		07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00	09:21 (T-11)	
	17:19		18:00	19:38	20:16	20:52	21:16	21:08	20:28	19:32	18:35	16:55	16:49	47 10:08 (T-11)	
21	07:58		07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01	09:21 (T-11)	
	17:20		18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49	47 10:08 (T-11)	
22	07:57		07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:02	09:22 (T-11)	
	17:21		18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50	47 10:09 (T-11)	
23	07:56		07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02	09:22 (T-11)	
	17:23		18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50	47 10:09 (T-11)	
24	07:55		07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02	09:23 (T-11)	
	17:24		18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51	47 10:10 (T-11)	
25	07:54		07:13	07:22	06:28	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03	09:23 (T-11)	
	17:25		18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51	47 10:10 (T-11)	
26	07:53		07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03	09:23 (T-11)	
	17:27		18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52	47 10:10 (T-11)	
27	07:52		07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39	08:04	09:25 (T-11)	
	17:28		18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	18:24	16:50	7 09:38 (T-11)	16:53	46 10:11 (T-11)
28	07:51		07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	09:26 (T-11)	08:04	09:25 (T-11)
	17:29		18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16 09:42 (T-11)	16:53	46 10:11 (T-11)
29	07:50			07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	09:24 (T-11)	08:04	09:26 (T-11)
	17:31			19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	21 09:45 (T-11)	16:54	45 10:11 (T-11)
30	07:49			07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	09:23 (T-11)	08:04	09:26 (T-11)
	17:32			19:50	20:29	21:03	21:17	20:57	20:11	19:13	18:20	16:49	25 09:48 (T-11)	16:55	45 10:11 (T-11)
31	07:48			07:11		05:46		06:11	06:48		08:03		08:04	09:27 (T-11)	
	17:34			19:52		21:03		20:56	20:09		18:18		16:56	44 10:11 (T-11)	
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288			275	
Total, worst case	474										69			1325	
Sun reduction	0.58										0.48			0.52	
Oper. time red.	0.90										0.90			0.90	
Wind dir. red.	0.68										0.68			0.68	
Total reduction	0.36										0.29			0.32	
Total, real	169										20			422	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-194 - R-194
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:05 16:57 37	09:02 (T-11) 09:39 (T-11)	07:47 17:35	07:06 18:13	07:09 19:53	06:18 20:30	05:45 21:04	05:45 21:17	06:13 20:55	06:49 20:07	07:24 19:11	07:04 17:17	08:55 (T-11) 16:48 23
2	08:05 16:58 36	09:03 (T-11) 09:39 (T-11)	07:46 17:36	07:04 18:14	07:08 19:54	06:17 20:31	05:45 21:05	05:46 21:17	06:14 20:54	06:50 20:05	07:26 19:09	07:06 17:16	08:54 (T-11) 16:48 26
3	08:05 16:59 35	09:04 (T-11) 09:39 (T-11)	07:45 17:38	07:03 18:15	07:06 19:55	06:15 20:33	05:44 21:06	05:46 21:16	06:15 20:53	06:51 20:03	07:27 19:07	07:07 17:14	08:53 (T-11) 16:48 28
4	08:05 17:00 34	09:05 (T-11) 09:39 (T-11)	07:44 17:39	07:01 18:17	07:04 19:57	06:14 20:34	05:44 21:07	05:47 21:16	06:16 20:51	06:52 20:02	07:28 19:05	07:08 17:13	08:53 (T-11) 16:47 29
5	08:05 17:01 33	09:06 (T-11) 09:39 (T-11)	07:42 17:41	06:59 18:18	07:02 19:58	06:13 20:35	05:43 21:08	05:47 21:16	06:17 20:50	06:53 20:00	07:29 19:04	07:10 17:12	08:54 (T-11) 16:47 30
6	08:04 17:02 32	09:07 (T-11) 09:39 (T-11)	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:16	06:18 20:49	06:55 19:58	07:30 19:02	07:11 17:10	08:54 (T-11) 16:47 32
7	08:04 17:03 31	09:07 (T-11) 09:38 (T-11)	07:40 17:44	06:56 18:21	06:58 20:00	06:10 20:37	05:43 21:09	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	07:12 17:09	08:53 (T-11) 16:47 33
8	08:04 17:04 29	09:09 (T-11) 09:38 (T-11)	07:39 17:45	07:54 18:22	06:57 20:02	06:08 20:39	05:42 21:10	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	07:14 17:08	08:53 (T-11) 16:47 34
9	08:04 17:05 28	09:10 (T-11) 09:38 (T-11)	07:37 17:46	07:52 19:23	06:55 20:03	06:07 20:40	05:42 21:11	05:50 21:15	06:22 20:45	06:58 19:52	07:34 18:54	07:15 17:06	08:53 (T-11) 16:47 35
10	08:04 17:06 26	09:11 (T-11) 09:37 (T-11)	07:36 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:17 17:05	08:53 (T-11) 16:47 36
11	08:03 17:07 24	09:13 (T-11) 09:35 (T-11)	07:35 17:49	07:48 19:26	06:51 20:05	06:05 20:42	05:41 21:12	05:52 21:14	06:24 20:42	07:01 19:49	07:37 18:51	07:18 17:04	08:52 (T-11) 16:47 37
12	08:03 17:08 21	09:14 (T-11) 09:35 (T-11)	07:33 17:51	07:47 19:27	06:50 20:07	06:03 20:43	05:41 21:12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	08:53 (T-11) 16:47 36
13	08:02 17:10 17	09:17 (T-11) 09:34 (T-11)	07:32 17:52	07:45 19:29	06:48 20:08	06:02 20:45	05:41 21:13	05:53 21:13	06:26 20:39	07:03 19:45	07:39 18:47	07:21 17:02	08:53 (T-11) 16:47 37
14	08:02 17:11 13	09:19 (T-11) 09:32 (T-11)	07:30 17:53	07:43 19:30	06:46 20:09	06:01 20:46	05:41 21:13	05:54 21:12	06:28 20:37	07:04 19:43	07:40 18:46	07:22 17:01	08:53 (T-11) 16:47 38
15	08:01 17:12 6	09:23 (T-11) 09:29 (T-11)	07:29 17:55	07:41 19:31	06:44 20:10	06:00 20:47	05:41 21:14	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	08:54 (T-11) 16:47 38
16	08:01 17:13	07:27 17:56	07:39 19:33	06:43 20:12	05:59 20:48	05:41 21:14	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42	07:25 16:59	07:58 16:47	08:54 (T-11) 38 09:32 (T-11)
17	08:00 17:15	07:26 17:58	07:37 19:34	06:41 20:13	05:58 20:49	05:41 21:15	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:40	07:26 16:58	07:59 16:48	08:54 (T-11) 39 09:33 (T-11)
18	08:00 17:16	07:24 17:59	07:35 19:35	06:39 20:14	05:57 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:36	07:46 18:39	07:27 16:57	07:59 16:48	08:55 (T-11) 39 09:34 (T-11)
19	07:59 17:17	07:23 18:00	07:34 19:36	06:37 20:15	05:56 20:51	05:41 21:16	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37	07:29 16:56	08:00 16:48	08:55 (T-11) 39 09:34 (T-11)
20	07:58 17:19	07:21 18:00	07:32 19:38	06:36 20:16	05:55 20:52	05:41 21:16	06:00 21:08	06:35 20:28	07:11 19:32	07:48 18:35	07:30 16:55	08:00 16:49	08:56 (T-11) 39 09:35 (T-11)
21	07:58 17:20	07:19 18:02	07:30 19:39	06:34 20:18	05:54 20:54	05:41 21:16	06:01 21:07	06:36 20:26	07:12 19:30	07:50 18:34	07:31 16:54	08:01 16:49	08:55 (T-11) 40 09:35 (T-11)
22	07:57 17:21	07:18 18:03	07:28 19:40	06:32 20:19	05:53 20:55	05:42 21:16	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	07:33 16:54	08:02 16:50	08:56 (T-11) 40 09:36 (T-11)
23	07:56 17:23	07:16 18:05	07:26 19:41	06:31 20:20	05:52 20:56	05:42 21:17	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53	08:02 16:50	08:56 (T-11) 40 09:36 (T-11)
24	07:55 17:24	07:15 18:06	07:24 19:43	06:29 20:21	05:51 20:57	05:42 21:17	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	08:02 16:51	08:58 (T-11) 39 09:37 (T-11)
25	07:54 17:25	07:13 18:07	07:22 19:44	06:28 20:23	05:50 20:58	05:43 21:17	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	07:36 16:52	08:03 16:51	08:58 (T-11) 39 09:37 (T-11)
26	07:53 17:27	07:11 18:09	07:21 19:45	06:26 20:24	05:49 20:59	05:43 21:17	06:06 21:02	06:42 20:18	07:18 19:20	07:56 18:26	07:38 16:51	08:03 16:52	08:58 (T-11) 39 09:37 (T-11)
27	07:52 17:28	07:10 18:10	07:19 19:46	06:24 20:25	05:49 21:00	05:43 21:17	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	07:39 16:50	08:04 16:53	08:59 (T-11) 39 09:38 (T-11)
28	07:51 17:29	07:08 18:11	07:17 19:48	06:23 20:26	05:48 21:01	05:44 21:17	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50	08:04 16:53	09:00 (T-11) 38 09:38 (T-11)
29	07:50 17:31	07:15 19:49	07:15 20:28	06:21 21:02	05:47 21:02	05:44 21:17	06:09 20:59	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	08:04 16:54	09:00 (T-11) 38 09:38 (T-11)
30	07:49 17:32	07:13 19:50	07:13 20:29	06:20 21:03	05:46 21:03	05:45 21:17	06:10 20:57	06:46 20:11	07:23 19:13	08:02 18:20	07:42 16:49	08:04 16:55	09:01 (T-11) 37 09:38 (T-11)
31	07:48 17:34	07:11 19:52	07:11 21:03	06:19 21:03	05:46 21:03	05:45 21:17	06:11 20:56	06:48 20:09	08:03 18:18	08:03 16:56	07:42 16:56	08:04 16:56	09:01 (T-11) 37 09:38 (T-11)
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275	
Total, worst case	402										57		1112
Sun reduction	0.58										0.48		0.52
Oper. time red.	0.90										0.90		0.90
Wind dir. red.	0.68										0.68		0.68
Total reduction	0.35										0.29		0.32
Total, real	143										17		354

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-195 - R-195
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
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13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:16	20:52	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
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	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
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26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39	08:04
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28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
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	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:03			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-196 - R-196
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:15	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
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	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
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	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
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21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01
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26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
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	17:32		19:50	20:29	21:03	21:17	20:57	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46	05:45	06:11	06:48	08:03	08:03	08:03	08:04
	17:34		19:51	21:03	21:03	21:17	20:56	20:09	18:18	18:18	16:56	16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-197 - R-197
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
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	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:04			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-198 - R-198
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
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15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46	05:45	06:11	06:48		08:03	08:04	08:04
	17:34		19:52	21:04	21:04	21:17	20:56	20:09		18:18	16:56	16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-200 - R-200
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December					
1	08:05 16:57	07:47 17:35	07:06 18:13	17:14 (T-35) 19:53	06:18 20:30	05:45 21:04	05:45 21:17	06:13 20:55	06:49 20:07	07:24 19:11	17:55 (T-35) 18:46 (T-05)	07:04 17:17	07:44 16:49				
2	08:05 16:58	07:46 17:37	07:04 18:14	17:13 (T-35) 19:54	06:17 20:31	05:45 21:05	05:46 21:17	06:14 20:54	06:50 20:05	07:26 19:09	17:53 (T-35) 18:44 (T-05)	07:06 17:16	07:45 16:48				
3	08:05 16:59	07:45 17:38	07:03 18:16	17:12 (T-35) 19:55	06:16 20:33	05:44 21:06	05:46 21:17	06:15 20:53	06:51 20:04	07:27 19:07	17:52 (T-35) 18:42 (T-05)	07:07 17:14	07:46 16:48				
4	08:05 17:00	07:44 17:39	07:01 18:17	17:13 (T-35) 19:57	06:14 20:34	05:44 21:07	05:47 21:16	06:16 20:51	06:52 20:02	07:28 19:06	17:50 (T-35) 18:40 (T-05)	07:08 17:13	07:47 16:48				
5	08:05 17:01	07:43 17:41	06:59 18:18	17:13 (T-35) 19:58	06:13 20:35	05:43 21:08	05:48 21:16	06:17 20:50	06:54 20:00	07:29 19:04	17:49 (T-35) 18:38 (T-05)	07:10 17:12	07:48 16:47				
6	08:05 17:02	07:41 17:42	06:57 18:20	17:12 (T-35) 19:59	06:11 20:36	05:43 21:09	05:48 21:16	06:18 20:49	06:55 19:58	07:31 19:02	17:49 (T-35) 18:37 (T-05)	07:11 17:10	07:49 16:47				
7	08:04 17:03	07:40 17:44	06:56 18:21	17:12 (T-35) 20:00	06:10 20:38	05:43 21:09	05:49 21:15	06:20 20:47	06:56 19:56	07:32 19:00	17:48 (T-35) 18:35 (T-05)	07:13 17:09	07:50 16:47				
8	08:04 17:04	07:39 17:45	07:54 18:22	18:12 (T-35) 20:02	06:09 20:39	05:42 21:10	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	17:48 (T-35) 18:33 (T-05)	07:14 17:08	07:51 16:47				
9	08:04 17:05	07:37 17:47	07:52 19:24	18:13 (T-35) 20:03	06:07 20:40	05:42 21:11	05:50 21:15	06:22 20:45	06:58 19:53	07:34 18:55	17:48 (T-35) 18:31 (T-35)	07:15 17:07	07:52 16:47				
10	08:04 17:06	07:36 17:48	07:50 19:25	18:14 (T-35) 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:51	07:36 18:53	17:47 (T-35) 18:29 (T-05)	07:17 17:05	07:53 16:47				
11	08:03 17:07	07:35 17:49	07:48 19:26	18:14 (T-35) 20:05	06:05 20:42	05:42 21:12	05:52 21:14	06:24 20:42	07:01 19:49	07:37 18:51	17:47 (T-35) 18:27 (T-35)	07:18 17:04	07:54 16:47				
12	08:03 17:09	07:33 17:51	07:47 19:28	18:15 (T-35) 20:07	06:04 20:44	05:41 21:12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	17:47 (T-35) 18:25 (T-35)	07:19 17:03	07:55 16:47				
13	08:03 17:10	07:32 17:52	07:45 19:29	18:15 (T-35) 20:08	06:02 20:45	05:41 21:13	05:54 21:13	06:27 20:39	07:03 19:45	07:39 18:48	18:25 (T-35) 18:24 (T-35)	07:21 17:02	07:56 16:47				
14	08:02 17:11	07:30 17:54	07:43 19:30	18:16 (T-35) 20:09	06:01 20:46	05:41 21:14	05:54 21:12	06:28 20:37	07:04 19:43	07:41 18:46	17:47 (T-35) 18:22 (T-35)	07:22 17:01	07:56 16:47				
15	08:02 17:12	07:29 17:55	07:41 19:31	18:18 (T-35) 20:10	06:00 20:47	05:41 21:14	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	17:47 (T-35) 18:20 (T-35)	07:23 17:00	07:57 16:47				
16	08:01 17:14	07:27 17:56	07:39 19:33	18:20 (T-35) 20:12	06:43 20:48	05:41 21:14	05:56 21:11	06:30 20:34	07:07 19:39	07:43 18:42	17:48 (T-35) 18:19 (T-35)	07:25 16:59	07:58 16:48				
17	08:00 17:15	07:26 17:58	07:37 19:34	18:22 (T-35) 20:13	06:41 20:49	05:41 21:15	05:57 21:10	06:31 20:33	07:08 19:38	07:44 18:41	17:49 (T-35) 18:17 (T-35)	07:26 16:58	07:59 16:48				
18	08:00 17:16	07:24 17:59	07:36 19:35	18:26 (T-35) 20:14	06:39 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:36	07:46 18:39	18:17 (T-35) 18:14 (T-35)	07:27 16:57	07:59 16:48				
19	07:59 17:17	07:23 18:01	07:34 19:37	18:51 (T-05) 20:15	06:38 20:52	05:41 21:16	05:59 21:08	06:34 20:29	07:10 19:34	07:47 18:37	18:14 (T-35) 18:13 (T-35)	07:29 16:56	08:00 16:48				
20	07:58 17:19	07:21 18:02	07:32 19:38	18:52 (T-05) 20:17	06:36 20:53	05:41 21:16	06:00 21:08	06:35 20:28	07:11 19:32	07:48 18:36	18:13 (T-35) 18:11 (T-35)	07:30 16:49	08:01 16:49				
21	07:58 17:20	07:20 18:03	07:30 19:39	18:56 (T-05) 20:18	06:34 20:54	05:42 21:16	06:01 21:07	06:36 20:26	07:12 19:30	07:50 18:34	18:11 (T-35) 18:10 (T-35)	07:31 16:55	08:01 16:49				
22	07:57 17:21	07:18 18:03	07:28 19:40	19:02 (T-05) 20:19	06:33 20:55	05:42 21:16	06:02 21:06	06:37 20:25	07:14 19:28	07:51 18:32	18:10 (T-35) 18:08 (T-35)	07:33 16:54	08:02 16:50				
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 20:20	06:31 20:56	05:42 21:17	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:50	18:08 (T-05) 18:35 (T-05)	07:34 16:53	08:02 16:50				
24	07:55 17:24	07:15 18:06	07:24 19:43	06:29 20:22	06:29 20:57	05:42 21:17	06:04 21:04	06:39 20:21	07:16 19:24	07:54 18:52	18:35 (T-05) 18:05 (T-35)	07:35 16:52	08:03 16:51				
25	07:54 17:25	07:13 18:08	07:23 19:44	06:28 20:23	06:28 20:58	05:43 21:17	06:05 21:03	06:41 20:19	07:17 19:22	07:55 18:53	18:11 (T-35) 18:03 (T-35)	07:36 16:52	08:03 16:52				
26	07:54 17:27	07:11 18:09	07:21 19:45	06:26 20:24	06:26 20:59	05:43 21:17	06:06 21:02	06:42 20:18	07:18 19:21	07:56 18:05	18:05 (T-35) 18:53 (T-05)	07:38 16:51	08:03 16:52				
27	07:53 17:28	07:10 18:10	07:19 19:47	06:25 20:25	06:25 21:00	05:43 21:17	06:07 21:01	06:43 20:16	07:20 19:19	07:58 18:03	18:03 (T-35) 18:54 (T-05)	07:39 16:50	08:04 16:53				
28	07:52 17:30	07:08 18:12	07:17 19:48	06:23 20:27	06:23 21:01	05:44 21:17	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:00	18:00 (T-35) 18:52 (T-05)	07:40 16:50	08:04 16:54				
29	07:51 17:31	07:07 18:15	07:15 19:49	06:21 20:28	06:21 21:02	05:44 21:17	06:09 20:59	06:45 20:13	07:22 19:15	08:00 17:58	18:50 (T-05) 18:50 (T-05)	07:41 16:49	08:04 16:54				
30	07:50 17:32	07:06 18:13	07:13 19:50	06:20 20:29	06:20 21:03	05:45 21:17	06:10 20:58	06:47 20:11	07:23 19:13	08:02 17:55	18:52 (T-35) 18:48 (T-05)	07:43 16:49	08:04 16:55				
31	07:48 17:34	07:05 18:14	07:11 19:52	06:19 21:04	06:19 21:04	05:46 21:17	06:12 20:56	06:48 20:09	08:03 18:19	08:03 18:19	18:48 (T-05) 18:48 (T-05)	07:45 16:56	08:05 16:56				
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275					
Total, worst case		244		866					298		823						
Sun reduction		0.58		0.59					0.67		0.56						
Oper. time red.		0.90		0.90					0.90		0.90						
Wind dir. red.		0.58		0.58					0.58		0.58						
Total reduction		0.30		0.31					0.35		0.29						
Total, real		74		266					104		241						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-201 - R-201

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05 16:57	07:47 17:35	07:06 18:13	07:38 (T-06) 18:13	07:10 19:53	06:19 21:05
2	08:05 16:58	07:46 17:37	07:05 18:14	07:39 (T-06) 18:14	07:08 19:54	06:17 21:05
3	08:05 16:59	07:45 17:38	07:03 18:16	07:41 (T-06) 18:16	07:06 19:55	06:16 21:06
4	08:05 17:00	07:44 17:40	07:01 18:17	07:54 (T-06) 18:17	07:04 19:57	06:14 21:07
5	08:05 17:01	07:43 17:41	06:59 18:18		07:02 19:58	06:13 21:08
6	08:05 17:02	07:41 17:42	06:58 18:20		07:01 19:59	06:11 21:09
7	08:04 17:03	07:40 17:44	06:56 18:21		06:59 20:00	06:10 21:09
8	08:04 17:04	07:39 17:45	07:54 18:22		06:57 20:02	06:09 21:10
9	08:04 17:05	07:37 17:47	07:52 19:24		06:55 20:03	06:07 21:11
10	08:04 17:06	07:36 17:48	07:50 19:25		06:53 20:04	06:06 21:11
11	08:03 17:08	07:35 17:49	07:49 19:26		06:52 20:05	06:05 21:12
12	08:03 17:09	07:33 17:51	07:47 19:28		06:50 20:07	06:04 21:13
13	08:03 17:10	07:32 17:52	07:53 (T-06) 19:29		06:48 20:08	06:02 21:13
14	08:02 17:11	07:30 17:54	07:52 (T-06) 19:30		06:46 20:09	06:01 21:14
15	08:02 17:12	07:29 17:55	07:50 (T-06) 19:31		06:44 20:10	06:00 21:14
16	08:01 17:14	07:27 17:57	08:01 (T-06) 19:33		06:43 20:12	05:59 21:15
17	08:01 17:15	07:26 17:58	07:49 (T-06) 19:34		06:41 20:13	05:58 21:15
18	08:00 17:16	07:24 17:59	08:03 (T-06) 19:35		06:39 20:14	05:57 21:15
19	07:59 17:17	07:23 18:01	07:44 (T-06) 19:37		06:38 20:15	05:56 21:16
20	07:59 17:19	07:21 18:01	08:04 (T-06) 19:38		06:36 20:17	05:55 21:16
21	07:58 17:20	07:20 18:02	07:41 (T-06) 19:39		06:34 20:18	05:54 21:16
22	07:57 17:21	07:18 18:03	08:05 (T-06) 19:40		06:33 20:19	05:53 21:16
23	07:56 17:23	07:16 18:05	07:37 (T-06) 19:42		06:31 20:20	05:52 21:17
24	07:55 17:24	07:15 18:06	08:04 (T-06) 19:43		06:29 20:22	05:51 21:17
25	07:54 17:26	07:13 18:08	07:35 (T-06) 19:44		06:28 20:23	05:50 21:17
26	07:54 17:27	07:11 18:09	08:03 (T-06) 19:45		06:26 20:24	05:50 21:17
27	07:53 17:28	07:10 18:10	07:35 (T-06) 19:47		06:25 20:25	05:49 21:17
28	07:52 17:30	07:08 18:12	08:01 (T-06) 19:48		06:23 20:27	05:48 21:17
29	07:51 17:31		07:15 19:49		06:22 20:28	05:47 21:17
30	07:50 17:32		07:13 19:50		06:20 20:29	05:47 21:17
31	07:48 17:34		07:12 19:52		06:19 20:30	05:46 21:17
Potential sun hours	287	292	369	404	459	465
Total, worst case		324	52	219		
Sun reduction		0.58	0.59	0.63		
Oper. time red.		0.90	0.90	0.90		
Wind dir. red.		0.62	0.62	0.57		
Total reduction		0.33	0.33	0.32		
Total, real		105	17	71		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-201 - R-201
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-07) 20:07	07:24 19:11	07:04 17:17
2	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-07) 07:21 (T-07)	07:26 19:09	07:06 17:16
3	05:46 21:17	06:15 20:53	06:51 20:04	07:13 (T-07) 07:19 (T-07)	07:27 19:07	07:07 17:14
4	05:47 21:16	06:16 20:52	06:52 20:02	07:14 (T-07) 07:17 (T-07)	07:28 19:06	07:09 17:13
5	05:48 21:16	06:17 20:50	06:54 20:00	07:19 (T-07)	07:29 19:04	07:10 17:12
6	05:48 21:16	06:18 20:49	06:55 19:58	07:22 (T-07)	07:31 19:02	07:11 17:10
7	05:49 21:16	06:20 20:48	06:56 19:56	07:23 (T-07)	07:32 19:00	07:13 17:09
8	05:50 21:15	06:21 20:46	06:57 19:54	07:24 (T-07)	07:33 18:56	07:14 17:08
9	05:51 21:15	06:22 20:45	06:58 19:53	07:25 (T-07)	07:34 18:55	07:15 17:07
10	05:51 21:14	06:23 20:43	07:00 19:51	07:26 (T-07)	07:36 18:53	07:17 17:06
11	05:52 21:14	06:24 20:42	07:01 19:49	07:27 (T-07)	07:37 18:51	07:18 17:04
12	05:53 21:13	06:25 20:40	07:02 19:47	07:28 (T-07)	07:38 18:49	07:19 17:03
13	05:54 21:13	06:27 20:39	07:03 19:45	07:29 (T-07)	07:39 18:48	07:21 17:02
14	05:55 21:12	06:28 20:37	07:04 19:43	07:30 (T-07)	07:41 18:46	07:22 17:01
15	05:55 21:11	06:29 20:36	07:05 19:41	07:31 (T-07)	07:42 18:44	07:23 17:00
16	05:56 21:11	06:30 20:34	07:07 19:39	07:32 (T-07)	07:43 18:42	07:25 16:59
17	05:57 21:10	06:31 20:33	07:08 19:38	07:33 (T-07)	07:45 18:41	07:26 16:58
18	05:58 21:09	06:32 20:31	07:09 19:36	07:34 (T-07)	07:46 18:39	07:27 16:57
19	05:59 21:08	06:34 20:30	07:10 19:34	07:35 (T-07)	07:47 18:37	07:29 16:56
20	06:00 21:08	06:35 20:28	07:11 (T-07) 07:17 (T-07)	07:36 (T-07)	07:48 18:36	07:30 16:55
21	06:01 21:07	06:36 20:26	07:18 (T-07) 07:20 (T-07)	07:37 (T-07)	07:50 18:34	07:31 16:55
22	06:02 21:06	06:37 20:25	07:06 (T-07) 07:22 (T-07)	07:38 (T-07)	07:51 18:32	07:33 16:54
23	06:03 21:05	06:38 20:23	07:05 (T-07) 07:23 (T-07)	07:39 (T-07)	07:52 18:31	07:34 16:53
24	06:04 21:04	06:40 20:21	07:03 (T-07) 07:24 (T-07)	07:40 (T-07)	07:54 18:29	07:35 16:52
25	06:05 21:03	06:41 20:20	07:03 (T-07) 07:24 (T-07)	07:41 (T-07)	07:55 18:28	07:36 16:52
26	06:06 21:02	06:42 20:18	07:04 (T-07) 07:24 (T-07)	07:42 (T-07)	07:56 18:26	07:38 16:51
27	06:07 21:01	06:43 20:16	07:05 (T-07) 07:24 (T-07)	07:43 (T-07)	07:58 18:25	07:39 16:51
28	06:08 21:00	06:44 20:14	07:06 (T-07) 07:24 (T-07)	07:44 (T-07)	07:59 18:23	07:40 16:50
29	06:09 20:59	06:45 20:13	07:07 (T-07) 07:23 (T-07)	07:45 (T-07)	08:00 18:22	07:41 16:50
30	06:11 20:58	06:47 20:11	07:09 (T-07) 07:24 (T-07)	07:46 (T-07)	08:02 18:20	07:43 16:49
31	06:12 20:56	06:48 20:09	07:10 (T-07) 07:23 (T-07)	07:47 (T-07)	08:03 18:19	07:44 16:49
Potential sun hours	471	436	377	341	288	275
Total, worst case						
Sun reduction		0.72	0.67	0.56		
Oper. time red.		0.90	0.90	0.90		
Wind dir. red.		0.57	0.57	0.62		
Total reduction		0.37	0.34	0.31		
Total, real		72	10	121		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-203 - R-203

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05 16:57	07:47 17:35	07:06 18:13	07:39 (T-83) 07:10	06:19 20:30	05:46 21:04
2	08:05 16:58	07:46 17:37	07:04 18:14	07:51 (T-83) 19:53	06:17 20:31	05:45 21:05
3	08:05 16:59	07:45 17:38	07:03 18:16	07:06 19:55	06:16 20:33	05:44 21:06
4	08:05 17:00	07:44 17:40	07:01 18:17	07:04 19:57	06:14 20:34	05:44 21:07
5	08:05 17:01	07:42 17:41	06:59 18:18	07:02 19:58	06:13 20:35	05:44 21:08
6	08:04 17:02	07:41 17:42	06:57 18:20	07:00 19:59	06:11 20:36	05:43 21:08
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	06:10 20:37	05:43 21:09
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	06:09 20:39	05:42 21:10
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 20:03	06:07 20:40	05:42 21:10
10	08:04 17:06	07:36 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11
11	08:03 17:08	07:35 17:49	07:48 19:26	06:51 20:05	06:05 20:42	05:42 21:12
12	08:03 17:09	07:33 17:51	07:47 19:28	06:50 20:07	06:04 20:43	05:42 21:12
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	06:02 20:45	05:41 21:13
14	08:02 17:11	07:30 17:54	07:51 (T-83) 07:43	06:46 20:09	06:01 20:46	05:41 21:13
15	08:01 17:12	07:29 17:55	07:50 (T-83) 07:41	06:44 20:10	06:00 20:47	05:41 21:14
16	08:01 17:14	07:27 17:57	07:48 (T-83) 07:39	06:43 20:12	05:59 20:48	05:41 21:14
17	08:00 17:15	07:26 17:58	07:47 (T-83) 07:37	06:41 20:13	05:58 20:49	05:41 21:15
18	08:00 17:16	07:24 17:59	07:45 (T-83) 07:36	06:39 20:14	05:57 20:50	05:41 21:15
19	07:59 17:17	07:23 18:01	07:44 (T-83) 07:34	06:38 20:15	05:56 20:51	05:41 21:15
20	07:58 17:19	07:21 18:01	07:42 (T-83) 07:32	06:36 20:17	05:55 20:52	05:42 21:16
21	07:58 17:20	07:19 18:02	07:40 (T-83) 07:30	06:34 20:18	05:54 20:54	05:42 21:16
22	07:57 17:21	07:18 18:03	07:39 (T-83) 07:28	06:33 20:19	05:53 20:55	05:42 21:16
23	07:56 17:23	07:16 18:05	07:37 (T-83) 07:26	06:31 20:20	05:52 20:56	05:42 21:16
24	07:55 17:24	07:15 18:06	07:35 (T-83) 07:24	06:29 20:21	05:51 20:57	05:43 21:17
25	07:54 17:26	07:13 18:08	07:34 (T-83) 07:23	06:28 20:23	05:50 20:58	05:43 21:17
26	07:53 17:27	07:11 18:09	07:34 (T-83) 07:21	06:26 20:24	05:50 20:59	05:43 21:17
27	07:52 17:28	07:10 18:10	07:35 (T-83) 07:19	06:25 20:25	05:49 21:00	05:44 21:17
28	07:51 17:30	07:08 18:12	07:37 (T-83) 07:17	06:23 20:26	05:48 21:01	05:44 21:17
29	07:50 17:31		07:15 19:49	06:22 20:28	05:47 21:02	05:44 21:17
30	07:49 17:32		07:13 19:50	06:20 20:29	05:47 21:03	05:45 21:17
31	07:48 17:34		07:11 19:52	06:19 21:03	05:46 21:03	05:45 21:17
Potential sun hours	287	292	369	403	458	465
Total, worst case						
Sun reduction		240	12		591	719
Oper. time red.		0.58	0.59		0.66	0.73
Wind dir. red.		0.90	0.90		0.90	0.90
Total reduction		0.62	0.62		0.63	0.63
Total, real		0.32	0.33		0.38	0.42
		78	4		222	299

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-203 - R-203
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	20:13 (T-33)	06:13	20:13 (T-33)	06:49	07:24
	21:17	24 20:37 (T-33)	20:55	16 20:29 (T-33)	20:07	19:11
2	05:46	20:12 (T-33)	06:14	20:14 (T-33)	06:50	07:26
	21:17	25 20:37 (T-33)	20:54	13 20:27 (T-33)	20:05	19:09
3	05:47	20:13 (T-33)	06:15	20:14 (T-33)	06:51	07:27
	21:16	25 20:38 (T-33)	20:53	12 20:26 (T-33)	20:04	19:07
4	05:47	20:13 (T-33)	06:16	20:16 (T-33)	06:52	07:28
	21:16	26 20:39 (T-33)	20:51	10 20:26 (T-33)	20:02	19:06
5	05:48	20:12 (T-33)	06:17	20:17 (T-33)	06:54	07:29
	21:16	27 20:39 (T-33)	20:50	7 20:24 (T-33)	20:00	19:04
6	05:48	20:12 (T-33)	06:19	20:19 (T-33)	06:55	07:31
	21:16	28 20:40 (T-33)	20:49	4 20:23 (T-33)	19:58	19:02
7	05:49	20:13 (T-33)	06:20	20:21 (T-33)	06:56	07:32
	21:15	28 20:41 (T-33)	20:47	1 20:22 (T-33)	19:56	19:00
8	05:50	20:12 (T-33)	06:21		06:57	07:33
	21:15	29 20:41 (T-33)	20:46		19:54	18:56
9	05:51	20:12 (T-33)	06:22		06:58	07:34
	21:15	29 20:41 (T-33)	20:45		19:53	18:55
10	05:51	20:12 (T-33)	06:23		06:59	07:36
	21:14	30 20:42 (T-33)	20:43		19:51	18:53
11	05:52	20:11 (T-33)	06:24		07:01	07:37
	21:14	31 20:42 (T-33)	20:42		19:49	18:51
12	05:53	20:11 (T-33)	06:25		07:02	07:38
	21:13	32 20:43 (T-33)	20:40		19:47	18:49
13	05:54	20:11 (T-33)	06:27		07:03	07:39
	21:12	32 20:43 (T-33)	20:39		19:45	18:48
14	05:55	20:11 (T-33)	06:28		07:04	07:41
	21:12	33 20:44 (T-33)	20:37		19:43	18:46
15	05:56	20:11 (T-33)	06:29		07:05	07:42
	21:11	33 20:44 (T-33)	20:36		19:41	18:44
16	05:56	20:11 (T-33)	06:30		07:07	07:43
	21:11	33 20:44 (T-33)	20:34		19:39	18:42
17	05:57	20:10 (T-33)	06:31		07:08	07:44
	21:10	32 20:42 (T-33)	20:33		19:38	18:41
18	05:58	20:10 (T-33)	06:32		07:09	07:46
	21:09	32 20:42 (T-33)	20:31		19:36	18:39
19	05:59	20:10 (T-33)	06:34		07:10	07:47
	21:08	31 20:41 (T-33)	20:29		19:34	18:37
20	06:00	20:10 (T-33)	06:35		07:11	07:48
	21:07	30 20:40 (T-33)	20:28		19:32	18:36
21	06:01	20:10 (T-33)	06:36		07:12	07:50
	21:07	30 20:40 (T-33)	20:26		19:30	18:34
22	06:02	20:10 (T-33)	06:37		07:14	07:51
	21:06	29 20:39 (T-33)	20:24		19:28	18:32
23	06:03	20:11 (T-33)	06:38		07:15	07:52
	21:05	27 20:38 (T-33)	20:23		19:26	18:31
24	06:04	20:11 (T-33)	06:40		07:16	07:54
	21:04	26 20:37 (T-33)	20:21		19:24	18:29
25	06:05	20:11 (T-33)	06:41		07:17	07:55
	21:03	25 20:36 (T-33)	20:19		19:22	18:28
26	06:06	20:11 (T-33)	06:42		07:18	07:56
	21:02	24 20:35 (T-33)	20:18		19:21	18:26
27	06:07	20:11 (T-33)	06:43		07:20	07:58
	21:01	23 20:34 (T-33)	20:16		19:19	18:25
28	06:08	20:11 (T-33)	06:44		07:21	07:59
	21:00	22 20:33 (T-33)	20:14		19:17	18:23
29	06:10	20:12 (T-33)	06:45		07:22	08:00
	20:59	20 20:32 (T-33)	20:12		19:15	18:22
30	06:11	20:12 (T-33)	06:47		07:23	08:02
	20:57	19 20:31 (T-33)	20:11		19:13	18:20
31	06:12	20:13 (T-33)	06:48			08:03
	20:56	17 20:30 (T-33)	20:09			18:19
Potential sun hours	471		436		377	341
Total, worst case	852		63		257	
Sun reduction	0.75		0.72		0.56	
Oper. time red.	0.90		0.90		0.90	
Wind dir. red.	0.63		0.63		0.62	
Total reduction	0.43		0.41		0.31	
Total, real	364		26		80	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L085 73 GE3.8-154 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-204 - R-204 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with columns for months (January-December) and rows for time slots (08:05-17:34) and summary rows (Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, Total, real).

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) Minutes with flicker First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)

Project: South Deuel Wind Project

Description: Invenery Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L085 73 GE3.8-154 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-205 - R-205 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with 13 columns (months) and rows for each day of the year, including start/end times, shadow reduction percentages, and total real reduction. Includes summary rows at the bottom: Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, Total, real.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker (WTG causing flicker first time) Sun set (hh:mm) Minutes with flicker Last time (hh:mm) with flicker (WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-209 - R-209
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:10	06:19	05:46	06:12 (T-34)	05:46	06:13	06:49	07:25	07:04
	16:57	17:35	18:13	19:53	20:30	21:04	06:20 (T-34)	21:17	20:55	20:07	19:11	17:17
2	08:05	07:46	08:08 (T-39)	07:05	07:08	06:17	06:15 (T-34)	05:46	06:14	06:50	07:26	07:06
	16:58	17:37	08:09 (T-39)	18:14	19:54	20:31	06:19 (T-34)	21:17	20:54	20:05	19:09	17:16
3	08:05	07:45	08:07 (T-39)	07:03	07:06	06:16		05:47	06:15	06:51	07:27	07:07
	16:59	17:38	08:10 (T-39)	18:16	19:55	20:33		21:17	20:53	20:04	19:08	17:15
4	08:05	07:44	08:06 (T-39)	07:01	07:04	06:14		05:47	06:16	06:53	07:28	07:08
	17:00	17:40	08:10 (T-39)	18:17	19:57	20:34		21:16	20:51	20:02	19:06	17:13
5	08:05	07:43	08:04 (T-39)	06:59	07:02	06:13		05:48	06:17	06:54	07:29	07:10
	17:01	17:41	08:10 (T-39)	18:18	19:58	20:35		21:08	20:50	20:00	19:04	17:12
6	08:05	07:41	08:03 (T-39)	06:58	07:01	06:12		05:49	06:19	06:55	07:31	07:11
	17:02	17:43	08:10 (T-39)	18:20	19:59	20:36		21:08	20:49	19:58	19:02	17:11
7	08:04	07:40	08:02 (T-39)	06:56	06:59	06:10		05:49	06:20	06:56	07:32	07:13
	17:03	17:44	08:09 (T-39)	18:21	20:00	20:38		21:09	20:47	19:56	19:00	17:09
8	08:04	07:39	08:00 (T-39)	06:54	06:57	06:09		05:50	06:21	06:57	07:33	07:14
	17:04	17:45	08:10 (T-39)	18:22	20:02	20:39		21:10	20:46	19:54	18:57	17:08
9	08:04	07:37	08:00 (T-39)	07:52	06:55	06:08		05:51	06:22	06:58	07:34	07:15
	17:05	17:47	08:06 (T-39)	19:24	20:03	20:40		21:11	20:45	19:53	18:55	17:07
10	08:04	07:36	07:50	06:53	06:06	05:42		05:51	06:23	07:00	07:36	07:17
	17:07	17:48	19:25	20:04	20:41	21:11		21:14	20:43	19:51	18:53	17:06
11	08:03	07:35	07:49	06:52	06:05	05:42		05:52	06:24	07:01	07:37	07:18
	17:08	17:50	19:26	20:05	20:42	21:12		21:14	6 06:27 (T-34)	20:42	19:49	18:51
12	08:03	07:33	07:47	06:50	06:04	05:42		05:53	6 06:19 (T-34)	06:26	07:02	07:38
	17:09	17:51	19:28	20:07	20:44	21:12		21:13	9 06:28 (T-34)	20:40	19:47	18:49
13	08:02	07:32	07:45	06:48	06:03	05:42		05:54	06:19 (T-34)	06:27	07:03	07:39
	17:10	17:52	19:29	20:08	20:45	21:13		21:13	10 06:29 (T-34)	20:39	19:45	18:48
14	08:02	07:30	07:43	06:46	06:01	05:41		05:55	06:19 (T-34)	06:28	07:04	07:41
	17:11	17:54	19:30	20:09	20:46	21:13		21:12	12 06:31 (T-34)	20:37	19:43	18:46
15	08:02	07:29	07:41	06:45	06:00	05:41		05:56	06:20 (T-34)	06:29	07:05	07:42
	17:13	17:55	19:32	20:10	20:47	21:14		21:11	11 06:31 (T-34)	20:36	19:41	18:44
16	08:01	07:27	07:39	06:43	05:59	05:41		05:57	06:21 (T-34)	06:30	07:07	07:43
	17:14	17:57	19:33	20:12	20:48	2 06:23 (T-34)	21:14	21:11	11 06:32 (T-34)	20:34	19:40	18:42
17	08:00	07:26	07:38	06:41	05:58	06:20 (T-34)	05:41	05:57	06:22 (T-34)	06:31	07:08	07:45
	17:15	17:58	19:34	20:13	20:49	3 06:23 (T-34)	21:15	21:10	11 06:33 (T-34)	20:33	19:38	18:41
18	08:00	07:24	07:36	06:39	05:57	06:19 (T-34)	05:42	05:58	06:22 (T-34)	06:33	07:09	07:46
	17:16	17:59	19:35	20:14	20:50	4 06:23 (T-34)	21:15	21:09	11 06:33 (T-34)	20:31	19:36	18:39
19	07:59	07:23	07:34	06:38	05:56	06:18 (T-34)	05:42	05:59	10 06:23 (T-34)	06:34	07:10	07:47
	17:18	18:01	19:37	20:15	20:51	6 06:24 (T-34)	21:16	21:08	10 06:33 (T-34)	20:29	19:34	18:37
20	07:58	07:21	07:32	06:36	05:55	06:17 (T-34)	05:42	06:00	10 06:24 (T-34)	06:35	07:11	07:48
	17:19	18:01	19:38	20:17	20:53	7 06:24 (T-34)	21:16	21:08	10 06:34 (T-34)	20:28	19:32	18:36
21	07:58	07:20	07:30	06:34	05:54	06:17 (T-34)	05:42	06:01	9 06:25 (T-34)	06:36	07:13	07:50
	17:20	18:02	19:39	20:18	20:54	8 06:25 (T-34)	21:16	21:07	9 06:34 (T-34)	20:26	19:30	18:34
22	07:57	07:18	07:28	06:33	05:53	06:16 (T-34)	05:42	06:02	8 06:26 (T-34)	06:37	07:14	07:51
	17:22	18:04	19:40	20:19	20:55	8 06:24 (T-34)	21:16	21:06	8 06:34 (T-34)	20:25	19:28	18:32
23	07:56	07:16	07:26	06:31	05:52	06:15 (T-34)	05:42	06:03	06:27 (T-34)	06:38	07:15	07:52
	17:23	18:05	19:42	20:20	20:56	9 06:24 (T-34)	21:17	21:05	7 06:34 (T-34)	20:23	19:26	18:31
24	07:55	07:15	07:25	06:29	05:51	06:14 (T-34)	05:43	06:04	06:28 (T-34)	06:40	07:16	07:54
	17:24	18:06	19:43	20:22	20:57	10 06:24 (T-34)	21:17	21:04	6 06:34 (T-34)	20:21	19:24	18:29
25	07:54	07:13	07:23	06:28	05:50	06:13 (T-34)	05:43	06:05	06:29 (T-34)	06:41	07:17	07:55
	17:26	18:08	19:44	20:23	20:58	10 06:23 (T-34)	21:17	21:03	5 06:34 (T-34)	20:19	19:23	18:28
26	07:53	07:11	07:21	06:26	05:50	06:13 (T-34)	05:43	06:06	06:30 (T-34)	06:42	07:18	07:56
	17:27	18:09	19:45	20:24	20:59	11 06:24 (T-34)	21:17	21:02	4 06:34 (T-34)	20:18	19:21	18:26
27	07:53	07:10	07:19	06:25	05:49	06:12 (T-34)	05:44	06:07	06:31 (T-34)	06:43	07:20	07:58
	17:28	18:10	19:47	20:25	21:00	11 06:23 (T-34)	21:17	21:01	3 06:34 (T-34)	20:16	19:19	18:25
28	07:52	07:08	07:17	06:23	05:48	06:11 (T-34)	05:44	06:09	06:32 (T-34)	06:44	07:21	07:59
	17:30	18:12	19:48	20:27	21:01	11 06:22 (T-34)	21:17	21:00	1 06:33 (T-34)	20:14	19:17	18:23
29	07:51		07:15	06:22	05:48	06:11 (T-34)	05:45	06:10		06:46	07:22	08:00
	17:31		19:49	20:28	21:02	12 06:23 (T-34)	21:17	20:59		20:13	19:15	18:22
30	07:49		07:13	06:20	05:47	06:10 (T-34)	05:45	06:11		06:47	07:23	08:02
	17:33		19:50	20:29	21:03	12 06:22 (T-34)	21:17	20:58		20:11	19:13	18:20
31	07:48		07:12		05:46	06:12 (T-34)		06:12		06:48	07:24	08:03
	17:34		19:52		21:04	9 06:21 (T-34)		20:56		20:09	18:19	17:26
Potential sun hours	287	292	369	403	458	465		471		436	377	341
Total, worst case		42			133			144				289
Sun reduction		0.58			0.66			0.75				0.48
Oper. time red.		0.90			0.90			0.90				0.90
Wind dir. red.		0.64			0.59			0.59				0.64
Total reduction		0.33			0.35			0.40				0.28
Total, real		14			47			58				11

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-212 - R-212
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05 16:57	07:47 17:35	07:06 18:13									
2	08:05 16:58	07:46 17:37	07:05 18:14									
3	08:05 16:59	07:45 17:38	07:03 18:16									
4	08:05 17:00	07:44 17:40	07:01 18:17									
5	08:05 17:01	07:43 17:41	06:59 18:18									
6	08:05 17:02	07:41 17:43	06:58 18:20									
7	08:04 17:03	07:40 17:44	06:56 18:21	07:16 (T-33)								
8	08:04 17:04	07:39 17:45	07:54 18:22	07:17 (T-33)								
9	08:04 17:05	07:37 17:47	07:52 19:24	08:14 (T-33)								
10	08:04 17:07	07:36 17:48	07:50 19:25	08:17 (T-33)								
11	08:03 17:08	07:35 17:50	07:49 19:26	08:18 (T-33)								
12	08:03 17:09	07:33 17:51	07:47 19:28	08:19 (T-33)								
13	08:03 17:10	07:32 17:52	07:45 19:29	08:07 (T-33)								
14	08:02 17:11	07:30 17:54	07:43 19:30	08:08 (T-33)								
15	08:02 17:13	07:29 17:55	07:41 19:32	08:03 (T-33)								
16	08:01 17:14	07:27 17:57	07:39 19:33	08:17 (T-33)								
17	08:00 17:15	07:26 17:58	07:38 19:34	08:02 (T-33)								
18	08:00 17:16	07:24 17:59	07:36 19:35	08:13 (T-33)								
19	07:59 17:18	07:23 18:01	07:34 19:37	07:56 (T-34)								
20	07:58 17:19	07:21 18:01	07:32 19:38	07:54 (T-34)								
21	07:58 17:20	07:20 18:02	07:30 19:39	07:52 (T-34)								
22	07:57 17:22	07:18 18:04	07:28 19:40	07:50 (T-34)								
23	07:56 17:23	07:16 18:05	07:26 19:42	07:49 (T-34)								
24	07:55 17:24	07:15 18:06	07:25 19:43	07:47 (T-34)								
25	07:54 17:26	07:13 18:08	07:23 19:44	07:53 (T-34)								
26	07:54 17:27	07:11 18:09	07:21 19:45	06:29 (T-33)								
27	07:53 17:28	07:10 18:10	07:19 19:47	06:28 (T-33)								
28	07:52 17:30	07:08 18:12	07:17 19:48	06:27 (T-33)								
29	07:51 17:31		07:15 19:49	06:26 (T-33)								
30	07:50 17:33		07:13 19:50	06:25 (T-33)								
31	07:48 17:34		07:12 19:52	06:24 (T-33)								
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case			142									
Sun reduction			0.59									
Oper. time red.			0.90									
Wind dir. red.			0.60									
Total reduction			0.32									
Total, real			45									

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker (WTG causing flicker first time)
	Sun set (hh:mm)	Last time (hh:mm) with flicker (WTG causing flicker last time)
	Minutes with flicker	

Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-215 - R-215
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:05	07:47	07:06	07:27 (T-23)	07:10	06:19	05:46	05:45	06:13	06:49	07:25	07:04	07:44	
	16:57	17:35	18:13	11 07:38 (T-23)	19:53	20:30	21:05	21:17	20:55	20:07	19:11	17:17	16:49	
2	08:05	07:46	07:05	07:25 (T-23)	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45	
	16:58	17:37	18:14	12 07:37 (T-23)	19:54	20:32	21:05	21:17	20:54	20:06	19:09	17:16	16:48	
3	08:05	07:45	07:03	07:24 (T-23)	07:06	06:16	05:45	05:47	06:15	06:51	07:27	07:07	07:46	
	16:59	17:38	18:16	14 07:38 (T-23)	19:56	20:33	21:06	21:17	20:53	20:04	19:08	17:14	16:48	
4	08:05	07:44	07:01	07:22 (T-23)	07:04	06:14	05:44	05:47	06:16	06:53	07:28	07:09	07:47	
	17:00	17:40	18:17	15 07:37 (T-23)	19:57	20:34	21:07	21:16	20:52	20:02	19:06	17:13	16:48	
5	08:05	07:43	06:59	07:22 (T-23)	07:02	06:13	05:44	05:48	06:17	06:54	07:29	07:10	07:48	
	17:01	17:41	18:18	13 07:35 (T-23)	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:48	
6	08:05	07:41	06:58	07:24 (T-23)	07:01	06:11	05:43	05:48	06:19	06:55	07:31	07:11	07:49	
	17:02	17:42	18:20	9 07:33 (T-23)	19:59	20:36	21:09	21:16	20:49	19:58	19:02	17:11	16:47	
7	08:05	07:40	06:56	07:24 (T-23)	06:59	06:10	05:43	05:49	06:20	06:56	07:32	08:01 (T-23)	07:13	07:50
	17:03	17:44	18:21	20:01	20:38	21:09	21:16	20:48	19:56	19:00	6 08:07 (T-23)	17:09	16:47	
8	08:04	07:39	07:54	06:57	06:09	05:43	05:50	06:21	06:57	07:33	07:58 (T-23)	07:14	07:51	
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:55	18:57	11 08:09 (T-23)	17:08	16:47	
9	08:04	07:37	07:52	06:55	06:07	05:42	05:51	06:22	06:58	07:34	07:57 (T-23)	07:15	07:52	
	17:05	17:47	19:24	20:03	20:40	21:11	21:15	20:45	19:53	18:55	14 08:11 (T-23)	17:07	16:47	
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	07:00	07:36	07:57 (T-23)	07:17	07:53	
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	14 08:11 (T-23)	17:06	16:47	
11	08:03	07:35	07:49	06:52	06:05	05:42	05:52	06:24	07:01	07:37	07:58 (T-23)	07:18	07:54	
	17:08	17:50	19:26	20:06	20:42	21:12	21:14	20:42	19:49	18:51	13 08:11 (T-23)	17:04	16:47	
12	08:03	07:33	07:47	06:50	06:04	05:42	05:53	06:26	07:02	07:38	08:00 (T-23)	07:19	07:55	
	17:09	17:51	19:28	20:07	20:44	21:13	21:13	20:40	19:47	18:49	12 08:12 (T-23)	17:03	16:47	
13	08:03	07:32	07:45	06:48	06:03	05:41	05:54	06:27	07:03	07:39	08:01 (T-23)	07:21	07:56	
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:48	10 08:11 (T-23)	17:02	16:47	
14	08:02	07:30	07:43	06:46	06:01	05:41	05:55	06:28	07:04	07:41	08:02 (T-23)	07:22	07:57	
	17:11	17:54	19:30	20:09	20:46	21:14	21:12	20:37	19:43	18:46	8 08:10 (T-23)	17:01	16:47	
15	08:02	07:29	07:41	06:45	06:00	05:41	05:56	06:29	07:05	07:42	08:04 (T-23)	07:23	07:57	
	17:12	17:55	19:32	20:11	20:47	21:14	21:11	20:36	19:41	18:44	5 08:09 (T-23)	17:00	16:47	
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:07	07:43	08:05 (T-23)	07:25	07:58	
	17:14	17:57	19:33	20:12	20:48	21:15	21:11	20:34	19:40	18:42	2 08:07 (T-23)	16:59	16:48	
17	08:01	07:26	07:38	06:41	05:58	05:41	05:57	06:31	07:08	07:45		07:26	07:59	
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:38	18:41		16:58	16:48	
18	08:00	07:24	07:36	06:39	05:57	05:41	05:58	06:33	07:09	07:46		07:27	07:59	
	17:16	17:59	19:35	20:14	20:51	21:15	21:09	20:31	19:36	18:39		16:57	16:48	
19	07:59	07:23	07:34	06:38	05:56	05:42	05:59	06:34	07:10	07:47		07:29	08:00	
	17:18	18:01	19:37	20:15	20:52	21:16	21:09	20:30	19:34	18:37		16:56	16:49	
20	07:59	07:21	07:32	06:36	05:55	05:42	06:00	06:35	07:11	07:48		07:30	08:01	
	17:19	18:01	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:36		16:56	16:49	
21	07:58	07:20	07:30	06:34	05:54	05:42	06:01	06:36	07:13	07:50		07:31	08:01	
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34		16:55	16:50	
22	07:57	07:18	07:28	06:33	05:53	05:42	06:02	06:37	07:14	07:51		07:33	08:02	
	17:22	18:04	19:40	20:19	20:55	21:17	21:06	20:25	19:28	18:32		16:54	16:50	
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52		07:34	08:02	
	17:23	18:05	19:42	20:20	20:56	21:17	21:05	20:23	19:26	18:31		16:53	16:51	
24	07:55	07:15	07:25	06:29	05:51	05:43	06:04	06:40	07:16	07:54		07:35	08:03	
	17:24	18:06	19:43	20:22	20:57	21:17	21:04	20:21	19:24	18:29		16:53	16:51	
25	07:55	07:13	07:23	06:28	05:50	05:43	06:05	06:41	07:17	07:55		07:37	08:03	
	17:26	18:08	19:44	20:23	20:58	21:17	21:03	20:20	19:23	18:28		16:52	16:52	
26	07:54	07:11	07:32 (T-23)	07:21	06:26	05:50	05:43	06:06	06:42	07:19	07:56	07:38	08:03	
	17:27	18:09	4 07:36 (T-23)	19:46	20:24	20:59	21:17	21:02	20:18	19:21	18:26	16:51	16:52	
27	07:53	07:10	07:31 (T-23)	07:19	06:25	05:49	05:44	06:07	06:43	07:20	07:58	07:39	08:04	
	17:28	18:10	6 07:37 (T-23)	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:25	16:51	16:53	
28	07:52	07:08	07:29 (T-23)	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04	
	17:30	18:12	9 07:38 (T-23)	19:48	20:27	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:54	
29	07:51		07:15	06:22	05:47	05:44	06:10	06:46	07:22	08:00		07:41	08:04	
	17:31		19:49	20:28	21:02	21:17	20:59	20:13	19:15	18:22		16:50	16:55	
30	07:50		07:13	06:20	05:47	05:45	06:11	06:47	07:23	08:02		07:43	08:05	
	17:33		19:51	20:29	21:03	21:17	20:58	20:11	19:13	18:20		16:49	16:55	
31	07:49		07:12		05:46		06:12	06:48		08:03			08:05	
	17:34		19:52		21:04		20:57	20:09		18:19			16:56	
Potential sun hours	287	292	369	403	459	465	471	436	377	341		288	275	
Total, worst case		19	74							95				
Sun reduction		0.58	0.59							0.56				
Oper. time red.		0.90	0.90							0.90				
Wind dir. red.		0.60	0.60							0.60				
Total reduction		0.31	0.32							0.30				
Total, real		6	24							29				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-216 - R-216
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:05 16:57	07:47 17:35	07:06 18:13	07:10 19:53	07:30 (T-05) 08:11 (T-04)	06:19 20:30	05:46 21:05	05:45 21:17	06:13 20:55	06:49 20:07	07:25 19:11	07:05 17:17	07:44 16:49			
2	08:05 16:58	07:46 17:37	07:05 18:14	07:08 19:54	07:28 (T-05) 08:10 (T-04)	06:17 20:32	05:45 21:05	05:46 21:17	06:14 20:54	06:50 20:06	07:29 (T-05) 07:39 (T-05)	07:26 19:09	07:45 16:48			
3	08:05 16:59	07:45 17:38	07:03 18:16	07:06 19:56	07:26 (T-05) 08:08 (T-04)	06:16 20:33	05:44 21:06	05:47 21:17	06:15 20:53	06:51 20:04	10 14	07:39 (T-05) 07:24 (T-05)	07:27 19:08	07:46 16:48		
4	08:05 17:00	07:44 17:40	06:59 18:17	07:04 19:57	07:26 (T-05) 08:07 (T-04)	06:14 20:34	05:44 21:07	05:47 21:17	06:16 20:52	06:53 20:02	24	07:24 (T-05) 07:54 (T-04)	07:28 19:06	07:47 16:48		
5	08:05 17:01	07:43 17:41	06:59 18:18	07:02 19:58	07:27 (T-05) 08:06 (T-04)	06:13 20:35	05:44 21:08	05:48 21:16	06:17 20:50	06:54 20:00	34	07:23 (T-05) 07:57 (T-04)	07:29 19:04	07:48 16:47		
6	08:05 17:02	07:41 17:42	06:58 18:20	07:01 19:59	07:27 (T-05) 08:04 (T-04)	06:11 20:37	05:43 21:09	05:48 21:16	06:19 20:49	06:55 19:58	37	07:23 (T-05) 08:00 (T-04)	07:31 19:02	07:49 16:47		
7	08:05 17:03	07:40 17:44	06:56 18:21	06:59 20:01	07:27 (T-05) 08:01 (T-04)	06:10 20:38	05:43 21:09	05:49 21:16	06:20 20:48	06:56 19:56	39	08:02 (T-04) 07:21 (T-05)	07:32 19:00	07:50 16:47		
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	07:27 (T-05) 07:57 (T-04)	06:09 20:39	05:42 21:10	05:50 21:15	06:21 20:46	06:57 19:55	41	07:21 (T-05) 08:02 (T-04)	07:33 18:57	07:51 16:47		
9	08:04 17:05	07:38 17:47	07:52 19:24	06:55 20:03	07:28 (T-05) 07:42 (T-05)	06:07 20:40	05:42 21:11	05:51 21:15	06:22 20:45	06:58 19:53	41	07:21 (T-05) 08:02 (T-04)	07:34 18:55	07:52 16:47		
10	08:04 17:06	07:36 17:48	07:50 19:25	06:53 20:04	07:31 (T-05) 07:41 (T-05)	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	07:00 19:51	42	07:21 (T-05) 08:03 (T-04)	07:36 18:53	07:53 16:47		
11	08:03 17:08	07:35 17:50	07:49 19:26	06:52 20:06	07:31 (T-05) 07:41 (T-05)	06:06 20:41	05:42 21:11	05:52 21:14	06:24 20:42	07:01 19:49	41	07:22 (T-05) 08:03 (T-04)	07:37 18:51	07:54 16:47		
12	08:03 17:09	07:33 17:51	07:47 19:28	06:50 20:07	07:32 (T-05) 07:42 (T-05)	06:04 20:42	05:42 21:13	05:53 21:13	06:26 20:40	07:02 19:47	40	07:23 (T-05) 08:03 (T-04)	07:38 18:49	07:55 16:47		
13	08:03 17:10	07:32 17:52	07:45 19:29	06:48 20:08	07:33 (T-05) 07:43 (T-05)	06:02 20:43	05:41 21:13	05:54 21:13	06:27 20:39	07:03 19:45	38	07:24 (T-05) 08:02 (T-04)	07:39 18:48	07:56 16:47		
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	07:34 (T-05) 07:44 (T-05)	06:01 20:44	05:41 21:14	05:55 21:12	06:28 20:37	07:04 19:43	37	07:26 (T-05) 08:03 (T-04)	07:41 18:46	07:57 16:47		
15	08:02 17:12	07:29 17:55	07:41 19:32	06:45 20:11	07:35 (T-05) 07:45 (T-05)	06:00 20:45	05:41 21:14	05:56 21:12	06:29 20:36	07:05 19:41	35	07:27 (T-05) 08:02 (T-04)	07:42 18:44	07:57 16:47		
16	08:01 17:14	07:27 17:57	07:39 19:33	06:43 20:12	07:36 (T-05) 07:46 (T-05)	05:59 20:46	05:41 21:15	05:56 21:11	06:30 20:34	07:07 19:40	34	07:28 (T-05) 08:02 (T-04)	07:43 18:42	07:58 16:48		
17	08:01 17:15	07:26 17:58	07:38 19:34	06:41 20:13	07:37 (T-05) 07:47 (T-05)	05:58 20:47	05:41 21:15	05:57 21:10	06:31 20:33	07:08 19:38	32	07:29 (T-05) 08:01 (T-04)	07:45 18:41	07:59 16:48		
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 20:14	07:38 (T-05) 07:48 (T-05)	05:57 20:48	05:41 21:15	05:58 21:09	06:33 20:31	07:09 19:36	29	07:30 (T-05) 07:59 (T-04)	07:46 18:39	08:00 16:48		
19	07:59 17:18	07:23 18:01	07:34 19:37	06:38 20:16	07:39 (T-05) 07:49 (T-05)	05:56 20:49	05:41 21:16	05:59 21:09	06:34 20:30	07:10 19:34	26	07:32 (T-04) 07:58 (T-04)	07:47 18:37	08:00 16:49		
20	07:59 17:19	07:21 18:01	07:32 19:38	06:36 20:17	07:40 (T-04) 07:50 (T-04)	05:55 20:53	05:42 21:16	06:00 21:08	06:35 20:28	07:11 19:32	24	07:33 (T-04) 07:57 (T-04)	07:48 18:36	08:01 16:49		
21	07:58 17:20	07:20 18:02	07:30 19:39	06:34 20:18	07:41 (T-04) 07:51 (T-04)	05:54 20:54	05:42 21:16	06:01 21:07	06:36 20:26	07:13 19:30	22	07:34 (T-04) 07:56 (T-04)	07:50 18:34	08:01 16:49		
22	07:57 17:21	07:18 18:04	07:28 19:40	06:33 20:19	07:42 (T-04) 07:52 (T-04)	05:53 20:55	05:42 21:17	06:02 21:06	06:37 20:25	07:14 19:28	17	07:36 (T-04) 07:53 (T-04)	07:51 18:32	08:02 16:50		
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 20:20	07:43 (T-04) 07:53 (T-04)	05:52 20:56	05:42 21:17	06:03 21:05	06:38 20:23	07:15 19:26	12	07:38 (T-04) 07:50 (T-04)	07:52 18:31	08:02 16:50		
24	07:55 17:24	07:15 18:06	07:25 19:43	06:29 20:22	07:44 (T-04) 07:54 (T-04)	05:51 20:57	05:42 21:17	06:04 21:04	06:40 20:21	07:16 19:24		07:54 18:29	07:54 16:53	08:03 16:51		
25	07:55 17:26	07:13 18:08	07:23 19:44	06:28 20:23	07:45 (T-04) 07:55 (T-04)	05:50 20:58	05:43 21:17	06:05 21:03	06:41 20:20	07:17 19:23		07:55 18:28	07:55 16:52	08:03 16:52		
26	07:54 17:27	07:11 18:09	07:21 19:46	06:26 20:24	07:46 (T-04) 07:56 (T-04)	05:50 20:59	05:43 21:17	06:06 21:02	06:42 20:18	07:19 19:21		07:56 18:26	07:56 16:51	08:04 16:52		
27	07:53 17:28	07:10 18:10	07:19 19:47	06:25 20:25	07:47 (T-04) 07:57 (T-04)	05:49 21:00	05:44 21:17	06:07 21:01	06:43 20:16	07:20 19:19		07:57 18:25	07:57 16:51	08:04 16:53		
28	07:52 17:30	07:08 18:12	07:17 19:48	06:23 20:27	07:48 (T-04) 07:58 (T-04)	05:48 21:01	05:44 21:17	06:08 21:00	06:44 20:14	07:21 19:17		07:59 18:23	07:59 16:50	08:04 16:54		
29	07:51 17:31	07:15 18:09	07:25 19:49	06:22 20:28	07:49 (T-04) 07:59 (T-04)	05:47 21:02	05:44 21:17	06:10 20:59	06:46 20:13	07:22 19:15		08:00 18:22	08:00 16:50	08:04 16:54		
30	07:50 17:33	07:13 18:07	07:31 19:51	06:20 20:29	07:50 (T-04) 08:00 (T-04)	05:46 21:03	05:45 21:17	06:11 20:58	06:47 20:11	07:23 19:13		08:02 18:20	08:02 16:49	08:05 16:55		
31	07:49 17:34	07:12 18:02	07:29 19:52	06:19 20:28	07:51 (T-04) 08:01 (T-04)	05:45 21:04	05:44 21:17	06:12 20:57	06:48 20:09	07:24 19:14		08:03 18:19	08:03 16:49	08:05 16:56		
Potential sun hours	287	292	369	404		459	465	471	436	377		341	288		275	
Total, worst case					337		324			669						
Sun reduction					0.59		0.63			0.67						
Oper. time red.					0.90		0.90			0.90						
Wind dir. red.					0.59		0.59			0.59						
Total reduction					0.31		0.33			0.36						
Total, real					106		108			239						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-228 - R-228
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:13	07:51
	17:04	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:39	21:10	21:14	20:44	19:52	18:54	17:07	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:46	17:01	16:47
15	08:01	07:28	07:41	08:01 (T-H)	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:53
	17:12	17:55	19:31	1 08:02 (T-H)	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00
16	08:01	07:27	07:39	07:59 (T-H)	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:57
	17:13	17:56	19:32	3 08:02 (T-H)	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59
17	08:00	07:25	07:37	07:57 (T-H)	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:58
	17:15	17:58	19:34	4 08:01 (T-H)	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58
18	07:59	07:24	07:35	07:56 (T-H)	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:59
	17:16	17:59	19:35	6 08:02 (T-H)	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57
19	07:59	07:22	07:33	07:54 (T-H)	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:59
	17:17	18:00	19:36	7 08:01 (T-H)	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56
20	07:58	07:21	07:32	07:52 (T-H)	06:36	05:55	05:41	06:00	06:35	07:11	07:48	08:00
	17:19	18:00	19:37	7 07:59 (T-H)	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55
21	07:57	07:19	07:30	07:50 (T-H)	06:34	05:54	05:42	06:01	06:36	07:12	07:49	08:01
	17:20	18:02	19:39	7 07:57 (T-H)	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54
22	07:56	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:34 (T-H)	07:51	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	6 07:40 (T-H)	18:32	16:54
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:36 (T-H)	07:52	08:02
	17:23	18:05	19:41	20:20	20:55	21:16	21:04	20:22	19:26	7 07:43 (T-H)	18:31	16:53
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:37 (T-H)	07:53	08:02
	17:24	18:06	19:43	20:21	20:56	21:16	21:03	20:21	19:24	7 07:44 (T-H)	18:29	16:52
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:40	07:17	07:38 (T-H)	07:55	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	6 07:44 (T-H)	18:27	16:52
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:39 (T-H)	07:56	08:03
	17:27	18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	5 07:44 (T-H)	18:26	16:51
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:40 (T-H)	07:57	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:16	19:18	3 07:43 (T-H)	18:24	16:50
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:42 (T-H)	07:59	08:03
	17:29	18:11	19:48	20:26	21:00	21:16	20:59	20:14	19:16	2 07:44 (T-H)	18:23	16:50
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:47	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:12	06:48		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction			35						36			
Oper. time red.			0.59						0.67			
Wind dir. red.			0.90						0.90			
Wind dir. red.			0.60						0.60			
Total reduction			0.32						0.36			
Total, real			11						13			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-229 - R-229
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:47
	17:01	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:49
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:03	07:38	07:53	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	20:04	20:41	21:11	21:13	20:43	19:50	18:52	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:01	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:08	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:30	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:31	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:29	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:00
	17:20	18:02	19:39	20:17	20:53	21:15	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56	07:17	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:01
	17:23	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:18	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:03
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11	06:15	05:46		06:11	06:47		08:02		08:04
	17:34		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-231 - R-231
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43				
	16:57	17:35	18:13	19:52	20:29	21:04	21:16	20:54	20:07	19:11	17:17	16:48				
2	08:04	07:45	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44				
	16:58	17:36	18:14	19:54	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48				
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45				
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:48				
4	08:04	07:43	07:00	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46				
	17:00	17:39	18:17	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:13	16:47				
5	08:04	07:42	06:59	07:02	06:12	05:43	05:48	06:17	06:53	07:29	07:09	07:47				
	17:01	17:41	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47				
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48				
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:57	19:01	17:10	16:47				
7	08:04	07:39	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:49				
	17:03	17:43	18:21	20:00	20:37	21:08	21:15	20:47	19:56	19:00	17:09	16:47				
8	08:03	07:38	07:53	06:56	06:08	05:42	05:50	06:20	06:57	07:32	07:13	07:50				
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:08	16:47				
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:14	07:51				
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47				
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52				
	17:06	17:48	19:24	20:04	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:47				
11	08:02	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:17	07:53				
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47				
12	08:02	07:32	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:37	07:19	07:54				
	17:08	17:50	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:47				
13	08:02	07:31	07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55				
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	16:47				
14	08:01	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56				
	17:11	17:53	19:30	20:08	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47				
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:56				
	17:12	17:55	19:31	20:10	20:46	21:13	21:10	20:35	19:41	18:44	17:00	16:47				
16	08:00	07:27	07:39	06:42	07:03 (T-65)	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57			
	17:13	17:56	19:32	20:11	2	07:05 (T-65)	20:47	21:14	20:34	19:39	18:42	16:59	16:47			
17	08:00	07:25	07:37	06:41	07:01 (T-65)	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58			
	17:15	17:57	19:33	20:12	4	07:05 (T-65)	20:48	21:14	20:32	9	07:06 (T-65)	19:37	18:40	16:58	16:48	
18	07:59	07:24	07:35	06:39	06:59 (T-65)	05:57	05:41	05:58	06:32	06:55 (T-65)	07:08	07:45	07:27	07:58		
	17:16	17:59	19:35	20:13	6	07:05 (T-65)	20:50	21:14	20:30	13	07:08 (T-65)	19:35	18:39	16:57	16:48	
19	07:58	07:22	07:33	06:37	06:58 (T-65)	05:56	05:41	05:59	06:33	06:56 (T-65)	07:10	07:46	07:28	07:59		
	17:17	18:00	19:36	20:15	8	07:06 (T-65)	20:51	21:15	20:39	13	07:09 (T-65)	19:33	18:37	16:56	16:48	
20	07:58	07:20	07:31	06:36	06:56 (T-65)	05:55	05:41	06:00	06:34	06:57 (T-65)	07:11	07:48	07:29	08:00		
	17:18	18:00	19:37	20:16	9	07:05 (T-65)	20:52	21:15	20:27	12	07:09 (T-65)	19:31	18:35	16:55	16:49	
21	07:57	07:19	07:30	06:34	06:54 (T-65)	05:54	05:42	06:01	06:36	06:58 (T-65)	07:12	07:49	07:31	08:00		
	17:20	18:02	19:39	20:17	10	07:04 (T-65)	20:53	21:15	20:25	11	07:09 (T-65)	19:29	18:34	16:54	16:49	
22	07:56	07:17	07:28	06:32	06:53 (T-65)	05:53	05:42	06:02	06:37	06:59 (T-65)	07:13	07:50	07:32	08:01		
	17:21	18:03	19:40	20:18	11	07:04 (T-65)	20:54	21:16	20:24	10	07:09 (T-65)	19:28	18:32	16:54	16:50	
23	07:55	07:16	07:26	06:31	06:51 (T-65)	05:52	05:42	06:03	06:38	07:00 (T-65)	07:14	07:52	07:33	08:01		
	17:22	18:04	19:41	20:20	12	07:03 (T-65)	20:55	21:16	20:22	9	07:09 (T-65)	19:26	18:30	16:53	16:50	
24	07:55	07:14	07:24	06:29	06:50 (T-65)	05:51	05:42	06:04	06:39	07:01 (T-65)	07:15	07:53	07:34	08:02		
	17:24	18:06	19:42	20:21	13	07:03 (T-65)	20:56	21:16	20:23	8	07:09 (T-65)	19:24	18:29	16:52	16:51	
25	07:54	07:12	07:22	06:27	06:48 (T-65)	05:50	05:43	06:05	06:40	07:03 (T-65)	07:17	07:54	07:36	08:02		
	17:25	18:07	19:44	20:22	13	07:01 (T-65)	20:57	21:16	20:29	6	07:09 (T-65)	19:22	18:27	16:52	16:51	
26	07:53	07:11	07:20	06:26	06:51 (T-65)	05:49	05:43	06:06	06:41	07:04 (T-65)	07:18	07:56	07:37	08:02		
	17:27	18:08	19:45	20:23	8	06:59 (T-65)	20:58	21:16	20:17	4	07:08 (T-65)	19:20	18:26	16:51	16:52	
27	07:52	07:09	07:18	06:24	06:59 (T-65)	05:49	05:43	06:07	06:43	07:05 (T-65)	07:19	07:57	07:38	08:03		
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	2	07:07 (T-65)	19:18	18:24	16:50	16:53		
28	07:51	07:07	07:17	06:23	05:48	05:44	06:08	06:44	06:44	07:20	07:58	07:39	08:03			
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53				
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:21	08:00	07:40	08:03				
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54				
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04				
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55				
31	07:48		07:11		05:46		06:11	06:47		08:02		08:04				
	17:34		19:51		21:03		20:56	20:08		18:18		16:56				
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276				
Total, worst case					96											
Sun reduction					0.63											
Oper. time red.					0.90											
Wind dir. red.					0.58											
Total reduction					0.33											
Total, real					31			36								

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-241 - R-241
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:03	07:43
	16:57	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:17	05:45	05:46	06:13	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:30	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:15	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:00	07:03	06:14	05:44	05:47	06:16	06:52	07:27	07:07	07:46
	17:00	17:39	18:16	19:56	20:33	21:06	21:15	20:50	20:01	19:05	17:13	16:47
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:01	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
6	08:03	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48
	17:02	17:42	18:19	19:58	20:35	21:07	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:10	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:08	21:14	20:46	19:55	18:58	17:09	16:47
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:32	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:47
9	08:03	07:36	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:09	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:47
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:41	21:11	21:13	20:41	19:48	18:50	17:04	16:47
12	08:02	07:32	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:42	21:11	21:12	20:39	19:46	18:49	17:03	16:47
13	08:01	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:54
	17:10	17:52	19:28	20:07	20:44	21:12	21:11	20:38	19:44	18:47	17:02	16:47
14	08:01	07:29	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:55
	17:11	17:53	19:29	20:08	20:45	21:12	21:11	20:36	19:42	18:45	17:01	16:47
15	08:00	07:28	07:40	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:22	07:56
	17:12	17:55	19:31	20:09	20:46	21:13	21:10	20:35	19:41	18:43	17:00	16:47
16	08:00	07:26	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:13	21:10	20:33	19:39	18:42	16:59	16:47
17	07:59	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:26	07:58
	17:16	17:59	19:35	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:14	20:50	21:14	21:07	20:29	19:33	18:37	16:56	16:48
20	07:57	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:47	07:29	07:59
	17:18	18:00	19:37	20:16	20:51	21:15	21:06	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
	17:20	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:15	21:05	20:24	19:27	18:32	16:53	16:50
23	07:55	07:15	07:26	06:30	05:52	05:42	06:03	06:38	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:19	20:55	21:15	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:01
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52	16:51
25	07:53	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:35	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:52	07:10	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:16	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:13	19:16	18:22	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03
	17:31		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:48		07:13	06:20	05:46	05:45	06:10	06:46	07:22	08:01	07:41	08:03
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:20	16:49	16:55
31	07:47		07:11	06:19	05:46		06:11	06:47		08:02		08:03
	17:33		19:51		21:02		20:55	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	435	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L085 73 GE3.8-154 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-242 - R-242 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

Table with 16 columns: N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum. Values: 561, 438, 311, 293, 309, 330, 363, 461, 788, 773, 462, 449, 509, 600, 629, 608, 7,884

Main calendar table with columns for months (January to December) and rows for each day of the year, showing start/end times and shadow reduction values.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-243 - R-243

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:46	07:05	17:11 (T-72)	07:09	06:18
	16:57	17:35	18:12	26 17:37 (T-72)	19:52	20:29
2	08:04	07:45	07:04	17:12 (T-72)	07:07	06:17
	16:58	17:36	18:14	23 17:35 (T-72)	19:53	20:31
3	08:04	07:44	07:02	17:15 (T-72)	07:05	06:15
	16:59	17:38	18:15	18 17:33 (T-72)	19:55	20:32
4	08:04	07:43	07:00	17:18 (T-72)	07:03	06:14
	17:00	17:39	18:16	12 17:30 (T-72)	19:56	20:33
5	08:04	07:42	06:58	07:02	06:12	06:34 (T-75)
	17:01	17:40	18:18	19:57	20:34	22 06:56 (T-75)
6	08:03	07:40	06:57	07:00	06:11	06:32 (T-75)
	17:02	17:42	18:19	19:58	20:35	23 06:55 (T-75)
7	08:03	07:39	06:55	06:58	06:10	06:31 (T-75)
	17:03	17:43	18:20	20:00	20:37	24 06:55 (T-75)
8	08:03	07:38	07:53	06:56	06:08	06:30 (T-75)
	17:04	17:45	18:22	20:01	20:38	25 06:55 (T-75)
9	08:03	07:36	07:51	06:54	06:07	06:29 (T-75)
	17:05	17:46	19:23	20:02	20:39	24 06:53 (T-75)
10	08:03	07:35	17:18 (T-72)	07:50	06:06	06:30 (T-75)
	17:06	17:48	4 17:22 (T-72)	19:24	20:03	23 06:53 (T-75)
11	08:02	07:34	17:16 (T-72)	07:48	06:51	06:31 (T-75)
	17:07	17:49	8 17:24 (T-72)	19:26	20:05	20:41
12	08:02	07:32	17:14 (T-72)	07:46	06:49	06:32 (T-75)
	17:08	17:50	12 17:26 (T-72)	19:27	20:06	20:43
13	08:01	07:31	17:12 (T-72)	07:44	06:47	06:02
	17:09	17:52	15 17:27 (T-72)	19:28	20:07	20:44
14	08:01	07:29	17:12 (T-72)	07:42	06:46	06:01
	17:11	17:53	17 17:29 (T-72)	19:29	20:08	20:45
15	08:01	07:28	17:10 (T-72)	07:40	06:44	06:00
	17:12	17:55	20 17:30 (T-72)	19:31	20:10	20:46
16	08:00	07:26	17:10 (T-72)	07:39	06:42	05:59
	17:13	17:56	22 17:32 (T-72)	19:32	20:11	20:47
17	07:59	07:25	17:09 (T-72)	07:37	06:40	05:57
	17:14	17:57	24 17:33 (T-72)	19:33	20:12	20:48
18	07:59	07:23	17:08 (T-72)	07:35	06:39	05:56
	17:16	17:59	26 17:34 (T-72)	19:35	20:13	20:49
19	07:58	07:22	17:08 (T-72)	07:33	06:37	05:55
	17:17	18:00	28 17:36 (T-72)	19:36	20:14	20:50
20	07:57	07:20	17:07 (T-72)	07:31	06:35	05:54
	17:18	18:00	30 17:37 (T-72)	19:37	20:16	20:52
21	07:57	07:19	17:08 (T-72)	07:29	06:34	05:53
	17:20	18:01	32 17:40 (T-72)	19:38	20:17	20:53
22	07:56	07:17	17:08 (T-72)	07:27	06:32	05:52
	17:21	18:03	33 17:41 (T-72)	19:40	20:18	20:54
23	07:55	07:15	17:07 (T-72)	07:26	06:30	05:52
	17:22	18:04	34 17:41 (T-72)	19:41	20:19	20:55
24	07:54	07:14	17:08 (T-72)	07:24	06:29	06:49 (T-75)
	17:24	18:06	34 17:42 (T-72)	19:42	20:21	1 06:50 (T-75)
25	07:53	07:12	17:08 (T-72)	07:22	06:27	06:48 (T-75)
	17:25	18:07	33 17:41 (T-72)	19:43	20:22	4 06:52 (T-75)
26	07:53	07:11	17:08 (T-72)	07:20	06:26	06:46 (T-75)
	17:26	18:08	32 17:40 (T-72)	19:45	20:23	7 06:53 (T-75)
27	07:52	07:09	17:10 (T-72)	07:18	06:24	06:45 (T-75)
	17:28	18:10	30 17:40 (T-72)	19:46	20:24	9 06:54 (T-75)
28	07:51	07:07	17:10 (T-72)	07:16	06:23	06:43 (T-75)
	17:29	18:11	28 17:38 (T-72)	19:47	20:26	12 06:55 (T-75)
29	07:50		07:15	07:15	06:21	06:42 (T-75)
	17:31		19:48	20:27	14 06:56 (T-75)	21:01
30	07:49		07:13	07:13	06:19	06:40 (T-75)
	17:32		19:50	20:28	15 06:55 (T-75)	21:02
31	07:47		07:11	07:11		05:46
	17:33		19:51	21:02		
Potential sun hours	287	292	369	403	458	465
Total, worst case			79	62	298	400
Sun reduction		0.58	0.59	0.63	0.66	0.73
Oper. time red.		0.90	0.90	0.90	0.90	0.90
Wind dir. red.		0.59	0.59	0.59	0.59	0.62
Total reduction		0.31	0.31	0.33	0.35	0.41
Total, real		142	25	21	104	163

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-243 - R-243
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:09 (T-76) 20:48 (T-65)	06:12 20:54	06:42 (T-75) 20:06	07:24 19:10	07:03 16:48 (T-72)
2	05:46 21:16	06:10 (T-76) 20:48 (T-65)	06:13 20:53	06:41 (T-75) 20:05	06:50 19:09	07:05 17:15
3	05:46 21:15	06:10 (T-76) 20:48 (T-65)	06:15 20:52	06:40 (T-75) 20:03	06:51 19:07	07:06 17:14
4	05:47 21:15	06:11 (T-76) 20:48 (T-65)	06:16 20:50	06:39 (T-75) 20:01	06:52 19:05	07:27 17:13
5	05:47 21:15	06:12 (T-76) 20:48 (T-65)	06:17 20:49	06:40 (T-75) 20:01	06:53 19:03	07:29 17:11
6	05:48 21:15	06:12 (T-76) 20:47 (T-65)	06:18 20:48	06:41 (T-75) 19:57	06:54 19:01	07:30 17:10
7	05:49 21:14	06:13 (T-76) 20:47 (T-65)	06:19 20:47	06:42 (T-75) 19:55	06:55 18:58	07:31 17:09
8	05:49 21:14	06:14 (T-76) 20:47 (T-65)	06:20 20:45	06:43 (T-75) 19:54	06:57 18:56	07:32 17:07
9	05:50 21:14	06:14 (T-76) 20:46 (T-65)	06:21 20:44	06:44 (T-75) 19:52	07:34 18:54	17:55 (T-72) 17:06
10	05:51 21:13	06:15 (T-76) 20:46 (T-65)	06:23 20:42	06:46 (T-75) 19:50	06:59 18:52	17:50 (T-72) 17:05
11	05:52 21:13	06:16 (T-76) 20:45 (T-65)	06:24 20:41	06:47 (T-75) 19:48	07:00 18:50	17:47 (T-72) 17:04
12	05:53 21:12	06:17 (T-76) 06:18 (T-76)	06:25 20:39	06:48 (T-75) 19:46	07:01 18:49	17:46 (T-72) 17:03
13	05:53 21:12	06:18 (T-76) 20:38	06:26 20:38	06:49 (T-75) 19:44	07:02 18:47	17:44 (T-72) 17:02
14	05:54 21:11	06:19 (T-76) 20:36	06:27 20:36	06:50 (T-75) 19:42	07:04 18:45	17:42 (T-72) 17:01
15	05:55 21:10	06:20 (T-76) 20:35	06:28 20:35	06:51 (T-75) 19:41	07:05 18:43	17:42 (T-72) 17:00
16	05:56 21:10	06:21 (T-76) 20:33	06:30 20:33	06:52 (T-75) 19:39	07:06 18:42	17:40 (T-72) 16:59
17	05:57 21:09	06:22 (T-76) 20:32	06:31 20:32	06:53 (T-75) 19:37	07:07 18:40	17:39 (T-72) 16:58
18	05:58 21:08	06:23 (T-76) 20:30	06:32 20:30	06:54 (T-75) 19:35	07:08 18:38	17:39 (T-72) 16:57
19	05:59 21:07	06:24 (T-76) 20:29	06:33 20:29	06:55 (T-75) 19:33	07:09 18:37	17:39 (T-72) 16:56
20	06:00 21:07	06:25 (T-76) 20:27	06:34 20:27	06:56 (T-75) 19:31	07:11 18:35	17:38 (T-72) 16:55
21	06:01 21:06	06:26 (T-76) 20:25	06:35 20:25	06:57 (T-75) 19:29	07:12 18:33	17:38 (T-72) 16:54
22	06:02 21:05	06:27 (T-76) 20:24	06:36 20:24	06:58 (T-75) 19:27	07:13 18:32	17:38 (T-72) 16:53
23	06:03 21:04	06:28 (T-76) 20:22	06:37 20:22	06:59 (T-75) 19:25	07:14 18:30	17:38 (T-72) 16:53
24	06:04 21:03	06:29 (T-76) 20:20	06:38 20:20	07:00 (T-75) 19:24	07:15 18:29	17:39 (T-72) 16:52
25	06:05 21:02	06:30 (T-76) 20:19	06:39 20:19	07:01 (T-75) 19:22	07:16 18:27	17:39 (T-72) 16:51
26	06:06 21:01	06:31 (T-76) 20:17	06:40 20:17	07:02 (T-75) 19:20	07:17 18:25	17:40 (T-72) 16:51
27	06:07 21:00	06:32 (T-76) 20:15	06:41 20:15	07:03 (T-75) 19:19	07:18 18:24	17:40 (T-72) 16:50
28	06:08 20:59	06:33 (T-76) 06:49 (T-75) 06:56 (T-75)	06:42 06:44 20:13	07:04 (T-75) 19:16 18:22	07:19 18:22 16:50	17:41 (T-72) 16:50 16:50
29	06:09 20:58	06:34 (T-76) 06:46 (T-75) 06:58 (T-75)	06:43 06:45 20:12	07:05 (T-75) 19:14 18:21	07:20 18:21 16:49	17:42 (T-72) 16:49 16:49
30	06:10 20:57	06:35 (T-76) 06:44 (T-75) 07:00 (T-75)	06:44 06:46 20:10	07:06 (T-75) 19:12 18:19	07:21 18:19 16:49	17:43 (T-72) 16:49 16:49
31	06:11 20:55	06:36 (T-76) 06:43 (T-75) 07:01 (T-75)	06:45 06:47 20:08	07:07 (T-75) 19:11 18:18	07:22 18:18 16:48	17:44 (T-72) 16:48 16:56
Potential sun hours	471	436	377	341	289	276
Total, worst case	161	316	548	4		
Sun reduction	0.75	0.72	0.56	0.48		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.61	0.59	0.59	0.59		
Total reduction	0.41	0.38	0.30	0.25		
Total, real	66	120	162	1		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-244 - R-244

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:46	07:05	07:26 (T-75)	07:09	06:18
	16:57	17:35	18:12	38 08:04 (T-74)	19:52	20:29
2	08:04	07:45	07:04	07:24 (T-75)	07:07	19:30 (T-65)
	16:58	17:36	18:14	39 08:03 (T-74)	19:53	20:31
3	08:04	07:44	07:02	07:23 (T-75)	07:05	19:27 (T-65)
	16:59	17:38	18:15	40 08:03 (T-74)	19:55	20:32
4	08:04	07:43	07:00	07:21 (T-75)	07:03	19:26 (T-65)
	17:00	17:39	18:16	40 08:01 (T-74)	19:56	20:33
5	08:04	07:42	06:58	07:19 (T-75)	07:02	19:24 (T-65)
	17:01	17:40	18:18	41 08:00 (T-74)	19:57	20:34
6	08:04	07:40	06:57	07:18 (T-75)	07:00	19:23 (T-65)
	17:02	17:42	18:19	40 07:58 (T-74)	19:58	20:35
7	08:03	07:39	06:55	07:19 (T-75)	06:58	19:22 (T-65)
	17:03	17:43	18:20	37 07:56 (T-74)	20:00	20:37
8	08:03	07:38	07:53	08:22 (T-75)	06:56	19:21 (T-65)
	17:04	17:45	18:22	28 08:55 (T-74)	20:01	20:38
9	08:03	07:36	07:51	08:36 (T-74)	06:54	19:21 (T-65)
	17:05	17:46	19:23	16 08:52 (T-74)	20:02	20:39
10	08:03	07:35	07:50	08:41 (T-74)	06:53	07:13 (T-76)
	17:06	17:48	19:24	5 08:46 (T-74)	20:03	20:40
11	08:02	07:34	07:48		06:51	07:11 (T-76)
	17:07	17:49	19:26		20:05	20:41
12	08:02	07:32	07:46		06:49	07:09 (T-76)
	17:08	17:50	19:27		20:06	20:43
13	08:02	07:31	07:44		06:47	07:08 (T-76)
	17:09	17:52	19:28		20:07	20:44
14	08:01	07:29	07:51 (T-74)	07:42	06:46	07:06 (T-76)
	17:11	17:53	3 07:54 (T-74)	19:29	20:08	20:45
15	08:01	07:28	07:49 (T-74)	07:40	06:44	07:04 (T-76)
	17:12	17:55	7 07:56 (T-74)	19:31	20:10	20:46
16	08:00	07:26	07:48 (T-74)	07:39	06:42	19:21 (T-65)
	17:13	17:56	11 07:59 (T-74)	19:32	20:11	20:47
17	07:59	07:25	07:46 (T-74)	07:37	06:40	19:23 (T-65)
	17:14	17:57	14 08:00 (T-74)	19:33	20:12	20:48
18	07:59	07:23	07:44 (T-74)	07:35	06:39	19:24 (T-65)
	17:16	17:59	17 08:01 (T-74)	19:35	20:13	20:49
19	07:58	07:22	07:43 (T-74)	07:33	06:37	19:26 (T-65)
	17:17	18:00	19 08:02 (T-74)	19:36	20:15	20:51
20	07:58	07:20	07:41 (T-74)	07:31	06:35	19:44 (T-64)
	17:18	18:00	22 08:03 (T-74)	19:37	20:16	9 19:53 (T-64)
21	07:57	07:19	07:40 (T-74)	07:29	06:34	19:45 (T-64)
	17:20	18:01	24 08:04 (T-74)	19:38	20:17	9 19:54 (T-64)
22	07:56	07:17	07:38 (T-74)	07:28	06:32	19:46 (T-64)
	17:21	18:03	26 08:04 (T-74)	19:40	20:18	10 19:56 (T-64)
23	07:55	07:15	07:36 (T-74)	07:26	06:30	19:48 (T-64)
	17:22	18:04	28 08:04 (T-74)	19:41	20:19	7 19:55 (T-64)
24	07:54	07:14	07:35 (T-74)	07:24	06:29	05:51
	17:24	18:06	30 08:05 (T-74)	19:42	20:21	20:56
25	07:53	07:12	07:33 (T-74)	07:22	06:27	05:50
	17:25	18:07	32 08:05 (T-74)	19:43	20:22	20:57
26	07:53	07:11	07:31 (T-74)	07:20	06:26	05:49
	17:26	18:08	34 08:05 (T-74)	19:45	20:23	20:58
27	07:52	07:09	07:30 (T-74)	07:18	06:24	05:48
	17:28	18:10	35 08:05 (T-74)	19:46	20:24	20:59
28	07:51	07:07	07:28 (T-74)	07:16	06:23	05:48
	17:29	18:11	36 08:04 (T-74)	19:47	20:26	21:00
29	07:50		07:15	07:15	06:21	05:47
	17:31		19:48	20:27	21:01	21:16
30	07:49		07:13	06:19	05:46	05:44
	17:32		19:50	20:28	21:02	21:16
31	07:47		07:11		05:46	
	17:33		19:51		21:03	
Potential sun hours	287	292	369	403	458	465
Total, worst case		338	324	389		
Sun reduction		0.58	0.59	0.63		
Oper. time red.		0.90	0.90	0.90		
Wind dir. red.		0.61	0.61	0.60		
Total reduction		0.32	0.32	0.34		
Total, real		109	105	131		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-244 - R-244
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December		
1	05:45	06:12	06:48	07:10 (T-76)	07:24	07:03	07:43	
	21:16	20:54	20:06	19:41 (T-65)	19:10	17:17	16:48	
2	05:46	06:13	06:50	07:11 (T-76)	07:25	07:05	07:44	
	21:16	20:53	20:05	19:39 (T-65)	19:09	17:15	16:48	
3	05:46	06:15	06:51	19:18 (T-65)	07:26	07:06	07:45	
	21:16	20:52	20:03	19:38 (T-65)	19:07	17:14	16:48	
4	05:47	06:16	06:52	19:19 (T-65)	07:27	08:15 (T-74)	07:08	07:46
	21:15	20:51	20:01	19:37 (T-65)	19:05	12 08:27 (T-74)	17:13	16:47
5	05:47	06:17	06:53	19:19 (T-65)	07:29	08:12 (T-74)	07:09	07:47
	21:15	20:49	19:59	19:35 (T-65)	19:03	18 08:30 (T-74)	17:11	16:47
6	05:48	06:18	06:54	19:19 (T-65)	07:30	07:57 (T-75)	07:10	07:48
	21:15	20:48	19:57	19:33 (T-65)	19:01	33 08:32 (T-74)	17:10	16:47
7	05:49	06:19	06:55	19:19 (T-65)	07:31	07:54 (T-75)	07:12	07:49
	21:14	20:47	19:55	19:31 (T-65)	18:58	39 08:33 (T-74)	17:09	16:47
8	05:49	06:20	06:57	19:20 (T-65)	07:32	07:53 (T-75)	07:13	07:50
	21:14	20:45	19:54	9 19:29 (T-65)	18:56	41 08:34 (T-74)	17:07	16:47
9	05:50	06:21	06:58	19:21 (T-65)	07:34	07:55 (T-75)	07:14	07:51
	21:14	20:44	19:52	6 19:27 (T-65)	18:54	41 08:36 (T-74)	17:06	16:46
10	05:51	06:23	06:59	19:23 (T-65)	07:35	07:56 (T-75)	07:16	07:52
	21:13	20:42	19:50	2 19:25 (T-65)	18:52	40 08:36 (T-74)	17:05	16:46
11	05:52	06:24	07:00		07:36	07:57 (T-75)	07:17	07:53
	21:13	20:41	19:48		18:50	39 08:36 (T-74)	17:04	16:46
12	05:53	06:25	07:01		07:37	07:59 (T-75)	07:18	07:54
	21:12	20:39	19:46		18:49	38 08:37 (T-74)	17:03	16:47
13	05:53	06:26	07:02		07:39	08:00 (T-75)	07:20	07:55
	21:12	20:38	19:44		18:47	37 08:37 (T-74)	17:02	16:47
14	05:54	06:27	07:04		07:40	08:01 (T-74)	07:21	07:55
	21:11	20:36	19:42		18:45	36 08:37 (T-74)	17:01	16:47
15	05:55	06:28	07:05		07:41	08:03 (T-74)	07:22	07:56
	21:10	20:35	19:41		18:43	34 08:37 (T-74)	17:00	16:47
16	05:56	06:30	07:06		07:42	08:04 (T-74)	07:24	07:57
	21:10	20:33	19:39		18:42	33 08:37 (T-74)	16:59	16:47
17	05:57	06:31	07:07		07:44	08:05 (T-74)	07:25	07:58
	21:09	20:32	19:37		18:40	31 08:36 (T-74)	16:58	16:47
18	05:58	06:32	07:08		07:45	08:07 (T-74)	07:26	07:58
	21:08	20:30	19:35		18:38	30 08:37 (T-74)	16:57	16:48
19	05:59	06:33	07:09		07:46	08:08 (T-74)	07:28	07:59
	21:07	20:29	19:33		18:37	28 08:36 (T-74)	16:56	16:48
20	06:00	06:34	19:53 (T-64)	07:11	07:48	08:09 (T-74)	07:29	08:00
	21:07	20:27	8 20:01 (T-64)	19:31	18:35	26 08:35 (T-74)	16:55	16:49
21	06:01	06:35	19:51 (T-64)	07:12	07:49	08:11 (T-74)	07:30	08:00
	21:06	20:25	9 20:00 (T-64)	19:29	18:33	24 08:35 (T-74)	16:54	16:49
22	06:02	06:37	19:49 (T-64)	07:13	07:50	08:12 (T-74)	07:32	08:01
	21:05	20:24	10 19:59 (T-64)	19:27	18:32	21 08:33 (T-74)	16:53	16:50
23	06:03	06:38	19:48 (T-64)	07:14	07:51	08:13 (T-74)	07:33	08:01
	21:04	20:22	9 19:57 (T-64)	19:25	18:30	19 08:32 (T-74)	16:53	16:50
24	06:04	06:39	19:29 (T-65)	07:15	07:53	08:15 (T-74)	07:34	08:02
	21:03	20:20	19 19:55 (T-64)	19:24	18:29	16 08:31 (T-74)	16:52	16:51
25	06:05	06:40	19:27 (T-65)	07:17	07:54	08:16 (T-74)	07:35	08:02
	21:02	20:19	21 19:53 (T-64)	19:22	18:27	13 08:29 (T-74)	16:51	16:51
26	06:06	06:41	19:24 (T-65)	07:18	07:55	08:18 (T-74)	07:37	08:02
	21:01	20:17	25 19:52 (T-64)	19:20	18:25	10 08:28 (T-74)	16:51	16:52
27	06:07	06:42	19:24 (T-65)	07:19	07:57	08:19 (T-74)	07:38	08:03
	21:00	20:15	25 19:51 (T-64)	19:18	18:24	6 08:25 (T-74)	16:50	16:53
28	06:08	06:44	07:06 (T-76)	07:20	07:58	08:20 (T-74)	07:39	08:03
	20:59	20:13	31 19:49 (T-64)	19:16	18:22	1 08:21 (T-74)	16:50	16:53
29	06:09	06:45	07:07 (T-76)	07:21	07:59		07:40	08:03
	20:58	20:12	30 19:46 (T-65)	19:14	18:21		16:49	16:54
30	06:10	06:46	07:08 (T-76)	07:23	08:01		07:41	08:03
	20:57	20:10	30 19:45 (T-65)	19:12	18:19		16:49	16:55
31	06:11	06:47	07:09 (T-76)	19:12	08:02			08:04
	20:55	20:08	28 19:43 (T-65)		18:18			16:56
Potential sun hours	471	436	377	341	289	276		
Total, worst case			245	145	666			
Sun reduction			0.72	0.67	0.56			
Oper. time red.			0.90	0.90	0.90			
Wind dir. red.			0.59	0.60	0.61			
Total reduction			0.39	0.36	0.31			
Total, real			95	52	206			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-245 - R-245
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	15:18 (T-74)	07:46	07:05	07:09	06:18
	16:57	55 16:13 (T-74)	17:35	18:12	19:52	16 19:55 (T-67)
2	08:04	15:19 (T-74)	07:45	07:04	07:07	21:03
	16:58	55 16:14 (T-74)	17:36	18:14	19:53	19 06:27 (T-71)
3	08:04	15:20 (T-74)	07:44	07:02	07:05	20:30
	16:59	54 16:14 (T-74)	17:38	18:15	19:55	21:04
4	08:04	15:20 (T-74)	07:43	07:00	07:03	18 06:27 (T-71)
	17:00	55 16:15 (T-74)	17:39	18:16	19:56	05:44
5	08:04	15:21 (T-74)	07:42	06:58	07:02	20:30
	17:01	54 16:15 (T-74)	17:40	18:18	19:57	21:04
6	08:03	15:22 (T-74)	07:40	06:57	07:00	18 06:27 (T-71)
	17:02	53 16:15 (T-74)	17:42	18:19	19:58	05:44
7	08:03	15:22 (T-74)	07:39	06:55	06:58	20:30
	17:03	53 16:15 (T-74)	17:43	18:20	20:00	21:04
8	08:03	15:23 (T-74)	07:38	07:53	06:56	17 06:26 (T-71)
	17:04	52 16:15 (T-74)	17:45	18:22	20:01	21:08
9	08:03	15:24 (T-74)	07:36	07:51	06:54	13 06:25 (T-71)
	17:05	52 16:16 (T-74)	17:46	19:23	20:02	05:42
10	08:03	15:24 (T-74)	07:35	07:49	06:53	12 06:25 (T-71)
	17:06	53 16:38 (T-72)	17:47	19:24	20:03	11 06:25 (T-71)
11	08:02	15:25 (T-74)	07:34	07:48	06:51	8 06:23 (T-71)
	17:07	53 16:39 (T-72)	17:49	19:26	20:05	9 06:23 (T-71)
12	08:02	15:25 (T-74)	07:32	07:46	06:49	8 06:23 (T-71)
	17:08	53 16:40 (T-72)	17:50	19:27	20:06	7 06:22 (T-71)
13	08:01	15:27 (T-74)	07:31	07:44	06:47	6 06:24 (T-71)
	17:09	53 16:42 (T-72)	17:52	19:28	20:07	5 06:27 (T-71)
14	08:01	15:27 (T-74)	07:29	07:42	06:46	4 06:25 (T-71)
	17:11	53 16:43 (T-72)	17:53	19:29	20:08	3 06:23 (T-71)
15	08:01	15:29 (T-74)	07:28	07:40	06:44	2 06:26 (T-71)
	17:12	52 16:44 (T-72)	17:54	19:31	20:09	1 06:22 (T-71)
16	08:00	15:29 (T-74)	07:26	07:39	06:42	06:27 (T-71)
	17:13	51 16:45 (T-72)	17:56	19:32	20:11	06:27 (T-71)
17	07:59	15:30 (T-74)	07:25	07:37	06:40	06:20 (T-71)
	17:14	51 16:46 (T-72)	17:57	19:33	20:12	06:20 (T-71)
18	07:59	15:32 (T-74)	07:23	07:35	06:39	06:28 (T-71)
	17:16	49 16:48 (T-72)	17:59	19:35	20:13	06:19 (T-71)
19	07:58	15:32 (T-74)	07:22	07:33	06:37	06:28 (T-71)
	17:17	49 16:50 (T-72)	18:00	19:36	20:14	06:18 (T-71)
20	07:57	15:33 (T-74)	07:20	07:31	06:35	06:28 (T-71)
	17:18	48 16:51 (T-72)	18:00	19:37	20:16	06:17 (T-71)
21	07:57	15:35 (T-74)	07:19	07:29	06:34	06:29 (T-71)
	17:20	38 16:13 (T-74)	18:01	19:38	20:17	12 06:29 (T-71)
22	07:56	15:37 (T-74)	07:17	07:27	06:32	13 06:29 (T-71)
	17:21	36 16:13 (T-74)	18:03	19:40	20:18	11 06:15 (T-71)
23	07:55	15:38 (T-74)	07:15	07:26	06:30	14 06:29 (T-71)
	17:22	34 16:12 (T-74)	18:04	19:41	20:19	13 06:14 (T-71)
24	07:54	15:40 (T-74)	07:14	07:24	06:29	14 06:28 (T-71)
	17:24	31 16:11 (T-74)	18:06	19:42	20:21	12 06:13 (T-71)
25	07:53	15:42 (T-74)	07:12	07:22	06:27	15 06:28 (T-71)
	17:25	27 16:09 (T-74)	18:07	19:43	20:22	14 06:13 (T-71)
26	07:52	15:45 (T-74)	07:10	07:20	06:26	16 06:29 (T-71)
	17:26	22 16:07 (T-74)	18:08	19:45	20:23	16 06:12 (T-71)
27	07:52	15:48 (T-74)	07:09	07:18	06:24	17 06:29 (T-71)
	17:28	17 16:05 (T-74)	18:10	19:46	20:24	17 06:11 (T-71)
28	07:51	15:53 (T-74)	07:07	07:16	06:22	17 06:28 (T-71)
	17:29	7 16:00 (T-74)	18:11	19:47	20:26	17 06:11 (T-71)
29	07:50			07:14	06:21	18 06:29 (T-71)
	17:30			19:48	20:27	18 06:10 (T-71)
30	07:49			07:13	06:19	18 06:28 (T-71)
	17:32			19:50	20:28	18 06:09 (T-71)
31	07:47			07:11		18 06:27 (T-71)
	17:33			19:51		19 06:09 (T-71)
Potential sun hours	287	292	369	403	458	465
Total, worst case	1260			680	249	163
Sun reduction	0.58			0.63	0.66	0.73
Oper. time red.	0.90			0.90	0.90	0.90
Wind dir. red.	0.62			0.58	0.59	0.59
Total reduction	0.32			0.33	0.35	0.39
Total, real	407			225	88	63

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-245 - R-245
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time													N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884											

		July	August	September	October	November	December				
1	05:45	06:20 (T-71)	06:12	06:48	07:10 (T-76)	07:24	07:03	07:43	15:07 (T-74)		
	21:16	7 06:27 (T-71)	20:54	20:06	11 07:21 (T-76)	19:10	17:17	16:48	53 16:21 (T-72)		
2	05:45	06:20 (T-71)	06:13	06:49	07:11 (T-76)	07:25	07:05	07:44	15:07 (T-74)		
	21:16	8 06:28 (T-71)	20:53	20:05	8 07:19 (T-76)	19:09	17:15	16:48	52 16:21 (T-72)		
3	05:46	06:19 (T-71)	06:15	06:51	07:12 (T-76)	07:26	07:06	07:45	15:07 (T-74)		
	21:15	10 06:29 (T-71)	20:52	20:03	4 07:16 (T-76)	19:07	17:14	16:47	52 15:59 (T-74)		
4	05:47	06:18 (T-71)	06:16	06:52		07:27	07:07	07:46	15:07 (T-74)		
	21:15	12 06:30 (T-71)	20:50	20:01		19:05	17:12	16:47	52 15:59 (T-74)		
5	05:47	06:18 (T-71)	06:17	06:53		07:29	07:09	07:47	15:07 (T-74)		
	21:15	13 06:31 (T-71)	20:49	19:59		19:03	17:11	16:47	53 16:00 (T-74)		
6	05:48	06:17 (T-71)	06:18	06:54		07:30	07:10	07:48	15:08 (T-74)		
	21:15	14 06:31 (T-71)	20:48	19:57		19:01	17:10	16:47	53 16:01 (T-74)		
7	05:49	06:17 (T-71)	06:19	06:55		07:31	07:12	07:49	15:08 (T-74)		
	21:14	15 06:32 (T-71)	20:46	19:55		18:58	17:09	16:47	54 16:02 (T-74)		
8	05:49	06:17 (T-71)	06:20	06:56		07:32	07:13	07:50	15:08 (T-74)		
	21:14	16 06:33 (T-71)	20:45	19:54		18:56	17:07	16:46	55 16:03 (T-74)		
9	05:50	06:16 (T-71)	06:21	06:58		07:33	07:14	07:51	15:09 (T-74)		
	21:14	17 06:33 (T-71)	20:44	19:52		18:54	17:06	16:46	54 16:03 (T-74)		
10	05:51	06:16 (T-71)	06:23	06:59		07:35	07:16	07:52	15:08 (T-74)		
	21:13	18 06:34 (T-71)	20:42	19:50		18:52	17:05	16:46	55 16:03 (T-74)		
11	05:52	06:16 (T-71)	06:24	07:00		07:36	07:17	07:53	15:09 (T-74)		
	21:13	19 06:35 (T-71)	20:41	19:48		18:50	17:04	16:46	54 16:03 (T-74)		
12	05:52	06:17 (T-71)	06:25	07:01	07:08 (T-76)	07:01	07:37	07:54	15:09 (T-74)		
	21:12	19 06:36 (T-71)	20:39	20 07:05 (T-76)	19:46	18:49	17:03	16:46	55 16:04 (T-74)		
13	05:53	06:17 (T-71)	06:26	07:02	07:05 (T-76)	07:02	07:38	07:55	15:10 (T-74)		
	21:12	19 06:36 (T-71)	20:38	30 20:07 (T-67)	19:44	18:47	17:02	16:47	55 16:05 (T-74)		
14	05:54	06:18 (T-71)	06:27	07:03	07:03 (T-76)	07:03	07:40	07:21	15:24 (T-74)	07:55	15:10 (T-74)
	21:11	18 06:36 (T-71)	20:36	37 20:08 (T-67)	19:42	18:45	17:01	9 15:33 (T-74)	16:47	55 16:05 (T-74)	
15	05:55	06:19 (T-71)	06:28	07:01	07:01 (T-76)	07:05	07:41	07:22	15:19 (T-74)	07:56	15:11 (T-74)
	21:10	18 06:37 (T-71)	20:35	42 20:09 (T-67)	19:41	18:43	17:00	18 15:37 (T-74)	16:47	55 16:06 (T-74)	
16	05:56	06:20 (T-71)	06:30	07:00	07:00 (T-76)	07:06	07:42	07:24	15:17 (T-74)	07:57	15:10 (T-74)
	21:10	17 06:37 (T-71)	20:33	45 20:08 (T-67)	19:39	18:42	16:59	23 15:40 (T-74)	16:47	56 16:06 (T-74)	
17	05:57	06:21 (T-71)	06:31	06:59	07:01 (T-76)	07:07	07:44	07:25	15:15 (T-74)	07:58	15:11 (T-74)
	21:09	17 06:38 (T-71)	20:32	45 20:06 (T-67)	19:37	18:40	16:58	27 15:42 (T-74)	16:47	56 16:07 (T-74)	
18	05:58	06:22 (T-71)	06:32	06:58	07:01 (T-76)	07:08	07:45	07:26	15:14 (T-74)	07:58	15:12 (T-74)
	21:08	16 06:38 (T-71)	20:30	46 20:05 (T-67)	19:35	18:38	16:57	31 15:45 (T-74)	16:48	56 16:08 (T-74)	
19	05:59	06:23 (T-71)	06:33	06:58	07:01 (T-76)	07:09	07:46	07:28	15:12 (T-74)	07:59	15:12 (T-74)
	21:07	16 06:39 (T-71)	20:29	46 20:04 (T-67)	19:33	18:37	16:56	34 15:46 (T-74)	16:48	55 16:07 (T-74)	
20	06:00	06:24 (T-71)	06:34	06:57	07:01 (T-76)	07:11	07:47	07:29	15:12 (T-74)	07:59	15:13 (T-74)
	21:07	15 06:39 (T-71)	20:27	46 20:02 (T-67)	19:31	18:35	16:55	36 15:48 (T-74)	16:48	55 16:08 (T-74)	
21	06:01	06:25 (T-71)	06:35	06:58	07:01 (T-76)	07:12	07:49	07:30	15:11 (T-74)	08:00	15:13 (T-74)
	21:06	14 06:39 (T-71)	20:25	44 20:00 (T-66)	19:29	18:33	16:54	38 15:49 (T-74)	16:49	55 16:08 (T-74)	
22	06:02	06:26 (T-71)	06:37	06:59	07:01 (T-76)	07:13	07:50	07:32	15:09 (T-74)	08:01	15:14 (T-74)
	21:05	13 06:39 (T-71)	20:24	41 19:59 (T-66)	19:27	18:32	16:53	48 16:27 (T-72)	16:49	55 16:09 (T-74)	
23	06:03	06:26 (T-71)	06:38	07:00	07:01 (T-76)	07:14	07:51	07:33	15:09 (T-74)	08:01	15:14 (T-74)
	21:04	12 06:38 (T-71)	20:22	38 19:57 (T-66)	19:25	18:30	16:53	49 16:27 (T-72)	16:50	55 16:09 (T-74)	
24	06:04	06:27 (T-71)	06:39	07:01	07:01 (T-76)	07:15	07:53	07:34	15:09 (T-74)	08:01	15:15 (T-74)
	21:03	11 06:38 (T-71)	20:20	35 19:55 (T-66)	19:24	18:29	16:52	50 16:26 (T-72)	16:51	55 16:10 (T-74)	
25	06:05	06:28 (T-71)	06:40	07:02	07:01 (T-76)	07:16	07:54	07:35	15:08 (T-74)	08:02	15:15 (T-74)
	21:02	10 06:38 (T-71)	20:19	33 19:53 (T-66)	19:22	18:27	16:51	51 16:24 (T-72)	16:51	56 16:11 (T-74)	
26	06:06	06:29 (T-71)	06:41	07:03	07:01 (T-76)	07:18	07:55	07:37	15:08 (T-74)	08:02	15:15 (T-74)
	21:01	9 06:38 (T-71)	20:17	30 19:52 (T-66)	19:20	18:25	16:51	51 16:24 (T-72)	16:52	56 16:11 (T-74)	
27	06:07	06:30 (T-71)	06:42	07:05	07:01 (T-76)	07:19	07:57	07:38	15:08 (T-74)	08:03	15:16 (T-74)
	21:00	7 06:37 (T-71)	20:15	27 19:51 (T-66)	19:18	18:24	16:50	53 16:24 (T-72)	16:52	56 16:12 (T-74)	
28	06:08	06:32 (T-71)	06:44	07:06	07:01 (T-76)	07:20	07:58	07:39	15:07 (T-74)	08:03	15:17 (T-74)
	20:59	6 06:38 (T-71)	20:13	23 19:49 (T-66)	19:16	18:22	16:50	53 16:23 (T-72)	16:53	55 16:12 (T-74)	
29	06:09	06:33 (T-71)	06:45	07:07	07:01 (T-76)	07:21	07:59	07:40	15:07 (T-74)	08:03	15:17 (T-74)
	20:58	4 06:37 (T-71)	20:12	19 19:47 (T-66)	19:14	18:21	16:49	53 16:22 (T-72)	16:54	55 16:12 (T-74)	
30	06:10	06:34 (T-71)	06:46	07:08	07:01 (T-76)	07:22	08:01	07:41	15:07 (T-74)	08:03	15:17 (T-74)
	20:57	2 06:36 (T-71)	20:10	16 07:24 (T-76)	19:12	18:19	16:49	53 16:22 (T-72)	16:55	56 16:13 (T-74)	
31	06:11		06:47	07:09	07:01 (T-76)	07:23	08:02		15:08	08:03	15:18 (T-74)
	20:55		20:08	14 07:23 (T-76)	19:11	18:18			16:56	55 16:13 (T-74)	
Potential sun hours	471		436	377		341	289		276		
Total, worst case		392	677	23		677			1694		
Sun reduction		0.75	0.72	0.67		0.48			0.52		
Oper. time red.		0.90	0.90	0.90		0.90			0.90		
Wind dir. red.		0.59	0.58	0.57		0.62			0.62		
Total reduction		0.40	0.38	0.35		0.27			0.29		
Total, real		157	256	8		181			491		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-246 - R-246

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	09:19 (T-69) 07:46	08:08 (T-76) 07:05	07:26 (T-71) 07:09	07:32 (T-70) 06:18	05:45 20:23 (T-85)
2	16:57 64 15:59 (T-67) 17:35 27 17:09 (T-66) 18:12	09:20 (T-69) 07:45	08:07 (T-76) 07:04	07:28 (T-71) 19:52 35 08:07 (T-70) 20:29	07:32 (T-70) 06:16	21:03 14 20:37 (T-85)
3	16:58 61 15:58 (T-67) 17:36 29 17:10 (T-66) 18:14	09:20 (T-69) 07:44	08:06 (T-76) 07:02	07:28 (T-71) 19:53 34 08:06 (T-70) 20:31	07:33 (T-70) 06:15	21:04 15 20:38 (T-85)
4	16:59 57 15:57 (T-67) 17:38 30 17:12 (T-66) 18:15	09:21 (T-69) 07:43	08:05 (T-76) 07:00	07:29 (T-71) 19:55 31 08:04 (T-70) 20:32	07:34 (T-70) 06:14	21:05 16 20:38 (T-85)
5	17:00 49 10:10 (T-69) 17:39 32 17:14 (T-66) 18:16	09:22 (T-69) 07:42	08:04 (T-76) 06:58	07:28 (T-71) 19:56 30 08:04 (T-70) 20:33	07:35 (T-70) 06:12	21:06 17 20:40 (T-85)
6	17:01 48 10:10 (T-69) 17:40 32 17:15 (T-66) 18:18	09:23 (T-69) 07:40	08:07 (T-76) 06:57	07:19 (T-71) 07:02	08:02 (T-70) 20:34	05:43 21:07 18 20:41 (T-85)
7	17:02 47 10:10 (T-69) 17:42 26 17:16 (T-66) 18:19	09:24 (T-69) 07:39	08:07 (T-76) 06:57	07:17 (T-71) 07:00	07:36 (T-70) 06:11	05:43 21:07 18 20:41 (T-85)
8	17:03 45 10:09 (T-69) 17:43 19 17:15 (T-66) 18:20	09:25 (T-69) 07:38	16:56 (T-66) 06:55	07:15 (T-71) 06:58	08:00 (T-70) 20:35	05:42 21:08 19 20:42 (T-85)
9	17:04 44 10:09 (T-69) 17:45 16 17:13 (T-66) 18:22	09:26 (T-69) 07:36	16:57 (T-66) 07:53	07:23 (T-71) 20:00 19 07:57 (T-70) 20:37	07:38 (T-70) 06:09	05:42 21:08 19 20:42 (T-85)
10	17:05 43 10:09 (T-69) 17:46 12 17:12 (T-66) 19:23	09:27 (T-69) 07:35	17:00 (T-66) 07:51	06:56 07:40 (T-70) 06:08	07:54 (T-70) 20:38	05:42 21:09 19 20:42 (T-85)
11	17:06 41 10:08 (T-69) 17:47 6 17:09 (T-66) 19:24	09:28 (T-69) 07:34	17:03 (T-66) 07:50	06:54 20:01 14 07:54 (T-70) 20:38	06:07 20:39	05:42 21:10 19 20:43 (T-85)
12	17:07 40 10:08 (T-69) 17:49	09:28 (T-69) 07:34	17:09 (T-66) 19:24	06:51 20:03	06:04 20:40	05:41 21:10 20 20:43 (T-85)
13	17:08 38 10:08 (T-69) 17:50	09:30 (T-69) 07:32	07:46 19:26	06:49 20:05	06:03 20:41	05:41 21:11 20 20:44 (T-85)
14	17:09 36 10:07 (T-69) 17:52	09:31 (T-69) 07:31	07:44 19:27	06:47 20:06	06:02 20:43	05:41 21:11 20 20:44 (T-85)
15	17:11 33 10:05 (T-69) 17:53	09:32 (T-69) 07:29	07:42 19:28	06:46 20:07	06:01 20:44	05:41 21:12 21 20:45 (T-85)
16	17:12 31 10:05 (T-69) 17:54	09:34 (T-69) 07:28	07:42 19:29	06:44 20:08	06:01 20:45	05:41 21:12 22 20:46 (T-85)
17	17:13 27 10:03 (T-69) 17:56	09:36 (T-69) 07:26	07:39 19:32	06:42 20:11	05:58 19:47 (T-84) 20:47	05:41 21:13 21 20:46 (T-85)
18	17:14 23 10:02 (T-69) 17:57	10:03 (T-69) 17:56	07:37 19:33	06:40 20:12	05:57 19:47 (T-84) 20:47	05:41 21:13 21 20:46 (T-85)
19	17:16 19 10:00 (T-69) 17:59	09:39 (T-69) 07:25	07:37 19:33	06:40 20:12	05:57 19:47 (T-84) 20:47	05:41 21:14 22 20:47 (T-85)
20	17:17 11 09:56 (T-69) 18:00	10:03 (T-69) 17:56	07:35 19:35	06:39 20:13	05:56 19:46 (T-84) 20:49	05:41 21:14 22 20:47 (T-85)
21	17:18 2 16:51 (T-65) 18:00	09:41 (T-69) 07:23	07:33 19:36	06:37 20:13	05:55 19:51 (T-84) 20:49	05:41 21:14 22 20:47 (T-85)
22	17:20 3 16:50 (T-65) 18:01	10:07 (T-69) 17:57	07:33 19:36	06:37 20:13	05:55 19:46 (T-84) 20:49	05:41 21:15 22 20:47 (T-85)
23	17:21 4 16:50 (T-65) 18:02	10:08 (T-69) 17:58	07:31 19:37	06:35 20:14	05:54 19:52 (T-84) 20:51	05:41 21:15 22 20:47 (T-85)
24	17:22 6 16:56 (T-66) 18:04	10:09 (T-69) 17:59	07:29 19:37	06:34 20:16	05:54 19:46 (T-84) 20:51	05:41 21:16 22 20:48 (T-85)
25	17:24 6 16:57 (T-66) 18:06	10:10 (T-69) 18:00	07:27 19:38	06:32 20:17	05:53 19:53 (T-84) 20:52	05:41 21:17 22 20:48 (T-85)
26	17:25 7 16:58 (T-66) 18:07	10:11 (T-69) 18:01	07:27 19:38	06:32 20:17	05:53 19:46 (T-84) 20:53	05:41 21:17 22 20:48 (T-85)
27	17:26 10 17:00 (T-66) 18:08	10:12 (T-69) 18:02	07:27 19:38	06:32 20:17	05:52 19:54 (T-84) 20:53	05:41 21:18 22 20:48 (T-85)
28	17:27 12 17:01 (T-66) 18:10	10:13 (T-69) 18:03	07:26 19:39	06:30 20:18	05:52 19:47 (T-84) 20:52	05:41 21:19 22 20:48 (T-85)
29	17:29 16 17:03 (T-66) 18:11	10:14 (T-69) 18:04	07:26 19:40	06:30 20:18	05:52 19:56 (T-84) 20:54	05:41 21:20 22 20:48 (T-85)
30	17:30 19 17:05 (T-66) 18:12	10:15 (T-69) 18:05	07:26 19:41	06:30 20:18	05:52 19:48 (T-84) 20:52	05:41 21:21 22 20:48 (T-85)
31	17:32 22 17:06 (T-66) 18:13	10:16 (T-69) 18:06	07:26 19:42	06:30 20:18	05:52 19:57 (T-84) 20:55	05:41 21:22 22 20:48 (T-85)
Potential sun hours	287	292	369	403	458	465
Total, worst case	888	229	400	267	78	603
Sun reduction	0.58	0.58	0.59	0.63	0.66	0.73
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90
Wind dir. red.	0.67	0.60	0.59	0.59	0.64	0.64
Total reduction	0.35	0.32	0.32	0.34	0.38	0.42
Total, real	310	72	126	90	30	256

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-246 - R-246
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July		August		September		October		November		December					
1	05:45	20:28 (T-85)	06:12		06:48		07:24		07:03	16:31 (T-66)	07:43		09:11 (T-69)			
	21:16	20	20:48 (T-85)	20:54	20:06		19:10		17:17	8	16:39 (T-66)	16:48	39	09:50 (T-69)		
2	05:45	20:28 (T-85)	06:13		06:49		07:25		07:05	16:29 (T-66)	07:44		09:10 (T-69)			
	21:16	20	20:48 (T-85)	20:53	20:05		19:09		17:15	13	16:42 (T-66)	16:48	41	09:51 (T-69)		
3	05:46	20:28 (T-85)	06:15		06:51		07:26		07:06	16:27 (T-66)	07:45		09:09 (T-69)			
	21:16	20	20:48 (T-85)	20:52	20:03		19:07		17:14	16	16:43 (T-66)	16:47	43	09:52 (T-69)		
4	05:47	20:29 (T-85)	06:16		06:52	07:38 (T-70)	07:27		07:08	16:26 (T-66)	07:46		09:09 (T-69)			
	21:15	19	20:48 (T-85)	20:51	20:01	14	07:52 (T-70)	19:05	17:12	19	16:45 (T-66)	16:47	44	09:53 (T-69)		
5	05:47	20:29 (T-85)	06:17		06:53	07:35 (T-70)	07:29		07:09	07:37 (T-76)	07:47		09:10 (T-69)			
	21:15	19	20:48 (T-85)	20:49	19:59	19	07:54 (T-70)	19:03	17:11	27	16:46 (T-66)	16:47	45	09:55 (T-69)		
6	05:48	20:29 (T-85)	06:18		06:54	07:32 (T-70)	07:30		07:10	07:35 (T-76)	07:48		09:10 (T-69)			
	21:15	18	20:47 (T-85)	20:48	19:57	24	07:56 (T-70)	19:01	5	07:58 (T-71)	17:10	31	16:45 (T-66)	16:47	46	09:56 (T-69)
7	05:49	20:29 (T-85)	06:19		06:55	07:30 (T-70)	07:31		07:12	07:35 (T-76)	07:49		09:09 (T-69)			
	21:14	18	20:47 (T-85)	20:47	19:55	27	07:57 (T-70)	18:58	8	08:00 (T-71)	17:09	32	16:44 (T-66)	16:47	48	09:57 (T-69)
8	05:49	20:30 (T-85)	06:20		06:56	07:28 (T-70)	07:32		07:13	07:36 (T-76)	07:50		09:09 (T-69)			
	21:14	17	20:47 (T-85)	20:45	19:54	30	07:58 (T-70)	18:56	8	08:01 (T-71)	17:07	30	16:42 (T-66)	16:46	49	09:58 (T-69)
9	05:50	20:30 (T-85)	06:21		06:58	07:27 (T-70)	07:34		07:14	07:38 (T-76)	07:51		09:09 (T-69)			
	21:14	16	20:46 (T-85)	20:44	19:52	31	07:58 (T-70)	18:54	8	08:03 (T-71)	17:06	29	16:41 (T-66)	16:46	57	15:46 (T-67)
10	05:51	20:30 (T-85)	06:23		06:59	07:26 (T-70)	07:35		07:16	07:39 (T-76)	07:52		09:10 (T-69)			
	21:13	16	20:46 (T-85)	20:42	19:50	33	07:59 (T-70)	18:52	7	08:03 (T-71)	17:05	26	16:39 (T-66)	16:46	60	15:48 (T-67)
11	05:52	20:31 (T-85)	06:24		07:00	07:24 (T-70)	07:36		07:17	07:41 (T-76)	07:53		09:09 (T-69)			
	21:13	15	20:46 (T-85)	20:41	19:48	35	07:59 (T-70)	18:50	5	08:02 (T-71)	17:04	25	16:39 (T-66)	16:46	64	15:49 (T-67)
12	05:52	20:31 (T-85)	06:25		07:01	07:24 (T-70)	07:37		07:18	07:42 (T-76)	07:54		09:09 (T-69)			
	21:12	14	20:45 (T-85)	20:39	19:46	36	08:00 (T-70)	18:49	4	08:03 (T-71)	17:03	21	16:37 (T-66)	16:46	65	15:50 (T-67)
13	05:53	20:31 (T-85)	06:26		07:02	07:24 (T-70)	07:39		07:20	07:44 (T-76)	07:55		09:10 (T-69)			
	21:12	13	20:44 (T-85)	20:38	19:44	36	08:00 (T-70)	18:47	2	08:02 (T-71)	17:02	18	16:36 (T-66)	16:47	66	15:51 (T-67)
14	05:54	20:32 (T-85)	06:27		07:04	07:25 (T-70)	07:40		07:21	07:45 (T-76)	07:55		09:10 (T-69)			
	21:11	12	20:44 (T-85)	20:36	19:42	34	07:59 (T-70)	18:45	17:01	16	16:35 (T-66)	16:47	68	15:52 (T-67)		
15	05:55	20:32 (T-85)	06:28		07:05	07:26 (T-70)	07:41		07:22	07:47 (T-76)	07:56		09:10 (T-69)			
	21:10	11	20:43 (T-85)	20:35	19:41	33	07:59 (T-70)	18:43	17:00	12	16:34 (T-66)	16:47	71	15:54 (T-67)		
16	05:56	20:33 (T-85)	06:30		07:06	07:27 (T-70)	07:42		07:24	07:48 (T-76)	07:57		09:10 (T-69)			
	21:10	10	20:43 (T-85)	20:33	19:39	32	07:59 (T-70)	18:42	16:59	9	16:33 (T-66)	16:47	72	15:54 (T-67)		
17	05:57	20:34 (T-85)	06:31		07:07	07:28 (T-70)	07:44		07:25	16:24 (T-65)	07:58		09:11 (T-69)			
	21:09	8	20:42 (T-85)	20:32	19:37	30	07:58 (T-70)	18:40	16:58	7	16:31 (T-66)	16:47	72	15:55 (T-67)		
18	05:58	20:35 (T-85)	06:32		07:08	07:29 (T-70)	07:45		07:26	16:25 (T-65)	07:58		09:11 (T-69)			
	21:08	6	20:41 (T-85)	20:30	19:35	28	07:57 (T-70)	18:38	16:57	6	16:31 (T-66)	16:48	74	15:56 (T-67)		
19	05:59	20:35 (T-85)	06:33		07:09	07:31 (T-70)	07:46		07:28	16:24 (T-65)	07:59		09:11 (T-69)			
	21:07	6	20:41 (T-85)	20:29	6	20:02 (T-84)	19:33	26	07:57 (T-70)	18:37	16:56	6	16:30 (T-66)	16:48	74	15:56 (T-67)
20	06:00	20:36 (T-85)	06:34		07:11	19:54 (T-84)	07:11		07:29	16:25 (T-65)	08:00		09:12 (T-69)			
	21:07	4	20:40 (T-85)	20:27	8	20:02 (T-84)	19:31	24	07:56 (T-70)	18:35	16:55	4	16:29 (T-65)	16:48	74	15:57 (T-67)
21	06:01	20:38 (T-85)	06:35		07:12	19:52 (T-84)	07:12		07:30	16:25 (T-65)	08:00		09:12 (T-69)			
	21:06	1	20:39 (T-85)	20:25	8	20:00 (T-84)	19:29	22	07:55 (T-70)	18:33	16:54	3	16:28 (T-65)	16:49	74	15:57 (T-67)
22	06:02		06:37		07:13	19:51 (T-84)	07:13		07:32	16:25 (T-65)	08:01		09:13 (T-69)			
	21:05		20:24		8	19:59 (T-84)	19:27	19	07:53 (T-70)	18:32	16:53	2	16:27 (T-65)	16:49	74	15:58 (T-67)
23	06:03		06:38		07:14	19:50 (T-84)	07:14		07:33	09:23 (T-69)	08:01		09:13 (T-69)			
	21:04		20:22		7	19:57 (T-84)	19:25	16	07:51 (T-70)	18:30	16:53	10	09:33 (T-69)	16:50	74	15:58 (T-67)
24	06:04		06:39		07:15	19:49 (T-84)	07:15		07:34	09:19 (T-69)	08:02		09:14 (T-69)			
	21:03		20:20		6	19:55 (T-84)	19:24	13	07:49 (T-70)	18:29	16:52	18	09:37 (T-69)	16:51	74	15:59 (T-67)
25	06:05		06:40		07:16	19:49 (T-84)	07:16		07:35	09:16 (T-69)	08:02		09:14 (T-69)			
	21:02		20:19		4	19:53 (T-84)	19:22	10	07:48 (T-70)	18:27	16:51	23	09:39 (T-69)	16:51	74	15:59 (T-67)
26	06:06		06:41		07:18	19:49 (T-84)	07:18		07:37	09:15 (T-69)	08:02		09:15 (T-69)			
	21:01		20:17		3	19:52 (T-84)	19:20	6	07:45 (T-70)	18:25	16:51	27	09:42 (T-69)	16:52	72	15:59 (T-67)
27	06:07		06:42		07:19	19:50 (T-84)	07:19		07:38	09:14 (T-69)	08:03		09:16 (T-69)			
	21:00		20:15		1	19:51 (T-84)	19:18		16:50	30	09:44 (T-69)	16:52	72	16:00 (T-69)		
28	06:08		06:44		07:20		07:58		07:39	09:12 (T-69)	08:03		09:16 (T-69)			
	20:59		20:13		19:16		18:22		16:50	33	09:45 (T-69)	16:53	71	16:00 (T-67)		
29	06:09		06:45		07:21		07:59		07:40	09:12 (T-69)	08:03		09:17 (T-69)			
	20:58		20:12		19:14		18:21		16:49	36	09:48 (T-69)	16:54	69	15:59 (T-67)		
30	06:10		06:46		07:22		08:01		07:41	09:11 (T-69)	08:03		09:17 (T-69)			
	20:57		20:10		19:12		18:19		16:49	38	09:49 (T-69)	16:55	68	15:59 (T-67)		
31	06:11		06:47				08:02				08:04		09:18 (T-69)			
	20:55		20:08				18:18				16:56	66	15:59 (T-67)			
Potential sun hours	471		436		377		341		289		276					
Total, worst case	283		51		578		47		575		1960					
Sun reduction	0.75		0.72		0.67		0.56		0.48		0.52					
Oper. time red.	0.90		0.90		0.90		0.90		0.90		0.90					
Wind dir. red.	0.64		0.60		0.59		0.60		0.63		0.67					
Total reduction	0.44		0.39		0.36		0.30		0.27		0.31					
Total, real	123		20		207		14		157		615					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project: South Deuel Wind Project	Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L085 73 GE3.8-154 WTGs on 98m HH June 14, 2024	Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:01 PM/3.6.366
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SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-251 - R-251
 Assumptions for shadow calculations Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:46 17:35		07:05 18:12		07:09 19:52	06:18 20:29	05:45 21:03	05:45 21:16	06:12 20:54	06:48 20:06	
2	08:04 16:57	07:45 17:36	17:09 (T-80)	07:04 18:14		07:07 19:53	06:16 20:31	05:44 21:04	05:45 21:16	06:13 20:53	06:49 20:04	
3	08:04 16:58	07:44 17:37	17:08 (T-80)	07:02 18:15		07:05 19:55	06:15 20:32	05:44 21:05	05:46 21:16	06:14 20:52	06:51 20:03	
4	08:04 16:59	07:43 17:38	17:07 (T-80)	07:00 18:16		07:03 19:56	06:13 20:33	05:43 21:06	05:46 21:15	06:16 20:50	06:52 20:01	
5	08:04 17:00	07:42 17:40	17:05 (T-80)	06:58 18:18		07:02 19:57	06:12 20:34	05:43 21:07	05:47 21:15	06:17 20:49	06:53 20:59	
6	08:04 17:01	07:40 17:42	17:05 (T-80)	06:57 18:19	17:55 (T-62)	07:00 19:58	06:11 20:35	05:43 21:07	05:48 21:15	06:48 20:48	06:54 19:57	
7	08:03 17:02	07:39 17:43	17:04 (T-80)	06:55 18:20	17:55 (T-62)	06:58 20:00	06:09 20:37	05:42 21:08	05:48 21:14	06:19 20:47	06:55 19:55	
8	08:03 17:04	07:38 17:45	17:03 (T-80)	07:53 18:22	18:55 (T-62)	06:56 20:01	06:08 20:38	05:42 21:09	05:49 21:14	06:20 20:45	06:56 19:54	
9	08:03 17:05	07:36 17:46	17:03 (T-80)	07:51 19:23	18:55 (T-62)	06:54 20:02	06:07 20:39	05:42 21:10	05:50 21:14	06:21 20:44	06:58 19:52	
10	08:03 17:06	07:35 17:47	17:02 (T-80)	07:49 19:24	18:55 (T-62)	06:53 20:03	06:05 20:40	05:41 21:10	05:51 21:13	06:22 20:42	06:59 19:50	
11	08:02 17:07	07:34 17:49	17:03 (T-80)	07:48 19:25	18:56 (T-62)	06:51 20:05	06:04 20:41	05:41 21:11	05:51 21:13	06:24 20:41	07:00 19:48	
12	08:02 17:08	07:32 17:50	17:03 (T-80)	07:46 19:27	18:57 (T-63)	06:49 20:06	06:03 20:43	05:41 21:11	05:52 21:12	06:25 20:39	07:01 19:46	
13	08:02 17:09	07:31 17:52	17:03 (T-80)	07:44 19:28	18:57 (T-63)	06:47 20:07	06:02 20:44	05:41 21:12	05:53 21:12	06:26 20:38	07:02 19:44	
14	08:01 17:10	07:29 17:53	17:04 (T-80)	07:42 19:29	18:57 (T-63)	06:45 20:08	06:01 20:45	05:41 21:12	05:54 21:11	06:27 20:36	07:03 19:42	
15	08:01 17:12	07:28 17:54	17:04 (T-80)	07:40 19:31	18:58 (T-63)	06:44 20:09	05:59 20:46	05:41 21:13	05:55 21:10	06:28 20:35	07:05 19:40	
16	08:00 17:13	07:26 17:56	17:06 (T-80)	07:39 19:32	18:58 (T-63)	06:42 20:11	05:58 20:47	05:41 21:13	05:56 21:10	06:29 20:33	07:06 19:39	
17	07:59 17:14	07:25 17:57	17:05 (T-80)	07:37 19:33	18:59 (T-63)	06:40 20:12	05:57 20:48	05:41 21:14	05:57 21:09	06:31 20:32	07:07 19:37	
18	07:59 17:16	07:23 17:59	17:06 (T-80)	07:35 19:34	19:02 (T-63)	06:39 20:13	05:56 20:49	05:41 21:14	05:58 21:08	06:32 20:30	07:08 19:35	
19	07:58 17:17	07:22 18:00	17:08 (T-80)	07:33 19:36	19:08 (T-63)	06:38 20:14	05:55 20:50	05:41 21:15	05:59 21:07	06:33 20:29	07:09 19:33	
20	07:57 17:18	07:20 18:00	17:09 (T-80)	07:31 19:37	19:10 (T-63)	06:35 20:16	05:54 20:52	05:41 21:15	06:00 21:07	06:34 20:27	07:10 19:31	
21	07:57 17:19	07:19 18:01	17:12 (T-80)	07:29 19:38	19:11 (T-63)	06:34 20:17	05:53 20:53	05:41 21:15	06:00 21:06	06:35 20:25	07:12 19:29	
22	07:56 17:21	07:17 18:03		07:27 19:40	19:11 (T-63)	06:32 20:18	05:52 20:54	05:41 21:15	06:01 21:05	06:36 20:24	07:13 19:27	
23	07:55 17:22	07:15 18:04		07:26 19:41	19:12 (T-63)	06:30 20:19	05:51 20:55	05:42 21:16	06:02 21:04	06:38 20:22	07:14 19:25	
24	07:54 17:23	07:14 18:05		07:24 19:42	19:13 (T-63)	06:29 20:21	05:51 20:56	05:42 21:16	06:04 21:03	06:39 20:20	07:15 19:23	
25	07:53 17:25	07:12 18:07		07:22 19:43	19:14 (T-63)	06:27 20:22	05:50 20:57	05:42 21:16	06:05 21:02	06:40 20:19	07:16 19:22	
26	07:53 17:26	07:10 18:08		07:20 19:45	19:15 (T-63)	06:25 20:23	05:49 20:58	05:43 21:16	06:06 21:01	06:41 20:17	07:18 19:20	
27	07:52 17:28	07:09 18:10		07:18 19:46	19:16 (T-63)	06:24 20:24	05:48 20:59	05:43 21:16	06:07 21:00	06:42 20:15	07:19 19:18	
28	07:51 17:29	07:07 18:11		07:16 19:47	19:17 (T-63)	06:22 20:26	05:47 21:00	05:43 21:16	06:08 20:59	06:43 20:13	07:20 19:16	
29	07:50 17:30		17:04 (T-80)	07:14 19:48	19:18 (T-63)	06:21 20:27	05:47 21:01	05:44 21:16	06:09 20:58	06:45 20:12	07:21 19:14	
30	07:49 17:32		17:03 (T-80)	07:13 19:50	19:19 (T-63)	06:19 20:28	05:46 21:02	05:44 21:16	06:10 20:57	06:46 20:10	07:22 19:12	
31	07:47 17:33		17:01 (T-80)	07:11 19:51	19:20 (T-63)	06:18 21:03	05:45 21:03	05:45 20:55	06:11 20:55	06:47 20:08	07:23 18:18	
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case		336	105							284	99	
Sun reduction		0.58	0.59							0.56	0.48	
Oper. time red.		0.90	0.90							0.90	0.90	
Wind dir. red.		0.59	0.57							0.59	0.59	
Total reduction		0.31	0.30							0.30	0.26	
Total, real		104	32							84	25	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	First time (hh:mm) with flicker Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time) (WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-252 - R-252
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	ENE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 07:46 07:05 07:09 06:18				06:18	19:40 (T-80) 05:45	05:45	06:12	20:02 (T-80) 06:48	07:24	07:03	07:43
2	16:57 17:35 18:12 19:52				20:29	26 20:06 (T-63) 21:03	21:16	20:54	5 20:07 (T-80) 20:06	19:10	17:16	16:48
3	08:04 07:45 07:04 07:07				06:16	19:39 (T-80) 05:44	05:45	06:13	19:58 (T-80) 06:49	07:25	07:05	07:44
4	16:58 17:36 18:14 19:53				20:30	27 20:06 (T-63) 21:04	21:16	20:53	12 20:10 (T-80) 20:04	19:09	17:15	16:48
5	08:04 07:44 07:02 07:05				06:15	19:40 (T-80) 05:44	05:46	06:14	19:56 (T-80) 06:51	07:26	07:06	07:45
6	16:58 17:37 18:15 19:55				20:32	28 20:08 (T-63) 21:05	21:15	20:52	16 20:12 (T-80) 20:03	19:07	17:14	16:47
7	08:04 07:43 07:00 07:03				06:14	19:41 (T-80) 05:43	05:47	06:16	19:54 (T-80) 06:52	07:27	07:07	07:46
8	16:59 17:39 18:16 19:56				20:33	28 20:09 (T-63) 21:06	21:15	20:50	20 20:14 (T-80) 20:01	19:05	17:12	16:47
9	08:04 07:42 06:58 07:02				06:12	19:40 (T-80) 05:43	05:47	06:17	19:53 (T-80) 06:53	07:28	07:09	07:47
10	17:00 17:40 18:18 19:57				20:34	30 20:10 (T-63) 21:07	21:15	20:49	24 20:17 (T-63) 19:59	19:03	17:11	16:47
11	08:03 07:40 06:57 07:00				06:11	19:41 (T-80) 05:43	05:48	06:18	19:52 (T-80) 06:54	07:30	07:10	07:48
12	17:01 17:42 18:19 19:58				20:35	30 20:11 (T-63) 21:07	21:15	20:48	28 20:20 (T-63) 19:57	19:01	17:10	16:47
13	08:03 07:39 06:55 06:58				06:09	19:43 (T-80) 05:42	05:49	06:19	19:51 (T-80) 06:55	07:31	07:12	07:49
14	17:02 17:43 18:20 20:00				20:37	27 20:10 (T-63) 21:08	21:14	20:46	30 20:21 (T-63) 19:55	18:58	17:08	16:46
15	08:03 07:38 07:53 06:56				06:08	19:44 (T-80) 05:42	05:49	06:20	19:50 (T-80) 06:56	07:32	07:13	07:50
16	17:04 17:45 18:22 20:01				20:38	21 20:05 (T-80) 21:09	21:14	20:45	29 20:19 (T-63) 19:54	18:56	17:07	16:46
17	08:03 07:36 07:51 06:54				06:07	19:44 (T-80) 05:42	05:50	06:21	19:49 (T-80) 06:58	07:33	07:14	07:51
18	17:05 17:46 19:23 20:02				20:39	18 20:02 (T-80) 21:10	21:14	20:44	29 20:18 (T-63) 19:52	18:54	17:06	16:46
19	08:03 07:35 07:49 06:53				06:05	19:46 (T-80) 05:41	05:51	06:22	19:48 (T-80) 06:59	07:35	07:16	07:52
20	17:06 17:47 19:24 20:03				20:40	15 20:01 (T-80) 21:10	21:13	20:42	28 20:16 (T-63) 19:50	18:52	17:05	16:46
21	08:02 07:34 07:48 06:51				06:04	19:49 (T-80) 05:41	05:52	06:24	19:49 (T-80) 07:00	07:36	07:17	07:53
22	17:07 17:49 19:25 20:05				20:41	10 19:59 (T-80) 21:11	21:13	20:41	27 20:16 (T-63) 19:48	18:50	17:04	16:46
23	08:02 07:32 07:46 06:49				06:03	05:41	05:52	06:25	19:48 (T-80) 07:01	07:37	07:18	07:54
24	17:08 17:50 19:27 20:06				20:43	21:11	21:12	20:39	26 20:14 (T-63) 19:46	18:49	17:03	16:46
25	08:01 07:31 07:44 06:47			19:42 (T-62) 06:02	06:02	05:41	05:53	06:26	19:48 (T-80) 07:02	07:38	07:20	07:55
26	17:09 17:52 19:28 20:07			2 19:44 (T-62) 20:44	20:44	21:12	21:12	20:38	25 20:13 (T-63) 19:44	18:47	17:02	16:46
27	08:01 07:29 07:42 06:45			19:42 (T-62) 06:01	06:01	05:41	05:54	06:27	19:47 (T-80) 07:03	07:40	07:21	07:55
28	17:11 17:53 19:29 20:08			4 19:46 (T-62) 20:45	20:45	21:12	21:11	20:36	24 20:11 (T-63) 19:42	18:45	17:00	16:47
29	08:01 07:28 07:40 06:44			19:42 (T-62) 05:59	05:59	05:41	05:55	06:28	19:47 (T-80) 07:05	07:41	07:22	07:56
30	17:12 17:54 19:31 20:09			5 19:47 (T-62) 20:46	20:46	21:13	21:10	20:35	22 20:09 (T-63) 19:40	18:43	16:59	16:47
31	08:00 07:26 07:39 06:42			19:42 (T-62) 05:58	05:58	05:41	05:56	06:29	19:47 (T-80) 07:06	07:42	07:24	07:57
32	17:13 17:56 19:32 20:11			6 19:48 (T-62) 20:47	20:47	21:13	21:10	20:33	21 20:08 (T-63) 19:39	18:42	16:58	16:47
33	07:59 07:25 07:37 06:40			19:43 (T-62) 05:57	05:57	05:41	05:57	06:31	19:47 (T-80) 07:07	07:44	07:25	07:58
34	17:14 17:57 19:33 20:12			7 19:50 (T-62) 20:48	20:48	21:14	21:09	20:32	19 20:06 (T-80) 19:37	18:40	16:57	16:47
35	07:59 07:23 07:35 06:39			19:43 (T-62) 05:56	05:56	05:41	05:58	06:32	19:47 (T-80) 07:08	07:45	07:26	07:58
36	17:16 17:59 19:34 20:13			8 19:51 (T-62) 20:49	20:49	21:14	21:08	20:30	18 20:05 (T-80) 19:35	18:38	16:57	16:48
37	07:58 07:22 07:33 06:37			19:45 (T-62) 05:55	05:55	05:41	05:59	06:33	19:47 (T-80) 07:09	07:46	07:28	07:59
38	17:17 18:00 19:36 20:14			7 19:52 (T-80) 20:50	20:50	21:15	21:07	20:29	16 20:03 (T-80) 19:33	18:37	16:56	16:48
39	07:57 07:20 07:31 06:35			19:47 (T-80) 05:54	05:54	05:41	06:00	06:34	19:49 (T-80) 07:10	07:47	07:29	08:00
40	17:18 18:00 19:37 20:16			6 19:53 (T-80) 20:52	20:52	21:15	21:07	20:27	13 20:02 (T-80) 19:31	18:35	16:55	16:48
41	07:57 07:19 07:29 06:34			19:45 (T-80) 05:53	05:53	05:41	06:01	06:35	19:49 (T-80) 07:12	07:49	07:30	08:00
42	17:19 18:01 19:38 20:17			9 19:54 (T-80) 20:53	20:53	21:15	21:06	20:25	11 20:00 (T-80) 19:29	18:33	16:54	16:49
43	07:56 07:17 07:27 06:32			19:43 (T-80) 05:52	05:52	05:41	06:02	06:36	19:50 (T-80) 07:13	07:50	07:32	08:01
44	17:21 18:03 19:40 20:18			12 19:55 (T-80) 20:54	20:54	21:15	21:05	20:24	9 19:59 (T-80) 19:27	18:32	16:53	16:49
45	07:55 07:15 07:26 06:30			19:43 (T-80) 05:51	05:51	05:42	06:03	06:38	19:52 (T-80) 07:14	07:51	07:33	08:01
46	17:22 18:04 19:41 20:19			14 19:57 (T-80) 20:55	20:55	21:16	21:04	20:22	5 19:57 (T-80) 19:25	18:30	16:53	16:50
47	07:54 07:14 07:24 06:29			19:42 (T-80) 05:51	05:51	05:42	06:04	06:39	19:48 (T-62) 07:15	07:53	07:34	08:02
48	17:23 18:05 19:42 20:21			15 19:57 (T-80) 20:56	20:56	21:16	21:03	20:20	7 19:55 (T-62) 19:23	18:28	16:52	16:50
49	07:53 07:12 07:22 06:27			19:41 (T-80) 05:50	05:50	05:42	06:05	06:40	19:46 (T-62) 07:16	07:54	07:35	08:02
50	17:25 18:07 19:43 20:22			18 19:59 (T-80) 20:57	20:57	21:16	21:02	20:19	7 19:53 (T-62) 19:22	18:27	16:51	16:51
51	07:52 07:10 07:20 06:25			19:40 (T-80) 05:49	05:49	05:43	06:06	06:41	19:44 (T-62) 07:18	07:55	07:37	08:02
52	17:26 18:08 19:45 20:23			20 20:00 (T-63) 20:58	20:58	21:16	21:01	20:17	8 19:52 (T-62) 19:20	18:25	16:51	16:52
53	07:52 07:09 07:18 06:24			19:40 (T-80) 05:48	05:48	05:43	06:07	06:42	19:43 (T-62) 07:19	07:57	07:38	08:03
54	17:28 18:10 19:46 20:24			21 20:01 (T-63) 20:59	20:59	21:16	21:00	20:15	7 19:50 (T-62) 19:18	18:24	16:50	16:52
55	07:51 07:07 07:16 06:22			19:39 (T-80) 05:47	05:47	05:43	06:08	06:44	19:44 (T-62) 07:20	07:58	07:39	08:03
56	17:29 18:11 19:47 20:26			23 20:02 (T-63) 21:00	21:00	21:16	20:59	20:13	5 19:49 (T-62) 19:16	18:22	16:49	16:53
57	07:50 07:14 06:21 06:21			19:40 (T-80) 05:47	05:47	05:44	06:09	06:45	19:43 (T-62) 07:21	07:59	07:40	08:03
58	17:30 19:48 20:27 24 20:04 (T-63) 21:01			21:01	21:01	21:16	20:58	20:12	4 19:47 (T-62) 19:14	18:21	16:49	16:54
59	07:49 07:13 06:19 19:39 (T-80) 05:46			05:46	05:46	05:44	06:10	06:46	19:43 (T-62) 07:22	08:01	07:41	08:03
60	17:32 19:50 20:28 25 20:04 (T-63) 21:02			21:02	21:02	21:16	20:57	20:10	2 19:45 (T-62) 19:12	18:19	16:48	16:55
61	07:47 19:51 07:11 07:11			05:45	05:45	05:41	06:11	06:47		08:02	07:43	08:03
62	17:33 19:51 07:11 07:11			21:02	21:02	20:55	20:55	20:08		18:18	16:53	16:55
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case				226	260							

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-253 - R-253

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June		
1	08:04	15:54 (T-71)	07:46	07:05	07:09	06:18	05:45	
	16:57	34 16:28 (T-71)	17:35	18:12	19:52	20:29	21:03	
2	08:04	15:55 (T-71)	07:45	07:04	07:07	06:16	05:44	
	16:57	34 16:29 (T-71)	17:36	18:14	19:53	20:30	21:04	
3	08:04	15:55 (T-71)	07:44	07:02	07:05	06:15	05:44	
	16:58	35 16:30 (T-71)	17:37	18:15	19:54	20:32	21:05	
4	08:04	15:56 (T-71)	07:43	07:00	07:03	06:13	05:43	
	16:59	35 16:31 (T-71)	17:39	18:16	19:56	20:33	21:06	
5	08:04	15:57 (T-71)	07:42	06:58	07:01	06:12	05:43	
	17:00	34 16:31 (T-71)	17:40	18:18	19:57	20:34	21:07	
6	08:03	15:58 (T-71)	07:40	06:57	07:00	06:11	05:42	
	17:01	33 16:31 (T-71)	17:42	18:19	19:58	20:35	21:07	
7	08:03	15:57 (T-71)	07:39	06:55	06:58	06:09	05:42	
	17:02	34 16:31 (T-71)	17:43	18:20	19:59	20:36	21:08	
8	08:03	15:58 (T-71)	07:38	07:53	06:56	06:08	05:42	
	17:03	33 16:31 (T-71)	17:44	18:21	20:01	20:38	21:09	
9	08:03	15:59 (T-71)	07:36	07:51	19:01 (T-70)	06:54	06:07	05:42
	17:05	33 16:32 (T-71)	17:46	19:23	1 19:02 (T-70)	20:02	20:39	21:09
10	08:03	15:59 (T-71)	07:35	07:49	19:00 (T-70)	06:52	06:05	05:41
	17:06	32 16:31 (T-71)	17:47	19:24	3 19:03 (T-70)	20:03	20:40	21:10
11	08:02	16:01 (T-71)	07:34	07:48	18:59 (T-70)	06:51	06:04	05:41
	17:07	31 16:32 (T-71)	17:49	19:25	5 19:04 (T-70)	20:04	20:41	21:11
12	08:02	16:01 (T-71)	07:32	07:46	18:59 (T-70)	06:49	06:03	05:41
	17:08	30 16:31 (T-71)	17:50	19:27	6 19:05 (T-70)	20:06	20:42	21:11
13	08:01	16:02 (T-71)	07:31	07:44	18:58 (T-70)	06:47	06:02	05:41
	17:09	30 16:32 (T-71)	17:52	19:28	8 19:06 (T-70)	20:07	20:44	21:12
14	08:01	16:03 (T-71)	07:29	07:42	18:58 (T-70)	06:45	06:01	05:41
	17:10	28 16:31 (T-71)	17:53	19:29	10 19:08 (T-70)	20:08	20:45	21:12
15	08:00	16:04 (T-71)	07:28	07:40	19:00 (T-70)	06:44	05:59	05:41
	17:12	28 16:32 (T-71)	17:54	19:31	10 19:10 (T-70)	20:09	20:46	21:13
16	08:00	16:05 (T-71)	07:26	07:38	19:01 (T-70)	06:42	05:58	05:41
	17:13	26 16:31 (T-71)	17:56	19:32	10 19:11 (T-70)	20:11	20:47	21:13
17	07:59	16:06 (T-71)	07:25	07:37	19:04 (T-70)	06:40	05:57	05:41
	17:14	24 16:30 (T-71)	17:57	19:33	5 19:09 (T-70)	20:12	20:48	21:14
18	07:59	16:08 (T-71)	07:23	07:35	06:39	05:56	05:41	05:41
	17:15	22 16:30 (T-71)	17:59	19:34	20:13	20:49	21:14	21:14
19	07:58	16:09 (T-71)	07:22	07:33	06:37	05:55	05:41	05:41
	17:17	20 16:29 (T-71)	18:00	19:36	20:14	20:50	21:14	21:14
20	07:57	16:11 (T-71)	07:20	07:31	06:35	05:54	05:41	05:41
	17:18	17 16:28 (T-71)	18:00	19:37	20:16	20:51	21:15	21:15
21	07:57	16:13 (T-71)	07:19	07:29	06:33	05:53	05:41	05:41
	17:19	13 16:26 (T-71)	18:01	19:38	20:17	20:53	21:15	21:15
22	07:56	16:17 (T-71)	07:17	07:27	06:32	05:52	05:41	05:41
	17:21	7 16:24 (T-71)	18:03	19:39	20:18	20:54	21:15	21:15
23	07:55		07:15	07:25	06:30	05:51	05:42	05:42
	17:22		18:04	19:41	20:19	20:55	21:15	21:15
24	07:54		07:14	07:24	06:29	05:50	05:42	05:42
	17:23		18:05	19:42	20:21	20:56	21:16	21:16
25	07:53		07:12	07:22	06:27	05:50	05:42	05:42
	17:25		18:07	19:43	20:22	20:57	21:16	21:16
26	07:52		07:10	07:20	06:25	05:49	05:42	05:42
	17:26		18:08	19:44	20:23	20:58	21:16	21:16
27	07:51		07:09	07:18	06:24	05:48	05:43	05:43
	17:28		18:09	19:46	20:24	20:59	21:16	21:16
28	07:50		07:07	07:16	06:22	05:47	05:43	05:43
	17:29		18:11	19:47	20:25	21:00	21:16	21:16
29	07:49			07:14	06:21	05:47	05:44	05:44
	17:30			19:48	20:27	21:01	21:16	21:16
30	07:48			07:12	06:19	05:46	05:44	05:44
	17:32			19:49	20:28	21:02	21:16	21:16
31	07:47			07:11		05:45		
	17:33			19:51		21:02		
Potential sun hours	287	292	369	403	458	465		
Total, worst case	613		58					
Sun reduction	0.58		0.59					
Oper. time red.	0.90		0.90					
Wind dir. red.	0.61		0.57					
Total reduction	0.32		0.31					
Total, real	195		18					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Assumptions for shadow calculations

Shadow receptor: R-253 - R-253

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	18:38 (T-70) 17:16	07:43 16:48
2	05:45 21:16	06:13 20:53	06:49 20:04	07:25 19:08	18:38 (T-70) 17:15	07:44 16:48
3	05:46 21:15	06:14 20:52	06:50 20:03	07:26 19:07	18:37 (T-70) 17:14	07:45 16:47
4	05:46 21:15	06:15 20:50	06:52 20:01	07:27 19:05	18:37 (T-70) 17:12	07:46 16:47
5	05:47 21:15	06:17 20:49	06:53 19:59	07:28 19:03	07:09 17:11	07:47 16:47
6	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	07:10 17:10	07:48 16:47
7	05:48 21:14	06:19 20:46	06:55 19:55	07:31 18:57	07:11 17:08	07:49 16:46
8	05:49 21:14	06:20 20:45	06:56 19:53	07:32 18:56	07:13 17:07	07:50 16:46
9	05:50 21:13	06:21 20:44	06:58 19:52	07:33 18:54	07:14 17:06	07:51 16:46
10	05:51 21:13	06:22 20:42	06:59 19:50	07:35 18:52	07:16 17:05	07:52 16:46
11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:50	07:17 17:04	07:53 16:46
12	05:52 21:12	06:25 20:39	07:01 19:46	07:37 18:48	07:18 17:03	07:54 16:46
13	05:53 21:11	06:26 20:38	07:02 19:44	07:38 18:47	07:20 17:01	07:54 16:46
14	05:54 21:11	06:27 20:36	07:03 19:42	07:40 18:45	07:21 17:00	07:55 16:47
15	05:55 21:10	06:28 20:35	07:05 19:40	07:41 18:43	07:22 16:59	07:56 16:47
16	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	07:24 16:58	07:57 16:47
17	05:57 21:09	06:31 20:32	07:07 19:37	07:43 18:40	07:25 16:57	07:58 16:47
18	05:58 21:08	06:32 20:30	07:08 19:35	07:45 18:38	07:26 16:57	07:58 16:48
19	05:59 21:07	06:33 20:28	07:09 19:33	07:46 18:36	07:28 16:56	07:59 16:48
20	05:59 21:06	06:34 20:27	07:10 19:31	07:47 18:35	07:29 16:55	07:59 16:48
21	06:00 21:06	06:35 20:25	07:12 19:29	07:49 18:33	7 15:58 (T-71) 07:30	15:49 (T-71) 08:00
22	06:01 21:05	06:36 20:24	07:13 19:27	07:50 18:32	13 16:02 (T-71) 07:32	16:49 08:01
23	06:02 21:04	06:38 20:22	07:14 19:25	07:51 18:30	17 16:04 (T-71) 07:33	16:49 08:01
24	06:03 21:03	06:39 20:20	07:15 19:23	07:53 18:28	20 16:06 (T-71) 07:34	16:50 08:01
25	06:05 21:02	06:40 20:18	07:16 19:22	07:54 18:27	22 16:07 (T-71) 07:35	16:50 08:02
26	06:06 21:01	06:41 20:17	07:18 19:20	07:55 18:25	24 16:08 (T-71) 07:37	16:51 08:02
27	06:07 21:00	06:42 20:15	07:19 19:18	07:57 18:24	26 16:10 (T-71) 07:38	16:52 08:03
28	06:08 20:59	06:43 20:13	07:20 19:16	07:58 18:22	28 16:11 (T-71) 07:39	16:52 08:03
29	06:09 20:58	06:45 20:12	07:21 19:14	07:59 18:21	28 16:11 (T-71) 07:40	16:53 08:03
30	06:10 20:56	06:46 20:10	07:22 19:12	08:01 18:19	30 16:12 (T-71) 07:41	16:54 08:03
31	06:11 20:55	06:47 20:08		08:02 18:18	30 16:13 (T-71) 07:41	16:55 08:03
Potential sun hours	471	436	377	341	289	276
Total, worst case					245	1011
Sun reduction			0.67	0.56	0.48	0.52
Oper. time red.			0.90	0.90	0.90	0.90
Wind dir. red.			0.57	0.57	0.61	0.61
Total reduction			0.35	0.29	0.26	0.29
Total, real			14	6	65	288

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-255 - R-255

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June								
1	08:04	07:46	07:05	07:09	18:45 (T-71)	06:18	05:45							
	16:57	17:35	18:12	19:52	46	19:31 (T-71)	20:29	21:03						
2	08:04	07:45	07:04	07:07	18:45 (T-71)	06:16	05:44							
	16:57	17:36	18:14	19:53	45	19:30 (T-71)	20:30	21:04						
3	08:04	07:44	07:02	07:05	18:45 (T-71)	06:15	05:44							
	16:58	17:37	18:15	19:54	45	19:30 (T-71)	20:32	21:05						
4	08:04	07:43	17:12 (T-76)	07:00	18:44 (T-71)	06:13	05:43							
	16:59	17:39	17:13 (T-76)	18:16	19:56	45	19:29 (T-71)	20:33	21:06					
5	08:04	07:41	17:11 (T-76)	06:58	18:45 (T-71)	06:12	05:43							
	17:00	17:40	17:15 (T-76)	18:18	19:57	44	19:29 (T-71)	20:34	21:07					
6	08:03	07:40	17:10 (T-76)	06:57	18:45 (T-71)	06:11	05:43							
	17:01	17:42	17:17 (T-76)	18:19	19:58	43	19:28 (T-71)	20:35	21:07					
7	08:03	07:39	17:09 (T-76)	06:55	18:46 (T-71)	06:09	05:42							
	17:02	17:43	17:18 (T-76)	18:20	19:59	41	19:27 (T-71)	20:36	21:08					
8	08:03	07:38	17:08 (T-76)	07:53	18:46 (T-71)	06:08	05:42							
	17:04	17:44	17:19 (T-76)	18:21	20:01	40	19:26 (T-71)	20:38	21:09					
9	08:03	07:36	17:07 (T-76)	07:51	18:46 (T-71)	06:07	05:42							
	17:05	17:46	17:21 (T-76)	19:23	20:02	38	19:24 (T-71)	20:39	21:09					
10	08:02	07:35	17:06 (T-76)	07:49	18:48 (T-71)	06:05	05:41							
	17:06	17:47	17:22 (T-76)	19:24	20:03	36	19:24 (T-71)	20:40	21:10					
11	08:02	07:34	17:06 (T-76)	07:48	18:49 (T-71)	06:04	05:41							
	17:07	17:49	17:24 (T-76)	19:25	20:04	33	19:22 (T-71)	20:41	21:11					
12	08:02	07:32	17:05 (T-76)	07:46	18:50 (T-71)	06:03	05:41							
	17:08	17:50	17:25 (T-76)	19:27	20:06	30	19:20 (T-71)	20:42	21:11					
13	08:01	07:31	17:06 (T-76)	07:44	18:51 (T-71)	06:02	05:41							
	17:09	17:52	17:27 (T-76)	19:28	20:07	26	19:17 (T-71)	20:44	21:12					
14	08:01	07:29	17:06 (T-76)	07:42	18:54 (T-71)	06:01	05:41							
	17:10	17:53	17:29 (T-76)	19:29	20:08	22	19:16 (T-71)	20:45	21:12					
15	08:00	16:42 (T-75)	07:28	17:06 (T-76)	07:40	18:56 (T-71)	05:49	05:41						
	17:12	2	16:44 (T-75)	17:54	24	17:30 (T-76)	19:31	20:09	17	19:47 (T-70)	20:46	21:13		
16	08:00	16:42 (T-75)	07:26	17:06 (T-76)	07:38	19:02 (T-71)	05:58	05:41						
	17:13	3	16:45 (T-75)	17:56	25	17:31 (T-76)	19:32	20:11	6	19:48 (T-70)	20:47	21:13		
17	07:59	16:42 (T-75)	07:25	17:07 (T-76)	07:37	19:45 (T-70)	05:57	05:41						
	17:14	4	16:46 (T-75)	17:57	26	17:33 (T-76)	19:33	20:12	5	19:50 (T-70)	20:48	21:14		
18	07:59	16:44 (T-75)	07:23	17:07 (T-76)	07:35	19:05 (T-71)	06:39	05:56	05:41					
	17:15	4	16:48 (T-75)	17:59	26	17:33 (T-76)	19:34	8	19:13 (T-71)	20:13	7	19:51 (T-70)	20:49	21:14
19	07:58	16:44 (T-75)	07:22	17:08 (T-76)	07:33	19:01 (T-71)	06:37	19:43 (T-70)	05:55	05:41				
	17:17	6	16:50 (T-75)	18:00	25	17:33 (T-76)	19:36	13	19:14 (T-71)	20:14	9	19:52 (T-70)	20:50	21:14
20	07:57	16:44 (T-75)	07:20	17:09 (T-76)	07:31	18:58 (T-71)	06:35	19:44 (T-70)	05:54	05:41				
	17:18	7	16:51 (T-75)	18:00	23	17:32 (T-76)	19:37	17	19:15 (T-71)	20:16	9	19:53 (T-70)	20:51	21:15
21	07:57	16:45 (T-75)	07:19	17:09 (T-76)	07:29	18:56 (T-71)	06:34	19:44 (T-70)	05:53	05:41				
	17:19	7	16:52 (T-75)	18:01	21	17:30 (T-76)	19:38	21	19:17 (T-71)	20:17	10	19:54 (T-70)	20:52	21:15
22	07:56	16:47 (T-75)	07:17	17:12 (T-76)	07:27	18:55 (T-71)	06:32	19:44 (T-70)	05:52	05:41				
	17:21	7	16:54 (T-75)	18:03	17	17:29 (T-76)	19:39	24	19:19 (T-71)	20:18	11	19:55 (T-70)	20:54	21:15
23	07:55	16:48 (T-75)	07:15	17:14 (T-76)	07:25	18:53 (T-71)	06:30	19:46 (T-70)	05:51	05:42				
	17:22	8	16:56 (T-75)	18:04	12	17:26 (T-76)	19:41	27	19:20 (T-71)	20:19	11	19:57 (T-70)	20:55	21:15
24	07:54	16:50 (T-75)	07:14	17:24	19:42	30	19:21 (T-71)	20:21	9	19:56 (T-70)	20:56	21:16		
	17:23	7	16:57 (T-75)	18:05	07:22	18:50 (T-71)	06:27	19:47 (T-70)	05:51	05:42				
25	07:53	18:07	07:12	19:43	32	19:22 (T-71)	20:22	20:57	21:16					
	17:25	18:08	07:10	19:44	34	19:23 (T-71)	20:23	20:58	21:16					
26	07:52	18:09	07:09	19:45	36	19:24 (T-71)	20:24	20:59	21:16					
	17:26	18:10	07:08	19:46	38	19:25 (T-71)	20:25	21:00	21:16					
27	07:51	18:11	07:07	19:47	40	19:26 (T-71)	20:26	21:01	21:16					
	17:28	18:12	07:06	19:48	42	19:27 (T-71)	20:27	21:02	21:16					
28	07:50	18:13	07:05	19:49	44	19:28 (T-71)	20:28	21:03	21:16					
	17:29	18:14	07:04	19:50	46	19:29 (T-71)	20:29	21:04	21:16					
29	07:49	18:15	07:03	19:51	48	19:30 (T-71)	20:30	21:05	21:16					
	17:30	18:16	07:02	19:52	50	19:31 (T-71)	20:31	21:06	21:16					
30	07:48	18:17	07:01	19:53	52	19:32 (T-71)	20:32	21:07	21:16					
	17:32	18:18	07:00	19:54	54	19:33 (T-71)	20:33	21:08	21:16					
31	07:47	18:19	06:59	19:55	56	19:34 (T-71)	20:34	21:09	21:16					
	17:33	18:20	06:58	19:56	58	19:35 (T-71)	20:35	21:10	21:16					
Potential sun hours	287	292	369	403	458	465								
Total, worst case	55	343	405	628										
Sun reduction	0.58	0.58	0.59	0.63										
Oper. time red.	0.90	0.90	0.90	0.90										
Wind dir. red.	0.59	0.59	0.59	0.59										
Total reduction	0.31	0.31	0.31	0.33										
Total, real	17	106	127	210										

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-255 - R-255
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:54	06:48 20:06	18:48 (T-71) 19:21 (T-71)	07:24 19:10	07:03 16:36 (T-76)
2	05:45 21:16	06:13 20:53	06:49 20:04	18:46 (T-71) 19:22 (T-71)	07:25 19:08	07:05 16:37 (T-76)
3	05:46 21:15	06:14 20:52	06:50 20:03	18:44 (T-71) 19:22 (T-71)	07:26 19:07	07:06 16:37 (T-76)
4	05:46 21:15	06:16 20:50	06:52 20:01	18:43 (T-71) 19:23 (T-71)	07:27 19:05	07:07 16:38 (T-76)
5	05:47 21:15	06:17 20:49	06:53 19:59	18:42 (T-71) 19:23 (T-71)	07:28 19:03	07:09 16:40 (T-76)
6	05:48 21:15	06:18 20:48	06:54 19:57	18:41 (T-71) 19:24 (T-71)	07:30 19:01	07:10 16:41 (T-76)
7	05:48 21:14	06:19 20:46	06:55 19:55	18:40 (T-71) 19:24 (T-71)	07:31 18:57	07:11 16:43 (T-76)
8	05:49 21:14	06:20 20:45	06:56 19:53	18:40 (T-71) 19:24 (T-71)	07:32 18:56	07:13 16:44 (T-76)
9	05:50 21:13	06:21 20:44	06:58 19:52	18:39 (T-71) 19:24 (T-71)	07:33 18:54	07:14 16:46
10	05:51 21:13	06:22 20:42	06:59 19:50	18:38 (T-71) 19:23 (T-71)	07:35 18:52	07:16 16:46
11	05:51 21:13	06:24 20:41	07:00 19:48	18:37 (T-71) 19:23 (T-71)	07:36 18:50	07:17 16:46
12	05:52 21:12	06:25 20:39	07:01 19:46	18:37 (T-71) 19:21 (T-71)	07:37 18:49	07:18 16:46
13	05:53 21:11	06:26 20:38	07:02 19:44	18:37 (T-71) 19:20 (T-71)	07:38 18:47	07:20 16:46
14	05:54 21:11	06:27 20:36	07:03 19:42	18:37 (T-71) 19:18 (T-71)	07:40 18:45	07:21 16:47
15	05:55 21:10	06:28 20:35	07:05 19:40	18:37 (T-71) 19:16 (T-71)	07:41 18:43	07:22 16:47
16	05:56 21:10	06:29 20:33	07:06 19:39	18:37 (T-71) 19:14 (T-71)	07:42 18:42	07:24 16:47
17	05:57 21:09	06:31 20:32	07:07 19:37	18:37 (T-71) 19:12 (T-71)	07:43 18:40	07:25 16:47
18	05:58 21:08	06:32 20:30	19:55 (T-70) 19:59 (T-70)	07:08 19:35	18:37 (T-71) 19:10 (T-71)	07:26 17:48 (T-76)
19	05:59 21:07	06:33 20:28	19:52 (T-70) 20:02 (T-70)	07:09 19:33	18:37 (T-71) 19:08 (T-71)	07:28 17:44 (T-76)
20	06:00 21:06	06:34 20:27	19:51 (T-70) 20:02 (T-70)	07:10 19:31	18:39 (T-71) 19:07 (T-71)	07:29 17:42 (T-76)
21	06:00 21:06	06:35 20:25	19:50 (T-70) 20:00 (T-70)	07:12 19:29	18:40 (T-71) 19:04 (T-71)	07:30 17:40 (T-76)
22	06:01 21:05	06:36 20:24	19:49 (T-70) 19:59 (T-70)	07:13 19:27	18:41 (T-71) 19:02 (T-71)	07:31 18:02 (T-76)
23	06:02 21:04	06:38 20:22	19:48 (T-70) 19:57 (T-70)	07:14 19:25	18:42 (T-71) 19:00 (T-71)	07:33 17:37 (T-76)
24	06:04 21:03	06:39 20:20	19:47 (T-70) 19:55 (T-70)	07:15 19:23	18:44 (T-71) 18:58 (T-71)	07:34 17:37 (T-76)
25	06:05 21:02	06:40 20:18	19:47 (T-70) 19:53 (T-70)	07:16 19:22	18:46 (T-71) 18:56 (T-71)	07:35 17:36 (T-76)
26	06:06 21:01	06:41 20:17	19:47 (T-70) 19:52 (T-70)	07:18 19:20	18:53 (T-71) 18:55 (T-71)	07:37 18:02 (T-76)
27	06:07 21:00	06:42 20:15	19:03 (T-71) 19:50 (T-70)	07:19 19:18	18:25 18:24	25 18:00 (T-76)
28	06:08 20:59	06:43 20:13	18:58 (T-71) 19:49 (T-70)	07:20 19:16	18:58 (T-71) 18:22	27 17:35 (T-76)
29	06:09 20:58	06:45 20:12	18:54 (T-71) 19:17 (T-71)	07:21 19:14	18:59 (T-71) 18:21	22 17:57 (T-76)
30	06:10 20:56	06:46 20:10	18:52 (T-71) 19:19 (T-71)	07:22 19:12	18:21 18:19	21 17:56 (T-76)
31	06:11 20:55	06:47 20:08	18:50 (T-71) 19:20 (T-71)	07:23 19:12	18:19 18:18	19 17:54 (T-76)
Potential sun hours	471	436	377	341	289	276
Total, worst case			875	875	291	118
Sun reduction		0.72	0.67	0.56	0.48	
Oper. time red.		0.90	0.90	0.90	0.90	
Wind dir. red.		0.59	0.59	0.59	0.59	
Total reduction		0.38	0.36	0.30	0.25	
Total, real		68	311	87	30	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
--------------	------------------	-----------------	----------------------	---------------------------------	--------------------------------	----------------------------------	---------------------------------

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-256 - R-256

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	
1	08:04	07:46	07:05	17:32 (T-75)	07:09	06:18	19:53 (T-76)
	16:57	17:35	18:12	17:50 (T-75)	20:29	21:03	44 20:37 (T-76)
2	08:04	07:45	07:04	17:33 (T-75)	07:07	06:16	19:54 (T-76)
	16:58	17:36	18:14	17:48 (T-75)	19:53	20:30	21:04 44 20:38 (T-76)
3	08:04	07:44	07:02	17:35 (T-75)	07:05	06:15	19:53 (T-76)
	16:58	17:37	18:15	17:45 (T-75)	19:54	20:32	21:05 45 20:38 (T-76)
4	08:04	07:43	07:00		07:03	06:14	19:54 (T-76)
	16:59	17:39	18:16		19:56	20:33	2 20:09 (T-69) 21:06 45 20:39 (T-76)
5	08:04	07:42	06:58		07:02	06:12	20:06 (T-69) 05:43 19:54 (T-76)
	17:00	17:40	18:18		19:57	20:34	4 20:10 (T-69) 21:07 47 20:41 (T-76)
6	08:03	07:40	06:57		07:00	06:11	20:07 (T-69) 05:43 19:53 (T-76)
	17:01	17:42	18:19		19:58	20:35	4 20:11 (T-69) 21:07 48 20:41 (T-76)
7	08:03	07:39	06:55	17:56 (T-74)	06:58	06:09	20:07 (T-69) 05:42 19:54 (T-76)
	17:02	17:43	18:20	2 17:58 (T-74)	19:59	20:36	6 20:13 (T-69) 21:08 48 20:42 (T-76)
8	08:03	07:38	07:53	18:55 (T-74)	06:56	06:08	20:07 (T-69) 05:42 19:54 (T-76)
	17:04	17:45	18:22	5 19:00 (T-74)	20:01	20:38	7 20:14 (T-69) 21:09 48 20:42 (T-76)
9	08:03	07:36	07:51	18:56 (T-74)	06:54	06:07	20:07 (T-69) 05:42 19:54 (T-76)
	17:05	17:46	19:23	6 19:02 (T-74)	20:02	20:39	7 20:14 (T-69) 21:09 48 20:42 (T-76)
10	08:02	07:35	07:49	18:56 (T-74)	06:53	06:05	20:08 (T-69) 05:41 19:54 (T-76)
	17:06	17:47	19:24	7 19:03 (T-74)	20:03	20:40	8 20:16 (T-69) 21:10 49 20:43 (T-76)
11	08:02	07:34	07:48	18:57 (T-74)	06:51	06:04	20:08 (T-69) 05:41 19:54 (T-76)
	17:07	17:49	19:25	7 19:04 (T-74)	20:04	20:41	9 20:17 (T-76) 21:11 50 20:44 (T-76)
12	08:02	07:32	07:46	18:58 (T-74)	06:49	06:03	20:08 (T-76) 05:41 19:55 (T-76)
	17:08	17:50	19:27	7 19:05 (T-74)	20:06	20:42	10 20:18 (T-76) 21:11 49 20:44 (T-76)
13	08:01	07:31	07:44	19:00 (T-74)	06:47	06:02	20:06 (T-76) 05:41 19:55 (T-76)
	17:09	17:52	19:28	5 19:05 (T-74)	20:07	20:44	13 20:19 (T-76) 21:12 50 20:45 (T-76)
14	08:01	07:29	07:42		06:45	06:01	20:04 (T-76) 05:41 19:55 (T-76)
	17:11	17:53	19:29		20:08	20:45	17 20:21 (T-76) 21:12 50 20:45 (T-76)
15	08:00	07:28	07:40		06:44	05:59	20:02 (T-76) 05:41 19:55 (T-76)
	17:12	17:54	19:31		20:09	20:46	20 20:22 (T-76) 21:13 51 20:46 (T-76)
16	08:00	07:26	07:38		06:42	05:58	20:00 (T-76) 05:41 19:55 (T-76)
	17:13	17:56	19:32		20:11	20:47	22 20:22 (T-76) 21:13 51 20:46 (T-76)
17	07:59	07:25	07:37		06:40	05:57	19:59 (T-76) 05:41 19:56 (T-76)
	17:14	17:57	19:33		20:12	20:48	24 20:23 (T-76) 21:14 51 20:47 (T-76)
18	07:59	07:23	07:35		06:39	05:56	19:58 (T-76) 05:41 19:56 (T-76)
	17:16	17:59	19:34		20:13	20:49	26 20:24 (T-76) 21:14 51 20:47 (T-76)
19	07:58	07:22	17:34 (T-75)	07:33	06:37	05:55	19:58 (T-76) 05:41 19:56 (T-76)
	17:17	18:00	2 17:36 (T-75)	19:36	20:14	20:50	28 20:26 (T-76) 21:14 51 20:47 (T-76)
20	07:57	07:20	17:32 (T-75)	07:31	06:35	05:54	19:57 (T-76) 05:41 19:56 (T-76)
	17:18	18:00	5 17:37 (T-75)	19:37	20:16	20:51	30 20:27 (T-76) 21:15 51 20:47 (T-76)
21	07:57	07:19	17:31 (T-75)	07:29	06:34	05:53	19:57 (T-76) 05:41 19:56 (T-76)
	17:19	18:01	8 17:39 (T-75)	19:38	20:17	20:53	31 20:28 (T-76) 21:15 51 20:47 (T-76)
22	07:56	07:17	17:31 (T-75)	07:27	06:32	05:52	19:56 (T-76) 05:41 19:57 (T-76)
	17:21	18:03	10 17:41 (T-75)	19:39	20:18	20:54	32 20:28 (T-76) 21:15 51 20:48 (T-76)
23	07:55	07:15	17:30 (T-75)	07:25	06:30	05:51	19:55 (T-76) 05:42 19:57 (T-76)
	17:22	18:04	12 17:42 (T-75)	19:41	20:19	20:55	34 20:29 (T-76) 21:15 51 20:48 (T-76)
24	07:54	07:14	17:31 (T-75)	07:24	06:29	05:51	19:55 (T-76) 05:42 19:57 (T-76)
	17:24	18:05	13 17:44 (T-75)	19:42	20:21	20:56	35 20:30 (T-76) 21:16 51 20:48 (T-76)
25	07:53	07:12	17:30 (T-75)	07:22	06:27	05:50	19:55 (T-76) 05:42 19:58 (T-76)
	17:25	18:07	15 17:45 (T-75)	19:43	20:22	20:57	37 20:32 (T-76) 21:16 51 20:49 (T-76)
26	07:52	07:10	17:30 (T-75)	07:20	06:25	05:49	19:54 (T-76) 05:43 19:57 (T-76)
	17:26	18:08	16 17:46 (T-75)	19:44	20:23	20:58	38 20:32 (T-76) 21:16 51 20:48 (T-76)
27	07:51	07:09	17:30 (T-75)	07:18	06:24	05:48	19:54 (T-76) 05:43 19:57 (T-76)
	17:28	18:10	17 17:47 (T-75)	19:46	20:24	20:59	39 20:33 (T-76) 21:16 51 20:48 (T-76)
28	07:50	07:07	17:31 (T-75)	07:16	06:22	05:47	19:54 (T-76) 05:43 19:58 (T-76)
	17:29	18:11	18 17:49 (T-75)	19:47	20:25	21:00	40 20:34 (T-76) 21:16 51 20:49 (T-76)
29	07:49		07:14		06:21	05:47	19:54 (T-76) 05:44 19:58 (T-76)
	17:30		19:48		20:27	21:01	41 20:35 (T-76) 21:16 50 20:48 (T-76)
30	07:48		07:13		06:19	05:46	19:53 (T-76) 05:44 19:59 (T-76)
	17:32		19:49		20:28	21:01	42 20:35 (T-76) 21:16 50 20:49 (T-76)
31	07:47		07:11		05:45		19:54 (T-76)
	17:33		19:51		21:02	43 20:37 (T-76)	
Potential sun hours	287	292	369	403	458	465	1479
Total, worst case							649
Sun reduction		0.58		0.59			0.66
Oper. time red.		0.90		0.90			0.90
Wind dir. red.		0.58		0.58			0.64
Total reduction		0.30		0.31			0.38
Total, real		35		25			245
							620

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-256 - R-256
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July		August		September		October		November		December		
1	05:45	19:58 (T-76)	06:12	20:20 (T-76)	06:48	07:24	18:38 (T-74)	07:03	07:42				
	21:16	50	20:48 (T-76)	20:54	8	20:28 (T-76)	20:06	19:10	8	18:46 (T-74)	17:16	16:48	
2	05:45	19:59 (T-76)	06:13	20:19 (T-69)	06:49	07:25	18:36 (T-74)	07:05	07:44				
	21:16	49	20:48 (T-76)	20:53	8	20:27 (T-76)	20:04	19:08	7	18:43 (T-74)	17:15	16:48	
3	05:46	19:59 (T-76)	06:14	20:18 (T-69)	06:51	07:26	18:34 (T-74)	07:06	07:45				
	21:15	49	20:48 (T-76)	20:52	8	20:26 (T-69)	20:03	19:07	7	18:41 (T-74)	17:14	16:47	
4	05:47	19:59 (T-76)	06:16	20:17 (T-69)	06:52	07:27	18:33 (T-74)	07:07	07:46				
	21:15	49	20:48 (T-76)	20:50	8	20:25 (T-69)	20:01	19:05	6	18:39 (T-74)	17:12	16:47	
5	05:47	20:00 (T-76)	06:17	20:17 (T-69)	06:53	07:28	18:33 (T-74)	07:09	07:47				
	21:15	48	20:48 (T-76)	20:49	6	20:23 (T-69)	19:59	19:03	5	18:38 (T-74)	17:11	16:47	
6	05:48	20:00 (T-76)	06:18	20:16 (T-69)	06:54	07:30	18:33 (T-74)	07:10	07:48				
	21:15	47	20:47 (T-76)	20:48	6	20:22 (T-69)	19:57	19:01	3	18:36 (T-74)	17:10	16:47	
7	05:49	20:00 (T-76)	06:19	20:16 (T-69)	06:55	07:31	18:32 (T-74)	07:11	07:49				
	21:14	47	20:47 (T-76)	20:46	4	20:20 (T-69)	19:55	18:57	2	18:34 (T-74)	17:08	16:47	
8	05:49	20:01 (T-76)	06:20	20:16 (T-69)	06:56	07:32	18:32 (T-74)	07:13	07:50				
	21:14	46	20:47 (T-76)	20:45	3	20:19 (T-69)	19:53	18:56				16:46	
9	05:50	20:00 (T-76)	06:21	20:16 (T-69)	06:58	07:33	18:33 (T-74)	07:14	07:51				
	21:13	46	20:46 (T-76)	20:44	2	20:18 (T-69)	19:52	18:54				17:06	16:46
10	05:51	20:01 (T-76)	06:22		06:59	07:35	18:12 (T-75)	07:16	07:52				
	21:13	45	20:46 (T-76)	20:42		19:50	18:52	6	18:18 (T-75)	17:05	16:46		
11	05:52	20:01 (T-76)	06:24		07:00	07:36	18:08 (T-75)	07:17	07:53				
	21:13	44	20:45 (T-76)	20:41		19:48	18:50	13	18:21 (T-75)	17:04	16:46		
12	05:52	20:02 (T-76)	06:25		07:01	07:37	18:06 (T-75)	07:18	07:54				
	21:12	43	20:45 (T-76)	20:39		19:46	18:49	16	18:22 (T-75)	17:03	16:46		
13	05:53	20:01 (T-76)	06:26		07:02	07:38	18:05 (T-75)	07:20	07:54				
	21:11	43	20:44 (T-76)	20:38		19:44	18:47	18	18:23 (T-75)	17:02	16:46		
14	05:54	20:02 (T-76)	06:27		07:03	07:40	18:03 (T-75)	07:21	07:55				
	21:11	41	20:43 (T-76)	20:36		19:42	18:45	18	18:21 (T-75)	17:00	16:47		
15	05:55	20:03 (T-76)	06:28		07:05	07:41	18:02 (T-75)	07:22	07:56				
	21:10	40	20:43 (T-76)	20:35		19:40	18:43	17	18:19 (T-75)	16:59	16:47		
16	05:56	20:03 (T-76)	06:29		07:06	07:42	18:02 (T-75)	07:24	07:57				
	21:10	40	20:43 (T-76)	20:33		19:39	18:42	16	18:18 (T-75)	16:58	16:47		
17	05:57	20:04 (T-76)	06:31		07:07	07:43	18:02 (T-75)	07:25	07:57				
	21:09	38	20:42 (T-76)	20:32		19:37	18:40	14	18:16 (T-75)	16:57	16:47		
18	05:58	20:04 (T-76)	06:32		07:08	07:45	18:01 (T-75)	07:26	07:58				
	21:08	37	20:41 (T-76)	20:30		19:35	18:38	13	18:14 (T-75)	16:57	16:48		
19	05:59	20:05 (T-76)	06:33		07:09	07:46	18:02 (T-75)	07:28	07:59				
	21:07	36	20:41 (T-76)	20:28		19:33	18:37	11	18:13 (T-75)	16:56	16:48		
20	06:00	20:05 (T-76)	06:34		07:10	07:47	18:02 (T-75)	07:29	07:59				
	21:06	35	20:40 (T-76)	20:27		19:31	18:35	9	18:11 (T-75)	16:55	16:48		
21	06:01	20:05 (T-76)	06:35		07:12	07:49	18:03 (T-75)	07:30	08:00				
	21:06	33	20:38 (T-76)	20:25		19:29	18:33	7	18:10 (T-75)	16:54	16:49		
22	06:02	20:06 (T-76)	06:36		07:13	07:50	18:03 (T-75)	07:31	08:00				
	21:05	32	20:38 (T-76)	20:24		19:27	18:32	5	18:08 (T-75)	16:53	16:49		
23	06:03	20:06 (T-76)	06:38		07:14	07:51	18:04 (T-75)	07:33	08:01				
	21:04	31	20:37 (T-76)	20:22		19:25	18:30	1	18:05 (T-75)	16:53	16:50		
24	06:04	20:07 (T-76)	06:39		07:15	07:53		07:34	08:01				
	21:03	29	20:36 (T-76)	20:20		19:23	18:28		16:52	16:50			
25	06:05	20:08 (T-76)	06:40		07:16	07:54		07:35	08:02				
	21:02	27	20:35 (T-76)	20:18		19:22	18:27		16:51	16:51			
26	06:06	20:09 (T-76)	06:41		07:18	07:55		07:37	08:02				
	21:01	25	20:34 (T-76)	20:17		19:20	18:25		16:51	16:52			
27	06:07	20:10 (T-76)	06:42		07:19	07:57		07:38	08:02				
	21:00	23	20:33 (T-76)	20:15		19:18	18:24		16:50	16:52			
28	06:08	20:11 (T-76)	06:43		07:20	07:58		07:39	08:03				
	20:59	21	20:32 (T-76)	20:13		19:16	18:22		16:49	16:53			
29	06:09	20:13 (T-76)	06:45		07:21	07:59		07:40	08:03				
	20:58	18	20:31 (T-76)	20:12		19:14	18:21		16:49	16:54			
30	06:10	20:15 (T-76)	06:46		07:22	08:01		07:41	08:03				
	20:56	16	20:31 (T-76)	20:10		19:12	18:19		16:49	16:55			
31	06:11	20:17 (T-76)	06:47			08:02			08:03				
	20:55	13	20:30 (T-76)	20:08		18:18			16:55				
Potential sun hours	471		436		377	341		289	276				
Total, worst case	1141		53			202							
Sun reduction	0.75		0.72			0.56							
Oper. time red.	0.90		0.90			0.90							
Wind dir. red.	0.64		0.63			0.58							
Total reduction	0.43		0.41			0.29							
Total, real	491		21			59							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-257 - R-257

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June		
1	08:04	07:46	07:05	07:09	19:02 (T-75)	06:18	05:45	
	16:57	17:35	18:12	19:52	29 19:31 (T-74)	20:29	21:03	
2	08:04	07:45	07:04	07:07	19:00 (T-75)	06:16	05:44	
	16:58	17:36	18:14	19:53	32 19:32 (T-74)	20:30	21:04	
3	08:04	07:44	07:02	07:05	18:59 (T-75)	06:15	05:44	
	16:59	17:37	18:15	19:55	34 19:33 (T-74)	20:32	21:05	
4	08:04	07:43	07:00	07:03	18:58 (T-75)	06:14	05:43	
	16:59	17:39	18:16	19:56	36 19:34 (T-74)	20:33	21:06	
5	08:04	07:42	06:58	07:02	18:58 (T-75)	06:12	05:43	
	17:00	17:40	18:18	19:57	38 19:36 (T-74)	20:34	21:07	
6	08:03	07:40	06:57	07:00	18:57 (T-75)	06:11	05:43	
	17:01	17:42	18:19	19:58	40 19:37 (T-74)	20:35	21:07	
7	08:03	07:39	06:55	06:58	18:57 (T-75)	06:09	05:42	
	17:03	17:43	18:20	19:59	41 19:38 (T-74)	20:37	21:08	
8	08:03	07:38	07:53	06:56	18:56 (T-75)	06:08	05:42	
	17:04	17:45	18:22	20:01	43 19:39 (T-74)	20:38	21:09	
9	08:03	07:36	07:51	06:54	18:55 (T-75)	06:07	05:42	
	17:05	17:46	19:23	20:02	45 19:40 (T-74)	20:39	21:09	
10	08:03	07:35	17:21 (T-73)	07:49	06:53	18:56 (T-75)	06:06	05:41
	17:06	17:47	1 17:22 (T-73)	19:24	20:03	46 19:42 (T-74)	20:40	21:10
11	08:02	07:34	17:21 (T-73)	07:48	06:51	18:56 (T-75)	06:04	05:41
	17:07	17:49	3 17:24 (T-73)	19:25	20:04	46 19:42 (T-74)	20:41	21:11
12	08:02	07:32	17:22 (T-73)	07:46	06:49	18:56 (T-75)	06:03	05:41
	17:08	17:50	4 17:26 (T-73)	19:27	20:06	45 19:41 (T-74)	20:42	21:11
13	08:01	07:31	17:22 (T-73)	07:44	06:47	18:55 (T-75)	06:02	05:41
	17:09	17:52	5 17:27 (T-73)	19:28	20:07	44 19:39 (T-74)	20:44	21:12
14	08:01	07:29	17:23 (T-73)	07:42	06:45	18:56 (T-75)	06:01	05:41
	17:11	17:53	6 17:29 (T-73)	19:29	20:08	42 19:38 (T-75)	20:45	21:12
15	08:00	07:28	17:24 (T-73)	07:40	06:44	18:56 (T-75)	06:00	05:41
	17:12	17:54	6 17:30 (T-73)	19:31	20:09	41 19:37 (T-75)	20:46	21:13
16	08:00	07:26	17:25 (T-73)	07:38	06:42	18:57 (T-75)	05:58	05:41
	17:13	17:56	6 17:31 (T-73)	19:32	20:11	39 19:36 (T-75)	20:47	21:13
17	07:59	07:25	07:37	06:40	06:40	18:58 (T-75)	05:57	05:41
	17:14	17:57	19:33	20:12	38 19:36 (T-75)	20:48	21:14	
18	07:59	07:23	07:35	06:39	20:13	18:58 (T-75)	05:56	05:41
	17:16	17:59	19:34	20:13	36 19:34 (T-75)	20:49	21:14	
19	07:58	07:22	07:33	06:37	20:14	18:59 (T-75)	05:55	05:41
	17:17	18:00	19:36	20:14	33 19:32 (T-75)	20:50	21:14	
20	07:57	07:20	07:31	06:35	20:15	19:01 (T-75)	05:54	05:41
	17:18	18:00	19:37	20:16	30 19:31 (T-75)	20:51	21:15	
21	07:57	07:19	07:29	06:34	20:17	19:02 (T-75)	05:53	05:41
	17:20	18:01	19:38	20:17	27 19:29 (T-75)	20:53	21:15	
22	07:56	07:17	07:27	06:32	20:18	19:03 (T-75)	05:52	05:41
	17:21	18:03	19:40	20:18	24 19:27 (T-75)	20:54	21:15	
23	07:55	07:15	07:26	06:30	20:19	19:06 (T-75)	05:51	05:42
	17:22	18:04	19:41	20:19	19 19:25 (T-75)	20:55	21:15	
24	07:54	07:14	07:24	06:29	20:20	19:09 (T-75)	05:51	05:42
	17:24	18:05	19:42	20:21	11 19:20 (T-75)	20:56	21:16	
25	07:53	07:12	07:22	06:27	20:22	05:50	05:42	
	17:25	18:07	19:43	20:22	20:57	21:16		
26	07:52	07:10	07:20	19:15 (T-75)	06:26	05:49	05:43	
	17:26	18:08	19:45	8 19:23 (T-75)	20:23	20:58	21:16	
27	07:51	07:09	07:18	19:11 (T-75)	06:24	05:48	05:43	
	17:28	18:10	19:46	13 19:24 (T-75)	20:24	20:59	21:16	
28	07:51	07:07	07:16	19:08 (T-75)	06:22	05:48	05:43	
	17:29	18:11	19:47	17 19:25 (T-75)	20:26	21:00	21:16	
29	07:49		07:14	19:07 (T-75)	06:21	05:47	05:44	
	17:30		19:48	20 19:27 (T-75)	20:27	21:01	21:16	
30	07:48		07:13	19:05 (T-75)	06:19	05:46	05:44	
	17:32		19:50	23 19:28 (T-75)	20:28	21:01	21:16	
31	07:47		07:11	19:03 (T-75)		05:46		
	17:33		19:51	26 19:29 (T-75)		21:02		
Potential sun hours	287	292	369	403	458	465		
Total, worst case		31	107	859				
Sun reduction		0.58	0.59	0.63				
Oper. time red.		0.90	0.90	0.90				
Wind dir. red.		0.59	0.60	0.60				
Total reduction		0.31	0.32	0.34				
Total, real		10	34	290				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-257 - R-257
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:54	06:48 20:06	18:55 (T-75) 19:41 (T-74)	07:24 19:10	07:03 16:51 (T-73)
2	05:45 21:16	06:13 20:53	06:49 20:04	18:54 (T-75) 19:39 (T-74)	07:25 19:09	16:48 07:44
3	05:46 21:15	06:14 20:52	06:51 20:03	18:53 (T-75) 19:38 (T-74)	07:26 19:07	16:48 07:45
4	05:47 21:15	06:16 20:50	06:52 20:01	18:53 (T-75) 19:36 (T-74)	07:27 19:05	16:47 07:46
5	05:47 21:15	06:17 20:49	06:53 19:59	18:54 (T-75) 19:35 (T-74)	07:28 19:03	16:47 07:47
6	05:48 21:15	06:18 20:48	06:54 19:57	18:53 (T-75) 19:33 (T-74)	07:30 19:01	16:47 07:48
7	05:49 21:14	06:19 20:46	06:55 19:55	18:53 (T-75) 19:31 (T-74)	07:31 18:58	16:47 07:49
8	05:49 21:14	06:20 20:45	06:56 19:54	18:53 (T-75) 19:29 (T-74)	07:32 18:56	16:46 07:50
9	05:50 21:13	06:21 20:44	06:58 19:52	18:53 (T-75) 19:27 (T-74)	07:33 18:54	16:46 07:51
10	05:51 21:13	06:22 20:42	06:59 19:50	18:53 (T-75) 19:25 (T-74)	07:35 18:52	16:46 07:52
11	05:52 21:13	06:24 20:41	07:00 19:48	18:54 (T-75) 19:23 (T-74)	07:36 18:50	16:46 07:53
12	05:52 21:12	06:25 20:39	07:01 19:46	18:54 (T-75) 19:21 (T-74)	07:37 18:49	16:46 07:54
13	05:53 21:11	06:26 20:38	07:02 19:44	18:56 (T-75) 19:20 (T-75)	07:38 18:47	16:47 07:55
14	05:54 21:11	06:27 20:36	07:03 19:42	18:57 (T-75) 19:18 (T-75)	07:40 18:45	16:47 07:56
15	05:55 21:10	06:28 20:35	07:05 19:40	18:58 (T-75) 19:16 (T-75)	07:41 18:43	16:47 07:57
16	05:56 21:10	06:29 20:33	07:06 19:39	19:00 (T-75) 19:14 (T-75)	07:42 18:42	16:47 07:58
17	05:57 21:09	06:31 20:32	07:07 19:37	19:02 (T-75) 19:12 (T-75)	07:44 18:40	16:47 07:58
18	05:58 21:08	06:32 20:30	07:08 19:35	19:08 (T-75) 19:10 (T-75)	07:45 18:38	16:48 07:58
19	05:59 21:07	06:33 20:28	19:15 (T-75) 19:28 (T-75)	07:09 19:33	07:46 18:37	16:48 07:59
20	06:00 21:06	06:34 20:27	19:11 (T-75) 19:31 (T-75)	07:10 19:31	07:47 18:35	16:48 07:59
21	06:01 21:06	06:35 20:25	19:09 (T-75) 19:33 (T-75)	07:12 19:29	07:49 18:33	16:49 08:00
22	06:02 21:05	06:36 20:24	19:06 (T-75) 19:34 (T-75)	07:13 19:27	07:50 18:32	16:49 08:00
23	06:03 21:04	06:38 20:22	19:04 (T-75) 19:35 (T-75)	07:14 19:25	07:51 18:30	16:50 08:01
24	06:04 21:03	06:39 20:20	19:03 (T-75) 19:36 (T-75)	07:15 19:23	07:53 18:28	16:51 08:01
25	06:05 21:02	06:40 20:18	19:01 (T-75) 19:37 (T-75)	07:16 19:22	07:54 18:27	16:51 08:02
26	06:06 21:01	06:41 20:17	19:00 (T-75) 19:38 (T-75)	07:18 19:20	07:55 18:25	16:51 08:02
27	06:07 21:00	06:42 20:15	18:58 (T-75) 19:38 (T-75)	07:19 19:18	6 18:01 (T-73)	16:52 08:03
28	06:08 20:59	06:44 20:13	18:58 (T-75) 19:39 (T-75)	07:20 19:16	6 17:59 (T-73)	16:50 08:03
29	06:09 20:58	06:45 20:12	18:57 (T-75) 19:39 (T-75)	07:21 19:14	6 17:57 (T-73)	16:50 08:03
30	06:10 20:57	06:46 20:10	18:56 (T-75) 19:40 (T-74)	07:22 19:12	5 17:56 (T-73)	16:49 08:03
31	06:11 20:55	06:47 20:08	18:55 (T-75) 19:41 (T-74)	07:22 19:12	4 17:55 (T-73)	16:49 08:03
Potential sun hours	471	436	377	341	289	276
Total, worst case		436	545	30	1	
Sun reduction		0.72	0.67	0.56	0.48	
Oper. time red.		0.90	0.90	0.90	0.90	
Wind dir. red.		0.60	0.60	0.59	0.59	
Total reduction		0.39	0.36	0.30	0.25	
Total, real		168	196	9	0	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-258 - R-258
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:03	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	19:38 (T-75)	07:24	07:03	07:42
	16:57	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	3 19:41 (T-75)	19:10	17:16	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	19:38 (T-75)	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:30	21:04	21:15	20:53	20:04	1 19:39 (T-75)	19:08	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51		07:26	07:06	07:45
	16:58	17:37	18:15	19:54	20:32	21:05	21:15	20:52	20:03		19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:14	05:43	05:47	06:16	06:52		07:27	07:07	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:50	20:01		19:05	17:12	16:47
5	08:03	07:41	06:58	07:01	06:12	05:43	05:47	06:17	06:53		07:28	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:06	21:15	20:49	19:59		19:03	17:11	16:47
6	08:03	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54		07:30	07:10	07:48
	17:01	17:42	18:19	19:58	20:35	21:07	21:15	20:48	19:57		19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:09	05:42	05:49	06:19	06:55		07:31	07:11	07:49
	17:02	17:43	18:20	19:59	20:36	21:08	21:14	20:46	19:55		18:57	17:08	16:46
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56		07:32	07:13	07:50
	17:04	17:45	18:21	20:01	20:38	21:09	21:14	20:45	19:53		18:56	17:07	16:46
9	08:03	07:36	07:51	06:54	06:07	05:42	05:50	06:21	06:58		07:33	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:09	21:13	20:44	19:52		18:54	17:06	16:46
10	08:02	07:35	07:49	06:52	19:40 (T-75)	06:05	05:41	05:51	06:22	06:59	07:35	07:15	07:52
	17:06	17:47	19:24	20:03	2 19:42 (T-75)	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	19:39 (T-75)	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:25	20:04	3 19:42 (T-75)	20:41	21:11	21:12	20:41	19:48	18:50	17:04	16:46
12	08:02	07:32	07:46	06:49	19:38 (T-75)	06:03	05:41	05:52	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	5 19:43 (T-75)	20:42	21:11	21:12	20:39	19:46	18:49	17:03	16:46
13	08:01	07:31	07:44	06:47	19:38 (T-75)	06:02	05:41	05:53	06:26	07:02	07:38	07:20	07:54
	17:09	17:52	19:28	20:07	6 19:44 (T-75)	20:44	21:12	21:11	20:38	19:44	18:47	17:01	16:46
14	08:01	07:29	07:42	06:45	19:38 (T-75)	06:01	05:41	05:54	06:27	07:03	07:40	07:21	07:55
	17:11	17:53	19:29	20:08	8 19:46 (T-75)	20:45	21:12	21:11	20:36	19:42	18:45	17:00	16:47
15	08:00	07:28	07:40	06:44	19:38 (T-75)	05:59	05:41	05:55	06:28	07:05	07:41	07:22	07:56
	17:12	17:54	19:31	20:09	9 19:47 (T-75)	20:46	21:13	21:10	20:35	19:40	18:43	16:59	16:47
16	08:00	07:26	07:38	06:42	19:39 (T-75)	05:58	05:41	05:56	06:29	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	9 19:48 (T-75)	20:47	21:13	21:09	20:33	19:39	18:42	16:58	16:47
17	07:59	07:25	07:37	06:40	19:41 (T-75)	05:57	05:41	05:57	06:31	07:07	07:43	07:25	07:57
	17:14	17:57	19:33	20:12	9 19:50 (T-75)	20:48	21:14	21:09	20:32	19:37	18:40	16:57	16:47
18	07:59	07:23	07:35	06:39	19:42 (T-75)	05:56	05:41	05:58	06:32	07:08	07:45	07:26	07:58
	17:16	17:59	19:34	20:13	6 19:48 (T-75)	20:49	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:14	20:50	21:14	21:07	20:28	19:33	18:37	18:37	16:56	16:48
20	07:57	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:10	07:10	07:47	07:29	07:59
	17:18	18:00	19:37	20:16	20:51	21:15	21:06	20:27	19:31	18:35	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:12	07:49	07:30	08:00
	17:19	18:01	19:38	20:17	20:52	21:15	21:06	20:25	19:29	18:33	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:02	06:36	07:13	07:13	07:50	07:31	08:00
	17:21	18:03	19:39	20:18	20:54	21:15	21:05	20:23	19:27	18:32	18:32	16:53	16:49
23	07:55	07:15	07:25	06:30	05:51	05:42	06:03	06:38	07:14	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:19	20:55	21:15	21:04	20:22	19:25	18:30	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:15	07:53	07:34	08:01
	17:23	18:05	19:42	20:21	20:56	21:16	21:03	20:20	19:23	18:28	18:28	16:52	16:50
25	07:53	07:12	07:22	06:27	05:50	05:42	06:05	06:40	19:45 (T-75)	07:16	07:54	07:35	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:18	7 19:52 (T-75)	19:22	18:27	16:51	16:51
26	07:52	07:10	07:20	06:25	05:49	05:43	06:06	06:41	19:42 (T-75)	07:18	07:55	07:36	08:02
	17:26	18:08	19:44	20:23	20:58	21:16	21:01	20:17	10 19:52 (T-75)	19:20	18:25	16:51	16:52
27	07:51	07:09	07:18	06:24	05:48	05:43	06:07	06:42	19:41 (T-75)	07:19	07:57	07:38	08:02
	17:28	18:09	19:46	20:24	20:59	21:16	21:00	20:15	9 19:50 (T-75)	19:18	18:24	16:50	16:52
28	07:50	07:07	07:16	06:22	05:47	05:43	06:08	06:43	19:40 (T-75)	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:25	21:00	21:16	20:59	20:13	9 19:49 (T-75)	19:16	18:22	16:49	16:53
29	07:49	07:14	06:21	06:21	05:47	05:44	06:09	06:45	19:39 (T-75)	07:21	07:59	07:40	08:03
	17:30	18:00	19:48	20:27	21:01	21:16	20:58	20:11	8 19:47 (T-75)	19:14	18:21	16:49	16:54
30	07:48	07:12	06:19	06:19	05:46	05:44	06:10	06:46	19:39 (T-75)	07:22	08:01	07:41	08:03
	17:32	18:02	19:49	20:28	21:01	21:16	20:56	20:10	6 19:45 (T-75)	19:12	18:19	16:48	16:55
31	07:47	07:11	06:15	06:15	05:45	05:41	06:11	06:47	19:38 (T-75)		08:02	07:41	08:03
	17:33	18:03	19:51	20:30	21:02	20:55	20:55	20:08	5 19:43 (T-75)		18:18	16:48	16:55
Potential sun hours	287	292	369	403	458	465	471	436	377		341	289	276
Total, worst case				57						4			
Sun reduction				0.63				0.72		0.67			
Oper. time red.				0.90				0.90		0.90			
Wind dir. red.				0.60				0.60		0.60			
Total reduction				0.34				0.39		0.36			
Total, real				19				21		1			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-280 - R-280
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:03			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-281 - R-281
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
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13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:16	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
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25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
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26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:03			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-282 - R-282
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:47	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	18:34 (T-48)	07:04	07:43			
	16:56	17:35	18:12	19:52	20:29	21:04	21:16	20:54	20:06	19:10	7	18:41 (T-48)	17:16	16:48		
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	18:31 (T-48)	07:05	07:44			
	16:57	17:36	18:14	19:53	20:31	21:05	21:16	20:53	20:05	19:09	12	18:43 (T-48)	17:15	16:48		
3	08:04	07:44	07:02	17:52 (T-48)	07:05	06:15	05:44	05:46	06:14	06:51	07:26	18:29 (T-48)	07:06	07:45		
	16:58	17:37	18:15	2	17:54 (T-48)	19:55	20:32	21:05	21:16	20:52	20:03	19:07	12	18:41 (T-48)	17:14	16:47
4	08:04	07:43	07:00	17:51 (T-48)	07:03	06:13	05:43	05:46	06:15	06:52	07:27	18:27 (T-48)	07:08	07:46		
	16:59	17:39	18:16	4	17:55 (T-48)	19:56	20:33	21:06	21:16	20:51	20:01	19:05	12	18:39 (T-48)	17:12	16:47
5	08:04	07:42	06:59	17:50 (T-48)	07:02	06:12	05:43	05:47	06:17	06:53	07:29	18:27 (T-48)	07:09	07:47		
	17:00	17:40	18:18	6	17:56 (T-48)	19:57	20:34	21:07	21:15	20:49	19:59	19:03	11	18:38 (T-48)	17:11	16:47
6	08:04	07:41	06:57	17:50 (T-48)	07:00	06:11	05:42	05:48	06:18	06:54	07:30	18:26 (T-48)	07:10	07:48		
	17:01	17:42	18:19	7	17:57 (T-48)	19:58	20:36	21:08	21:15	20:48	19:57	19:01	10	18:36 (T-48)	17:10	16:47
7	08:04	07:39	06:55	17:49 (T-48)	06:58	06:09	05:42	05:48	06:19	06:55	07:31	18:25 (T-48)	07:12	07:49		
	17:02	17:43	18:20	9	17:58 (T-48)	20:00	20:37	21:08	21:15	20:47	19:56	18:58	9	18:34 (T-48)	17:08	16:46
8	08:03	07:38	07:53	18:50 (T-48)	06:56	06:08	05:42	05:49	06:20	06:56	07:32	18:26 (T-48)	07:13	07:50		
	17:03	17:44	18:22	10	19:00 (T-48)	20:01	20:38	21:09	21:14	20:45	19:54	18:56	7	18:33 (T-48)	17:07	16:46
9	08:03	07:37	07:51	18:50 (T-48)	06:54	06:07	05:41	05:50	06:21	06:58	07:34	18:26 (T-48)	07:15	07:51		
	17:05	17:46	19:23	12	19:02 (T-48)	20:02	20:39	21:10	21:14	20:44	19:52	18:54	4	18:30 (T-48)	17:06	16:46
10	08:03	07:35	07:50	18:51 (T-48)	06:53	06:05	05:41	05:51	06:22	06:59	07:35	18:26 (T-48)	07:16	07:52		
	17:06	17:47	19:24	12	19:03 (T-48)	20:03	20:40	21:10	21:13	20:43	19:50	18:52	2	18:28 (T-48)	17:05	16:46
11	08:03	07:34	07:48	18:51 (T-48)	06:51	06:04	05:41	05:51	06:24	07:00	07:36	18:26 (T-48)	07:17	07:53		
	17:07	17:49	19:26	13	19:04 (T-48)	20:05	20:42	21:11	21:13	20:41	19:48	18:50	17:04	16:46		
12	08:02	07:32	07:46	18:53 (T-48)	06:49	06:03	05:41	05:52	06:25	07:01	07:37	18:26 (T-48)	07:19	07:54		
	17:08	17:50	19:27	10	19:03 (T-48)	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:46		
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	18:26 (T-48)	07:20	07:55			
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:01	16:46				
14	08:01	07:30	07:42	06:45	06:01	05:41	05:54	06:27	07:03	07:40	18:26 (T-48)	07:21	07:56			
	17:10	17:53	19:29	20:08	20:45	21:13	21:11	20:37	19:42	18:45	17:00	16:46				
15	08:01	07:28	07:40	06:44	05:59	05:41	05:55	06:28	07:05	07:41	18:26 (T-48)	07:23	07:56			
	17:12	17:54	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:43	16:59	16:47				
16	08:00	07:27	07:39	06:42	05:58	05:41	05:56	06:29	07:06	07:42	18:26 (T-48)	07:24	07:57			
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:33	19:39	18:42	16:58	16:47				
17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	18:26 (T-48)	07:25	07:58			
	17:14	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:57	16:47				
18	07:59	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	18:26 (T-48)	07:27	07:59			
	17:15	17:59	19:35	20:13	20:50	21:14	21:08	20:30	19:35	18:38	16:56	16:47				
19	07:58	07:22	07:33	06:37	05:55	05:41	05:58	06:33	07:09	07:46	18:26 (T-48)	07:28	07:59			
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48				
20	07:58	07:20	07:31	06:35	05:54	05:41	05:59	06:34	07:11	07:48	18:26 (T-48)	07:29	08:00			
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48				
21	07:57	07:19	07:29	06:34	05:53	05:41	06:00	06:35	07:12	07:49	18:26 (T-48)	07:31	08:00			
	17:19	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	16:49				
22	07:56	07:17	07:27	06:32	05:52	05:41	06:01	06:36	07:13	07:50	18:26 (T-48)	07:32	08:01			
	17:21	18:03	19:40	20:18	20:54	21:16	21:05	20:24	19:27	18:32	16:53	16:49				
23	07:55	07:16	07:26	06:30	05:51	05:41	06:02	06:38	07:14	07:52	18:26 (T-48)	07:33	08:01			
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:52	16:50				
24	07:55	07:14	07:24	06:29	05:50	05:42	06:03	06:39	07:15	07:53	18:26 (T-48)	07:34	08:02			
	17:23	18:05	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:28	16:52	16:50				
25	07:54	07:12	07:22	06:27	05:50	05:42	06:04	06:40	07:16	07:54	18:26 (T-48)	07:36	08:02			
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51				
26	07:53	07:11	07:20	06:25	05:49	05:42	06:06	06:41	07:18	07:56	18:26 (T-48)	07:37	08:03			
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:50	16:52				
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	18:26 (T-48)	07:38	08:03			
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52				
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	18:26 (T-48)	07:39	08:03			
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:22	16:49	16:53				
29	07:50		07:14	06:21	05:47	05:44	06:09	06:45	07:21	08:00	18:26 (T-48)	07:41	08:03			
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54				
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:23	08:01	18:26 (T-48)	07:42	08:04			
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:48	16:55				
31	07:48		07:11		05:45		06:11	06:47		08:02		08:04				
	17:33		19:51		21:03		20:56	20:08		18:18		16:55				
Potential sun hours	287	292	369	403	459	465	471	436	377	341		289	275			
Total, worst case											86					
Sun reduction			85								0.56					
Oper. time red.			0.90								0.90					
Wind dir. red.			0.57								0.57					
Total reduction			0.30								0.29					
Total, real			26								25					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
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SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-283 - R-283
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	15:26 (T-80) 07:46		07:05	17:41 (T-62) 07:09	06:18 05:45
	16:57	50 16:16 (T-80) 17:35		18:12	9 17:50 (T-63) 19:52	20:29 21:03
2	08:04	15:27 (T-80) 07:45		07:04	17:41 (T-62) 07:07	06:16 05:44
	16:58	49 16:16 (T-80) 17:36		18:14	11 17:52 (T-63) 19:53	20:31 21:04
3	08:04	15:27 (T-80) 07:44		07:02	17:41 (T-62) 07:05	06:15 05:44
	16:58	49 16:16 (T-80) 17:37		18:15	13 17:54 (T-63) 19:55	20:32 21:05
4	08:04	15:28 (T-80) 07:43		07:00	17:41 (T-63) 07:03	06:14 05:43
	16:59	49 16:17 (T-80) 17:39		18:16	14 17:55 (T-63) 19:56	20:33 21:06
5	08:04	15:29 (T-80) 07:42	17:14 (T-85) 06:58	17:41 (T-63) 07:02	06:12	05:43
	17:00	48 16:17 (T-80) 17:40	1 17:15 (T-85) 18:18	15 17:56 (T-63) 19:57	20:34	21:07
6	08:04	15:30 (T-80) 07:40	17:14 (T-85) 06:57	17:40 (T-63) 07:00	06:11	05:43
	17:01	48 16:18 (T-80) 17:42	2 17:16 (T-85) 18:19	17 17:57 (T-63) 19:58	20:35	21:07
7	08:03	15:30 (T-80) 07:39	17:15 (T-85) 06:55	17:39 (T-63) 06:58	06:09	05:42
	17:02	47 16:17 (T-80) 17:43	3 17:18 (T-85) 18:20	19 17:58 (T-63) 20:00	20:37	21:08
8	08:03	15:31 (T-80) 07:38	17:14 (T-85) 07:53	18:40 (T-63) 06:56	06:08	05:42
	17:04	47 16:18 (T-80) 17:45	5 17:19 (T-85) 18:22	21 19:01 (T-63) 20:01	20:38	21:09
9	08:03	15:32 (T-80) 07:36	17:15 (T-85) 07:51	18:39 (T-63) 06:54	06:07	05:42
	17:05	46 16:18 (T-80) 17:46	6 17:21 (T-85) 19:23	23 19:02 (T-63) 20:02	20:39	21:10
10	08:03	15:32 (T-80) 07:35	17:16 (T-85) 07:49	18:39 (T-63) 06:53	06:05	05:41
	17:06	46 16:18 (T-80) 17:47	7 17:23 (T-85) 19:24	24 19:03 (T-63) 20:03	20:40	21:10
11	08:02	15:33 (T-80) 07:34	17:17 (T-85) 07:48	18:40 (T-63) 06:51	06:04	05:41
	17:07	45 16:18 (T-80) 17:49	7 17:24 (T-85) 19:25	24 19:04 (T-63) 20:05	20:41	21:11
12	08:02	15:34 (T-80) 07:32	17:20 (T-85) 07:46	18:40 (T-63) 06:49	06:03	05:41
	17:08	45 16:19 (T-80) 17:50	6 17:26 (T-85) 19:27	24 19:04 (T-63) 20:06	20:43	21:11
13	08:02	15:34 (T-80) 07:31	07:44	18:41 (T-63) 06:47	06:02	05:41
	17:09	44 16:18 (T-80) 17:52	19:28	22 19:03 (T-63) 20:07	20:44	21:12
14	08:01	15:35 (T-80) 07:29	07:42	18:43 (T-63) 06:45	06:01	05:41
	17:11	42 16:17 (T-80) 17:53	19:29	19 19:02 (T-63) 20:08	20:45	21:12
15	08:01	15:36 (T-80) 07:28	07:40	18:44 (T-63) 06:44	05:59	05:41
	17:12	42 16:18 (T-80) 17:54	19:31	15 18:59 (T-63) 20:10	20:46	21:13
16	08:00	15:37 (T-80) 07:26	07:39	18:47 (T-63) 06:42	05:58	05:41
	17:13	40 16:17 (T-80) 17:56	19:32	9 18:56 (T-63) 20:11	20:47	21:13
17	07:59	15:39 (T-80) 07:25	07:37	06:40	05:57	05:41
	17:14	39 16:18 (T-80) 17:57	19:33	20:12	20:48	21:14
18	07:59	15:40 (T-80) 07:23	07:35	06:39	05:56	05:41
	17:16	37 16:17 (T-80) 17:59	19:34	20:13	20:49	21:14
19	07:58	15:41 (T-80) 07:22	07:33	06:37	05:55	05:41
	17:17	35 16:16 (T-80) 18:00	19:36	20:14	20:51	21:15
20	07:57	15:42 (T-80) 07:20	07:31	06:35	05:54	05:41
	17:18	33 16:15 (T-80) 18:00	19:37	20:16	20:52	21:15
21	07:57	15:44 (T-80) 07:19	07:29	06:34	05:53	05:41
	17:19	31 16:15 (T-80) 18:01	19:38	20:17	20:53	21:15
22	07:56	15:46 (T-80) 07:17	07:27	06:32	05:52	05:41
	17:21	28 16:14 (T-80) 18:03	19:40	20:18	20:54	21:15
23	07:55	15:47 (T-80) 07:15	07:26	06:30	05:51	05:42
	17:22	26 16:13 (T-80) 18:04	19:41	20:19	20:55	21:16
24	07:54	15:49 (T-80) 07:14	07:24	06:29	05:51	05:42
	17:24	22 16:11 (T-80) 18:05	19:42	20:21	20:56	21:16
25	07:53	15:52 (T-80) 07:12	07:22	06:27	05:50	05:42
	17:25	17 16:09 (T-80) 18:07	19:43	20:22	20:57	21:16
26	07:53	15:56 (T-80) 07:10	17:44 (T-62) 07:20	06:25	05:49	05:43
	17:26	9 16:05 (T-80) 18:08	2 17:46 (T-62) 19:45	20:23	20:58	21:16
27	07:52	07:09	17:43 (T-62) 07:18	06:24	05:48	05:43
	17:28	18:10	5 17:48 (T-62) 19:46	20:24	20:59	21:16
28	07:51	07:07	17:42 (T-62) 07:16	06:22	05:47	05:43
	17:29	18:11	7 17:49 (T-63) 19:47	20:26	21:00	21:16
29	07:50		07:14	06:21	05:47	05:44
	17:30		19:48	20:27	21:01	21:16
30	07:49		07:13	06:19	05:46	05:44
	17:32		19:50	20:28	21:02	21:16
31	07:47		07:11		05:45	
	17:33		19:51		21:03	
Potential sun hours	287	292	369	403	458	465
Total, worst case	1014	51	279			
Sun reduction	0.58	0.58	0.59			
Oper. time red.	0.90	0.90	0.90			
Wind dir. red.	0.62	0.59	0.57			
Total reduction	0.32	0.31	0.31			
Total, real	326	16	85			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
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6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-283 - R-283
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December	
1	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	18:20 (T-63) 23 18:43 (T-63)	07:03 7 16:45 (T-85)	07:43 15:15 (T-80)
2	05:45 21:16	06:13 20:53	06:49 20:05	07:25 19:09	18:19 (T-63) 24 18:43 (T-63)	07:05 6 16:51 (T-85)	07:44 16:01 (T-80)
3	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	18:17 (T-63) 24 18:41 (T-63)	07:06 5 16:49 (T-85)	07:45 16:01 (T-80)
4	05:47 21:15	06:16 20:51	06:52 20:01	07:27 19:05	18:16 (T-63) 23 18:39 (T-63)	07:08 4 16:48 (T-85)	07:46 16:02 (T-80)
5	05:47 21:15	06:17 20:49	06:53 19:59	07:29 19:03	18:17 (T-63) 21 18:38 (T-63)	07:09 2 16:46 (T-85)	07:47 16:03 (T-80)
6	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	18:16 (T-63) 20 18:36 (T-63)	07:10 17:10	07:48 15:16 (T-80)
7	05:49 21:14	06:19 20:47	06:55 19:55	07:31 18:58	18:15 (T-63) 19 18:34 (T-63)	07:12 17:08	07:49 16:04 (T-80)
8	05:49 21:14	06:20 20:45	06:56 19:54	07:32 18:56	18:15 (T-63) 17 18:32 (T-63)	07:13 17:07	07:50 16:05 (T-80)
9	05:50 21:14	06:21 20:44	06:58 19:52	07:33 18:54	18:16 (T-63) 15 18:31 (T-63)	07:14 17:06	07:51 16:05 (T-80)
10	05:51 21:13	06:22 20:42	06:59 19:50	07:35 18:52	18:15 (T-62) 13 18:28 (T-63)	07:16 17:05	07:52 16:06 (T-80)
11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:50	18:15 (T-62) 11 18:26 (T-63)	07:17 17:04	07:53 16:06 (T-80)
12	05:52 21:12	06:25 20:39	07:01 19:46	07:37 18:49	18:15 (T-62) 10 18:25 (T-63)	07:18 17:03	07:54 16:06 (T-80)
13	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	18:15 (T-62) 8 18:23 (T-63)	07:20 17:02	07:55 16:07 (T-80)
14	05:54 21:11	06:27 20:36	07:03 19:42	07:40 18:45	18:15 (T-62) 6 18:21 (T-62)	07:21 17:00	07:55 16:08 (T-80)
15	05:55 21:10	06:28 20:35	07:05 19:41	07:41 18:43	18:16 (T-62) 4 18:20 (T-62)	07:22 16:59	07:56 16:08 (T-80)
16	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	18:16 (T-62) 2 18:18 (T-62)	07:24 16:58	07:57 16:08 (T-80)
17	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	07:25 16:57	9 15:29 (T-80)	07:58 16:09 (T-80)
18	05:58 21:08	06:32 20:30	07:08 19:35	07:45 18:38	15:42 (T-80) 07:26 15:23 (T-80)	17:58 07:58	50 16:20 (T-80)
19	05:59 21:07	06:33 20:29	07:09 19:33	07:46 18:37	16:57 22 15:45 (T-80)	07:59 16:48	50 16:10 (T-80)
20	06:00 21:07	06:34 20:27	07:10 19:31	07:47 18:35	15:21 (T-80) 26 15:47 (T-80)	08:00 16:48	51 16:10 (T-80)
21	06:01 21:06	06:35 20:25	07:12 19:29	07:49 18:33	15:19 (T-80) 31 15:50 (T-80)	08:00 16:49	51 16:11 (T-80)
22	06:02 21:05	06:36 20:24	07:13 19:27	07:50 18:32	15:18 (T-80) 33 15:51 (T-80)	08:01 16:49	51 16:12 (T-80)
23	06:03 21:04	06:38 20:22	07:14 19:25	07:51 18:30	15:18 (T-80) 35 15:53 (T-80)	08:01 16:50	51 16:12 (T-80)
24	06:04 21:03	06:39 20:20	07:15 19:24	07:53 18:28	15:17 (T-80) 37 15:54 (T-80)	08:02 16:50	51 16:13 (T-80)
25	06:05 21:02	06:40 20:19	07:16 19:22	07:54 18:27	15:16 (T-80) 39 15:55 (T-80)	08:02 16:51	50 16:13 (T-80)
26	06:06 21:01	06:41 20:17	07:18 19:20	07:55 18:25	15:16 (T-80) 40 15:56 (T-80)	08:02 16:52	50 16:13 (T-80)
27	06:07 21:00	06:42 20:15	07:19 19:18	07:57 18:31 (T-63)	15:15 (T-80) 42 15:57 (T-80)	08:03 16:52	50 16:14 (T-80)
28	06:08 20:59	06:44 20:13	07:20 19:16	07:58 18:26 (T-63)	15:15 (T-80) 42 15:57 (T-80)	08:03 16:53	50 16:14 (T-80)
29	06:09 20:58	06:45 20:12	07:21 19:14	07:59 18:23 (T-63)	15:16 (T-80) 43 15:59 (T-80)	08:03 16:54	50 16:15 (T-80)
30	06:10 20:57	06:46 20:10	07:22 19:12	08:01 18:21 (T-63)	17:48 (T-85) 6 17:54 (T-85)	08:03 16:48	50 16:15 (T-80)
31	06:11 20:55	06:47 20:08	07:22 19:12	08:02 18:19	17:47 (T-85) 6 17:53 (T-85)	08:04 16:48	50 16:15 (T-80)
Potential sun hours	471	436	377	341	289	275	1529
Total, worst case					513		0.52
Sun reduction			0.67		0.56		0.90
Oper. time red.			0.90		0.90		0.62
Wind dir. red.			0.57		0.58		0.29
Total reduction			0.35		0.29		0.29
Total, real			19	73	136		441

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-284 - R-284
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January			February			March			April			May			June		
1	08:04	16:13 (T-76)	07:46		16:39 (T-71)	07:05			07:09	06:18	05:45							
	16:57	15	16:28 (T-76)	17:35	23	17:02 (T-71)	18:12		19:52	20:29	21:03							
2	08:04	16:14 (T-76)	07:45		16:40 (T-71)	07:04			07:07	06:16	05:44							
	16:57	15	16:29 (T-76)	17:36	22	17:02 (T-71)	18:14		19:53	20:30	21:04							
3	08:04	16:15 (T-76)	07:44		16:42 (T-71)	07:02			07:05	06:15	05:44							
	16:58	15	16:30 (T-76)	17:37	19	17:01 (T-71)	18:15		19:54	20:32	21:05							
4	08:04	16:16 (T-76)	07:43		16:43 (T-71)	07:00			07:03	06:13	05:43							
	16:59	15	16:31 (T-76)	17:39	16	16:59 (T-71)	18:16		19:56	20:33	21:06							
5	08:04	16:17 (T-76)	07:41		16:46 (T-71)	06:58			07:01	06:12	05:43							
	17:00	14	16:31 (T-76)	17:40	10	16:56 (T-71)	18:18		19:57	20:34	21:07							
6	08:03	16:18 (T-76)	07:40			06:57			07:00	06:11	05:42							
	17:01	13	16:31 (T-76)	17:42		18:19			19:58	20:35	21:07							
7	08:03	16:18 (T-76)	07:39			06:55			06:58	06:09	05:42							
	17:02	12	16:30 (T-76)	17:43		18:20			19:59	20:36	21:08							
8	08:03	16:20 (T-76)	07:38			07:53			06:56	06:08	05:42							
	17:03	10	16:30 (T-76)	17:44		18:21			20:01	20:38	21:09							
9	08:03	16:22 (T-76)	07:36			07:51			06:54	06:07	05:42							
	17:05	10	16:37 (T-71)	17:46		19:23			20:02	20:39	21:09							
10	08:02	16:24 (T-76)	07:35			07:49			06:52	06:05	05:41							
	17:06	7	16:38 (T-71)	17:47		19:24			20:03	20:40	21:10							
11	08:02	16:34 (T-71)	07:34			07:48			06:51	06:04	05:41							
	17:07	5	16:39 (T-71)	17:49		19:25			20:04	20:41	21:11							
12	08:02	16:33 (T-71)	07:32			07:46			06:49	06:03	05:41							
	17:08	7	16:40 (T-71)	17:50		19:27			20:06	20:42	21:11							
13	08:01	16:34 (T-71)	07:31			07:44		19:05 (T-70)	06:47	06:02	05:41							
	17:09	8	16:42 (T-71)	17:52		19:28	1	19:06 (T-70)	20:07	20:44	21:12							
14	08:01	16:33 (T-71)	07:29			07:42		19:04 (T-70)	06:45	06:01	05:41							
	17:10	9	16:42 (T-71)	17:53		19:29	4	19:08 (T-70)	20:08	20:45	21:12							
15	08:00	16:34 (T-71)	07:28			07:40		19:05 (T-70)	06:44	05:59	05:41							
	17:12	10	16:44 (T-71)	17:54		19:31	5	19:10 (T-70)	20:09	20:46	21:13							
16	08:00	16:33 (T-71)	07:26			07:38		19:05 (T-70)	06:42	05:58	05:41							
	17:13	12	16:45 (T-71)	17:56		19:32	6	19:11 (T-70)	20:11	20:47	21:13							
17	07:59	16:33 (T-71)	07:25			07:37		19:05 (T-70)	06:40	05:57	05:41							
	17:14	13	16:46 (T-71)	17:57		19:33	7	19:12 (T-70)	20:12	20:48	21:14							
18	07:59	16:33 (T-71)	07:23			07:35		19:06 (T-70)	06:39	05:56	05:41							
	17:15	15	16:48 (T-71)	17:59		19:34	7	19:13 (T-70)	20:13	20:49	21:14							
19	07:58	16:33 (T-71)	07:22			07:33		19:08 (T-70)	06:37	05:55	05:41							
	17:17	17	16:50 (T-71)	18:00		19:36	6	19:14 (T-70)	20:14	20:50	21:14							
20	07:57	16:33 (T-71)	07:20			07:31			06:35	05:54	05:41							
	17:18	18	16:51 (T-71)	18:00		19:37			20:16	20:51	21:15							
21	07:57	16:33 (T-71)	07:19			07:29			06:33	05:53	05:41							
	17:19	19	16:52 (T-71)	18:01		19:38			20:17	20:53	21:15							
22	07:56	16:34 (T-71)	07:17			07:27			06:32	05:52	05:41							
	17:21	20	16:54 (T-71)	18:03		19:39			20:18	20:54	21:15							
23	07:55	16:34 (T-71)	07:15			07:25			06:30	05:51	05:42							
	17:22	22	16:56 (T-71)	18:04		19:41			20:19	20:55	21:15							
24	07:54	16:34 (T-71)	07:14			07:24			06:29	05:50	05:42							
	17:23	23	16:57 (T-71)	18:05		19:42			20:21	20:56	21:16							
25	07:53	16:34 (T-71)	07:12			07:22			06:27	05:50	05:42							
	17:25	24	16:58 (T-71)	18:07		19:43			20:22	20:57	21:16							
26	07:52	16:35 (T-71)	07:10			07:20			06:25	05:49	05:42							
	17:26	25	17:00 (T-71)	18:08		19:44			20:23	20:58	21:16							
27	07:51	16:35 (T-71)	07:09			07:18			06:24	05:48	05:43							
	17:28	26	17:01 (T-71)	18:09		19:46			20:24	20:59	21:16							
28	07:50	16:36 (T-71)	07:07			07:16			06:22	05:47	05:43							
	17:29	27	17:03 (T-71)	18:11		19:47			20:25	21:00	21:16							
29	07:49	16:37 (T-71)				07:14			06:21	05:47	05:44							
	17:30	27	17:04 (T-71)			19:48			20:27	21:01	21:16							
30	07:48	16:36 (T-71)				07:12			06:19	05:46	05:44							
	17:32	27	17:03 (T-71)			19:49			20:28	21:01	21:16							
31	07:47	16:37 (T-71)				07:11				05:45								
	17:33	26	17:03 (T-71)			19:51				21:02								
Potential sun hours	287		292			369			403	458	465							
Total, worst case	506		90			36												
Sun reduction	0.58		0.58			0.59												
Oper. time red.	0.90		0.90			0.90												
Wind dir. red.	0.59		0.59			0.58												
Total reduction	0.31		0.31			0.31												
Total, real	156		28			11												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-284 - R-284
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	18:45 (T-70) 17:16	07:42 16:48
2	05:45 21:16	06:13 20:53	06:49 20:04	07:25 19:08	18:46 (T-70) 17:15	5 16:21 (T-71)
3	05:46 21:15	06:14 20:52	06:50 20:03	07:26 19:07	17:14 17:14	6 16:21 (T-71)
4	05:46 21:15	06:15 20:50	06:52 20:01	07:27 19:05	17:12 17:12	10 16:20 (T-71)
5	05:47 21:15	06:17 20:49	06:53 19:59	07:28 19:03	17:09 17:11	11 16:20 (T-71)
6	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	17:10 17:10	11 16:15 (T-71)
7	05:48 21:14	06:19 20:46	06:55 19:55	07:31 18:57	17:08 17:08	12 16:15 (T-71)
8	05:49 21:14	06:20 20:45	06:56 19:53	07:32 18:56	17:07 17:07	13 16:14 (T-71)
9	05:50 21:13	06:21 20:44	06:57 19:52	07:33 18:54	17:06 17:06	14 16:13 (T-71)
10	05:51 21:13	06:22 20:42	06:59 19:50	07:35 18:52	17:05 17:05	15 16:12 (T-71)
11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:50	17:04 17:04	16 16:11 (T-71)
12	05:52 21:12	06:25 20:39	07:01 19:46	07:37 18:48	17:03 17:03	17 16:10 (T-71)
13	05:53 21:11	06:26 20:38	07:02 19:44	07:38 18:47	17:02 17:02	18 16:09 (T-71)
14	05:54 21:11	06:27 20:36	07:03 19:42	07:40 18:45	17:01 17:01	19 16:08 (T-71)
15	05:55 21:10	06:28 20:35	07:05 19:40	07:41 18:43	17:00 17:00	20 16:07 (T-71)
16	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	16:59 16:59	21 16:06 (T-71)
17	05:57 21:09	06:31 20:32	07:07 19:37	07:43 18:40	16:58 16:58	22 16:05 (T-71)
18	05:58 21:08	06:32 20:30	07:08 19:35	07:45 18:38	16:57 16:57	23 16:04 (T-71)
19	05:59 21:07	06:33 20:28	07:09 19:33	07:46 18:36	16:56 16:56	24 16:03 (T-71)
20	05:59 21:06	06:34 20:27	07:10 19:31	07:47 18:35	16:55 16:55	25 16:02 (T-71)
21	06:00 21:06	06:35 20:25	07:12 19:29	07:49 18:33	16:54 16:54	26 16:01 (T-71)
22	06:01 21:05	06:36 20:24	07:13 19:27	07:50 18:32	16:53 16:53	27 16:00 (T-71)
23	06:02 21:04	06:38 20:22	07:14 19:25	07:51 18:30	16:52 16:52	28 15:59 (T-71)
24	06:03 21:03	06:39 20:20	07:15 19:23	18:54 (T-70) 18:28	16:51 16:51	29 15:58 (T-71)
25	06:05 21:02	06:40 20:18	07:16 19:22	18:49 (T-70) 18:27	16:50 16:50	30 15:57 (T-71)
26	06:06 21:01	06:41 20:17	07:18 19:20	18:56 (T-70) 18:25	16:49 16:49	31 15:56 (T-71)
27	06:07 21:00	06:42 20:15	07:19 19:18	18:47 (T-70) 18:24	16:48 16:48	1 15:55 (T-71)
28	06:08 20:59	06:43 20:13	07:20 19:16	18:53 (T-70) 18:22	16:47 16:47	2 15:54 (T-71)
29	06:09 20:58	06:45 20:12	07:21 19:14	18:45 (T-70) 18:21	16:46 16:46	3 15:53 (T-71)
30	06:10 20:56	06:46 20:10	07:22 19:12	18:49 (T-70) 18:19	16:45 16:45	4 15:52 (T-71)
31	06:11 20:55	06:47 20:08		18:44 (T-70) 18:18	16:44 16:44	5 15:51 (T-71)
Potential sun hours	471	436	377	341	289	276
Total, worst case					469	411
Sun reduction			0.34	0.67	0.56	0.52
Oper. time red.			0.90	0.90	0.90	0.90
Wind dir. red.			0.58	0.58	0.59	0.61
Total reduction			0.35	0.29	0.25	0.28
Total, real			12	0	119	117

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-285 - R-285
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June				
1	08:04	16:14 (T-76)	07:46	16:40 (T-71)	07:05	07:09				
	16:57	14	16:28 (T-76)	17:35	23	17:03 (T-71)	18:12	19:52	20:29	21:03
2	08:04	16:15 (T-76)	07:45	16:42 (T-71)	07:04	07:07	06:16	05:44		
	16:57	14	16:29 (T-76)	17:36	21	17:03 (T-71)	18:14	19:53	20:30	21:04
3	08:04	16:16 (T-76)	07:44	16:43 (T-71)	07:02	07:05	06:15	05:44		
	16:58	14	16:30 (T-76)	17:37	19	17:02 (T-71)	18:15	19:54	20:32	21:05
4	08:04	16:17 (T-76)	07:43	16:45 (T-71)	07:00	07:03	06:13	05:43		
	16:59	14	16:31 (T-76)	17:39	14	16:59 (T-71)	18:16	19:56	20:33	21:06
5	08:04	16:18 (T-76)	07:41	16:48 (T-71)	06:58	07:01	06:12	05:43		
	17:00	14	16:32 (T-76)	17:40	9	16:57 (T-71)	18:18	19:57	20:34	21:07
6	08:03	16:18 (T-76)	07:40	06:57	07:00	06:11	05:42			
	17:01	14	16:32 (T-76)	17:42	18:19	19:58	20:35	21:07		
7	08:03	16:19 (T-76)	07:39	06:55	06:58	06:09	05:42			
	17:02	13	16:32 (T-76)	17:43	18:20	19:59	20:36	21:08		
8	08:03	16:21 (T-76)	07:38	07:53	06:56	06:08	05:42			
	17:03	11	16:32 (T-76)	17:44	18:21	20:01	20:38	21:09		
9	08:03	16:22 (T-76)	07:36	07:51	06:54	06:07	05:42			
	17:05	10	16:32 (T-76)	17:46	19:23	20:02	20:39	21:09		
10	08:02	16:24 (T-76)	07:35	07:49	06:52	06:05	05:41			
	17:06	7	16:38 (T-71)	17:47	19:24	20:03	20:40	21:10		
11	08:02	16:37 (T-71)	07:34	07:48	06:51	06:04	05:41			
	17:07	2	16:39 (T-71)	17:49	19:25	20:04	20:41	21:11		
12	08:02	16:36 (T-71)	07:32	07:46	06:49	06:03	05:41			
	17:08	4	16:40 (T-71)	17:50	19:27	20:06	20:42	21:11		
13	08:01	16:36 (T-71)	07:31	07:44	19:04 (T-70)	06:47	06:02	05:41		
	17:09	6	16:42 (T-71)	17:52	19:28	2	19:06 (T-70)	20:07	20:44	21:12
14	08:01	16:35 (T-71)	07:29	07:42	19:03 (T-70)	06:45	06:01	05:41		
	17:10	7	16:42 (T-71)	17:53	19:29	5	19:08 (T-70)	20:08	20:45	21:12
15	08:00	16:36 (T-71)	07:28	07:40	19:04 (T-70)	06:44	05:59	05:41		
	17:12	8	16:44 (T-71)	17:54	19:31	6	19:10 (T-70)	20:09	20:46	21:13
16	08:00	16:35 (T-71)	07:26	07:38	19:05 (T-70)	06:42	05:58	05:41		
	17:13	10	16:45 (T-71)	17:56	19:32	6	19:11 (T-70)	20:11	20:47	21:13
17	07:59	16:35 (T-71)	07:25	07:37	19:05 (T-70)	06:40	05:57	05:41		
	17:14	11	16:46 (T-71)	17:57	19:33	7	19:12 (T-70)	20:12	20:48	21:14
18	07:59	16:35 (T-71)	07:23	07:35	19:07 (T-70)	06:39	05:56	05:41		
	17:15	13	16:48 (T-71)	17:59	19:34	6	19:13 (T-70)	20:13	20:49	21:14
19	07:58	16:35 (T-71)	07:22	07:33	06:37	05:55	05:41			
	17:17	15	16:50 (T-71)	18:00	19:36	20:14	20:50	21:14		
20	07:57	16:35 (T-71)	07:20	07:31	06:35	05:54	05:41			
	17:18	16	16:51 (T-71)	18:00	19:37	20:16	20:51	21:15		
21	07:57	16:35 (T-71)	07:19	07:29	06:33	05:53	05:41			
	17:19	17	16:52 (T-71)	18:01	19:38	20:17	20:53	21:15		
22	07:56	16:36 (T-71)	07:17	07:27	06:32	05:52	05:41			
	17:21	18	16:54 (T-71)	18:03	19:39	20:18	20:54	21:15		
23	07:55	16:36 (T-71)	07:15	07:25	06:30	05:51	05:42			
	17:22	20	16:56 (T-71)	18:04	19:41	20:19	20:55	21:15		
24	07:54	16:36 (T-71)	07:14	07:24	06:29	05:50	05:42			
	17:23	21	16:57 (T-71)	18:05	19:42	20:21	20:56	21:16		
25	07:53	16:36 (T-71)	07:12	07:22	06:27	05:50	05:42			
	17:25	22	16:58 (T-71)	18:07	19:43	20:22	20:57	21:16		
26	07:52	16:36 (T-71)	07:10	07:20	06:25	05:49	05:42			
	17:26	24	17:00 (T-71)	18:08	19:44	20:23	20:58	21:16		
27	07:51	16:37 (T-71)	07:09	07:18	06:24	05:48	05:43			
	17:28	24	17:01 (T-71)	18:09	19:46	20:24	20:59	21:16		
28	07:50	16:38 (T-71)	07:07	07:16	06:22	05:47	05:43			
	17:29	25	17:03 (T-71)	18:11	19:47	20:25	21:00	21:16		
29	07:49	16:38 (T-71)	07:06	07:14	06:21	05:47	05:44			
	17:30	27	17:05 (T-71)	18:12	19:48	20:27	21:01	21:16		
30	07:48	16:38 (T-71)	07:05	07:12	06:19	05:46	05:44			
	17:32	26	17:04 (T-71)	18:11	19:49	20:28	21:01	21:16		
31	07:47	16:39 (T-71)	07:04	07:11	06:18	05:45				
	17:33	25	17:04 (T-71)	18:10	19:51	21:02				
Potential sun hours	287	292	369	403	458	465				
Total, worst case	466	86	32							
Sun reduction	0.58	0.58	0.59							
Oper. time red.	0.90	0.90	0.90							
Wind dir. red.	0.59	0.59	0.58							
Total reduction	0.31	0.31	0.31							
Total, real	144	26	10							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-285 - R-285
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:12	06:48	07:24	18:44 (T-70)	07:03
	21:16	20:54	20:06	19:10	2	18:46 (T-70)
2	05:45	06:13	06:49	07:25	07:05	07:44
	21:16	20:53	20:04	19:08	17:15	16:48
3	05:46	06:14	06:50	07:26	07:06	07:45
	21:15	20:52	20:03	19:07	17:14	16:47
4	05:46	06:15	06:52	07:27	07:07	07:46
	21:15	20:50	20:01	19:05	17:12	16:47
5	05:47	06:17	06:53	07:28	07:09	07:47
	21:15	20:49	19:59	19:03	17:11	16:47
6	05:48	06:18	06:54	07:30	07:10	16:17 (T-71)
	21:15	20:48	19:57	19:01	17:10	10
7	05:48	06:19	06:55	07:31	07:11	16:15 (T-71)
	21:14	20:46	19:55	18:57	17:08	15
8	05:49	06:20	06:56	07:32	07:13	16:30 (T-71)
	21:14	20:45	19:53	18:56	17:07	19
9	05:50	06:21	06:57	07:33	07:14	16:32 (T-71)
	21:13	20:44	19:52	18:54	17:06	21
10	05:51	06:22	06:59	07:35	07:16	16:34 (T-71)
	21:13	20:42	19:50	18:52	17:05	23
11	05:51	06:24	07:00	07:36	07:17	16:11 (T-71)
	21:13	20:41	19:48	18:50	17:04	25
12	05:52	06:25	07:01	07:37	07:18	16:10 (T-71)
	21:12	20:39	19:46	18:48	17:03	26
13	05:53	06:26	07:02	07:38	07:20	16:10 (T-71)
	21:11	20:38	19:44	18:47	17:01	26
14	05:54	06:27	07:03	07:40	07:21	16:36 (T-71)
	21:11	20:36	19:42	18:45	17:00	26
15	05:55	06:28	07:05	07:41	07:22	16:09 (T-71)
	21:10	20:35	19:40	18:43	17:00	26
16	05:56	06:29	07:06	07:42	07:24	16:35 (T-71)
	21:10	20:33	19:39	18:42	16:59	24
17	05:57	06:31	07:07	07:43	07:25	16:33 (T-71)
	21:09	20:32	19:37	18:40	16:58	24
18	05:58	06:32	07:08	07:45	07:26	16:09 (T-71)
	21:08	20:30	19:35	18:38	16:57	22
19	05:59	06:33	07:09	07:46	07:28	16:31 (T-71)
	21:07	20:28	19:33	18:36	16:56	21
20	05:59	06:34	07:10	07:47	07:29	16:10 (T-71)
	21:06	20:27	19:31	18:35	16:55	18
21	06:00	06:35	07:12	07:49	07:30	16:28 (T-71)
	21:06	20:25	19:29	18:33	16:54	17
22	06:01	06:36	07:13	07:50	07:31	16:11 (T-71)
	21:05	20:23	19:27	18:32	16:53	16
23	06:02	06:38	07:14	07:51	07:33	16:27 (T-71)
	21:04	20:22	19:25	18:30	16:52	15
24	06:03	06:39	07:15	07:53	07:34	16:12 (T-71)
	21:03	20:20	19:23	18:28	16:52	13
25	06:05	06:40	07:16	18:51 (T-70)	07:35	16:25 (T-71)
	21:02	20:18	19:22	4	18:55 (T-70)	18:27
26	06:06	06:41	07:18	18:48 (T-70)	07:37	16:13 (T-71)
	21:01	20:17	19:20	7	18:55 (T-70)	18:25
27	06:07	06:42	07:19	18:46 (T-70)	07:38	16:24 (T-71)
	21:00	20:15	19:18	7	18:53 (T-70)	18:24
28	06:08	06:43	07:20	18:45 (T-70)	07:39	16:15 (T-71)
	20:59	20:13	19:16	6	18:51 (T-70)	18:22
29	06:09	06:45	07:21	18:44 (T-70)	07:40	16:23 (T-71)
	20:58	20:12	19:14	5	18:49 (T-70)	18:21
30	06:10	06:46	07:22	18:43 (T-70)	07:41	16:16 (T-71)
	20:56	20:10	19:12	4	18:47 (T-70)	18:19
31	06:11	06:47		08:02	16:48	4
	20:55	20:08		18:18		
Potential sun hours	471	436	377	341	289	276
Total, worst case					428	383
Sun reduction			0.67	0.56	0.48	0.52
Oper. time red.			0.90	0.90	0.90	0.90
Wind dir. red.			0.58	0.58	0.59	0.61
Total reduction			0.35	0.29	0.25	0.28
Total, real			12	1	109	109

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-286 - R-286
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:03	07:43
	16:57	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:17	05:45	05:46	06:13	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:30	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:15	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:00	07:03	06:14	05:44	05:47	06:16	06:52	07:27	07:07	07:46
	17:00	17:39	18:16	19:56	20:33	21:06	21:15	20:50	20:01	19:05	17:13	16:47
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:01	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
6	08:03	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48
	17:02	17:42	18:19	19:58	20:35	21:07	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:10	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:08	21:14	20:46	19:55	18:58	17:09	16:47
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:32	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:47
9	08:03	07:36	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:09	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:41	21:11	21:13	20:41	19:48	18:50	17:04	16:47
12	08:02	07:32	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:42	21:11	21:12	20:39	19:46	18:49	17:03	16:47
13	08:01	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:11	20:38	19:44	18:47	17:02	16:47
14	08:01	07:29	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:55
	17:11	17:53	19:29	20:08	20:45	21:12	21:11	20:36	19:42	18:45	17:01	16:47
15	08:00	07:28	07:40	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:22	07:56
	17:12	17:55	19:31	20:10	20:46	21:13	21:10	20:35	19:41	18:43	17:00	16:47
16	08:00	07:26	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:13	21:10	20:33	19:39	18:42	16:59	16:47
17	07:59	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:26	07:58
	17:16	17:59	19:35	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:14	20:50	21:14	21:07	20:29	19:33	18:37	16:56	16:48
20	07:57	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:47	07:29	07:59
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
	17:20	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:15	21:05	20:24	19:27	18:32	16:53	16:50
23	07:55	07:15	07:26	06:30	05:52	05:42	06:03	06:38	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:19	20:55	21:15	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:01
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52	16:51
25	07:53	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:35	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:52	07:10	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:16	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:13	19:16	18:22	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03
	17:31		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:48		07:13	06:20	05:46	05:45	06:10	06:46	07:22	08:01	07:41	08:03
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55
31	07:47		07:11	06:19	05:46		06:11	06:47		08:02		08:03
	17:33		19:51	21:02	21:02		20:55	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	435	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-289 - R-289

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05	08:29 (T-13)	07:47	07:06	07:09	06:18
	16:57	19 08:48 (T-13)	17:35	18:13	19:53	20:30
2	08:05	08:29 (T-13)	07:46	07:04	07:08	06:17
	16:58	20 08:49 (T-13)	17:36	18:14	19:54	20:31
3	08:05	08:29 (T-13)	07:45	07:03	07:06	06:15
	16:59	21 08:50 (T-13)	17:38	18:15	19:55	20:32
4	08:05	08:29 (T-13)	07:44	07:01	07:04	06:14
	17:00	21 08:50 (T-13)	17:39	18:17	19:56	20:34
5	08:04	08:29 (T-13)	07:42	06:59	07:02	06:12
	17:01	22 08:51 (T-13)	17:41	18:18	19:58	20:35
6	08:04	08:29 (T-13)	07:41	06:57	07:00	06:11
	17:02	23 08:52 (T-13)	17:42	18:19	19:59	20:36
7	08:04	08:28 (T-13)	07:40	06:55	06:58	06:10
	17:03	23 08:51 (T-13)	17:44	18:21	20:00	20:37
8	08:04	08:28 (T-13)	07:38	07:54	06:57	06:08
	17:04	24 08:52 (T-13)	17:45	18:22	20:01	20:39
9	08:04	08:28 (T-13)	07:37	07:52	06:55	06:07
	17:05	25 08:53 (T-13)	17:46	19:23	20:03	20:40
10	08:03	08:27 (T-13)	07:36	07:50	06:53	06:06
	17:06	26 08:53 (T-13)	17:48	19:25	20:04	20:41
11	08:03	08:27 (T-13)	07:34	07:48	06:51	06:05
	17:07	26 08:53 (T-13)	17:49	19:26	20:05	20:42
12	08:03	08:26 (T-13)	07:33	07:46	06:49	06:03
	17:08	27 08:53 (T-13)	17:51	19:27	20:06	20:43
13	08:02	08:26 (T-13)	07:32	07:45	06:48	06:02
	17:10	28 08:54 (T-13)	17:52	19:29	20:08	20:44
14	08:02	08:26 (T-13)	07:30	07:43	06:46	06:01
	17:11	28 08:54 (T-13)	17:53	19:30	20:09	20:46
15	08:01	08:27 (T-13)	07:29	07:41	06:44	06:00
	17:12	28 08:55 (T-13)	17:55	19:31	20:10	20:47
16	08:01	08:28 (T-13)	07:27	07:39	06:42	05:59
	17:13	26 08:54 (T-13)	17:56	19:32	20:11	20:48
17	08:00	08:28 (T-13)	07:26	07:37	06:41	05:58
	17:15	26 08:54 (T-13)	17:58	19:34	20:13	20:49
18	08:00	08:29 (T-13)	07:24	07:35	06:39	05:57
	17:16	26 08:55 (T-13)	17:59	19:35	20:14	20:50
19	07:59	08:30 (T-13)	07:23	07:34	06:37	05:56
	17:17	24 08:54 (T-13)	18:00	19:36	20:15	20:51
20	07:58	08:31 (T-13)	07:21	07:32	06:36	05:55
	17:18	23 08:54 (T-13)	18:00	19:38	20:16	20:52
21	07:58	08:32 (T-13)	07:19	07:30	06:34	05:54
	17:20	21 08:53 (T-13)	18:02	19:39	20:18	20:53
22	07:57	08:33 (T-13)	07:18	07:28	06:32	05:53
	17:21	19 08:52 (T-13)	18:03	19:40	20:19	20:55
23	07:56	08:35 (T-13)	07:16	07:26	06:31	05:52
	17:22	17 08:52 (T-13)	18:05	19:41	20:20	20:56
24	07:55	08:37 (T-13)	07:14	07:24	06:29	05:51
	17:24	14 08:51 (T-13)	18:06	19:43	20:21	20:57
25	07:54	08:39 (T-13)	07:13	07:22	06:27	05:50
	17:25	10 08:49 (T-13)	18:07	19:44	20:23	20:58
26	07:53		07:11	07:21	06:26	05:49
	17:27		18:09	19:45	20:24	20:59
27	07:52		07:09	07:19	06:24	05:48
	17:28		18:10	19:46	20:25	21:00
28	07:51		07:08	07:17	06:23	05:48
	17:29		18:11	19:48	20:26	21:01
29	07:50			07:15	06:21	05:47
	17:31			19:49	20:28	21:02
30	07:49			07:13	06:20	05:46
	17:32			19:50	20:29	21:02
31	07:48			07:11	06:18	05:45
	17:34			19:51	21:03	21:03
Potential sun hours	287	292	369	404	459	465
Total, worst case	567				560	561
Sun reduction	0.58				0.66	0.73
Oper. time red.	0.90				0.90	0.90
Wind dir. red.	0.66				0.63	0.63
Total reduction	0.34				0.38	0.42
Total, real	195				211	234

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-289 - R-289
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

July			August			September			October			November			December		
1	05:45	20:15 (T-11)	06:13		20:14 (T-11)	06:49	07:24	07:04		07:43		08:09 (T-13)					
	21:17	19 20:34 (T-11)	20:55	15	20:29 (T-11)	20:07	19:11	17:17		16:48	27	08:36 (T-13)					
2	05:46	20:15 (T-11)	06:14		20:14 (T-11)	06:50	07:25	07:06		07:45		08:10 (T-13)					
	21:17	19 20:34 (T-11)	20:54	14	20:28 (T-11)	20:05	19:09	17:15		16:48	26	08:36 (T-13)					
3	05:46	20:15 (T-11)	06:15		20:15 (T-11)	06:51	07:27	07:07		07:46		08:11 (T-13)					
	21:16	20 20:35 (T-11)	20:53	11	20:26 (T-11)	20:03	19:07	17:14		16:48	25	08:36 (T-13)					
4	05:47	20:14 (T-11)	06:16		20:16 (T-11)	06:52	07:28	07:08		07:47		08:12 (T-13)					
	21:16	21 20:35 (T-11)	20:51	9	20:25 (T-11)	20:02	19:05	17:13		16:47	24	08:36 (T-13)					
5	05:47	20:14 (T-11)	06:17		20:17 (T-11)	06:53	07:29	07:10		07:48		08:13 (T-13)					
	21:16	22 20:36 (T-11)	20:50	7	20:24 (T-11)	20:00	19:04	17:11		16:47	23	08:36 (T-13)					
6	05:48	20:13 (T-11)	06:18		20:19 (T-11)	06:55	07:30	07:11		07:49		08:14 (T-13)					
	21:16	23 20:36 (T-11)	20:49	3	20:22 (T-11)	19:58	19:02	17:10		16:47	23	08:37 (T-13)					
7	05:49	20:13 (T-11)	06:19			06:56	07:32	07:12		07:50		08:15 (T-13)					
	21:15	24 20:37 (T-11)	20:47			19:56	19:00	17:09		16:47	22	08:37 (T-13)					
8	05:49	20:13 (T-11)	06:20			06:57	07:33	07:14		07:51		08:17 (T-13)					
	21:15	25 20:38 (T-11)	20:46			19:54	18:56	17:08		16:47	21	08:38 (T-13)					
9	05:50	20:13 (T-11)	06:22			06:58	07:34	07:15		07:52		08:17 (T-13)					
	21:14	26 20:39 (T-11)	20:44			19:52	18:54	17:06		16:47	21	08:38 (T-13)					
10	05:51	20:12 (T-11)	06:23			06:59	07:35	07:16		07:53		08:18 (T-13)					
	21:14	27 20:39 (T-11)	20:43			19:50	18:53	17:05		16:47	20	08:38 (T-13)					
11	05:52	20:12 (T-11)	06:24			07:00	07:37	07:18		07:54		08:19 (T-13)					
	21:14	28 20:40 (T-11)	20:42			19:49	18:51	17:04		16:47	20	08:39 (T-13)					
12	05:53	20:12 (T-11)	06:25			07:02	07:38	07:19		07:55		08:20 (T-13)					
	21:13	28 20:40 (T-11)	20:40			19:47	18:49	17:03		16:47	19	08:39 (T-13)					
13	05:53	20:12 (T-11)	06:26			07:03	07:39	07:20		07:55		08:21 (T-13)					
	21:12	29 20:41 (T-11)	20:39			19:45	18:47	17:02		16:47	18	08:39 (T-13)					
14	05:54	20:12 (T-11)	06:27			07:04	07:40	07:22		07:56		08:22 (T-13)					
	21:12	30 20:42 (T-11)	20:37			19:43	18:46	17:01		16:47	18	08:40 (T-13)					
15	05:55	20:11 (T-11)	06:29			07:05	07:42	07:23		07:57		08:23 (T-13)					
	21:11	30 20:41 (T-11)	20:36			19:41	18:44	17:00		16:47	18	08:41 (T-13)					
16	05:56	20:11 (T-11)	06:30			07:06	07:43	07:25		07:58		08:23 (T-13)					
	21:10	31 20:42 (T-11)	20:34			19:39	18:42	16:59		16:47	17	08:40 (T-13)					
17	05:57	20:11 (T-11)	06:31			07:07	07:44	07:26		07:58		08:24 (T-13)					
	21:10	31 20:42 (T-11)	20:32			19:37	18:40	16:58	10	08:22 (T-13)	16:48	17	08:41 (T-13)				
18	05:58	20:11 (T-11)	06:32			07:09	07:46	07:27		07:59		08:25 (T-13)					
	21:09	31 20:42 (T-11)	20:31			19:35	18:39	16:57	14	08:25 (T-13)	16:48	17	08:42 (T-13)				
19	05:59	20:11 (T-11)	06:33			07:10	07:47	07:28		08:09 (T-13)	08:00		08:25 (T-13)				
	21:08	30 20:41 (T-11)	20:29			19:34	18:37	16:56	17	08:26 (T-13)	16:48	17	08:42 (T-13)				
20	06:00	20:11 (T-11)	06:35			07:11	07:48	07:30		08:08 (T-13)	08:00		08:26 (T-13)				
	21:07	30 20:41 (T-11)	20:28			19:32	18:35	16:55	19	08:27 (T-13)	16:49	16	08:42 (T-13)				
21	06:01	20:11 (T-11)	06:36			07:12	07:49	07:31		08:08 (T-13)	08:01		08:26 (T-13)				
	21:07	29 20:40 (T-11)	20:26			19:30	18:34	16:54	21	08:29 (T-13)	16:49	16	08:42 (T-13)				
22	06:02	20:11 (T-11)	06:37			07:13	07:51	07:32		08:07 (T-13)	08:01		08:27 (T-13)				
	21:06	28 20:39 (T-11)	20:24			19:28	18:32	16:54	23	08:30 (T-13)	16:50	16	08:43 (T-13)				
23	06:03	20:11 (T-11)	06:38			07:15	07:52	07:34		08:07 (T-13)	08:02		08:27 (T-13)				
	21:05	27 20:38 (T-11)	20:23			19:26	18:30	16:53	24	08:31 (T-13)	16:50	16	08:43 (T-13)				
24	06:04	20:11 (T-11)	06:39			07:16	07:53	07:35		08:07 (T-13)	08:02		08:28 (T-13)				
	21:04	26 20:37 (T-11)	20:21			19:24	18:29	16:52	25	08:32 (T-13)	16:51	16	08:44 (T-13)				
25	06:05	20:12 (T-11)	06:40			07:17	07:55	07:36		08:06 (T-13)	08:03		08:28 (T-13)				
	21:03	24 20:36 (T-11)	20:19			19:22	18:27	16:51	26	08:32 (T-13)	16:51	17	08:45 (T-13)				
26	06:06	20:12 (T-11)	06:42			07:18	07:56	07:37		08:07 (T-13)	08:03		08:28 (T-13)				
	21:02	23 20:35 (T-11)	20:18			19:20	18:26	16:51	26	08:33 (T-13)	16:52	17	08:45 (T-13)				
27	06:07	20:12 (T-11)	06:43			07:19	07:57	07:39		08:06 (T-13)	08:03		08:29 (T-13)				
	21:01	22 20:34 (T-11)	20:16			19:18	18:24	16:50	28	08:34 (T-13)	16:53	17	08:46 (T-13)				
28	06:08	20:12 (T-11)	06:44			07:21	07:59	07:40		08:06 (T-13)	08:04		08:29 (T-13)				
	21:00	21 20:33 (T-11)	20:14			19:17	18:23	16:50	28	08:34 (T-13)	16:53	17	08:46 (T-13)				
29	06:09	20:12 (T-11)	06:45			07:22	08:00	07:41		08:06 (T-13)	08:04		08:29 (T-13)				
	20:59	20 20:32 (T-11)	20:12			19:15	18:21	16:49	28	08:34 (T-13)	16:54	18	08:47 (T-13)				
30	06:10	20:13 (T-11)	06:46			07:23	08:01	07:42		08:08 (T-13)	08:04		08:29 (T-13)				
	20:57	18 20:31 (T-11)	20:11			19:13	18:20	16:49	27	08:35 (T-13)	16:55	18	08:47 (T-13)				
31	06:11	20:13 (T-11)	06:47				08:03			08:04			08:29 (T-13)				
	20:56	17 20:30 (T-11)	20:09				18:18			16:56	19	08:48 (T-13)					
Potential sun hours	471		436			377	341	288		275							
Total, worst case		779		59				316		596							
Sun reduction		0.75		0.72				0.48		0.52							
Oper. time red.		0.90		0.90				0.90		0.90							
Wind dir. red.		0.63		0.63				0.66		0.66							
Total reduction		0.43		0.41				0.28		0.31							
Total, real		334		24				90		184							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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South Deuel Wind Project

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Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
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L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
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1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-290 - R-290

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-45)	07:47	07:06	07:09	06:18
	16:57	45 15:59 (T-42)	17:35	18:12	19:52	21:04
2	08:04	08:29 (T-45)	07:46	07:04	07:07	23 20:37 (T-18)
	16:58	44 15:59 (T-42)	17:36	18:14	19:54	05:44 06:08 (T-21)
3	08:04	08:29 (T-45)	07:44	07:02	07:05	25 20:39 (T-18)
	16:58	44 15:59 (T-42)	17:38	18:15	19:55	05:44 06:07 (T-21)
4	08:04	08:29 (T-45)	07:43	07:00	07:04	27 20:39 (T-18)
	16:59	41 15:58 (T-42)	17:39	18:16	19:56	05:43 06:07 (T-21)
5	08:04	08:28 (T-45)	07:42	06:59	07:02	27 20:40 (T-18)
	17:00	41 15:57 (T-42)	17:40	18:18	19:57	05:43 06:07 (T-21)
6	08:04	08:28 (T-45)	07:41	06:57	07:00	28 20:41 (T-18)
	17:01	39 15:56 (T-42)	17:42	18:19	19:59	05:43 06:06 (T-21)
7	08:04	08:28 (T-45)	07:39	06:55	06:58	29 20:41 (T-18)
	17:03	36 15:55 (T-42)	17:43	18:20	20:00	05:42 06:06 (T-21)
8	08:04	08:28 (T-45)	07:38	07:53	06:56	29 20:42 (T-18)
	17:04	31 15:53 (T-42)	17:45	18:22	20:01	05:42 06:07 (T-21)
9	08:03	08:27 (T-45)	07:37	07:52	06:55	29 20:43 (T-18)
	17:05	28 08:55 (T-45)	17:46	19:23	20:02	05:42 06:07 (T-21)
10	08:03	08:27 (T-45)	07:35	07:50	06:53	29 20:43 (T-18)
	17:06	29 08:56 (T-45)	17:48	19:24	20:04	05:41 06:08 (T-21)
11	08:03	08:26 (T-45)	07:34	07:48	06:51	27 20:44 (T-18)
	17:07	29 08:55 (T-45)	17:49	19:26	20:05	05:41 06:09 (T-21)
12	08:02	08:26 (T-45)	07:33	07:46	06:49	26 20:44 (T-18)
	17:08	30 08:56 (T-45)	17:50	19:27	20:06	05:41 06:10 (T-21)
13	08:02	08:25 (T-45)	07:31	07:44	06:47	25 20:45 (T-18)
	17:09	31 08:56 (T-45)	17:52	19:28	20:07	05:41 20:25 (T-18)
14	08:02	08:26 (T-45)	07:30	07:42	06:46	21 20:46 (T-18)
	17:11	31 08:57 (T-45)	17:53	19:30	20:09	05:41 20:25 (T-18)
15	08:01	08:26 (T-45)	07:28	07:41	06:44	21 20:46 (T-18)
	17:12	30 08:56 (T-45)	17:55	19:31	20:10	05:41 20:25 (T-18)
16	08:00	08:27 (T-45)	07:27	07:39	06:42	21 20:46 (T-18)
	17:13	30 08:57 (T-45)	17:56	19:32	20:11	05:41 20:25 (T-18)
17	08:00	08:28 (T-45)	07:25	07:37	06:40	22 20:47 (T-18)
	17:14	29 08:57 (T-45)	17:57	19:33	20:12	05:41 20:25 (T-18)
18	07:59	08:28 (T-45)	07:24	07:35	06:39	22 20:47 (T-18)
	17:16	29 08:57 (T-45)	17:59	19:35	20:14	05:41 20:25 (T-18)
19	07:59	08:30 (T-45)	07:22	07:33	06:37	22 20:47 (T-18)
	17:17	27 08:57 (T-45)	18:00	19:36	20:15	05:41 20:26 (T-18)
20	07:58	08:21 (T-48)	07:21	07:31	06:35	22 20:48 (T-18)
	17:18	28 08:57 (T-45)	18:00	19:37	20:16	05:41 20:26 (T-18)
21	07:57	08:20 (T-48)	07:19	07:30	06:34	22 20:48 (T-18)
	17:20	27 08:56 (T-45)	18:02	19:39	20:17	05:41 20:27 (T-18)
22	07:56	08:19 (T-48)	07:17	07:28	06:32	1 06:16 (T-21)
	17:21	26 08:55 (T-45)	18:03	19:40	20:19	05:41 06:17 (T-21)
23	07:56	08:18 (T-48)	07:16	07:26	06:30	1 06:17 (T-21)
	17:22	27 08:55 (T-45)	18:04	19:41	20:20	2 06:18 (T-21)
24	07:55	08:17 (T-48)	07:14	07:24	06:29	3 06:18 (T-21)
	17:24	26 08:54 (T-45)	18:06	19:42	20:21	4 06:14 (T-21)
25	07:54	08:16 (T-48)	07:12	07:22	06:27	5 06:14 (T-21)
	17:25	22 08:52 (T-45)	18:07	19:44	20:22	6 06:13 (T-21)
26	07:53	08:15 (T-48)	07:11	07:20	06:26	7 06:13 (T-21)
	17:26	18 08:50 (T-45)	18:08	19:45	20:24	8 06:12 (T-21)
27	07:52	08:14 (T-48)	07:09	07:18	06:24	9 06:12 (T-21)
	17:28	11 08:46 (T-45)	18:10	19:46	20:25	10 06:11 (T-21)
28	07:51	08:13 (T-48)	07:07	07:17	06:23	13 20:33 (T-18)
	17:29	8 08:21 (T-48)	18:11	19:47	20:26	14 06:11 (T-21)
29	07:50	08:14 (T-48)		07:15	06:21	15 06:11 (T-21)
	17:31	5 08:19 (T-48)		19:49	20:27	16 06:10 (T-21)
30	07:49			07:13	06:19	17 20:35 (T-18)
	17:32			19:50	20:28	18 06:09 (T-21)
31	07:48			07:11	06:17	19 20:35 (T-18)
	17:33			19:51	21:03	20 20:36 (T-18)
Potential sun hours	287	292	369	403	459	465
Total, worst case	842			45	133	716
Sun reduction	0.58			0.63	0.66	0.73
Oper. time red.	0.90			0.90	0.90	0.90
Wind dir. red.	0.65			0.61	0.62	0.64
Total reduction	0.34			0.34	0.37	0.42
Total, real	287			15	49	300

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



<p>Project: South Deuel Wind Project</p>	<p>Description: Invenergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L085 73 GE3.8-154 WTGs on 98m HH June 14, 2024</p>	<p>Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:01 PM/3.6.366</p>
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SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-290 - R-290
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:13 (T-21) 20:49 (T-18)	06:12 20:55	06:48 20:07	07:24 19:11	07:04 17:17
2	05:45 21:16	06:13 (T-21) 20:49 (T-18)	06:13 20:53	06:50 20:05	07:25 19:09	07:05 17:15
3	05:46 21:16	06:12 (T-21) 20:48 (T-18)	06:15 20:52	06:51 20:03	07:26 19:07	07:07 17:14
4	05:47 21:16	06:12 (T-21) 20:48 (T-18)	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:12
5	05:47 21:16	06:12 (T-21) 20:48 (T-18)	06:17 20:50	06:53 19:59	07:29 19:03	07:09 17:11
6	05:48 21:15	06:12 (T-21) 20:48 (T-18)	06:18 20:48	06:54 19:58	07:30 19:01	07:11 17:10
7	05:49 21:15	06:13 (T-21) 20:48 (T-18)	06:19 20:47	06:55 19:56	07:31 19:00	07:12 17:09
8	05:49 21:15	06:14 (T-21) 20:48 (T-18)	06:20 20:46	06:57 19:54	07:33 18:56	07:13 17:07
9	05:50 21:14	06:14 (T-21) 20:46 (T-18)	06:21 20:44	06:58 19:52	07:34 18:54	07:15 17:06
10	05:51 21:14	06:15 (T-21) 20:46 (T-18)	06:23 20:43	06:59 19:50	07:35 18:52	07:16 17:05
11	05:52 21:13	06:16 (T-21) 20:46 (T-18)	06:24 20:41	07:00 19:48	07:36 18:51	07:17 17:04
12	05:52 21:13	06:17 (T-21) 20:46 (T-18)	06:25 20:40	07:01 19:46	07:38 18:49	07:19 17:03
13	05:53 21:12	06:17 (T-21) 20:44 (T-18)	06:26 20:38	07:02 19:45	07:39 18:47	07:20 17:02
14	05:54 21:11	06:18 (T-21) 20:44 (T-18)	06:27 20:37	20:04 (T-17) 20:11 (T-17)	07:04 19:43	07:21 18:45
15	05:55 21:11	06:19 (T-21) 20:44 (T-18)	06:28 20:35	20:02 (T-17) 20:10 (T-17)	07:05 19:41	07:23 18:44
16	05:56 21:10	06:20 (T-21) 20:43 (T-18)	06:30 20:34	20:00 (T-17) 20:08 (T-17)	07:06 19:39	07:24 18:42
17	05:57 21:09	06:21 (T-21) 20:42 (T-18)	06:31 20:32	19:59 (T-17) 20:06 (T-17)	07:07 18:40	07:26 16:58
18	05:58 21:09	06:22 (T-21) 20:42 (T-18)	06:32 20:31	20:00 (T-17) 20:06 (T-17)	07:08 19:35	07:27 16:57
19	05:59 21:08	06:23 (T-21) 20:41 (T-18)	06:33 20:29	19:59 (T-17) 20:04 (T-17)	07:10 19:33	07:28 18:37
20	06:00 21:07	06:24 (T-21) 20:41 (T-18)	06:34 20:27	19:59 (T-17) 20:02 (T-17)	07:11 19:31	07:29 18:35
21	06:01 21:06	06:25 (T-21) 06:28 (T-21)	06:35 20:26	19:58 (T-17) 20:01 (T-17)	07:12 19:29	07:31 18:33
22	06:02 21:05	06:26 (T-21) 06:28 (T-21)	06:37 20:24	07:13 19:28	07:32 18:32	07:32 16:53
23	06:03 21:04	06:26 (T-21) 06:27 (T-21)	06:38 20:22	07:14 19:26	07:33 18:30	07:33 16:53
24	06:04 21:03		06:39 20:21	07:15 19:24	07:35 18:29	07:35 16:52
25	06:05 21:02		06:40 20:19	07:17 19:22	07:36 18:27	07:36 16:51
26	06:06 21:01		06:41 20:17	07:18 19:20	07:37 18:25	07:37 16:51
27	06:07 21:00		06:43 20:15	07:19 19:18	07:38 18:24	07:38 16:50
28	06:08 20:59		06:44 20:14	07:20 19:16	07:38 18:22	07:40 16:49
29	06:09 20:58		06:45 20:12	07:21 19:14	08:00 18:21	07:41 16:49
30	06:10 20:57		06:46 20:10	07:23 19:13	08:01 18:19	07:42 16:49
31	06:11 20:56		06:47 20:08	08:02 18:18		08:04 16:56
Potential sun hours	471	436		377	341	289
Total, worst case			47			438
Sun reduction			0.72			0.48
Oper. time red.			0.90			0.90
Wind dir. red.			0.62			0.66
Total reduction			0.39			0.28
Total, real	186	18			124	399

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



<p>Project: South Deuel Wind Project</p>	<p>Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L085 73 GE3.8-154 WTGs on 98m HH June 14, 2024</p>	<p>Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:01 PM/3.6.366</p>
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SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-291 - R-291
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December					
1	08:04	08:29 (T-54)	07:47	08:09 (T-55)	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04		07:43	08:08 (T-54)	
16:57		4 08:33 (T-54)	17:35	3 08:12 (T-55)	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17		16:48	10 08:18 (T-54)	
2	08:04	08:29 (T-54)	07:46	08:08 (T-55)	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05		07:44	08:10 (T-54)	
16:58		4 08:33 (T-54)	17:36	4 08:12 (T-55)	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15		16:48	9 08:19 (T-54)	
3	08:04	08:29 (T-54)	07:45	08:06 (T-55)	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07		07:45	08:11 (T-54)	
16:59		5 08:34 (T-54)	17:38	5 08:11 (T-55)	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14		16:48	9 08:20 (T-54)	
4	08:04	08:29 (T-54)	07:43	08:05 (T-55)	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08		07:46	08:12 (T-54)	
17:00		6 08:34 (T-54)	17:39	5 08:10 (T-55)	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13		16:47	8 08:20 (T-54)	
5	08:04	08:28 (T-54)	07:42	08:04 (T-55)	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09		07:48	08:13 (T-54)	
17:01		6 08:34 (T-54)	17:41	6 08:10 (T-55)	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	5	07:32 (T-55)	07:48	7 08:20 (T-54)
6	08:04	08:28 (T-54)	07:41	08:02 (T-55)	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11		07:34 (T-55)	07:49	08:14 (T-54)
17:02		7 08:35 (T-54)	17:42	5 08:07 (T-55)	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	6	07:42 (T-55)	07:49	7 08:21 (T-54)
7	08:04	08:28 (T-54)	07:40		06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12		07:35 (T-55)	07:50	08:15 (T-54)
17:03		7 08:35 (T-54)	17:44		18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	5	07:40 (T-55)	07:47	6 08:21 (T-54)
8	08:04	08:28 (T-54)	07:38		07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:13		07:37 (T-55)	07:51	08:16 (T-54)
17:04		8 08:36 (T-54)	17:45		18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	5	07:42 (T-55)	07:47	6 08:22 (T-54)
9	08:03	08:27 (T-54)	07:37		07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15		07:38 (T-55)	07:52	08:17 (T-54)
17:05		9 08:36 (T-54)	17:46		19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	4	07:42 (T-55)	07:47	5 08:22 (T-54)
10	08:03	08:27 (T-54)	07:36		07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16		07:40 (T-55)	07:52	08:18 (T-54)
17:06		9 08:36 (T-54)	17:48		19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	3	07:40 (T-55)	07:47	5 08:23 (T-54)
11	08:03	08:26 (T-54)	07:34		07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:17		07:41 (T-55)	07:53	08:19 (T-54)
17:07		10 08:36 (T-54)	17:49		19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	2	07:43 (T-55)	07:47	4 08:23 (T-54)
12	08:02	08:26 (T-54)	07:33		07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19		07:54	08:20 (T-54)	
17:08		10 08:36 (T-54)	17:51		19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03		08:24 (T-54)	08:24 (T-54)	
13	08:02	08:25 (T-54)	07:31		07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20		07:55	08:21 (T-54)	
17:10		11 08:36 (T-54)	17:52		19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02		08:21 (T-54)	08:21 (T-54)	
14	08:02	08:25 (T-54)	07:30		07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22		07:56	08:24 (T-54)	
17:11		11 08:36 (T-54)	17:53		19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01		08:24 (T-54)	08:24 (T-54)	
15	08:01	08:24 (T-54)	07:28		07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23		07:57	08:22 (T-54)	
17:12		11 08:35 (T-54)	17:55		19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00		08:23 (T-54)	08:23 (T-54)	
16	08:01	08:25 (T-54)	07:27		07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24		07:57	08:24 (T-54)	
17:13		10 08:35 (T-54)	17:56		19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59		08:24 (T-54)	08:24 (T-54)	
17	08:00	08:26 (T-54)	07:25		07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26		07:58	08:24 (T-54)	
17:15		8 08:34 (T-54)	17:58		19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58		08:24 (T-54)	08:24 (T-54)	
18	07:59		07:24		07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27		07:59	08:24 (T-54)	
17:16			17:59		19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57		08:25 (T-54)	08:25 (T-54)	
19	07:59		07:22		07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28		07:59	08:25 (T-54)	
17:17			18:00		19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56		08:26 (T-54)	08:26 (T-54)	
20	07:58		07:21		07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30		08:00	08:25 (T-54)	
17:19			18:00		19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55		08:26 (T-54)	08:26 (T-54)	
21	07:57		07:19		07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31		08:01	08:26 (T-54)	
17:20			18:02		19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54		08:26 (T-54)	08:26 (T-54)	
22	07:56		07:18		07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32		08:01	08:26 (T-54)	
17:21			18:03		19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54		08:27 (T-54)	08:27 (T-54)	
23	07:56		07:16		07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33		08:02	08:27 (T-54)	
17:23			18:05		19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53		08:27 (T-54)	08:27 (T-54)	
24	07:55		07:14		07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35		08:02	08:27 (T-54)	
17:24			18:06		19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52		08:27 (T-54)	08:27 (T-54)	
25	07:54		07:13		07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36		08:02	08:28 (T-54)	
17:25			18:07		19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	7	08:11 (T-54)	08:29 (T-54)	
26	07:53		07:11		07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37		08:03 (T-54)	08:03 (T-54)	
17:27			18:09		19:45	20:24	20:58	21:16	21:01	20:17	19:20	18:26	16:51	10	08:13 (T-54)	08:28 (T-54)	
27	07:52		07:09		07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38		08:03 (T-54)	08:03 (T-54)	
17:28			18:10		19:46	20:25	20:59	21:16	21:00	20:16	19:18	18:24	16:50	11	08:14 (T-54)	08:28 (T-54)	
28	07:51		07:08		07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40		08:05 (T-54)	08:03 (T-54)	
17:29			18:11		19:48	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	11	08:16 (T-54)	08:28 (T-54)	
29	07:50		07:15		07:25	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41		08:06 (T-54)	08:04 (T-54)	
17:31			18:13		19:49	20:27	21:01	21:16	20:58	20:12	19:15	18:21	16:49	11	08:17 (T-54)	08:29 (T-54)	
30	07:49		07:13		07:23	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42		08:07 (T-54)	08:04 (T-54)	
17:32			18:15		19:50	20:29	21:02	21:16	20:57	20:10	19:13	18:20	16:49	10	08:17 (T-54)	08:29 (T-54)	
31	07:48		07:11		07:21		05:46		06:11	06:47		08:03			08:04	08:29 (T-54)	
17:34		2 08:12 (T-55)			19:51		21:03		20:56	20:09		18:18			16:56	3 08:32 (T-54)	
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289				275		
Total, worst case	138		28								90				114		
Sun reduction	0.58		0.58								0.48				0.52		
Oper. time red.	0.90		0.90								0.90				0.90		
Wind dir. red.	0.65		0.64								0.65				0.65		
Total reduction	0.34		0.33								0.28				0.30		
Total, real	47		9								25				35		

Table layout: For

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-294 - R-294

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December							
1	08:04	16:08 (T-89)	07:47		07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:27 (T-57)	07:43		15:55 (T-89)		
1	16:57	21	16:29 (T-89)	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	5	07:32 (T-57)	16:48	22	16:17 (T-89)	
2	08:04	16:08 (T-89)	07:46		07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05		07:28 (T-57)	07:44		15:56 (T-89)	
2	16:58	22	16:30 (T-89)	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	5	07:33 (T-57)	16:48	22	16:18 (T-89)	
3	08:04	16:09 (T-89)	07:44		07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07		07:30 (T-57)	07:45		15:56 (T-89)	
3	16:59	22	16:31 (T-89)	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	5	07:35 (T-57)	16:48	23	16:19 (T-89)	
4	08:04	16:08 (T-89)	07:43		07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08		07:31 (T-57)	07:46		15:56 (T-89)	
4	17:00	23	16:31 (T-89)	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	5	07:36 (T-57)	16:47	23	16:19 (T-89)	
5	08:04	16:09 (T-89)	07:42		08:04 (T-57)	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09		07:32 (T-57)	07:47		15:56 (T-89)
5	17:01	23	16:32 (T-89)	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	4	07:36 (T-57)	16:47	24	16:20 (T-89)	
6	08:04	16:10 (T-89)	07:41		08:02 (T-57)	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11		07:34 (T-57)	07:49		15:56 (T-89)
6	17:02	23	16:33 (T-89)	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	2	07:36 (T-57)	16:47	24	16:20 (T-89)	
7	08:04	16:11 (T-89)	07:39		08:01 (T-57)	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12		07:35 (T-57)	07:50		15:56 (T-89)
7	17:03	24	16:35 (T-89)	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	1	07:36 (T-57)	16:47	23	16:19 (T-89)	
8	08:04	16:12 (T-89)	07:38		08:00 (T-57)	07:53	06:56	06:08	05:42	05:50	06:20	06:57	07:33	07:13		07:37	07:51		15:56 (T-89)
8	17:04	23	16:35 (T-89)	17:45	18:22	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:08			07:38	07:47	23	16:19 (T-89)
9	08:03	16:12 (T-89)	07:37		07:58 (T-57)	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15		07:39	07:51		15:57 (T-89)
9	17:05	23	16:35 (T-89)	17:46	18:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06			07:40	07:52	22	16:19 (T-89)
10	08:03	16:13 (T-89)	07:35		07:58 (T-57)	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16		07:41	07:52		15:57 (T-89)
10	17:06	22	16:35 (T-89)	17:48	18:24	20:03	20:41	21:11	21:14	20:43	19:50	18:52	17:05			07:42	07:53	22	16:19 (T-89)
11	08:03	16:13 (T-89)	07:34		07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:17			07:43	07:53		15:58 (T-89)
11	17:07	22	16:35 (T-89)	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04			07:44	07:54	21	16:19 (T-89)
12	08:02	16:14 (T-89)	07:33		07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19		07:49 (T-56)	07:54		15:58 (T-89)	
12	17:08	21	16:35 (T-89)	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	7	07:56 (T-56)	07:54	21	16:19 (T-89)	
13	08:02	16:15 (T-89)	07:31		07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20		07:46 (T-56)	07:55		15:59 (T-89)	
13	17:10	20	16:35 (T-89)	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	12	07:58 (T-56)	07:56	20	16:19 (T-89)	
14	08:01	16:16 (T-89)	07:30		07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21		07:46 (T-56)	07:56		15:58 (T-89)	
14	17:11	19	16:35 (T-89)	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	14	08:00 (T-56)	07:56	21	16:19 (T-89)	
15	08:01	16:17 (T-89)	07:28		07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23		07:47 (T-56)	07:57		15:59 (T-89)	
15	17:12	18	16:34 (T-89)	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	14	08:01 (T-56)	07:56	20	16:19 (T-89)	
16	08:00	16:18 (T-89)	07:27		07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24		07:48 (T-56)	07:57		16:00 (T-89)	
16	17:13	17	16:34 (T-89)	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	13	08:01 (T-56)	07:56	19	16:19 (T-89)	
17	08:00	16:19 (T-89)	07:25		07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25		07:50 (T-56)	07:58		16:01 (T-89)	
17	17:15	17	16:33 (T-89)	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	12	08:02 (T-56)	07:56	19	16:20 (T-89)	
18	07:59	16:20 (T-89)	07:24		07:35	06:39	05:57	05:41	05:58	06:32	07:08	07:45	07:27		07:51 (T-56)	07:59		16:00 (T-89)	
18	17:16	15	16:32 (T-89)	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	12	08:03 (T-56)	07:56	19	16:20 (T-89)	
19	07:59	16:21 (T-89)	07:22		07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28		07:53 (T-56)	07:59		16:01 (T-89)	
19	17:17	10	16:30 (T-89)	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	11	08:04 (T-56)	07:56	19	16:20 (T-89)	
20	07:58	16:22 (T-89)	07:21		07:32	06:36	05:55	05:41	06:00	06:34	07:11	07:48	07:29		07:54 (T-56)	08:00		16:01 (T-89)	
20	17:18	7	08:28 (T-56)	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	10	08:04 (T-56)	07:56	19	16:20 (T-89)	
21	07:57	16:23 (T-89)	07:19		07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31		07:55 (T-56)	08:01		16:02 (T-89)	
21	17:20	9	08:29 (T-56)	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	9	08:04 (T-56)	07:56	19	16:21 (T-89)	
22	07:56	16:24 (T-89)	07:17		07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32		07:57 (T-56)	08:01		16:02 (T-89)	
22	17:21	10	08:29 (T-56)	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	7	08:04 (T-56)	07:56	19	16:21 (T-89)	
23	07:56	16:25 (T-89)	07:16		07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33		07:58 (T-56)	08:02		16:03 (T-89)	
23	17:22	11	08:29 (T-56)	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	9	08:05 (T-89)	08:02	19	16:22 (T-89)	
24	07:55	16:26 (T-89)	07:14		07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35		08:00 (T-56)	08:02		16:03 (T-89)	
24	17:24	12	08:29 (T-56)	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	14	08:09 (T-89)	08:04	19	16:22 (T-89)	
25	07:54	16:27 (T-89)	07:13		07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36		08:01 (T-56)	08:02		16:04 (T-89)	
25	17:25	13	08:28 (T-56)	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	17	08:11 (T-89)	08:04	20	16:24 (T-89)	
26	07:53	16:28 (T-89)	07:11		07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37		08:02 (T-56)	08:03		16:05 (T-89)	
26	17:27	13	08:28 (T-56)	18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	18:26	16:51	17	08:12 (T-89)	08:03	19	16:24 (T-89)	
27	07:52	16:29 (T-89)	07:09		07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38		08:03 (T-56)	08:03		16:05 (T-89)	
27	17:28	14	08:28 (T-56)	18:10	19:46	20:25	20:												

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-305 - R-305
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:47
	17:01	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:49
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:01	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:29	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:00
	17:20	18:02	19:39	20:17	20:53	21:15	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56	07:17	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:01
	17:23	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:54
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11	06:15	05:46		06:11	06:47		08:02		08:04
	17:34		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-306 - R-306

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	07:06 18:13	07:09 19:52	06:18 20:30	05:45 21:04	05:45 21:16	06:13 20:55	06:36 (T-J) 06:43 (T-J)	06:49 20:07	07:24 19:11	07:04 17:17
2	08:04 16:58	07:46 17:36	07:04 18:14	07:07 19:54	06:17 20:31	05:45 21:05	05:46 21:16	06:14 20:53	06:37 (T-J) 06:43 (T-J)	06:50 20:05	07:25 19:09	07:05 17:16
3	08:04 16:59	07:44 17:38	07:02 18:15	07:06 19:55	06:15 20:32	05:44 21:05	05:46 21:16	06:15 20:52	06:38 (T-J) 06:42 (T-J)	06:51 20:03	07:26 19:07	07:07 17:14
4	08:04 17:00	07:43 17:39	07:01 18:17	07:04 19:56	06:14 20:33	05:44 21:06	05:47 21:16	06:16 20:51	06:39 (T-J) 06:42 (T-J)	06:52 20:01	07:28 19:05	07:08 17:13
5	08:04 17:01	07:42 17:41	06:59 18:18	07:02 19:57	06:13 20:35	05:43 21:07	05:48 21:15	06:17 20:50	06:40 (T-J) 06:41 (T-J)	06:53 19:59	07:29 19:03	07:09 17:11
6	08:04 17:02	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:02	07:11 19:02	07:11 17:10
7	08:04 17:03	07:39 17:44	06:55 18:21	06:58 20:00	06:10 20:37	05:43 21:09	05:49 21:15	06:19 20:47	06:56 19:56	07:31 19:00	07:12 17:09	07:12 16:49
8	08:04 17:04	07:38 17:45	07:53 18:22	06:57 20:01	06:08 20:38	05:42 21:09	05:50 21:14	06:21 20:46	06:57 19:54	07:33 18:56	07:13 17:08	07:13 16:47
9	08:03 17:05	07:37 17:46	07:52 19:23	06:55 20:02	06:07 20:39	05:42 21:10	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54	07:15 17:06	07:15 16:47
10	08:03 17:06	07:35 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:53	07:16 17:05	07:16 16:47
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:05 20:42	05:42 21:11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51	07:17 17:04	07:17 16:47
12	08:02 17:09	07:33 17:51	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:19 16:47
13	08:02 17:10	07:31 17:52	07:44 19:28	06:48 20:07	06:02 20:44	05:41 21:12	05:54 21:12	06:26 20:38	07:03 19:45	07:39 18:47	07:20 17:02	07:20 16:47
14	08:01 17:11	07:30 17:53	07:43 19:30	06:46 20:09	06:01 20:45	05:41 21:13	05:54 21:11	06:28 20:37	07:04 19:43	07:40 18:45	07:21 17:01	07:21 16:47
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	06:00 20:46	05:41 21:13	05:55 21:11	06:29 20:35	07:05 19:41	07:41 18:44	07:23 17:00	07:23 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:59 20:48	05:41 21:14	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59	07:24 16:47
17	08:00 17:15	07:25 17:58	07:37 19:34	06:41 20:12	05:58 20:49	05:41 21:14	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	07:25 16:58	07:25 16:48
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:14	05:57 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:35	07:45 18:39	07:27 16:57	07:27 16:48
19	07:59 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:56 20:51	05:41 21:15	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	07:28 16:56	07:28 16:48
20	07:58 17:19	07:21 18:00	07:32 19:37	06:36 20:16	05:55 20:52	05:41 21:15	06:00 21:07	06:25 20:27	07:11 19:31	07:48 18:35	07:29 16:55	08:00 16:49
21	07:57 17:20	07:19 18:02	07:30 19:39	06:34 20:17	05:54 20:53	05:42 21:16	06:01 21:06	06:25 20:26	07:12 19:30	07:49 18:34	07:31 16:54	08:00 16:49
22	07:56 17:21	07:17 18:03	07:28 19:40	06:32 20:19	05:53 20:54	05:42 21:16	06:02 21:05	06:26 20:24	07:13 19:28	07:50 18:32	07:32 16:54	08:01 16:50
23	07:56 17:23	07:16 18:05	07:26 19:41	06:31 20:20	05:52 20:55	05:42 21:16	06:03 21:04	06:27 20:22	07:14 19:26	07:52 18:30	07:33 16:53	08:01 16:50
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	05:51 20:56	05:42 21:16	06:04 21:03	06:28 20:21	07:16 19:24	07:53 18:29	07:35 16:52	08:02 16:51
25	07:54 17:25	07:13 18:07	07:22 19:44	06:27 20:22	05:50 20:57	05:43 21:16	06:05 21:02	06:29 20:19	07:17 19:22	07:54 18:27	07:36 16:52	08:02 16:51
26	07:53 17:27	07:11 18:09	07:20 19:45	06:26 20:24	05:49 20:58	05:43 21:16	06:06 21:01	06:43 20:17	07:18 19:20	07:56 18:26	07:37 16:51	08:03 16:52
27	07:52 17:28	07:09 18:10	07:19 19:46	06:24 20:25	05:49 20:59	05:43 21:16	06:07 21:00	06:43 20:16	07:19 19:18	07:57 18:24	07:38 16:50	08:03 16:53
28	07:51 17:29	07:07 18:11	07:17 19:47	06:23 20:26	05:48 21:00	05:44 21:16	06:08 20:59	06:32 20:14	07:20 19:16	07:58 18:23	07:39 16:50	08:03 16:54
29	07:50 17:31		07:15 19:49	06:21 20:27	05:47 21:01	05:44 21:16	06:09 20:58	06:44 20:12	07:22 19:15	08:00 18:21	07:41 16:49	08:04 16:54
30	07:49 17:32		07:13 19:50	06:20 20:28	05:47 21:02	05:45 21:16	06:10 20:57	06:34 20:10	07:23 19:13	08:01 18:20	07:42 16:49	08:04 16:55
31	07:48 17:34		07:11 19:51	05:46 21:03	05:46 21:03	05:46 20:56	06:11 20:56	06:44 20:08	08:02 18:18			08:04 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case					194				21			
Sun reduction					0.66				0.72			
Oper. time red.					0.90				0.90			
Wind dir. red.					0.59				0.59			
Total reduction					0.35				0.38			
Total, real					68				8			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-314 - R-314

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04		07:47	07:06	07:09	06:18
	16:57		17:35	18:12	19:52	06:39 (T-48)
2	08:04		07:46	07:04	07:07	20:30
	16:58		17:36	18:14	19:54	19 06:58 (T-48)
3	08:04		07:44	07:02	07:05	20:31
	16:58		17:38	18:15	19:55	20 06:58 (T-48)
4	08:04		07:43	07:00	07:04	20:32
	16:59		17:39	18:16	19:56	22 06:58 (T-48)
5	08:04	08:28 (T-51)	07:42	06:59	07:02	06:14
	17:00	1 08:29 (T-51)	17:40	18:18	19:57	24 06:59 (T-48)
6	08:04	08:28 (T-51)	07:41	06:57	07:00	20:33
	17:01	1 08:29 (T-51)	17:42	18:19	19:59	24 06:59 (T-48)
7	08:04	08:28 (T-51)	07:39	06:55	06:58	06:12
	17:03	2 08:30 (T-51)	17:43	18:20	20:00	20:35
8	08:04	08:28 (T-51)	07:38	07:53	06:56	25 06:59 (T-48)
	17:04	3 08:31 (T-51)	17:45	18:22	20:01	20:36
9	08:03	08:27 (T-51)	07:37	07:52	06:54	26 06:58 (T-48)
	17:05	4 08:31 (T-51)	17:46	19:23	20:02	27 06:58 (T-48)
10	08:03	08:27 (T-51)	07:35	07:50	06:53	28 06:58 (T-48)
	17:06	5 08:32 (T-51)	17:47	19:24	20:04	20:07
11	08:03	08:26 (T-51)	07:34	07:48	06:51	20:37
	17:07	5 08:31 (T-51)	17:49	19:26	20:05	27 06:58 (T-48)
12	08:02	08:26 (T-51)	07:33	07:46	06:49	20:37
	17:08	6 08:32 (T-51)	17:50	19:27	20:06	27 06:58 (T-48)
13	08:02	08:25 (T-51)	07:31	07:44	06:47	20:38
	17:09	7 08:32 (T-51)	17:52	19:28	20:07	28 06:58 (T-48)
14	08:01	08:25 (T-51)	07:30	07:42	06:46	20:38
	17:11	7 08:32 (T-51)	17:53	19:30	20:09	28 06:58 (T-48)
15	08:01	08:24 (T-51)	07:28	07:41	06:44	20:39
	17:12	8 08:32 (T-51)	17:55	19:31	20:10	29 06:57 (T-48)
16	08:00	08:24 (T-51)	07:27	07:39	06:42	20:40
	17:13	8 08:32 (T-51)	17:56	19:32	20:11	29 06:57 (T-48)
17	08:00	08:23 (T-51)	07:25	07:37	06:40	20:41
	17:14	9 08:32 (T-51)	17:57	19:33	20:12	30 06:57 (T-48)
18	07:59	08:22 (T-51)	07:24	07:35	06:39	20:42
	17:16	9 08:31 (T-51)	17:59	19:35	20:14	30 06:57 (T-48)
19	07:59	08:22 (T-51)	07:22	07:33	06:37	20:43
	17:17	8 08:30 (T-51)	18:00	19:36	20:15	31 06:57 (T-48)
20	07:58	08:25 (T-51)	07:21	07:31	06:35	20:44
	17:18	3 08:28 (T-51)	18:00	19:37	20:16	31 06:57 (T-48)
21	07:57		07:19	07:29	06:34	20:45
	17:20		18:01	19:38	20:17	31 06:57 (T-48)
22	07:56		07:17	07:28	06:32	20:46
	17:21		18:03	19:40	20:18	31 06:57 (T-48)
23	07:56		07:16	07:26	06:30	20:47
	17:22		18:04	19:41	20:20	31 06:57 (T-48)
24	07:55		07:14	07:24	06:29	20:48
	17:24		18:06	19:42	20:21	31 06:57 (T-48)
25	07:54		07:12	07:22	06:27	20:49
	17:25		18:07	19:44	20:22	3 06:48 (T-48)
26	07:53		07:11	07:20	06:26	20:50
	17:26		18:08	19:45	20:23	4 06:51 (T-48)
27	07:52		07:09	07:18	06:24	20:51
	17:28		18:10	19:46	20:25	20:32 (T-42)
28	07:51		07:07	07:16	06:22	20:52
	17:29		18:11	19:47	20:26	20:33 (T-42)
29	07:50			07:15	06:21	20:53
	17:30			19:49	20:27	20:34 (T-42)
30	07:49			07:13	06:19	20:54
	17:32			19:50	20:28	20:35 (T-42)
31	07:48			07:11		20:55
	17:33			19:51		20:36 (T-42)
Potential sun hours	287	292	369	403	459	465
Total, worst case	86			64	564	711
Sun reduction	0.58			0.63	0.66	0.73
Oper. time red.	0.90			0.90	0.90	0.90
Wind dir. red.	0.65			0.59	0.59	0.64
Total reduction	0.34			0.33	0.35	0.42
Total, real	29			21	199	301

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-314 - R-314
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December			
1	05:45	20:24 (T-43)	06:12	06:38 (T-48)	06:48	07:24	07:04	07:43	08:08 (T-51)
	21:16	24 20:48 (T-42)	20:55	30 07:08 (T-48)	20:07	19:11	17:17	16:48	5 08:13 (T-51)
2	05:45	20:25 (T-43)	06:13	06:38 (T-48)	06:50	07:25	07:05	07:44	08:10 (T-51)
	21:16	24 20:49 (T-42)	20:53	30 07:08 (T-48)	20:05	19:09	17:15	16:48	5 08:15 (T-51)
3	05:46	20:25 (T-43)	06:15	06:38 (T-48)	06:51	07:26	07:06	07:45	08:11 (T-51)
	21:16	23 20:48 (T-42)	20:52	30 07:08 (T-48)	20:03	19:07	17:14	16:47	4 08:15 (T-51)
4	05:47	20:26 (T-43)	06:16	06:39 (T-48)	06:52	07:28	07:08	07:46	08:12 (T-51)
	21:16	22 20:48 (T-42)	20:51	29 07:08 (T-48)	20:01	19:05	17:12	16:47	3 08:15 (T-51)
5	05:47	20:27 (T-43)	06:17	06:40 (T-48)	06:53	07:29	07:09	07:47	08:13 (T-51)
	21:15	21 20:48 (T-42)	20:50	28 07:08 (T-48)	19:59	19:03	17:11	16:47	2 08:15 (T-51)
6	05:48	20:27 (T-43)	06:18	06:41 (T-48)	06:54	07:30	07:11	07:48	08:14 (T-51)
	21:15	20 20:47 (T-42)	20:48	27 07:08 (T-48)	19:58	19:01	17:10	16:47	2 08:16 (T-51)
7	05:49	20:27 (T-43)	06:19	06:42 (T-48)	06:55	07:31	07:12	07:49	08:15 (T-51)
	21:15	20 20:47 (T-42)	20:47	26 07:08 (T-48)	19:56	19:00	17:09	16:47	1 08:16 (T-51)
8	05:49	20:28 (T-43)	06:20	06:43 (T-48)	06:57	07:32	07:13	07:50	
	21:14	19 20:47 (T-42)	20:45	25 07:08 (T-48)	19:54	18:56	17:07	16:46	
9	05:50	20:28 (T-43)	06:21	06:44 (T-48)	06:58	07:34	07:15	07:51	
	21:14	18 20:46 (T-42)	20:44	23 07:07 (T-48)	19:52	18:54	17:06	16:46	
10	05:51	20:29 (T-43)	06:23	06:46 (T-48)	06:59	07:35	07:16	07:52	
	21:14	17 20:46 (T-42)	20:43	22 07:08 (T-48)	19:50	18:52	17:05	16:46	
11	05:52	20:30 (T-43)	06:24	06:47 (T-48)	07:00	07:36	07:17	07:53	
	21:13	16 20:46 (T-42)	20:41	20 07:07 (T-48)	19:48	18:51	17:04	16:46	
12	05:52	20:31 (T-43)	06:25	06:48 (T-48)	07:01	07:37	07:19	07:54	
	21:13	15 20:46 (T-42)	20:40	18 07:06 (T-48)	19:46	18:49	17:03	16:46	
13	05:53	20:31 (T-43)	06:26	06:49 (T-48)	07:02	07:39	07:20	07:55	
	21:12	13 20:44 (T-42)	20:38	16 07:05 (T-48)	19:44	18:47	17:02	16:46	
14	05:54	20:32 (T-43)	06:27	06:50 (T-48)	07:04	07:40	07:21	07:56	
	21:11	12 20:44 (T-42)	20:37	14 07:04 (T-48)	19:43	18:45	17:01	16:47	
15	05:55	20:33 (T-43)	06:28	06:51 (T-48)	07:05	07:41	07:23	07:57	
	21:11	10 20:43 (T-42)	20:35	12 07:03 (T-48)	19:41	18:44	17:00	16:47	
16	05:56	20:34 (T-43)	06:30	06:52 (T-48)	07:06	07:43	07:24	07:57	
	21:10	9 20:43 (T-42)	20:34	9 07:01 (T-48)	19:39	18:42	16:59	16:47	
17	05:57	20:36 (T-42)	06:31	06:53 (T-48)	07:07	07:44	07:25	07:58	
	21:09	6 20:42 (T-42)	20:32	6 06:59 (T-48)	19:37	18:40	16:58	16:47	
18	05:58	20:37 (T-42)	06:32	06:55 (T-48)	07:08	07:45	07:27	07:59	
	21:09	5 20:42 (T-42)	20:30	2 06:57 (T-48)	19:35	18:38	16:57	16:48	
19	05:59	20:37 (T-42)	06:33		07:10	07:46	07:28	07:59	
	21:08	4 20:41 (T-42)	20:29		19:33	18:37	16:56	16:48	
20	06:00	20:38 (T-42)	06:34		07:11	07:48	07:29	08:00	
	21:07	2 20:40 (T-42)	20:27		19:31	18:35	16:55	16:48	
21	06:01	20:39 (T-42)	06:35		07:12	07:49	07:31	08:00	
	21:06	1 20:40 (T-42)	20:26		19:29	18:33	16:54	16:49	
22	06:02	06:50 (T-48)	06:37		07:13	07:50	07:32	08:01	
	21:05	6 06:56 (T-48)	20:24		19:28	18:32	16:53	2 08:04 (T-51)	16:49
23	06:03	06:46 (T-48)	06:38		07:14	07:52	07:33	07:59 (T-51)	08:02
	21:04	12 06:58 (T-48)	20:22		19:26	18:30	16:53	8 08:07 (T-51)	16:50
24	06:04	06:44 (T-48)	06:39		07:15	07:53	07:35	07:59 (T-51)	08:02
	21:03	16 07:00 (T-48)	20:21		19:24	18:29	16:52	9 08:08 (T-51)	16:50
25	06:05	06:43 (T-48)	06:40		07:17	07:54	07:36	08:01 (T-51)	08:02
	21:02	18 07:01 (T-48)	20:19		19:22	18:27	16:51	9 08:10 (T-51)	16:51
26	06:06	06:42 (T-48)	06:41		07:18	07:56	07:37	08:02 (T-51)	08:03
	21:01	21 07:03 (T-48)	20:17		19:20	18:25	16:51	9 08:11 (T-51)	16:52
27	06:07	06:42 (T-48)	06:42		07:19	07:57	07:38	08:03 (T-51)	08:03
	21:00	23 07:05 (T-48)	20:15		19:18	18:24	16:50	8 08:11 (T-51)	16:52
28	06:08	06:41 (T-48)	06:44		07:20	07:58	07:39	08:05 (T-51)	08:03
	20:59	24 07:05 (T-48)	20:14		19:16	18:22	16:49	7 08:12 (T-51)	16:53
29	06:09	06:40 (T-48)	06:45		07:21	08:00	07:41	08:06 (T-51)	08:04
	20:58	26 07:06 (T-48)	20:12		19:14	18:21	16:49	7 08:13 (T-51)	16:54
30	06:10	06:40 (T-48)	06:46		07:23	08:01	07:42	08:07 (T-51)	08:04
	20:57	27 07:07 (T-48)	20:10		19:12	18:19	16:49	6 08:13 (T-51)	16:55
31	06:11	06:39 (T-48)	06:47			08:02		08:04	
	20:56	28 07:07 (T-48)	20:08			18:18		16:56	
Potential sun hours	471	436	377	341	289	275			
Total, worst case	502	367			65		22		
Sun reduction	0.75	0.72			0.48		0.52		
Oper. time red.	0.90	0.90			0.90		0.90		
Wind dir. red.	0.62	0.59			0.65		0.65		
Total reduction	0.42	0.38			0.28		0.30		
Total, real	210	139			18		7		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-320 - R-320
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	20:18 (T-38)	06:49	07:24	07:04	
1	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	11	20:29 (T-38)	20:07	19:11	
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	20:17 (T-38)	06:50	07:25	07:05	
2	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	10	20:27 (T-38)	20:05	19:09	
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	20:17 (T-38)	06:51	07:27	07:07	
3	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	9	20:26 (T-38)	20:03	19:07	
4	08:04	07:43	07:01	07:04	06:14	20:08 (T-38)	05:44	05:47	20:16 (T-38)	06:52	07:28	07:08	
4	17:00	17:39	18:17	19:56	20:34	2	20:10 (T-38)	21:07	21:16	20:51	9	20:25 (T-38)	20:01
5	08:04	07:42	06:59	07:02	06:13	20:07 (T-38)	05:43	05:48	06:17	20:16 (T-38)	06:53	07:29	07:09
5	17:01	17:41	18:19	19:58	20:35	4	20:11 (T-38)	21:07	21:16	20:50	7	20:23 (T-38)	20:00
6	08:04	07:41	06:57	07:00	06:11	20:07 (T-38)	05:43	05:48	06:18	20:16 (T-38)	06:55	07:30	07:11
6	17:02	17:42	18:19	19:59	20:36	6	20:13 (T-38)	21:08	21:15	20:48	6	20:22 (T-38)	19:58
7	08:04	07:40	06:55	06:58	06:10	20:06 (T-38)	05:43	05:49	06:19	20:17 (T-38)	06:56	07:31	07:12
7	17:03	17:44	18:21	20:00	20:37	7	20:14 (T-38)	21:09	21:15	20:47	5	20:22 (T-38)	19:56
8	08:04	07:38	07:54	06:57	06:08	20:06 (T-38)	05:42	05:50	06:21	20:17 (T-38)	06:57	07:33	07:14
8	17:04	17:45	18:22	20:01	20:38	8	20:14 (T-38)	21:09	21:15	20:46	3	20:20 (T-38)	19:54
9	08:04	07:37	07:52	06:55	06:07	20:07 (T-38)	05:42	05:50	06:22	20:18 (T-38)	06:58	07:34	07:15
9	17:05	17:46	19:23	20:03	20:40	9	20:16 (T-38)	21:10	21:14	20:44	1	20:19 (T-38)	19:52
10	08:03	07:36	07:50	06:53	06:06	20:07 (T-38)	05:42	05:51	06:23	20:19 (T-38)	06:59	07:35	07:16
10	17:06	17:48	19:25	20:04	20:41	10	20:17 (T-38)	21:11	21:14	20:43	19:50	18:53	17:05
11	08:03	07:34	07:48	06:51	06:05	20:07 (T-38)	05:41	05:52	06:24	07:00	07:36	07:18	07:53
11	17:07	17:49	19:26	20:05	20:42	10	20:17 (T-38)	21:11	21:13	20:41	19:49	18:51	17:04
12	08:03	07:33	07:46	06:49	06:03	20:07 (T-38)	05:41	05:53	06:25	07:02	07:38	07:19	07:54
12	17:08	17:51	19:27	20:06	20:43	11	20:18 (T-38)	21:12	21:13	20:40	19:47	18:49	17:03
13	08:02	07:31	07:45	06:48	06:02	20:08 (T-38)	05:41	05:54	06:26	07:03	07:39	07:20	07:55
13	17:10	17:52	19:29	20:08	20:44	12	20:20 (T-38)	21:13	21:12	20:38	19:45	18:47	17:02
14	08:02	07:30	07:43	06:46	06:01	20:09 (T-38)	05:41	05:54	06:28	07:04	07:40	07:22	07:56
14	17:11	17:53	19:30	20:09	20:45	12	20:21 (T-38)	21:13	21:12	20:37	19:43	18:46	17:01
15	08:01	07:28	07:41	06:44	06:00	20:11 (T-38)	05:41	05:55	06:29	07:05	07:42	07:23	07:57
15	17:12	17:55	19:31	20:10	20:47	9	20:20 (T-38)	21:14	21:11	20:35	19:41	18:44	17:00
16	08:01	07:27	07:39	06:42	05:59	20:13 (T-38)	05:41	05:56	06:30	07:06	07:43	07:24	07:58
16	17:13	17:56	19:32	20:11	20:48	5	20:18 (T-38)	21:14	21:10	20:34	19:39	18:42	16:59
17	08:00	07:25	07:37	06:41	05:58	20:14 (T-38)	05:41	05:57	06:31	07:07	07:44	07:26	07:58
17	17:15	17:58	19:34	20:13	20:49	21:14	21:10	20:32	19:37	18:40	16:58	16:48	
18	07:59	07:24	07:35	06:39	19:49 (T-37)	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
18	17:16	17:59	19:35	20:14	2	19:51 (T-37)	20:50	21:15	21:09	20:31	19:35	18:39	16:57
19	07:59	07:22	07:33	06:37	19:49 (T-37)	05:56	05:41	05:59	06:33	19:58 (T-37)	07:10	07:47	07:28
19	17:17	18:00	19:36	20:15	4	19:53 (T-37)	20:51	21:15	21:08	20:29	6	20:04 (T-37)	19:33
20	07:58	07:21	07:32	06:36	19:49 (T-37)	05:55	05:41	06:00	06:35	19:56 (T-37)	07:11	07:48	07:30
20	17:19	18:00	19:38	20:16	4	19:53 (T-37)	20:52	21:15	21:07	20:27	6	20:02 (T-37)	19:32
21	07:57	07:19	07:30	06:34	19:50 (T-37)	05:54	05:42	06:01	06:36	19:54 (T-37)	07:12	07:49	07:31
21	17:20	18:02	19:39	20:17	5	19:55 (T-37)	20:53	21:16	21:06	20:26	7	20:01 (T-37)	19:30
22	07:57	07:18	07:28	06:32	19:50 (T-37)	05:53	05:42	06:02	06:37	19:53 (T-37)	07:13	07:51	07:32
22	17:21	18:03	19:40	20:19	6	19:56 (T-37)	20:54	21:16	21:05	20:24	6	19:59 (T-37)	19:28
23	07:56	07:16	07:26	06:31	19:50 (T-37)	05:52	05:42	06:03	06:38	19:53 (T-37)	07:15	07:52	07:33
23	17:23	18:05	19:41	20:20	7	19:57 (T-37)	20:55	21:16	21:05	20:22	4	19:57 (T-37)	19:26
24	07:55	07:14	07:24	06:29	19:53 (T-37)	05:51	05:42	06:04	06:39	19:53 (T-37)	07:16	07:53	07:35
24	17:24	18:06	19:43	20:21	5	19:58 (T-37)	20:56	21:16	21:04	20:21	3	19:56 (T-37)	19:24
25	07:54	07:13	07:22	06:27	05:50	05:43	06:05	06:40	06:40	19:53 (T-37)	07:17	07:55	07:36
25	17:25	18:07	19:44	20:22	20:57	21:16	21:03	20:19	21:03	20:19	1	19:54 (T-37)	19:22
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	06:42	06:42	07:18	07:56	07:37
26	17:27	18:09	19:45	20:24	20:58	21:17	21:02	20:17	20:17	20:17	19:20	18:26	16:51
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	06:43	06:43	07:19	07:57	07:38
27	17:28	18:10	19:46	20:25	20:59	21:17	21:01	20:16	20:16	20:16	19:18	18:24	16:50
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	06:44	06:44	07:21	07:59	07:40
28	17:29	18:11	19:48	20:26	21:00	21:17	20:59	8	20:30 (T-38)	20:14	19:16	18:23	16:50
29	07:50	07:15	06:21	05:47	05:47	05:44	06:09	06:45	06:45	06:45	07:22	08:00	07:41
29	17:31	19:49	20:27	20:57	21:01	21:17	20:58	11	20:32 (T-38)	20:12	19:15	18:21	16:49
30	07:49	07:13	06:20	05:46	05:46	05:45	06:10	06:46	06:46	06:46	07:23	08:01	07:42
30	17:32	19:50	20:29	20:59	21:02	21:17	20:57	12	20:31 (T-38)	20:10	19:13	18:20	16:49
31	07:48	07:11	06:18	05:46	05:46	06:11	06:11	06:47	06:47	06:47	08:03	08:03	08:04
31	17:34	19:51	20:30	21:03	21:03	20:56	11	20:30 (T-38)	20:09	20:09	18:18	18:18	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	
Total, worst case				33	105			94					
Sun reduction				0.63	0.66			0.72					
Oper. time red.				0.90	0.90			0.90					
Wind dir. red.				0.60	0.63			0.62					
Total reduction				0.34	0.37			0.40					
Total, real				11	39			18					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L085 73 GE3.8-154 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-321 - R-321 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with columns for months (January to December) and rows for specific times (08:00 to 17:34). Includes summary rows for 'Potential sun hours', 'Total, worst case', 'Sun reduction', 'Oper. time red.', 'Wind dir. red.', 'Total reduction', and 'Total, real'.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-322 - R-322

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:11 (T-54)	07:24	07:45 (T-H)	07:04	07:43		
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	5	07:16 (T-54)	19:11	10	07:55 (T-H)	17:17	16:49
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:12 (T-54)	07:25	07:46 (T-H)	07:05	07:44		
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	4	07:16 (T-54)	19:09	9	07:55 (T-H)	17:16	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:13 (T-54)	07:27	07:48 (T-H)	07:07	07:45		
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	3	07:16 (T-54)	19:07	8	07:56 (T-H)	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:14 (T-54)	07:28	07:49 (T-H)	07:08	07:46		
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	1	07:15 (T-54)	19:05	6	07:55 (T-H)	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	07:29	07:29	07:29	07:50 (T-H)	07:09	07:48		
	17:01	17:41	18:18	19:58	20:35	21:07	21:15	20:50	20:00		19:03	4	07:54 (T-H)	17:11	16:47	
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:30	07:51 (T-H)	07:11	07:49		
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58		19:02	2	07:53 (T-H)	17:10	16:47	
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:31	07:52 (T-H)	07:12	07:50		
	17:03	17:44	18:21	19:59	20:37	21:09	21:15	20:47	19:56		19:00		17:09	16:47		
8	08:04	07:38	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:33	07:53 (T-H)	07:13	07:51		
	17:04	17:45	18:22	3	08:14 (T-H)	20:01	1	07:18 (T-54)	20:38	21:09	21:14	20:46	19:54	17:08	16:47	
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:34	07:54 (T-H)	07:15	07:52		
	17:05	17:46	19:23	5	08:17 (T-H)	20:02	3	07:18 (T-54)	20:39	21:10	21:14	20:44	19:52	17:06	16:47	
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:35	07:55 (T-H)	07:16	07:52		
	17:06	17:48	19:25	7	08:17 (T-H)	20:04	4	07:17 (T-54)	20:41	21:11	21:14	20:43	18:53	17:05	16:47	
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:36	07:36	07:56 (T-H)	07:17	07:53		
	17:07	17:49	19:26	8	08:17 (T-H)	20:05	5	07:16 (T-54)	20:42	21:11	21:13	20:41	19:48	17:04	16:47	
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:38	07:58 (T-H)	07:19	07:54		
	17:09	17:51	19:27	9	08:16 (T-H)	20:06	5	07:15 (T-54)	20:43	21:12	21:13	20:40	19:47	17:03	16:47	
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:39	07:59 (T-H)	07:20	07:55		
	17:10	17:52	19:29	10	08:15 (T-H)	20:07	5	07:13 (T-54)	20:44	21:12	21:12	20:38	19:45	17:02	16:47	
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:40	07:60 (T-H)	07:22	07:56		
	17:11	17:53	19:30	11	08:14 (T-H)	20:09	3	07:09 (T-54)	20:45	21:13	21:11	20:37	19:43	17:01	16:47	
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:41	07:61 (T-H)	07:23	07:57		
	17:12	17:55	19:31	10	08:11 (T-H)	20:10	20:46	21:13	21:11	20:35	20:35	19:41	18:44	17:00	16:47	
16	08:00	07:27	07:39	06:42	06:03	05:41	05:56	06:30	07:06	07:42	07:42	07:62 (T-H)	07:24	07:57		
	17:13	17:56	19:32	3	08:02 (T-J)	20:11	20:48	21:14	21:10	20:34	20:34	19:39	18:42	16:59	16:47	
17	08:00	07:25	07:37	06:41	06:02	05:41	05:57	06:31	07:07	07:44	07:44	07:64 (T-H)	07:26	07:58		
	17:15	17:58	19:34	3	08:00 (T-J)	20:12	20:49	21:14	21:09	20:32	20:32	19:37	18:40	16:58	16:48	
18	07:59	07:24	07:35	06:39	06:04	05:41	05:58	06:32	07:09	07:45	07:45	07:65 (T-H)	07:27	07:59		
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	18:39	16:57	16:48			
19	07:59	07:22	07:33	06:37	06:05	05:41	05:59	06:33	07:10	07:47	07:47	07:67 (T-H)	07:28	07:59		
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	18:37	16:56	16:48			
20	07:58	07:21	07:32	06:36	06:06	05:41	06:00	06:35	07:11	07:48	07:48	07:68 (T-H)	07:29	08:00		
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:32	18:35	18:35	16:55	16:49			
21	07:57	07:19	07:30	06:34	06:04	05:42	06:01	06:36	07:12	07:49	07:49	07:69 (T-H)	07:31	08:01		
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	18:34	16:54	16:49			
22	07:56	07:18	07:28	06:32	06:03	05:42	06:02	06:37	07:13	07:51	07:51	07:71 (T-H)	07:32	08:01		
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	18:32	16:54	16:50			
23	07:56	07:16	07:26	06:31	06:03	05:42	06:03	06:38	07:14	07:52	07:52	07:72 (T-H)	07:33	08:02		
	17:23	18:05	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	18:30	16:53	16:50			
24	07:55	07:14	07:24	06:29	06:04	05:42	06:04	06:39	07:16	07:53	07:53	07:73 (T-H)	07:35	08:02		
	17:24	18:06	19:43	20:21	20:56	21:16	21:03	20:21	19:24	18:29	18:29	16:52	16:51			
25	07:54	07:13	07:22	06:28	06:05	05:43	06:05	06:40	07:17	07:55	07:55	07:75 (T-H)	07:36	08:02		
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	18:27	16:52	16:51			
26	07:53	07:11	07:20	06:26	06:06	05:43	06:06	06:42	07:18	07:56	07:56	07:76 (T-H)	07:37	08:03		
	17:27	18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	2	07:41 (T-J)	18:26	16:51	16:52		
27	07:52	07:09	07:19	06:24	06:07	05:43	06:07	06:43	07:19	07:57	07:57	07:77 (T-H)	07:38	08:03		
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:16	19:18	3	07:43 (T-J)	18:24	16:50	16:53		
28	07:51	07:08	07:17	06:23	06:08	05:44	06:08	06:44	07:20	07:58	07:58	07:78 (T-H)	07:40	08:03		
	17:29	18:11	19:48	20:26	21:00	21:16	20:59	20:14	19:16	10	07:52 (T-H)	18:23	16:50	16:54		
29	07:50	07:15	07:24	06:21	06:09	05:44	06:09	06:45	07:22	07:60	07:60	07:80 (T-H)	07:41	08:04		
	17:31	18:13	19:50	20:27	21:01	21:16	20:58	20:12	4	07:07 (T-54)	19:15	11	07:54 (T-54)	18:21	16:49	
30	07:49	07:13	07:22	06:20	06:10	05:45	06:10	06:46	07:23	07:61	07:61	07:81 (T-H)	07:42	08:04		
	17:32	18:15	19:52	20:29	21:02	21:16	20:57	20:10	5	07:13 (T-54)	19:13	10	07:54 (T-H)	18:20	16:49	
31	07:48	07:11	07:20	06:18	06:12	05:46	06:17	06:53	07:29	07:67	07:67	07:87 (T-H)	07:43	08:04		
	17:34	18:17	19:54	20:31	21:03	21:17	20:56	20:09	5	07:14 (T-54)			18:18	16:56		
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275				
Total, worst case				70	26			14	49		39					
Sun reduction				0.59	0.63			0.72	0.67		0.56					
Oper. time red.				0.90	0.90			0.90	0.90		0.90					
Wind dir. red.				0.60	0.57			0.57	0.59		0.60					
Total reduction				0.32	0.32			0.37	0.36		0.30					
Total, real				22	8			5	17		12					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-323 - R-323

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June						
1	08:04	07:46	07:05	07:09	19:15 (T-76)	06:18	05:45	20:09 (T-71)				
	16:57	17:35	18:12	19:52	16	19:31 (T-76)	20:29	21:03	27	20:36 (T-71)		
2	08:04	07:45	07:04	07:07	19:15 (T-76)	06:16	05:44	20:10 (T-71)				
	16:57	17:36	18:14	19:53	17	19:32 (T-76)	20:30	21:04	26	20:36 (T-71)		
3	08:04	07:44	07:02	07:05	19:15 (T-76)	06:15	05:44	20:10 (T-71)				
	16:58	17:37	18:15	19:54	18	19:33 (T-76)	20:32	21:05	25	20:35 (T-71)		
4	08:04	07:43	07:00	07:03	19:15 (T-76)	06:13	05:43	20:11 (T-71)				
	16:59	17:39	18:16	19:56	19	19:34 (T-76)	20:33	21:06	25	20:36 (T-71)		
5	08:03	07:41	06:58	07:01	19:17 (T-76)	06:12	05:43	20:12 (T-71)				
	17:00	17:40	18:18	19:57	17	19:34 (T-76)	20:34	21:07	24	20:36 (T-71)		
6	08:03	07:40	06:57	07:00	19:18 (T-76)	06:11	05:43	20:12 (T-71)				
	17:01	17:42	18:19	19:58	14	19:32 (T-76)	20:35	21:07	23	20:35 (T-71)		
7	08:03	07:39	06:55	06:58	19:20 (T-76)	06:09	05:42	20:13 (T-71)				
	17:02	17:43	18:20	19:59	8	19:28 (T-76)	20:36	21:08	22	20:35 (T-71)		
8	08:03	07:38	07:53	06:56	06:08		05:42	20:14 (T-71)				
	17:04	17:44	18:21	20:01	20:38		21:09	21	20:35 (T-71)			
9	08:03	07:36	07:51	06:54	06:07		05:42	20:13 (T-71)				
	17:05	17:46	19:23	20:02	20:39		21:09	21	20:34 (T-71)			
10	08:02	07:35	07:49	06:52	06:05		05:41	20:14 (T-71)				
	17:06	17:47	19:24	20:03	20:40	2	20:16 (T-71)	21:10	20	20:34 (T-71)		
11	08:02	07:34	07:48	06:51	06:04		05:41	20:15 (T-71)				
	17:07	17:49	19:25	20:04	20:41	5	20:17 (T-71)	21:11	19	20:34 (T-71)		
12	08:02	07:32	07:46	06:49	06:03		05:41	20:15 (T-71)				
	17:08	17:50	19:27	20:06	20:42	7	20:18 (T-71)	21:11	19	20:34 (T-71)		
13	08:01	07:31	07:44	06:47	06:02		05:41	20:16 (T-71)				
	17:09	17:52	19:28	20:07	20:44	8	20:19 (T-71)	21:12	18	20:34 (T-71)		
14	08:01	07:29	07:42	06:45	06:01		05:41	20:16 (T-71)				
	17:10	17:53	19:29	20:08	20:45	11	20:21 (T-71)	21:12	18	20:34 (T-71)		
15	08:00	07:28	07:40	06:44	05:59		05:41	20:17 (T-71)				
	17:12	17:54	19:31	20:09	20:46	13	20:21 (T-71)	21:13	17	20:34 (T-71)		
16	08:00	07:26	07:38	06:42	05:58		05:41	20:17 (T-71)				
	17:13	17:56	19:32	20:11	20:47	14	20:22 (T-71)	21:13	17	20:34 (T-71)		
17	07:59	07:25	07:37	06:40	05:57		05:41	20:18 (T-71)				
	17:14	17:57	19:33	20:12	20:48	16	20:23 (T-71)	21:14	16	20:34 (T-71)		
18	07:59	07:23	07:35	06:39	05:56		05:41	20:18 (T-71)				
	17:15	17:59	19:34	20:13	20:49	17	20:24 (T-71)	21:14	16	20:34 (T-71)		
19	07:58	07:22	07:33	06:37	05:55		05:41	20:18 (T-71)				
	17:17	18:00	19:36	20:14	20:50	18	20:26 (T-71)	21:14	16	20:34 (T-71)		
20	07:57	07:20	07:31	06:35	05:54		05:41	20:18 (T-71)				
	17:18	18:00	19:37	20:16	20:51	19	20:27 (T-71)	21:15	16	20:34 (T-71)		
21	07:57	07:19	17:37 (T-75)	07:29	05:53		05:41	20:18 (T-71)				
	17:19	18:01	2	17:39 (T-75)	20:17	21	20:28 (T-71)	21:15	16	20:34 (T-71)		
22	07:56	07:17	17:38 (T-75)	07:27	05:52		05:41	20:19 (T-71)				
	17:21	18:03	3	17:41 (T-75)	20:18	21	20:28 (T-71)	21:15	16	20:35 (T-71)		
23	07:55	07:15	17:38 (T-75)	07:25	05:51		05:42	20:19 (T-71)				
	17:22	18:04	4	17:42 (T-75)	20:19	22	20:29 (T-71)	21:15	16	20:35 (T-71)		
24	07:54	07:14	17:38 (T-75)	07:24	05:51		05:42	20:19 (T-71)				
	17:23	18:05	5	17:43 (T-75)	20:21	23	20:30 (T-71)	21:16	16	20:35 (T-71)		
25	07:53	07:12	17:40 (T-75)	07:22	05:50		05:42	20:20 (T-71)				
	17:25	18:07	5	17:45 (T-75)	20:22	24	20:32 (T-71)	21:16	16	20:36 (T-71)		
26	07:52	07:10	17:42 (T-75)	07:20	05:49		05:43	20:20 (T-71)				
	17:26	18:08	4	17:46 (T-75)	20:23	24	20:32 (T-71)	21:16	16	20:36 (T-71)		
27	07:51	07:09	07:18	19:18 (T-76)	05:48		05:43	20:19 (T-71)				
	17:28	18:09	6	19:24 (T-76)	20:24	25	20:33 (T-71)	21:16	17	20:36 (T-71)		
28	07:50	07:07	07:16	19:17 (T-76)	05:47		05:43	20:20 (T-71)				
	17:29	18:11	8	19:25 (T-76)	20:25	25	20:33 (T-71)	21:16	17	20:37 (T-71)		
29	07:49		07:14	19:16 (T-76)	05:47		05:44	20:19 (T-71)				
	17:30		19:48	10	19:26 (T-76)	20:27	21:01	26	20:35 (T-71)	21:16	18	20:37 (T-71)
30	07:48		07:12	19:16 (T-76)	05:46		05:44	20:20 (T-71)				
	17:32		19:49	12	19:28 (T-76)	20:28	21:01	26	20:35 (T-71)	21:16	18	20:38 (T-71)
31	07:47		07:11	19:15 (T-76)	05:45		05:45	20:09 (T-71)				
	17:33		19:51	14	19:29 (T-76)	21:02	27	20:36 (T-71)				
Potential sun hours	287	292	369	403	458		465	572				
Total, worst case								572				
Sun reduction		23	53	109	394			73				
Oper. time red.		0.58	0.59	0.63	0.66			0.90				
Wind dir. red.		0.90	0.90	0.90	0.90			0.64				
Total reduction		0.58	0.59	0.59	0.64			0.42				
Total, real		0.30	0.32	0.34	0.38			239				
		7	17	37	149							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-323 - R-323
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July			August			September			October			November			December		
1	05:45		20:19 (T-71)	06:12		20:22 (T-71)	06:48			07:24			07:03			07:42		
	21:16	19	20:38 (T-71)	20:54	6	20:28 (T-71)	20:06			19:10			17:16			16:48		
2	05:45		20:19 (T-71)	06:13		20:24 (T-71)	06:49			07:25			07:05			07:44		
	21:16	20	20:39 (T-71)	20:53	3	20:27 (T-71)	20:04			19:08			17:15			16:48		
3	05:46		20:19 (T-71)	06:14		20:25 (T-71)	06:50			07:26			07:06			07:45		
	21:15	20	20:39 (T-71)	20:52	1	20:26 (T-71)	20:03			19:07			17:14			16:47		
4	05:46		20:19 (T-71)	06:16			06:52			07:27			07:07			07:46		
	21:15	21	20:40 (T-71)	20:50			20:01			19:05			17:12			16:47		
5	05:47		20:18 (T-71)	06:17			06:53	19:17 (T-76)		07:28			07:09			07:47		
	21:15	22	20:40 (T-71)	20:49			19:59	7 19:24 (T-76)		19:03			17:11			16:47		
6	05:48		20:18 (T-71)	06:18			06:54	19:14 (T-76)		07:30			07:10			07:48		
	21:15	23	20:41 (T-71)	20:48			19:57	14 19:28 (T-76)		19:01			17:10			16:47		
7	05:48		20:18 (T-71)	06:19			06:55	19:12 (T-76)		07:31			07:11			07:49		
	21:14	24	20:42 (T-71)	20:46			19:55	17 19:29 (T-76)		18:57			17:08			16:46		
8	05:49		20:19 (T-71)	06:20			06:56	19:10 (T-76)		07:32			07:13			07:50		
	21:14	24	20:43 (T-71)	20:45			19:53	19 19:29 (T-76)		18:56			17:07			16:46		
9	05:50		20:18 (T-71)	06:21			06:57	19:09 (T-76)		07:33			07:14			07:51		
	21:13	25	20:43 (T-71)	20:44			19:52	18 19:27 (T-76)		18:54			17:06			16:46		
10	05:51		20:18 (T-71)	06:22			06:59	19:08 (T-76)		07:35			07:16			07:52		
	21:13	25	20:43 (T-71)	20:42			19:50	17 19:25 (T-76)		18:52			17:05			16:46		
11	05:51		20:18 (T-71)	06:24			07:00	19:07 (T-76)		07:36			07:17			07:53		
	21:12	26	20:44 (T-71)	20:41			19:48	16 19:23 (T-76)		18:50			17:04			16:46		
12	05:52		20:18 (T-71)	06:25			07:01	19:06 (T-76)		07:37			07:18			07:54		
	21:12	27	20:45 (T-71)	20:39			19:46	15 19:21 (T-76)		18:48			17:03			16:46		
13	05:53		20:17 (T-71)	06:26			07:02	19:06 (T-76)		07:38			07:20			07:54		
	21:11	27	20:44 (T-71)	20:38			19:44	13 19:19 (T-76)		18:47			17:01			16:46		
14	05:54		20:17 (T-71)	06:27			07:03	19:07 (T-76)		07:40			07:21			07:55		
	21:11	26	20:43 (T-71)	20:36			19:42	11 19:18 (T-76)		18:45			17:00			16:47		
15	05:55		20:17 (T-71)	06:28			07:05	19:07 (T-76)		07:41			07:22			07:56		
	21:10	26	20:43 (T-71)	20:35			19:40	9 19:16 (T-76)		18:43			16:59			16:47		
16	05:56		20:17 (T-71)	06:29			07:06	19:07 (T-76)		07:42			07:24			07:57		
	21:09	26	20:43 (T-71)	20:33			19:38	7 19:14 (T-76)		18:42	5 18:18 (T-75)		16:58			16:47		
17	05:57		20:17 (T-71)	06:31			07:07	19:08 (T-76)		07:43			18:11 (T-75)			07:57		
	21:09	25	20:42 (T-71)	20:32			19:37	4 19:12 (T-76)		18:40	5 18:16 (T-75)		16:57			16:47		
18	05:58		20:17 (T-71)	06:32			07:08	19:09 (T-76)		07:45			18:09 (T-75)			07:58		
	21:08	24	20:41 (T-71)	20:30			19:35	1 19:10 (T-76)		18:38	5 18:14 (T-75)		16:57			16:48		
19	05:59		20:17 (T-71)	06:33			07:09			07:46			18:09 (T-75)			07:59		
	21:07	24	20:41 (T-71)	20:28			19:33			18:36	4 18:13 (T-75)		16:56			16:48		
20	05:59		20:16 (T-71)	06:34			07:10			07:47			18:08 (T-75)			07:59		
	21:06	23	20:39 (T-71)	20:27			19:31			18:35	3 18:11 (T-75)		16:55			16:48		
21	06:00		20:17 (T-71)	06:35			07:12			07:49			18:08 (T-75)			08:00		
	21:06	21	20:38 (T-71)	20:25			19:29			18:33	1 18:09 (T-75)		16:54			16:49		
22	06:01		20:17 (T-71)	06:36			07:13			07:50			07:31			08:00		
	21:05	21	20:38 (T-71)	20:23			19:27			18:32			16:53			16:49		
23	06:02		20:17 (T-71)	06:38			07:14			07:51			07:33			08:01		
	21:04	20	20:37 (T-71)	20:22			19:25			18:30			16:52			16:50		
24	06:04		20:17 (T-71)	06:39			07:15			07:53			07:34			08:01		
	21:03	19	20:36 (T-71)	20:20			19:23			18:28			16:52			16:50		
25	06:05		20:17 (T-71)	06:40			07:16			07:54			07:35			08:02		
	21:02	18	20:35 (T-71)	20:18			19:22			18:27			16:51			16:51		
26	06:06		20:18 (T-71)	06:41			07:18			07:55			07:36			08:02		
	21:01	16	20:34 (T-71)	20:17			19:20			18:25			16:51			16:52		
27	06:07		20:18 (T-71)	06:42			07:19			07:57			07:38			08:02		
	21:00	15	20:33 (T-71)	20:15			19:18			18:24			16:50			16:52		
28	06:08		20:19 (T-71)	06:43			07:20			07:58			07:39			08:03		
	20:59	13	20:32 (T-71)	20:13			19:16			18:22			16:49			16:53		
29	06:09		20:19 (T-71)	06:45			07:21			07:59			07:40			08:03		
	20:58	12	20:31 (T-71)	20:11			19:14			18:21			16:49			16:54		
30	06:10		20:20 (T-71)	06:46			07:22			08:01			07:41			08:03		
	20:56	10	20:30 (T-71)	20:10			19:12			18:19			16:48			16:55		
31	06:11		20:21 (T-71)	06:47						08:02						08:03		
	20:55	9	20:30 (T-71)	20:08						18:18						16:55		
Potential sun hours	471			436			377			341			289			276		
Total, worst case	651			10			168			23								
Sun reduction	0.75			0.72			0.67			0.56								
Oper. time red.	0.90			0.90			0.90			0.90								
Wind dir. red.	0.64			0.64			0.59			0.58								
Total reduction	0.43			0.41			0.36			0.29								
Total, real	279			4			60			7								

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-324 - R-324
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-45)	07:47	07:06	07:09	06:18
	16:57	11 08:40 (T-45)	17:35	18:12	19:52	21:04
2	08:04	08:29 (T-45)	07:46	07:04	07:07	06:17
	16:58	12 08:41 (T-45)	17:36	18:14	19:54	21:05
3	08:04	08:29 (T-45)	07:44	07:02	07:05	06:15
	16:58	12 08:41 (T-45)	17:38	18:15	19:55	21:06
4	08:04	08:29 (T-45)	07:43	07:00	07:04	06:14
	16:59	13 08:42 (T-45)	17:39	18:16	19:56	21:06
5	08:04	08:28 (T-45)	07:42	06:59	07:02	06:12
	17:00	14 08:42 (T-45)	17:40	18:18	19:57	21:07
6	08:04	08:28 (T-45)	07:41	06:57	07:00	06:11
	17:01	15 08:43 (T-45)	17:42	18:19	19:59	21:08
7	08:04	08:28 (T-45)	07:39	06:55	06:58	06:09
	17:03	15 08:43 (T-45)	17:43	18:20	20:00	20:37
8	08:04	08:28 (T-45)	07:38	07:53	06:56	06:08
	17:04	16 08:44 (T-45)	17:45	18:22	20:01	20:38
9	08:03	08:27 (T-45)	07:37	07:52	06:55	06:07
	17:05	17 08:44 (T-45)	17:46	19:23	20:02	20:39
10	08:03	08:27 (T-45)	07:35	07:50	06:53	06:06
	17:06	18 08:45 (T-45)	17:48	19:24	20:04	20:41
11	08:03	08:26 (T-45)	07:34	07:48	06:51	06:04
	17:07	19 08:45 (T-45)	17:49	19:26	20:05	20:42
12	08:02	08:26 (T-45)	07:33	07:46	06:49	06:03
	17:08	20 08:46 (T-45)	17:50	19:27	20:06	20:43
13	08:02	08:26 (T-45)	07:31	07:44	06:47	06:02
	17:09	20 08:46 (T-45)	17:52	19:28	20:07	20:44
14	08:02	08:25 (T-45)	07:30	07:42	06:46	06:01
	17:11	21 08:46 (T-45)	17:53	19:30	20:09	20:45
15	08:01	08:24 (T-45)	07:28	07:41	06:44	06:00
	17:12	22 08:46 (T-45)	17:55	19:31	20:10	20:46
16	08:01	08:24 (T-45)	07:27	07:39	06:42	05:58
	17:13	23 08:47 (T-45)	17:56	19:32	20:11	20:48
17	08:00	08:23 (T-45)	07:25	07:37	06:40	05:57
	17:14	24 08:47 (T-45)	17:57	19:33	20:12	20:49
18	07:59	08:22 (T-45)	07:24	07:35	06:39	05:56
	17:16	24 08:46 (T-45)	17:59	19:35	20:14	20:50
19	07:59	08:24 (T-45)	07:22	07:33	06:37	05:55
	17:17	23 08:47 (T-45)	18:00	19:36	20:15	20:51
20	07:58	08:24 (T-45)	07:21	07:31	06:35	05:54
	17:18	23 08:47 (T-45)	18:00	19:37	20:16	20:52
21	07:57	08:25 (T-45)	07:19	07:30	06:34	05:53
	17:20	21 08:46 (T-45)	18:02	19:39	20:17	20:53
22	07:56	08:26 (T-45)	07:17	07:28	06:32	05:52
	17:21	19 08:45 (T-45)	18:03	19:40	20:19	20:54
23	07:56	08:27 (T-45)	07:16	07:26	06:30	05:51
	17:22	18 08:45 (T-45)	18:04	19:41	20:20	20:55
24	07:55	08:29 (T-45)	07:14	07:24	06:29	05:51
	17:24	14 08:43 (T-45)	18:06	19:42	20:21	20:56
25	07:54	08:31 (T-45)	07:12	07:22	06:27	05:50
	17:25	11 08:42 (T-45)	18:07	19:44	20:22	20:57
26	07:53	08:34 (T-45)	07:11	07:20	06:26	05:49
	17:26	5 08:39 (T-45)	18:08	19:45	20:24	20:58
27	07:52		07:09	07:18	06:24	05:48
	17:28		18:10	19:46	20:25	20:59
28	07:51		07:07	07:17	06:23	05:47
	17:29		18:11	19:47	20:26	21:00
29	07:50		07:15	06:21	06:21	05:47
	17:31		19:49	20:27	21:01	21:05
30	07:49		07:13	06:19	06:19	05:46
	17:32		19:50	20:28	21:02	21:06
31	07:48		07:11	06:17	06:17	05:46
	17:33		19:51	20:29	21:03	21:07
Potential sun hours	287	292	369	403	459	465
Total, worst case	450			75	149	735
Sun reduction	0.58			0.63	0.66	0.73
Oper. time red.	0.90			0.90	0.90	0.90
Wind dir. red.	0.65			0.60	0.62	0.64
Total reduction	0.34			0.34	0.37	0.42
Total, real	153			26	55	312

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-324 - R-324
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time														Sum		
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

July		August		September		October		November		December						
1	05:45	20:24 (T-18)	06:12	06:36 (T-21)	06:48	07:24	07:04	07:43	08:08 (T-45)							
2	05:45	20:25 (T-18)	06:13	06:37 (T-21)	06:50	07:25	07:05	07:44	08:10 (T-45)							
3	05:46	20:24 (T-18)	06:15	06:38 (T-21)	06:51	07:26	07:07	07:45	08:11 (T-45)							
4	05:47	20:25 (T-18)	06:16	06:39 (T-21)	06:52	07:28	07:08	07:46	08:12 (T-45)							
5	05:47	20:26 (T-18)	06:17	06:40 (T-21)	06:53	07:29	07:09	07:48	08:13 (T-45)							
6	05:48	20:26 (T-18)	06:18	06:41 (T-21)	06:54	07:30	07:11	07:49	08:14 (T-45)							
7	05:49	20:26 (T-18)	06:19	06:42 (T-21)	06:55	07:31	07:12	07:50	08:15 (T-45)							
8	05:49	20:27 (T-18)	06:20		06:57	07:33	07:13	07:51	08:16 (T-45)							
9	05:50	20:27 (T-18)	06:21		06:58	07:34	07:15	07:52	08:17 (T-45)							
10	05:51	20:28 (T-18)	06:23		06:59	07:35	07:16	07:52	08:18 (T-45)							
11	05:52	20:28 (T-18)	06:24		07:00	07:36	07:17	07:53	08:19 (T-45)							
12	05:52	20:29 (T-18)	06:25		07:01	07:38	07:19	07:54	08:20 (T-45)							
13	05:53	20:29 (T-18)	06:26		07:02	07:39	07:20	07:55	08:21 (T-45)							
14	05:54	20:30 (T-18)	06:27		07:04	07:40	07:22	07:56	08:22 (T-45)							
15	05:55	20:31 (T-18)	06:28		07:05	07:41	07:23	07:57	08:22 (T-45)							
16	05:56	20:32 (T-18)	06:30	19:58 (T-17)	07:06	07:43	07:24	07:57	08:23 (T-45)							
17	05:57	20:33 (T-18)	06:31	19:56 (T-17)	07:07	07:44	07:26	07:58	08:24 (T-45)							
18	05:58	20:35 (T-18)	06:32	19:55 (T-17)	07:08	07:45	07:27	07:59	08:24 (T-45)							
19	05:59	20:36 (T-18)	06:33	19:54 (T-17)	07:10	07:47	07:28	08:02 (T-45)	07:59	08:25 (T-45)						
20	06:00	20:38 (T-18)	06:34	19:53 (T-17)	07:11	07:48	07:29	08:01 (T-45)	08:00	08:25 (T-45)						
21	06:01	20:41 (T-18)	06:35	19:52 (T-17)	07:12	07:49	07:31	08:01 (T-45)	08:01	08:26 (T-45)						
22	06:02	20:42 (T-18)	06:37	19:52 (T-17)	07:13	07:50	07:32	08:00 (T-45)	08:01	08:26 (T-45)						
23	06:03	20:44 (T-18)	06:38	19:51 (T-17)	07:14	07:52	07:33	08:00 (T-45)	08:02	08:27 (T-45)						
24	06:04	20:46 (T-18)	06:39	19:50 (T-17)	07:15	07:53	07:35	08:00 (T-45)	08:02	08:27 (T-45)						
25	06:05	20:48 (T-18)	06:40	19:50 (T-17)	07:16	07:54	07:36	08:01 (T-45)	08:02	08:28 (T-45)						
26	06:06	20:50 (T-18)	06:41	19:50 (T-17)	07:17	07:55	07:37	08:02 (T-45)	08:03	08:28 (T-45)						
27	06:07	20:52 (T-18)	06:42	19:50 (T-17)	07:18	07:56	07:38	08:02 (T-45)	08:03	08:28 (T-45)						
28	06:08	20:54 (T-18)	06:43	19:50 (T-17)	07:19	07:57	07:38	08:03 (T-45)	08:03	08:28 (T-45)						
29	06:09	20:56 (T-18)	06:44	19:50 (T-17)	07:20	07:58	07:40	08:05 (T-45)	08:03	08:28 (T-45)						
30	06:10	20:58 (T-18)	06:45	19:50 (T-17)	07:22	08:00	07:41	08:06 (T-45)	08:04	08:29 (T-45)						
31	06:11	20:59 (T-18)	06:46	19:50 (T-17)	07:23	08:01	07:42	08:07 (T-45)	08:04	08:29 (T-45)						
Potential sun hours	471	436	377	341	288	275	336	0.52	0.90	0.65	0.31	103				
Total, worst case																
Sun reduction	0.75		0.72				0.48									
Oper. time red.	0.90		0.90				0.90									
Wind dir. red.	0.64		0.60				0.65									
Total reduction	0.43		0.39				0.28									
Total, real	160		39				82									

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-325 - R-325
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June										
1	08:04	07:46	07:05	17:32 (T-75)	07:09	06:18	05:45	19:47 (T-76)								
	16:57	17:35	18:12	13 17:45 (T-75)	19:52	20:29	21:03	50 20:37 (T-76)								
2	08:04	07:45	07:04	17:36 (T-75)	07:07	06:16	05:44	19:47 (T-76)								
	16:58	17:36	18:14	5 17:41 (T-75)	19:53	20:30	1 20:06 (T-69)	21:04	51 20:38 (T-76)							
3	08:04	07:44	07:02	07:05	06:15	05:44	05:44	19:47 (T-76)								
	16:58	17:37	18:15	19:54	20:32	3 20:08 (T-69)	21:05	51 20:38 (T-76)								
4	08:04	07:43	07:00	07:03	06:14	05:43	05:43	19:47 (T-76)								
	16:59	17:39	18:16	19:56	20:33	4 20:09 (T-69)	21:06	51 20:38 (T-76)								
5	08:04	07:42	06:58	07:02	06:12	05:43	05:43	19:48 (T-76)								
	17:00	17:40	18:18	19:57	20:34	6 20:10 (T-69)	21:07	51 20:39 (T-76)								
6	08:03	07:40	06:57	17:55 (T-74)	07:00	06:11	05:43	19:47 (T-76)								
	17:01	17:42	18:19	2 17:57 (T-74)	19:58	20:35	6 20:11 (T-76)	21:07	52 20:39 (T-76)							
7	08:03	07:39	06:55	17:54 (T-74)	06:58	06:09	05:42	19:48 (T-76)								
	17:02	17:43	18:20	4 17:58 (T-74)	19:59	20:36	10 20:13 (T-76)	21:08	51 20:39 (T-76)							
8	08:03	07:38	07:53	18:54 (T-74)	06:56	06:08	05:42	19:48 (T-76)								
	17:04	17:45	18:22	6 19:00 (T-74)	20:01	20:38	13 20:14 (T-76)	21:09	51 20:39 (T-76)							
9	08:03	07:36	07:51	18:55 (T-74)	06:54	06:07	05:42	19:48 (T-76)								
	17:05	17:46	19:23	7 19:02 (T-74)	20:02	20:39	16 20:14 (T-76)	21:09	51 20:39 (T-76)							
10	08:02	07:35	07:49	18:55 (T-74)	06:53	06:05	19:56 (T-76)	05:41	19:48 (T-76)							
	17:06	17:47	19:24	8 19:03 (T-74)	20:03	20:40	20 20:16 (T-76)	21:10	51 20:39 (T-76)							
11	08:02	07:34	07:48	18:57 (T-74)	06:51	06:04	19:55 (T-76)	05:41	19:49 (T-76)							
	17:07	17:49	19:25	7 19:04 (T-74)	20:04	20:41	22 20:17 (T-76)	21:11	50 20:39 (T-76)							
12	08:02	07:32	07:46	19:00 (T-74)	06:49	06:03	19:54 (T-76)	05:41	19:49 (T-76)							
	17:08	17:50	19:27	2 19:02 (T-74)	20:06	20:42	24 20:18 (T-76)	21:11	51 20:40 (T-76)							
13	08:01	07:31	07:44	06:47	06:02	19:53 (T-76)	05:41	19:49 (T-76)								
	17:09	17:52	19:28	20:07	20:44	26 20:19 (T-76)	21:12	51 20:40 (T-76)								
14	08:01	07:29	07:42	06:45	06:01	19:52 (T-76)	05:41	19:50 (T-76)								
	17:11	17:53	19:29	20:08	20:45	29 20:21 (T-76)	21:12	50 20:40 (T-76)								
15	08:00	07:28	07:40	06:44	05:59	19:51 (T-76)	05:41	19:50 (T-76)								
	17:12	17:54	19:31	20:09	20:46	31 20:22 (T-76)	21:13	50 20:40 (T-76)								
16	08:00	07:26	07:38	06:42	05:58	19:49 (T-76)	05:41	19:50 (T-76)								
	17:13	17:56	19:32	20:11	20:47	33 20:22 (T-76)	21:13	51 20:41 (T-76)								
17	07:59	07:25	17:32 (T-75)	07:37	06:40	05:57	19:49 (T-76)	05:41	19:50 (T-76)							
	17:14	17:57	1 17:33 (T-75)	19:33	20:12	20:48	34 20:23 (T-76)	21:14	51 20:41 (T-76)							
18	07:59	07:23	17:30 (T-75)	07:35	06:39	05:56	19:48 (T-76)	05:41	19:50 (T-76)							
	17:16	17:59	4 17:34 (T-75)	19:34	20:13	20:49	36 20:24 (T-76)	21:14	51 20:41 (T-76)							
19	07:58	07:22	17:30 (T-75)	07:33	06:37	05:55	19:49 (T-76)	05:41	19:50 (T-76)							
	17:17	18:00	6 17:36 (T-75)	19:36	20:14	20:50	37 20:26 (T-76)	21:14	51 20:41 (T-76)							
20	07:57	07:20	17:29 (T-75)	07:31	06:35	05:54	19:48 (T-76)	05:41	19:51 (T-76)							
	17:18	18:00	8 17:37 (T-75)	19:37	20:16	20:51	39 20:27 (T-76)	21:15	50 20:41 (T-76)							
21	07:57	07:19	17:28 (T-75)	07:29	06:34	05:53	19:48 (T-76)	05:41	19:51 (T-76)							
	17:19	18:01	11 17:39 (T-75)	19:38	20:17	20:53	40 20:28 (T-76)	21:15	50 20:41 (T-76)							
22	07:56	07:17	17:28 (T-75)	07:27	06:32	05:52	19:47 (T-76)	05:41	19:52 (T-76)							
	17:21	18:03	13 17:41 (T-75)	19:39	20:18	20:54	41 20:28 (T-76)	21:15	50 20:42 (T-76)							
23	07:55	07:15	17:28 (T-75)	07:25	06:30	05:51	19:47 (T-76)	05:42	19:51 (T-76)							
	17:22	18:04	14 17:42 (T-75)	19:41	20:19	20:55	42 20:29 (T-76)	21:15	51 20:42 (T-76)							
24	07:54	07:14	17:29 (T-75)	07:24	06:29	05:51	19:46 (T-76)	05:42	19:51 (T-76)							
	17:24	18:05	15 17:44 (T-75)	19:42	20:21	20:56	44 20:30 (T-76)	21:16	51 20:42 (T-76)							
25	07:53	07:12	17:28 (T-75)	07:22	06:27	05:50	19:47 (T-76)	05:42	19:52 (T-76)							
	17:25	18:07	17 17:45 (T-75)	19:43	20:22	20:57	45 20:32 (T-76)	21:16	51 20:43 (T-76)							
26	07:52	07:10	17:29 (T-75)	07:20	06:25	05:49	19:47 (T-76)	05:43	19:52 (T-76)							
	17:26	18:08	17 17:46 (T-75)	19:44	20:23	20:58	45 20:32 (T-76)	21:16	51 20:43 (T-76)							
27	07:51	07:09	17:29 (T-75)	07:18	06:24	05:48	19:46 (T-76)	05:43	19:52 (T-76)							
	17:28	18:10	18 17:47 (T-75)	19:46	20:24	20:59	47 20:33 (T-76)	21:16	51 20:43 (T-76)							
28	07:50	07:07	17:31 (T-75)	07:16	06:22	05:47	19:47 (T-76)	05:43	19:53 (T-76)							
	17:29	18:11	16 17:47 (T-75)	19:47	20:25	21:00	47 20:34 (T-76)	21:16	50 20:43 (T-76)							
29	07:49		07:14	19:48	06:21	05:47	19:47 (T-76)	05:44	19:52 (T-76)							
	17:30		19:48	20:27	21:01	48 20:35 (T-76)	21:16	51 20:43 (T-76)								
30	07:48		07:13	19:49	06:19	05:46	19:46 (T-76)	05:44	19:53 (T-76)							
	17:32		19:49	20:28	21:01	49 20:35 (T-76)	21:16	51 20:44 (T-76)								
31	07:47		07:11	19:51	05:45	19:47 (T-76)										
	17:33		19:51	21:02	50 20:37 (T-76)											
Potential sun hours	287	292	369	403	458	465	1523									
Total, worst case							888		1523							
Sun reduction		0.58		0.59			0.66		0.73							
Oper. time red.		0.90		0.90			0.90		0.90							
Wind dir. red.		0.59		0.57			0.63		0.63							
Total reduction		0.31		0.30			0.38		0.42							
Total, real		43		16			334		634							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-325 - R-325
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July		August		September		October		November		December	
1	05:45	19:53 (T-76)	06:12	20:05 (T-76)	06:48	07:24			07:03	07:42		
	21:16	51 20:44 (T-76)	20:54	23 20:28 (T-76)	20:06	19:10			17:16	16:48		
2	05:45	19:53 (T-76)	06:13	20:06 (T-76)	06:49	07:25			18:36 (T-74)	07:05	07:44	
	21:16	51 20:44 (T-76)	20:53	21 20:27 (T-76)	20:04	19:08	7	18:43 (T-74)	17:15	16:48		
3	05:46	19:53 (T-76)	06:14	20:07 (T-76)	06:51	07:26			18:34 (T-74)	07:06	07:45	
	21:15	51 20:44 (T-76)	20:52	19 20:26 (T-76)	20:03	19:07	7	18:41 (T-74)	17:14	16:47		
4	05:47	19:54 (T-76)	06:16	20:09 (T-76)	06:52	07:27			18:32 (T-74)	07:07	07:46	
	21:15	51 20:45 (T-76)	20:50	16 20:25 (T-76)	20:01	19:05	7	18:39 (T-74)	17:12	16:47		
5	05:47	19:54 (T-76)	06:17	20:11 (T-76)	06:53	07:28			18:32 (T-74)	07:09	07:47	
	21:15	51 20:45 (T-76)	20:49	12 20:23 (T-76)	19:59	19:03	6	18:38 (T-74)	17:11	16:47		
6	05:48	19:54 (T-76)	06:18	20:14 (T-76)	06:54	07:30			18:31 (T-74)	07:10	07:48	
	21:15	51 20:45 (T-76)	20:48	8 20:22 (T-76)	19:57	19:01	5	18:36 (T-74)	17:10	16:47		
7	05:49	19:54 (T-76)	06:19	20:14 (T-69)	06:55	07:31			18:30 (T-74)	07:11	07:49	
	21:14	51 20:45 (T-76)	20:46	6 20:20 (T-69)	19:55	18:57	4	18:34 (T-74)	17:08	16:47		
8	05:49	19:55 (T-76)	06:20	20:14 (T-69)	06:56	07:32			18:30 (T-74)	07:13	07:50	
	21:14	51 20:46 (T-76)	20:45	5 20:19 (T-69)	19:53	18:56	2	18:32 (T-74)	17:07	16:46		
9	05:50	19:54 (T-76)	06:21	20:14 (T-69)	06:58	07:33			18:30 (T-74)	07:14	07:51	
	21:13	51 20:45 (T-76)	20:44	4 20:18 (T-69)	19:52	18:54			17:06	16:46		
10	05:51	19:54 (T-76)	06:22	20:14 (T-69)	06:59	07:35			17:16	07:52		
	21:13	52 20:46 (T-76)	20:42	2 20:16 (T-69)	19:50	18:52			17:05	16:46		
11	05:52	19:55 (T-76)	06:24	20:15 (T-69)	07:00	07:36			17:17	07:53		
	21:13	50 20:45 (T-76)	20:41	1 20:16 (T-69)	19:48	18:50			17:04	16:46		
12	05:52	19:55 (T-76)	06:25		07:01	07:37			18:07 (T-75)	07:18	07:54	
	21:12	50 20:45 (T-76)	20:39		19:46	18:49	9	18:16 (T-75)	17:03	16:46		
13	05:53	19:55 (T-76)	06:26		07:02	07:38			18:05 (T-75)	07:20	07:54	
	21:11	49 20:44 (T-76)	20:38		19:44	18:47	14	18:19 (T-75)	17:02	16:46		
14	05:54	19:55 (T-76)	06:27		07:03	07:40			18:03 (T-75)	07:21	07:55	
	21:11	48 20:43 (T-76)	20:36		19:42	18:45	17	18:20 (T-75)	17:00	16:47		
15	05:55	19:55 (T-76)	06:28		07:05	07:41			18:01 (T-75)	07:22	07:56	
	21:10	48 20:43 (T-76)	20:35		19:40	18:43	18	18:19 (T-75)	16:59	16:47		
16	05:56	19:56 (T-76)	06:29		07:06	07:42			18:01 (T-75)	07:24	07:57	
	21:10	47 20:43 (T-76)	20:33		19:39	18:42	17	18:18 (T-75)	16:58	16:47		
17	05:57	19:56 (T-76)	06:31		07:07	07:43			18:00 (T-75)	07:25	07:57	
	21:09	46 20:42 (T-76)	20:32		19:37	18:40	16	18:16 (T-75)	16:57	16:47		
18	05:58	19:56 (T-76)	06:32		07:08	07:45			17:59 (T-75)	07:26	07:58	
	21:08	45 20:41 (T-76)	20:30		19:35	18:38	15	18:14 (T-75)	16:57	16:48		
19	05:59	19:57 (T-76)	06:33		07:09	07:46			17:59 (T-75)	07:28	07:59	
	21:07	44 20:41 (T-76)	20:28		19:33	18:37	14	18:13 (T-75)	16:56	16:48		
20	06:00	19:57 (T-76)	06:34		07:10	07:47			17:59 (T-75)	07:29	07:59	
	21:06	43 20:40 (T-76)	20:27		19:31	18:35	12	18:11 (T-75)	16:55	16:48		
21	06:01	19:57 (T-76)	06:35		07:12	07:49			18:00 (T-75)	07:30	08:00	
	21:06	41 20:38 (T-76)	20:25		19:29	18:33	10	18:10 (T-75)	16:54	16:49		
22	06:02	19:57 (T-76)	06:36		07:13	07:50			18:00 (T-75)	07:31	08:00	
	21:05	41 20:38 (T-76)	20:24		19:27	18:32	8	18:08 (T-75)	16:53	16:49		
23	06:03	19:57 (T-76)	06:38		07:14	07:51			18:00 (T-75)	07:33	08:01	
	21:04	40 20:37 (T-76)	20:22		19:25	18:30	5	18:05 (T-75)	16:53	16:50		
24	06:04	19:58 (T-76)	06:39		07:15	07:53			18:01 (T-75)	07:34	08:01	
	21:03	38 20:36 (T-76)	20:20		19:23	18:28	3	18:04 (T-75)	16:52	16:50		
25	06:05	19:58 (T-76)	06:40		07:16	07:54			17:35	08:02		
	21:02	37 20:35 (T-76)	20:18		19:22	18:27			16:51	16:51		
26	06:06	19:59 (T-76)	06:41		07:18	07:55			17:37	08:02		
	21:01	35 20:34 (T-76)	20:17		19:20	18:25			16:51	16:52		
27	06:07	20:00 (T-76)	06:42		07:19	07:57			17:38	08:02		
	21:00	33 20:33 (T-76)	20:15		19:18	18:24			16:50	16:52		
28	06:08	20:00 (T-76)	06:43		07:20	07:58			17:39	08:03		
	20:59	32 20:32 (T-76)	20:13		19:16	18:22			16:49	16:53		
29	06:09	20:01 (T-76)	06:45		07:21	07:59			17:40	08:03		
	20:58	30 20:31 (T-76)	20:12		19:14	18:21			16:49	16:54		
30	06:10	20:03 (T-76)	06:46		07:22	08:01			17:41	08:03		
	20:56	28 20:31 (T-76)	20:10		19:12	18:19			16:48	16:55		
31	06:11	20:04 (T-76)	06:47			08:02				08:03		
	20:55	26 20:30 (T-76)	20:08			18:18				16:55		
Potential sun hours	471		436		377	341		289		276		
Total, worst case	1362		117			196						
Sun reduction	0.75		0.72			0.56						
Oper. time red.	0.90		0.90			0.90						
Wind dir. red.	0.63		0.63			0.58						
Total reduction	0.43		0.41			0.29						
Total, real	583		48			57						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-326 - R-326
Assumptions for shadow calculations Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time		Operational time												Sum			
		N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
		561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	7,884
		January February March April May June July August September October November December															
1	08:04																
1	16:57																
2	08:04																
1	16:58																
3	08:04																
1	16:59																
4	08:04																
1	17:00																
5	08:04																
1	17:01																
6	08:04																
1	17:02																
7	08:04																
1	17:03																
8	08:04																
1	17:04																
9	08:03																
1	17:05																
10	08:03																
1	17:06																
11	08:03																
1	17:07																
12	08:02																
1	17:08																
13	08:02																
1	17:09																
14	08:02																
1	17:11																
15	08:01																
1	17:12																
16	08:01																
1	17:13																
17	08:00																
1	17:14																
18	07:59																
1	17:16																
19	07:59																
1	17:17																
20	07:58																
1	17:18																
21	07:57																
1	17:20																
22	07:56																
1	17:21																
23	07:56																
1	17:22																
24	07:55																
1	17:24																
25	07:54																
1	17:25																
26	07:53																
1	17:26																
27	07:52																
1	17:28																
28	07:51																
1	17:29																
29	07:50																
1	17:31																
30	07:49																
1	17:32																
31	07:48																
1	17:33																
Potential sun hours		287	292	369	403	459	465	471	436	377	341	289	766	275	359	109	
Total, worst case		851	157										60				
Sun reduction		0.58	0.58										0.56	0.48			0.52
Oper. time red.		0.90	0.90										0.90	0.90			0.90
Wind dir. red.		0.65	0.64										0.61	0.65			0.65
Total reduction		0.34	0.33										0.31	0.28			0.30
Total, real		288	52										19	215			109

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-327 - R-327
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

January			February			March			April			May			June			July			August			September			October			November			December		
1	08:05 16:57	07:47 17:35	07:06 18:13				07:10 19:53		07:30 (T-33) 20:30	06:19 21:04	05:46 21:17	05:46 20:55	06:13 20:55				06:49 20:07		07:11 (T-33) 36	07:25 19:11	07:04 17:17	07:44 16:49													
2	08:05 16:58	07:46 17:37	07:05 18:14				07:08 19:54	19	07:28 (T-33) 20:31	06:17 21:05	05:45 21:17	05:46 20:54	06:14 20:54				06:50 20:05	35	07:12 (T-33) 35	07:26 19:09	07:06 17:16	07:45 16:48													
3	08:05 16:59	07:45 17:38	07:03 18:16				07:06 19:55	22	07:26 (T-33) 20:33	06:16 21:06	05:45 21:17	05:47 20:53	06:15 20:53				06:51 20:04	33	07:13 (T-33) 33	07:27 19:08	07:07 17:14	07:46 16:48													
4	08:05 17:00	07:44 17:40	07:01 18:17				07:04 19:57	24	07:24 (T-33) 20:34	06:14 21:07	05:44 21:16	05:47 20:51	06:16 20:51				06:53 20:02	32	07:14 (T-33) 32	07:28 19:06	07:08 17:13	07:47 16:48													
5	08:05 17:01	07:43 17:41	06:59 18:18				07:02 19:58	26	07:23 (T-33) 20:35	06:13 21:08	05:44 21:16	05:48 20:50	06:17 20:50				06:54 20:00	30	07:15 (T-33) 30	07:29 19:04	07:10 17:12	07:48 16:48													
6	08:05 17:02	07:41 17:42	06:58 18:20				07:01 19:59	28	07:21 (T-33) 20:36	06:12 21:08	05:43 21:16	05:49 20:49	06:19 20:49				06:55 19:58	28	07:17 (T-33) 28	07:31 19:02	07:11 17:11	07:49 16:47													
7	08:04 17:03	07:40 17:44	06:56 18:21				06:59 20:00	30	07:19 (T-33) 20:38	06:10 21:09	05:43 21:15	05:49 20:47	06:20 20:47				06:56 19:56	26	07:18 (T-33) 26	07:32 19:00	07:13 17:09	07:50 16:47													
8	08:04 17:04	07:39 17:45	07:54 18:22				06:57 20:02	32	07:17 (T-33) 20:39	06:09 21:10	05:43 21:15	05:50 20:46	06:21 20:46				06:57 19:54	24	07:19 (T-33) 24	07:33 18:57	07:14 17:08	07:51 16:47													
9	08:04 17:05	07:37 17:47	07:52 19:24				06:55 20:03	33	07:15 (T-33) 20:40	06:08 21:11	05:42 21:15	05:51 20:45	06:22 20:45				06:58 19:53	22	07:20 (T-33) 22	07:34 18:55	07:15 17:07	07:52 16:47													
10	08:04 17:07	07:36 17:48	07:50 19:25				06:53 20:04	35	07:14 (T-33) 20:41	06:06 21:11	05:42 21:14	05:51 20:43	06:23 20:43				07:00 19:51	20	07:21 (T-33) 20	07:36 18:53	07:17 17:06	07:53 16:47													
11	08:03 17:08	07:35 17:50	07:49 19:26				06:52 20:05	36	07:12 (T-33) 20:42	06:05 21:12	05:42 21:14	05:52 20:42	06:24 20:42				07:01 19:49	17	07:22 (T-33) 17	07:37 18:51	07:18 17:04	07:54 16:47													
12	08:03 17:09	07:33 17:51	07:47 19:28				06:50 20:07	37	07:10 (T-33) 20:44	06:04 21:12	05:42 21:13	05:53 20:40	06:26 20:40				07:02 19:47	14	07:23 (T-33) 14	07:38 18:49	07:19 17:03	07:55 16:47													
13	08:02 17:10	07:32 17:52	07:45 19:29				06:48 20:08	38	07:08 (T-33) 20:45	06:03 21:13	05:42 21:13	05:54 20:39	06:27 20:39				07:03 19:45	11	07:24 (T-33) 11	07:39 18:48	07:21 17:02	07:56 16:47													
14	08:02 17:11	07:30 17:54	07:43 19:30				06:46 20:09	37	07:09 (T-33) 20:46	06:01 21:13	05:41 21:12	05:55 20:37	06:28 20:37				07:04 19:43	7	07:26 (T-33) 7	07:41 18:46	07:22 17:01	07:57 16:47													
15	08:02 17:12	07:29 17:55	07:41 19:31				06:45 20:10	36	07:09 (T-33) 20:47	06:00 21:14	05:41 21:11	05:56 20:36	06:29 20:36				07:05 19:41	3	07:27 (T-33) 3	07:42 18:44	07:23 17:00	07:57 16:48													
16	08:01 17:14	07:27 17:57	07:39 19:33				06:43 20:12	35	07:09 (T-33) 20:48	05:59 21:14	05:41 21:11	05:57 20:34	06:30 20:34	6	06:53 (T-24) 6	07:07 19:39			07:01 (T-24) 19:39		07:43 18:42	07:25 16:59	07:58 16:48												
17	08:00 17:15	07:26 17:58	07:38 19:34				06:41 20:13	32	07:10 (T-33) 20:49	05:58 21:15	05:41 21:10	05:57 20:33	06:31 20:33	7	06:59 (T-24) 7	07:08 19:38			06:55 (T-24) 19:38		07:44 18:41	07:26 16:58	07:59 16:48												
18	08:00 17:16	07:24 17:59	07:36 19:35				06:39 20:14	30	07:11 (T-33) 20:50	05:57 21:15	05:41 21:09	05:58 20:31	06:33 20:31	7	07:02 (T-24) 7	07:09 19:36			06:55 (T-24) 19:36		07:46 18:39	07:27 16:57	07:59 16:48												
19	07:59 17:18	07:23 18:01	07:34 19:37				06:38 20:15	27	07:12 (T-33) 20:51	05:56 21:16	05:42 21:08	05:59 20:29	06:34 20:29	6	07:02 (T-24) 6	07:10 19:34			07:12 (T-33) 19:34		07:47 18:37	07:29 16:56	07:59 16:49												
20	07:58 17:19	07:21 18:01	07:32 19:38				06:36 20:17	26	06:57 (T-24) 20:53	05:55 21:16	05:42 21:08	05:55 20:28	06:35 20:28	13	07:02 (T-24) 13	07:11 19:32			06:57 (T-24) 19:32		07:48 18:36	07:30 16:56	08:01 16:49												
21	07:58 17:20	07:20 18:02	07:30 19:39				06:34 20:18	24	06:55 (T-24) 20:54	05:54 21:16	05:42 21:07	05:54 20:26	06:36 20:26	21	07:39 (T-33) 21	07:13 19:30			06:59 (T-24) 19:30		07:50 18:34	07:31 16:55	08:01 16:50												
22	07:57 17:22	07:18 18:04	07:28 19:40				06:33 20:19	20	06:53 (T-24) 20:55	05:53 21:16	05:42 21:06	05:53 20:25	06:37 20:25	24	07:00 (T-24) 24	07:14 19:28			07:00 (T-24) 19:28		07:51 18:32	07:33 16:54	08:02 16:50												
23	07:56 17:23	07:16 18:05	07:26 19:42				06:31 20:20	11	06:52 (T-24) 20:56	05:52 21:17	05:42 21:05	05:58 20:23	06:38 20:23	27	07:01 (T-33) 27	07:15 19:26			07:01 (T-24) 19:26		07:52 18:31	07:34 16:53	08:02 16:51												
24	07:55 17:24	07:15 18:06	07:25 19:43				06:29 20:22	6	06:50 (T-24) 20:57	05:51 21:17	05:43 21:04	05:51 20:21	06:30 20:21	27	07:16 (T-33) 27	07:16 19:24			07:16 (T-33) 19:24		07:54 18:29	07:35 16:53	08:03 16:51												
25	07:54 17:26	07:13 18:08	07:23 19:44				06:28 20:23	7	06:49 (T-24) 20:58	05:50 21:17	05:43 21:03	05:54 20:19	06:41 20:19	30	07:44 (T-33) 30	07:17 19:22			07:14 (T-33) 19:22		07:55 18:28	07:36 16:52	08:03 16:52												
26	07:53 17:27	07:11 18:09	07:21 19:45				06:26 20:24	7	06:47 (T-24) 20:59	05:50 21:17	05:43 21:02	05:50 20:18	06:42 20:18	33	07:12 (T-33) 33	07:18 19:21			07:12 (T-33) 19:21		07:56 18:26	07:38 16:51	08:03 16:52												
27	07:53 17:28	07:10 18:10	07:19 19:47				06:25 20:25	4	06:47 (T-24) 21:00	05:49 21:17	05:44 21:01	05:44 20:16	06:43 20:16	35	07:11 (T-33) 35	07:20 19:19			06:47 (T-33) 19:19		07:58 18:25	07:39 16:51	08:04 16:53												
28	07:52 17:30	07:08 18:12	07:17 19:48				06:23 20:27		06:51 (T-24) 20:27	05:48 21:01	05:44 21:17	05:44 20:04	06:44 20:04	36	07:46 (T-33) 36	07:21 19:14			07:00 (T-33) 19:14		07:59 18:23	07:40 16:50	08:04 16:54												
29	07:51 17:31	07:13 18:09	07:23 19:44				06:22 20:23		07:35 (T-33) 20:28	06:22 21:02	05:45 21:17	06:10 20:59	06:46 20:13	38	07:09 (T-34) 38	07:22 19:15			07:09 (T-33) 19:15		07:57 18:22	07:36 16:50	08:03 16:55												
30	07:49 17:33	07:13 18:09	07:21 19:45				06:20 20:29		07:34 (T-33) 20:29	06:20 21:03	05:47 21:17	06:11 20:58	06:47 20:11	38	07:09 (T-33) 38	07:23 19:13			07:09 (T-33) 19:13		07:57 18:20	07:42 16:49	08:04 16:55												
31	07:48 17:34	07:12 18:06	07:21 19:46				06:19 20:29		07:32 (T-33) 20:29	06:19 21:04	05:46 20:56	06:12 20:09	06:48 20:09	37	07:10 (T-33) 37	07:13 19:06			07:10 (T-33) 19:06		08:03 18:19	07:42 16:56	08:05 16:56												
Potential sun hours	287	292	369				403		474	458	465	471	436				377		341		289	275													
Total, worst case			33				679						385				338																		

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-328 - R-328

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:46 17:35	07:05 18:12	07:09 19:52	06:18 20:29	05:45 21:04	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	07:04 17:17	07:43 16:48
2	08:04 16:58	07:45 17:36	07:04 18:14	07:07 19:53	06:16 20:31	05:44 21:04	05:45 21:16	06:13 20:53	06:49 20:05	07:25 19:09	07:05 17:15	07:44 16:48
3	08:04 16:58	07:44 17:37	07:02 18:15	07:05 19:55	06:15 20:32	05:44 21:05	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	07:06 17:14	07:45 16:47
4	08:04 16:59	07:43 17:39	07:00 18:16	07:03 19:56	06:14 20:33	05:43 21:06	05:47 21:15	06:16 20:51	06:52 20:01	07:27 19:05	07:08 17:12	07:46 16:47
5	08:04 17:00	07:42 17:40	06:58 18:18	07:02 19:57	06:12 20:34	05:43 21:07	05:47 21:15	06:17 20:49	06:53 19:59	07:29 19:03	07:09 17:11	07:47 16:47
6	08:04 17:01	07:40 17:42	06:57 18:19	07:00 19:58	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	07:10 17:10	07:48 16:47
7	08:03 17:02	07:39 17:43	06:55 18:20	06:58 20:00	06:09 20:37	05:42 21:08	05:49 21:15	06:19 20:47	06:55 19:55	07:31 18:58	07:12 17:09	07:49 16:46
8	08:03 17:04	07:38 17:45	07:53 18:22	06:56 20:01	06:08 20:38	05:42 21:09	05:49 21:14	06:20 20:45	06:56 19:54	07:32 18:56	07:13 17:07	07:50 16:46
9	08:03 17:05	07:37 17:46	07:51 19:23	06:54 20:02	06:07 20:39	05:42 21:10	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	07:14 17:06	07:51 16:46
10	08:03 17:06	07:35 17:47	07:50 19:24	06:53 20:03	06:05 20:40	05:41 21:10	05:51 21:13	06:22 20:42	06:59 19:50	07:35 18:52	07:16 17:05	07:52 16:46
11	08:02 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:41	05:41 21:11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:50	07:17 17:04	07:53 16:46
12	08:02 17:08	07:32 17:50	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:52 21:12	06:25 20:40	07:01 19:46	07:37 18:49	07:18 17:03	07:54 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	05:41 21:12	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	07:20 17:02	07:55 16:46
14	08:01 17:11	07:30 17:53	07:42 19:29	06:46 20:08	06:01 20:45	05:41 21:13	05:54 21:11	06:27 20:36	07:03 19:42	07:40 18:45	07:21 17:00	07:56 16:47
15	08:01 17:12	07:28 17:54	07:40 19:31	06:44 20:10	05:59 20:46	05:41 21:13	05:55 21:10	06:28 20:35	07:05 19:41	07:41 18:43	07:23 16:59	07:56 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:58 20:47	05:41 21:14	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	07:24 16:58	07:57 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:48	05:41 21:14	05:57 21:09	06:31 20:32	7 19:58 (T-53) 07:07	07:44 18:40	07:25 16:58	07:58 16:47
18	07:59 17:16	07:23 17:59	07:35 19:35	06:39 20:13	3 19:48 (T-53) 05:56	05:41 20:50	05:58 21:14	06:32 20:30	10 19:55 (T-53) 07:08	07:45 18:38	07:27 16:57	07:58 16:48
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:15	3 19:47 (T-53) 05:55	05:41 20:51	05:59 21:15	06:33 20:29	9 19:55 (T-53) 07:09	07:46 18:37	07:28 16:56	07:59 16:48
20	07:58 17:18	07:20 18:00	07:31 19:37	06:35 20:16	5 19:52 (T-53) 05:51	05:41 21:15	06:00 21:07	06:34 20:27	9 20:04 (T-53) 07:11	07:48 18:35	07:29 16:55	08:00 16:48
21	07:57 17:19	07:19 18:01	07:29 19:38	06:34 20:17	5 19:53 (T-53) 05:52	05:41 20:53	06:01 21:15	06:35 20:25	8 20:02 (T-53) 07:12	07:49 18:33	07:30 16:54	08:00 16:49
22	07:56 17:21	07:17 18:03	07:27 19:40	06:32 20:18	7 19:54 (T-53) 05:52	05:41 21:16	06:02 21:05	06:37 20:24	8 19:52 (T-53) 07:13	07:50 18:32	07:32 16:53	08:01 16:49
23	07:55 17:22	07:16 18:04	07:26 19:41	06:30 20:20	8 19:48 (T-53) 05:51	05:42 21:16	06:03 21:04	06:38 20:22	7 19:59 (T-53) 07:14	07:51 18:30	07:33 16:53	08:01 16:50
24	07:54 17:24	07:14 18:06	07:24 19:42	06:29 20:21	9 19:57 (T-53) 05:51	05:42 20:56	06:04 21:16	06:39 20:20	5 19:57 (T-53) 07:15	07:53 18:28	07:34 16:52	08:02 16:50
25	07:54 17:25	07:12 18:07	07:22 19:43	06:27 20:22	9 19:50 (T-53) 05:50	05:42 21:16	06:05 21:02	06:40 20:19	4 19:55 (T-53) 07:16	07:54 18:27	07:36 16:51	08:02 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:23	9 19:59 (T-53) 05:49	05:43 21:16	06:06 21:01	06:41 20:17	2 19:53 (T-53) 07:18	07:55 18:25	07:37 16:51	08:02 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:24	5 19:57 (T-53) 05:48	05:43 21:16	06:07 21:00	06:42 20:15	07:19 19:18	07:57 18:24	07:38 16:50	08:03 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47	06:22 20:26	05:47 21:00	05:43 21:16	06:08 20:59	06:44 20:13	07:20 19:16	07:58 18:22	07:39 16:49	08:03 16:53
29	07:50 17:30		07:14 19:48	06:21 20:27	05:47 21:01	05:44 21:16	06:09 20:58	06:45 20:12	07:21 19:14	07:59 18:21	07:40 16:49	08:03 16:54
30	07:49 17:32		07:13 19:50	06:19 20:28	05:46 21:02	05:44 21:16	06:10 20:57	06:46 20:10	07:22 19:12	08:01 18:19	07:42 16:48	08:03 16:55
31	07:48 17:33		07:11 19:51		05:45 21:03	06:11 20:56	06:47 20:08		08:02 18:18			08:04 16:55
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case				60				60				
Sun reduction				0.63				0.72				
Oper. time red.				0.90				0.90				
Wind dir. red.				0.60				0.60				
Total reduction				0.34				0.39				
Total, real				20				23				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-329 - R-329

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	15:16 (T-74)	07:46	07:05	07:09	06:18
	16:57	59 16:15 (T-74)	17:35	18:12	19:52	37 20:29
2	08:04	15:17 (T-74)	07:45	07:04	07:07	06:16
	16:58	58 16:15 (T-74)	17:36	18:14	19:53	32 20:30
3	08:04	15:17 (T-74)	07:44	07:02	07:05	06:15
	16:59	59 16:16 (T-74)	17:38	18:15	19:55	22 20:32
4	08:04	15:18 (T-74)	07:43	07:00	07:03	06:14
	17:00	58 16:16 (T-74)	17:39	18:16	19:56	7 20:33
5	08:04	15:19 (T-74)	07:42	06:58	07:02	06:12
	17:01	58 16:17 (T-74)	17:40	18:18	19:57	20:34
6	08:03	15:20 (T-74)	07:40	06:57	07:00	06:11
	17:02	57 16:17 (T-74)	17:42	18:19	19:58	20:35
7	08:03	15:19 (T-74)	07:39	06:55	06:58	06:09
	17:03	58 16:17 (T-74)	17:43	18:20	20:00	20:37
8	08:03	15:20 (T-74)	07:38	07:53	06:56	06:08
	17:04	57 16:17 (T-74)	17:45	18:22	20:01	20:38
9	08:03	15:21 (T-74)	07:36	07:51	06:54	06:07
	17:05	57 16:18 (T-74)	17:46	19:23	20:02	20:39
10	08:03	15:21 (T-74)	07:35	07:49	06:53	06:06
	17:06	57 16:38 (T-72)	17:47	19:24	20:03	20:40
11	08:02	15:22 (T-74)	07:34	07:48	06:51	07:11 (T-76)
	17:07	57 16:39 (T-72)	17:49	19:26	20:05	3 07:14 (T-76)
12	08:02	15:23 (T-74)	07:32	07:46	06:49	07:09 (T-76)
	17:08	56 16:40 (T-72)	17:50	19:27	20:06	7 07:16 (T-76)
13	08:01	15:24 (T-74)	07:31	07:44	06:47	07:08 (T-76)
	17:09	57 16:42 (T-72)	17:52	19:28	20:07	10 07:18 (T-76)
14	08:01	15:24 (T-74)	07:29	07:42	06:46	07:06 (T-76)
	17:11	59 16:43 (T-72)	17:53	19:29	20:08	13 07:19 (T-76)
15	08:01	15:25 (T-74)	07:28	07:40	06:44	07:04 (T-76)
	17:12	57 16:44 (T-72)	17:54	19:31	20:09	15 07:19 (T-76)
16	08:00	15:26 (T-74)	07:26	07:39	06:42	07:02 (T-76)
	17:13	57 16:45 (T-72)	17:56	19:32	20:11	19 19:48 (T-66)
17	07:59	15:26 (T-74)	07:25	07:37	06:40	07:01 (T-76)
	17:14	57 16:46 (T-72)	17:57	19:33	20:12	23 19:50 (T-66)
18	07:59	15:28 (T-74)	07:23	07:35	06:39	06:59 (T-76)
	17:16	56 16:48 (T-72)	17:59	19:35	20:13	26 19:51 (T-66)
19	07:58	15:29 (T-74)	07:22	07:33	06:37	06:57 (T-76)
	17:17	55 16:50 (T-72)	18:00	19:36	20:14	29 19:51 (T-66)
20	07:57	15:30 (T-74)	07:20	07:31	06:35	06:56 (T-76)
	17:18	54 16:51 (T-72)	18:00	19:37	20:16	31 19:53 (T-66)
21	07:57	15:31 (T-74)	07:19	07:29	06:34	06:54 (T-76)
	17:20	52 16:52 (T-72)	18:01	19:38	20:17	35 19:54 (T-66)
22	07:56	15:33 (T-74)	07:17	07:27	06:32	06:53 (T-76)
	17:21	43 16:16 (T-74)	18:03	19:40	20:18	37 19:56 (T-66)
23	07:55	15:34 (T-74)	07:15	07:26	06:30	06:51 (T-76)
	17:22	42 16:16 (T-74)	18:04	19:41	20:19	40 19:57 (T-66)
24	07:54	15:35 (T-74)	07:14	07:24	06:29	06:49 (T-76)
	17:24	40 16:15 (T-74)	18:06	19:42	20:21	42 19:57 (T-66)
25	07:53	15:37 (T-74)	07:12	07:22	06:27	06:48 (T-76)
	17:25	37 16:14 (T-74)	18:07	19:43	20:22	44 19:59 (T-67)
26	07:52	15:38 (T-74)	07:10	07:20	06:26	06:47 (T-76)
	17:26	35 16:13 (T-74)	18:08	19:45	20:23	46 20:00 (T-67)
27	07:52	15:40 (T-74)	07:09	07:18	06:24	06:48 (T-76)
	17:28	32 16:12 (T-74)	18:10	19:46	20:24	45 20:01 (T-67)
28	07:51	15:42 (T-74)	07:07	07:16	06:22	06:48 (T-76)
	17:29	28 16:10 (T-74)	18:11	19:47	20:26	45 20:02 (T-67)
29	07:50	15:45 (T-74)		07:14	06:21	06:50 (T-76)
	17:30	23 16:08 (T-74)		19:48	20:27	44 20:04 (T-67)
30	07:49	15:49 (T-74)		07:13	06:19	06:50 (T-76)
	17:32	16 16:05 (T-74)		19:50	20:28	42 20:04 (T-67)
31	07:47	15:55 (T-74)		07:11		06:46
	17:33	3 15:58 (T-74)		19:51		21:02
Potential sun hours	287	292	369	403	458	465
Total, worst case	1494			596		289
Sun reduction	0.58			0.63		0.66
Oper. time red.	0.90			0.90		0.90
Wind dir. red.	0.62			0.58		0.59
Total reduction	0.32			0.33		0.35
Total, real	482			198		102

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L085 73 GE3.8-154 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:01 PM/3.6.366

SHADOW - Calendar

Calculation: L085 Shadow Flicker Assessment Shadow receptor: R-329 - R-329
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

		July	August	September	October	November	December
1	05:45	06:16 (T-71)	06:12	06:48	07:10 (T-76)	07:24	07:03
	21:16	11 06:27 (T-71)	20:54	20:06	3 07:13 (T-76)	19:10	17:17
2	05:45	06:16 (T-71)	06:13	06:49	07:25	07:05	16:48
	21:16	12 06:28 (T-71)	20:53	20:05	19:09	17:15	15:04
3	05:46	06:15 (T-71)	06:15	06:51	07:26	07:06	16:48
	21:15	13 06:28 (T-71)	20:52	20:03	19:07	17:14	15:04
4	05:47	06:15 (T-71)	06:16	06:52	07:27	07:07	16:47
	21:15	15 06:30 (T-71)	20:50	20:01	19:05	17:12	15:04
5	05:47	06:15 (T-71)	06:17	06:53	07:29	07:09	16:47
	21:15	16 06:31 (T-71)	20:49	19:59	19:03	17:11	15:04
6	05:48	06:14 (T-71)	06:18	06:54	07:30	07:10	16:47
	21:15	17 06:31 (T-71)	20:48	19:57	19:01	17:10	15:06
7	05:49	06:14 (T-71)	06:19	06:55	07:31	07:12	16:47
	21:14	18 06:32 (T-71)	20:46	19:55	18:58	17:09	15:06
8	05:49	06:15 (T-71)	06:20	06:56	07:32	07:13	16:47
	21:14	17 06:32 (T-71)	20:45	19:54	18:56	17:07	15:06
9	05:50	06:14 (T-71)	06:21	20:00 (T-67)	06:58	07:33	07:14
	21:14	18 06:32 (T-71)	20:44	8 20:08 (T-67)	19:52	18:54	17:06
10	05:51	06:15 (T-71)	06:23	07:05 (T-76)	06:59	07:35	07:16
	21:13	18 06:33 (T-71)	20:42	25 20:11 (T-67)	19:50	18:52	17:05
11	05:52	06:16 (T-71)	06:24	07:02 (T-76)	07:00	07:36	07:17
	21:13	18 06:34 (T-71)	20:41	34 20:13 (T-67)	19:48	18:50	17:04
12	05:52	06:17 (T-71)	06:25	07:00 (T-76)	07:01	07:37	07:18
	21:12	18 06:35 (T-71)	20:39	40 20:14 (T-67)	19:46	18:49	17:03
13	05:53	06:17 (T-71)	06:26	06:59 (T-76)	07:02	07:38	07:20
	21:12	17 06:34 (T-71)	20:38	42 20:13 (T-67)	19:44	18:47	17:02
14	05:54	06:18 (T-71)	06:27	06:57 (T-76)	07:03	07:40	07:21
	21:11	17 06:35 (T-71)	20:36	44 20:11 (T-67)	19:42	18:45	17:01
15	05:55	06:19 (T-71)	06:28	06:56 (T-76)	07:05	07:41	07:22
	21:10	16 06:35 (T-71)	20:35	44 20:09 (T-67)	19:41	18:43	17:00
16	05:56	06:20 (T-71)	06:30	06:55 (T-76)	07:06	07:42	07:24
	21:10	16 06:36 (T-71)	20:33	46 20:08 (T-67)	19:39	18:42	16:59
17	05:57	06:21 (T-71)	06:31	06:54 (T-76)	07:07	07:44	07:25
	21:09	15 06:36 (T-71)	20:32	45 20:06 (T-67)	19:37	18:40	16:58
18	05:58	06:22 (T-71)	06:32	06:54 (T-76)	07:08	07:45	07:26
	21:08	14 06:36 (T-71)	20:30	45 20:05 (T-67)	19:35	18:38	16:57
19	05:59	06:23 (T-71)	06:33	06:56 (T-76)	07:09	07:46	07:28
	21:07	14 06:37 (T-71)	20:29	42 20:04 (T-66)	19:33	18:37	16:56
20	06:00	06:24 (T-71)	06:34	06:57 (T-76)	07:11	07:47	07:29
	21:07	13 06:37 (T-71)	20:27	39 20:02 (T-66)	19:31	18:35	16:55
21	06:01	06:25 (T-71)	06:35	06:58 (T-76)	07:12	07:49	07:30
	21:06	12 06:37 (T-71)	20:25	36 20:00 (T-66)	19:29	18:33	16:54
22	06:02	06:26 (T-71)	06:37	06:59 (T-76)	07:13	07:50	07:32
	21:05	11 06:37 (T-71)	20:24	35 19:59 (T-66)	19:27	18:32	16:53
23	06:03	06:26 (T-71)	06:38	07:00 (T-76)	07:14	07:51	07:33
	21:04	10 06:36 (T-71)	20:22	32 19:57 (T-66)	19:25	18:30	16:53
24	06:04	06:27 (T-71)	06:39	07:01 (T-76)	07:15	07:53	07:34
	21:03	9 06:36 (T-71)	20:20	29 19:55 (T-66)	19:24	18:29	16:52
25	06:05	06:28 (T-71)	06:40	07:02 (T-76)	07:16	07:54	07:35
	21:02	7 06:35 (T-71)	20:19	26 19:53 (T-66)	19:22	18:27	16:51
26	06:06	06:29 (T-71)	06:41	07:03 (T-76)	07:18	07:55	07:37
	21:01	6 06:35 (T-71)	20:17	23 19:52 (T-66)	19:20	18:25	16:51
27	06:07	06:30 (T-71)	06:42	07:05 (T-76)	07:19	07:57	07:38
	21:00	4 06:34 (T-71)	20:15	19 19:51 (T-66)	19:18	18:24	16:50
28	06:08	06:32 (T-71)	06:44	07:06 (T-76)	07:20	07:58	07:39
	20:59	3 06:35 (T-71)	20:13	15 07:21 (T-76)	19:16	18:22	16:50
29	06:09	06:33 (T-71)	06:45	07:07 (T-76)	07:21	07:59	07:40
	20:58	1 06:34 (T-71)	20:12	12 07:19 (T-76)	19:14	18:21	16:49
30	06:10		06:46	07:08 (T-76)	07:22	08:01	07:41
	20:57		20:10	10 07:18 (T-76)	19:12	18:19	16:49
31	06:11		06:47	07:09 (T-76)		08:02	
	20:55		20:08	7 07:16 (T-76)		18:18	
Potential sun hours	471		436	377	341	289	276
Total, worst case		376	698			862	1818
Sun reduction		0.75	0.72	0.67		0.48	0.52
Oper. time red.		0.90	0.90	0.90		0.90	0.90
Wind dir. red.		0.59	0.59	0.58		0.62	0.62
Total reduction		0.40	0.38	0.35		0.27	0.29
Total, real		150	265	1		230	526

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-006 - R-006
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:47
6	08:05	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:59	06:10	05:43	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:38	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:55	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:41	07:22	07:56
	17:11	17:54	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:36	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:01	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:01	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:14	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:22	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:41	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:52	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:05
	17:34		19:52	21:04			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-007 - R-007

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:47
6	08:05	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:41	07:22	07:56
	17:11	17:54	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:41	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:52	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:04			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-021 - R-021

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	07:06 18:12		07:09 20:30	06:18 21:04	05:45 21:16	05:45 20:55	06:12 20:07	06:48 19:11	07:24 17:17	07:43 16:48
2	08:04 16:57	07:46 17:36	07:04 18:14	14	07:04 19:54	06:16 20:31	05:44 21:05	05:44 21:16	06:13 20:54	06:50 20:05	07:25 19:09	07:44 16:48
3	08:04 16:58	07:45 17:37	07:02 18:15	13	07:05 19:55	06:15 20:32	05:44 21:06	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	07:45 16:47
4	08:04 16:59	07:43 17:39	07:00 18:16	9	07:04 19:55	06:14 20:33	05:43 21:06	05:46 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:47 16:47
5	08:04 17:00	07:42 17:40	06:59 18:18		07:02 19:56	06:12 20:33	05:43 21:06	05:47 21:16	06:17 20:51	06:53 20:01	07:29 19:03	07:48 16:47
6	08:04 17:01	07:41 17:42	06:57 18:19		07:00 19:57	06:11 20:35	05:42 21:07	05:48 21:16	06:18 20:50	06:54 19:59	07:30 19:03	07:49 16:47
7	08:04 17:02	07:40 17:43	06:55 18:20		06:58 20:00	06:09 20:37	05:42 21:09	05:48 21:15	06:19 20:47	06:55 19:56	07:31 19:00	07:50 16:46
8	08:04 17:03	07:38 17:45	07:53 18:22		06:56 20:01	06:08 20:38	05:42 21:09	05:49 21:15	06:20 20:46	06:57 19:54	07:33 18:56	07:51 16:46
9	08:03 17:05	07:37 17:46	07:52 19:23		06:54 20:02	06:07 20:39	05:41 21:10	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	07:52 17:06
10	08:03 17:06	07:36 17:47	07:50 19:24		06:53 20:04	06:05 20:41	05:41 21:11	05:51 21:14	06:22 20:43	06:59 19:50	07:35 18:52	07:53 16:46
11	08:03 17:07	07:34 17:49	07:48 19:26		06:51 20:05	06:04 20:42	05:41 21:11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:51	07:53 17:04
12	08:02 17:08	07:33 17:50	07:46 19:27		06:49 20:06	06:03 20:43	05:41 21:12	05:52 21:13	06:25 20:40	07:01 19:46	07:38 18:49	07:54 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28		06:47 20:07	06:02 20:44	05:41 21:13	05:53 21:12	06:26 20:38	07:02 19:45	07:39 18:47	07:55 16:46
14	08:02 17:10	07:30 17:53	07:42 19:30		06:46 20:09	06:01 20:45	05:41 21:13	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	07:56 16:47
15	08:01 17:12	07:28 17:54	07:41 19:31		06:44 20:10	05:59 20:47	05:41 21:14	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:43	07:57 16:47
16	08:01 17:13	07:27 17:56	07:39 19:32		06:42 20:11	05:58 20:48	05:41 21:14	05:56 21:10	06:29 20:34	07:06 19:39	07:43 18:42	07:58 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33		06:40 20:12	05:57 20:49	05:41 21:14	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40	07:58 16:47
18	07:59 17:15	07:24 17:59	07:35 19:35		06:39 20:14	05:56 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:08 19:35	07:45 18:38	07:59 16:48
19	07:59 17:17	07:22 18:00	07:33 19:36		06:37 20:15	05:55 20:51	05:41 21:15	05:58 21:08	06:33 20:29	07:10 19:33	07:47 18:37	08:00 16:48
20	07:58 17:18	07:21 18:00	07:31 19:37		06:35 20:16	05:54 20:52	05:41 21:15	05:59 21:07	06:34 20:27	07:11 19:31	07:48 18:35	08:00 16:48
21	07:57 17:19	07:19 18:01	07:30 19:39		06:34 20:17	05:53 20:53	05:41 21:16	06:00 21:06	06:35 20:26	07:12 19:29	07:49 18:33	08:01 16:49
22	07:56 17:21	07:17 18:03	07:28 19:40		06:32 20:19	05:52 20:54	05:41 21:16	06:01 21:05	06:37 20:24	07:13 19:28	07:50 18:32	08:01 16:49
23	07:56 17:22	07:16 18:04	07:26 19:41		06:30 20:20	05:51 20:55	05:41 21:16	06:02 21:04	06:38 20:22	07:14 19:26	07:52 18:30	08:02 16:50
24	07:55 17:23	07:14 18:06	07:24 19:42		06:29 20:21	05:50 20:56	05:42 21:16	06:03 21:04	06:39 20:21	07:15 19:24	07:53 18:29	08:02 16:50
25	07:54 17:25	07:12 18:07	07:22 19:44		06:27 20:22	05:50 20:57	05:42 21:16	06:05 21:03	06:40 20:19	07:17 19:22	07:54 18:27	08:03 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45		06:26 20:24	05:49 20:58	05:42 21:17	06:06 21:02	06:41 20:17	07:18 19:20	07:56 18:25	08:03 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46		06:24 20:25	05:48 20:59	05:43 21:17	06:07 21:00	06:42 20:16	07:19 19:18	07:57 18:24	08:03 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47		06:22 20:26	05:47 21:00	05:43 21:17	06:08 20:59	06:44 20:14	07:20 19:16	07:58 18:22	08:03 16:49
29	07:50 17:30		07:15 19:49		06:21 20:27	05:47 21:01	05:44 21:17	06:09 20:58	06:45 20:12	07:21 19:21	08:00 18:21	08:04 16:54
30	07:49 17:32		07:13 19:50		06:19 20:29	05:46 21:02	05:44 21:17	06:10 20:57	06:46 20:10	07:23 19:12	08:01 18:19	08:04 16:55
31	07:48 17:33		07:11 19:51		06:17 21:03	05:45 21:03	05:44 20:56	06:11 20:56	06:47 20:08	08:03 18:18	08:04 18:18	08:04 16:55
Potential sun hours	287	292	369		404	459	465	471	436	377	341	288
Total, worst case											101	
Sun reduction		0.58			0.59						0.56	
Oper. time red.		0.90			0.90						0.90	
Wind dir. red.		0.58			0.58						0.58	
Total reduction		0.30			0.31						0.29	
Total, real		20			11						30	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-022 - R-022

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	08:09 (T-90)	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04
	16:57	17:35	08:41 (T-90)	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17
2	08:04	07:46	08:08 (T-90)	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05
	16:58	17:36	08:41 (T-90)	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15
3	08:04	07:45	08:06 (T-90)	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07
	16:58	17:38	08:41 (T-90)	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14
4	08:04	07:43	08:05 (T-90)	07:01	07:04	06:14	05:43	05:47	06:16	06:52	07:28	07:08
	16:59	17:39	08:41 (T-90)	18:17	19:56	20:34	21:07	21:16	20:51	20:01	19:05	17:13
5	08:04	07:42	08:04 (T-90)	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09
	17:00	17:40	08:41 (T-90)	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11
6	08:04	07:41	08:05 (T-90)	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11
	17:01	17:42	08:41 (T-90)	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10
7	08:04	07:40	08:05 (T-90)	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12
	17:03	17:43	08:40 (T-90)	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09
8	08:04	07:38	08:06 (T-90)	07:54	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:14
	17:04	17:45	08:40 (T-90)	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:07
9	08:04	07:37	08:07 (T-90)	07:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15
	17:05	17:46	08:40 (T-90)	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:06
10	08:03	07:36	08:07 (T-90)	07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16
	17:06	17:48	08:38 (T-90)	19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05
11	08:03	07:34	08:09 (T-90)	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:18
	17:07	17:49	08:38 (T-90)	19:26	20:05	20:42	21:12	21:13	20:41	19:48	18:51	17:04
12	08:03	07:33	08:10 (T-90)	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19
	17:08	17:50	08:36 (T-90)	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03
13	08:02	07:31	08:12 (T-90)	07:44	06:47	06:02	05:41	05:53	06:26	07:03	07:39	07:20
	17:09	17:52	08:35 (T-90)	19:28	20:08	20:44	21:13	21:12	20:38	19:45	18:47	17:02
14	08:02	07:30	08:13 (T-90)	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22
	17:11	17:53	08:32 (T-90)	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:45	17:01
15	08:01	08:25 (T-90)	07:28	08:17 (T-90)	07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:42
	17:12	08:26 (T-90)	17:55	08:30 (T-90)	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44
16	08:01	08:24 (T-90)	07:27	07:39	06:42	05:58	05:41	05:56	06:30	07:06	07:43	07:24
	17:13	08:27 (T-90)	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	17:00
17	08:00	08:23 (T-90)	07:25	07:37	06:41	05:57	05:41	05:57	06:31	07:07	07:44	07:26
	17:14	08:29 (T-90)	17:57	19:34	20:12	20:49	21:15	21:10	20:32	19:37	18:40	16:59
18	07:59	08:23 (T-90)	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27
	17:16	08:31 (T-90)	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:38	16:57
19	07:59	08:22 (T-90)	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28
	17:17	08:32 (T-90)	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56
20	07:58	08:21 (T-90)	07:21	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:30
	17:18	08:33 (T-90)	18:00	19:37	20:16	20:52	21:16	21:07	20:27	19:31	18:35	16:55
21	07:57	08:20 (T-90)	07:19	07:30	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:31
	17:20	08:34 (T-90)	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54
22	07:57	08:19 (T-90)	07:18	07:28	06:32	05:52	05:41	06:02	06:37	07:13	07:51	07:32
	17:21	08:35 (T-90)	18:03	19:40	20:19	20:54	21:16	21:06	20:24	19:28	18:32	16:53
23	07:56	08:18 (T-90)	07:16	07:26	06:30	05:51	05:42	06:03	06:38	07:14	07:52	07:34
	17:22	08:36 (T-90)	18:04	19:41	20:20	20:55	21:16	21:05	20:22	19:26	18:30	16:53
24	07:55	08:18 (T-90)	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35
	17:24	08:37 (T-90)	18:06	19:42	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52
25	07:54	08:17 (T-90)	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:55	07:36
	17:25	08:38 (T-90)	18:07	19:44	20:22	20:57	21:17	21:03	20:19	19:22	18:27	16:51
26	07:53	08:16 (T-90)	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37
	17:26	08:39 (T-90)	18:08	19:45	20:24	20:59	21:17	21:02	20:17	19:20	18:26	16:51
27	07:52	08:15 (T-90)	07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39
	17:28	08:40 (T-90)	18:10	19:46	20:25	20:59	21:17	21:01	20:16	19:18	18:24	16:50
28	07:51	08:13 (T-90)	07:08	07:17	06:23	05:47	05:43	06:08	06:44	07:20	07:59	07:40
	17:29	08:39 (T-90)	18:11	19:47	20:26	21:00	21:17	21:00	20:14	19:16	18:23	16:50
29	07:50	08:12 (T-90)	07:07	07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41
	17:31	08:40 (T-90)	18:12	19:49	20:27	21:01	21:17	20:58	20:12	19:14	18:21	16:49
30	07:49	08:11 (T-90)	07:06	07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42
	17:32	08:40 (T-90)	18:13	19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49
31	07:48	08:10 (T-90)	07:05	07:11	06:19	05:46	05:44	06:11	06:47	07:24	08:03	07:42
	17:33	08:41 (T-90)	18:14	19:51	20:31	21:03	21:18	20:56	20:09	18:18	17:25	16:48
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case	290	452								118	634	
Sun reduction	0.58	0.58								0.56	0.48	
Oper. time red.	0.90	0.90								0.90	0.90	
Wind dir. red.	0.65	0.65								0.65	0.65	
Total reduction	0.34	0.34								0.33	0.28	
Total, real	98	152								38	177	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Last time (hh:mm) with flicker	(WTG causing flicker last time)
	Minutes with flicker		



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-024 - R-024

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:16	05:44	05:45	06:13	06:50	07:25	07:05	07:44
	16:57	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:07	07:45
	16:58	17:37	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:04	06:14	05:43	05:46	06:16	06:52	07:28	07:08	07:47
	16:59	17:39	18:16	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:12	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:48
	17:00	17:40	18:18	19:57	20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:42	05:48	06:18	06:54	07:30	07:11	07:49
	17:01	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10	16:47
7	08:04	07:40	06:55	06:58	06:09	05:42	05:48	06:19	06:55	07:31	07:12	07:50
	17:02	17:43	18:20	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:46
8	08:04	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:51
	17:03	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:07	16:46
9	08:03	07:37	07:52	06:54	06:07	05:41	05:50	06:21	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:05	05:41	05:51	06:22	06:59	07:35	07:16	07:53
	17:06	17:47	19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	05:51	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:50	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:13	21:12	20:38	19:45	18:47	17:02	16:46
14	08:02	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
	17:10	17:53	19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	17:00	16:46
15	08:01	07:28	07:41	06:44	05:59	05:41	05:55	06:28	07:05	07:41	07:23	07:57
	17:12	17:54	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:43	16:59	16:47
16	08:01	07:27	07:39	06:42	05:58	05:41	05:56	06:29	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:14	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:57	16:47
18	07:59	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:59
	17:15	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:38	16:57	16:48
19	07:59	07:22	07:33	06:37	05:55	05:41	05:58	06:33	07:10	07:47	07:28	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:31	06:35	05:54	05:41	05:59	06:34	07:11	07:48	07:30	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	05:41	06:00	06:35	07:12	07:49	07:31	08:01
	17:19	18:01	19:39	20:17	20:53	21:16	21:06	20:26	19:29	18:33	16:54	16:49
22	07:56	07:17	07:28	06:32	05:52	05:41	06:01	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:53	16:49
23	07:56	07:16	07:26	06:30	05:51	05:41	06:02	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:52	16:50
24	07:55	07:14	07:24	06:29	05:50	05:42	06:03	06:39	07:15	07:53	07:35	08:02
	17:23	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:50
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	08:03
	17:25	18:07	19:44	20:22	20:57	21:16	21:03	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:42	06:06	06:41	07:18	07:56	07:37	08:03
	17:26	18:08	19:45	20:24	20:58	21:17	21:01	20:17	19:20	18:25	16:50	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:40	08:03
	17:29	18:11	19:47	20:26	21:00	21:17	20:59	20:14	19:16	18:22	16:49	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:21	08:00	07:41	08:04
	17:30		19:49	20:27	21:01	21:17	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:17	20:57	20:10	19:12	18:19	16:48	16:55
31	07:48		07:11		05:45		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:55
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-025 - R-025
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June						
1	08:04	07:47	07:06	07:09	19:26 (T-15)	06:18	06:39 (T-41)	05:45	06:08 (T-19)			
	16:57	17:35	18:12	19:52	5	19:31 (T-15)	20:30	31	20:06 (T-16)	21:04	18	06:26 (T-19)
2	08:04	07:46	07:04	07:07	07:27 (T-20)	06:16	06:39 (T-41)	05:44	06:08 (T-19)			
	16:58	17:36	18:14	19:54	11	19:32 (T-15)	20:31	32	20:08 (T-16)	21:05	19	06:27 (T-19)
3	08:04	07:45	07:02	07:05	07:26 (T-20)	06:15	06:40 (T-41)	05:44	06:07 (T-19)			
	16:58	17:38	18:15	19:55	17	19:34 (T-15)	20:32	29	20:08 (T-16)	21:06	21	06:28 (T-19)
4	08:04	07:43	07:01	07:04	07:24 (T-20)	06:14	06:43 (T-41)	05:43	06:07 (T-19)			
	16:59	17:39	18:16	19:56	20	19:35 (T-15)	20:33	25	20:10 (T-16)	21:06	22	06:29 (T-19)
5	08:04	07:42	06:59	07:02	07:22 (T-20)	06:12	19:53 (T-16)	05:43	06:07 (T-19)			
	17:00	17:40	18:18	19:57	24	19:36 (T-15)	20:35	18	20:11 (T-16)	21:07	23	06:30 (T-19)
6	08:04	07:41	06:57	07:00	07:20 (T-20)	06:11	19:53 (T-16)	05:43	06:06 (T-19)			
	17:01	17:42	18:19	19:59	27	19:37 (T-15)	20:36	19	20:12 (T-16)	21:08	24	06:30 (T-19)
7	08:04	07:40	06:55	06:58	07:18 (T-20)	06:09	19:54 (T-16)	05:42	06:06 (T-19)			
	17:02	17:43	18:20	20:00	29	19:38 (T-15)	20:37	17	20:11 (T-16)	21:09	25	06:31 (T-19)
8	08:04	07:38	07:53	06:56	07:16 (T-20)	06:08	19:55 (T-16)	05:42	06:06 (T-19)			
	17:04	17:45	18:22	20:01	31	19:39 (T-15)	20:38	15	20:10 (T-16)	21:09	26	06:32 (T-19)
9	08:03	07:37	07:52	06:55	07:15 (T-20)	06:07	19:56 (T-16)	05:42	06:05 (T-19)			
	17:05	17:46	19:23	20:02	27	19:37 (T-15)	20:39	11	20:07 (T-16)	21:10	27	06:32 (T-19)
10	08:03	07:36	07:50	06:53	07:13 (T-20)	06:06	20:00 (T-16)	05:41	06:05 (T-19)			
	17:06	17:47	19:24	20:04	22	07:35 (T-20)	20:41	4	20:04 (T-16)	21:11	27	06:32 (T-19)
11	08:03	07:34	07:48	06:51	07:11 (T-20)	06:04		05:41	06:05 (T-19)			
	17:07	17:49	19:26	20:05	23	07:34 (T-20)	20:42		21:11	28	06:33 (T-19)	
12	08:02	07:33	07:46	06:49	07:09 (T-20)	06:03		05:41	06:05 (T-19)			
	17:08	17:50	19:27	20:06	24	07:33 (T-20)	20:43		21:12	29	06:34 (T-19)	
13	08:02	07:31	07:44	06:47	07:08 (T-20)	06:02		05:41	06:05 (T-19)			
	17:09	17:52	19:28	20:07	25	07:33 (T-20)	20:44		21:13	29	06:34 (T-19)	
14	08:02	07:30	07:43	06:46	07:06 (T-20)	06:01		05:41	06:05 (T-19)			
	17:11	17:53	19:30	20:09	26	07:32 (T-20)	20:45		21:13	30	06:35 (T-19)	
15	08:01	07:28	07:41	06:44	07:07 (T-20)	06:00		05:41	06:05 (T-19)			
	17:12	17:55	19:31	20:10	24	07:31 (T-20)	20:47		21:14	30	06:35 (T-19)	
16	08:01	07:27	07:39	06:42	07:08 (T-20)	05:58		05:41	06:05 (T-19)			
	17:13	17:56	19:32	20:11	22	07:30 (T-20)	20:48		21:14	30	06:35 (T-19)	
17	08:00	07:25	07:37	06:40	07:09 (T-20)	05:57		05:41	06:05 (T-19)			
	17:14	17:57	19:33	20:12	19	07:28 (T-20)	20:49		21:14	31	06:36 (T-19)	
18	07:59	07:24	07:35	06:39	07:11 (T-20)	05:56		05:41	06:05 (T-19)			
	17:16	17:59	19:35	20:14	14	07:25 (T-20)	20:50		21:15	31	06:36 (T-19)	
19	07:59	07:22	07:33	06:37	07:14 (T-20)	05:55		05:41	06:05 (T-19)			
	17:17	18:00	19:36	20:15	9	07:23 (T-20)	20:51		21:15	31	06:36 (T-19)	
20	07:58	07:21	07:31	06:35	06:56 (T-41)	05:54		05:41	06:05 (T-19)			
	17:18	18:00	19:37	20:16	1	06:57 (T-41)	20:52		21:15	31	06:36 (T-19)	
21	07:57	07:19	07:30	06:34	06:54 (T-41)	05:53		05:41	06:06 (T-19)			
	17:20	18:02	19:39	20:17	3	06:57 (T-41)	20:53		21:16	31	06:37 (T-19)	
22	07:56	07:17	07:28	06:32	06:53 (T-41)	05:52		05:41	06:06 (T-19)			
	17:21	18:03	19:40	20:19	6	06:59 (T-41)	20:54		21:16	31	06:37 (T-19)	
23	07:56	07:16	07:26	06:30	06:51 (T-41)	05:51		05:42	06:06 (T-19)			
	17:22	18:04	19:41	20:20	8	19:57 (T-16)	20:55		21:16	31	06:37 (T-19)	
24	07:55	07:14	07:24	06:29	06:49 (T-41)	05:51		05:42	06:06 (T-19)			
	17:24	18:06	19:42	20:21	13	19:58 (T-16)	20:56		21:16	31	06:37 (T-19)	
25	07:54	07:13	07:22	06:27	06:48 (T-41)	05:50		05:42	06:07 (T-19)			
	17:25	18:07	19:44	20:22	16	19:59 (T-16)	20:57		21:16	31	06:38 (T-19)	
26	07:53	07:11	07:20	06:26	06:46 (T-41)	05:49	06:12 (T-19)	05:43	06:07 (T-19)			
	17:26	18:08	19:45	20:24	20	20:00 (T-16)	20:58	4	06:16 (T-19)	21:17	30	06:37 (T-19)
27	07:52	07:09	07:18	06:24	06:45 (T-41)	05:48		06:11 (T-19)	05:43	06:07 (T-19)		
	17:28	18:10	19:46	20:25	23	20:02 (T-16)	20:59	7	06:18 (T-19)	21:17	30	06:37 (T-19)
28	07:51	07:07	07:17	06:22	06:43 (T-41)	05:47		06:11 (T-19)	05:43	06:08 (T-19)		
	17:29	18:11	19:47	20:26	25	20:02 (T-16)	21:00	10	06:21 (T-19)	21:17	30	06:38 (T-19)
29	07:50		07:15	06:21	06:42 (T-41)	05:47		06:10 (T-19)	05:44	06:08 (T-19)		
	17:30		19:49	20:27	28	20:04 (T-16)	21:01	12	06:22 (T-19)	21:17	29	06:37 (T-19)
30	07:49		07:13	06:19	06:40 (T-41)	05:46		06:09 (T-19)	05:44	06:09 (T-19)		
	17:32		19:50	20:29	31	20:05 (T-16)	21:02	14	06:23 (T-19)	21:17	29	06:38 (T-19)
31	07:48		07:11									
	17:33		19:51	3	19:27 (T-15)							
Potential sun hours	287	292	369	404	459	465						
Total, worst case			3	573	264	835						
Sun reduction			0.59	0.63	0.66	0.73						
Oper. time red.			0.90	0.90	0.90	0.90						
Wind dir. red.			0.60	0.59	0.60	0.59						
Total reduction			0.32	0.33	0.36	0.39						
Total, real			1	190	94	322						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-025 - R-025

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December	
1	05:45 21:16	06:09 (T-19) 06:37 (T-19)	06:12 20:55	06:48 20:07	07:10 (T-20) 07:33 (T-20)	07:24 19:11	07:43 17:17
2	05:45 21:16	06:10 (T-19) 06:38 (T-19)	06:13 20:54	06:50 20:05	07:11 (T-20) 07:33 (T-20)	07:25 19:09	07:44 17:15
3	05:46 21:16	06:10 (T-19) 06:37 (T-19)	06:14 20:52	06:51 20:03	07:13 (T-20) 19:35 (T-15)	07:26 19:07	07:45 17:14
4	05:47 21:16	06:11 (T-19) 06:37 (T-19)	06:16 20:51	06:52 20:01	07:14 (T-20) 19:37 (T-15)	07:28 19:05	07:47 17:12
5	05:47 21:16	06:12 (T-19) 06:37 (T-19)	06:17 20:50	06:53 20:20 (T-16)	07:15 (T-20) 19:35 (T-15)	07:29 19:03	07:48 17:11
6	05:48 21:15	06:12 (T-19) 06:37 (T-19)	06:18 20:48	06:54 20:21 (T-16)	07:16 (T-20) 19:33 (T-15)	07:30 19:01	07:49 17:10
7	05:48 21:15	06:13 (T-19) 06:37 (T-19)	06:19 20:47	06:55 20:21 (T-16)	07:17 (T-20) 19:31 (T-15)	07:31 19:00	07:50 17:09
8	05:49 21:15	06:14 (T-19) 06:36 (T-19)	06:20 20:46	06:57 20:19 (T-16)	07:18 (T-20) 19:29 (T-15)	07:33 18:56	07:51 17:07
9	05:50 21:14	06:14 (T-19) 06:35 (T-19)	06:21 20:44	06:58 20:18 (T-16)	07:19 (T-20) 19:27 (T-15)	07:34 18:54	07:52 17:06
10	05:51 21:14	06:15 (T-19) 06:35 (T-19)	06:23 20:43	06:59 20:18 (T-16)	07:20 (T-20) 19:25 (T-15)	07:35 18:52	07:53 17:05
11	05:52 21:13	06:16 (T-19) 06:35 (T-19)	06:24 20:41	07:00 20:16 (T-16)	07:22 (T-20) 19:24 (T-15)	07:36 18:51	07:53 17:04
12	05:52 21:13	06:17 (T-19) 06:34 (T-19)	06:25 20:40	07:01 20:15 (T-16)	07:23 (T-20) 19:22 (T-15)	07:38 18:49	07:54 17:03
13	05:53 21:12	06:17 (T-19) 06:32 (T-19)	06:26 20:38	07:02 20:13 (T-16)	07:24 (T-20) 19:21 (T-15)	07:39 18:47	07:55 17:02
14	05:54 21:12	06:18 (T-19) 06:31 (T-19)	06:27 20:37	07:04 20:11 (T-16)	07:25 (T-20) 19:20 (T-15)	07:40 18:45	07:56 17:01
15	05:55 21:11	06:19 (T-19) 06:30 (T-19)	06:28 20:35	07:05 20:10 (T-16)	07:26 (T-20) 19:19 (T-15)	07:41 18:44	07:57 17:00
16	05:56 21:10	06:20 (T-19) 06:29 (T-19)	06:30 20:34	07:06 20:08 (T-16)	07:27 (T-20) 19:18 (T-15)	07:42 18:42	07:57 16:59
17	05:57 21:09	06:21 (T-19) 06:27 (T-19)	06:31 20:32	07:07 20:06 (T-16)	07:28 (T-20) 19:17 (T-15)	07:43 18:40	07:57 16:58
18	05:58 21:09	06:22 (T-19) 06:23 (T-19)	06:32 20:31	07:08 20:06 (T-16)	07:29 (T-20) 19:16 (T-15)	07:44 18:38	07:59 16:57
19	05:59 21:08	06:23 (T-19)	06:33	07:10	07:30 (T-20)	07:45	08:00
20	06:00 21:07		06:34	07:11	07:31 (T-20)	07:46	08:00
21	06:01 21:06		06:35	07:12	07:32 (T-20)	07:47	08:01
22	06:02 21:05		06:37	07:13	07:33 (T-20)	07:48	08:01
23	06:03 21:04		06:38	07:14	07:34 (T-20)	07:49	08:02
24	06:04 21:04		06:39	07:16 (T-20)	07:35 (T-20)	07:50	08:02
25	06:05 21:03		06:40	07:17 (T-20)	07:36 (T-20)	07:51	08:03
26	06:06 21:02		06:41	07:18 (T-20)	07:37 (T-20)	07:52	08:03
27	06:07 21:01		06:43	07:19 (T-20)	07:38 (T-20)	07:53	08:03
28	06:08 20:59		06:44	07:20 (T-20)	07:39 (T-20)	07:54	08:03
29	06:09 20:58		06:45	07:22 (T-20)	07:40 (T-20)	07:55	08:04
30	06:10 20:57		06:46	07:23 (T-20)	07:41 (T-20)	07:56	08:04
31	06:11 20:56		06:47	07:24 (T-20)	07:42 (T-20)	07:57	08:04
Potential sun hours	471	436	377	341	288	275	
Total, worst case	337	544	242				
Sun reduction	0.75	0.72	0.67				
Oper. time red.	0.90	0.90	0.90				
Wind dir. red.	0.59	0.59	0.58				
Total reduction	0.40	0.38	0.35				
Total, real	133	209	85				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-026 - R-026

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04 16:57	07:47 17:35	07:06 18:13	17:36 (T-30) 18:13 15	07:09 19:53	06:18 20:30
2	08:04 16:58	07:46 17:36	07:04 18:14	17:36 (T-30) 17:52 (T-30)	07:07 19:54	06:17 20:31
3	08:04 16:59	07:45 17:38	07:02 18:15	17:36 (T-30) 17:54 (T-30)	07:06 19:55	06:15 20:32
4	08:04 17:00	07:43 17:39	07:01 18:17	17:36 (T-30) 17:55 (T-30)	07:04 19:56	06:14 20:34
5	08:04 17:01	07:42 17:41	06:59 18:18	17:36 (T-30) 17:56 (T-30)	07:02 19:58	06:12 20:35
6	08:04 17:02	07:41 17:42	06:57 18:19	17:38 (T-30) 17:56 (T-30)	07:00 19:59	06:11 20:36
7	08:04 17:03	07:40 17:43	06:55 18:21	17:39 (T-30) 17:54 (T-30)	06:58 20:00	06:10 20:37
8	08:04 17:04	07:38 17:45	07:54 18:22	18:42 (T-30) 18:51 (T-30)	06:56 20:01	06:08 20:38
9	08:04 17:05	07:37 17:46	07:52 19:23	07:52 20:03	06:55 20:40	06:07 21:10
10	08:03 17:06	07:36 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:41 21:11
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:42	05:41 21:11
12	08:03 17:08	07:33 17:50	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12
13	08:02 17:09	07:31 17:52	07:44 19:28	06:48 20:08	06:02 20:44	05:41 21:13
14	08:02 17:11	07:30 17:53	07:43 19:30	06:46 20:09	06:01 20:45	05:41 21:13
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	06:00 20:47	05:41 21:14
16	08:01 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:59 20:48	05:41 21:14
17	08:00 17:14	07:25 17:57	07:37 19:34	06:41 20:12	05:57 20:49	05:41 21:14
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:14	05:56 20:50	05:41 21:15
19	07:59 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	05:41 21:15
20	07:58 17:18	07:21 18:00	07:32 19:37	06:36 20:16	05:54 20:52	05:41 21:16
21	07:57 17:20	07:19 18:02	07:30 19:39	06:34 20:17	05:53 20:53	05:41 21:16
22	07:57 17:21	07:18 18:03	07:28 19:40	06:32 20:19	05:53 20:54	05:42 21:16
23	07:56 17:22	07:16 18:04	17:41 (T-30) 17:42 (T-30)	07:26 19:41	06:31 20:20	05:52 20:55
24	07:55 17:24	07:14 18:06	17:39 (T-30) 18:06 (T-30)	07:24 19:42	06:29 20:21	05:51 20:56
25	07:54 17:25	07:13 18:07	17:37 (T-30) 17:45 (T-30)	07:22 19:44	06:27 20:22	05:50 20:57
26	07:53 17:26	07:11 18:09	17:37 (T-30) 17:47 (T-30)	07:20 19:45	06:26 20:24	05:49 20:58
27	07:52 17:28	07:09 18:10	17:36 (T-30) 17:48 (T-30)	07:19 19:46	06:24 20:25	05:48 20:59
28	07:51 17:29	07:08 18:11	17:36 (T-30) 17:49 (T-30)	07:17 19:48	06:23 20:26	05:48 21:00
29	07:50 17:31		07:15 19:49	06:21 20:27	05:47 21:01	05:44 21:17
30	07:49 17:32		07:13 19:50	06:20 20:29	05:46 21:02	05:44 21:17
31	07:48 17:33		07:11 19:51		05:46 21:03	
Potential sun hours	287	292	369	403	459	465
Total, worst case						
Sun reduction		49	130	57	75	
Oper. time red.		0.58	0.59	0.63	0.66	
Wind dir. red.		0.90	0.90	0.90	0.90	
Total reduction		0.58	0.58	0.58	0.58	
Total, real		0.30	0.31	0.33	0.35	
		15	40	19	26	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-026 - R-026

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45	06:12		06:49	07:24	07:04
	21:16	20:55		20:07	19:11	17:17
2	05:45	06:14		06:50	07:25	07:05
	21:16	20:54		20:05	19:09	17:15
3	05:46	06:15		06:51	07:27	07:07
	21:16	20:52		20:03	19:07	17:14
4	05:47	06:16		06:52	07:28	07:08
	21:16	20:51		20:01	19:05	17:13
5	05:47	06:17		06:53	07:29	07:09
	21:16	20:50		20:00	19:03	17:11
6	05:48	06:18		06:54	07:30	07:11
	21:15	20:48		19:58	19:02	17:10
7	05:49	06:19	3	06:52 (T-18)	07:31	07:12
	21:15	20:47	10	06:55 (T-18)	19:56	19:00
8	05:49	06:20		06:44 (T-18)	06:57	07:33
	21:15	20:46	14	06:58 (T-18)	19:54	18:56
9	05:50	06:22		06:45 (T-18)	06:58	07:34
	21:14	20:44	14	06:59 (T-18)	19:52	18:54
10	05:51	06:23		06:46 (T-18)	06:59	07:35
	21:14	20:43	14	07:00 (T-18)	19:50	18:52
11	05:52	06:24		06:47 (T-18)	07:00	07:36
	21:13	20:41	13	07:00 (T-18)	19:48	18:51
12	05:52	06:25		06:48 (T-18)	07:01	07:38
	21:13	20:40	13	07:01 (T-18)	19:47	18:49
13	05:53	06:26		06:49 (T-18)	07:03	07:39
	21:12	20:38	12	07:01 (T-18)	19:45	18:47
14	05:54	06:27		06:50 (T-18)	07:04	07:40
	21:12	20:37	11	07:01 (T-18)	19:43	18:45
15	05:55	06:29		06:51 (T-18)	07:05	07:42
	21:11	20:35	9	07:00 (T-18)	19:41	18:44
16	05:56	06:30		06:52 (T-18)	07:06	07:43
	21:10	20:34	8	07:00 (T-18)	19:39	18:42
17	05:57	06:31		06:54 (T-18)	07:07	07:44
	21:10	20:32	6	07:00 (T-18)	19:37	18:40
18	05:58	06:32		06:55 (T-18)	07:09	07:45
	21:09	20:31	5	07:00 (T-18)	19:35	18:39
19	05:59	06:33		06:56 (T-18)	07:10	07:47
	21:08	20:29	3	06:59 (T-18)	19:33	18:37
20	06:00	06:34		06:57 (T-18)	07:11	07:48
	21:07	20:27	1	06:58 (T-18)	19:31	18:35
21	06:01	06:36			07:12	07:49
	21:06	20:26			19:30	18:34
22	06:02	06:37			07:13	07:51
	21:05	20:24			19:28	18:32
23	06:03	06:38			07:14	07:52
	21:05	20:22			19:26	18:30
24	06:04	06:39			07:16	07:53
	21:04	20:21			19:24	18:29
25	06:05	06:40			07:17	07:55
	21:03	20:19			19:22	18:27
26	06:06	06:41			07:18	07:56
	21:02	20:17			19:20	18:26
27	06:07	06:43			07:19	07:57
	21:01	20:16			19:18	18:24
28	06:08	06:44			07:20	07:59
	20:59	20:14			19:16	18:23
29	06:09	06:45			07:22	08:00
	20:58	20:12			19:15	18:21
30	06:10	06:46			07:23	08:01
	20:57	20:10			19:13	18:20
31	06:11	06:47				08:03
	20:56	20:09				18:18
Potential sun hours	471	436		377	341	288
Total, worst case			136		179	
Sun reduction			0.72		0.56	
Oper. time red.			0.90		0.90	
Wind dir. red.			0.58		0.58	
Total reduction			0.38		0.29	
Total, real		52			52	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-027 - R-027

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	08:09 (T-18)	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04
	16:57	17:35	28 08:37 (T-18)	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17
2	08:04	07:46	08:08 (T-18)	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05
	16:58	17:36	29 08:37 (T-18)	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15
3	08:04	07:45	08:06 (T-18)	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07
	16:59	17:38	30 08:36 (T-18)	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14
4	08:04	07:43	08:06 (T-18)	07:01	07:04	06:14	05:43	05:47	06:16	06:52	07:28	07:08
	17:00	17:39	30 08:36 (T-18)	18:17	19:56	20:34	21:07	21:16	20:51	20:01	19:05	17:13
5	08:04	07:42	08:07 (T-18)	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09
	17:01	17:40	29 08:36 (T-18)	18:18	19:57	20:35	21:07	21:16	20:50	20:00	19:03	17:11
6	08:04	07:41	08:09 (T-18)	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11
	17:02	17:42	26 08:35 (T-18)	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10
7	08:04	07:40	08:09 (T-18)	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12
	17:03	17:43	25 08:34 (T-18)	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09
8	08:04	07:38	08:11 (T-18)	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13
	17:04	17:45	22 08:33 (T-18)	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:07
9	08:04	07:37	08:12 (T-18)	07:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15
	17:05	17:46	19 08:31 (T-18)	19:23	20:02	20:40	21:10	21:14	20:44	19:52	18:54	17:06
10	08:03	07:36	08:14 (T-18)	07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16
	17:06	17:48	15 08:29 (T-18)	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05
11	08:03	07:34	08:19 (T-18)	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:18
	17:07	17:49	7 08:26 (T-18)	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04
12	08:03	07:33		07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19
	17:08	17:50		19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03
13	08:02	07:31		06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:39	07:20
	17:09	17:52		19:28	20:07	20:44	21:13	21:12	20:38	19:45	18:47	17:02
14	08:02	07:30		07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22
	17:11	17:53		19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	17:01
15	08:01	07:28		07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:23
	17:12	17:55		19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00
16	08:01	08:24 (T-18)	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24
	17:13	2 08:26 (T-18)	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59
17	08:00	08:23 (T-18)	07:25	07:37	06:41	05:57	05:41	05:57	06:31	07:07	07:44	07:26
	17:14	4 08:27 (T-18)	17:57	19:34	20:12	20:49	21:14	21:10	20:32	19:37	18:40	16:58
18	07:59	08:22 (T-18)	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27
	17:16	6 08:28 (T-18)	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57
19	07:59	08:22 (T-18)	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28
	17:17	8 08:30 (T-18)	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56
20	07:58	08:21 (T-18)	07:21	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:30
	17:18	10 08:31 (T-18)	18:00	19:37	20:16	20:52	21:16	21:07	20:27	19:31	18:35	16:55
21	07:57	08:20 (T-18)	07:19	07:30	06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31
	17:20	12 08:32 (T-18)	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54
22	07:57	08:19 (T-18)	07:18	07:28	06:32	05:52	05:41	06:02	06:37	07:13	07:51	07:32
	17:21	13 08:32 (T-18)	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:53
23	07:56	08:18 (T-18)	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33
	17:22	15 08:33 (T-18)	18:04	19:41	20:20	20:55	21:16	21:05	20:22	19:26	18:30	16:53
24	07:55	08:17 (T-18)	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35
	17:24	17 08:34 (T-18)	18:06	19:42	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52
25	07:54	08:17 (T-18)	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:55	07:36
	17:25	18 08:35 (T-18)	18:07	19:44	20:22	20:57	21:17	21:03	20:19	19:22	18:27	16:51
26	07:53	08:16 (T-18)	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37
	17:26	20 08:36 (T-18)	18:08	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51
27	07:52	08:14 (T-18)	07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39
	17:28	21 08:35 (T-18)	18:10	19:46	20:25	20:59	21:17	21:01	20:16	19:18	18:24	16:50
28	07:51	08:13 (T-18)	07:08	07:17	06:23	05:48	05:43	06:08	06:44	07:20	07:59	07:40
	17:29	23 08:36 (T-18)	18:11	19:47	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50
29	07:50	08:12 (T-18)		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41
	17:31	24 08:36 (T-18)		19:49	20:27	21:01	21:17	20:58	20:12	19:14	18:21	16:49
30	07:49	08:11 (T-18)		07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42
	17:32	25 08:36 (T-18)		19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49
31	07:48	08:10 (T-18)		07:11		05:46		06:11	06:47		08:03	08:04
	17:33	27 08:37 (T-18)		19:51	21:03			20:56	20:09		18:18	16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case	245	260								9	502	
Sun reduction	0.58	0.58								0.56	0.48	
Oper. time red.	0.90	0.90								0.90	0.90	
Wind dir. red.	0.65	0.65								0.65	0.65	
Total reduction	0.34	0.34								0.33	0.28	
Total, real	83	88								3	140	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christianajansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-028 - R-028
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57 09:18 (T-44)	07:47 17:35 09:13 (T-44)	07:06 18:12 08:37 (T-45)	07:09 19:52 08:37 (T-45)	06:18 20:30 19:52	05:45 21:04 20:30	05:45 21:16 20:55	06:12 20:07 20:55	06:48 19:11 06:13	07:04 17:17 06:50	07:04 17:15 07:05	07:43 16:48 08:13 (T-45)
31	07:48 17:33	08:38 (T-45) 18:01	07:11 19:51	06:11 21:03	05:46 20:58	06:11 20:58	06:47 20:10	06:47 20:08	08:02 18:18	07:42 16:49	08:04 16:56	08:04 16:56
	Potential sun hours	287	292	369	403	459	465	471	377	341	288	275
	Total, worst case	382	53								418	343
	Sun reduction	0.58	0.58								0.48	0.52
	Oper. time red.	0.90	0.90								0.80	0.90
	Wind dir. red.	0.65	0.65								0.65	0.68
	Total reduction	0.34	0.34								0.28	0.32
	Total, real	129	18								117	109

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker (WTG causing flicker first time)	Last time (hh:mm) with flicker (WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-054 - R-054

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:56	17:34	18:12	19:52	20:30	21:04	21:16	20:55	20:06	19:10	17:16	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:57	17:36	18:14	19:53	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:47
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:13	05:43	05:46	06:15	06:52	07:27	07:08	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:12	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:42	05:48	06:18	06:54	07:30	07:10	07:48
	17:01	17:42	18:19	19:58	20:36	21:08	21:15	20:48	19:57	19:01	17:10	16:46
7	08:04	07:39	06:55	06:58	06:09	05:42	05:48	06:19	06:55	07:31	07:12	07:49
	17:02	17:43	18:20	20:00	20:37	21:09	21:15	20:47	19:56	18:58	17:08	16:46
8	08:04	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50
	17:03	17:44	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	06:07	05:41	05:50	06:21	06:58	07:34	07:15	07:51
	17:04	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:05	05:41	05:50	06:22	06:59	07:35	07:16	07:52
	17:06	17:47	19:24	20:03	20:40	21:11	21:14	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	05:51	06:23	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:50	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:19	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:02	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:01	16:46
14	08:01	07:30	07:42	06:45	06:00	05:40	05:54	06:27	07:03	07:40	07:21	07:56
	17:10	17:53	19:29	20:08	20:45	21:13	21:11	20:37	19:42	18:45	17:00	16:46
15	08:01	07:28	07:40	06:44	05:59	05:40	05:55	06:28	07:05	07:41	07:23	07:57
	17:12	17:54	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:43	16:59	16:47
16	08:00	07:27	07:39	06:42	05:58	05:40	05:56	06:29	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57	05:40	05:56	06:30	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:57	16:47
18	07:59	07:24	07:35	06:39	05:56	05:40	05:57	06:32	07:08	07:45	07:27	07:59
	17:15	17:59	19:35	20:13	20:50	21:15	21:09	20:30	19:35	18:38	16:56	16:47
19	07:59	07:22	07:33	06:37	05:55	05:41	05:58	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	05:59	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:33	05:53	05:41	06:00	06:35	07:12	07:49	07:31	08:00
	17:19	18:01	19:38	20:17	20:53	21:16	21:06	20:26	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:01	06:36	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:16	21:05	20:24	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	05:51	05:41	06:02	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:52	16:50
24	07:55	07:14	07:24	06:29	05:50	05:42	06:03	06:39	07:15	07:53	07:35	08:02
	17:23	18:05	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:28	16:52	16:50
25	07:54	07:12	07:22	06:27	05:49	05:42	06:04	06:40	07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:25	05:49	05:42	06:05	06:41	07:18	07:56	07:37	08:03
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:50	16:51
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:27	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:43	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:22	16:49	16:53
29	07:50		07:14	06:21	05:47	05:44	06:09	06:45	07:21	08:00	07:41	08:04
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:48	16:54
31	07:48		07:11		05:45		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:55
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-055 - R-055
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:47	07:06	17:48 (T-22)	07:09	06:18	05:45	05:45	06:12	06:48	07:24	18:23 (T-22)	07:04	07:43		
	16:56	17:34	18:12	2	17:50 (T-22)	19:52	20:30	21:04	21:16	20:55	20:06	19:10	21	18:44 (T-22)	17:16	16:48
2	08:04	07:45	07:04	17:46 (T-22)	07:07	06:16	05:44	05:45	06:13	06:49	07:25	18:21 (T-22)	07:05	07:44		
	16:57	17:36	18:14	5	17:51 (T-22)	19:53	20:31	21:05	21:16	20:53	20:05	19:09	22	18:43 (T-22)	17:15	16:48
3	08:04	07:44	07:02	17:45 (T-22)	07:05	06:15	05:44	05:46	06:14	06:51	07:26	18:20 (T-22)	07:06	07:45		
	16:58	17:37	18:15	9	17:54 (T-22)	19:55	20:32	21:05	21:16	20:52	20:03	19:07	21	18:41 (T-22)	17:14	16:47
4	08:04	07:43	07:00	17:44 (T-22)	07:03	06:13	05:43	05:46	06:15	06:52	07:27	18:20 (T-22)	07:08	07:46		
	16:59	17:39	18:16	11	17:55 (T-22)	19:56	20:33	21:06	21:16	20:51	20:01	19:05	20	18:40 (T-22)	17:12	16:47
5	08:04	07:42	06:59	17:43 (T-22)	07:02	06:12	05:43	05:47	06:17	06:53	07:29	18:19 (T-22)	07:09	07:47		
	17:00	17:40	18:18	13	17:56 (T-22)	19:57	20:34	21:07	21:15	20:49	19:59	19:03	19	18:38 (T-22)	17:11	16:47
6	08:04	07:41	06:57	17:42 (T-22)	07:00	06:11	05:42	05:48	06:18	06:54	07:30	18:28 (T-22)	07:10	07:48		
	17:01	17:42	18:19	15	17:57 (T-22)	19:58	20:36	21:08	21:15	20:48	19:57	19:01	18	18:36 (T-22)	17:10	16:46
7	08:04	07:39	06:55	17:42 (T-22)	06:58	06:09	05:42	05:48	06:19	06:55	07:31	18:31	18	18:36 (T-22)	17:10	16:46
	17:02	17:43	18:20	16	17:58 (T-22)	20:00	20:37	21:09	21:15	20:47	19:56	18:58	16	18:34 (T-22)	17:08	16:46
8	08:03	07:38	07:53	18	18:42 (T-22)	06:56	06:08	05:42	05:49	06:20	06:56	07:32	16	18:19 (T-22)	07:13	07:50
	17:03	17:44	18:22	18	19:00 (T-22)	20:01	20:38	21:09	21:14	20:45	19:54	18:56	14	18:33 (T-22)	17:07	16:46
9	08:03	07:37	07:51	18	18:42 (T-22)	06:54	06:07	05:41	05:50	06:21	06:58	07:34	14	18:19 (T-22)	07:15	07:51
	17:04	17:46	19:23	20	19:02 (T-22)	20:02	20:39	21:10	21:14	20:44	19:52	18:54	11	18:30 (T-22)	17:06	16:46
10	08:03	07:35	07:50	18	18:42 (T-22)	06:53	06:05	05:41	05:51	06:22	06:59	07:35	9	18:19 (T-22)	07:16	07:52
	17:06	17:47	19:24	21	19:03 (T-22)	20:03	20:40	21:11	21:14	20:43	19:50	18:52	9	18:28 (T-22)	17:05	16:46
11	08:03	07:34	07:48	18	18:42 (T-22)	06:51	06:04	05:41	05:51	06:23	07:00	07:36	7	18:19 (T-22)	07:17	07:53
	17:07	17:49	19:26	22	19:04 (T-22)	20:05	20:42	21:11	21:13	20:41	19:48	18:50	7	18:26 (T-22)	17:04	16:46
12	08:02	07:33	07:46	18	18:43 (T-22)	06:49	06:03	05:41	05:52	06:25	07:01	07:37	4	18:21 (T-22)	07:19	07:54
	17:08	17:50	19:27	22	19:05 (T-22)	20:06	20:43	21:12	21:12	20:40	19:46	18:49	4	18:25 (T-22)	17:02	16:46
13	08:02	07:31	07:44	18	18:43 (T-22)	06:47	06:02	05:41	05:53	06:26	07:02	07:39	1	18:22 (T-22)	07:20	07:55
	17:09	17:52	19:28	20	19:03 (T-22)	20:07	20:44	21:12	21:12	20:38	19:44	18:47	1	18:23 (T-22)	17:01	16:46
14	08:01	07:30	07:42	18	18:46 (T-22)	06:45	06:00	05:41	05:54	06:27	07:03	07:40			07:21	07:56
	17:10	17:53	19:29	16	19:02 (T-22)	20:08	20:45	21:13	21:11	20:37	19:42	18:45			17:00	16:46
15	08:01	07:28	07:40	18	18:47 (T-22)	06:44	05:59	05:40	05:55	06:28	07:05	07:41			07:23	07:57
	17:12	17:54	19:31	12	18:59 (T-22)	20:10	20:46	21:13	21:11	20:35	19:41	18:43			16:59	16:47
16	08:00	07:27	07:39		06:42	05:58	05:40	05:56	06:29	07:06	07:42	07:42			07:24	07:57
	17:13	17:56	19:32		20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:58			16:58	16:47
17	08:00	07:25	07:37		06:40	05:57	05:40	05:56	06:31	07:07	07:44	07:44			07:25	07:58
	17:14	17:57	19:33		20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:57			16:57	16:47
18	07:59	07:24	07:35		06:39	05:56	05:41	05:57	06:32	07:08	07:45	07:45			07:27	07:59
	17:15	17:59	19:35		20:13	20:50	21:15	21:09	20:30	19:35	18:38	16:56			16:56	16:47
19	07:58	07:22	07:33		06:37	05:55	05:41	05:58	06:33	07:09	07:46	07:46			07:28	07:59
	17:17	18:00	19:36		20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56			16:56	16:48
20	07:58	07:20	07:31		06:35	05:54	05:41	05:59	06:34	07:11	07:48	07:48			07:29	08:00
	17:18	18:00	19:37		20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55			16:55	16:48
21	07:57	07:19	07:29		06:33	05:53	05:41	06:00	06:35	07:12	07:49	07:49			07:31	08:00
	17:19	18:01	19:38		20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54			16:54	16:49
22	07:56	07:17	07:27		06:32	05:52	05:41	06:01	06:36	07:13	07:50	07:50			07:32	08:01
	17:21	18:03	19:40		20:18	20:54	21:16	21:05	20:24	19:27	18:32	16:53			16:53	16:49
23	07:55	07:16	07:26		06:30	05:51	05:41	06:02	06:38	07:14	07:52	07:52			07:33	08:01
	17:22	18:04	19:41		20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:52			16:52	16:50
24	07:55	07:14	07:24		06:29	05:50	05:42	06:03	06:39	07:15	07:53	07:53			07:34	08:02
	17:23	18:05	19:42		20:21	20:56	21:16	21:03	20:20	19:24	18:28	16:52			16:52	16:50
25	07:54	07:12	07:22		06:27	05:50	05:42	06:04	06:40	07:16	07:54	07:54			07:36	08:02
	17:25	18:07	19:43		20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51			16:51	16:51
26	07:53	07:11	07:20		06:25	05:49	05:42	06:05	06:41	07:18	07:56	07:56			07:37	08:03
	17:26	18:08	19:45		20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:50			16:50	16:51
27	07:52	07:09	07:18		06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:57			07:38	08:03
	17:27	18:10	19:46		20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50			16:50	16:52
28	07:51	07:07	07:16		06:22	05:47	05:43	06:08	06:43	07:20	07:58	07:58			07:39	08:03
	17:29	18:11	19:47		20:26	21:00	21:16	20:59	20:14	19:16	18:22	16:49			16:49	16:53
29	07:50		07:14		06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:59			07:41	08:03
	17:30		19:48		20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49			16:49	16:54
30	07:49		07:13		06:19	05:46	05:44	06:10	06:46	07:23	07:59	07:59			07:42	08:04
	17:32		19:50		20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:48			16:48	16:54
31	07:48		07:11			05:45		06:11	06:47		08:02	08:02				08:04
	17:33		19:51			21:03		20:56	20:08		18:18	16:55				16:55
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275				
Total, worst case			222						43		183					
Sun reduction			0.59						0.67		0.56					
Oper. time red.			0.90						0.90		0.90					
Wind dir. red.			0.57						0.57		0.57					
Total reduction			0.30						0.35		0.29					
Total, real			68					15			53					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project: South Deuel Wind Project

Description: Invenergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Assumptions for shadow calculations

Shadow receptor: R-061 - R-061

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with columns for months (January to December) and rows for specific times of day (08:04 to 17:33). Includes summary rows for Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, and Total, real.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-062 - R-062
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:29	21:04	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:14	05:43	05:47	06:16	06:52	07:27	07:08	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:12	16:47
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
6	08:04	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48
	17:01	17:42	18:19	19:58	20:36	21:08	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:09	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:02	17:43	18:20	20:00	20:37	21:08	21:15	20:47	19:55	18:58	17:09	16:46
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:06	05:41	05:51	06:22	06:59	07:35	07:16	07:52
	17:06	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:41	21:11	21:13	20:41	19:48	18:50	17:04	16:46
12	08:02	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	16:46
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	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:33	19:39	18:42	16:58	16:47
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18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:58
	17:16	17:59	19:35	20:13	20:50	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
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22	07:56	07:17	07:27	06:32	05:52	05:41	06:02	06:37	07:13	07:50	07:32	08:01
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	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:28	16:52	16:50
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02
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27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:39	08:03
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	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
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	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55
31	07:48		07:11		05:45		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:55
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-064 - R-064

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:14	05:43	05:47	06:16	06:52	07:27	07:08	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:12	16:47
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
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	17:01	17:42	18:19	19:58	20:35	21:08	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:09	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:08	21:14	20:47	19:55	18:58	17:09	16:47
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	17:06	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
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16	08:00	07:27	07:39	06:42	05:58	05:41	05:56	06:29	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:13	21:10	20:33	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:58	16:47
18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:26	07:58
	17:16	17:59	19:35	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16:57	16:48
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	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
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25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:36	08:02
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	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
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	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:22	08:01	07:42	08:03
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55
31	07:48		07:11	06:17	05:46		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-065 - R-065

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:29	21:04	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
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	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:12	16:47
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	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
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	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46
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	17:06	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
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12	08:02	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:18	07:54
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17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
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19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
	17:20	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:15	21:05	20:24	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	05:51	05:42	06:03	06:38	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52	16:50
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:13	19:16	18:22	16:49	16:53
29	07:50		07:14	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:22	08:01	07:42	08:03
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55
31	07:48		07:11	06:17	05:46		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-066 - R-066

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:47	07:05	07:09	19:11 (T-53)	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43			
	16:57	17:35	18:12	19:52	20	19:31 (T-53)	20:29	21:04	21:16	20:54	20:06	19:10	17:17	16:48		
2	08:04	07:45	07:04	07:07	19:11 (T-53)	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44			
	16:58	17:36	18:14	19:53	21	19:32 (T-53)	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48		
3	08:04	07:44	07:02	07:05	19:11 (T-53)	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45			
	16:58	17:37	18:15	19:55	22	19:33 (T-53)	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47		
4	08:04	07:43	07:00	07:03	19:12 (T-53)	06:14	05:43	05:47	06:16	06:52	19:17 (T-53)	07:27	07:08	07:46		
	16:59	17:39	18:16	19:56	23	19:35 (T-53)	20:33	21:06	21:15	20:51	20:01	19:22 (T-53)	19:05	17:12	16:47	
5	08:04	07:42	06:59	07:02	19:13 (T-53)	06:12	05:43	05:47	06:17	06:53	19:12 (T-53)	07:29	07:09	07:47		
	17:00	17:40	18:18	19:57	20	19:33 (T-53)	20:34	21:07	21:15	20:49	19:59	14	19:26 (T-53)	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	19:14 (T-53)	06:11	05:43	05:48	06:18	06:54	19:10 (T-53)	07:30	07:10	07:48		
	17:01	17:42	18:19	19:58	17	19:31 (T-53)	20:36	21:08	21:15	20:48	19:57	17	19:27 (T-53)	19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	19:15 (T-53)	06:09	05:42	05:49	06:19	06:55	19:27 (T-53)	07:31	07:12	07:49		
	17:03	17:43	18:20	20:00	14	19:29 (T-53)	20:37	21:08	21:15	20:47	19:56	20	19:28 (T-53)	18:58	17:09	16:47
8	08:03	07:38	07:53	06:56	19:19 (T-53)	06:08	05:42	05:49	06:20	06:56	19:06 (T-53)	07:32	07:13	07:50		
	17:04	17:45	18:22	20:01	5	19:24 (T-53)	20:38	21:09	21:14	20:45	19:54	23	19:29 (T-53)	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	20:02	06:07	05:42	05:50	06:21	06:58	19:05 (T-53)	07:34	07:14	07:51		
	17:05	17:46	18:23	20:02	20:39	21:10	21:14	20:44	19:52	22	19:27 (T-53)	18:54	17:06	16:46		
10	08:03	07:35	07:50	06:53	20:03	06:06	05:41	05:51	06:22	06:59	19:04 (T-53)	07:35	07:16	07:52		
	17:06	17:47	18:24	20:03	20:40	21:10	21:13	20:42	19:50	21	19:25 (T-53)	18:52	17:05	16:46		
11	08:02	07:34	07:48	06:51	20:04	06:04	05:41	05:52	06:24	07:00	19:03 (T-53)	07:36	07:17	07:53		
	17:07	17:49	18:26	20:05	20:42	21:11	21:13	20:41	19:48	20	19:23 (T-53)	18:50	17:04	16:46		
12	08:02	07:32	07:46	06:49	20:06	06:03	05:41	05:52	06:25	07:01	19:03 (T-53)	07:37	07:19	07:54		
	17:08	17:50	18:27	20:06	20:43	21:12	21:12	20:40	19:46	19	19:22 (T-53)	18:49	17:03	16:46		
13	08:02	07:31	07:44	06:47	20:07	06:02	05:41	05:53	06:26	07:02	19:03 (T-53)	07:39	07:20	07:55		
	17:09	17:52	18:28	20:07	20:44	21:12	21:12	20:38	19:44	17	19:20 (T-53)	18:47	17:02	16:46		
14	08:01	07:30	07:42	06:46	20:08	06:01	05:41	05:54	06:27	07:04	19:02 (T-53)	07:40	07:21	07:56		
	17:11	17:53	18:29	20:08	20:45	21:13	21:11	20:37	19:42	16	19:18 (T-53)	18:45	17:00	16:47		
15	08:01	07:28	07:40	06:44	20:09	06:00	05:41	05:55	06:28	07:05	19:02 (T-53)	07:41	07:23	07:56		
	17:12	17:54	18:31	20:10	20:46	21:13	21:11	20:35	19:41	14	19:16 (T-53)	18:43	16:59	16:47		
16	08:00	07:27	07:39	06:42	20:11	05:58	05:41	05:56	06:29	07:06	19:02 (T-53)	07:42	07:24	07:57		
	17:13	17:56	18:32	20:11	20:47	21:14	21:10	20:33	19:39	12	19:14 (T-53)	18:42	16:58	16:47		
17	08:00	07:25	07:37	06:40	20:12	05:57	05:41	05:57	06:31	07:07	19:02 (T-53)	07:44	07:25	07:58		
	17:14	17:57	18:33	20:12	20:48	21:14	21:09	20:32	19:37	10	19:12 (T-53)	18:40	16:58	16:47		
18	07:59	07:24	07:35	06:39	20:13	05:56	05:41	05:58	06:32	07:08	19:03 (T-53)	07:45	07:27	07:58		
	17:16	17:59	18:35	20:13	20:50	21:14	21:08	20:30	19:35	7	19:10 (T-53)	18:38	16:57	16:48		
19	07:58	07:22	07:33	06:37	20:15	05:55	05:41	05:59	06:33	07:09	19:05 (T-53)	07:46	07:28	07:59		
	17:17	18:00	18:36	20:15	20:51	21:15	21:08	20:29	19:33	4	19:09 (T-53)	18:37	16:56	16:48		
20	07:58	07:20	07:31	06:35	20:16	05:54	05:41	06:00	06:34	07:11	19:06 (T-53)	07:48	07:29	08:00		
	17:18	18:00	18:37	20:16	20:52	21:15	21:07	20:27	19:31	1	19:07 (T-53)	18:35	16:55	16:48		
21	07:57	07:19	07:29	06:34	20:17	05:53	05:41	06:01	06:35	07:12	19:07 (T-53)	07:49	07:30	08:00		
	17:20	18:01	18:38	20:17	20:53	21:15	21:06	20:25	19:29			18:33	16:54	16:49		
22	07:56	07:17	07:28	06:32	20:18	05:52	05:41	06:02	06:37	07:13	19:03 (T-53)	07:50	07:32	08:01		
	17:21	18:03	18:40	20:18	20:54	21:16	21:05	20:24	19:27			18:32	16:53	16:49		
23	07:55	07:16	07:26	06:30	20:19	05:51	05:42	06:03	06:38	07:14	19:04 (T-53)	07:52	07:33	08:01		
	17:22	18:04	18:41	20:20	20:55	21:16	21:04	20:22	19:26			18:30	16:53	16:50		
24	07:54	07:14	07:24	06:29	19:18 (T-53)	05:51	05:42	06:04	06:39	07:15	19:03 (T-53)	07:53	07:34	08:02		
	17:24	18:06	18:42	20:21	20:56	21:16	21:03	20:20	19:24			18:29	16:52	16:50		
25	07:54	07:12	07:22	06:27	19:16 (T-53)	05:50	05:42	06:05	06:40	07:17	19:04 (T-53)	07:54	07:36	08:02		
	17:25	18:07	18:43	20:22	20:57	21:16	21:02	20:19	19:22			18:27	16:51	16:51		
26	07:53	07:11	07:20	06:26	19:14 (T-53)	05:49	05:43	06:06	06:41	07:18	19:05 (T-53)	07:56	07:37	08:02		
	17:26	18:08	18:45	20:23	20:58	21:16	21:01	20:17	19:20			18:25	16:51	16:52		
27	07:52	07:09	07:18	06:24	19:13 (T-53)	05:48	05:43	06:07	06:42	07:19	19:06 (T-53)	07:57	07:38	08:03		
	17:28	18:10	18:46	20:25	20:59	21:16	21:00	20:15	19:18			18:24	16:50	16:52		
28	07:51	07:07	07:16	06:22	19:12 (T-53)	05:47	05:43	06:08	06:44	07:20	19:07 (T-53)	07:58	07:39	08:03		
	17:29	18:11	18:47	20:26	21:00	21:16	20:59	20:14	19:16			18:22	16:49	16:53		
29	07:50	07:15	07:24	06:21	19:12 (T-53)	05:47	05:44	06:09	06:45	07:21	19:08 (T-53)	08:00	07:40	08:03		
	17:30	18:12	18:48	20:27	21:01	21:16	20:58	20:12	19:14			18:21	16:49	16:54		
30	07:49	07:13	07:22	06:19	19:12 (T-53)	05:46	05:44	06:10	06:46	07:23	19:09 (T-53)	08:01	07:42	08:04		
	17:32	18:14	18:50	20:28	21:02	21:16	20:57	20:10	19:12			18:19	16:49	16:55		
31	07:48	07:11	07:20	06:18	19:11 (T-53)	05:45	05:41	06:11	06:47			08:02	07:43	08:04		
	17:33	18:15	18:51	20:29	21:03	21:17	20:56	20:08				18:18	16:49	16:55		
Potential sun hours	287	292	369	403	458	465	471	436	377	242	341	289	275			
Total, worst case			91	142												
Sun reduction			0.59	0.63						0.67						
Oper. time red.			0.90	0.90						0.90						
Wind dir. red.			0.59	0.59						0.59						
Total reduction			0.32	0.34						0.36						
Total, real			29	48						87						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-067 - R-067

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:09	06:18	05:45
	16:57	17:35	18:12	19:52	20:29	21:04
2	08:04	07:45	07:04	07:07	06:16	05:44
	16:58	17:36	18:14	19:53	20:31	21:04
3	08:04	07:44	07:02	07:05	06:15	05:44
	16:59	17:38	18:15	19:55	20:32	21:05
4	08:04	07:43	07:00	07:03	06:14	05:43
	16:59	17:39	18:16	19:56	20:33	21:06
5	08:04	07:42	06:59	07:02	06:12	05:43
	17:00	17:40	18:18	19:57	20:34	21:07
6	08:04	07:41	17:14 (T-58)	06:57	07:00	06:11
	17:02	17:42	2 17:16 (T-58)	18:19	19:58	20:36
7	08:04	07:39	17:13 (T-58)	06:55	06:58	06:09
	17:03	17:43	5 17:18 (T-58)	18:20	20:00	20:37
8	08:03	07:38	17:11 (T-58)	07:53	06:56	06:08
	17:04	17:45	8 17:19 (T-58)	18:22	20:01	20:38
9	08:03	07:37	17:11 (T-58)	07:51	06:54	06:07
	17:05	17:46	10 17:21 (T-58)	19:23	20:02	20:39
10	08:03	07:35	17:11 (T-58)	07:50	06:53	06:06
	17:06	17:47	12 17:23 (T-58)	19:24	20:03	20:40
11	08:02	07:34	17:10 (T-58)	07:48	06:51	06:04
	17:07	17:49	14 17:24 (T-58)	19:26	20:05	20:42
12	08:02	07:32	17:10 (T-58)	07:46	06:49	06:03
	17:08	17:50	16 17:26 (T-58)	19:27	20:06	20:43
13	08:02	07:31	17:10 (T-58)	07:44	06:47	06:02
	17:09	17:52	17 17:27 (T-58)	19:28	20:07	20:44
14	08:01	07:30	17:10 (T-58)	07:42	06:46	06:01
	17:11	17:53	19 17:29 (T-58)	19:29	20:08	20:45
15	08:01	07:28	17:10 (T-58)	07:40	06:44	06:00
	17:12	17:55	20 17:30 (T-58)	19:31	20:10	20:46
16	08:00	07:27	17:11 (T-58)	07:39	06:42	05:58
	17:13	17:56	21 17:32 (T-58)	19:32	20:11	20:47
17	08:00	07:25	17:11 (T-58)	07:37	06:40	05:57
	17:14	17:57	22 17:33 (T-58)	19:33	20:12	20:48
18	07:59	07:24	17:12 (T-58)	07:35	06:39	05:56
	17:16	17:59	21 17:33 (T-58)	19:35	20:13	20:50
19	07:58	07:22	17:13 (T-58)	07:33	06:37	05:55
	17:17	18:00	18 17:31 (T-58)	19:36	20:15	20:51
20	07:58	07:20	17:14 (T-58)	07:31	06:35	05:54
	17:18	18:00	15 17:29 (T-58)	19:37	20:16	20:52
21	07:57	07:19	17:18 (T-58)	07:29	06:34	05:53
	17:20	18:01	9 17:27 (T-58)	19:38	20:17	20:53
22	07:56	07:17		07:28	06:32	05:52
	17:21	18:03		19:40	20:18	20:54
23	07:55	07:16		07:26	06:30	05:51
	17:22	18:04		19:41	20:20	20:55
24	07:54	07:14		07:24	06:29	05:51
	17:24	18:06		19:42	20:21	20:56
25	07:54	07:12		07:22	06:27	05:50
	17:25	18:07		19:43	20:22	20:57
26	07:53	07:11		07:20	06:26	05:49
	17:26	18:08		19:45	20:23	20:58
27	07:52	07:09		07:18	06:24	05:48
	17:28	18:10		19:46	20:25	20:59
28	07:51	07:07		07:16	06:22	05:48
	17:29	18:11		19:47	20:26	21:00
29	07:50			07:15	06:21	05:47
	17:30			19:48	20:27	21:01
30	07:49			07:13	06:19	05:46
	17:32			19:50	20:28	21:02
31	07:48			07:11	06:17	05:46
	17:33			19:51	21:03	21:03
Potential sun hours	287	292	369	403	458	465
Total, worst case					60	500
Sun reduction					0.66	0.73
Oper. time red.					0.90	0.90
Wind dir. red.					0.64	0.64
Total reduction					0.38	0.42
Total, real		70			23	210

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-067 - R-067

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December		
1	05:45	20:31 (T-52)	06:12	06:48	07:24	07:43		
	21:16	17 20:48 (T-52)	20:54	20:06	19:11	17:17 11 16:51 (T-58)	16:48	
2	05:45	20:32 (T-52)	06:13	06:50	07:25	07:05	16:41 (T-58)	07:44
	21:16	17 20:49 (T-52)	20:53	20:05	19:09	17:15 10 16:51 (T-58)	16:48	
3	05:46	20:32 (T-52)	06:15	06:51	07:26	07:06	16:41 (T-58)	07:45
	21:16	16 20:48 (T-52)	20:52	20:03	19:07	17:14 8 16:49 (T-58)	16:47	
4	05:47	20:32 (T-52)	06:16	06:52	07:27	07:08	16:43 (T-58)	07:46
	21:15	16 20:48 (T-52)	20:51	20:01	19:05	17:12 5 16:48 (T-58)	16:47	
5	05:47	20:33 (T-52)	06:17	06:53	07:29	07:09	16:44 (T-58)	07:47
	21:15	15 20:48 (T-52)	20:49	19:59	19:03	17:11 2 16:46 (T-58)	16:47	
6	05:48	20:32 (T-52)	06:18	06:54	07:30	07:10		07:48
	21:15	15 20:47 (T-52)	20:48	19:57	19:01	17:10		16:47
7	05:49	20:33 (T-52)	06:19	06:55	07:31	07:12		07:49
	21:15	14 20:47 (T-52)	20:47	19:56	18:58	17:09		16:47
8	05:49	20:33 (T-52)	06:20	06:57	07:32	07:13		07:50
	21:14	14 20:47 (T-52)	20:45	19:54	18:56	17:07		16:46
9	05:50	20:33 (T-52)	06:21	06:58	07:34	07:14		07:51
	21:14	13 20:46 (T-52)	20:44	19:52	18:54	17:06		16:46
10	05:51	20:33 (T-52)	06:23	06:59	07:35	07:16		07:52
	21:13	13 20:46 (T-52)	20:42	19:50	18:52	17:05		16:46
11	05:52	20:34 (T-52)	06:24	07:00	07:36	07:17		07:53
	21:13	12 20:46 (T-52)	20:41	19:48	18:50	17:04		16:46
12	05:52	20:34 (T-52)	06:25	07:01	07:37	07:19		07:54
	21:12	11 20:45 (T-52)	20:40	19:46	18:49	17:03		16:46
13	05:53	20:34 (T-52)	06:26	07:02	07:39	07:20		07:55
	21:12	10 20:44 (T-52)	20:38	19:44	18:47	17:02		16:47
14	05:54	20:34 (T-52)	06:27	07:04	07:40	07:21		07:56
	21:11	10 20:44 (T-52)	20:37	19:43	18:45	17:01		16:47
15	05:55	20:35 (T-52)	06:28	07:05	07:41	07:23		07:56
	21:11	8 20:43 (T-52)	20:35	19:41	18:43	17:00		16:47
16	05:56	20:35 (T-52)	06:30	07:06	07:42	07:24		07:57
	21:10	8 20:43 (T-52)	20:33	19:39	18:42	16:59		16:47
17	05:57	20:36 (T-52)	06:31	07:07	07:44	07:25		07:58
	21:09	6 20:42 (T-52)	20:32	19:37	18:40	16:58		16:47
18	05:58	20:36 (T-52)	06:32	07:08	07:45	07:27		07:58
	21:08	6 20:42 (T-52)	20:30	19:35	18:38	16:57		16:48
19	05:59	20:37 (T-52)	06:33	07:09	07:46	07:28		07:59
	21:08	4 20:41 (T-52)	20:29	19:33	18:37	16:56		16:48
20	06:00	20:38 (T-52)	06:34	07:11	07:48	07:29		08:00
	21:07	2 20:40 (T-52)	20:27	19:31	18:35	16:55		16:48
21	06:01	20:39 (T-52)	06:35	07:12	07:49	17:47 (T-58)	07:30	08:00
	21:06	1 20:40 (T-52)	20:25	19:29	18:33	11 17:58 (T-58)	16:54	16:49
22	06:02		06:37	07:13	07:50	17:44 (T-58)	07:32	08:01
	21:05		20:24	19:27	18:32	16 18:00 (T-58)	16:53	16:49
23	06:03		06:38	07:14	07:52	17:43 (T-58)	07:33	08:01
	21:04		20:22	19:26	18:30	19 18:02 (T-58)	16:53	16:50
24	06:04		06:39	07:15	07:53	17:42 (T-58)	07:34	08:02
	21:03		20:20	19:24	18:29	21 18:03 (T-58)	16:52	16:51
25	06:05		06:40	07:17	07:54	17:40 (T-58)	07:36	08:02
	21:02		20:19	19:22	18:27	22 18:02 (T-58)	16:51	16:51
26	06:06		06:41	07:18	07:56	17:40 (T-58)	07:37	08:02
	21:01		20:17	19:20	18:25	21 18:01 (T-58)	16:51	16:52
27	06:07		06:42	07:19	07:57	17:39 (T-58)	07:38	08:03
	21:00		20:15	19:18	18:24	20 17:59 (T-58)	16:50	16:52
28	06:08		06:44	07:20	07:58	17:40 (T-58)	07:39	08:03
	20:59		20:14	19:16	18:22	18 17:58 (T-58)	16:50	16:53
29	06:09		06:45	07:21	08:00	17:39 (T-58)	07:40	08:03
	20:58		20:12	19:14	18:21	17 17:56 (T-58)	16:49	16:54
30	06:10		06:46	07:23	08:01	17:39 (T-58)	07:42	08:04
	20:57		20:10	19:12	18:19	15 17:54 (T-58)	16:49	16:55
31	06:11		06:47	07:24	08:02	17:40 (T-58)		08:04
	20:56		20:08		18:18	13 17:53 (T-58)		16:56
Potential sun hours	471	436	377	341	289		275	
Total, worst case		228			193		36	
Sun reduction		0.75			0.56		0.48	
Oper. time red.		0.90			0.90		0.90	
Wind dir. red.		0.64			0.59		0.59	
Total reduction		0.43			0.30		0.25	
Total, real		99			57		9	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project:
South Deuel Wind Project

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Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-068 - R-068
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04 16:57	07:47 17:35	07:06 18:12	07:09 19:52	18:54 (T-53) 19:29 (T-53)	06:18 20:29	05:45 21:04	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:11	07:04 17:17	07:43 16:48	
2	08:04 16:58	07:45 17:36	07:04 18:14	07:07 19:53	18:54 (T-53) 19:28 (T-53)	06:16 20:31	05:44 21:04	05:45 21:16	06:13 20:53	06:49 20:05	07:25 19:09	07:05 17:15	07:44 16:48	
3	08:04 16:58	07:44 17:38	07:02 18:15	07:05 19:55	18:54 (T-53) 19:26 (T-53)	06:15 20:32	05:44 21:05	05:46 21:16	06:14 20:52	06:51 20:03	19:05 (T-53) 19:08 (T-53)	07:26 19:07	07:06 17:14	07:45 16:47
4	08:04 16:59	07:43 17:39	07:00 18:16	07:03 19:56	18:56 (T-53) 19:26 (T-53)	06:14 20:33	05:43 21:06	05:47 21:15	06:16 20:51	06:52 20:01	19:00 (T-53) 19:14 (T-53)	07:27 19:05	07:08 17:12	07:46 16:47
5	08:04 17:00	07:42 17:40	06:59 18:18	07:02 19:57	18:57 (T-53) 19:24 (T-53)	06:12 20:34	05:43 21:07	05:47 21:15	06:17 20:49	06:53 19:59	18:56 (T-53) 19:17 (T-53)	07:29 19:03	07:09 17:11	07:47 16:47
6	08:04 17:01	07:41 17:42	06:57 18:19	07:00 19:58	18:58 (T-53) 19:22 (T-53)	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:54 19:57	18:54 (T-53) 19:18 (T-53)	07:30 19:01	07:10 17:10	07:48 16:47
7	08:04 17:03	07:39 17:43	06:55 18:20	06:58 20:00	18:59 (T-53) 19:20 (T-53)	06:09 20:37	05:42 21:08	05:49 21:15	06:19 20:47	06:55 19:56	18:52 (T-53) 19:19 (T-53)	07:31 18:58	07:12 17:09	07:49 16:47
8	08:03 17:04	07:38 17:45	07:53 18:22	06:56 20:01	19:02 (T-53) 19:16 (T-53)	06:08 20:38	05:42 21:09	05:49 21:14	06:20 20:45	06:57 19:54	18:50 (T-53) 19:20 (T-53)	07:32 18:56	07:13 17:07	07:50 16:46
9	08:03 17:05	07:37 17:46	07:51 19:23	06:54 20:02	19:08 (T-53) 19:11 (T-53)	06:07 20:39	05:42 21:10	05:50 21:14	06:21 20:44	06:58 19:52	18:49 (T-53) 19:20 (T-53)	07:34 18:54	07:14 17:06	07:51 16:46
10	08:03 17:06	07:35 17:47	07:50 19:24	06:53 20:03	19:11 (T-53)	06:06 20:40	05:41 21:10	05:51 21:13	06:23 20:42	06:59 19:50	18:47 (T-53) 19:21 (T-53)	07:35 18:52	07:16 17:05	07:52 16:46
11	08:02 17:07	07:34 17:49	07:48 19:26	06:51 20:05	19:12 (T-53)	06:04 20:42	05:41 21:11	05:52 21:13	06:24 20:41	07:00 19:48	18:46 (T-53) 19:21 (T-53)	07:36 18:50	07:17 17:04	07:53 16:46
12	08:02 17:08	07:32 17:50	07:46 19:27	06:49 20:06	19:13 (T-53)	06:03 20:43	05:41 21:12	05:52 21:12	06:25 20:40	07:01 19:46	18:46 (T-53) 19:22 (T-53)	07:37 18:49	07:19 17:03	07:54 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	19:14 (T-53)	06:02 20:44	05:41 21:12	05:53 21:12	06:26 20:38	07:02 19:44	18:45 (T-53) 19:20 (T-53)	07:39 18:47	07:20 17:02	07:55 16:46
14	08:01 17:11	07:30 17:53	07:42 19:29	06:46 20:08	19:15 (T-53)	06:01 20:45	05:41 21:13	05:54 21:11	06:27 20:37	07:04 19:43	18:45 (T-53) 19:18 (T-53)	07:40 18:45	07:21 17:01	07:56 16:47
15	08:01 17:12	07:28 17:54	07:40 19:31	06:44 20:10	19:16 (T-52)	06:00 20:46	05:41 21:13	05:55 21:11	06:28 20:35	07:05 19:41	18:44 (T-53) 19:16 (T-53)	07:41 18:43	07:23 16:59	07:56 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	19:17 (T-52)	05:58 20:47	05:41 21:14	05:56 21:10	06:30 20:33	07:06 19:39	18:43 (T-53) 19:14 (T-53)	07:42 18:42	07:24 16:59	07:57 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	19:18 (T-52)	05:57 20:48	05:41 21:14	05:57 21:09	06:31 20:32	07:07 19:37	18:43 (T-53) 19:12 (T-53)	07:44 18:40	07:25 16:58	07:58 16:47
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:13	19:19 (T-53)	05:56 20:50	05:41 21:14	05:58 21:08	06:32 20:30	07:08 19:35	18:43 (T-53) 19:10 (T-53)	07:45 18:38	07:27 16:57	07:59 16:48
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:15	19:20 (T-53)	05:55 20:51	05:41 21:15	05:59 21:08	06:33 20:29	07:09 19:33	18:44 (T-53) 19:09 (T-53)	07:46 18:37	07:28 16:56	07:59 16:48
20	07:58 17:18	07:20 18:00	07:31 19:37	06:35 20:16	19:21 (T-53)	05:54 20:52	05:41 21:15	06:00 21:07	06:34 20:27	07:11 19:31	18:44 (T-53) 19:07 (T-53)	07:48 18:35	07:29 16:55	08:00 16:48
21	07:57 17:20	07:19 18:01	07:29 19:38	06:34 20:17	19:22 (T-53)	05:53 20:53	05:41 21:15	06:01 21:06	06:35 20:25	07:12 19:29	18:44 (T-53) 19:04 (T-53)	07:49 18:33	07:31 16:54	08:00 16:49
22	07:56 17:21	07:17 18:03	07:28 19:40	06:32 20:18	19:23 (T-53)	05:52 20:54	05:41 21:16	06:02 21:05	06:37 20:28	07:13 19:27	18:44 (T-53) 19:02 (T-53)	07:50 18:32	07:32 16:53	08:01 16:49
23	07:55 17:22	07:16 18:04	07:26 19:41	06:30 20:20	19:24 (T-53)	05:51 20:55	05:42 21:16	06:03 21:04	06:38 20:22	07:14 19:26	18:45 (T-53) 19:00 (T-53)	07:52 18:30	07:33 16:53	08:01 16:50
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	19:25 (T-53)	05:51 20:56	05:42 21:16	06:04 21:03	06:39 20:20	07:15 19:24	18:46 (T-53) 18:58 (T-53)	07:53 18:29	07:34 16:52	08:02 16:50
25	07:54 17:25	07:12 18:07	07:22 19:43	06:27 20:22	19:26 (T-53)	05:50 20:57	05:42 21:16	06:05 21:02	06:40 20:19	07:17 19:22	18:49 (T-53) 18:57 (T-53)	07:54 18:27	07:36 16:51	08:02 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:23	19:27 (T-53)	05:49 20:58	05:43 21:16	06:06 21:01	06:41 20:17	07:18 19:20	18:50 (T-52) 18:55 (T-53)	07:56 18:25	07:37 16:51	08:03 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	19:28 (T-53)	05:48 20:59	05:43 21:16	06:07 21:00	06:42 20:15	07:19 19:18	18:51 (T-52) 18:53 (T-52)	07:57 18:24	07:38 16:50	08:03 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47	06:22 20:26	19:29 (T-53)	05:47 21:00	05:43 21:16	06:08 20:59	06:44 20:14	07:20 19:16	18:53 (T-52)	07:58 18:22	07:39 16:49	08:03 16:53
29	07:50 17:30	07:05 18:11	07:15 19:48	06:21 20:27	19:30 (T-53)	05:47 21:01	05:44 21:16	06:09 20:58	06:45 20:12	07:21 19:14	18:54 (T-53)	08:00 18:21	07:40 16:49	08:03 16:54
30	07:49 17:32	07:03 18:15	07:13 19:50	06:19 20:28	19:31 (T-53)	05:46 21:02	05:44 21:16	06:10 20:57	06:46 20:10	07:23 19:12	18:55 (T-53)	08:01 18:19	07:42 16:49	08:04 16:55
31	07:48 17:33	07:11 19:51	07:11 19:29	06:19 20:28	19:32 (T-53)	05:46 21:03	05:44 21:16	06:11 20:56	06:47 20:08	07:24 19:12	18:56 (T-53)	08:02 18:18	07:43 16:56	08:04 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	570	341	289	275	
Total, worst case			339	220						570				
Sun reduction			0.59	0.63						0.67				
Oper. time red.			0.90	0.90						0.90				
Wind dir. red.			0.59	0.59						0.59				
Total reduction			0.31	0.33						0.35				
Total, real			106	74						202				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-069 - R-069
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Table with 12 columns (Jan-Dec) and 2 rows of sunshine probability values.

Operational time

Table with 17 columns (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum) and 2 rows of operational time values.

Main calendar table with columns for months (January-December) and rows for each day (1-31) showing start and end times for shadow calculations.

Table layout: For each day in each month the following matrix apply

Matrix table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)



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Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

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Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-070 - R-070
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December							
1	08:04	07:47	07:06	07:09	06:18	05:45	06:08 (T-51)	05:45	06:13 (T-51)	06:12	06:48	07:24	07:04	07:43					
	16:57	17:35	18:12	19:52	20:30	21:04	06:22 (T-51)	21:16	06:24 (T-51)	20:55	20:07	19:11	17:17	16:48					
2	08:04	07:45	07:04	07:07	06:17	05:44	06:08 (T-51)	05:45	06:13 (T-51)	06:13	06:50	07:25	07:05	07:44					
	16:58	17:36	18:14	19:54	20:31	21:05	06:22 (T-51)	21:16	06:25 (T-51)	20:53	20:05	19:09	17:15	16:48					
3	08:04	07:44	07:02	07:05	06:15	05:44	06:07 (T-51)	05:46	06:12 (T-51)	06:15	06:51	07:26	07:06	07:45					
	16:59	17:38	18:15	19:55	20:32	21:05	06:22 (T-51)	21:16	06:25 (T-51)	20:52	20:03	19:07	17:14	16:47					
4	08:04	07:43	07:00	07:04	06:14	05:43	06:07 (T-51)	05:47	06:12 (T-51)	06:16	06:52	07:28	07:08	07:46					
	17:00	17:39	18:16	19:56	20:33	21:06	06:22 (T-51)	21:16	06:26 (T-51)	20:51	20:01	19:05	17:13	16:47					
5	08:04	07:42	06:59	07:02	06:12	05:43	06:07 (T-51)	05:47	06:13 (T-51)	06:17	06:53	07:29	07:09	07:47					
	17:01	17:40	18:18	19:57	20:34	21:07	06:22 (T-51)	21:15	06:27 (T-51)	20:49	19:59	19:03	17:11	16:47					
6	08:04	07:41	06:57	07:00	06:11	05:43	06:06 (T-51)	05:48	06:12 (T-51)	06:18	06:54	07:30	07:10	07:48					
	17:02	17:42	18:19	19:59	20:36	21:08	06:21 (T-51)	21:15	06:27 (T-51)	20:48	19:57	19:01	17:10	16:47					
7	08:04	07:39	06:55	06:58	06:10	05:42	06:06 (T-51)	05:49	06:13 (T-51)	06:19	06:55	07:31	07:12	07:49					
	17:03	17:43	18:20	20:00	20:37	21:08	06:21 (T-51)	21:15	06:28 (T-51)	20:47	19:56	19:00	17:09	16:47					
8	08:03	07:38	07:53	06:56	06:08	05:42	06:07 (T-51)	05:49	06:14 (T-51)	06:20	06:57	07:32	07:13	07:50					
	17:04	17:45	18:22	20:01	20:38	21:09	06:21 (T-51)	21:14	06:29 (T-51)	20:45	19:54	18:56	17:07	16:46					
9	08:03	07:37	07:51	06:54	06:07	05:42	06:08 (T-51)	05:50	06:14 (T-51)	06:21	06:58	07:34	07:15	07:51					
	17:05	17:46	19:23	20:02	20:39	21:10	06:21 (T-51)	21:14	06:29 (T-51)	20:44	19:52	18:54	17:06	16:46					
10	08:03	07:35	07:50	06:53	06:06	05:41	06:08 (T-51)	05:51	06:15 (T-51)	06:23	06:59	07:35	07:16	07:52					
	17:06	17:48	19:24	20:04	20:40	21:11	06:20 (T-51)	21:13	06:29 (T-51)	20:43	19:50	18:52	17:05	16:46					
11	08:03	07:34	07:48	06:51	06:04	05:41	06:09 (T-51)	05:52	06:16 (T-51)	06:24	07:00	07:36	07:17	07:53					
	17:07	17:49	19:26	20:05	20:42	21:11	06:20 (T-51)	21:13	06:30 (T-51)	20:41	19:48	18:51	17:04	16:46					
12	08:02	07:33	07:46	06:49	06:03	05:41	06:10 (T-51)	05:52	06:17 (T-51)	06:25	07:01	07:37	07:19	07:54					
	17:08	17:50	19:27	20:06	20:43	21:12	06:19 (T-51)	21:12	06:31 (T-51)	20:40	19:46	18:49	17:03	16:46					
13	08:02	07:31	07:44	06:47	06:02	05:41	06:10 (T-51)	05:53	06:17 (T-51)	06:26	07:02	07:39	07:20	07:55					
	17:09	17:52	19:28	20:07	20:44	21:12	06:19 (T-51)	21:12	06:30 (T-51)	20:38	19:44	18:47	17:02	16:47					
14	08:01	07:30	07:42	06:46	06:01	05:41	06:11 (T-51)	05:54	06:18 (T-51)	06:27	07:04	07:40	07:21	07:56					
	17:11	17:53	19:30	20:08	20:45	21:13	06:19 (T-51)	21:11	06:31 (T-51)	20:37	19:43	18:45	17:01	16:47					
15	08:01	07:28	07:41	06:44	06:00	05:41	06:12 (T-51)	05:55	06:19 (T-51)	06:28	07:05	07:41	07:23	07:56					
	17:12	17:55	19:31	20:10	20:46	21:13	06:18 (T-51)	21:11	06:31 (T-51)	20:35	19:41	18:44	17:00	16:47					
16	08:00	07:27	07:39	06:42	05:58	05:41	06:13 (T-51)	05:56	06:20 (T-51)	06:30	07:06	07:43	07:24	07:57					
	17:13	17:56	19:32	20:11	20:47	21:14	06:18 (T-51)	21:10	06:32 (T-51)	20:34	19:39	18:42	16:59	16:47					
17	08:00	07:25	07:37	06:40	05:57	05:41	06:14 (T-51)	05:57	06:21 (T-51)	06:31	07:07	07:44	07:25	07:58					
	17:14	17:57	19:33	20:12	20:49	21:14	06:18 (T-51)	21:09	06:32 (T-51)	20:32	19:37	18:40	16:58	16:47					
18	07:59	07:24	07:35	06:39	05:56	05:41	06:19 (T-51)	05:58	06:22 (T-51)	06:32	07:08	07:45	07:27	07:59					
	17:16	17:59	19:35	20:13	20:50	21:15	06:21 (T-51)	21:15	06:17 (T-51)	21:08	11	06:33 (T-51)	20:30	19:35	18:38	16:57	16:48		
19	07:58	07:22	07:33	06:37	05:55	05:41	06:18 (T-51)	05:41	06:23 (T-51)	06:33	07:09	07:46	07:28	07:59					
	17:17	18:00	19:36	20:15	20:51	21:15	06:22 (T-51)	21:15	06:33 (T-51)	20:29	19:33	18:37	16:56	16:48					
20	07:58	07:21	07:31	06:35	05:54	05:41	06:17 (T-51)	05:41	06:24 (T-51)	06:34	07:11	07:48	07:29	08:00					
	17:18	18:00	19:37	20:16	20:52	21:15	06:22 (T-51)	21:15	06:33 (T-51)	20:27	19:31	18:35	16:55	16:48					
21	07:57	07:19	07:29	06:34	05:53	05:41	06:16 (T-51)	05:41	06:25 (T-51)	06:35	07:12	07:49	07:31	08:00					
	17:20	18:02	19:38	20:17	20:53	21:15	06:22 (T-51)	21:15	06:33 (T-51)	20:26	19:29	18:33	16:54	16:49					
22	07:56	07:17	07:28	06:32	05:52	05:41	06:15 (T-51)	05:41	06:26 (T-51)	06:37	07:13	07:50	07:32	08:01					
	17:21	18:03	19:40	20:18	20:54	21:16	06:22 (T-51)	21:16	06:33 (T-51)	20:24	19:27	18:32	16:53	16:49					
23	07:55	07:16	07:26	06:30	05:52	05:42	06:14 (T-51)	05:42	06:27 (T-51)	06:38	07:14	07:52	07:33	08:01					
	17:22	18:04	19:41	20:20	20:55	21:16	06:22 (T-51)	21:16	06:33 (T-51)	20:22	19:26	18:30	16:53	16:50					
24	07:55	07:14	07:24	06:29	05:51	05:42	06:13 (T-51)	05:42	06:28 (T-51)	06:39	07:15	07:53	07:34	08:02					
	17:24	18:06	19:42	20:21	20:56	21:16	06:22 (T-51)	21:16	06:18 (T-51)	21:03	4	06:32 (T-51)	20:21	19:24	18:29	16:52	16:51		
25	07:54	07:12	07:22	06:27	05:50	05:42	06:13 (T-51)	05:42	06:16 (T-51)	06:05	06:29 (T-51)	06:40	07:17	07:54	07:36	08:02			
	17:25	18:07	19:44	20:22	20:57	21:16	06:23 (T-51)	21:16	06:19 (T-51)	21:02	3	06:32 (T-51)	20:19	19:22	18:27	16:51	16:51		
26	07:53	07:11	07:20	06:26	05:49	05:43	06:12 (T-51)	05:43	06:15 (T-51)	06:06	06:30 (T-51)	06:41	07:18	07:56	07:37	08:03			
	17:26	18:08	19:45	20:23	20:58	21:16	06:23 (T-51)	21:16	06:20 (T-51)	21:01	1	06:31 (T-51)	20:17	19:20	18:25	16:51	16:52		
27	07:52	07:09	07:18	06:24	05:48	05:43	06:11 (T-51)	05:43	06:14 (T-51)	06:07	06:43	07:19	07:57	07:38	08:03				
	17:28	18:10	19:46	20:25	20:59	21:16	06:23 (T-51)	21:16	06:20 (T-51)	21:00	20:15	19:18	18:24	16:50	16:52				
28	07:51	07:07	07:16	06:23	05:48	05:43	06:11 (T-51)	05:43	06:15 (T-51)	06:08	06:44	07:20	07:58	07:39	08:03				
	17:29	18:11	19:47	20:26	21:00	21:16	06:23 (T-51)	21:16	06:22 (T-51)	20:59	20:14	19:16	18:22	16:50	16:53				
29	07:50	07:15	07:25	06:21	05:47	05:44	06:10 (T-51)	05:44	06:14 (T-51)	06:09	06:45	07:21	08:00	07:41	08:03				
	17:31	18:13	19:49	20:27	21:01	21:16	06:23 (T-51)	21:16	06:22 (T-51)	20:58	20:12	19:14	18:21	16:49	16:54				
30	07:49	07:13	07:23	06:19	05:46	05:44	06:09 (T-51)	05:44	06:14 (T-51)	06:10	06:46	07:23	08:01	07:42	08:04				
	17:32	18:14	19:50	20:28	21:02	21:16	06:22 (T-51)	21:16	06:23 (T-51)	20:57	20:10	19:12	18:19	16:49	16:55				
31	07:48	07:11	07:21	06:17	05:46	05:41	06:09 (T-51)	05:41	06:14 (T-51)	06:11	06:47	08:02	08:02	08:04					
	17:33	18:15	19:51	21:03	21:03	14	06:23 (T-51)	20:56	06:20	20:08	06:47	18:18	16:49	16:56					
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275							
Total, worst case						127	237	286											
Sun reduction						0.66	0.73	0.75											
Oper. time red.						0.90	0.90	0.90											
Wind dir. red.						0.59	0.59	0.59											
Total reduction						0.35	0.39	0.40											
Total, real						45	92	114											

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
	Sun set (hh:mm)					



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-071 - R-071

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:04	06:14	05:43	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:16	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:01	17:40	18:18	19:57	20:34	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:57	19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:32	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:24	20:04	20:40	21:11	21:14	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:19	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	16:47
14	08:01	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:58	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:47
18	07:59	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:59
	17:16	17:59	19:35	20:13	20:50	21:15	21:09	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:31	08:00
	17:20	18:02	19:39	20:17	20:53	21:15	21:06	20:26	19:29	18:33	16:54	16:49
22	07:56	07:17	07:28	06:32	05:52	05:41	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:16	21:05	20:24	19:28	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:01
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:03
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:23	05:48	05:43	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:22	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:21	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-073 - R-073

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:04	07:47	07:06	07:09	06:18	06:39 (T-51)	05:45	05:45	06:12	06:41 (T-51)	06:48	07:24	07:04	07:43	
	16:57	17:35	18:12	19:52	20:30	30 07:09 (T-51)	21:04	21:16	20:55	36 07:17 (T-51)	20:07	19:11	17:17	16:48	
2	08:04	07:45	07:04	07:07	06:16	06:38 (T-51)	05:44	05:45	06:13	06:40 (T-51)	06:50	07:25	07:05	07:44	
	16:58	17:36	18:14	19:54	20:31	31 07:09 (T-51)	21:05	21:16	20:53	37 07:17 (T-51)	20:05	19:09	17:15	16:48	
3	08:04	07:44	07:02	07:05	06:15	06:36 (T-51)	05:44	05:46	06:14	06:40 (T-51)	06:51	07:26	07:06	07:45	
	16:58	17:38	18:15	19:55	20:32	33 07:09 (T-51)	21:05	21:16	20:52	38 07:18 (T-51)	20:03	19:07	17:14	16:47	
4	08:04	07:43	07:00	07:04	06:14	06:35 (T-51)	05:43	05:47	06:16	06:39 (T-51)	06:52	07:27	07:08	07:46	
	16:59	17:39	18:16	19:56	20:33	34 07:09 (T-51)	21:06	21:16	20:51	39 07:18 (T-51)	20:01	19:05	17:12	16:47	
5	08:04	07:42	06:59	07:02	06:12	06:34 (T-51)	05:43	05:47	06:17	06:40 (T-51)	06:53	07:29	07:09	07:47	
	17:00	17:40	18:18	19:57	20:34	35 07:09 (T-51)	21:07	21:15	20:49	38 07:18 (T-51)	19:59	19:03	17:11	16:47	
6	08:04	07:41	06:57	07:00	06:11	06:32 (T-51)	05:43	05:48	06:18	06:41 (T-51)	06:54	07:30	07:10	07:48	
	17:01	17:42	18:19	19:59	20:36	36 07:08 (T-51)	21:08	21:15	20:48	37 07:18 (T-51)	19:57	19:01	17:10	16:47	
7	08:04	07:39	06:55	06:58	06:09	06:31 (T-51)	05:42	05:49	06:19	06:42 (T-51)	06:55	07:31	07:12	07:49	
	17:03	17:43	18:20	20:00	20:37	37 07:08 (T-51)	21:08	21:15	20:47	36 07:18 (T-51)	19:56	18:58	17:09	16:47	
8	08:03	07:38	07:53	06:56	06:08	06:30 (T-51)	05:42	05:49	06:20	06:43 (T-51)	06:57	07:32	07:13	07:50	
	17:04	17:45	18:22	20:01	20:38	38 07:08 (T-51)	21:09	21:14	20:45	35 07:18 (T-51)	19:54	18:56	17:07	16:46	
9	08:03	07:37	07:51	06:54	06:07	06:29 (T-51)	05:42	05:50	06:21	06:44 (T-51)	06:58	07:34	07:15	07:51	
	17:05	17:46	19:23	20:02	20:39	38 07:07 (T-51)	21:10	21:14	20:44	33 07:17 (T-51)	19:52	18:54	17:06	16:46	
10	08:03	07:35	07:50	06:53	06:06	06:29 (T-51)	05:41	05:51	06:23	06:46 (T-51)	06:59	07:35	07:16	07:52	
	17:06	17:47	19:24	20:03	20:40	38 07:07 (T-51)	21:10	21:13	20:43	32 07:18 (T-51)	19:50	18:52	17:05	16:46	
11	08:03	07:34	07:48	06:51	06:04	06:30 (T-51)	05:41	05:52	06:24	06:47 (T-51)	07:00	07:36	07:17	07:53	
	17:07	17:49	19:26	20:05	20:42	36 07:06 (T-51)	21:11	21:13	20:41	31 07:18 (T-51)	19:48	18:50	17:04	16:46	
12	08:02	07:33	07:46	06:49	06:03	06:30 (T-51)	05:41	05:52	06:25	06:48 (T-51)	07:01	07:37	07:19	07:54	
	17:08	17:50	19:27	20:06	20:43	36 07:06 (T-51)	21:12	21:12	20:40	29 07:17 (T-51)	19:46	18:49	17:03	16:46	
13	08:02	07:31	07:44	06:47	06:02	06:31 (T-51)	05:41	05:53	06:26	06:49 (T-51)	07:02	07:39	07:20	07:55	
	17:09	17:52	19:28	20:07	20:44	35 07:06 (T-51)	21:12	21:12	20:38	28 07:17 (T-51)	19:44	18:47	17:02	16:46	
14	08:01	07:30	07:42	06:46	06:01	06:32 (T-51)	05:41	05:54	06:27	06:50 (T-51)	07:04	07:40	07:21	07:56	
	17:11	17:53	19:30	20:08	20:45	33 07:05 (T-51)	21:13	21:11	20:37	26 07:16 (T-51)	19:43	18:45	17:01	16:47	
15	08:01	07:28	07:41	06:44	06:00	06:32 (T-51)	05:41	05:55	06:28	06:51 (T-51)	07:05	07:41	07:23	07:56	
	17:12	17:55	19:31	20:10	20:46	32 07:04 (T-51)	21:13	21:11	20:35	24 07:15 (T-51)	19:41	18:43	17:00	16:47	
16	08:00	07:27	07:39	06:42	05:58	06:33 (T-51)	05:41	05:56	06:30	06:52 (T-51)	07:06	07:43	07:24	07:57	
	17:13	17:56	19:32	20:11	20:47	31 07:04 (T-51)	21:14	21:10	20:34	22 07:14 (T-51)	19:39	18:42	16:59	16:47	
17	08:00	07:25	07:37	06:40	05:57	06:34 (T-51)	05:41	05:57	06:31	06:53 (T-51)	07:07	07:44	07:25	07:58	
	17:14	17:57	19:33	20:12	20:49	29 07:03 (T-51)	21:14	21:09	20:32	20 07:13 (T-51)	19:37	18:40	16:58	16:47	
18	07:59	07:24	07:35	06:39	05:56	06:35 (T-51)	05:41	05:58	06:32	06:54 (T-51)	07:08	07:45	07:27	07:59	
	17:16	17:59	19:35	20:13	20:50	27 07:02 (T-51)	21:14	21:08	20:30	18 07:12 (T-51)	19:35	18:38	16:57	16:48	
19	07:58	07:22	07:33	06:37	05:55	06:36 (T-51)	05:41	05:59	06:33	06:56 (T-51)	07:09	07:46	07:28	07:59	
	17:17	18:00	19:36	20:15	20:51	25 07:01 (T-51)	21:15	21:08	20:29	15 07:11 (T-51)	19:33	18:37	16:56	16:48	
20	07:58	07:20	07:31	06:35	06:56 (T-51)	05:54	05:41	06:00	06:34	06:57 (T-51)	07:11	07:48	07:29	08:00	
	17:18	18:00	19:37	20:16	3 06:59 (T-51)	20:52	21:15	21:07	9 07:03 (T-51)	20:27	13 07:10 (T-51)	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	06:54 (T-51)	05:53	05:41	06:01	06:35	06:52 (T-51)	07:12	07:49	07:31	08:00	
	17:20	18:01	19:38	20:17	7 07:01 (T-51)	20:53	21:15	21:06	14 07:06 (T-51)	20:26	10 07:08 (T-51)	19:29	18:33	16:54	16:49
22	07:56	07:17	07:28	06:32	06:53 (T-51)	05:52	05:41	06:02	06:36	06:50 (T-51)	07:13	07:50	07:32	08:01	
	17:21	18:03	19:40	20:18	10 07:03 (T-51)	20:54	21:16	21:05	18 07:08 (T-51)	20:24	6 07:05 (T-51)	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	06:51 (T-51)	05:51	05:42	06:03	06:48 (T-51)	07:14	07:14	07:52	07:33	08:01	
	17:22	18:04	19:41	20:20	13 07:04 (T-51)	20:55	21:16	21:04	20 07:08 (T-51)	20:22	2 07:02 (T-51)	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	06:49 (T-51)	05:51	05:42	06:04	06:46 (T-51)	07:15	07:15	07:53	07:34	08:02	
	17:24	18:06	19:42	20:21	16 07:05 (T-51)	20:56	21:16	21:03	24 07:10 (T-51)	20:20	19:24	18:29	16:52	16:50	
25	07:54	07:12	07:22	06:27	06:48 (T-51)	05:50	05:42	06:05	06:45 (T-51)	07:16	07:17	07:54	07:36	08:02	
	17:25	18:07	19:43	20:22	18 07:06 (T-51)	20:57	21:16	21:02	26 07:11 (T-51)	20:19	19:22	18:27	16:51	16:51	
26	07:53	07:11	07:20	06:26	06:46 (T-51)	05:49	05:43	06:06	06:44 (T-51)	07:16	07:18	07:56	07:37	08:03	
	17:26	18:08	19:45	20:23	21 07:07 (T-51)	20:58	21:16	21:01	28 07:12 (T-51)	20:17	19:20	18:25	16:51	16:52	
27	07:52	07:09	07:18	06:24	06:45 (T-51)	05:48	05:43	06:07	06:43 (T-51)	07:18	07:19	07:57	07:38	08:03	
	17:28	18:10	19:46	20:25	23 07:08 (T-51)	20:59	21:16	21:00	30 07:13 (T-51)	20:15	19:18	18:24	16:50	16:52	
28	07:51	07:07	07:16	06:22	06:43 (T-51)	05:47	05:43	06:08	06:44 (T-51)	07:19	07:20	07:58	07:39	08:03	
	17:29	18:11	19:47	20:26	25 07:08 (T-51)	21:00	21:16	20:59	31 07:15 (T-51)	20:14	19:16	18:22	16:49	16:53	
29	07:50	07:15	06:21	06:42 (T-51)	05:47	05:44	06:09	06:43 (T-51)	06:45	07:21	07:21	08:00	07:41	08:03	
	17:30	18:12	19:49	20:27	26 07:08 (T-51)	21:01	21:16	20:58	32 07:15 (T-51)	20:12	19:14	18:21	16:49	16:54	
30	07:49	07:13	06:19	06:40 (T-51)	05:46	05:44	06:10	06:42 (T-51)	06:46	07:23	07:23	08:01	07:42	08:04	
	17:32	18:14	19:50	20:28	28 07:08 (T-51)	21:02	21:16	20:57	34 07:16 (T-51)	20:10	19:12	18:19	16:49	16:55	
31	07:48	07:11	07:11	06:16	05:46	05:44	06:11	06:41 (T-51)	06:47	07:24	07:24	08:02	07:43	08:04	
	17:33	18:15	19:51	20:29	21:03	20:56	20:56	20:56	35 07:16 (T-51)	20:08	19:10	18:18	16:49	16:56	
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275			
Total, worst case				190	707				605						
Sun reduction				0.63	0.66				0.72						
Oper. time red.				0.90	0.90				0.90						
Wind dir. red.				0.58	0.58				0.58						
Total reduction				0.33	0.35				0.38						
Total, real				63	246				229						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-074 - R-074
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:47	07:06	07:09	06:18	05:45	06:25 (T-48)	05:45	20:46 (T-42)	06:12	06:36 (T-48)	06:48	07:24	07:04	07:43	
2	08:04	07:46	07:04	07:07	06:16	06:38 (T-48)	05:44	06:27 (T-48)	05:45	20:47 (T-42)	06:13	06:37 (T-48)	06:50	07:25	07:05	07:44
3	08:04	07:44	07:02	07:05	06:15	06:36 (T-48)	05:44	06:28 (T-48)	05:46	20:47 (T-42)	06:15	06:38 (T-48)	06:51	07:26	07:06	07:45
4	08:04	07:43	07:00	07:04	06:14	06:40 (T-48)	21:05	06:35 (T-48)	05:43	20:48 (T-42)	06:16	06:39 (T-48)	06:52	07:28	07:08	07:46
5	08:04	07:42	06:59	07:02	06:12	06:42 (T-48)	21:06	06:34 (T-48)	05:43	20:49 (T-42)	06:17	06:39 (T-48)	06:53	07:29	07:09	07:47
6	08:04	07:41	06:57	07:00	06:11	06:43 (T-48)	21:07	06:33 (T-48)	05:43	20:50 (T-42)	06:18	06:40 (T-48)	06:54	07:30	07:11	07:48
7	08:04	07:39	06:55	06:58	06:09	06:44 (T-48)	21:08	06:32 (T-48)	05:43	20:51 (T-42)	06:19	06:41 (T-48)	06:54	07:31	07:12	07:49
8	08:04	07:38	06:53	06:56	06:08	06:45 (T-48)	21:09	06:31 (T-48)	05:42	20:52 (T-42)	06:20	06:42 (T-48)	06:55	07:32	07:13	07:50
9	08:03	07:37	06:52	06:54	06:07	06:46 (T-48)	21:10	06:30 (T-48)	05:42	20:53 (T-42)	06:21	06:43 (T-48)	06:56	07:33	07:14	07:51
10	08:03	07:35	06:50	06:53	06:06	06:47 (T-48)	21:11	06:29 (T-48)	05:41	20:54 (T-42)	06:22	06:44 (T-48)	06:57	07:34	07:15	07:52
11	08:03	07:34	06:48	06:51	06:04	06:48 (T-48)	21:12	06:28 (T-48)	05:41	20:55 (T-42)	06:23	06:45 (T-48)	06:58	07:35	07:16	07:53
12	08:02	07:33	06:46	06:49	06:03	06:49 (T-48)	21:13	06:27 (T-48)	05:41	20:56 (T-42)	06:24	06:46 (T-48)	06:59	07:36	07:17	07:54
13	08:02	07:31	06:44	06:47	06:02	06:50 (T-48)	21:14	06:26 (T-48)	05:41	20:57 (T-42)	06:25	06:47 (T-48)	07:00	07:37	07:18	07:55
14	08:01	07:30	06:42	06:45	06:01	06:51 (T-48)	21:15	06:25 (T-48)	05:41	20:58 (T-42)	06:26	06:48 (T-48)	07:01	07:38	07:19	07:56
15	08:01	07:29	06:41	06:44	06:00	06:52 (T-48)	21:16	06:24 (T-48)	05:41	20:59 (T-42)	06:27	06:49 (T-48)	07:02	07:39	07:20	07:57
16	08:00	07:27	06:39	06:42	05:58	06:53 (T-48)	21:17	06:23 (T-48)	05:41	21:00 (T-42)	06:28	06:50 (T-48)	07:03	07:40	07:21	07:58
17	08:00	07:25	06:37	06:40	05:57	06:54 (T-48)	21:18	06:22 (T-48)	05:41	21:01 (T-42)	06:29	06:51 (T-48)	07:04	07:41	07:22	07:59
18	08:00	07:24	06:35	06:39	05:56	06:55 (T-48)	21:19	06:21 (T-48)	05:41	21:02 (T-42)	06:30	06:52 (T-48)	07:05	07:42	07:23	08:00
19	07:59	07:22	06:33	06:37	05:55	06:56 (T-48)	21:20	06:20 (T-48)	05:41	21:03 (T-42)	06:31	06:53 (T-48)	07:06	07:43	07:24	08:01
20	07:59	07:21	06:31	06:35	05:54	06:57 (T-48)	21:21	06:19 (T-48)	05:41	21:04 (T-42)	06:32	06:54 (T-48)	07:07	07:44	07:25	08:02
21	07:58	07:20	06:29	06:33	05:53	06:58 (T-48)	21:22	06:18 (T-48)	05:41	21:05 (T-42)	06:33	06:55 (T-48)	07:08	07:45	07:26	08:03
22	07:58	07:19	06:27	06:31	05:52	06:59 (T-48)	21:23	06:17 (T-48)	05:41	21:06 (T-42)	06:34	06:56 (T-48)	07:09	07:46	07:27	08:04
23	07:57	07:18	06:25	06:29	05:51	07:00 (T-48)	21:24	06:16 (T-48)	05:41	21:07 (T-42)	06:35	06:57 (T-48)	07:10	07:47	07:28	08:05
24	07:57	07:17	06:24	06:28	05:50	07:01 (T-48)	21:25	06:15 (T-48)	05:41	21:08 (T-42)	06:36	06:58 (T-48)	07:11	07:48	07:29	08:06
25	07:56	07:16	06:22	06:26	05:49	07:02 (T-48)	21:26	06:14 (T-48)	05:41	21:09 (T-42)	06:37	06:59 (T-48)	07:12	07:49	07:30	08:07
26	07:56	07:15	06:21	06:25	05:48	07:03 (T-48)	21:27	06:13 (T-48)	05:41	21:10 (T-42)	06:38	07:00 (T-48)	07:13	07:50	07:31	08:08
27	07:55	07:14	06:20	06:24	05:47	07:04 (T-48)	21:28	06:12 (T-48)	05:41	21:11 (T-42)	06:39	07:01 (T-48)	07:14	07:51	07:32	08:09
28	07:55	07:13	06:19	06:23	05:46	07:05 (T-48)	21:29	06:11 (T-48)	05:41	21:12 (T-42)	06:40	07:02 (T-48)	07:15	07:52	07:33	08:10
29	07:54	07:12	06:18	06:22	05:45	07:06 (T-48)	21:30	06:10 (T-48)	05:41	21:13 (T-42)	06:41	07:03 (T-48)	07:16	07:53	07:34	08:11
30	07:54	07:11	06:17	06:21	05:44	07:07 (T-48)	21:31	06:09 (T-48)	05:41	21:14 (T-42)	06:42	07:04 (T-48)	07:17	07:54	07:35	08:12
31	07:53	07:10	06:16	06:20	05:43	07:08 (T-48)	21:32	06:08 (T-48)	05:41	21:15 (T-42)	06:43	07:05 (T-48)	07:18	07:55	07:36	08:13
Potential sun hours	287	292	369	403	459	465	471	436		377	341	289	275			
Total, worst case					606	114		133								
Sun reduction					0.66	0.73		0.72								
Oper. time red.					0.90	0.90		0.90								
Wind dir. red.					0.59	0.63		0.59								
Total reduction					0.35	0.41		0.38								
Total, real					212	47		51								

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-076 - R-076 Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum and values 561, 438, 311, 293, 309, 330, 363, 461, 788, 773, 462, 449, 509, 600, 629, 608, 7,884

Main calendar table with columns for months (January to December) and rows for each day (1-31) showing sunrise/sunset times and shadow reduction percentages.

Table layout: For each day in each month the following matrix apply

Matrix table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-077 - R-077

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	16:05 (T-45) 07:47	16:12 (T-45) 07:06	07:09	06:18	06:39 (T-49) 05:45
	16:57 24	16:29 (T-45) 17:35 57	17:09 (T-43) 18:12	19:52	20:30 4	06:43 (T-49) 21:04
2	08:04	16:05 (T-45) 07:46	16:12 (T-45) 07:04	07:07	06:16	06:38 (T-49) 05:44
	16:57 24	16:29 (T-45) 17:36 58	17:10 (T-43) 18:14	19:54	20:31 7	06:45 (T-49) 21:05
3	08:04	16:05 (T-45) 07:44	16:13 (T-45) 07:02	07:05	06:15	06:36 (T-49) 05:44
	16:58 26	16:31 (T-45) 17:37 58	17:11 (T-43) 18:15	19:55	20:32 10	06:46 (T-49) 21:06
4	08:04	16:05 (T-45) 07:43	16:15 (T-45) 07:00	07:04	06:14	06:35 (T-49) 05:43
	16:59 26	16:31 (T-45) 17:39 53	17:10 (T-43) 18:16	19:56	20:33 12	06:47 (T-49) 21:06
5	08:04	16:05 (T-45) 07:42	16:16 (T-45) 06:59	07:02	06:12	06:33 (T-49) 05:43
	17:00 27	16:32 (T-45) 17:40 51	17:15 (T-44) 18:18	19:57	20:35 14	06:47 (T-49) 21:07
6	08:04	16:05 (T-45) 07:41	16:17 (T-45) 06:57	07:00	06:11	06:32 (T-49) 05:42
	17:01 28	16:33 (T-45) 17:42 43	17:16 (T-44) 18:19	19:59	20:36 16	06:48 (T-49) 21:08
7	08:04	16:06 (T-45) 07:39	16:18 (T-45) 06:55	06:58	06:09	06:31 (T-49) 05:42
	17:02 28	16:34 (T-45) 17:43 42	17:18 (T-44) 18:20	20:00	20:37 18	06:49 (T-49) 21:09
8	08:04	16:06 (T-45) 07:38	16:20 (T-45) 07:53	06:56	06:08	06:30 (T-49) 05:42
	17:04 30	16:36 (T-45) 17:45 41	17:20 (T-44) 18:22	20:01	20:38 19	06:49 (T-49) 21:09
9	08:03	16:05 (T-45) 07:37	16:22 (T-45) 07:51	06:54	06:07	06:28 (T-49) 05:42
	17:05 31	16:36 (T-45) 17:46 39	17:21 (T-44) 19:23	20:02	20:39 21	06:49 (T-49) 21:10
10	08:03	16:06 (T-45) 07:35	16:25 (T-45) 07:50	06:53	06:05	06:27 (T-49) 05:41
	17:06 32	16:38 (T-45) 17:47 36	17:23 (T-44) 19:24	20:04	20:41 22	06:49 (T-49) 21:11
11	08:03	16:05 (T-45) 07:34	16:28 (T-45) 07:48	06:51	06:04	06:26 (T-49) 05:41
	17:07 34	16:39 (T-45) 17:49 32	17:24 (T-44) 19:26	20:05	20:42 23	06:49 (T-49) 21:11
12	08:02	16:06 (T-45) 07:33	17:06 (T-44) 07:46	06:49	06:03	06:25 (T-49) 05:41
	17:08 34	16:40 (T-45) 17:50 20	17:26 (T-44) 19:27	20:06	20:43 24	06:49 (T-49) 21:12
13	08:02	16:05 (T-45) 07:31	17:06 (T-44) 07:44	06:47	06:02	06:24 (T-49) 05:41
	17:09 36	16:41 (T-45) 17:52 21	17:27 (T-44) 19:28	20:07	20:44 26	06:50 (T-49) 21:12
14	08:01	16:06 (T-45) 07:30	17:06 (T-44) 07:42	06:46	06:01	06:23 (T-49) 05:41
	17:10 37	16:43 (T-45) 17:53 23	17:29 (T-44) 19:30	20:09	20:45 27	06:50 (T-49) 21:13
15	08:01	16:06 (T-45) 07:28	17:06 (T-44) 07:41	06:44	05:59	06:22 (T-49) 05:41
	17:12 38	16:44 (T-45) 17:54 24	17:30 (T-44) 19:31	20:10	20:46 27	06:49 (T-49) 21:13
16	08:00	16:06 (T-45) 07:27	17:07 (T-44) 07:39	06:42	05:58	06:21 (T-49) 05:41
	17:13 40	16:46 (T-45) 17:56 25	17:32 (T-44) 19:32	20:11	20:48 28	06:49 (T-49) 21:14
17	08:00	16:06 (T-45) 07:25	17:06 (T-44) 07:37	06:40	05:57	06:19 (T-49) 05:41
	17:14 41	16:47 (T-45) 17:57 27	17:33 (T-44) 19:33	20:12	20:49 29	06:48 (T-49) 21:14
18	07:59	16:06 (T-45) 07:24	17:08 (T-44) 07:35	06:39	05:56	06:19 (T-49) 05:41
	17:16 42	16:48 (T-45) 17:59 27	17:35 (T-44) 19:35	20:14	20:50 30	06:49 (T-49) 21:15
19	07:59	16:07 (T-45) 07:22	17:08 (T-44) 07:33	06:37	05:55	06:19 (T-49) 05:41
	17:17 43	16:50 (T-45) 18:00 27	17:35 (T-44) 19:36	20:15	20:51 29	06:48 (T-49) 21:15
20	07:58	16:07 (T-45) 07:21	17:09 (T-44) 07:31	06:35	05:54	06:19 (T-49) 05:41
	17:18 44	16:51 (T-45) 18:00 25	17:34 (T-44) 19:37	20:16	20:52 29	06:48 (T-49) 21:15
21	07:57	16:07 (T-45) 07:19	17:10 (T-44) 07:29	06:34	05:53	06:20 (T-49) 05:41
	17:19 45	16:52 (T-43) 18:01 23	17:33 (T-44) 19:38	20:17	20:53 27	06:47 (T-49) 21:16
22	07:56	16:07 (T-45) 07:17	17:11 (T-44) 07:28	06:32	05:52	06:20 (T-49) 05:41
	17:21 47	16:54 (T-43) 18:03 20	17:31 (T-44) 19:40	20:18	20:54 27	06:47 (T-49) 21:16
23	07:56	16:07 (T-45) 07:16	17:14 (T-44) 07:26	06:30	05:51	06:21 (T-49) 05:42
	17:22 48	16:55 (T-43) 18:04 15	17:29 (T-44) 19:41	20:20	20:55 25	06:46 (T-49) 21:16
24	07:55	16:08 (T-45) 07:14	17:16 (T-44) 07:24	06:29	05:51	06:21 (T-49) 05:42
	17:24 48	16:56 (T-43) 18:06 10	17:26 (T-44) 19:42	20:21	20:56 24	06:45 (T-49) 21:16
25	07:54	16:08 (T-45) 07:12	17:11 (T-44) 07:22	06:27	05:50	06:23 (T-49) 05:42
	17:25 50	16:58 (T-43) 18:07 19	17:27 (T-44) 19:44	20:22	20:57 22	06:45 (T-49) 21:16
26	07:53	16:08 (T-45) 07:11	17:10 (T-44) 07:20	06:26	05:49	06:23 (T-49) 05:42
	17:26 51	16:59 (T-43) 18:08 17	17:28 (T-44) 19:45	20:23	20:58 21	06:44 (T-49) 21:16
27	07:52	16:09 (T-45) 07:09	17:09 (T-44) 07:18	06:24	05:48	06:24 (T-49) 05:43
	17:28 52	17:01 (T-43) 18:10 16	17:29 (T-44) 19:46	20:25	20:59 19	06:43 (T-49) 21:16
28	07:51	16:09 (T-45) 07:07	17:09 (T-44) 07:16	06:22	05:47	06:26 (T-49) 05:43
	17:29 53	17:02 (T-43) 18:11 15	17:29 (T-44) 19:47	20:26	21:00 17	06:43 (T-49) 21:16
29	07:50	16:10 (T-45) 07:06	17:10 (T-44) 07:15	06:21	05:47	06:27 (T-49) 05:44
	17:30 54	17:04 (T-43) 18:13 14	17:29 (T-44) 19:49	20:27	21:01 15	06:42 (T-49) 21:16
30	07:49	16:11 (T-45) 07:05	17:11 (T-44) 07:13	06:19	05:46	06:28 (T-49) 05:44
	17:32 55	17:06 (T-43) 18:15 13	17:30 (T-44) 19:50	20:28	21:02 12	06:40 (T-49) 21:16
31	07:48	16:11 (T-45) 07:04	17:12 (T-44) 07:11	06:18	05:45	06:30 (T-49) 05:44
	17:33 56	17:07 (T-43) 18:16 12	17:31 (T-44) 19:51	20:29	21:03 9	06:39 (T-49) 21:16
Potential sun hours	287	292	369	403	459	465
Total, worst case	1224	797			633	
Sun reduction	0.58	0.58		0.63	0.66	
Oper. time red.	0.90	0.90		0.90	0.90	
Wind dir. red.	0.60	0.59		0.59	0.59	
Total reduction	0.31	0.31		0.33	0.35	
Total, real	382	247		0	222	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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South Deuel Wind Project

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Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

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Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-077 - R-077
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:12	06:36 (T-49)	06:48	07:24	07:04
	21:16	20:55	24 07:00 (T-49)	20:07	19:11	17:17
2	05:45	06:13	06:37 (T-49)	06:49	07:25	07:05
	21:16	20:53	23 07:00 (T-49)	20:05	19:09	17:15
3	05:46	06:14	06:38 (T-49)	06:51	07:26	07:06
	21:16	20:52	21 06:59 (T-49)	20:03	19:07	17:14
4	05:46	06:16	06:39 (T-49)	06:52	07:28	07:08
	21:16	20:51	20 06:59 (T-49)	20:01	19:05	17:12
5	05:47	06:17	06:40 (T-49)	06:53	07:29	07:09
	21:15	20:50	19 06:59 (T-49)	19:59	19:03	17:11
6	05:48	06:18	06:41 (T-49)	06:54	07:30	07:11
	21:15	20:48	17 06:58 (T-49)	19:57	19:01	17:10
7	05:48	06:19	06:42 (T-49)	06:55	07:31	07:12
	21:15	20:47	15 06:57 (T-49)	19:56	18:58	17:09
8	05:49	06:20	06:43 (T-49)	06:57	07:32	07:13
	21:14	20:45	13 06:56 (T-49)	19:54	18:56	17:07
9	05:50	06:21	06:44 (T-49)	06:58	07:34	07:15
	21:14	20:44	11 06:55 (T-49)	19:52	18:54	17:06
10	05:51	06:22	06:46 (T-49)	06:59	07:35	07:16
	21:14	20:43	9 06:55 (T-49)	19:50	18:52	17:05
11	05:51	06:24	06:47 (T-49)	07:00	07:36	07:17
	21:13	20:41	6 06:53 (T-49)	19:48	18:50	17:04
12	05:52	06:25	06:48 (T-49)	07:01	07:37	07:19
	21:13	6 06:46 (T-49)	20:40	3 06:51 (T-49)	19:46	18:49
13	05:53	06:26	06:49 (T-49)	07:02	07:39	07:20
	21:12	10 06:47 (T-49)	20:38		19:44	18:47
14	05:54	06:27	06:50 (T-49)	07:03	07:40	07:21
	21:11	13 06:49 (T-49)	20:37		19:43	18:45
15	05:55	06:28	06:51 (T-49)	07:04	07:41	07:23
	21:11	16 06:51 (T-49)	20:35		19:41	18:43
16	05:56	06:29	06:52 (T-49)	07:05	07:42	07:24
	21:10	18 06:52 (T-49)	20:34		19:39	18:42
17	05:57	06:30	06:53 (T-49)	07:06	07:43	07:25
	21:09	20 06:53 (T-49)	20:32		19:37	18:40
18	05:58	06:31	06:54 (T-49)	07:07	07:44	07:26
	21:09	21 06:54 (T-49)	20:30		19:35	18:38
19	05:59	06:32	06:55 (T-49)	07:08	07:45	07:27
	21:08	23 06:55 (T-49)	20:29		19:33	18:37
20	06:00	06:33	06:56 (T-49)	07:09	07:46	07:28
	21:07	25 06:56 (T-49)	20:27		19:31	18:35
21	06:00	06:34	06:57 (T-49)	07:10	07:47	07:29
	21:06	26 06:57 (T-49)	20:26		19:29	18:33
22	06:01	06:35	06:58 (T-49)	07:11	07:48	07:30
	21:05	28 06:58 (T-49)	20:24		19:27	18:32
23	06:03	06:36	06:59 (T-49)	07:12	07:49	07:31
	21:04	28 06:59 (T-49)	20:22		19:26	18:30
24	06:04	06:37	07:00 (T-49)	07:13	07:50	07:32
	21:03	29 06:58 (T-49)	20:21		19:24	18:29
25	06:05	06:38	07:01 (T-49)	07:14	07:51	07:33
	21:02	30 06:59 (T-49)	20:20		19:23	18:28
26	06:06	06:39	07:02 (T-49)	07:15	07:52	07:34
	21:01	30 06:59 (T-49)	20:19		19:22	18:27
27	06:07	06:40	07:03 (T-49)	07:16	07:53	07:35
	21:00	29 06:59 (T-49)	20:18		19:21	18:26
28	06:08	06:41	07:04 (T-49)	07:17	07:54	07:36
	20:59	28 06:59 (T-49)	20:17		19:20	18:25
29	06:09	06:42	07:05 (T-49)	07:18	07:55	07:37
	20:58	27 07:00 (T-49)	20:16		19:19	18:24
30	06:10	06:43	07:06 (T-49)	07:19	07:56	07:38
	20:57	26 07:00 (T-49)	20:15		19:18	18:23
31	06:11	06:44	07:07 (T-49)	07:20	07:57	07:39
	20:56	25 07:00 (T-49)	20:14		19:17	18:22
Potential sun hours	471	436		377	341	289
Total, worst case	458	181		326	1396	729
Sun reduction	0.75	0.72		0.56	0.48	0.52
Oper. time red.	0.90	0.90		0.90	0.90	0.90
Wind dir. red.	0.59	0.59		0.59	0.60	0.60
Total reduction	0.40	0.38		0.30	0.26	0.28
Total, real	182	69		97	360	204

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-078 - R-078
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:39 (T-22)	07:09	06:18
	16:57	17:35	18:12	46 08:25 (T-22)	19:52	19:33 (T-20)
2	08:04	07:46	07:04	07:40 (T-22)	07:07	20:30
	16:57	17:36	18:14	45 08:25 (T-22)	19:54	33 20:06 (T-19)
3	08:04	07:44	07:02	07:41 (T-22)	07:05	06:16
	16:58	17:37	18:15	43 08:24 (T-22)	19:55	35 20:08 (T-19)
4	08:04	07:43	07:00	07:41 (T-22)	07:03	06:15
	16:59	17:39	18:16	41 08:22 (T-22)	19:56	36 20:08 (T-19)
5	08:04	07:42	08:04 (T-22)	06:59	07:42 (T-22)	07:02
	17:00	17:40	7 08:11 (T-22)	18:18	39 08:21 (T-22)	19:57
6	08:04	07:41	08:02 (T-22)	06:57	07:43 (T-22)	07:00
	17:01	17:42	12 08:14 (T-22)	18:19	36 08:19 (T-22)	19:59
7	08:04	07:39	08:01 (T-22)	06:55	07:45 (T-22)	06:58
	17:02	17:43	16 08:17 (T-22)	18:20	33 08:18 (T-22)	20:00
8	08:04	07:38	08:00 (T-22)	07:53	08:47 (T-22)	06:56
	17:03	17:45	19 08:19 (T-22)	18:22	28 09:15 (T-22)	20:01
9	08:03	07:37	07:58 (T-22)	07:51	08:49 (T-22)	06:54
	17:05	17:46	22 08:20 (T-22)	19:23	23 09:12 (T-22)	20:02
10	08:03	07:35	07:57 (T-22)	07:50	08:52 (T-22)	06:53
	17:06	17:47	25 08:22 (T-22)	19:24	17 09:09 (T-22)	20:04
11	08:03	07:34	07:55 (T-22)	07:48	06:51	06:04
	17:07	17:49	28 08:23 (T-22)	19:26	20:05	39 20:12 (T-20)
12	08:02	07:33	07:54 (T-22)	07:46	06:49	06:03
	17:08	17:50	31 08:25 (T-22)	19:27	20:06	37 20:11 (T-20)
13	08:02	07:31	07:52 (T-22)	07:44	06:47	06:02
	17:09	17:52	33 08:25 (T-22)	19:28	20:07	36 20:11 (T-20)
14	08:01	07:30	07:51 (T-22)	07:42	06:46	06:01
	17:10	17:53	35 08:26 (T-22)	19:30	20:09	36 20:11 (T-20)
15	08:01	07:28	07:49 (T-22)	07:41	06:44	05:59
	17:12	17:54	38 08:27 (T-22)	19:31	20:10	34 20:09 (T-20)
16	08:00	07:27	07:48 (T-22)	07:39	06:42	05:58
	17:13	17:56	40 08:28 (T-22)	19:32	20:11	32 20:08 (T-20)
17	08:00	07:25	07:46 (T-22)	07:37	06:40	05:57
	17:14	17:57	42 08:28 (T-22)	19:33	20:12	31 20:08 (T-20)
18	07:59	07:24	07:45 (T-22)	07:35	06:39	05:56
	17:15	17:59	44 08:29 (T-22)	19:35	20:14	30 20:07 (T-20)
19	07:59	07:22	07:43 (T-22)	07:33	06:37	05:55
	17:17	18:00	46 08:29 (T-22)	19:36	20:15	28 20:07 (T-20)
20	07:58	07:21	07:42 (T-22)	07:31	06:35	05:54
	17:18	18:00	47 08:29 (T-22)	19:37	20:16	6 19:48 (T-20)
21	07:57	07:19	07:40 (T-22)	07:29	06:34	26 20:06 (T-20)
	17:19	18:01	49 08:29 (T-22)	19:38	10 19:54 (T-20)	23 20:05 (T-20)
22	07:56	07:17	07:38 (T-22)	07:28	06:32	19:43 (T-20)
	17:21	18:03	51 08:29 (T-22)	19:40	13 19:56 (T-20)	20 20:03 (T-20)
23	07:56	07:16	07:39 (T-22)	07:26	06:30	19:40 (T-20)
	17:22	18:04	50 08:29 (T-22)	19:41	17 19:57 (T-20)	17 20:01 (T-20)
24	07:55	07:14	07:38 (T-22)	07:24	06:29	19:38 (T-20)
	17:23	18:06	51 08:29 (T-22)	19:42	20:21	20 19:58 (T-20)
25	07:54	07:12	07:38 (T-22)	07:22	06:27	19:38 (T-20)
	17:25	18:07	50 08:28 (T-22)	19:44	21 19:59 (T-19)	7 19:57 (T-20)
26	07:53	07:11	07:39 (T-22)	07:20	06:26	19:36 (T-20)
	17:26	18:08	49 08:28 (T-22)	19:45	20:23	24 20:00 (T-19)
27	07:52	07:09	07:39 (T-22)	07:18	06:24	19:36 (T-20)
	17:28	18:10	48 08:27 (T-22)	19:46	20:25	26 20:02 (T-19)
28	07:51	07:07	07:39 (T-22)	07:16	06:22	19:34 (T-20)
	17:29	18:11	48 08:27 (T-22)	19:47	20:26	28 20:02 (T-19)
29	07:50		07:15		06:21	19:34 (T-20)
	17:30		19:49		20:27	30 20:04 (T-19)
30	07:49		07:13		06:19	19:33 (T-20)
	17:32		19:50		20:28	32 20:05 (T-19)
31	07:48		07:11			05:45
	17:33		19:51			21:03
Potential sun hours	287	292	369	404	459	465
Total, worst case		881	351	227	789	
Sun reduction		0.58	0.59	0.63	0.66	
Oper. time red.		0.90	0.90	0.90	0.90	
Wind dir. red.		0.63	0.63	0.61	0.61	
Total reduction		0.33	0.33	0.35	0.36	
Total, real		290	117	79	287	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-078 - R-078
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	19:44 (T-20) 20:22 (T-20)	06:48 20:07	07:24 19:11	07:04 17:16
2	05:45 21:16	06:13 20:53	19:44 (T-20) 20:22 (T-20)	06:49 20:05	07:25 19:09	07:05 17:15
3	05:46 21:16	06:14 20:52	19:43 (T-20) 20:23 (T-20)	06:51 20:03	07:26 19:07	07:06 17:14
4	05:46 21:16	06:16 20:51	19:43 (T-20) 20:23 (T-19)	06:52 20:01	07:28 19:05	07:08 17:12
5	05:47 21:15	06:17 20:50	19:42 (T-20) 20:24 (T-19)	06:53 19:59	07:29 19:03	07:09 17:11
6	05:48 21:15	06:18 20:48	19:42 (T-20) 20:22 (T-19)	06:54 19:57	07:30 19:01	07:11 17:10
7	05:48 21:15	06:19 20:47	19:42 (T-20) 20:21 (T-19)	06:55 19:56	07:31 18:58	07:12 17:08
8	05:49 21:14	06:20 20:46	19:41 (T-20) 20:19 (T-19)	06:57 19:54	07:32 18:56	07:13 17:07
9	05:50 21:14	06:21 20:44	19:41 (T-20) 20:18 (T-19)	06:58 19:52	07:34 18:54	07:15 17:06
10	05:51 21:14	06:22 20:43	19:41 (T-20) 20:17 (T-19)	06:59 19:50	07:35 18:52	07:16 17:05
11	05:51 21:13	06:24 20:41	19:42 (T-20) 20:16 (T-19)	07:00 19:48	07:36 18:50	07:17 17:04
12	05:52 21:13	06:25 20:40	19:42 (T-20) 20:14 (T-19)	07:01 19:46	07:37 18:49	07:19 17:03
13	05:53 21:12	06:26 20:38	19:42 (T-20) 20:13 (T-19)	07:02 19:44	07:39 18:47	07:20 17:01
14	05:54 21:11	06:27 20:37	19:42 (T-20) 20:11 (T-19)	07:04 19:43	07:40 18:45	07:21 17:00
15	05:55 21:11	06:28 20:35	19:42 (T-20) 20:10 (T-19)	07:05 19:41	07:41 18:43	07:23 16:59
16	05:56 21:10	06:29 20:34	19:43 (T-20) 20:08 (T-19)	07:06 19:39	07:43 18:42	07:24 16:58
17	05:57 21:09	06:31 20:32	19:43 (T-20) 20:06 (T-19)	07:07 19:37	07:44 18:40	07:25 16:57
18	05:58 21:09	06:32 20:30	19:44 (T-20) 20:05 (T-19)	07:08 19:35	07:45 18:38	07:27 16:57
19	05:58 21:08	19:58 (T-20) 20:08 (T-20)	06:33 20:29	19:45 (T-20) 20:04 (T-20)	07:09 19:33	07:28 18:37
20	05:59 21:07	19:55 (T-20) 20:10 (T-20)	06:34 20:27	19:46 (T-20) 20:02 (T-20)	07:11 19:31	07:29 18:35
21	06:00 21:06	19:53 (T-20) 20:12 (T-20)	06:35 20:26	19:48 (T-20) 20:01 (T-20)	07:12 19:29	07:31 18:33
22	06:01 21:05	19:52 (T-20) 20:13 (T-20)	06:36 20:24	19:49 (T-20) 19:59 (T-20)	07:13 19:27	07:32 18:32
23	06:02 21:04	19:51 (T-20) 20:15 (T-20)	06:38 20:22	19:52 (T-20) 19:57 (T-20)	07:14 19:26	07:33 18:30
24	06:03 21:03	19:50 (T-20) 20:16 (T-20)	06:39 20:21	19:54 (T-20) 19:24	07:15 19:24	07:35 18:28
25	06:05 21:02	19:49 (T-20) 20:17 (T-20)	06:40 20:19	19:57 (T-20) 19:22	07:17 19:22	07:36 18:27
26	06:06 21:01	19:48 (T-20) 20:18 (T-20)	06:41 20:17	19:58 (T-20) 19:20	07:18 19:20	07:37 18:25
27	06:07 21:00	19:47 (T-20) 20:19 (T-20)	06:42 20:15	19:59 (T-20) 19:18	07:19 18:24	07:38 18:24
28	06:08 20:59	19:46 (T-20) 20:19 (T-20)	06:44 20:14	19:58 (T-20) 19:16	07:20 18:22	07:40 18:22
29	06:09 20:58	19:45 (T-20) 20:20 (T-20)	06:45 20:12	19:57 (T-20) 19:14	07:21 18:21	07:41 18:21
30	06:10 20:57	19:46 (T-20) 20:21 (T-20)	06:46 20:10	19:56 (T-20) 19:12	07:22 18:19	07:42 18:19
31	06:11 20:56	19:45 (T-20) 20:22 (T-20)	06:47 20:08	19:55 (T-20)	07:23 18:18	07:43 18:18
Potential sun hours	471	436	377	341	288	275
Total, worst case	345	674	1153	98		
Sun reduction	0.75	0.72	0.56	0.48		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.61	0.61	0.63	0.63		
Total reduction	0.41	0.40	0.32	0.27		
Total, real	143	268	366	27		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-079 - R-079

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	15:52 (T-21)	07:47	07:06	07:09	06:18
	16:56	17	16:09 (T-21)	17:35	18:12	19:52
2	08:04	15:53 (T-21)	07:46	07:04	07:07	20:30
	16:57	16	16:09 (T-21)	17:36	18:14	19:53
3	08:04	15:54 (T-21)	07:44	07:02	07:05	20:31
	16:58	15	16:09 (T-21)	17:37	18:15	19:55
4	08:04	15:55 (T-21)	07:43	07:00	07:03	20:32
	16:59	12	16:07 (T-21)	17:39	18:16	19:56
5	08:04	15:57 (T-21)	07:42	06:59	07:02	20:33
	17:00	9	16:06 (T-21)	17:40	18:18	19:57
6	08:04	16:00 (T-21)	07:41	06:57	07:00	20:35
	17:01	5	16:05 (T-21)	17:42	18:19	19:58
7	08:04	07:39	06:55	06:58	19:35 (T-41)	06:09
	17:02	17:43	18:20	20:00	3	19:38 (T-41)
8	08:04	07:38	07:53	06:56	19:33 (T-41)	20:37
	17:03	17:44	18:22	20:01	6	19:39 (T-41)
9	08:03	07:37	07:51	06:54	19:33 (T-41)	20:38
	17:05	17:46	19:23	20:02	8	19:41 (T-41)
10	08:03	07:35	07:50	06:53	19:32 (T-41)	20:39
	17:06	17:47	19:24	20:03	10	19:42 (T-41)
11	08:03	07:34	07:48	06:51	19:31 (T-41)	20:40
	17:07	17:49	19:26	20:05	12	19:43 (T-41)
12	08:02	07:33	07:46	06:49	19:30 (T-41)	20:41
	17:08	17:50	19:27	20:06	14	19:44 (T-41)
13	08:02	07:31	07:44	06:47	19:30 (T-41)	20:42
	17:09	17:52	19:28	20:07	16	19:46 (T-41)
14	08:01	07:30	07:42	06:45	19:30 (T-41)	20:44
	17:10	17:53	19:29	20:08	16	19:46 (T-41)
15	08:01	07:28	07:41	06:44	19:30 (T-41)	20:45
	17:12	17:54	19:31	20:10	17	19:47 (T-41)
16	08:00	07:27	07:39	06:42	19:29 (T-41)	20:46
	17:13	17:56	19:32	20:11	19	19:48 (T-41)
17	08:00	07:25	07:37	06:40	19:30 (T-41)	20:48
	17:14	17:57	19:33	20:12	20	19:50 (T-41)
18	07:59	07:24	07:35	19:11 (T-20)	06:39	19:31 (T-41)
	17:15	17:59	19:35	2	19:13 (T-20)	20:49
19	07:59	07:22	07:33	19:10 (T-20)	20:13	19:31 (T-41)
	17:17	18:00	19:36	4	19:14 (T-20)	20:50
20	07:58	07:20	07:31	19:09 (T-20)	20:37	19:31 (T-41)
	17:18	18:00	19:37	6	19:15 (T-20)	20:51
21	07:57	07:19	07:29	19:09 (T-20)	20:15	19:33 (T-41)
	17:19	18:01	19:38	8	19:17 (T-20)	20:52
22	07:56	07:17	07:28	19:08 (T-20)	20:16	19:35 (T-41)
	17:21	18:03	19:40	11	19:19 (T-20)	20:53
23	07:56	07:16	07:26	19:08 (T-20)	20:17	19:45 (T-41)
	17:22	18:04	19:41	12	19:20 (T-20)	20:54
24	07:55	07:14	07:24	19:08 (T-20)	20:18	20:54
	17:23	18:05	19:42	13	19:21 (T-20)	20:55
25	07:54	07:12	07:22	19:09 (T-20)	20:19	20:55
	17:25	18:07	19:43	13	19:22 (T-20)	20:56
26	07:53	07:11	07:20	19:09 (T-20)	20:20	20:56
	17:26	18:08	19:45	14	19:23 (T-20)	20:57
27	07:52	07:09	07:18	19:11 (T-20)	20:21	20:57
	17:28	18:10	19:46	11	19:22 (T-20)	20:58
28	07:51	07:07	07:16	19:15 (T-20)	20:22	20:58
	17:29	18:11	19:47	4	19:19 (T-20)	20:59
29	07:50	07:14	07:14	06:21	20:22	20:59
	17:30	19:48	20:27	20:27	21:00	20:59
30	07:49	07:13	06:19	06:19	21:01	20:59
	17:32	19:50	20:28	20:28	21:02	20:59
31	07:48	07:11	06:19	06:19	21:03	20:59
	17:33	19:51	21:03	21:03	21:03	20:59
Potential sun hours	287	292	369	404	459	465
Total, worst case	74		98	204		
Sun reduction	0.58		0.59	0.63		
Oper. time red.	0.90		0.90	0.90		
Wind dir. red.	0.62		0.59	0.60		
Total reduction	0.32		0.31	0.34		
Total, real	24		31	69		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-079 - R-079

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	06:48 20:07	19:30 (T-41) 19:10	07:24 17:16	07:43 16:48
2	05:45 21:16	06:13 20:53	06:49 20:05	19:30 (T-41) 19:09	07:25 17:15	07:44 16:48
3	05:46 21:16	06:14 20:52	06:51 20:03	19:30 (T-41) 19:07	07:26 17:14	07:45 16:47
4	05:46 21:16	06:15 20:51	06:52 20:01	19:31 (T-41) 19:05	07:27 17:12	07:46 16:47
5	05:47 21:15	06:17 20:50	06:53 19:59	19:32 (T-41) 19:03	07:29 17:11	07:47 16:47
6	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	07:11 17:10	07:48 16:46
7	05:48 21:15	06:19 20:47	06:55 19:56	07:31 18:58	07:12 17:08	5 15:51 (T-21) 07:49 15:44 (T-21)
8	05:49 21:14	06:20 20:45	06:56 19:54	07:32 18:56	07:13 17:07	9 15:53 (T-21) 07:50 15:43 (T-21)
9	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	07:15 17:06	12 15:55 (T-21) 07:51 15:43 (T-21)
10	05:51 21:14	06:22 20:43	06:59 19:50	07:35 18:52	07:16 17:05	14 15:57 (T-21) 07:52 15:42 (T-21)
11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:50	07:17 17:04	16 15:58 (T-21) 07:53 15:42 (T-21)
12	05:52 21:13	06:25 20:40	07:01 19:46	07:37 18:49	07:19 17:03	17 15:59 (T-21) 07:54 15:42 (T-21)
13	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	07:20 17:01	18 16:00 (T-21) 07:55 15:42 (T-21)
14	05:54 21:11	06:27 20:37	07:04 19:43	07:40 18:45	07:21 17:00	19 16:01 (T-21) 07:56 15:41 (T-21)
15	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:43	07:23 16:59	20 16:01 (T-21) 07:57 15:42 (T-21)
16	05:56 21:10	06:29 20:34	07:06 19:39	07:43 19:00 (T-20) 19:11 (T-20)	07:24 07:43 18:42	20 16:02 (T-21) 07:57 15:42 (T-21)
17	05:57 21:09	06:31 20:32	07:07 19:37	11 19:11 (T-20) 18:58 (T-20)	07:25 07:44	21 16:03 (T-21) 07:58 15:43 (T-21)
18	05:57 21:09	06:32 20:30	07:08 19:35	14 19:12 (T-20) 18:56 (T-20)	07:26 07:45	21 16:04 (T-21) 07:59 15:43 (T-21)
19	05:58 21:08	06:33 20:29	07:09 19:33	14 19:10 (T-20) 18:54 (T-20)	07:27 07:46	21 16:04 (T-21) 07:59 15:43 (T-21)
20	05:59 21:07	06:34 20:27	07:11 19:31	13 19:09 (T-20) 18:55 (T-20)	07:28 07:48	22 16:05 (T-21) 08:00 15:43 (T-21)
21	06:00 21:06	06:35 20:26	07:12 19:29	12 19:07 (T-20) 18:54 (T-20)	07:29 07:49	22 16:05 (T-21) 08:01 15:44 (T-21)
22	06:01 21:05	06:36 20:24	07:13 19:27	10 19:04 (T-20) 18:53 (T-20)	07:30 07:50	22 16:06 (T-21) 08:01 15:44 (T-21)
23	06:02 21:04	06:38 20:22	07:14 19:26	9 19:02 (T-20) 18:53 (T-20)	07:33 07:52	22 16:06 (T-21) 08:02 15:45 (T-21)
24	06:03 21:03	06:39 20:21	07:15 19:24	7 19:00 (T-20) 18:53 (T-20)	07:35 07:53	22 16:07 (T-21) 08:02 15:45 (T-21)
25	06:04 21:02	06:40 20:19	07:17 19:22	5 18:58 (T-20) 18:54 (T-20)	07:36 07:54	22 16:07 (T-21) 08:02 15:46 (T-21)
26	06:06 21:01	06:41 20:17	07:18 19:20	3 18:57 (T-20) 18:57 (T-20)	07:37 07:56	22 16:08 (T-21) 08:03 15:47 (T-21)
27	06:07 21:00	06:42 20:15	07:19 19:18	07:38 18:24	07:38 16:50	21 16:08 (T-21) 08:03 15:47 (T-21)
28	06:08 20:59	06:44 20:14	07:20 19:16	07:39 18:22	07:39 16:49	21 16:08 (T-21) 08:03 15:48 (T-21)
29	06:09 20:58	06:45 20:12	07:21 19:14	08:00 18:21	07:41 16:49	20 16:08 (T-21) 08:04 15:50 (T-21)
30	06:10 20:57	06:46 20:10	07:23 19:12	08:01 18:19	07:42 16:48	19 16:09 (T-21) 08:04 15:51 (T-21)
31	06:11 20:56	06:47 20:08	07:24 19:12	08:02 18:18	07:43 16:47	18 16:09 (T-21) 08:04 15:51 (T-21)
Potential sun hours	471	436	377	341	288	275
Total, worst case						486
Sun reduction		164	137			0.52
Oper. time red.		0.72	0.67			0.90
Wind dir. red.		0.90	0.90			0.62
Total reduction		0.60	0.59			0.29
Total, real		0.39	0.36			140

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-080 - R-080
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	07:47 17:35	07:06 18:12	07:09 19:52	06:18 20:30	06:39 (T-19) 20:30	05:45 21:04	05:45 21:16	06:12 20:55	06:48 20:07	19:25 (T-15) 19:42 (T-15)	07:24 19:11	07:04 17:17
2	08:04 16:58	07:46 17:36	07:04 18:14	07:07 19:54	06:17 20:31	06:38 (T-19) 21:05	05:44 21:16	05:45 20:54	06:13 20:54	06:50 20:05	19:26 (T-15) 19:40 (T-15)	07:25 19:09	07:05 17:15
3	08:04 16:58	07:45 17:38	07:02 18:15	07:05 19:55	06:15 20:32	06:38 (T-19) 21:06	05:44 21:16	05:46 20:52	06:15 20:52	06:51 20:03	19:27 (T-15) 19:39 (T-15)	07:26 19:07	07:07 17:14
4	08:04 16:59	07:43 17:39	07:01 18:17	07:04 19:56	06:14 20:33	06:40 (T-19) 21:07	05:43 21:16	05:47 20:51	06:16 20:51	06:52 20:01	19:28 (T-15) 19:37 (T-15)	07:28 19:05	07:08 17:13
5	08:04 17:00	07:42 17:40	06:59 18:18	07:02 19:57	06:12 20:35	06:42 (T-19) 21:07	05:43 21:16	05:47 20:50	06:17 20:50	06:53 19:59	19:30 (T-15) 19:35 (T-15)	07:29 19:03	07:09 17:11
6	08:04 17:01	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	06:44 (T-19) 21:08	05:43 21:15	05:48 20:48	06:18 20:48	06:54 19:58	19:30 (T-15) 19:01	07:30 17:10	07:11 16:47
7	08:04 17:03	07:40 17:43	06:55 18:21	06:58 20:00	06:10 20:37	19:33 (T-15) 19:38 (T-15)	05:42 21:09	05:49 21:15	06:19 20:47	06:55 19:56	19:01 (T-19) 19:00	07:31 17:09	07:12 16:47
8	08:04 17:04	07:38 17:45	07:53 18:22	06:56 20:01	06:08 20:38	19:31 (T-15) 19:40 (T-15)	05:42 21:10	05:49 21:15	06:20 20:46	06:57 19:54	19:33 (T-19) 18:56	07:33 17:03	07:13 16:46
9	08:04 17:05	07:37 17:46	07:52 19:23	06:55 20:02	06:07 20:40	19:29 (T-15) 19:41 (T-15)	05:42 21:10	05:50 21:14	06:21 20:44	06:58 19:52	19:05 (T-19) 18:54	07:34 17:06	07:15 16:46
10	08:03 17:06	07:36 17:48	07:50 19:24	06:53 20:04	06:06 20:41	19:28 (T-15) 19:42 (T-15)	05:41 21:11	05:51 21:14	06:23 20:43	06:59 19:50	19:06 (T-19) 18:52	07:35 17:06	07:16 16:46
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:42	19:26 (T-15) 19:43 (T-15)	05:41 21:11	05:52 21:13	06:24 20:41	07:00 19:48	19:07 (T-19) 18:51	07:36 17:04	07:18 16:46
12	08:03 17:08	07:33 17:50	07:46 19:27	06:49 20:06	06:03 20:43	19:25 (T-15) 19:44 (T-15)	05:41 21:12	05:52 21:13	06:25 20:40	07:01 19:47	19:08 (T-15) 18:49	07:38 17:03	07:19 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	19:24 (T-15) 19:46 (T-15)	05:41 21:13	05:53 21:12	06:26 20:38	07:03 19:45	19:09 (T-15) 18:47	07:39 17:02	07:20 16:46
14	08:02 17:11	07:30 17:53	07:43 19:30	06:46 20:09	06:01 20:45	19:23 (T-15) 19:46 (T-15)	05:41 21:13	05:54 21:12	06:27 20:37	07:04 19:43	19:05 (T-15) 18:45	07:40 17:01	07:22 16:47
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	06:00 20:47	19:23 (T-15) 19:47 (T-15)	05:41 21:14	05:55 21:11	06:28 20:35	07:05 19:41	19:06 (T-15) 18:44	07:41 17:00	07:23 16:47
16	08:01 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:58 20:48	19:23 (T-15) 19:49 (T-15)	05:41 21:14	05:56 21:10	06:30 20:34	07:06 19:39	19:07 (T-15) 18:42	07:43 16:59	07:24 16:47
17	08:00 17:14	07:25 17:57	07:37 19:34	06:41 20:12	05:57 20:49	19:22 (T-15) 19:50 (T-15)	05:41 21:14	05:57 21:10	06:31 20:32	07:07 19:37	19:08 (T-15) 18:40	07:44 16:58	07:26 16:47
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:14	05:56 20:50	19:22 (T-15) 19:51 (T-15)	05:41 21:15	05:58 21:09	06:32 20:31	07:08 19:35	19:09 (T-15) 18:38	07:45 16:57	07:27 16:48
19	07:59 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	19:22 (T-15) 19:53 (T-15)	05:41 21:15	05:59 21:08	06:33 20:29	07:10 19:33	19:10 (T-15) 18:37	07:47 16:56	08:00 16:48
20	07:58 17:18	07:21 18:00	07:31 19:37	06:35 20:16	05:54 20:52	19:22 (T-15) 19:54 (T-15)	05:41 21:15	06:00 21:07	06:34 20:27	07:11 19:31	19:11 (T-15) 18:35	07:48 16:55	08:00 16:48
21	07:57 17:20	07:19 18:02	07:30 19:39	06:34 20:17	05:53 20:53	19:24 (T-15) 19:54 (T-15)	05:41 21:16	06:01 21:06	06:35 20:26	07:12 19:30	19:12 (T-15) 18:33	07:49 16:54	08:01 16:49
22	07:57 17:21	07:17 18:03	07:28 19:40	06:32 20:19	05:52 20:54	19:23 (T-15) 19:56 (T-15)	05:41 21:16	06:02 21:05	06:37 20:24	07:13 19:28	19:13 (T-15) 18:32	07:51 16:53	08:01 16:49
23	07:56 17:22	07:16 18:04	07:26 19:41	06:30 20:20	05:51 20:55	19:23 (T-15) 19:55 (T-15)	05:42 21:16	06:03 21:05	06:38 20:22	07:14 19:26	19:14 (T-15) 18:30	07:52 16:53	08:02 16:50
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	05:51 20:56	19:24 (T-15) 19:54 (T-15)	05:42 21:16	06:04 21:04	06:39 20:21	07:16 19:24	19:15 (T-15) 18:29	07:53 16:52	08:02 16:50
25	07:54 17:25	07:13 18:07	07:22 19:44	06:27 20:22	05:50 20:57	19:24 (T-15) 19:53 (T-15)	05:42 21:16	06:05 21:03	06:40 20:19	07:17 19:22	19:16 (T-15) 18:27	07:54 16:51	08:03 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:24	05:49 20:58	19:24 (T-15) 19:51 (T-15)	05:43 21:17	06:06 21:02	06:41 20:17	07:18 19:20	19:17 (T-15) 18:26	07:56 16:51	08:03 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	05:48 20:59	19:24 (T-15) 19:50 (T-15)	05:43 21:17	06:07 21:00	06:43 20:16	07:19 19:18	19:18 (T-15) 18:24	07:57 16:50	08:03 16:52
28	07:51 17:29	07:07 18:11	07:17 19:47	06:23 20:26	05:47 21:00	19:24 (T-15) 19:48 (T-15)	05:43 21:17	06:08 20:59	06:44 20:14	07:20 19:16	19:19 (T-15) 18:22	07:59 16:50	08:04 16:53
29	07:50 17:31	07:05 18:13	07:15 19:48	06:21 20:27	05:47 21:01	19:24 (T-15) 19:47 (T-15)	05:44 21:17	06:09 20:58	06:45 20:12	07:22 19:14	19:20 (T-15) 18:21	08:00 16:49	08:04 16:54
30	07:49 17:32	07:03 18:15	07:13 19:50	06:19 20:29	05:46 21:02	19:24 (T-15) 19:43 (T-15)	05:44 21:17	06:10 20:57	06:46 20:10	07:23 19:13	19:21 (T-15) 18:20	08:01 16:49	08:04 16:55
31	07:48 17:33	07:01 18:15	07:11 19:51	06:18 21:03	05:46 21:03	19:24 (T-15) 19:43 (T-15)	05:44 21:17	06:11 20:56	06:47 20:09	07:24 19:13	19:22 (T-15) 18:18	08:02 16:48	08:04 16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275	
Total, worst case				687	91			732	57				
Sun reduction				0.63	0.66			0.72	0.67				
Oper. time red.				0.90	0.90			0.90	0.90				
Wind dir. red.				0.59	0.58			0.59	0.60				
Total reduction				0.34	0.35			0.38	0.36				
Total, real				232	31			281	21				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-081 - R-081

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	08:09 (T-42)	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04
	16:57	17:35	08:41 (T-42)	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17
2	08:04	07:46	08:08 (T-42)	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05
	16:58	17:36	08:41 (T-42)	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15
3	08:04	07:45	08:08 (T-42)	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07
	16:59	17:38	08:40 (T-42)	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14
4	08:04	07:43	08:09 (T-42)	07:01	07:04	06:14	05:43	05:47	06:16	06:52	07:28	07:08
	17:00	17:39	08:39 (T-42)	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13
5	08:04	07:42	08:10 (T-42)	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09
	17:01	17:40	08:39 (T-42)	18:18	19:57	20:35	21:07	21:16	20:50	19:59	19:03	17:11
6	08:04	07:41	08:12 (T-42)	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11
	17:02	17:42	08:39 (T-42)	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10
7	08:04	07:40	08:12 (T-42)	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12
	17:03	17:43	08:37 (T-42)	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09
8	08:04	07:38	08:14 (T-42)	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13
	17:04	17:45	08:36 (T-42)	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:07
9	08:03	07:37	08:15 (T-42)	07:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15
	17:05	17:46	08:34 (T-42)	19:23	20:02	20:40	21:10	21:14	20:44	19:52	18:54	17:06
10	08:03	07:36	08:18 (T-42)	07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16
	17:06	17:48	08:32 (T-42)	19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05
11	08:03	07:34	08:24 (T-42)	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:18
	17:07	17:49	08:26 (T-42)	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04
12	08:02	07:33	08:26 (T-42)	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19
	17:08	08:27 (T-42)	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03
13	08:02	07:31	08:26 (T-42)	07:44	06:47	06:02	05:41	05:53	06:26	07:03	07:39	07:20
	17:09	08:29 (T-42)	17:52	19:28	20:07	20:44	21:13	21:12	20:38	19:45	18:47	17:02
14	08:02	07:30	08:25 (T-42)	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22
	17:11	08:30 (T-42)	17:53	19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	17:01
15	08:01	07:28	08:24 (T-42)	07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:23
	17:12	08:31 (T-42)	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00
16	08:01	07:27	08:24 (T-42)	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24
	17:13	08:32 (T-42)	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	17:00
17	08:00	07:25	08:23 (T-42)	07:37	06:41	05:57	05:41	05:57	06:31	07:07	07:44	07:26
	17:14	08:33 (T-42)	17:57	19:34	20:12	20:49	21:14	21:10	20:32	19:37	18:40	16:58
18	07:59	07:24	08:22 (T-42)	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27
	17:16	08:34 (T-42)	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57
19	07:59	07:22	08:22 (T-42)	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28
	17:17	08:36 (T-42)	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56
20	07:58	07:21	08:21 (T-42)	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:30
	17:18	08:36 (T-42)	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55
21	07:57	07:19	08:20 (T-42)	07:30	06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31
	17:20	08:37 (T-42)	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54
22	07:57	07:17	08:19 (T-42)	07:28	06:32	05:52	05:41	06:02	06:37	07:13	07:51	07:32
	17:21	08:37 (T-42)	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:53
23	07:56	07:16	08:18 (T-42)	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33
	17:22	08:38 (T-42)	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53
24	07:55	07:14	08:17 (T-42)	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35
	17:24	08:38 (T-42)	18:06	19:42	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52
25	07:54	07:13	08:16 (T-42)	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36
	17:25	08:39 (T-42)	18:07	19:44	20:22	20:57	21:16	21:03	20:19	19:22	18:27	16:51
26	07:53	07:11	08:15 (T-42)	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37
	17:26	08:39 (T-42)	18:08	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51
27	07:52	07:09	08:14 (T-42)	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38
	17:28	08:40 (T-42)	18:10	19:46	20:25	20:59	21:17	21:00	20:16	19:18	18:24	16:50
28	07:51	07:07	08:13 (T-42)	07:17	06:23	05:48	05:43	06:08	06:44	07:20	07:59	07:40
	17:29	08:40 (T-42)	18:11	19:47	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50
29	07:50	07:05	08:12 (T-42)	07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41
	17:31	08:40 (T-42)	18:11	19:49	20:27	21:01	21:17	20:58	20:12	19:14	18:21	16:49
30	07:49	07:02	08:11 (T-42)	07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42
	17:32	08:41 (T-42)	18:12	19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49
31	07:48	07:00	08:10 (T-42)	07:11	06:20	05:46	06:11	06:47	08:03	08:51 (T-42)	08:04	08:04
	17:33	08:41 (T-42)	18:13	19:51	21:03	21:03	20:56	20:09	18:18	6	08:57 (T-42)	16:56
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275
Total, worst case	340	265								6	604	
Sun reduction	0.58	0.58								0.56	0.48	
Oper. time red.	0.90	0.90								0.90	0.90	
Wind dir. red.	0.65	0.65								0.65	0.65	
Total reduction	0.34	0.34								0.33	0.28	
Total, real	115	89								2	169	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-082 - R-082

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December					
1	08:04	08:29 (T-42)	07:47	08:34 (T-42)	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43	08:09 (T-42)		
1	16:57	08:50 (T-42)	17:35	08:52 (T-42)	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48	29	08:38 (T-42)	
2	08:04	08:29 (T-42)	07:46	08:37 (T-42)	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05	07:44	08:10 (T-42)		
2	16:58	08:51 (T-42)	17:36	08:49 (T-42)	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48	28	08:38 (T-42)	
3	08:04	08:29 (T-42)	07:45	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45	07:45	08:11 (T-42)		
3	16:59	08:51 (T-42)	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48	27	08:38 (T-42)		
4	08:04	08:29 (T-42)	07:43	07:01	07:04	06:14	05:43	05:47	06:16	06:52	07:28	07:08	07:47	07:47	08:12 (T-42)		
4	17:00	08:52 (T-42)	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47	26	08:38 (T-42)		
5	08:04	08:28 (T-42)	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:48	07:48	08:13 (T-42)		
5	17:01	08:52 (T-42)	17:40	18:18	19:57	20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	26	08:39 (T-42)		
6	08:04	08:28 (T-42)	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49	07:49	08:14 (T-42)		
6	17:02	08:53 (T-42)	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10	16:47	25	08:39 (T-42)		
7	08:04	08:28 (T-42)	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:50	07:50	08:15 (T-42)		
7	17:03	08:54 (T-42)	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47	24	08:39 (T-42)		
8	08:04	08:28 (T-42)	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:51	07:51	08:16 (T-42)		
8	17:04	08:54 (T-42)	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:07	16:46	23	08:39 (T-42)		
9	08:03	08:27 (T-42)	07:37	07:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15	08:07 (T-42)	07:52	08:17 (T-42)		
9	17:05	08:54 (T-42)	17:46	19:23	20:02	20:40	21:10	21:14	20:44	19:52	18:54	17:06	13	08:20 (T-42)	16:46	22	08:39 (T-42)
10	08:03	08:27 (T-42)	07:36	07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16	08:05 (T-42)	07:53	08:18 (T-42)		
10	17:06	08:55 (T-42)	17:48	19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	18	08:23 (T-42)	16:46	22	08:40 (T-42)
11	08:03	08:27 (T-42)	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:18	08:03 (T-42)	07:53	08:19 (T-42)		
11	17:07	08:56 (T-42)	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	21	08:24 (T-42)	16:46	21	08:40 (T-42)
12	08:02	08:26 (T-42)	07:33	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19	08:02 (T-42)	07:54	08:20 (T-42)		
12	17:08	08:56 (T-42)	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	25	08:27 (T-42)	16:46	20	08:40 (T-42)
13	08:02	08:26 (T-42)	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:03	07:39	07:20	08:00 (T-42)	07:55	08:21 (T-42)		
13	17:09	08:57 (T-42)	17:52	19:28	20:07	20:44	21:13	21:12	20:38	19:45	18:47	17:02	28	08:28 (T-42)	16:47	20	08:41 (T-42)
14	08:02	08:25 (T-42)	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	08:00 (T-42)	07:56	08:22 (T-42)		
14	17:11	08:57 (T-42)	17:53	19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	17:01	29	08:29 (T-42)	16:47	19	08:41 (T-42)
15	08:01	08:24 (T-42)	07:28	07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:23	07:59 (T-42)	07:57	08:22 (T-42)		
15	17:12	08:57 (T-42)	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00	31	08:30 (T-42)	16:47	19	08:41 (T-42)
16	08:01	08:24 (T-42)	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:59 (T-42)	07:57	08:23 (T-42)		
16	17:13	08:58 (T-42)	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	32	08:31 (T-42)	16:47	18	08:41 (T-42)
17	08:00	08:23 (T-42)	07:25	07:37	06:41	05:57	05:41	05:57	06:31	07:07	07:44	07:26	07:58 (T-42)	07:58	08:24 (T-42)		
17	17:14	08:58 (T-42)	17:57	19:34	20:12	20:49	21:14	21:10	20:32	19:37	18:40	16:58	34	08:32 (T-42)	16:47	18	08:42 (T-42)
18	07:59	08:22 (T-42)	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:58 (T-42)	07:59	08:24 (T-42)		
18	17:16	08:58 (T-42)	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:38	16:57	34	08:32 (T-42)	16:48	18	08:42 (T-42)
19	07:59	08:22 (T-42)	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28	07:58 (T-42)	08:00	08:25 (T-42)		
19	17:17	08:59 (T-42)	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	35	08:33 (T-42)	16:48	18	08:43 (T-42)
20	07:58	08:22 (T-42)	07:21	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:30	07:57 (T-42)	08:00	08:26 (T-42)		
20	17:18	08:59 (T-42)	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	37	08:34 (T-42)	16:49	18	08:44 (T-42)
21	07:57	08:22 (T-42)	07:19	07:30	06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31	07:58 (T-42)	08:01	08:26 (T-42)		
21	17:20	08:59 (T-42)	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	37	08:35 (T-42)	16:49	17	08:43 (T-42)
22	07:56	08:22 (T-42)	07:17	07:28	06:32	05:52	05:41	06:02	06:37	07:13	07:51	07:32	07:58 (T-42)	08:01	08:27 (T-42)		
22	17:21	08:59 (T-42)	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:53	37	08:35 (T-42)	16:49	17	08:44 (T-42)
23	07:56	08:23 (T-42)	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	07:58 (T-42)	08:02	08:27 (T-42)		
23	17:22	08:58 (T-42)	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	37	08:35 (T-42)	16:50	17	08:44 (T-42)
24	07:55	08:24 (T-42)	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:00 (T-42)	08:02	08:27 (T-42)		
24	17:24	08:58 (T-42)	18:06	19:42	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52	36	08:36 (T-42)	16:51	18	08:45 (T-42)
25	07:54	08:24 (T-42)	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	08:01 (T-42)	08:03	08:28 (T-42)		
25	17:25	08:58 (T-42)	18:07	19:44	20:22	20:57	21:16	21:03	20:19	19:22	18:27	16:51	35	08:36 (T-42)	16:51	18	08:46 (T-42)
26	07:53	08:25 (T-42)	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:02 (T-42)	08:03	08:28 (T-42)		
26	17:26	08:57 (T-42)	18:08	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51	34	08:36 (T-42)	16:52	18	08:46 (T-42)
27	07:52	08:26 (T-42)	07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:04 (T-42)	08:03	08:28 (T-42)		
27	17:28	08:57 (T-42)	18:10	19:46	20:25	20:59	21:17	21:00	20:16	19:18	18:24	16:50	33	08:37 (T-42)	16:52	18	08:46 (T-42)
28	07:51	08:27 (T-42)	07:07	07:17	06:23	05:48	05:43	06:08	06:44	07:20	07:58	07:40	08:05 (T-42)	08:03	08:28 (T-42)		
28	17:29	08:56 (T-42)	18:11	19:47	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	32	08:37 (T-42)	16:53	19	08:47 (T-42)
29	07:50	08:29 (T-42)		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:06 (T-42)	08:04	08:29 (T-42)		
29	17:31	08:56 (T-42)		19:49	20:27	21:01	21:17	20:58	20:12	19:14	18:21	16:49	31	08:37 (T-42)	16:54	19	08:48 (T-42)
30	07:49	08:30 (T-42)		07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:07 (T-42)	08:04	08:29 (T-42)		
30	17:32	08:55 (T-42)		19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49	30	08:37 (T-42)	16:55	20	08:49 (T-42)
31	07:48	08:32 (T-42)		07:11	06:18	05:46	06:11	06:47			08:03		08:04	08:04	08:29 (T-42)		
31	17:33	08:53 (T-42)		19:51	20:30	21:03	20:56	20:09			18:18		16:56	20	08:49 (T-42)		
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	679	275	642			
Total, worst case	920	30															
Sun reduction	0.58	0.58										0.48		0.52			
Oper. time red.	0.																

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-084 - R-084

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:00	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:01	17:40	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:07	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:03	16:47
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:01	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:47
18	07:59	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:30	19:35	18:38	16:57	16:48
19	07:59	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:29	18:33	16:54	16:49
22	07:56	07:17	07:28	06:32	05:52	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:53	16:49
23	07:56	07:16	07:26	06:30	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:03
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	05:48	05:43	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11	06:17	05:46		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-085 - R-085

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:00	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:01	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:49
	17:03	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:01	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:30	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31	08:00
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:29	18:34	16:54	16:49
22	07:56	07:17	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:53	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:03
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11	06:17	05:46		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-086 - R-086
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04 16:57	07:47 17:35	07:06 18:12	07:09 19:52	07:29 (T-53) 07:40 (T-52)	06:18 20:30	05:45 21:04	05:45 21:16	06:12 20:55	06:48 20:07	07:10 (T-53) 07:45 (T-52)	07:24 19:11	07:04 17:17	07:43 16:48
2	08:04 16:58	07:46 17:36	07:04 18:14	07:07 19:54	07:27 (T-53) 07:42 (T-52)	06:17 20:31	05:45 21:05	05:46 21:16	06:13 20:53	06:50 20:05	07:11 (T-53) 07:45 (T-52)	07:25 19:09	07:05 17:15	07:44 16:48
3	08:04 16:59	07:44 17:38	07:02 18:15	07:05 19:55	07:26 (T-53) 07:44 (T-52)	06:15 20:32	05:44 21:05	05:46 21:16	06:15 20:52	06:51 20:03	07:13 (T-53) 07:45 (T-52)	07:26 19:07	07:06 17:14	07:45 16:48
4	08:04 17:00	07:43 17:39	07:00 18:16	07:04 19:56	07:24 (T-53) 07:45 (T-52)	06:14 20:33	05:44 21:06	05:47 21:16	06:16 20:51	06:52 20:01	07:14 (T-53) 07:44 (T-52)	07:28 19:05	07:08 17:13	07:46 16:47
5	08:04 17:01	07:42 17:40	06:59 18:18	07:02 19:57	07:22 (T-53) 07:45 (T-52)	06:12 20:34	05:43 21:07	05:47 21:15	06:17 20:50	06:53 20:05	07:15 (T-53) 07:43 (T-52)	07:29 19:03	07:09 17:11	07:47 16:47
6	08:04 17:02	07:41 17:42	06:57 18:19	07:00 19:59	07:20 (T-53) 07:46 (T-52)	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:54 20:06	07:16 (T-53) 07:42 (T-52)	07:30 19:01	07:11 17:10	07:48 16:47
7	08:04 17:03	07:39 17:43	06:55 18:20	06:58 20:00	07:18 (T-53) 07:46 (T-52)	06:10 20:37	05:42 21:09	05:49 21:15	06:19 20:47	06:55 20:07	07:17 (T-53) 07:40 (T-52)	07:31 19:00	07:12 17:09	07:49 16:47
8	08:03 17:04	07:38 17:45	07:53 18:23	06:56 20:01	07:17 (T-53) 07:47 (T-52)	06:08 20:38	05:42 21:09	05:49 21:14	06:20 20:45	06:57 20:08	07:18 (T-53) 07:39 (T-52)	07:32 18:56	07:13 17:07	07:50 16:50
9	08:03 17:05	07:37 17:46	07:52 19:23	06:55 20:02	07:15 (T-53) 07:47 (T-52)	06:07 20:39	05:42 21:10	05:50 21:14	06:21 20:44	06:58 20:09	07:19 (T-53) 07:35 (T-52)	07:34 18:54	07:15 17:06	07:51 16:46
10	08:03 17:06	07:35 17:48	07:50 19:24	06:53 20:04	07:13 (T-53) 07:47 (T-52)	06:06 20:40	05:42 21:11	05:51 21:13	06:23 20:43	06:59 20:10	07:20 (T-53) 07:35 (T-52)	07:35 18:52	07:16 17:05	07:52 16:46
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	07:11 (T-53) 07:46 (T-52)	06:04 20:42	05:41 21:11	05:52 21:13	06:24 20:41	07:00 20:11	07:22 (T-53) 07:33 (T-52)	07:36 18:51	07:17 17:04	07:53 16:46
12	08:02 17:08	07:33 17:50	07:46 19:27	06:49 20:06	07:09 (T-53) 07:46 (T-52)	06:03 20:43	05:41 21:12	05:52 21:12	06:25 20:40	07:01 20:12	07:23 (T-52) 07:30 (T-52)	07:37 18:49	07:19 17:03	07:54 16:47
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	07:08 (T-52) 07:47 (T-52)	06:02 20:44	05:41 21:12	05:53 21:12	06:26 20:38	07:03 20:15	07:24 (T-52) 07:26 (T-52)	07:39 18:47	07:20 17:02	07:55 16:47
14	08:01 17:11	07:30 17:53	07:42 19:30	06:46 20:09	07:06 (T-52) 07:46 (T-52)	06:01 20:45	05:41 21:13	05:54 21:11	06:27 20:37	07:04 20:11	07:25 (T-52) 07:35 (T-52)	07:40 18:45	07:21 17:01	07:56 16:47
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	07:04 (T-52) 07:45 (T-52)	06:00 20:46	05:41 21:13	05:55 21:11	06:28 20:35	07:05 20:13	07:26 (T-52) 07:35 (T-52)	07:41 18:44	07:23 17:00	07:57 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	07:03 (T-52) 07:45 (T-52)	05:59 20:47	05:41 21:14	05:56 21:10	06:30 20:34	07:06 20:19	07:18 (T-52) 07:37 (T-52)	07:43 18:42	07:24 16:59	07:57 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33	06:41 20:12	07:03 (T-52) 07:44 (T-52)	05:57 20:49	05:41 21:14	05:57 21:09	06:31 20:32	07:07 20:23	07:16 (T-52) 07:39 (T-52)	07:44 18:40	07:25 16:58	07:58 16:47
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:14	07:03 (T-52) 07:43 (T-52)	05:56 20:50	05:41 21:15	05:58 21:09	06:32 20:30	07:08 20:27	07:15 (T-52) 07:42 (T-52)	07:45 18:38	07:27 16:57	07:59 16:48
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:15	07:04 (T-52) 07:43 (T-52)	05:55 20:51	05:41 21:15	05:59 21:08	06:33 20:29	07:10 20:30	07:13 (T-52) 07:43 (T-52)	07:46 18:37	07:28 16:56	07:59 16:48
20	07:58 17:18	07:21 18:00	07:31 19:37	06:35 20:16	07:04 (T-52) 07:42 (T-52)	05:54 20:52	05:41 21:15	06:00 21:07	06:34 20:27	07:11 20:33	07:11 (T-52) 07:44 (T-52)	07:48 18:35	07:29 16:55	08:00 16:49
21	07:57 17:20	07:19 18:02	07:30 19:39	06:34 20:17	07:04 (T-52) 07:40 (T-52)	05:53 20:53	05:41 21:15	06:01 21:06	06:36 20:26	07:12 20:35	07:10 (T-52) 07:45 (T-52)	07:49 18:33	07:31 16:54	08:00 16:49
22	07:56 17:21	07:17 18:03	07:28 19:40	06:32 20:18	07:05 (T-52) 07:40 (T-52)	05:52 20:54	05:42 21:16	06:02 21:05	06:37 20:24	07:13 20:36	07:09 (T-52) 07:45 (T-52)	07:50 18:32	07:32 16:53	08:01 16:50
23	07:55 17:22	07:16 18:04	07:26 19:41	06:30 20:20	07:06 (T-52) 07:38 (T-52)	05:52 20:55	05:42 21:16	06:03 21:04	06:38 20:22	07:14 20:39	07:07 (T-52) 07:46 (T-52)	07:52 18:30	07:33 16:53	08:01 16:50
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	07:07 (T-52) 07:37 (T-52)	05:51 20:56	05:42 21:16	06:04 21:03	06:39 20:21	07:15 20:40	07:06 (T-52) 07:46 (T-52)	07:53 18:29	07:34 16:52	08:02 16:51
25	07:54 17:25	07:12 18:07	07:22 19:44	06:27 20:22	07:08 (T-52) 07:35 (T-52)	05:50 20:57	05:42 21:16	06:05 21:02	06:40 20:19	07:17 20:41	07:05 (T-52) 07:46 (T-52)	07:54 18:27	07:36 16:51	08:02 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:23	07:09 (T-52) 07:32 (T-52)	05:49 20:58	05:43 21:16	06:06 21:01	06:41 20:17	07:18 20:41	07:06 (T-52) 07:47 (T-52)	07:56 18:26	07:37 16:51	08:03 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	07:12 (T-52) 07:30 (T-52)	05:48 20:59	05:43 21:16	06:07 21:00	06:43 20:15	07:19 20:42	07:05 (T-52) 07:47 (T-52)	07:57 18:24	07:38 16:50	08:03 16:53
28	07:51 17:29	07:07 18:11	07:17 19:47	06:23 20:26	07:15 (T-52) 07:26 (T-52)	05:48 21:00	05:44 21:16	06:08 20:59	06:44 20:14	07:20 20:41	07:06 (T-52) 07:47 (T-52)	07:58 18:23	07:39 16:50	08:03 16:53
29	07:50 17:31	07:05 18:15	07:15 19:49	06:21 20:27	07:15 (T-52) 07:34 (T-52)	05:47 21:01	05:44 21:16	06:09 20:58	06:45 20:12	07:21 20:40	07:07 (T-52) 07:47 (T-52)	08:00 18:21	07:41 16:49	08:03 16:54
30	07:49 17:32	07:04 18:12	07:13 19:50	06:20 20:28	07:33 (T-52) 07:34 (T-52)	05:46 21:02	05:44 21:16	06:10 20:57	06:46 20:10	07:23 20:38	07:08 (T-52) 07:46 (T-52)	08:01 18:20	07:42 16:49	08:04 16:55
31	07:48 17:33	07:03 18:15	07:11 19:51	06:19 20:29	07:31 (T-52) 07:38 (T-52)	05:46 21:03	05:44 21:16	06:11 20:56	06:47 20:08	07:24 20:37	07:09 (T-53) 07:46 (T-52)	08:02 18:18	07:43 16:56	08:04 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275		
Total, worst case			8	842				575		282				
Sun reduction			0.59	0.63				0.72		0.67				
Oper. time red.			0.90	0.90				0.90		0.90				
Wind dir. red.			0.58	0.58				0.58		0.58				
Total reduction			0.31	0.33				0.37		0.35				
Total, real			2	276				215		98				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-087 - R-087
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	08:30 (T-58)	07:47	07:06	07:09	06:18
	16:57	23 08:53 (T-58)	17:35	18:12	19:52	20:30
2	08:04	08:31 (T-58)	07:46	07:04	07:07	06:17
	16:58	22 08:53 (T-58)	17:36	18:14	19:54	20:31
3	08:04	08:31 (T-58)	07:44	07:02	07:05	06:15
	16:59	21 08:52 (T-58)	17:38	18:15	19:55	20:32
4	08:04	08:31 (T-58)	07:43	07:00	07:04	06:14
	17:00	21 08:52 (T-58)	17:39	18:17	19:56	20:33
5	08:04	08:32 (T-58)	07:42	06:59	07:02	06:12
	17:01	21 08:53 (T-58)	17:41	18:18	19:57	20:34
6	08:04	08:34 (T-58)	07:41	06:57	07:00	06:11
	17:02	19 08:53 (T-58)	17:42	18:19	19:59	20:36
7	08:04	08:35 (T-58)	07:39	06:55	06:58	06:10
	17:03	18 08:53 (T-58)	17:43	18:20	20:00	20:37
8	08:03	08:35 (T-58)	07:38	07:53	06:56	06:08
	17:04	17 08:52 (T-58)	17:45	18:22	20:01	20:38
9	08:03	08:37 (T-58)	07:37	07:52	06:55	06:07
	17:05	15 08:52 (T-58)	17:46	19:23	20:02	20:39
10	08:03	08:38 (T-58)	07:35	07:50	06:53	06:06
	17:06	14 08:52 (T-58)	17:48	19:24	20:04	20:40
11	08:03	08:39 (T-58)	07:34	07:48	06:51	06:04
	17:07	11 08:50 (T-58)	17:49	19:26	20:05	20:42
12	08:02	08:42 (T-58)	07:33	07:46	06:49	06:03
	17:08	7 08:49 (T-58)	17:50	19:27	20:06	20:43
13	08:02		07:31	07:44	06:47	06:02
	17:10		17:52	19:28	20:07	20:44
14	08:01		07:30	07:42	06:46	06:01
	17:11		17:53	19:30	20:09	20:45
15	08:01		07:28	07:41	06:44	06:00
	17:12		17:55	19:31	20:10	20:46
16	08:00		07:27	07:39	06:42	05:59
	17:13		17:56	19:32	20:11	20:47
17	08:00		07:25	07:37	06:41	05:57
	17:14		17:57	19:33	20:12	20:49
18	07:59		07:24	07:35	06:39	05:56
	17:16		17:59	19:35	20:14	20:50
19	07:58		07:22	07:33	06:37	05:55
	17:17		18:00	19:36	20:15	20:51
20	07:58		07:21	07:31	06:35	05:54
	17:18		18:00	19:37	20:16	20:52
21	07:57		07:19	07:30	06:34	05:53
	17:20		18:02	19:39	20:17	20:53
22	07:56		07:17	07:28	06:32	05:53
	17:21		18:03	19:40	20:18	20:54
23	07:55		07:16	07:26	06:31	05:52
	17:22		18:04	19:41	20:20	20:55
24	07:55		07:14	07:24	06:29	05:51
	17:24		18:06	19:42	20:21	20:56
25	07:54		07:12	07:22	06:27	05:50
	17:25		18:07	19:44	20:22	20:57
26	07:53		07:11	07:20	06:26	05:49
	17:26		18:08	19:45	20:23	20:58
27	07:52		07:09	07:18	06:24	05:48
	17:28		18:10	19:46	20:25	20:59
28	07:51		07:07	07:17	06:23	05:48
	17:29		18:11	19:47	20:26	21:00
29	07:50			07:15	06:21	05:47
	17:31			19:49	20:27	21:01
30	07:49			07:13	06:20	05:46
	17:32			19:50	20:28	21:02
31	07:48			07:11		05:46
	17:33			19:51		21:03
Potential sun hours	287	292	369	403	458	465
Total, worst case		209				610
Sun reduction		0.58				0.66
Oper. time red.		0.90				0.90
Wind dir. red.		0.66				0.59
Total reduction		0.35				0.35
Total, real		73				215

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-087 - R-087
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:12	06:36 (T-52)	06:48	07:24	07:04
	21:16	20:55	25 07:01 (T-52)	20:07	19:11	17:17
2	05:46	06:14	06:37 (T-52)	06:50	07:25	07:05
	21:16	20:53	24 07:01 (T-52)	20:05	19:09	17:15
3	05:46	06:15	06:38 (T-52)	06:51	07:26	07:06
	21:16	20:52	23 07:01 (T-52)	20:03	19:07	17:14
4	05:47	06:16	06:39 (T-52)	06:52	07:28	07:08
	21:16	20:51	22 07:01 (T-52)	20:01	19:05	17:13
5	05:47	06:17	06:40 (T-52)	06:53	07:29	07:09
	21:15	20:50	21 07:01 (T-52)	19:59	19:03	17:11
6	05:48	06:18	06:41 (T-52)	06:54	07:30	07:11
	21:15	20:48	19 07:00 (T-52)	19:58	19:01	17:10
7	05:49	06:19	06:42 (T-52)	06:55	07:31	07:12
	21:15	20:47	18 07:00 (T-52)	19:56	19:00	17:09
8	05:49	06:20	06:43 (T-52)	06:57	07:32	07:13
	21:14	20:45	16 06:59 (T-52)	19:54	18:56	17:07
9	05:50	06:22	06:45 (T-52)	06:58	07:34	07:15
	21:14	20:44	14 06:59 (T-52)	19:52	18:54	17:06
10	05:51	06:23	06:46 (T-52)	06:59	07:35	07:16
	21:13	20:43	12 06:58 (T-52)	19:50	18:52	17:05
11	05:52	06:24	06:47 (T-52)	07:00	07:36	07:17
	21:13	20:41	10 06:57 (T-52)	19:48	18:51	17:04
12	05:53	06:25	06:48 (T-52)	07:01	07:38	07:19
	21:12	20:40	11 06:59 (T-53)	19:46	18:49	17:03
13	05:53	06:26	06:49 (T-53)	07:03	07:39	07:20
	21:12	20:38	12 07:01 (T-53)	19:45	18:47	17:02
14	05:54	06:43 (T-52)	06:27	06:50 (T-53)	07:04	07:21
	21:11	1 06:44 (T-52)	20:37	12 07:02 (T-53)	19:43	18:45
15	05:55	06:39 (T-52)	06:28	06:51 (T-53)	07:05	07:41
	21:11	9 06:48 (T-52)	20:35	12 07:03 (T-53)	19:41	18:44
16	05:56	06:38 (T-52)	06:30	06:52 (T-53)	07:06	07:43
	21:10	13 06:51 (T-52)	20:34	11 07:03 (T-53)	19:39	18:42
17	05:57	06:36 (T-52)	06:31	06:53 (T-53)	07:07	07:44
	21:09	16 06:52 (T-52)	20:32	10 07:03 (T-53)	19:37	18:40
18	05:58	06:35 (T-52)	06:32	06:55 (T-53)	07:08	07:45
	21:09	19 06:54 (T-52)	20:30	9 07:04 (T-53)	19:35	18:38
19	05:59	06:35 (T-52)	06:33	06:56 (T-53)	07:10	07:46
	21:08	20 06:55 (T-52)	20:29	8 07:04 (T-53)	19:33	18:37
20	06:00	06:34 (T-52)	06:34	06:57 (T-53)	07:11	07:48
	21:07	22 06:56 (T-52)	20:27	7 07:04 (T-53)	19:31	18:35
21	06:01	06:33 (T-52)	06:36	06:58 (T-53)	07:12	07:49
	21:06	24 06:57 (T-52)	20:26	5 07:03 (T-53)	19:29	18:34
22	06:02	06:33 (T-52)	06:37	06:59 (T-53)	07:13	07:50
	21:05	25 06:58 (T-52)	20:24	3 07:02 (T-53)	19:28	18:32
23	06:03	06:32 (T-52)	06:38	07:00 (T-53)	07:14	07:52
	21:04	27 06:59 (T-52)	20:22	1 07:01 (T-53)	19:26	18:30
24	06:04	06:31 (T-52)	06:39		07:15	07:53
	21:03	28 06:59 (T-52)	20:21		19:24	18:29
25	06:05	06:31 (T-52)	06:40		07:17	07:54
	21:02	29 07:00 (T-52)	20:19		19:22	18:27
26	06:06	06:31 (T-52)	06:41		07:18	07:56
	21:01	29 07:00 (T-52)	20:17		19:20	18:26
27	06:07	06:31 (T-52)	06:43		07:19	07:57
	21:00	30 07:01 (T-52)	20:15		19:18	18:24
28	06:08	06:32 (T-52)	06:44		07:20	07:58
	20:59	29 07:01 (T-52)	20:14		19:16	18:23
29	06:09	06:33 (T-52)	06:45		07:21	08:00
	20:58	28 07:01 (T-52)	20:12		19:14	18:21
30	06:10	06:34 (T-52)	06:46		07:23	08:01
	20:57	27 07:01 (T-52)	20:10		19:13	18:20
31	06:11	06:35 (T-52)	06:47			08:02
	20:56	26 07:01 (T-52)	20:08			18:18
Potential sun hours	471	436		377	341	289
Total, worst case	402	305				6
Sun reduction	0.75	0.72				0.48
Oper. time red.	0.90	0.90				0.90
Wind dir. red.	0.59	0.59				0.66
Total reduction	0.40	0.38				0.29
Total, real	161	117				2

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-088 - R-088
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	08:29 (T-57)	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:43	08:18 (T-57)		
	16:57	16	08:45 (T-57)	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48	6	08:24 (T-57)
2	08:04	08:29 (T-57)	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44	08:17 (T-57)		
	16:58	16	08:45 (T-57)	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48	10	08:27 (T-57)
3	08:04	08:29 (T-57)	07:44	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45	08:16 (T-57)		
	16:59	17	08:46 (T-57)	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48	12	08:28 (T-57)
4	08:04	08:28 (T-57)	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46	08:16 (T-57)		
	17:00	17	08:45 (T-57)	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47	13	08:29 (T-57)
5	08:04	08:28 (T-57)	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47	08:15 (T-57)		
	17:01	17	08:45 (T-57)	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47	15	08:30 (T-57)
6	08:04	08:29 (T-57)	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48	08:15 (T-57)		
	17:02	16	08:45 (T-57)	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10	16:47	16	08:31 (T-57)
7	08:04	08:30 (T-57)	07:39	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:49	08:15 (T-57)		
	17:03	15	08:45 (T-57)	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47	17	08:32 (T-57)
8	08:04	08:32 (T-57)	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:50	08:16 (T-57)		
	17:04	13	08:45 (T-57)	17:45	18:22	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:08	16:47	17	08:33 (T-57)
9	08:03	08:32 (T-57)	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:51	08:17 (T-57)		
	17:05	12	08:44 (T-57)	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47	17	08:34 (T-57)
10	08:03	08:34 (T-57)	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52	08:18 (T-57)		
	17:06	10	08:44 (T-57)	17:48	19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:47	16	08:34 (T-57)
11	08:03	08:35 (T-57)	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:17	07:53	08:19 (T-57)		
	17:07	7	08:42 (T-57)	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47	16	08:35 (T-57)
12	08:02		07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54	08:20 (T-57)		
	17:08		17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:03	16:47	16	08:36 (T-57)	
13	08:02		07:31	07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55	08:21 (T-57)		
	17:10		17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47	16	08:37 (T-57)	
14	08:01		07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56	08:21 (T-57)		
	17:11		17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47	15	08:36 (T-57)	
15	08:01		07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57	08:22 (T-57)		
	17:12		17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47	15	08:37 (T-57)	
16	08:00		07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57	08:23 (T-57)		
	17:13		17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47	15	08:38 (T-57)	
17	08:00		07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58	08:24 (T-57)		
	17:15		17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48	15	08:39 (T-57)	
18	07:59		07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:59	08:24 (T-57)		
	17:16		17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48	15	08:39 (T-57)	
19	07:59		07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28	07:59	08:25 (T-57)		
	17:17		18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48	15	08:40 (T-57)	
20	07:58		07:21	07:31	06:36	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00	08:25 (T-57)		
	17:18		18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49	15	08:40 (T-57)	
21	07:57		07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01	08:26 (T-57)		
	17:20		18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49	15	08:41 (T-57)	
22	07:56		07:17	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01	08:26 (T-57)		
	17:21		18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50	15	08:41 (T-57)	
23	07:56		07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02	08:27 (T-57)		
	17:22		18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50	15	08:42 (T-57)	
24	07:55		07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02	08:27 (T-57)		
	17:24		18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51	15	08:42 (T-57)	
25	07:54		07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	08:02	08:28 (T-57)		
	17:25		18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51	15	08:43 (T-57)	
26	07:53		07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:03	08:28 (T-57)		
	17:27		18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52	15	08:43 (T-57)	
27	07:52		07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03	08:28 (T-57)		
	17:28		18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53	15	08:43 (T-57)	
28	07:51		07:07	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03	08:28 (T-57)		
	17:29		18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53	15	08:43 (T-57)	
29	07:50			07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04	08:28 (T-57)		
	17:31			19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54	15	08:43 (T-57)	
30	07:49			07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04	08:29 (T-57)		
	17:32			19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55	16	08:45 (T-57)	
31	07:48			07:11		05:46		06:11	06:47		08:02		08:04	08:29 (T-57)		
	17:33			19:51		21:03		20:56	20:08		18:18		16:56	16	08:45 (T-57)	
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275				
Total, worst case		156													459	
Sun reduction		0.58													0.52	
Oper. time red.		0.90													0.90	
Wind dir. red.		0.66													0.66	
Total reduction		0.34													0.31	
Total, real		54													142	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invenergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-090 - R-090 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum and values 561, 438, 311, 293, 309, 330, 363, 461, 788, 773, 462, 449, 509, 600, 629, 608, 7,884

Main shadow calculation table with columns for months (January to June) and rows for each day of the month, including start/end times and shadow reduction factors.

Table layout: For each day in each month the following matrix apply

Matrix table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-090 - R-090

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December					
1	05:45 21:16	20:48 (T-H) 20:49 (T-H)	06:12 20:55	06:36 (T-92) 06:41 (T-92)	06:49 20:07	07:14 (T-60) 07:34 (T-60)	07:24 19:11	07:04 17:17	07:43 16:48		
2	05:46 21:16		06:14 20:53	06:37 (T-92) 06:41 (T-92)	06:50 20:05	07:12 (T-60) 07:35 (T-60)	07:25 19:09	07:05 17:15	07:44 16:48		
3	05:46 21:16		06:15 20:52	06:38 (T-92) 06:41 (T-92)	06:51 20:03	07:13 (T-60) 07:37 (T-60)	07:26 19:07	07:06 17:14	07:45 16:48		
4	05:47 21:16		06:16 20:51	06:39 (T-92) 06:40 (T-92)	06:52 20:01	07:14 (T-60) 07:37 (T-60)	07:28 19:05	07:08 17:13	07:46 16:47		
5	05:47 21:15		06:17 20:49		06:53 19:59	07:15 (T-60) 07:37 (T-60)	07:29 19:03	07:09 17:11	07:47 16:47		
6	05:48 21:15		06:18 20:48		06:54 19:58	07:16 (T-60) 07:37 (T-60)	07:30 19:01	07:11 17:10	07:48 16:47		
7	05:49 21:15		06:19 20:47		06:56 19:56	07:17 (T-60) 07:37 (T-60)	07:31 19:00	07:12 17:09	07:49 16:47		
8	05:50 21:14		06:20 20:45		06:57 19:54	07:18 (T-60) 07:37 (T-60)	07:33 18:56	07:13 17:08	07:50 16:47		
9	05:50 21:14		06:22 20:44		06:58 19:52	07:19 (T-60) 07:36 (T-60)	07:34 18:54	07:15 17:06	07:51 16:47		
10	05:51 21:13		06:23 20:43		06:59 19:50	07:21 (T-60) 07:37 (T-60)	07:35 18:52	07:16 17:05	07:52 16:47		
11	05:52 21:13		06:24 20:41		07:00 19:48	07:22 (T-60) 07:36 (T-60)	07:36 18:51	07:17 17:04	07:53 16:47		
12	05:53 21:12		06:25 20:40		07:01 19:46	07:23 (T-60) 07:35 (T-60)	07:38 18:49	07:19 17:03	07:54 16:47		
13	05:53 21:12		06:26 20:38		07:03 19:45	07:24 (T-60) 07:33 (T-60)	07:39 18:47	07:20 17:02	07:55 16:47		
14	05:54 21:11		06:27 20:37		07:04 19:43	07:25 (T-60) 07:32 (T-60)	07:40 18:45	07:21 17:01	07:56 16:47		
15	05:55 21:11		06:29 20:35		07:05 19:41	07:26 (T-60) 07:30 (T-60)	07:41 18:44	07:23 17:00	07:56 16:47		
16	05:56 21:10		06:30 20:34		07:06 19:39	07:27 (T-60) 07:28 (T-60)	07:43 18:42	07:24 16:59	07:57 16:47		
17	05:57 21:09		06:31 20:32		07:07 19:37		07:44 18:40	07:25 16:58	07:58 16:48		
18	05:58 21:08		06:32 20:30		07:08 19:35		07:45 18:39	07:27 16:57	07:59 16:48		
19	05:59 21:08	06:29 (T-92) 3 06:32 (T-92)	06:33 20:29		07:10 19:33		07:46 18:37	07:28 16:56	07:59 16:48		
20	06:00 21:07	06:26 (T-92) 9 06:35 (T-92)	06:34 20:27		07:11 19:31		07:48 18:35	07:29 16:55	08:00 16:49		
21	06:01 21:06	06:25 (T-92) 12 06:37 (T-92)	06:36 20:26		07:12 19:29		07:49 18:34	07:31 16:54	08:00 16:49		
22	06:02 21:05	06:26 (T-92) 12 06:38 (T-92)	06:37 20:24		07:13 19:28		07:50 18:32	07:32 16:54	08:01 16:50		
23	06:03 21:04	06:27 (T-92) 12 06:39 (T-92)	06:38 20:22		07:14 19:26		07:52 18:30	07:33 16:53	08:01 16:50		
24	06:04 21:03	06:28 (T-92) 12 06:40 (T-92)	06:39 20:21		07:16 19:24		07:53 18:29	07:34 16:52	08:02 16:51		
25	06:05 21:02	06:29 (T-92) 11 06:40 (T-92)	06:40 20:19		07:17 19:22		07:54 18:27	07:36 16:51	08:02 16:51		
26	06:06 21:01	06:30 (T-92) 11 06:41 (T-92)	06:41 20:17		07:18 19:20		07:56 18:26	07:37 16:51	08:03 16:52		
27	06:07 21:00	06:31 (T-92) 10 06:41 (T-92)	06:43 20:15		07:19 19:18		07:57 18:24	07:38 16:50	08:03 16:53		
28	06:08 20:59	06:32 (T-92) 9 06:41 (T-92)	06:44 20:14		07:20 19:16		07:58 18:23	07:39 16:50	08:03 16:53		
29	06:09 20:58	06:33 (T-92) 9 06:42 (T-92)	06:45 20:12		07:22 19:14		08:00 18:21	07:41 16:49	08:03 16:54		
30	06:10 20:57	06:34 (T-92) 8 06:42 (T-92)	06:46 20:10	07:19 (T-60) 12 07:31 (T-60)	07:23 19:13		08:01 18:20	07:42 16:49	08:04 16:55		
31	06:11 20:56	06:35 (T-92) 7 06:42 (T-92)	06:47 20:08	07:16 (T-60) 17 07:33 (T-60)			08:02 18:18		08:04 16:56		
Potential sun hours	471		436		377		341		289		275
Total, worst case	126		42		252						
Sun reduction	0.75		0.72		0.67						
Oper. time red.	0.90		0.90		0.90						
Wind dir. red.	0.59		0.59		0.58						
Total reduction	0.40		0.38		0.35						
Total, real	50		16		89						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-091 - R-091
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

January		February		March		April		May		June					
1	08:04	08:29 (T-J)	07:47	08:20 (T-J)	07:06	07:09	07:29 (T-55)	06:18	19:27 (T-89)	05:45					
	16:57	2	08:31 (T-J)	17:35	23	08:43 (T-J)	18:13	19:52	52	08:24 (T-54)	20:30	20	19:47 (T-89)	21:04	
2	08:04	08:29 (T-J)	07:46	08:21 (T-J)	07:04	07:07	07:28 (T-55)	06:17	19:30 (T-89)	05:45					
	16:58	3	08:32 (T-J)	17:36	19	08:40 (T-J)	18:14	19:54	46	08:21 (T-54)	20:31	16	19:46 (T-89)	21:05	
3	08:04	08:29 (T-J)	07:44	08:23 (T-J)	07:02	07:23 (T-54)	07:06	07:26 (T-56)	06:15	19:32 (T-89)	05:44				
	16:59	4	08:33 (T-J)	17:38	16	08:39 (T-J)	18:15	19:55	37	08:16 (T-54)	20:32	10	19:42 (T-89)	21:06	
4	08:04	08:28 (T-J)	07:43	08:26 (T-J)	07:01	07:21 (T-54)	07:04	07:24 (T-56)	06:14	19:34 (T-89)	05:44				
	17:00	5	08:33 (T-J)	17:39	11	08:37 (T-J)	18:17	19:56	28	07:52 (T-55)	20:33			21:06	
5	08:04	08:28 (T-J)	07:42		06:59	07:19 (T-54)	07:02	07:22 (T-56)	06:12	19:36 (T-89)	05:43				
	17:01	6	08:34 (T-J)	17:41	18:18	13	07:32 (T-54)	19:57	27	07:49 (T-55)	20:35			21:07	
6	08:04	08:28 (T-J)	07:41		06:57	07:18 (T-54)	07:00	07:20 (T-56)	06:11	19:38 (T-89)	05:43				
	17:02	7	08:35 (T-J)	17:42	18:19	17	07:35 (T-54)	19:59	25	07:47 (T-55)	20:36			21:08	
7	08:04	08:28 (T-J)	07:39		06:55	07:16 (T-54)	06:58	07:18 (T-56)	06:10	19:40 (T-89)	05:43				
	17:03	8	08:36 (T-J)	17:43	18:21	21	07:37 (T-54)	20:00	20	07:43 (T-55)	20:37			21:09	
8	08:04	08:28 (T-J)	07:38		07:53	08:14 (T-54)	06:56	07:17 (T-56)	06:08	19:42 (T-89)	05:42				
	17:04	9	08:37 (T-J)	17:45	18:22	24	08:38 (T-54)	20:01	15	19:40 (T-89)	20:38			21:09	
9	08:03	08:27 (T-J)	07:37		07:52	08:12 (T-54)	06:55	07:15 (T-56)	06:07	19:42 (T-89)	05:42				
	17:05	10	08:37 (T-J)	17:46	19:23	27	08:39 (T-54)	20:02	20	19:41 (T-89)	20:39			21:10	
10	08:03	08:27 (T-J)	07:35		07:50	08:10 (T-54)	06:53	07:13 (T-56)	06:06	19:43 (T-89)	05:42				
	17:06	12	08:39 (T-J)	17:48	19:25	29	08:39 (T-54)	20:04	25	19:42 (T-89)	20:41			21:11	
11	08:03	08:26 (T-J)	07:34		07:48	08:08 (T-54)	06:51	07:11 (T-56)	06:05	19:44 (T-89)	05:41				
	17:07	13	08:39 (T-J)	17:49	19:26	32	08:40 (T-54)	20:05	28	19:43 (T-89)	20:42			21:11	
12	08:02	08:26 (T-J)	07:33		07:46	08:07 (T-54)	06:49	07:14 (T-56)	06:03	19:45 (T-89)	05:41				
	17:08	14	08:40 (T-J)	17:51	19:27	34	08:41 (T-54)	20:06	25	19:44 (T-89)	20:43			21:12	
13	08:02	08:25 (T-J)	07:31		07:44	08:05 (T-54)	06:48	19:26 (T-89)	06:02	19:46 (T-89)	05:41				
	17:10	15	08:40 (T-J)	17:52	19:28	36	08:41 (T-54)	20:07	19	19:45 (T-89)	20:44			21:12	
14	08:01	08:25 (T-J)	07:30		07:43	08:03 (T-54)	06:46	19:25 (T-89)	06:01	19:47 (T-89)	05:41				
	17:11	17	08:42 (T-J)	17:53	19:30	38	08:41 (T-54)	20:09	21	19:46 (T-89)	20:45			21:13	
15	08:01	08:24 (T-J)	07:28		07:41	08:01 (T-54)	06:44	19:24 (T-89)	06:00	19:48 (T-89)	05:41				
	17:12	18	08:42 (T-J)	17:55	19:31	40	08:41 (T-54)	20:10	23	19:47 (T-89)	20:46			21:13	
16	08:00	08:24 (T-J)	07:27		07:39	07:59 (T-54)	06:42	19:24 (T-89)	05:59	19:49 (T-89)	05:41				
	17:13	19	08:43 (T-J)	17:56	19:32	42	08:41 (T-54)	20:11	25	19:49 (T-89)	20:48			21:14	
17	08:00	08:23 (T-J)	07:25		07:37	07:57 (T-54)	06:41	19:23 (T-89)	05:58	19:51 (T-89)	05:41				
	17:15	20	08:43 (T-J)	17:58	19:34	44	08:41 (T-54)	20:12	27	19:50 (T-89)	20:49			21:14	
18	07:59	08:22 (T-J)	07:24		07:35	07:55 (T-54)	06:39	19:22 (T-89)	05:57	19:52 (T-89)	05:41				
	17:16	21	08:43 (T-J)	17:59	19:35	46	08:41 (T-54)	20:14	29	19:51 (T-89)	20:50			21:15	
19	07:59	08:22 (T-J)	07:22		07:33	07:54 (T-54)	06:37	19:22 (T-89)	05:56	19:53 (T-89)	05:41				
	17:17	23	08:45 (T-J)	18:00	19:36	47	08:41 (T-54)	20:15	31	19:53 (T-89)	20:51			21:15	
20	07:58	08:21 (T-J)	07:21		07:32	07:52 (T-55)	06:36	19:21 (T-89)	05:55	19:54 (T-89)	05:41				
	17:18	24	08:45 (T-J)	18:00	19:37	49	08:41 (T-54)	20:16	32	19:53 (T-89)	20:52			21:15	
21	07:57	08:20 (T-J)	07:19		07:30	07:50 (T-55)	06:34	19:21 (T-89)	05:54	19:55 (T-89)	05:41				
	17:20	25	08:45 (T-J)	18:02	19:39	50	08:40 (T-54)	20:17	33	19:54 (T-89)	20:53			21:16	
22	07:56	08:19 (T-J)	07:17		07:28	07:48 (T-55)	06:32	19:22 (T-89)	05:53	19:56 (T-89)	05:41				
	17:21	26	08:45 (T-J)	18:03	19:40	51	08:39 (T-54)	20:19	34	19:56 (T-89)	20:54			21:16	
23	07:56	08:18 (T-J)	07:16		07:26	07:46 (T-55)	06:31	19:21 (T-89)	05:52	19:57 (T-89)	05:41				
	17:23	27	08:45 (T-J)	18:04	19:41	52	08:38 (T-54)	20:20	35	19:56 (T-89)	20:55			21:16	
24	07:55	08:17 (T-J)	07:14		07:24	07:44 (T-55)	06:29	19:22 (T-89)	05:51	19:58 (T-89)	05:41				
	17:24	28	08:45 (T-J)	18:06	19:42	53	08:37 (T-54)	20:21	34	19:56 (T-89)	20:56			21:16	
25	07:54	08:16 (T-J)	07:13		07:22	07:42 (T-55)	06:27	19:22 (T-89)	05:50	19:59 (T-89)	05:41				
	17:25	29	08:45 (T-J)	18:07	19:44	54	08:36 (T-54)	20:22	33	19:55 (T-89)	20:57			21:16	
26	07:53	08:15 (T-J)	07:11		07:20	07:41 (T-55)	06:26	19:23 (T-89)	05:49	19:59 (T-89)	05:41				
	17:27	30	08:45 (T-J)	18:09	19:45	55	08:36 (T-54)	20:24	32	19:55 (T-89)	20:58			21:16	
27	07:52	08:15 (T-J)	07:09		07:19	07:39 (T-55)	06:24	19:23 (T-89)	05:49	19:59 (T-89)	05:41				
	17:28	30	08:45 (T-J)	18:10	19:46	55	08:34 (T-54)	20:25	30	19:53 (T-89)	20:59			21:16	
28	07:51	08:15 (T-J)	07:07		07:17	07:37 (T-55)	06:23	19:24 (T-89)	05:48	19:59 (T-89)	05:41				
	17:29	30	08:45 (T-J)	18:11	19:47	56	08:33 (T-54)	20:26	29	19:53 (T-89)	21:00			21:16	
29	07:50	08:16 (T-J)			07:15	07:35 (T-55)	06:21	19:25 (T-89)	05:47	19:59 (T-89)	05:41				
	17:31	28	08:44 (T-J)		19:49	56	08:31 (T-54)	20:27	26	19:51 (T-89)	21:01			21:16	
30	07:49	08:17 (T-J)			07:13	07:33 (T-55)	06:20	19:26 (T-89)	05:46	19:59 (T-89)	05:41				
	17:32	27	08:44 (T-J)		19:50	56	08:29 (T-54)	20:28	24	19:50 (T-89)	21:02			21:16	
31	07:48	08:19 (T-J)			07:11	07:31 (T-55)			05:46						
	17:34	24	08:43 (T-J)		19:51	54	08:26 (T-54)		21:03						
Potential sun hours	287		292		369		403		458					465	
Total, worst case	554		69		1143		865		46						
Sun reduction	0.58		0.58		0.59		0.63		0.66						
Oper. time red.	0.90		0.90		0.90		0.90		0.90						
Wind dir. red.	0.65		0.65		0.60		0.59		0.60						
Total reduction	0.34		0.34		0.32		0.34		0.36						
Total, real	188		23		363		292		16						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-092 - R-092

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	15:50 (T-89) 07:47	08:18 (T-55) 07:06	07:09 06:18	06:18 05:45	05:45 05:45	05:45 06:13	06:13 06:49	07:24 07:04	07:04 07:04	07:04 07:04	07:43 15:37 (T-89)
2	16:57 38 16:28 (T-89) 17:35	9 08:27 (T-55) 07:04	18:13 19:52 20:30	18:13 19:52 20:30	21:04 21:16 20:55	21:04 21:16 20:55	20:07 19:11 17:17	20:07 19:11 17:17	19:11 17:17	17:17 17:17	17:17 17:17	16:48 35 16:12 (T-89)
3	08:04 16:58 37 16:28 (T-89) 17:36	07:04 07:07 06:17	07:04 07:07 06:17	05:45 05:46 06:14	05:45 05:46 06:14	06:50 07:25 07:05	07:25 07:05	07:05 07:05	07:05 07:05	07:05 07:05	07:05 07:05	07:44 16:48 35 16:13 (T-89)
4	16:59 37 16:28 (T-89) 17:38	07:02 07:06 06:15	07:02 07:06 06:15	05:44 05:46 06:15	05:44 05:46 06:15	06:51 07:26 07:07	07:26 07:07	07:07 07:07	07:07 07:07	07:07 07:07	07:07 07:07	07:45 16:48 36 16:14 (T-89)
5	08:04 17:00 37 16:28 (T-89) 17:39	07:01 07:04 06:14	07:01 07:04 06:14	05:44 05:47 06:16	05:44 05:47 06:16	06:52 07:28 07:08	07:28 07:08	07:08 07:08	07:08 07:08	07:08 07:08	07:08 07:08	07:46 16:47 36 16:14 (T-89)
6	08:04 17:01 38 16:29 (T-89) 17:41	06:59 07:02 06:12	06:59 07:02 06:12	05:43 05:47 06:17	05:43 05:47 06:17	06:53 07:29 07:09	07:29 07:09	07:09 07:09	07:09 07:09	07:09 07:09	07:09 07:09	07:47 16:47 37 16:15 (T-89)
7	08:04 17:02 37 16:29 (T-89) 17:42	06:58 07:01 06:11	06:58 07:01 06:11	05:43 05:48 06:18	05:43 05:48 06:18	06:54 07:30 07:11	07:30 07:11	07:11 07:11	07:11 07:11	07:11 07:11	07:11 07:11	07:49 16:47 37 16:15 (T-89)
8	08:04 17:03 37 16:30 (T-89) 17:43	06:55 06:58 06:10	06:55 06:58 06:10	05:43 05:49 06:19	05:43 05:49 06:19	06:56 07:31 07:12	07:31 07:12	07:12 07:12	07:12 07:12	07:12 07:12	07:12 07:12	07:50 16:47 38 16:16 (T-89)
9	08:04 17:04 36 16:30 (T-89) 17:45	06:57 07:00 06:11	06:57 07:00 06:11	05:43 05:50 06:20	05:43 05:50 06:20	06:57 07:33 07:13	07:33 07:13	07:13 07:13	07:13 07:13	07:13 07:13	07:13 07:13	07:51 16:47 37 16:16 (T-89)
10	08:03 17:05 36 16:30 (T-89) 17:46	06:57 07:00 06:11	06:57 07:00 06:11	05:42 05:50 06:22	05:42 05:50 06:22	06:58 07:34 07:15	07:34 07:15	07:15 07:15	07:15 07:15	07:15 07:15	07:15 07:15	07:51 16:47 38 16:17 (T-89)
11	08:03 17:06 35 16:30 (T-89) 17:48	06:57 07:00 06:11	06:57 07:00 06:11	05:42 05:51 06:23	05:42 05:51 06:23	06:59 07:35 07:16	07:35 07:16	07:16 07:16	07:16 07:16	07:16 07:16	07:16 07:16	07:52 16:47 37 16:17 (T-89)
12	08:02 17:07 35 16:30 (T-89) 17:49	06:57 07:00 06:11	06:57 07:00 06:11	05:42 05:52 06:24	05:42 05:52 06:24	07:00 07:36 07:17	07:36 07:17	07:17 07:17	07:17 07:17	07:17 07:17	07:17 07:17	07:53 16:47 38 16:18 (T-89)
13	08:02 17:08 35 16:31 (T-89) 17:51	06:57 07:00 06:11	06:57 07:00 06:11	05:41 05:53 06:25	05:41 05:53 06:25	07:01 07:38 07:19	07:38 07:19	07:19 07:19	07:19 07:19	07:19 07:19	07:19 07:19	07:54 16:47 37 16:18 (T-89)
14	08:02 17:10 35 16:30 (T-89) 17:52	06:57 07:00 06:11	06:57 07:00 06:11	05:41 05:54 06:26	05:41 05:54 06:26	07:03 07:39 07:20	07:39 07:20	07:20 07:20	07:20 07:20	07:20 07:20	07:20 07:20	07:55 16:47 38 16:19 (T-89)
15	08:02 17:11 36 16:31 (T-89) 17:53	06:57 07:00 06:11	06:57 07:00 06:11	05:41 05:54 06:27	05:41 05:54 06:27	07:04 07:40 07:21	07:40 07:21	07:21 07:21	07:21 07:21	07:21 07:21	07:21 07:21	07:56 16:47 38 16:19 (T-89)
16	08:01 17:12 36 16:30 (T-89) 17:55	06:57 07:00 06:11	06:57 07:00 06:11	05:41 05:55 06:29	05:41 05:55 06:29	07:05 07:41 07:23	07:41 07:23	07:23 07:23	07:23 07:23	07:23 07:23	07:23 07:23	07:57 16:47 37 16:18 (T-89)
17	08:00 17:13 37 16:31 (T-89) 17:56	06:57 07:00 06:11	06:57 07:00 06:11	05:41 05:56 06:30	05:41 05:56 06:30	07:06 07:43 07:24	07:43 07:24	07:24 07:24	07:24 07:24	07:24 07:24	07:24 07:24	07:58 16:47 37 16:19 (T-89)
18	08:00 17:15 36 16:30 (T-89) 17:58	06:57 07:00 06:11	06:57 07:00 06:11	05:41 05:57 06:31	05:41 05:57 06:31	07:07 07:44 07:26	07:44 07:26	07:26 07:26	07:26 07:26	07:26 07:26	07:26 07:26	07:58 16:47 37 16:19 (T-89)
19	07:59 17:16 36 16:29 (T-89) 17:59	06:57 07:00 06:11	06:57 07:00 06:11	05:41 05:58 06:32	05:41 05:58 06:32	07:09 07:45 07:27	07:45 07:27	07:27 07:27	07:27 07:27	07:27 07:27	07:27 07:27	07:59 16:47 37 16:20 (T-89)
20	07:59 17:17 36 16:29 (T-89) 18:00	06:57 07:00 06:11	06:57 07:00 06:11	05:41 05:59 06:33	05:41 05:59 06:33	07:10 07:47 07:28	07:47 07:28	07:28 07:28	07:28 07:28	07:28 07:28	07:28 07:28	07:59 16:47 37 16:20 (T-89)
21	07:58 17:18 35 16:29 (T-89) 18:01	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:00 06:34	05:41 06:00 06:34	07:11 07:48 07:29	07:48 07:29	07:29 07:29	07:29 07:29	07:29 07:29	07:29 07:29	08:00 16:47 36 16:20 (T-89)
22	07:58 17:19 35 16:28 (T-89) 18:02	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:01 06:35	05:41 06:01 06:35	07:12 07:49 07:31	07:49 07:31	07:31 07:31	07:31 07:31	07:31 07:31	07:31 07:31	08:01 16:47 36 16:21 (T-89)
23	07:56 17:20 34 16:28 (T-89) 18:03	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:02 06:36	05:41 06:02 06:36	07:13 07:50 07:32	07:50 07:32	07:32 07:32	07:32 07:32	07:32 07:32	07:32 07:32	08:01 16:47 36 16:21 (T-89)
24	07:56 17:21 34 16:27 (T-89) 18:03	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:03 06:37	05:41 06:03 06:37	07:14 07:51 07:33	07:51 07:33	07:33 07:33	07:33 07:33	07:33 07:33	07:33 07:33	08:02 16:47 36 16:22 (T-89)
25	07:55 17:22 31 16:25 (T-89) 18:04	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:04 06:38	05:41 06:04 06:38	07:15 07:52 07:34	07:52 07:34	07:34 07:34	07:34 07:34	07:34 07:34	07:34 07:34	08:02 16:47 36 16:22 (T-89)
26	07:55 17:24 27 16:23 (T-89) 18:06	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:05 06:39	05:41 06:05 06:39	07:16 07:53 07:35	07:53 07:35	07:35 07:35	07:35 07:35	07:35 07:35	07:35 07:35	08:02 16:47 36 16:22 (T-89)
27	07:54 17:25 17 16:18 (T-89) 18:07	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:06 06:40	05:41 06:06 06:40	07:17 07:54 07:36	07:54 07:36	07:36 07:36	07:36 07:36	07:36 07:36	07:36 07:36	08:02 16:47 36 16:22 (T-89)
28	07:53 17:27 17 08:15 (T-55) 07:11	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:07 06:41	05:41 06:07 06:41	07:18 07:55 07:37	07:55 07:37	07:37 07:37	07:37 07:37	07:37 07:37	07:37 07:37	08:03 16:47 37 16:24 (T-89)
29	07:52 17:28 17 08:14 (T-55) 07:09	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:08 06:42	05:41 06:08 06:42	07:19 07:56 07:38	07:56 07:38	07:38 07:38	07:38 07:38	07:38 07:38	07:38 07:38	08:03 16:47 37 16:24 (T-89)
30	07:52 17:29 18 08:13 (T-55) 07:07	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:09 06:43	05:41 06:09 06:43	07:20 07:57 07:39	07:57 07:39	07:39 07:39	07:39 07:39	07:39 07:39	07:39 07:39	08:03 16:47 37 16:24 (T-89)
31	07:51 17:29 18 08:31 (T-55) 18:11	06:57 07:00 06:11	06:57 07:00 06:11	05:41 06:10 06:44	05:41 06:10 06:44	07:21 07:58 07:40	07:58 07:40	07:40 07:40	07:40 07:40	07:40 07:40	07:40 07:40	08:04 16:47 38 16:25 (T-89)
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case	967	9									575	1142
Sun reduction	0.58	0.58									0.48	0.52
Oper. time red.	0.90	0.90									0.80	0.90
Wind dir. red.	0.62	0.65									0.62	0.61
Total reduction	0.32	0.34									0.27	0.29
Total, real	312	3									155	326

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-093 - R-093

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:13	07:51
	17:04	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
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	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
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	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
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26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
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	17:28	18:10	19:46	20:25	20:59	21:17	21:00	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40	08:03
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	17:32		19:50	20:29	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-096 - R-096

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
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	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
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	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
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16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
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17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
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	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:34	07:11	07:48	07:29	08:00
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30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11	06:19	05:46		06:11	06:47		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-099 - R-099

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
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	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
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	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47
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	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
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17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:34	07:11	07:48	07:30	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:22	20:57	21:16	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:00	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40	08:03
	17:29	18:11	19:48	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:17	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11	06:15	05:46		06:11	06:47		08:03		08:04
	17:34		19:51	21:03	21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-100 - R-100
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:48
	17:01	17:41	18:18	19:57	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:51
	17:04	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:02	20:40	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:18	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:13	21:12	20:38	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:54	05:41	06:00	06:34	07:11	07:48	07:30	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:22	20:57	21:16	21:03	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:00	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40	08:03
	17:29	18:11	19:47	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:17	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11	06:17	05:46		06:11	06:47		08:03		08:04
	17:33		19:51	21:03	21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-101 - R-101
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:04	07:47	07:06	07:09	06:18	05:45	06:08 (T-42)	05:45	06:09 (T-42)	06:12	06:49	07:24	07:04	07:43	
	16:57	17:35	18:13	19:52	20:30	21:04	06:18 (T-42)	21:16	13	06:22 (T-42)	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	06:08 (T-42)	05:46	06:10 (T-42)	06:14	06:50	07:25	07:05	07:44	
	16:58	17:36	18:14	19:54	20:31	21:05	06:18 (T-42)	21:16	13	06:23 (T-42)	20:54	20:05	19:09	17:15	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	06:08 (T-42)	05:46	06:11 (T-42)	06:15	06:51	07:26	07:07	07:45	
	16:59	17:38	18:15	19:55	20:32	21:06	06:19 (T-42)	21:16	13	06:24 (T-42)	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	06:07 (T-42)	05:47	06:11 (T-42)	06:16	06:52	07:28	07:08	07:47	
	17:00	17:39	18:17	19:56	20:33	21:06	06:18 (T-42)	21:16	12	06:23 (T-42)	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	06:07 (T-42)	05:47	06:12 (T-42)	06:17	06:53	07:29	07:09	07:48	
	17:01	17:41	18:18	19:57	20:35	21:07	06:19 (T-42)	21:16	12	06:24 (T-42)	20:50	20:00	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	06:19 (T-42)	05:48	06:12 (T-42)	06:18	06:54	07:30	07:11	07:49	
	17:02	17:42	18:19	19:59	20:36	21:08	06:18 (T-42)	21:15	12	06:24 (T-42)	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:42	06:06 (T-42)	05:49	06:13 (T-42)	06:19	06:56	07:31	07:12	07:50	
	17:03	17:43	18:21	20:00	20:37	21:09	06:18 (T-42)	21:15	12	06:25 (T-42)	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:56	06:08	05:42	06:06 (T-42)	05:49	06:14 (T-42)	06:20	06:57	07:33	07:13	07:51	
	17:04	17:45	18:22	20:01	20:38	21:09	06:18 (T-42)	21:15	11	06:25 (T-42)	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	06:06 (T-42)	05:50	06:14 (T-42)	06:22	06:58	07:34	07:15	07:52	
	17:05	17:46	19:23	20:02	20:40	21:10	06:18 (T-42)	21:14	11	06:25 (T-42)	20:44	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	06:05 (T-42)	05:51	06:15 (T-42)	06:23	06:59	07:35	07:16	07:53	
	17:06	17:48	19:25	20:04	20:41	21:11	06:18 (T-42)	21:14	11	06:26 (T-42)	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	06:05 (T-42)	05:52	06:16 (T-42)	06:24	07:00	07:36	07:18	07:53	
	17:07	17:49	19:26	20:05	20:42	21:11	06:18 (T-42)	21:13	10	06:26 (T-42)	20:41	19:48	18:51	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	05:41	06:05 (T-42)	05:53	06:17 (T-42)	06:25	07:01	07:38	07:19	07:54	
	17:08	17:50	19:27	20:06	20:43	21:12	06:18 (T-42)	21:13	10	06:27 (T-42)	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	06:05 (T-42)	05:53	06:18 (T-42)	06:26	07:03	07:39	07:20	07:55	
	17:10	17:52	19:28	20:07	20:44	21:13	06:18 (T-42)	21:12	9	06:27 (T-42)	20:38	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	06:05 (T-42)	05:54	06:18 (T-42)	06:27	07:04	07:40	07:22	07:56	
	17:11	17:53	19:30	20:09	20:45	21:13	06:18 (T-42)	21:12	8	06:26 (T-42)	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	06:05 (T-42)	05:55	06:19 (T-42)	06:29	07:05	07:41	07:23	07:57	
	17:12	17:55	19:31	20:10	20:47	21:14	06:18 (T-42)	21:11	8	06:27 (T-42)	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	06:05 (T-42)	05:56	06:20 (T-42)	06:30	07:06	07:43	07:24	07:57	
	17:13	17:56	19:32	20:11	20:48	21:14	06:18 (T-42)	21:10	7	06:27 (T-42)	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	06:05 (T-42)	05:57	06:21 (T-42)	06:31	07:07	07:44	07:26	07:58	
	17:14	17:57	19:34	20:12	20:49	21:14	06:18 (T-42)	21:09	6	06:27 (T-42)	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:56	05:41	06:05 (T-42)	05:58	06:22 (T-42)	06:32	07:08	07:45	07:27	07:59	
	17:16	17:59	19:35	20:14	20:50	21:15	06:18 (T-42)	21:09	5	06:27 (T-42)	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:55	05:41	06:05 (T-42)	05:59	06:23 (T-42)	06:33	07:10	07:47	07:28	08:00	
	17:17	18:00	19:36	20:15	20:51	21:15	06:18 (T-42)	21:08	4	06:27 (T-42)	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:54	05:41	06:06 (T-42)	06:00	06:24 (T-42)	06:34	07:11	07:48	07:30	08:00	
	17:18	18:00	19:37	20:16	20:52	21:15	06:19 (T-42)	21:07	3	06:27 (T-42)	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:53	05:41	06:06 (T-42)	06:01	06:25 (T-42)	06:36	07:12	07:49	07:31	08:01	
	17:20	18:02	19:39	20:17	20:53	21:16	06:19 (T-42)	21:06	2	06:27 (T-42)	20:26	19:30	18:34	16:54	16:49
22	07:56	07:18	07:28	06:32	05:53	05:42	06:06 (T-42)	06:02	06:26 (T-42)	06:37	07:13	07:51	07:32	08:01	
	17:21	18:03	19:40	20:19	20:54	1	06:16 (T-42)	21:16	13	06:19 (T-42)	21:05	20:24	18:32	16:53	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:14 (T-42)	05:42	06:06 (T-42)	06:03	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	3	06:17 (T-42)	21:16	13	06:19 (T-42)	21:04	20:22	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:14 (T-42)	05:42	06:06 (T-42)	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	4	06:18 (T-42)	21:16	13	06:19 (T-42)	21:04	20:21	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:42	06:13 (T-42)	05:42	06:07 (T-42)	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:22	20:57	5	06:18 (T-42)	21:16	13	06:20 (T-42)	21:03	20:19	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:12 (T-42)	05:43	06:07 (T-42)	06:06	06:41	07:18	07:56	07:37	08:03
	17:26	18:09	19:45	20:24	20:58	6	06:18 (T-42)	21:17	13	06:20 (T-42)	21:02	20:17	18:26	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:11 (T-42)	05:43	06:08 (T-42)	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	7	06:18 (T-42)	21:17	13	06:21 (T-42)	21:00	20:16	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:11 (T-42)	05:44	06:08 (T-42)	06:08	06:44	07:20	07:59	07:40	08:03
	17:29	18:11	19:47	20:26	21:00	7	06:18 (T-42)	21:17	13	06:21 (T-42)	20:59	20:14	18:23	16:50	16:53
29	07:50	07:15	07:21	06:21	05:47	05:44	06:10 (T-42)	05:44	06:08 (T-42)	06:09	06:45	07:22	08:00	07:41	08:04
	17:31	18:13	19:49	20:27	21:01	8	06:18 (T-42)	21:17	13	06:21 (T-42)	20:58	20:12	18:21	16:49	16:54
30	07:49	07:13	07:20	06:20	05:46	05:44	06:10 (T-42)	05:44	06:09 (T-42)	06:10	06:46	07:23	08:01	07:42	08:04
	17:32	18:14	19:50	20:29	21:02	9	06:19 (T-42)	21:16	13	06:22 (T-42)	20:57	20:10	18:20	16:49	16:55
31	07:48	07:11	07:18	06:20	05:46	05:44	06:09 (T-42)	05:44	06:11	06:11	06:47	07:24	08:03	07:44	08:04
	17:33	18:15	19:51	21:03	21:03	9	06:18 (T-42)	21:16	13	06:22 (T-42)	20:56	20:09	18:18	16:49	16:56
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275			
Total, worst case					59	375	193								
Sun reduction					0.66	0.73	0.75								
Oper. time red.					0.90	0.90	0.90								
Wind dir. red.					0.59	0.59	0.59								
Total reduction					0.35	0.39	0.40								
Total, real					21	145	77								

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-155 - R-155

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:04	15:37 (T-32)	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:43	15:24 (T-32)	
	16:57	49 16:26 (T-32)	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48	48 16:12 (T-32)	
2	08:04	15:37 (T-32)	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44	15:24 (T-32)	
	16:58	49 16:26 (T-32)	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48	48 16:12 (T-32)	
3	08:04	15:38 (T-32)	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46	15:24 (T-32)	
	16:59	49 16:27 (T-32)	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48	48 16:12 (T-32)	
4	08:04	15:38 (T-32)	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47	15:24 (T-32)	
	17:00	49 16:27 (T-32)	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:01	19:05	17:13	16:47	49 16:13 (T-32)	
5	08:04	15:39 (T-32)	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:48	15:25 (T-32)	
	17:01	49 16:28 (T-32)	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47	48 16:13 (T-32)	
6	08:04	15:40 (T-32)	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49	15:25 (T-32)	
	17:02	49 16:28 (T-32)	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47	49 16:14 (T-32)	
7	08:04	15:40 (T-32)	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:50	15:25 (T-32)	
	17:03	48 16:28 (T-32)	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47	49 16:14 (T-32)	
8	08:04	15:40 (T-32)	07:38	07:54	06:57	06:08	05:42	05:49	06:20	06:57	07:33	07:14	07:51	15:25 (T-32)	
	17:04	49 16:29 (T-32)	17:45	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:08	16:47	50 16:15 (T-32)	
9	08:04	15:40 (T-32)	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52	15:26 (T-32)	
	17:05	48 16:28 (T-32)	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:06	16:47	49 16:15 (T-32)	
10	08:03	15:41 (T-32)	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53	15:26 (T-32)	
	17:06	48 16:29 (T-32)	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47	49 16:15 (T-32)	
11	08:03	15:42 (T-32)	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:18	07:54	15:27 (T-32)	
	17:07	48 16:30 (T-32)	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47	49 16:16 (T-32)	
12	08:03	15:42 (T-32)	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54	15:27 (T-32)	
	17:08	47 16:29 (T-32)	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	13 15:50 (T-32)	16:47	50 16:17 (T-32)
13	08:02	15:43 (T-32)	07:31	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55	15:28 (T-32)	
	17:10	47 16:30 (T-32)	17:52	19:29	20:08	20:44	21:13	21:12	20:38	19:45	18:47	17:02	19 15:53 (T-32)	16:47	49 16:17 (T-32)
14	08:02	15:44 (T-32)	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56	15:29 (T-32)	
	17:11	46 16:30 (T-32)	17:53	19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	17:01	24 15:56 (T-32)	16:47	49 16:18 (T-32)
15	08:01	15:45 (T-32)	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57	15:28 (T-32)	
	17:12	45 16:30 (T-32)	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00	27 15:57 (T-32)	16:47	50 16:18 (T-32)
16	08:01	15:45 (T-32)	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:58	15:29 (T-32)	
	17:13	45 16:30 (T-32)	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	30 15:59 (T-32)	16:47	49 16:19 (T-32)
17	08:00	15:46 (T-32)	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58	15:30 (T-32)	
	17:15	44 16:30 (T-32)	17:58	19:34	20:13	20:49	21:14	21:10	20:32	19:37	18:40	16:58	32 16:00 (T-32)	16:48	49 16:19 (T-32)
18	07:59	15:47 (T-32)	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59	15:30 (T-32)	
	17:16	43 16:30 (T-32)	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	35 16:01 (T-32)	16:48	49 16:19 (T-32)
19	07:59	15:48 (T-32)	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28	08:00	15:30 (T-32)	
	17:17	42 16:30 (T-32)	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	37 16:03 (T-32)	16:48	50 16:20 (T-32)
20	07:58	15:48 (T-32)	07:21	07:32	06:36	05:54	05:41	06:00	06:34	07:11	07:48	07:30	08:00	15:31 (T-32)	
	17:18	41 16:29 (T-32)	18:00	19:37	20:16	20:52	21:16	21:07	20:27	19:32	18:35	16:55	38 16:03 (T-32)	16:49	50 16:21 (T-32)
21	07:57	15:49 (T-32)	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01	15:31 (T-32)	
	17:20	40 16:29 (T-32)	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	40 16:05 (T-32)	16:49	50 16:21 (T-32)
22	07:57	15:50 (T-32)	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01	15:32 (T-32)	
	17:21	38 16:28 (T-32)	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	41 16:05 (T-32)	16:50	50 16:22 (T-32)
23	07:56	15:51 (T-32)	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:34	08:02	15:32 (T-32)	
	17:22	37 16:28 (T-32)	18:04	19:41	20:20	20:55	21:16	21:05	20:23	19:26	18:30	16:53	42 16:06 (T-32)	16:50	50 16:22 (T-32)
24	07:55	15:52 (T-32)	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02	15:32 (T-32)	
	17:24	35 16:27 (T-32)	18:06	19:43	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52	43 16:07 (T-32)	16:51	50 16:22 (T-32)
25	07:54	15:53 (T-32)	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03	15:34 (T-32)	
	17:25	32 16:27 (T-32)	18:07	19:44	20:22	20:57	21:17	21:03	20:19	19:22	18:27	16:51	44 16:08 (T-32)	16:51	49 16:23 (T-32)
26	07:53	15:56 (T-32)	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03	15:34 (T-32)	
	17:27	30 16:26 (T-32)	18:09	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51	45 16:08 (T-32)	16:52	49 16:23 (T-32)
27	07:52	15:58 (T-32)	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39	08:03	15:34 (T-32)	
	17:28	27 16:25 (T-32)	18:10	19:46	20:25	20:59	21:17	21:01	20:16	19:18	18:24	16:50	45 16:09 (T-32)	16:53	49 16:23 (T-32)
28	07:51	15:59 (T-32)	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40	08:04	15:34 (T-32)	
	17:29	23 16:22 (T-32)	18:11	19:48	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	46 16:10 (T-32)	16:53	49 16:24 (T-32)
29	07:50	16:02 (T-32)		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04	15:35 (T-32)	
	17:31	19 16:21 (T-32)		19:49	20:27	21:01	21:17	20:58	20:12	19:15	18:21	16:49	47 16:10 (T-32)	16:54	50 16:25 (T-32)
30	07:49	16:06 (T-32)		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04	15:36 (T-32)	
	17:32	11 16:17 (T-32)		19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49	47 16:10 (T-32)	16:55	49 16:25 (T-32)
31	07:48			07:11		05:46		06:11	06:47		08:03		08:04	15:36 (T-32)	
	17:34			19:51		21:03		20:56	20:09		18:18		16:56	49 16:25 (T-32)	
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289		275		
Total, worst case	1227										695		1525		
Sun reduction	0.58										0.48		0.52		
Oper. time red.	0.90										0.90		0.90		
Wind dir. red.	0.61										0.61		0.61		
Total reduction	0.32										0.26		0.29		
Total, real	392										184		437		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-156 - R-156

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:47	08:09 (T-42)	07:06	07:09	06:18
	16:57	17:35	7 08:16 (T-42)	18:13	19:52	20:30
2	08:04	07:46	08:08 (T-42)	07:04	07:07	06:17
	16:58	17:36	9 08:17 (T-42)	18:14	19:54	20:31
3	08:04	07:45	08:06 (T-42)	07:02	07:06	06:15
	16:59	17:38	11 08:17 (T-42)	18:15	19:55	20:32
4	08:04	07:43	08:05 (T-42)	07:01	07:04	06:14
	17:00	17:39	12 08:17 (T-42)	18:17	19:56	20:33
5	08:04	07:42	08:04 (T-42)	06:59	07:02	06:12
	17:01	17:41	14 08:18 (T-42)	18:18	19:57	20:35
6	08:04	07:41	08:03 (T-42)	06:57	07:00	06:11
	17:02	17:42	15 08:18 (T-42)	18:19	19:59	20:36
7	08:04	07:40	08:01 (T-42)	06:55	06:58	06:10
	17:03	17:43	16 08:17 (T-42)	18:21	20:00	20:37
8	08:04	07:38	08:00 (T-42)	07:53	06:56	06:08
	17:04	17:45	17 08:17 (T-42)	18:22	20:01	20:38
9	08:04	07:37	07:58 (T-42)	07:52	06:55	06:07
	17:05	17:46	18 08:16 (T-42)	19:23	20:02	20:40
10	08:03	07:36	07:57 (T-42)	07:50	06:53	06:06
	17:06	17:48	19 08:16 (T-42)	19:25	20:04	20:41
11	08:03	07:34	07:58 (T-42)	07:48	06:51	06:04
	17:07	17:49	17 08:15 (T-42)	19:26	20:05	20:42
12	08:03	07:33	07:59 (T-42)	07:46	06:49	06:03
	17:08	17:50	14 08:13 (T-42)	19:27	20:06	20:43
13	08:02	07:31	08:02 (T-42)	07:44	06:48	06:02
	17:09	17:52	9 08:11 (T-42)	19:28	20:07	20:44
14	08:02	07:30	07:43	06:46	06:01	05:41
	17:11	17:53	19:30	20:09	20:45	21:13
15	08:01	07:28	07:41	06:44	06:00	05:41
	17:12	17:55	19:31	20:10	20:47	21:14
16	08:01	07:27	07:39	06:42	05:59	05:41
	17:13	17:56	19:32	20:11	20:48	21:14
17	08:00	07:25	07:37	06:41	05:57	05:41
	17:14	17:57	19:34	20:12	20:49	21:14
18	07:59	07:24	07:35	06:39	05:56	05:41
	17:16	17:59	19:35	20:14	20:50	21:15
19	07:59	07:22	07:33	06:37	05:55	05:41
	17:17	18:00	19:36	20:15	20:51	21:15
20	07:58	07:21	07:31	06:35	05:54	05:41
	17:18	18:00	19:37	20:16	20:52	21:15
21	07:57	07:19	07:30	06:34	05:53	05:41
	17:20	18:02	19:39	20:17	20:53	21:16
22	07:57	07:18	07:28	06:32	05:52	05:41
	17:21	18:03	19:40	20:19	20:54	21:16
23	07:56	07:16	07:26	06:31	05:52	05:42
	17:22	18:04	19:41	20:20	20:55	21:16
24	07:55	07:14	07:24	06:29	05:51	05:42
	17:24	18:06	19:42	20:21	20:56	21:16
25	07:54	07:13	07:22	06:27	05:50	05:42
	17:25	18:07	19:44	20:22	20:57	21:16
26	07:53	07:11	07:20	06:26	05:49	05:43
	17:26	18:08	19:45	20:24	20:58	21:17
27	07:52	07:09	07:18	06:24	05:48	05:43
	17:28	18:10	19:46	20:25	20:59	21:17
28	07:51	07:08	07:17	06:23	05:48	05:43
	17:29	18:11	19:47	20:26	21:00	21:17
29	07:50	08:12 (T-42)	07:15	06:21	05:47	05:44
	17:31	1 08:13 (T-42)	19:49	20:27	21:01	21:17
30	07:49	08:11 (T-42)	07:13	06:20	05:46	05:44
	17:32	4 08:15 (T-42)	19:50	20:29	21:02	21:17
31	07:48	08:10 (T-42)	07:11	05:46	05:46	06:09 (T-18)
	17:33	6 08:16 (T-42)	19:51	21:03	21:03	06:18 (T-18)
Potential sun hours	287	292	369	403	459	465
Total, worst case	11	178				250
Sun reduction	0.58	0.58				0.73
Oper. time red.	0.90	0.90				0.90
Wind dir. red.	0.64	0.64				0.59
Total reduction	0.34	0.34				0.39
Total, real	4	60				97

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-156 - R-156

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:09 (T-18) 06:18 (T-18)	06:12 20:55	06:49 20:07	07:24 19:11	
2	05:45 21:16	06:10 (T-18) 06:18 (T-18)	06:13 20:54	06:50 20:05	07:25 19:09	
3	05:46 21:16	06:10 (T-18) 06:18 (T-18)	06:15 20:52	06:51 20:03	07:26 19:07	
4	05:47 21:16	06:11 (T-18) 06:18 (T-18)	06:16 20:51	06:52 20:01	07:28 19:05	
5	05:47 21:16	06:12 (T-18) 06:18 (T-18)	06:17 20:50	06:53 20:00	07:29 19:03	
6	05:48 21:15	06:12 (T-18) 06:17 (T-18)	06:18 20:48	06:54 19:58	07:30 19:01	
7	05:49 21:15	06:13 (T-18) 06:17 (T-18)	06:19 20:47	06:56 19:56	07:31 19:00	
8	05:49 21:15	06:14 (T-18) 06:17 (T-18)	06:20 20:46	06:57 19:54	07:33 18:56	
9	05:50 21:14	06:14 (T-18) 06:15 (T-18)	06:21 20:44	06:58 19:52	07:34 18:54	
10	05:51 21:14		06:23 20:43	06:59 19:50	07:35 18:52	
11	05:52 21:13		06:24 20:41	07:00 19:48	07:36 18:51	
12	05:52 21:13		06:25 20:40	07:01 19:47	07:38 18:49	
13	05:53 21:12		06:26 20:38	07:03 19:45	07:39 18:47	
14	05:54 21:12		06:27 20:37	07:04 19:43	07:40 18:45	
15	05:55 21:11		06:28 20:35	07:05 19:41	07:41 18:44	
16	05:56 21:10		06:30 20:34	07:06 19:39	07:43 18:42	
17	05:57 21:10		06:31 20:32	07:07 19:37	07:44 18:40	
18	05:58 21:09		06:32 20:31	07:08 19:35	07:45 18:39	
19	05:59 21:08		06:33 20:29	07:10 19:33	07:47 18:37	
20	06:00 21:07		06:34 20:27	07:11 19:31	07:48 18:35	
21	06:01 21:06		06:36 20:26	07:12 19:30	07:49 18:34	
22	06:02 21:05		06:37 20:24	07:13 19:28	07:51 18:32	
23	06:03 21:05		06:38 20:22	07:14 19:26	07:52 18:30	
24	06:04 21:04		06:39 20:21	07:16 19:24	07:53 18:29	
25	06:05 21:03		06:40 20:19	07:17 19:22	07:55 18:27	
26	06:06 21:02		06:41 20:17	07:18 19:20	07:56 18:26	
27	06:07 21:00		06:43 20:16	07:19 19:18	07:57 18:24	
28	06:08 20:59		06:44 20:14	07:20 19:16	07:59 18:23	
29	06:09 20:58		06:45 20:12	07:22 19:14	08:00 18:21	08:30 (T-42)
30	06:10 20:57		06:46 20:10	07:23 19:13	08:01 18:20	08:41 (T-42) 08:28 (T-42)
31	06:11 20:56		06:47 20:09	07:24 18:18	08:03 18:18	08:43 (T-42) 08:26 (T-42)
Potential sun hours	471	436	377	341	289	275
Total, worst case				44		147
Sun reduction	0.75			0.56		0.48
Oper. time red.	0.90			0.90		0.90
Wind dir. red.	0.59			0.64		0.64
Total reduction	0.40			0.32		0.28
Total, real	20			14		41

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-157 - R-157

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June				
1	08:04	07:47	16:44 (T-30)	07:06	07:09	19:15 (T-29)	06:18	06:39 (T-17)	05:45	19:59 (T-13)
	16:57	17:35	25 17:09 (T-30)	18:13	19:53	19:31 (T-29)	20:30	12 20:06 (T-13)	21:04	16 20:15 (T-13)
2	08:04	07:46	16:43 (T-30)	07:04	07:07	19:15 (T-29)	06:17	06:38 (T-17)	05:45	20:00 (T-13)
	16:58	17:36	28 17:11 (T-30)	18:14	19:54	19:33 (T-29)	20:31	18 20:08 (T-13)	21:05	14 20:14 (T-13)
3	08:04	07:45	16:42 (T-30)	07:02	07:06	19:15 (T-29)	06:15	06:36 (T-17)	05:44	20:02 (T-13)
	16:59	17:38	30 17:12 (T-30)	18:15	19:55	19:34 (T-29)	20:32	22 20:08 (T-13)	21:06	11 20:13 (T-13)
4	08:04	07:43	16:42 (T-30)	07:01	07:04	19:15 (T-29)	06:14	06:35 (T-17)	05:44	20:03 (T-13)
	17:00	17:39	31 17:13 (T-30)	18:17	19:56	19:35 (T-29)	20:34	26 20:10 (T-13)	21:07	8 20:11 (T-13)
5	08:04	07:42	16:41 (T-30)	06:59	07:02	19:15 (T-29)	06:12	06:34 (T-17)	05:43	
	17:01	17:41	34 17:15 (T-30)	18:18	19:58	19:36 (T-29)	20:35	29 20:11 (T-13)	21:07	
6	08:04	07:41	16:41 (T-30)	06:57	07:00	19:15 (T-29)	06:11	06:32 (T-17)	05:43	
	17:02	17:42	36 17:17 (T-30)	18:19	19:59	19:37 (T-29)	20:36	34 20:12 (T-13)	21:08	
7	08:04	07:40	16:40 (T-30)	06:55	06:58	19:15 (T-29)	06:10	06:31 (T-17)	05:42	
	17:03	17:43	38 17:18 (T-30)	18:21	20:00	19:36 (T-29)	20:37	36 20:13 (T-13)	21:09	
8	08:04	07:38	16:40 (T-30)	07:54	06:57	19:17 (T-29)	06:08	06:30 (T-17)	05:42	
	17:04	17:45	40 17:20 (T-30)	18:22	20:01	19:35 (T-29)	20:38	38 20:14 (T-13)	21:10	
9	08:04	07:37	16:41 (T-30)	07:52	06:55	19:18 (T-29)	06:07	06:29 (T-17)	05:42	
	17:05	17:46	41 17:22 (T-30)	19:23	20:03	19:33 (T-29)	20:40	43 20:16 (T-13)	21:10	
10	08:03	07:36	16:40 (T-30)	07:50	06:53	19:20 (T-29)	06:06	06:27 (T-17)	05:42	
	17:06	17:48	43 17:23 (T-30)	19:25	20:04	19:31 (T-29)	20:41	44 20:16 (T-13)	21:11	
11	08:03	07:34	16:40 (T-30)	07:48	06:51		06:04	44 20:16 (T-13)	21:11	
	17:07	17:49	45 17:25 (T-30)	19:26	20:05		20:42	46 20:17 (T-13)	21:12	
12	08:03	07:33	16:40 (T-30)	07:46	06:49		06:03	46 20:17 (T-13)	21:12	
	17:08	17:51	46 17:26 (T-30)	19:27	20:06		20:43	49 20:19 (T-13)	21:12	
13	08:02	07:31	16:40 (T-30)	07:44	06:48		06:02	49 20:19 (T-13)	21:12	
	17:10	17:52	48 17:28 (T-30)	19:28	20:08		20:44	51 20:20 (T-13)	21:13	
14	08:02	07:30	16:40 (T-30)	07:43	06:46		06:01	51 20:20 (T-13)	21:13	
	17:11	17:53	47 17:27 (T-30)	19:30	20:09		20:45	52 20:21 (T-13)	21:13	
15	08:01	07:28	16:40 (T-30)	07:41	06:44		06:00	52 20:21 (T-13)	21:13	
	17:12	17:55	47 17:27 (T-30)	19:31	20:10		20:47	53 20:22 (T-13)	21:14	
16	08:01	07:27	16:40 (T-30)	07:39	06:42		05:59	53 20:22 (T-13)	21:14	
	17:13	17:56	47 17:27 (T-30)	19:32	20:11		20:48	54 20:23 (T-13)	21:14	
17	08:00	07:25	16:41 (T-30)	07:37	06:41		05:58	54 20:23 (T-13)	21:14	
	17:15	17:58	46 17:27 (T-30)	19:34	20:13		20:49	51 20:22 (T-13)	21:15	
18	07:59	07:24	16:41 (T-30)	07:35	06:39		05:56	51 20:22 (T-13)	21:15	
	17:16	17:59	45 17:26 (T-30)	19:35	20:14		20:50	49 20:22 (T-13)	21:15	
19	07:59	07:22	16:41 (T-30)	07:33	06:37		05:55	49 20:22 (T-13)	21:15	
	17:17	18:00	44 17:25 (T-30)	19:36	20:15		20:51	45 20:22 (T-13)	21:15	
20	07:58	07:21	16:42 (T-30)	07:32	06:36		05:54	45 20:22 (T-13)	21:15	
	17:18	18:00	43 17:25 (T-30)	19:37	20:16		20:52	40 20:22 (T-13)	21:16	
21	07:57	07:19	16:43 (T-30)	07:30	06:34		05:53	40 20:22 (T-13)	21:16	
	17:20	18:02	41 17:24 (T-30)	19:39	20:18		20:53	31 20:21 (T-13)	21:16	
22	07:57	07:18	16:44 (T-30)	07:28	06:32		05:53	31 20:21 (T-13)	21:16	
	17:21	18:03	39 17:23 (T-30)	19:40	20:19		20:54	31 20:21 (T-13)	21:16	
23	07:56	07:16	16:45 (T-30)	07:26	06:31		05:52	31 20:21 (T-13)	21:16	
	17:22	18:04	37 17:22 (T-30)	19:41	20:20		20:55	29 20:20 (T-13)	21:16	
24	07:55	07:14	16:46 (T-30)	07:24	06:29		05:51	29 20:20 (T-13)	21:16	
	17:24	18:06	34 17:20 (T-30)	19:43	20:21		20:56	28 20:20 (T-13)	21:16	
25	07:54		16:54 (T-30)	07:22	06:27		05:50	28 20:20 (T-13)	21:16	
	17:25	5 16:59 (T-30)	18:07	19:44	20:22		20:57	27 20:20 (T-13)	21:17	
26	07:53	16:52 (T-30)	07:11	07:20	06:26		05:49	27 20:20 (T-13)	21:17	
	17:27	8 17:00 (T-30)	18:09	19:45	20:24		20:58	26 20:19 (T-13)	21:17	
27	07:52	16:50 (T-30)	07:09	07:19	06:24	19:22 (T-29)	05:48	26 20:19 (T-13)	21:17	
	17:28	12 17:02 (T-30)	18:10	19:46	20:25	3 19:25 (T-29)	20:25	25 20:18 (T-13)	21:17	
28	07:51	16:48 (T-30)	07:08	07:17	06:23	19:20 (T-29)	05:48	25 20:18 (T-13)	21:17	
	17:29	14 17:02 (T-30)	18:11	19:48	20:26	6 19:26 (T-29)	20:26	23 20:18 (T-13)	21:17	
29	07:50	16:46 (T-30)		07:15	06:21	19:18 (T-29)	05:47	23 20:18 (T-13)	21:17	
	17:31	18 17:04 (T-30)		19:49	20:27	9 19:27 (T-29)	20:27	22 20:17 (T-13)	21:17	
30	07:49	16:45 (T-30)		07:13	06:20	19:17 (T-29)	05:46	22 20:17 (T-13)	21:17	
	17:32	21 17:06 (T-30)		19:50	20:29	11 19:28 (T-29)	20:29	20 20:17 (T-13)	21:17	
31	07:48	16:45 (T-30)		07:11	06:19	19:16 (T-29)	05:46	20 20:17 (T-13)	21:17	
	17:33	22 17:07 (T-30)		19:51	20:29	14 19:30 (T-29)	21:03	18 20:16 (T-13)	21:17	
Potential sun hours	287		292	369	403		459		465	
Total, worst case	100		1050	43		188		1072		49
Sun reduction	0.58		0.58	0.59		0.63		0.66		0.73
Oper. time red.	0.90		0.90	0.90		0.90		0.90		0.90
Wind dir. red.	0.59		0.59	0.60		0.60		0.62		0.62
Total reduction	0.31		0.31	0.32		0.34		0.36		0.41
Total, real	31		323	14		63		391		20

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-157 - R-157

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December	
1	05:45	06:12	06:36 (T-17)	06:49	07:24	07:04	
	21:17	20:55	48 20:29 (T-13)	20:07	19:11	17:17 42 16:52 (T-30)	
2	05:46	06:14	06:37 (T-17)	06:50	07:25	07:05	
	21:16	20:54	46 20:28 (T-13)	20:05 11	19:30 (T-29)	19:09 17:15 41 16:50 (T-30)	
3	05:46	06:15	06:38 (T-17)	06:51	07:27	07:07	
	21:16	20:52	43 20:26 (T-13)	20:03 15	19:31 (T-29)	19:07 17:14 39 16:49 (T-30)	
4	05:47	06:16	06:39 (T-17)	06:52	07:28	07:08	
	21:16	20:51	41 20:25 (T-13)	20:01 18	19:32 (T-29)	19:05 17:13 38 16:48 (T-30)	
5	05:47	06:17	06:40 (T-17)	06:53	07:29	07:09	
	21:16	20:50	39 20:24 (T-13)	20:00 21	19:33 (T-29)	19:03 17:11 36 16:47 (T-30)	
6	05:48	06:18	06:41 (T-17)	06:54	07:30	07:11	
	21:15	20:48	35 20:22 (T-13)	19:58 22	19:33 (T-29)	19:02 17:10 34 16:45 (T-30)	
7	05:49	06:19	06:42 (T-17)	06:56	07:31	07:12	
	21:15	20:47	32 20:21 (T-13)	19:56 21	19:31 (T-29)	19:00 17:09 31 16:44 (T-30)	
8	05:49	20:12 (T-13)	06:20	06:57	07:33	07:14	
	21:15	5 20:17 (T-13)	20:46 28	20:20 (T-13)	19:54 20	19:29 (T-29)	18:56 17:08 29 16:42 (T-30)
9	05:50	20:10 (T-13)	06:22	06:58	07:34	07:15	
	21:14	10 20:20 (T-13)	20:44 25	20:19 (T-13)	19:52 19	19:27 (T-29)	18:54 17:06 28 16:41 (T-30)
10	05:51	20:08 (T-13)	06:23	06:59	07:35	07:16	
	21:14	13 20:21 (T-13)	20:43 21	20:17 (T-13)	19:50 17	19:26 (T-29)	18:53 17:05 25 16:40 (T-30)
11	05:52	20:07 (T-13)	06:24	07:00	07:36	07:18	
	21:13	15 20:22 (T-13)	20:41 16	20:16 (T-13)	19:48 16	19:24 (T-29)	18:51 17:04 22 16:38 (T-30)
12	05:53	20:06 (T-13)	06:25	07:01	07:38	07:19	
	21:13	18 20:24 (T-13)	20:40 10	20:14 (T-13)	19:47 14	19:22 (T-29)	18:49 17:03 21 16:38 (T-30)
13	05:53	20:06 (T-13)	06:26	07:03	07:39	07:20	
	21:12	19 20:25 (T-13)	20:38 4	20:13 (T-13)	19:45 12	19:20 (T-29)	18:47 9 17:40 (T-30)
14	05:54	20:04 (T-13)	06:27	07:04	07:40	07:22	
	21:12	21 20:25 (T-13)	20:37 10	19:43 10	19:18 (T-29)	18:45 18	17:45 (T-30)
15	05:55	20:04 (T-13)	06:29	07:05	07:42	07:23	
	21:11	22 20:26 (T-13)	20:35 7	19:41 7	19:16 (T-29)	18:44 24	17:47 (T-30)
16	05:56	20:03 (T-13)	06:30	07:06	07:43	07:24	
	21:10	24 20:27 (T-13)	20:34 4	19:39 4	19:14 (T-29)	18:42 29	17:49 (T-30)
17	05:57	20:03 (T-13)	06:31	07:07	07:44	07:26	
	21:10	25 20:28 (T-13)	20:32 10	19:37 10	19:18 (T-29)	18:40 32	17:51 (T-30)
18	05:58	20:02 (T-13)	06:32	07:09	07:45	07:27	
	21:09	27 20:29 (T-13)	20:31 10	19:35 10	19:19 (T-29)	18:42 24	17:47 (T-30)
19	05:59	20:02 (T-13)	06:33	07:10	07:47	07:28	
	21:08	28 20:30 (T-13)	20:29 10	19:33 10	19:18 (T-29)	18:41 24	17:46 (T-30)
20	06:00	20:01 (T-13)	06:34	07:11	07:48	07:30	
	21:07	29 20:30 (T-13)	20:27 10	19:32 10	19:17 (T-29)	18:40 24	17:45 (T-30)
21	06:01	20:01 (T-13)	06:36	07:12	07:49	07:31	
	21:06	30 20:31 (T-13)	20:26 10	19:30 10	19:16 (T-29)	18:39 24	17:44 (T-30)
22	06:02	20:01 (T-13)	06:37	07:13	07:51	07:32	
	21:06	30 20:31 (T-13)	20:24 10	19:28 10	19:15 (T-29)	18:38 24	17:43 (T-30)
23	06:03	06:39 (T-17)	06:38	07:14	07:52	07:34	
	21:05	37 20:32 (T-13)	20:23 10	19:26 10	19:14 (T-29)	18:37 24	17:42 (T-30)
24	06:04	06:36 (T-17)	06:39	07:16	07:53	07:35	
	21:04	43 20:32 (T-13)	20:21 10	19:24 10	19:13 (T-29)	18:36 24	17:41 (T-30)
25	06:05	06:35 (T-17)	06:40	07:17	07:55	07:36	
	21:03	47 20:33 (T-13)	20:19 10	19:22 10	19:12 (T-29)	18:35 24	17:40 (T-30)
26	06:06	06:33 (T-17)	06:42	07:18	07:56	07:37	
	21:02	50 20:33 (T-13)	20:17 10	19:20 10	19:11 (T-29)	18:34 24	17:39 (T-30)
27	06:07	06:32 (T-17)	06:43	07:19	07:57	07:39	
	21:01	53 20:33 (T-13)	20:16 10	19:18 10	19:10 (T-29)	18:33 24	17:38 (T-30)
28	06:08	06:32 (T-17)	06:44	07:20	07:59	07:40	
	20:59	54 20:33 (T-13)	20:14 10	19:16 10	19:09 (T-29)	18:32 24	17:37 (T-30)
29	06:09	06:33 (T-17)	06:45	07:22	08:00	07:41	
	20:58	52 20:32 (T-13)	20:12 10	19:15 10	19:08 (T-29)	18:31 24	17:36 (T-30)
30	06:10	06:34 (T-17)	06:46	07:23	08:01	07:42	
	20:57	51 20:31 (T-13)	20:10 10	19:13 10	19:07 (T-29)	18:30 24	17:35 (T-30)
31	06:11	06:35 (T-17)	06:47	07:24	08:02	07:43	
	20:56	49 20:30 (T-13)	20:09 10	19:12 10	19:06 (T-29)	18:29 24	17:34 (T-30)
Potential sun hours	471	436	377	341	288	275	
Total, worst case	752	388	227	721	443	443	
Sun reduction	0.75	0.72	0.67	0.56	0.48	0.48	
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90	
Wind dir. red.	0.62	0.61	0.60	0.59	0.59	0.59	
Total reduction	0.42	0.40	0.36	0.30	0.25	0.25	
Total, real	313	154	81	214	113	113	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-158 - R-158
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:15	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:49	06:20	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:12	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:32	20:11	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:54	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:18	18:00	19:38	20:16	20:52	21:16	21:07	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:22	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39	08:04
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:57	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46	05:45	06:11	06:48	08:03	08:03	08:03	08:04
	17:34		19:51	21:03	21:03	21:17	20:56	20:09	18:18	18:18	16:56	16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-160 - R-160
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:43		
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48		
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:45		
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48		
3	08:05	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46		
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48		
4	08:04	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47		
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:01	19:05	17:13	16:47		
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:10	07:48		
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47		
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49		
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47		
7	08:04	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50		
	17:03	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47		
8	08:04	07:38	07:54	06:57	06:08	05:42	05:49	06:20	06:57	07:33	07:14	07:51		
	17:04	17:45	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:08	16:47		
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52		
	17:05	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:06	16:46		
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53		
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:46		
11	08:03	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:37	07:18	07:54		
	17:07	17:49	19:26	20:05	20:42	21:12	21:13	20:42	19:49	18:51	17:04	16:46		
12	08:03	07:33	07:46	06:49	06:03	05:41	05:52	06:25	07:02	07:38	07:19	07:55		
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47		
13	08:02	07:31	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55		
	17:10	17:52	19:29	20:08	20:44	21:13	21:12	20:39	19:45	18:47	17:02	16:47		
14	08:02	07:30	07:43	08:03 (T-15)	06:46	06:01	05:41	06:27	07:04	07:40	07:22	07:56		
	17:11	17:53	19:30	2	08:05 (T-15)	20:09	20:46	21:13	21:12	20:37	19:43	18:45	17:01	16:47
15	08:01	07:29	07:41	08:01 (T-15)	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57	
	17:12	17:55	19:31	5	08:06 (T-15)	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	07:59 (T-15)	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:58	
	17:13	17:56	19:32	6	08:05 (T-15)	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	07:57 (T-15)	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58	
	17:14	17:58	19:34	8	08:05 (T-15)	20:13	20:49	21:15	21:10	20:32	19:37	18:40	16:58	16:47
18	08:00	07:24	07:35	07:56 (T-15)	06:39	05:56	05:41	05:58	06:32	07:09	07:45	07:27	07:59	
	17:16	17:59	19:35	9	08:05 (T-15)	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	07:54 (T-15)	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28	08:00	
	17:17	18:00	19:36	11	08:05 (T-15)	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	07:52 (T-15)	06:36	05:54	05:41	06:00	06:34	07:11	07:48	07:30	08:00	
	17:18	18:00	19:37	11	08:03 (T-15)	20:16	20:52	21:16	21:07	20:28	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	07:50 (T-15)	06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31	08:01	
	17:20	18:02	19:39	12	08:02 (T-15)	20:18	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	07:48 (T-15)	06:32	05:53	05:42	06:02	06:37	07:13	07:34 (T-15)	07:51	07:32	08:01
	17:21	18:03	19:40	12	08:00 (T-15)	20:19	20:54	21:16	21:06	20:24	19:28	18:32	16:53	16:50
23	07:56	07:16	07:26	07:50 (T-15)	06:31	05:52	05:42	06:03	06:38	07:14	07:36 (T-15)	07:52	07:34	08:02
	17:22	18:04	19:41	6	07:56 (T-15)	20:20	20:55	21:16	21:05	20:23	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:37 (T-15)	07:53	07:35	08:02	
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	11	07:48 (T-15)	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	10	07:38 (T-15)	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	10	07:48 (T-15)	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	9	07:39 (T-15)	07:56	07:37	08:03
	17:26	18:09	19:45	20:24	20:59	21:17	21:02	20:17	19:20	9	07:48 (T-15)	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	7	07:40 (T-15)	07:57	07:39	08:03
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	7	07:47 (T-15)	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	5	07:42 (T-15)	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:16	5	07:47 (T-15)	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	3	07:43 (T-15)	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:17	20:58	20:12	19:15	3	07:46 (T-15)	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:44	06:10	06:46	07:23	1	07:44 (T-15)	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:17	20:57	20:10	19:13	1	07:45 (T-15)	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47				08:03		08:04
	17:33		19:51		21:03		20:56	20:09				18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377		341	288		275
Total, worst case														
Sun reduction			82							80				
Oper. time red.			0.59							0.67				
Wind dir. red.			0.90							0.90				
Total reduction			0.60							0.60				
Total, real			0.32							0.36				
			26							29				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-161 - R-161
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:47	07:06	07:09	19:19 (T-11)	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:43			
	16:57	17:35	18:13	19:53	12	19:31 (T-11)	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48		
2	08:05	07:46	07:04	07:08	19:20 (T-11)	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:45			
	16:58	17:36	18:14	19:54	13	19:33 (T-11)	20:31	21:05	21:17	20:54	20:05	19:09	17:15	16:48		
3	08:05	07:45	07:03	07:06	19:19 (T-11)	06:15	05:44	05:46	06:15	06:51	19:23 (T-11)	07:27	07:07	07:46		
	16:59	17:38	18:15	19:55	15	19:34 (T-11)	20:32	21:06	21:16	20:53	20:03	19:30 (T-11)	19:07	17:14	16:48	
4	08:05	07:44	07:01	07:04	19:19 (T-11)	06:14	05:44	05:47	06:16	06:52	19:20 (T-11)	07:28	07:08	07:47		
	17:00	17:39	18:17	19:56	16	19:35 (T-11)	20:34	21:07	21:16	20:51	20:02	13	19:33 (T-11)	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	19:19 (T-11)	06:12	05:43	05:47	06:17	06:53	19:18 (T-11)	07:29	07:10	07:48		
	17:01	17:41	18:18	19:58	17	19:36 (T-11)	20:35	21:08	21:16	20:50	20:00	16	19:34 (T-11)	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	19:20 (T-11)	06:11	05:43	05:48	06:18	06:55	19:16 (T-11)	07:30	07:11	07:49		
	17:02	17:42	18:19	19:59	17	19:37 (T-11)	20:36	21:08	21:16	20:49	19:58	17	19:33 (T-11)	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	19:22 (T-11)	06:10	05:42	05:49	06:19	06:56	19:15 (T-11)	07:32	07:12	07:50		
	17:03	17:43	18:21	20:00	16	19:38 (T-11)	20:37	21:09	21:15	20:47	19:56	16	19:31 (T-11)	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	19:23 (T-11)	06:08	05:42	05:49	06:20	06:57	19:13 (T-11)	07:33	07:14	07:51		
	17:04	17:45	18:22	20:01	13	19:36 (T-11)	20:39	21:10	21:15	20:46	19:54	16	19:29 (T-11)	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	19:25 (T-11)	06:07	05:42	05:50	06:22	06:58	19:14 (T-11)	07:34	07:15	07:52		
	17:05	17:46	19:23	20:03	7	19:32 (T-11)	20:40	21:10	21:14	20:44	19:52	14	19:28 (T-11)	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	20:04	06:06	05:42	05:51	06:23	06:59	19:13 (T-11)	07:35	07:16	07:53		
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	13	19:26 (T-11)	18:53	17:05	16:47		
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	19:12 (T-11)	07:37	07:18	07:54			
	17:07	17:49	19:26	20:05	20:42	21:12	21:13	20:42	19:49	12	19:24 (T-11)	18:51	17:04	16:47		
12	08:03	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	19:12 (T-11)	07:38	07:19	07:55			
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	10	19:22 (T-11)	18:49	17:03	16:47		
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	19:12 (T-11)	07:39	07:20	07:55			
	17:10	17:52	19:29	20:08	20:44	21:13	21:12	20:39	19:45	8	19:20 (T-11)	18:47	17:02	16:47		
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	19:12 (T-11)	07:40	07:22	07:56			
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	6	19:18 (T-11)	18:46	17:01	16:47		
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	19:13 (T-11)	07:42	07:23	07:57			
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	3	19:16 (T-11)	18:44	17:00	16:47		
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:58				
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47				
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58				
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:32	19:37	18:40	16:58	16:48				
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59				
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48				
19	07:59	07:22	07:34	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28	08:00				
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:34	18:37	16:56	16:48				
20	07:58	07:21	07:32	06:36	05:54	05:41	06:00	06:34	07:11	07:48	07:30	08:00				
	17:18	18:00	19:38	20:16	20:52	21:16	21:07	20:28	19:32	18:35	16:55	16:49				
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01				
	17:20	18:02	19:39	20:18	20:53	21:16	21:07	20:26	19:30	18:34	16:54	16:49				
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01				
	17:21	18:03	19:40	20:19	20:54	21:16	21:06	20:24	19:28	18:32	16:54	16:50				
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02				
	17:22	18:05	19:41	20:20	20:56	21:16	21:05	20:23	19:26	18:30	16:53	16:50				
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02				
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51				
25	07:54	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03				
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:51	16:51				
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03				
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:17	19:20	18:26	16:51	16:52				
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39	08:03				
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	18:24	16:50	16:53				
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04				
	17:29	18:11	19:48	2	19:26 (T-11)	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53		
29	07:50	07:15	07:25	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04				
	17:31	19:49	5	19:27 (T-11)	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54			
30	07:49	07:13	07:23	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04				
	17:32	19:50	7	19:28 (T-11)	20:29	21:02	21:17	20:57	20:11	19:13	18:20	16:49	16:55			
31	07:48	07:11	07:21	06:19	05:46	05:46	06:11	06:47	07:24	08:03	07:43	08:04				
	17:34	19:51	10	19:30 (T-11)	21:03	21:03	20:56	20:09	07:25	18:18	16:49	16:56				
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275				
Total, worst case			24	126					151							
Sun reduction			0.59	0.63					0.67							
Oper. time red.			0.90	0.90					0.90							
Wind dir. red.			0.60	0.60					0.60							
Total reduction			0.32	0.34					0.36							
Total, real			8	43					54							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-162 - R-162

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	16:18 (T-29) 07:47	16:12 (T-13) 07:06	07:09	06:18	05:45
	16:57 10	16:28 (T-29) 17:35 52	17:04 (T-13) 18:13	19:53	20:30	21:04
2	08:04	16:18 (T-29) 07:46	16:12 (T-13) 07:04	07:07	06:17	05:45
	16:58 11	16:29 (T-29) 17:36 52	17:04 (T-13) 18:14	19:54	20:31	21:05
3	08:04	16:18 (T-29) 07:45	16:13 (T-13) 07:02	07:06	06:15	05:44
	16:59 12	16:30 (T-29) 17:38 52	17:05 (T-13) 18:15	19:55	20:32	21:06
4	08:04	16:18 (T-29) 07:43	16:12 (T-13) 07:01	07:04	06:14	05:44
	17:00 14	16:32 (T-29) 17:39 52	17:04 (T-13) 18:17	19:56	20:34	21:07
5	08:04	16:19 (T-29) 07:42	16:13 (T-13) 06:59	07:02	06:12	05:43
	17:01 14	16:33 (T-29) 17:41 51	17:04 (T-13) 18:18	19:58	20:35	21:07
6	08:04	16:18 (T-29) 07:41	16:14 (T-13) 06:57	07:18 (T-17) 07:00	06:11	05:43
	17:02 15	16:33 (T-29) 17:42 51	17:05 (T-13) 18:19	1 07:19 (T-17) 19:59	20:36	21:08
7	08:04	16:18 (T-29) 07:40	16:13 (T-13) 06:55	07:16 (T-17) 06:58	06:10	05:42
	17:03 16	16:34 (T-29) 17:43 51	17:04 (T-13) 18:21	3 07:19 (T-17) 20:00	20:37	21:09
8	08:04	16:19 (T-29) 07:38	16:14 (T-13) 07:54	08:14 (T-17) 06:57	06:08	05:42
	17:04 17	16:36 (T-29) 17:45 50	17:04 (T-13) 18:22	5 08:19 (T-17) 20:01	20:38	21:10
9	08:04	16:19 (T-29) 07:37	16:15 (T-13) 07:52	08:12 (T-17) 06:55	06:07	05:42
	17:05 18	16:37 (T-29) 17:46 49	17:04 (T-13) 19:23	7 08:19 (T-17) 20:03	20:40	21:10
10	08:03	16:18 (T-13) 07:36	16:15 (T-13) 07:50	08:10 (T-17) 06:53	06:06	05:42
	17:06 20	16:38 (T-29) 17:48 48	17:03 (T-13) 19:25	8 08:18 (T-17) 20:04	20:41	21:11
11	08:03	16:18 (T-13) 07:34	16:16 (T-13) 07:48	08:09 (T-17) 06:51	06:04	05:41
	17:07 22	16:40 (T-29) 17:49 47	17:03 (T-13) 19:26	9 08:18 (T-17) 20:05	20:42	21:12
12	08:03	16:16 (T-13) 07:33	16:17 (T-13) 07:46	08:07 (T-17) 06:49	06:03	05:41
	17:08 24	16:40 (T-29) 17:51 45	17:02 (T-13) 19:27	10 08:17 (T-17) 20:06	20:43	21:12
13	08:02	16:16 (T-13) 07:31	16:18 (T-13) 07:45	08:05 (T-17) 06:48	06:02	05:41
	17:10 26	16:42 (T-29) 17:52 43	17:01 (T-13) 19:29	11 08:16 (T-17) 20:08	20:44	21:13
14	08:02	16:16 (T-13) 07:30	16:18 (T-13) 07:43	08:03 (T-17) 06:46	06:01	05:41
	17:11 27	16:43 (T-29) 17:53 42	17:00 (T-13) 19:30	10 08:13 (T-17) 20:09	20:46	21:13
15	08:01	16:16 (T-13) 07:29	16:20 (T-13) 07:41	08:04 (T-17) 06:44	06:00	05:41
	17:12 29	16:45 (T-29) 17:55 39	16:59 (T-13) 19:31	6 08:10 (T-17) 20:10	20:47	21:14
16	08:01	16:15 (T-13) 07:27	16:21 (T-13) 07:39	06:42	05:59	05:41
	17:13 31	16:46 (T-29) 17:56 37	16:58 (T-13) 19:32	20:11	20:48	21:14
17	08:00	16:14 (T-13) 07:26	16:23 (T-13) 07:37	06:41	05:58	05:41
	17:15 33	16:47 (T-29) 17:58 34	16:57 (T-13) 19:34	20:13	20:49	21:15
18	08:00	16:14 (T-13) 07:24	16:25 (T-13) 07:35	06:39	05:56	05:41
	17:16 35	16:49 (T-29) 17:59 29	16:54 (T-13) 19:35	20:14	20:50	21:15
19	07:59	16:14 (T-13) 07:22	16:27 (T-13) 07:33	06:37	05:55	05:41
	17:17 36	16:50 (T-29) 18:00 25	16:52 (T-13) 19:36	20:15	20:51	21:15
20	07:58	16:13 (T-13) 07:21	16:30 (T-13) 07:32	06:36	05:54	05:41
	17:18 38	16:51 (T-29) 18:00 19	16:49 (T-13) 19:37	20:16	20:52	21:16
21	07:57	16:13 (T-13) 07:19	16:35 (T-13) 07:30	06:34	05:53	05:41
	17:20 39	16:52 (T-29) 18:02 9	16:44 (T-13) 19:39	20:18	20:53	21:16
22	07:57	16:12 (T-13) 07:18	07:28	06:32	05:53	05:42
	17:21 42	16:54 (T-13) 18:03	19:40	20:19	20:54	21:16
23	07:56	16:12 (T-13) 07:16	07:26	06:31	05:52	05:42
	17:22 43	16:55 (T-13) 18:04	19:41	20:20	20:55	21:16
24	07:55	16:13 (T-13) 07:14	07:24	06:29	05:51	05:42
	17:24 44	16:57 (T-13) 18:06	19:43	20:21	20:57	21:16
25	07:54	16:13 (T-13) 07:13	07:22	06:27	05:50	05:42
	17:25 46	16:59 (T-13) 18:07	19:44	20:23	20:58	21:17
26	07:53	16:12 (T-13) 07:11	07:20	06:26	05:49	05:43
	17:27 48	17:00 (T-13) 18:09	19:45	20:24	20:59	21:17
27	07:52	16:12 (T-13) 07:09	07:19	06:24	05:48	05:43
	17:28 50	17:02 (T-13) 18:10	19:46	20:25	21:00	21:17
28	07:51	16:12 (T-13) 07:08	07:17	06:23	05:48	05:44
	17:29 51	17:03 (T-13) 18:11	19:48	20:26	21:00	21:17
29	07:50	16:11 (T-13)	07:15	06:21	05:47	05:44
	17:31 51	17:02 (T-13)	19:49	20:27	21:01	21:17
30	07:49	16:12 (T-13)	07:13	06:20	05:46	05:44
	17:32 51	17:03 (T-13)	19:50	20:29	21:02	21:17
31	07:48	16:12 (T-13)	07:11	06:19	05:46	05:44
	17:34 51	17:03 (T-13)	19:51	21:03	21:03	21:17
Potential sun hours	287	292	369	403	459	465
Total, worst case	964	877	70			
Sun reduction	0.58	0.58	0.59			
Oper. time red.	0.90	0.90	0.90			
Wind dir. red.	0.59	0.59	0.60			
Total reduction	0.31	0.31	0.32			
Total, real	298	270	22			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-162 - R-162
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December			
1	05:45 21:17	06:12 20:55	06:49 20:07	07:24 19:11	07:45 (T-17) 10 07:55 (T-17)	07:04 17:17	15:45 (T-13) 16:33 (T-13)	07:43 16:48	16:00 (T-13) 22 16:22 (T-29)
2	05:46 21:16	06:14 20:54	06:50 20:05	07:25 19:09	07:46 (T-17) 10 07:56 (T-17)	07:05 17:15	15:44 (T-13) 16:33 (T-13)	07:44 16:48	16:01 (T-13) 20 16:21 (T-29)
3	05:46 21:16	06:15 20:52	06:51 20:03	07:27 19:07	07:48 (T-17) 9 07:57 (T-17)	07:07 17:14	15:44 (T-13) 16:34 (T-13)	07:46 16:48	16:02 (T-29) 18 16:20 (T-29)
4	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:49 (T-17) 7 07:56 (T-17)	07:08 17:13	15:43 (T-13) 16:34 (T-13)	07:47 16:47	16:03 (T-29) 17 16:20 (T-29)
5	05:47 21:16	06:17 20:50	06:53 20:00	07:29 19:03	07:50 (T-17) 6 07:56 (T-17)	07:09 17:11	15:43 (T-13) 16:34 (T-13)	07:48 16:47	16:03 (T-29) 16 16:19 (T-29)
6	05:48 21:15	06:18 20:49	06:54 19:58	07:30 19:02	07:51 (T-17) 4 07:55 (T-17)	07:11 17:10	15:43 (T-13) 16:34 (T-13)	07:49 16:47	16:04 (T-29) 15 16:19 (T-29)
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	07:53 (T-17) 2 07:55 (T-17)	07:12 17:09	15:43 (T-13) 16:35 (T-13)	07:50 16:47	16:05 (T-29) 14 16:19 (T-29)
8	05:49 21:15	06:20 20:46	06:57 19:54	07:33 18:56	07:54 (T-17) 17:09	07:14 17:08	15:43 (T-13) 16:35 (T-13)	07:51 16:47	16:05 (T-29) 14 16:19 (T-29)
9	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54	07:55 (T-17) 17:06	07:15 17:06	15:43 (T-13) 16:35 (T-13)	07:52 16:47	16:06 (T-29) 13 16:19 (T-29)
10	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:53	07:56 (T-17) 17:05	07:16 17:05	15:43 (T-13) 16:35 (T-13)	07:53 16:46	16:07 (T-29) 12 16:19 (T-29)
11	05:52 21:13	06:24 20:42	07:00 19:49	07:37 18:51	07:57 (T-17) 17:04	07:18 17:04	15:43 (T-13) 16:34 (T-13)	07:54 16:47	16:08 (T-29) 11 16:19 (T-29)
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:58 (T-17) 17:03	07:19 17:03	15:44 (T-13) 16:35 (T-13)	07:54 16:47	16:08 (T-29) 11 16:19 (T-29)
13	05:53 21:12	06:26 20:39	07:03 19:45	07:39 18:47	07:59 (T-17) 17:02	07:20 17:02	15:43 (T-13) 16:34 (T-13)	07:55 16:47	16:09 (T-29) 10 16:19 (T-29)
14	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	07:59 (T-17) 17:01	07:22 17:01	15:44 (T-13) 16:35 (T-13)	07:56 16:47	16:10 (T-29) 9 16:19 (T-29)
15	05:55 21:11	06:29 20:35	07:05 19:41	07:42 18:44	07:59 (T-17) 17:00	07:23 17:00	15:44 (T-13) 16:34 (T-13)	07:57 16:47	16:11 (T-29) 9 16:20 (T-29)
16	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:59 (T-17) 16:59	07:24 16:59	15:45 (T-13) 16:33 (T-13)	07:58 16:47	16:11 (T-29) 8 16:19 (T-29)
17	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40	07:59 (T-17) 16:58	07:26 16:58	15:46 (T-13) 16:32 (T-13)	07:58 16:48	16:12 (T-29) 8 16:20 (T-29)
18	05:58 21:09	06:32 20:31	07:09 19:35	07:45 18:39	07:59 (T-17) 16:57	07:27 16:57	15:47 (T-13) 16:31 (T-13)	07:59 16:48	16:13 (T-29) 7 16:20 (T-29)
19	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	07:59 (T-17) 16:56	07:28 16:56	15:47 (T-13) 16:30 (T-13)	08:00 16:48	16:13 (T-29) 7 16:20 (T-29)
20	06:00 21:07	06:34 20:28	07:11 19:32	07:48 18:35	07:59 (T-17) 16:55	07:30 16:55	15:47 (T-13) 16:29 (T-13)	08:00 16:49	16:14 (T-29) 7 16:21 (T-29)
21	06:01 21:06	06:36 20:26	07:12 19:30	07:49 18:34	17:03 (T-13) 14 17:17 (T-13)	07:31 16:54	15:49 (T-13) 16:28 (T-29)	08:01 16:49	16:14 (T-29) 7 16:21 (T-29)
22	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	17:00 (T-13) 21 17:21 (T-13)	07:32 16:54	15:49 (T-13) 16:27 (T-29)	08:01 16:50	16:15 (T-29) 7 16:22 (T-29)
23	06:03 21:05	06:38 20:23	07:14 19:26	07:52 18:30	16:56 (T-13) 27 17:23 (T-13)	07:34 16:53	15:50 (T-13) 16:26 (T-29)	08:02 16:50	16:15 (T-29) 7 16:22 (T-29)
24	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	16:54 (T-13) 31 17:25 (T-13)	07:35 16:52	15:51 (T-13) 16:26 (T-29)	08:02 16:51	16:16 (T-29) 7 16:23 (T-29)
25	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	16:52 (T-13) 35 17:27 (T-13)	07:36 16:51	15:52 (T-13) 16:25 (T-29)	08:03 16:51	16:16 (T-29) 7 16:23 (T-29)
26	06:06 21:02	06:42 20:17	07:18 19:20	07:56 18:26	16:50 (T-13) 38 17:28 (T-13)	07:37 16:51	15:53 (T-13) 16:24 (T-29)	08:03 16:52	16:16 (T-29) 7 16:23 (T-29)
27	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	16:50 (T-13) 39 17:29 (T-13)	07:39 16:50	15:55 (T-13) 16:24 (T-29)	08:03 16:53	16:16 (T-29) 8 16:24 (T-29)
28	06:08 21:00	06:44 20:14	07:20 19:16	07:59 18:23	16:48 (T-13) 42 17:30 (T-13)	07:40 16:50	15:56 (T-13) 16:23 (T-29)	08:04 16:53	16:17 (T-29) 8 16:25 (T-29)
29	06:09 20:58	06:45 20:12	07:22 19:15	07:43 (T-17) 10 07:53 (T-17)	16:47 (T-13) 44 17:31 (T-13)	07:41 16:49	15:56 (T-13) 16:22 (T-29)	08:04 16:54	16:17 (T-29) 9 16:26 (T-29)
30	06:10 20:57	06:46 20:10	07:23 19:13	07:44 (T-17) 11 07:55 (T-17)	16:46 (T-13) 45 17:31 (T-13)	07:42 16:49	15:58 (T-13) 16:22 (T-29)	08:04 16:55	16:17 (T-29) 10 16:27 (T-29)
31	06:11 20:56	06:47 20:09	07:24 19:11	08:03 18:18	16:45 (T-13) 47 17:32 (T-13)	07:43 16:48	16:22 (T-29) 16:56	08:04 16:56	16:17 (T-29) 10 16:27 (T-29)
Potential sun hours	471	436	377	341	288	275			
Total, worst case				431	1303	335			
Sun reduction			0.67	0.56	0.48	0.52			
Oper. time red.			0.90	0.90	0.90	0.90			
Wind dir. red.			0.60	0.59	0.59	0.60			
Total reduction			0.36	0.30	0.26	0.28			
Total, real			8	128	333	93			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-163 - R-163

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June			
1	08:04	07:47	16:34 (T-29)	07:06	16:30 (T-13)	07:09	06:18	05:45	
	16:57	17:35	35 17:09 (T-13)	18:13	50 17:20 (T-13)	19:53	20:30	21:04	
2	08:04	07:46	16:33 (T-13)	07:04	16:31 (T-13)	07:07	06:17	05:45	
	16:58	17:36	38 17:11 (T-13)	18:14	47 17:18 (T-13)	19:54	20:31	21:05	
3	08:04	07:45	16:32 (T-13)	07:02	16:32 (T-13)	07:06	06:15	05:44	
	16:59	17:38	41 17:13 (T-13)	18:15	45 17:17 (T-13)	19:55	20:32	21:06	
4	08:04	07:43	16:31 (T-13)	07:01	16:33 (T-13)	07:04	06:14	05:44	
	17:00	17:39	42 17:13 (T-13)	18:17	42 17:15 (T-13)	19:56	20:34	21:07	
5	08:04	07:42	16:30 (T-13)	06:59	16:35 (T-13)	07:02	06:12	05:43	
	17:01	17:41	45 17:15 (T-13)	18:18	39 17:14 (T-13)	19:58	20:35	21:07	
6	08:04	07:41	16:30 (T-13)	06:57	16:37 (T-13)	07:00	06:11	05:43	
	17:02	17:42	47 17:17 (T-13)	18:19	34 17:11 (T-13)	19:59	20:36	21:08	
7	08:04	07:40	16:28 (T-13)	06:55	16:39 (T-13)	06:58	06:10	05:42	
	17:03	17:43	50 17:18 (T-13)	18:21	30 17:09 (T-13)	20:00	20:37	21:09	
8	08:04	07:38	16:28 (T-13)	07:54	17:41 (T-13)	06:57	06:08	05:42	
	17:04	17:45	52 17:20 (T-13)	18:22	24 18:05 (T-13)	20:01	20:38	21:10	
9	08:04	16:36 (T-29)	07:37	16:28 (T-13)	07:52	17:45 (T-13)	06:55	06:07	05:42
	17:05	1 16:37 (T-29)	17:46	54 17:22 (T-13)	19:23	16 18:01 (T-13)	20:03	20:40	21:10
10	08:03	16:35 (T-29)	07:36	16:27 (T-13)	07:50		06:53	06:06	05:42
	17:06	3 16:38 (T-29)	17:48	56 17:23 (T-13)	19:25		20:04	20:41	21:11
11	08:03	16:35 (T-29)	07:34	16:27 (T-13)	07:48		06:51	06:05	05:41
	17:07	5 16:40 (T-29)	17:49	57 17:24 (T-13)	19:26		20:05	20:42	21:12
12	08:03	16:33 (T-29)	07:33	16:26 (T-13)	07:46		06:49	06:03	05:41
	17:08	7 16:40 (T-29)	17:51	58 17:24 (T-13)	19:27		20:06	20:43	21:12
13	08:02	16:34 (T-29)	07:31	16:26 (T-13)	07:45		06:48	06:02	05:41
	17:10	8 16:42 (T-29)	17:52	59 17:25 (T-13)	19:29		20:08	20:44	21:13
14	08:02	16:33 (T-29)	07:30	16:25 (T-13)	07:43		06:46	06:01	05:41
	17:11	10 16:43 (T-29)	17:53	60 17:25 (T-13)	19:30		20:09	20:46	21:13
15	08:01	16:33 (T-29)	07:29	16:26 (T-13)	07:41		06:44	06:00	05:41
	17:12	12 16:45 (T-29)	17:55	59 17:25 (T-13)	19:31		20:10	20:47	21:14
16	08:01	16:32 (T-29)	07:27	16:25 (T-13)	07:39		06:42	05:59	05:41
	17:13	14 16:46 (T-29)	17:56	60 17:25 (T-13)	19:32		20:11	20:48	21:14
17	08:00	16:32 (T-29)	07:26	16:25 (T-13)	07:37		06:41	05:58	05:41
	17:15	15 16:47 (T-29)	17:58	61 17:26 (T-13)	19:34		20:13	20:49	21:15
18	08:00	16:32 (T-29)	07:24	16:25 (T-13)	07:35		06:39	05:56	05:41
	17:16	17 16:49 (T-29)	17:59	60 17:25 (T-13)	19:35		20:14	20:50	21:15
19	07:59	16:32 (T-29)	07:22	16:25 (T-13)	07:33		06:37	05:55	05:41
	17:17	18 16:50 (T-29)	18:00	60 17:25 (T-13)	19:36		20:15	20:51	21:15
20	07:58	16:31 (T-29)	07:21	16:25 (T-13)	07:32		06:36	05:54	05:41
	17:18	20 16:51 (T-29)	18:00	60 17:25 (T-13)	19:37		20:16	20:52	21:16
21	07:57	16:31 (T-29)	07:19	16:25 (T-13)	07:30		06:34	05:53	05:41
	17:20	21 16:52 (T-29)	18:02	60 17:25 (T-13)	19:39		20:18	20:53	21:16
22	07:57	16:31 (T-29)	07:18	16:26 (T-13)	07:28		06:32	05:53	05:42
	17:21	23 16:54 (T-29)	18:03	59 17:25 (T-13)	19:40		20:19	20:54	21:16
23	07:56	16:31 (T-29)	07:16	16:26 (T-13)	07:26		06:31	05:52	05:42
	17:22	24 16:55 (T-29)	18:04	58 17:24 (T-13)	19:41		20:20	20:55	21:16
24	07:55	16:32 (T-29)	07:14	16:26 (T-13)	07:24		06:29	05:51	05:42
	17:24	25 16:57 (T-29)	18:06	57 17:23 (T-13)	19:43		20:21	20:57	21:16
25	07:54	16:32 (T-29)	07:13	16:27 (T-13)	07:22		06:27	05:50	05:42
	17:25	27 16:59 (T-29)	18:07	56 17:23 (T-13)	19:44		20:23	20:58	21:17
26	07:53	16:32 (T-29)	07:11	16:27 (T-13)	07:20		06:26	05:49	05:43
	17:27	28 17:00 (T-29)	18:09	55 17:22 (T-13)	19:45		20:24	20:59	21:17
27	07:52	16:32 (T-29)	07:09	16:28 (T-13)	07:19		06:24	05:48	05:43
	17:28	30 17:02 (T-29)	18:10	53 17:21 (T-13)	19:46		20:25	21:00	21:17
28	07:51	16:33 (T-29)	07:08	16:28 (T-13)	07:17		06:23	05:48	05:44
	17:29	30 17:03 (T-29)	18:11	52 17:20 (T-13)	19:48		20:26	21:00	21:17
29	07:50	16:32 (T-29)			07:15		06:21	05:47	05:44
	17:31	32 17:04 (T-29)			19:49		20:27	21:01	21:17
30	07:49	16:32 (T-29)			07:13		06:20	05:46	05:44
	17:32	34 17:06 (T-29)			19:50		20:29	21:02	21:17
31	07:48	16:33 (T-29)			07:11			05:46	
	17:34	34 17:07 (T-13)			19:51			21:03	
Potential sun hours	287	292	369		403	459	465		
Total, worst case	438	1504	327						
Sun reduction	0.58	0.58	0.59						
Oper. time red.	0.90	0.90	0.90						
Wind dir. red.	0.59	0.59	0.59						
Total reduction	0.31	0.31	0.31						
Total, real	134	463	102						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-163 - R-163

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:17	06:12 20:55	06:49 20:07	07:24 19:11	07:04 17:17	15:57 (T-13) 16:48 5
2	05:46 21:16	06:14 20:54	06:50 20:05	07:25 19:09	07:05 17:15	16:52 (T-13) 16:48 3
3	05:46 21:16	06:15 20:52	06:51 20:03	07:27 19:07	07:07 17:14	16:50 (T-13) 16:48 1
4	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	15:58 (T-13) 16:47 9
5	05:47 21:16	06:17 20:50	06:53 20:00	07:29 19:03	07:09 17:11	17:26 (T-13) 16:47 21
6	05:48 21:15	06:18 20:49	06:54 19:58	07:30 19:02	07:11 17:10	17:35 (T-13) 16:47 47
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	07:12 17:09	17:20 (T-13) 16:47 47
8	05:49 21:15	06:20 20:46	06:57 19:54	07:33 18:56	07:14 17:08	17:41 (T-13) 16:47 21
9	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54	07:15 17:06	17:16 (T-13) 16:47 27
10	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:53	07:16 17:05	17:43 (T-13) 16:47 45
11	05:52 21:13	06:24 20:42	07:00 19:49	07:37 18:51	07:18 17:04	17:14 (T-13) 16:47 42
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	17:20 (T-13) 16:47 34
13	05:53 21:12	06:26 20:39	07:03 19:45	07:39 18:47	07:20 17:02	17:00 (T-13) 16:47 32
14	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	07:22 17:01	17:09 (T-13) 16:47 31
15	05:55 21:11	06:29 20:35	07:05 19:41	07:42 18:44	07:23 17:00	17:11 (T-13) 16:47 30
16	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59	17:04 (T-13) 16:47 28
17	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40	07:26 16:58	17:05 (T-13) 16:47 27
18	05:58 21:09	06:32 20:31	07:09 19:35	07:45 18:39	07:27 16:57	17:06 (T-13) 16:47 25
19	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	07:28 16:56	17:07 (T-13) 16:47 24
20	06:00 21:07	06:34 20:28	07:11 19:32	07:48 18:35	07:30 16:55	17:08 (T-13) 16:47 23
21	06:01 21:06	06:36 20:26	07:12 19:30	07:49 18:34	07:31 16:54	17:09 (T-13) 16:47 21
22	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:53	17:10 (T-13) 16:47 20
23	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:30	07:34 16:53	17:11 (T-13) 16:47 18
24	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	17:12 (T-13) 16:47 17
25	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	07:36 16:51	17:13 (T-13) 16:47 15
26	06:06 21:02	06:42 20:17	07:18 19:20	07:56 18:26	07:37 16:51	17:14 (T-13) 16:47 14
27	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	07:39 16:50	17:15 (T-13) 16:47 12
28	06:08 21:00	06:44 20:14	07:20 19:16	07:59 18:23	07:40 16:50	17:16 (T-13) 16:47 10
29	06:09 20:58	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	17:17 (T-13) 16:47 8
30	06:10 20:57	06:46 20:10	07:23 19:13	08:01 18:20	07:42 16:49	17:18 (T-13) 16:47 7
31	06:11 20:56	06:47 20:09	07:24 19:11	08:03 18:18	07:43 16:48	17:19 (T-13) 16:47 5
Potential sun hours	471	436	377	341	288	275
Total, worst case				1399	886	9
Sun reduction				0.56	0.48	0.52
Oper. time red.				0.90	0.90	0.90
Wind dir. red.				0.59	0.59	0.59
Total reduction				0.30	0.25	0.27
Total, real				416	225	2

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-164 - R-164
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June			
1	08:04	07:47	07:06	07:27 (T-30)	07:09	07:30 (T-29)	06:18	06:39 (T-13)	05:45
	16:57	17:35	18:13	10 07:37 (T-30)	19:53	31 08:01 (T-29)	20:30	26 07:05 (T-13)	21:04
2	08:05	07:46	07:04	07:25 (T-30)	07:08	07:28 (T-29)	06:17	06:39 (T-13)	05:45
	16:58	17:36	18:14	12 07:37 (T-30)	19:54	33 08:01 (T-29)	20:31	26 07:05 (T-13)	21:05
3	08:05	07:45	07:03	07:23 (T-30)	07:06	07:26 (T-29)	06:15	06:40 (T-13)	05:44
	16:59	17:38	18:15	13 07:36 (T-30)	19:55	35 08:01 (T-29)	20:32	25 07:05 (T-13)	21:06
4	08:05	07:44	07:01	07:21 (T-30)	07:04	07:24 (T-29)	06:14	06:40 (T-13)	05:44
	17:00	17:39	18:17	14 07:35 (T-30)	19:56	37 08:01 (T-29)	20:34	23 07:03 (T-13)	21:07
5	08:04	07:42	06:59	07:20 (T-30)	07:02	07:22 (T-29)	06:13	06:41 (T-13)	05:43
	17:01	17:41	18:18	15 07:35 (T-30)	19:58	38 08:00 (T-29)	20:35	21 07:02 (T-13)	21:08
6	08:04	07:41	06:57	07:18 (T-30)	07:00	07:20 (T-29)	06:11	06:43 (T-13)	05:43
	17:02	17:42	18:19	16 07:34 (T-30)	19:59	40 08:00 (T-29)	20:36	19 07:02 (T-13)	21:08
7	08:04	07:40	06:55	07:18 (T-30)	06:58	07:20 (T-29)	06:10	06:43 (T-13)	05:43
	17:03	17:44	18:21	14 07:32 (T-30)	20:00	40 08:00 (T-29)	20:37	16 06:59 (T-13)	21:09
8	08:04	07:38	07:54	08:20 (T-30)	06:57	07:19 (T-29)	06:08	06:46 (T-13)	05:42
	17:04	17:45	18:22	9 08:29 (T-30)	20:01	40 07:59 (T-29)	20:39	11 06:57 (T-13)	21:10
9	08:04	07:37	07:52	07:52	06:55	07:19 (T-29)	06:07	06:49 (T-13)	05:42
	17:05	17:46	19:23		20:03	39 07:58 (T-29)	20:40	5 06:54 (T-13)	21:10
10	08:03	07:36	07:50		06:53	07:19 (T-29)	06:06		05:42
	17:06	17:48	19:25		20:04	38 07:57 (T-29)	20:41		21:11
11	08:03	07:34	07:48		06:51	07:19 (T-29)	06:05		05:41
	17:07	17:49	19:26		20:05	37 07:56 (T-29)	20:42		21:12
12	08:03	07:33	07:46		06:49	07:21 (T-29)	06:03		05:41
	17:08	17:51	19:27		20:06	35 07:56 (T-29)	20:43		21:12
13	08:02	07:32	07:45		06:48	07:21 (T-29)	06:02		05:41
	17:10	17:52	19:29		20:08	33 07:54 (T-29)	20:44		21:13
14	08:02	07:30	07:43		06:46	07:22 (T-29)	06:01		05:41
	17:11	17:53	19:30		20:09	31 07:53 (T-29)	20:46		21:13
15	08:01	07:29	07:41		06:44	07:23 (T-29)	06:00		05:41
	17:12	17:55	19:31		20:10	29 07:52 (T-29)	20:47		21:14
16	08:01	07:27	07:39		06:42	07:24 (T-29)	05:59		05:41
	17:13	17:56	19:32		20:11	25 07:49 (T-29)	20:48		21:14
17	08:00	07:26	07:37		06:41	07:26 (T-29)	05:58		05:41
	17:15	17:58	19:34		20:13	21 07:47 (T-29)	20:49		21:15
18	08:00	07:24	07:35		06:39	07:28 (T-29)	05:57		05:41
	17:16	17:59	19:35		20:14	15 07:43 (T-29)	20:50		21:15
19	07:59	07:22	07:34		06:37	06:58 (T-13)	05:56		05:41
	17:17	18:00	19:36		20:15	9 07:38 (T-29)	20:51		21:15
20	07:58	07:21	07:32		06:36	06:56 (T-13)	05:55		05:41
	17:19	18:00	19:38		20:16	8 07:04 (T-13)	20:52		21:16
21	07:58	07:19	07:30		06:34	06:55 (T-13)	05:54		05:41
	17:20	18:02	19:39		20:18	10 07:05 (T-13)	20:53		21:16
22	07:57	07:18	07:28		06:32	06:53 (T-13)	05:53		05:42
	17:21	18:03	19:40		20:19	13 07:06 (T-13)	20:54		21:16
23	07:56	07:16	07:26		06:31	06:51 (T-13)	05:52		05:42
	17:23	18:05	19:41		20:20	15 07:06 (T-13)	20:56		21:16
24	07:55	07:14	07:24		06:29	06:50 (T-13)	05:51		05:42
	17:24	18:06	19:43	8 07:44 (T-29)	06:29	07:07 (T-13)	20:57		21:17
25	07:54	07:13	07:22	07:34 (T-30)	06:28	06:48 (T-13)	05:50		05:43
	17:25	18:07	2 07:36 (T-30)	19:44	12 07:55 (T-29)	20:23	19 07:07 (T-13)	20:58	21:17
26	07:53	07:11	07:32 (T-30)	07:21	07:41 (T-29)	06:26	06:47 (T-13)	05:49	05:43
	17:27	18:09	4 07:36 (T-30)	19:45	16 07:57 (T-29)	20:24	20 07:07 (T-13)	20:59	21:17
27	07:52	07:09	07:30 (T-30)	07:19	07:39 (T-29)	06:24	06:45 (T-13)	05:49	05:43
	17:28	18:10	6 07:36 (T-30)	19:46	19 07:58 (T-29)	20:25	22 07:07 (T-13)	21:00	21:17
28	07:51	07:08	07:28 (T-30)	07:17	07:37 (T-29)	06:23	06:44 (T-13)	05:48	05:44
	17:29	18:11	8 07:36 (T-30)	19:48	22 07:59 (T-29)	20:26	23 07:07 (T-13)	21:01	21:17
29	07:50		07:15	07:35 (T-29)	06:21	06:42 (T-13)	05:47		05:44
	17:31		19:49	25 08:00 (T-29)	20:28	24 07:06 (T-13)	21:01		21:17
30	07:49		07:13	07:33 (T-29)	06:20	06:41 (T-13)	05:46		05:45
	17:32		19:50	27 08:00 (T-29)	20:29	25 07:06 (T-13)	21:02		21:17
31	07:48		07:11	07:31 (T-29)			05:46		
	17:34		19:51	29 08:00 (T-29)			21:03		
Potential sun hours	287	292	369	403	459	465			
Total, worst case			261	802	172				
Sun reduction		0.58	0.59	0.63	0.66				
Oper. time red.		0.90	0.90	0.90	0.90				
Wind dir. red.		0.60	0.59	0.59	0.58				
Total reduction		0.31	0.31	0.33	0.35				
Total, real		6	82	266	59				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December				
1	05:45	06:13	06:49	07:19 (T-29)	07:24	07:04	07:43			
	21:17	20:55	20:07	37 07:56 (T-29)	19:11	17:17	16:48			
2	05:46	06:14	06:50	07:18 (T-29)	07:25	07:05	07:45			
	21:17	20:54	20:05	38 07:56 (T-29)	19:09	17:16	16:48			
3	05:46	06:15	06:51	07:17 (T-29)	07:27	07:07	07:46			
	21:16	20:53	20:03	39 07:56 (T-29)	19:07	17:14	16:48			
4	05:47	06:16	06:52 (T-13)	06:52	07:16 (T-29)	07:28	07:47			
	21:16	20:51	8 07:05 (T-13)	20:02	40 07:56 (T-29)	19:05	17:13	16:47		
5	05:47	06:17	06:54 (T-13)	06:53	07:16 (T-29)	07:29	07:48			
	21:16	20:50	14 07:08 (T-13)	20:00	40 07:56 (T-29)	19:04	4 07:59 (T-30)	07:10	17:11	16:47
6	05:48	06:18	06:52 (T-13)	06:55	07:16 (T-29)	07:30	07:56 (T-30)	07:11	07:49	
	21:16	20:49	17 07:09 (T-13)	19:58	40 07:56 (T-29)	19:02	11 08:07 (T-30)	17:10	16:47	
7	05:49	06:19	06:52 (T-13)	06:56	07:17 (T-29)	07:32	07:53 (T-30)	07:12	07:50	
	21:15	20:47	20 07:12 (T-13)	19:56	39 07:56 (T-29)	19:00	16 08:09 (T-30)	17:09	16:47	
8	05:50	06:21	06:51 (T-13)	06:57	07:18 (T-29)	07:33	07:54 (T-30)	07:14	07:51	
	21:15	20:46	21 07:12 (T-13)	19:54	37 07:55 (T-29)	18:56	16 08:10 (T-30)	17:08	16:47	
9	05:50	06:22	06:50 (T-13)	06:58	07:20 (T-29)	07:34	07:55 (T-30)	07:15	07:52	
	21:14	20:44	23 07:13 (T-13)	19:52	35 07:55 (T-29)	18:54	15 08:10 (T-30)	17:06	16:47	
10	05:51	06:23	06:49 (T-13)	06:59	07:21 (T-29)	07:35	07:57 (T-30)	07:16	07:53	
	21:14	20:43	25 07:14 (T-13)	19:50	34 07:55 (T-29)	18:53	14 08:11 (T-30)	17:05	16:47	
11	05:52	06:24	06:48 (T-13)	07:00	07:22 (T-29)	07:37	07:58 (T-30)	07:18	07:54	
	21:13	20:42	26 07:14 (T-13)	19:49	32 07:54 (T-29)	18:51	13 08:11 (T-30)	17:04	16:47	
12	05:53	06:25	06:48 (T-13)	07:02	07:23 (T-29)	07:38	07:59 (T-30)	07:19	07:55	
	21:13	20:40	26 07:14 (T-13)	19:47	30 07:53 (T-29)	18:49	11 08:10 (T-30)	17:03	16:47	
13	05:53	06:26	06:49 (T-13)	07:03	07:24 (T-29)	07:39	08:01 (T-30)	07:20	07:55	
	21:12	20:39	25 07:14 (T-13)	19:45	27 07:51 (T-29)	18:47	10 08:11 (T-30)	17:02	16:47	
14	05:54	06:28	06:50 (T-13)	07:04	07:25 (T-29)	07:40	08:02 (T-30)	07:22	07:56	
	21:12	20:37	24 07:14 (T-13)	19:43	25 07:50 (T-29)	18:46	8 08:10 (T-30)	17:01	16:47	
15	05:55	06:29	06:51 (T-13)	07:05	07:26 (T-29)	07:42	08:03 (T-30)	07:23	07:57	
	21:11	20:36	23 07:14 (T-13)	19:41	22 07:48 (T-29)	18:44	6 08:09 (T-30)	17:00	16:47	
16	05:56	06:30	06:53 (T-13)	07:06	07:28 (T-29)	07:43	08:05 (T-30)	07:24	07:58	
	21:10	20:34	21 07:14 (T-13)	19:39	20 07:48 (T-29)	18:42	3 08:08 (T-30)	16:59	16:47	
17	05:57	06:31	06:54 (T-13)	07:07	07:29 (T-29)	07:44		07:26	07:58	
	21:10	20:32	20 07:14 (T-13)	19:37	17 07:46 (T-29)	18:40		16:58	16:48	
18	05:58	06:32	06:55 (T-13)	07:09	07:30 (T-29)	07:46		07:27	07:59	
	21:09	20:31	18 07:13 (T-13)	19:35	13 07:43 (T-29)	18:39		16:57	16:48	
19	05:59	06:33	06:56 (T-13)	07:10	07:31 (T-29)	07:47		07:28	08:00	
	21:08	20:29	17 07:13 (T-13)	19:34	9 07:40 (T-29)	18:37		16:56	16:48	
20	06:00	06:35	06:57 (T-13)	07:11	07:32 (T-29)	07:48		07:30	08:00	
	21:07	20:28	15 07:12 (T-13)	19:32	3 07:35 (T-29)	18:35		16:55	16:49	
21	06:01	06:36	06:58 (T-13)	07:12		07:49		07:31	08:01	
	21:07	20:26	12 07:10 (T-13)	19:30		18:34		16:54	16:49	
22	06:02	06:37	06:59 (T-13)	07:13		07:51		07:32	08:01	
	21:06	20:24	10 07:09 (T-13)	19:28		18:32		16:54	16:50	
23	06:03	06:38	07:00 (T-13)	07:15		07:52		07:34	08:02	
	21:05	20:23	7 07:07 (T-13)	19:26		18:31		16:53	16:50	
24	06:04	06:39	07:02 (T-13)	07:16		07:53		07:35	08:02	
	21:04	20:21	10 07:43 (T-29)	19:24		18:29		16:52	16:51	
25	06:05	06:40	07:32 (T-29)	07:17		07:55		07:36	08:03	
	21:03	20:19	16 07:48 (T-29)	19:22		18:27		16:52	16:51	
26	06:06	06:42	07:29 (T-29)	07:18		07:56		07:37	08:03	
	21:02	20:18	21 07:50 (T-29)	19:20		18:26		16:51	16:52	
27	06:07	06:43	07:26 (T-29)	07:19		07:57		07:39	08:03	
	21:01	20:16	25 07:51 (T-29)	19:18		18:24		16:50	16:53	
28	06:08	06:44	07:24 (T-29)	07:21		07:59		07:40	08:04	
	21:00	20:14	29 07:53 (T-29)	19:17		18:23		16:50	16:53	
29	06:09	06:45	07:22 (T-29)	07:22		08:00		07:41	08:04	
	20:59	20:12	32 07:54 (T-29)	19:15		18:21		16:49	16:54	
30	06:10	06:46	07:21 (T-29)	07:23		08:01		07:42	08:04	
	20:57	20:11	33 07:54 (T-29)	19:13		18:20		16:49	16:55	
31	06:11	06:48	07:20 (T-29)			08:03			08:04	
	20:56	20:09	35 07:55 (T-29)			18:18			16:56	
Potential sun hours	471	436	377	341	288	275				
Total, worst case			573	577		127				
Sun reduction			0.72	0.67		0.56				
Oper. time red.			0.90	0.90		0.90				
Wind dir. red.			0.58	0.59		0.60				
Total reduction			0.38	0.35		0.30				
Total, real			217	204		38				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-165 - R-165
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June				
1	08:04	07:47	07:06	07:09	19:17 (T-82)	06:18	19:15 (T-31)	05:45		
	16:57	17:35	18:13	19:53	14	19:31 (T-82)	20:30	42	19:57 (T-31)	21:04
2	08:04	07:46	07:04	07:07	19:19 (T-82)	06:17	19:16 (T-31)	05:45		
	16:58	17:36	18:14	19:54	10	19:29 (T-82)	20:31	40	19:56 (T-31)	21:05
3	08:04	07:45	07:02	07:06	19:19 (T-82)	06:15	19:16 (T-31)	05:44		
	16:59	17:38	18:15	19:55		20:32	39	19:55 (T-31)	21:06	
4	08:04	07:43	07:01	07:04	19:19 (T-82)	06:14	19:16 (T-31)	05:44		
	17:00	17:39	18:17	19:56		20:34	39	19:55 (T-31)	21:07	
5	08:04	07:42	06:59	07:02	19:19 (T-82)	06:12	19:18 (T-31)	05:43		
	17:01	17:41	18:18	19:58		20:35	36	19:54 (T-31)	21:07	
6	08:04	07:41	06:57	07:00	19:19 (T-82)	06:11	19:18 (T-31)	05:43		
	17:02	17:42	18:19	19:59		20:36	35	20:12 (T-93)	21:08	
7	08:04	07:40	06:55	06:58	19:19 (T-82)	06:10	19:19 (T-31)	05:42		
	17:03	17:43	18:21	20:00		20:37	35	20:13 (T-93)	21:09	
8	08:04	07:38	07:54	06:57	19:19 (T-82)	06:08	19:20 (T-31)	05:42		
	17:04	17:45	18:22	20:01		20:38	35	20:14 (T-93)	21:10	
9	08:04	07:37	07:52	06:55	19:19 (T-82)	06:07	19:22 (T-31)	05:42		
	17:05	17:46	19:23	20:03		20:40	34	20:16 (T-93)	21:10	
10	08:03	07:36	07:50	06:53	19:19 (T-82)	06:06	19:22 (T-31)	05:42		
	17:06	17:48	19:25	20:04	10	19:42 (T-31)	20:41	32	20:16 (T-93)	21:11
11	08:03	07:34	07:48	06:51	19:19 (T-82)	06:05	19:24 (T-31)	05:41		
	17:07	17:49	19:26	20:05	14	19:43 (T-31)	20:42	30	20:17 (T-93)	21:11
12	08:03	07:33	07:46	06:49	19:19 (T-82)	06:03	19:27 (T-31)	05:41		
	17:08	17:51	19:27	20:06	18	19:45 (T-31)	20:43	27	20:19 (T-93)	21:12
13	08:02	07:31	07:45	06:48	19:19 (T-82)	06:02	19:30 (T-31)	05:41		
	17:10	17:52	19:29	20:08	21	19:45 (T-31)	20:44	21	20:20 (T-93)	21:13
14	08:02	07:30	07:43	06:46	19:19 (T-82)	06:01	20:09 (T-93)	05:41		
	17:11	17:53	19:30	20:09	24	19:46 (T-31)	20:45	12	20:21 (T-93)	21:13
15	08:01	07:28	07:41	06:44	19:19 (T-82)	06:00	20:10 (T-93)	05:41		
	17:12	17:55	19:31	20:10	26	19:47 (T-31)	20:47	12	20:22 (T-93)	21:14
16	08:01	07:27	07:39	06:42	19:19 (T-82)	05:59	20:10 (T-93)	05:41		
	17:13	17:56	19:32	20:11	29	19:49 (T-31)	20:48	13	20:23 (T-93)	21:14
17	08:00	07:25	07:37	06:41	19:19 (T-82)	05:58	20:11 (T-93)	05:41		
	17:15	17:58	19:34	20:13	31	19:50 (T-31)	20:49	13	20:24 (T-93)	21:14
18	07:59	07:24	07:35	06:39	19:19 (T-82)	05:57	20:11 (T-93)	05:41		
	17:16	17:59	19:35	20:14	34	19:51 (T-31)	20:50	14	20:25 (T-93)	21:15
19	07:59	07:22	07:33	06:37	19:19 (T-82)	05:56	20:12 (T-93)	05:41		
	17:17	18:00	19:36	20:15	36	19:53 (T-31)	20:51	14	20:26 (T-93)	21:15
20	07:58	07:21	07:32	06:36	19:19 (T-82)	05:55	20:13 (T-93)	05:41		
	17:18	18:00	19:37	20:16	37	19:53 (T-31)	20:52	13	20:26 (T-93)	21:15
21	07:57	07:19	07:30	06:34	19:19 (T-82)	05:54	20:14 (T-93)	05:41		
	17:20	18:02	19:39	20:17	39	19:54 (T-31)	20:53	11	20:25 (T-93)	21:16
22	07:57	07:18	07:28	06:32	19:19 (T-82)	05:53	20:16 (T-93)	05:42		
	17:21	18:03	19:40	20:19	41	19:56 (T-31)	20:54	7	20:23 (T-93)	21:16
23	07:56	07:16	07:26	19:19 (T-82)	06:31	19:15 (T-31)	05:52		05:42	
	17:22	18:05	19:41	1	19:20 (T-82)	20:20	42	19:57 (T-31)	20:55	21:16
24	07:55	07:14	07:24	19:17 (T-82)	06:29	19:15 (T-31)	05:51		05:42	
	17:24	18:06	19:43	4	19:21 (T-82)	20:21	44	19:59 (T-31)	20:56	21:16
25	07:54	07:13	07:22	19:16 (T-82)	06:27	19:14 (T-31)	05:50		05:42	
	17:25	18:07	19:44	6	19:22 (T-82)	20:22	45	19:59 (T-31)	20:57	21:17
26	07:53	07:11	07:20	19:16 (T-82)	06:26	19:15 (T-31)	05:49		05:43	
	17:27	18:09	19:45	8	19:24 (T-82)	20:24	44	19:59 (T-31)	20:58	21:17
27	07:52	07:09	07:19	19:16 (T-82)	06:24	19:14 (T-31)	05:48		05:43	
	17:28	18:10	19:46	9	19:25 (T-82)	20:25	45	19:59 (T-31)	20:59	21:17
28	07:51	07:08	07:17	19:15 (T-82)	06:23	19:15 (T-31)	05:48		05:44	
	17:29	18:11	19:48	11	19:26 (T-82)	20:26	44	19:59 (T-31)	21:00	21:17
29	07:50		07:15	19:15 (T-82)	06:21	19:14 (T-31)	05:47		05:44	
	17:31		19:49	12	19:27 (T-82)	20:27	44	19:58 (T-31)	21:01	21:17
30	07:49		07:13	19:15 (T-82)	06:20	19:15 (T-31)	05:46		05:45	
	17:32		19:50	13	19:28 (T-82)	20:29	43	19:58 (T-31)	21:02	21:17
31	07:48		07:11	19:16 (T-82)			05:46			
	17:34		19:51	13	19:29 (T-82)		21:03			
Potential sun hours	287	292	369	403		459		465		
Total, worst case			77	735			554			
Sun reduction			0.59	0.63			0.66			
Oper. time red.			0.90	0.90			0.90			
Wind dir. red.			0.59	0.60			0.61			
Total reduction			0.31	0.34			0.36			
Total, real			24	248			199			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-165 - R-165
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December					
1	05:45	06:13	19:36 (T-31)	06:49	19:29 (T-31)	07:24	07:04	07:43			
	21:16	20:55	29 20:29 (T-93)	20:07	14 19:43 (T-31)	19:11	17:17	16:48			
2	05:46	06:14	19:34 (T-31)	06:50	19:31 (T-31)	07:25	07:05	07:44			
	21:16	20:54	31 20:27 (T-93)	20:05	10 19:41 (T-31)	19:09	17:15	16:48			
3	05:46	06:15	19:32 (T-31)	06:51		07:27	07:07	07:46			
	21:16	20:52	33 20:26 (T-93)	20:03		19:07	17:14	16:48			
4	05:47	06:16	19:31 (T-31)	06:52		07:28	07:08	07:47			
	21:16	20:51	34 20:25 (T-93)	20:01		19:05	17:13	16:47			
5	05:47	06:17	19:29 (T-31)	06:53		07:29	07:09	07:48			
	21:16	20:50	36 20:24 (T-93)	20:00		19:03	17:11	16:47			
6	05:48	06:18	19:28 (T-31)	06:55		07:30	07:11	07:49			
	21:15	20:48	35 20:22 (T-93)	19:58		19:02	17:10	16:47			
7	05:49	06:19	19:28 (T-31)	06:56		07:31	07:12	07:50			
	21:15	20:47	35 20:03 (T-31)	19:56		19:00	17:09	16:47			
8	05:50	06:20	19:27 (T-31)	06:57		07:33	07:14	07:51			
	21:15	20:46	37 20:04 (T-31)	19:54		18:56	17:08	16:47			
9	05:50	06:22	19:26 (T-31)	06:58		07:34	07:15	07:52			
	21:14	20:44	38 20:04 (T-31)	19:52		18:54	17:06	16:47			
10	05:51	06:23	19:25 (T-31)	06:59		07:35	07:16	07:53			
	21:14	20:43	40 20:05 (T-31)	19:50	9 19:22 (T-82)	18:53	17:05	16:47			
11	05:52	06:24	19:24 (T-31)	07:00		19:10 (T-82)	07:36	07:18	07:54		
	21:13	20:41	41 20:05 (T-31)	19:48	13 19:23 (T-82)	18:51	17:04	16:47			
12	05:53	06:25	19:23 (T-31)	07:02		19:08 (T-82)	07:38	07:19	07:54		
	21:13	20:40	42 20:05 (T-31)	19:47	14 19:22 (T-82)	18:49	17:03	16:47			
13	05:53	06:26	19:23 (T-31)	07:03		19:07 (T-82)	07:39	07:20	07:55		
	21:12	20:38	42 20:05 (T-31)	19:45	13 19:20 (T-82)	18:47	17:02	16:47			
14	05:54	06:27	19:22 (T-31)	07:04		19:05 (T-82)	07:40	07:22	07:56		
	21:12	20:37	43 20:05 (T-31)	19:43	13 19:18 (T-82)	18:46	17:01	16:47			
15	05:55	06:29	19:21 (T-31)	07:05		19:05 (T-82)	07:42	07:23	07:57		
	21:11	20:35	44 20:05 (T-31)	19:41	11 19:16 (T-82)	18:44	17:00	16:47			
16	05:56	06:30	19:22 (T-31)	07:06		19:04 (T-82)	07:43	07:24	07:58		
	21:10	20:34	44 20:06 (T-31)	19:39	10 19:14 (T-82)	18:42	16:59	16:47			
17	05:57	06:31	19:21 (T-31)	07:07		19:05 (T-82)	07:44	07:26	07:58		
	21:10	20:32	45 20:06 (T-31)	19:37	8 19:13 (T-82)	18:40	16:58	16:48			
18	05:58	06:32	19:21 (T-31)	07:09		19:04 (T-82)	07:45	07:27	07:59		
	21:09	20:31	45 20:06 (T-31)	19:35	7 19:11 (T-82)	18:39	16:57	16:48			
19	05:59	06:33	19:21 (T-31)	07:10		19:05 (T-82)	07:47	07:28	08:00		
	21:08	20:29	43 20:04 (T-31)	19:33	4 19:09 (T-82)	18:37	16:56	16:48			
20	06:00	06:35	19:20 (T-31)	07:11		19:05 (T-82)	07:48	07:30	08:00		
	21:07	20:27	42 20:02 (T-31)	19:32	2 19:07 (T-82)	18:35	16:55	16:49			
21	06:01	20:28 (T-93)	06:36	19:20 (T-31)	07:12		07:49	07:31	08:01		
	21:06	4 20:32 (T-93)	20:26	41 20:01 (T-31)	19:30		18:34	16:54	16:49		
22	06:02	20:25 (T-93)	06:37	19:20 (T-31)	07:13		07:51	07:32	08:01		
	21:05	10 20:35 (T-93)	20:24	39 19:59 (T-31)	19:28		18:32	16:54	16:50		
23	06:03	20:24 (T-93)	06:38	19:20 (T-31)	07:15		07:52	07:34	08:02		
	21:05	12 20:36 (T-93)	20:22	37 19:57 (T-31)	19:26		18:30	16:53	16:50		
24	06:04	20:23 (T-93)	06:39	19:21 (T-31)	07:16		07:53	07:35	08:02		
	21:04	14 20:37 (T-93)	20:21	35 19:56 (T-31)	19:24		18:29	16:52	16:51		
25	06:05	20:22 (T-93)	06:40	19:21 (T-31)	07:17		07:55	07:36	08:03		
	21:03	14 20:36 (T-93)	20:19	34 19:55 (T-31)	19:22		18:27	16:52	16:51		
26	06:06	20:22 (T-93)	06:42	19:22 (T-31)	07:18		07:56	07:37	08:03		
	21:02	13 20:35 (T-93)	20:17	31 19:53 (T-31)	19:20		18:26	16:51	16:52		
27	06:07	20:21 (T-93)	06:43	19:22 (T-31)	07:19		07:57	07:39	08:03		
	21:01	13 20:34 (T-93)	20:16	29 19:51 (T-31)	19:18		18:24	16:50	16:53		
28	06:08	20:20 (T-93)	06:44	19:23 (T-31)	07:20		07:59	07:40	08:04		
	20:59	13 20:33 (T-93)	20:14	26 19:49 (T-31)	19:16		18:23	16:50	16:53		
29	06:09	20:20 (T-93)	06:45	19:23 (T-31)	07:22		08:00	07:41	08:04		
	20:58	12 20:32 (T-93)	20:12	24 19:47 (T-31)	19:15		18:21	16:49	16:54		
30	06:10	19:45 (T-31)	06:46	19:24 (T-31)	07:23		08:01	07:42	08:04		
	20:57	13 20:31 (T-93)	20:10	21 19:45 (T-31)	19:13		18:20	16:49	16:55		
31	06:11	19:39 (T-31)	06:47	19:26 (T-31)			08:03		08:04		
	20:56	24 20:30 (T-93)	20:09	17 19:43 (T-31)			18:18		16:56		
Potential sun hours	471		436		377		341		289		275
Total, worst case	142		1113		128						
Sun reduction	0.75		0.72		0.67						
Oper. time red.	0.90		0.90		0.90						
Wind dir. red.	0.63		0.60		0.59						
Total reduction	0.42		0.39		0.36						
Total, real	60		431		46						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-166 - R-166

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:09	06:18	19:34 (T-37) 05:45 20:26 (T-38)
	16:57	17:35	18:13	19:53	20:30	19 19:53 (T-37) 21:04 20:38 (T-38)
2	08:04	07:46	07:04	07:08	06:17	19:36 (T-37) 05:45 20:24 (T-38)
	16:58	17:36	18:14	19:54	20:31	15 19:51 (T-37) 21:05 20:38 (T-38)
3	08:04	07:45	07:02	07:06	06:15	19:39 (T-37) 05:44 20:24 (T-38)
	16:59	17:38	18:15	19:55	20:32	9 19:48 (T-37) 21:06 20:40 (T-38)
4	08:04	07:43	07:01	07:04	06:14	05:44 20:23 (T-38)
	17:00	17:39	18:17	19:56	20:34	21:07 17 20:40 (T-38)
5	08:04	07:42	06:59	07:02	06:13	05:43 20:23 (T-38)
	17:01	17:41	18:18	19:58	20:35	21:07 18 20:41 (T-38)
6	08:04	07:41	06:57	07:00	06:11	05:43 20:23 (T-38)
	17:02	17:42	18:19	19:59	20:36	21:08 19 20:42 (T-38)
7	08:04	07:40	06:55	06:58	06:10	05:43 20:21 (T-38)
	17:03	17:44	18:21	20:00	20:37	21:09 21 20:42 (T-38)
8	08:04	07:38	07:54	06:57	06:09	05:42 20:21 (T-38)
	17:04	17:45	18:22	20:01	20:38	21:10 22 20:43 (T-38)
9	08:04	07:37	07:52	06:55	06:07	05:42 20:21 (T-38)
	17:05	17:46	19:23	20:03	20:40	21:10 23 20:44 (T-38)
10	08:03	07:36	07:50	06:53	06:06	05:42 20:21 (T-38)
	17:06	17:48	19:25	20:04	20:41	21:11 23 20:44 (T-38)
11	08:03	07:34	07:48	06:51	19:40 (T-37) 06:05	05:42 20:21 (T-38)
	17:07	17:49	19:26	20:05	3 19:43 (T-37) 20:42	21:12 24 20:45 (T-38)
12	08:03	07:33	07:46	06:49	19:38 (T-37) 06:03	05:41 20:21 (T-38)
	17:09	17:51	19:27	20:06	7 19:45 (T-37) 20:43	21:12 24 20:45 (T-38)
13	08:02	07:31	07:45	06:48	19:36 (T-37) 06:02	05:41 20:21 (T-38)
	17:10	17:52	19:29	20:08	9 19:45 (T-37) 20:44	21:13 24 20:45 (T-38)
14	08:02	07:30	07:43	06:46	19:34 (T-37) 06:01	05:41 20:21 (T-38)
	17:11	17:53	19:30	20:09	12 19:46 (T-37) 20:46	21:13 25 20:46 (T-38)
15	08:01	07:29	07:41	06:44	19:33 (T-37) 06:00	05:41 20:21 (T-38)
	17:12	17:55	19:31	20:10	15 19:48 (T-37) 20:47	21:14 25 20:46 (T-38)
16	08:01	07:27	07:39	06:43	19:32 (T-37) 05:59	05:41 20:21 (T-38)
	17:13	17:56	19:32	20:11	17 19:49 (T-37) 20:48	21:14 26 20:47 (T-38)
17	08:00	07:26	07:37	06:41	19:31 (T-37) 05:58	05:41 20:21 (T-38)
	17:15	17:58	19:34	20:13	19 19:50 (T-37) 20:49	21:15 26 20:47 (T-38)
18	07:59	07:24	07:35	06:39	19:30 (T-37) 05:57	05:41 20:21 (T-38)
	17:16	17:59	19:35	20:14	21 19:51 (T-37) 20:50	21:15 26 20:47 (T-38)
19	07:59	07:22	07:34	06:37	19:30 (T-37) 05:56	05:41 20:22 (T-38)
	17:17	18:00	19:36	20:15	23 19:53 (T-37) 20:51	21:15 26 20:48 (T-38)
20	07:58	07:21	07:32	06:36	19:29 (T-37) 05:55	05:41 20:22 (T-38)
	17:19	18:00	19:38	20:16	24 19:53 (T-37) 20:52	21:16 27 20:49 (T-38)
21	07:57	07:19	07:30	06:34	19:29 (T-37) 05:54	05:42 20:22 (T-38)
	17:20	18:02	19:39	20:18	26 19:55 (T-37) 20:53	21:16 27 20:49 (T-38)
22	07:57	07:18	07:28	06:32	19:29 (T-37) 05:53	05:42 20:22 (T-38)
	17:21	18:03	19:40	20:19	27 19:56 (T-37) 20:54	21:16 27 20:49 (T-38)
23	07:56	07:16	07:26	06:31	19:29 (T-37) 05:52	05:42 20:22 (T-38)
	17:23	18:05	19:41	20:20	28 19:57 (T-37) 20:55	21:16 26 20:48 (T-38)
24	07:55	07:14	07:24	06:29	19:29 (T-37) 05:51	05:42 20:23 (T-38)
	17:24	18:06	19:43	20:21	30 19:59 (T-37) 20:56	21:16 26 20:49 (T-38)
25	07:54	07:13	07:22	06:28	19:29 (T-37) 05:50	05:43 20:23 (T-38)
	17:25	18:07	19:44	20:23	30 19:59 (T-37) 20:57	21:17 26 20:49 (T-38)
26	07:53	07:11	07:21	06:26	19:30 (T-37) 05:49	05:43 20:23 (T-38)
	17:27	18:09	19:45	20:24	29 19:59 (T-37) 20:58	21:17 26 20:49 (T-38)
27	07:52	07:09	07:19	06:24	19:30 (T-37) 05:49	05:43 20:24 (T-38)
	17:28	18:10	19:46	20:25	28 19:58 (T-37) 20:59	21:17 25 20:49 (T-38)
28	07:51	07:08	07:17	06:23	19:31 (T-37) 05:48	20:32 (T-38) 05:44 20:24 (T-38)
	17:29	18:11	19:48	20:26	27 19:58 (T-37) 21:00	3 20:35 (T-38) 21:17 25 20:49 (T-38)
29	07:50		07:15	06:21	19:31 (T-37) 05:47	20:29 (T-38) 05:44 20:25 (T-38)
	17:31		19:49	20:27	25 19:56 (T-37) 21:01	6 20:35 (T-38) 21:17 25 20:50 (T-38)
30	07:49		07:13	06:20	19:33 (T-37) 05:47	20:28 (T-38) 05:45 20:25 (T-38)
	17:32		19:50	20:29	22 19:55 (T-37) 21:02	9 20:37 (T-38) 21:17 24 20:49 (T-38)
31	07:48		07:11		05:46	20:26 (T-38)
	17:34		19:51		21:03	11 20:37 (T-38)
Potential sun hours	287	292	369	403	458	465
Total, worst case				422	72	695
Sun reduction				0.63	0.66	0.73
Oper. time red.				0.90	0.90	0.90
Wind dir. red.				0.60	0.62	0.65
Total reduction				0.34	0.37	0.42
Total, real				142	26	295

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-166 - R-166

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December		
1	05:45	20:25 (T-38)	06:13	06:49	19:40 (T-37)	07:24	07:04	07:43
	21:17	24 20:49 (T-38)	20:55	20:07	2 19:42 (T-37)	19:11	17:17	16:49
2	05:46	20:25 (T-38)	06:14	06:50		07:25	07:05	07:44
	21:16	24 20:49 (T-38)	20:54	20:05		19:09	17:16	16:48
3	05:46	20:26 (T-38)	06:15	06:51		07:27	07:07	07:46
	21:16	23 20:49 (T-38)	20:52	20:03		19:07	17:14	16:48
4	05:47	20:26 (T-38)	06:16	06:52		07:28	07:08	07:47
	21:16	22 20:48 (T-38)	20:51	20:01		19:05	17:13	16:48
5	05:48	20:27 (T-38)	06:17	06:53		07:29	07:09	07:48
	21:16	21 20:48 (T-38)	20:50	20:00		19:04	17:12	16:47
6	05:48	20:29 (T-38)	06:18	06:55		07:30	07:11	07:49
	21:15	19 20:48 (T-38)	20:49	19:58		19:02	17:10	16:47
7	05:49	20:29 (T-38)	06:19	06:56		07:32	07:12	07:50
	21:15	18 20:47 (T-38)	20:47	19:56		19:00	17:09	16:47
8	05:50	20:30 (T-38)	06:21	06:57		07:33	07:14	07:51
	21:15	17 20:47 (T-38)	20:46	19:54		18:56	17:08	16:47
9	05:50	20:31 (T-38)	06:22	06:58		07:34	07:15	07:52
	21:14	16 20:47 (T-38)	20:44	19:52		18:54	17:07	16:47
10	05:51	20:31 (T-38)	06:23	19:47 (T-37)	06:59	07:35	07:16	07:53
	21:14	15 20:46 (T-38)	20:43	11 19:58 (T-37)	19:50	18:53	17:05	16:47
11	05:52	20:32 (T-38)	06:24	19:44 (T-37)	07:00	07:37	07:18	07:54
	21:13	14 20:46 (T-38)	20:41	16 20:00 (T-37)	19:49	18:51	17:04	16:47
12	05:53	20:34 (T-38)	06:25	19:42 (T-37)	07:02	07:38	07:19	07:54
	21:13	12 20:46 (T-38)	20:40	20 20:02 (T-37)	19:47	18:49	17:03	16:47
13	05:54	20:35 (T-38)	06:26	19:40 (T-37)	07:03	07:39	07:20	07:55
	21:12	10 20:45 (T-38)	20:39	23 20:03 (T-37)	19:45	18:47	17:02	16:47
14	05:54	20:37 (T-38)	06:28	19:39 (T-37)	07:04	07:40	07:22	07:56
	21:12	8 20:45 (T-38)	20:37	25 20:04 (T-37)	19:43	18:46	17:01	16:47
15	05:55	20:39 (T-38)	06:29	19:39 (T-37)	07:05	07:42	07:23	07:57
	21:11	4 20:43 (T-38)	20:35	27 20:06 (T-37)	19:41	18:44	17:00	16:47
16	05:56	20:42 (T-38)	06:30	19:37 (T-37)	07:06	07:43	07:24	07:58
	21:10	1 20:43 (T-38)	20:34	29 20:06 (T-37)	19:39	18:42	16:59	16:47
17	05:57		06:31	19:36 (T-37)	07:07	07:44	07:26	07:58
	21:10		20:32	30 20:06 (T-37)	19:37	18:40	16:58	16:48
18	05:58		06:32	19:36 (T-37)	07:09	07:45	07:27	07:59
	21:09		20:31	30 20:06 (T-37)	19:35	18:39	16:57	16:48
19	05:59		06:33	19:35 (T-37)	07:10	07:47	07:28	08:00
	21:08		20:29	29 20:04 (T-37)	19:34	18:37	16:56	16:48
20	06:00		06:35	19:34 (T-37)	07:11	07:48	07:30	08:00
	21:07		20:28	28 20:02 (T-37)	19:32	18:35	16:55	16:49
21	06:01		06:36	19:34 (T-37)	07:12	07:49	07:31	08:01
	21:06		20:26	27 20:01 (T-37)	19:30	18:34	16:54	16:49
22	06:02		06:37	19:33 (T-37)	07:13	07:51	07:32	08:01
	21:06		20:24	26 19:59 (T-37)	19:28	18:32	16:54	16:50
23	06:03		06:38	19:33 (T-37)	07:15	07:52	07:34	08:02
	21:05		20:23	24 19:57 (T-37)	19:26	18:31	16:53	16:50
24	06:04		06:39	19:34 (T-37)	07:16	07:53	07:35	08:02
	21:04		20:21	22 19:56 (T-37)	19:24	18:29	16:52	16:51
25	06:05		06:40	19:34 (T-37)	07:17	07:55	07:36	08:03
	21:03		20:19	20 19:54 (T-37)	19:22	18:27	16:52	16:51
26	06:06		06:42	19:34 (T-37)	07:18	07:56	07:37	08:03
	21:02		20:17	19 19:53 (T-37)	19:20	18:26	16:51	16:52
27	06:07		06:43	19:34 (T-37)	07:19	07:57	07:39	08:03
	21:01		20:16	17 19:51 (T-37)	19:18	18:24	16:50	16:53
28	06:08		06:44	19:34 (T-37)	07:21	07:59	07:40	08:04
	21:00		20:14	15 19:49 (T-37)	19:17	18:23	16:50	16:54
29	06:09		06:45	19:35 (T-37)	07:22	08:00	07:41	08:04
	20:58		20:12	12 19:47 (T-37)	19:15	18:21	16:49	16:54
30	06:10		06:46	19:36 (T-37)	07:23	08:01	07:42	08:04
	20:57		20:10	9 19:45 (T-37)	19:13	18:20	16:49	16:55
31	06:12		06:48	19:37 (T-37)		08:03		08:04
	20:56		20:09	6 19:43 (T-37)		18:18		16:56
Potential sun hours	471	436	377	341	289	275		
Total, worst case		465	2					
Sun reduction	0.75	0.72	0.67					
Oper. time red.	0.90	0.90	0.90					
Wind dir. red.	0.65	0.60	0.60					
Total reduction	0.44	0.39	0.36					
Total, real	108	179	1					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-167 - R-167

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:37	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:01	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:07	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:45	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:08	20:44	21:13	21:12	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:54	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:58
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:58
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:19	18:00	19:38	20:16	20:52	21:16	21:07	20:28	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:18	20:53	21:16	21:06	20:26	19:30	18:34	16:55	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:55	21:16	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:41	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:57	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:39	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:00	21:17	21:00	20:14	19:17	18:23	16:50	16:54
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:17	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:47	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:12	06:48		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-169 - R-169 Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

Table with 13 columns: N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum. Values range from 561 to 7,884.

Main calendar table with columns for months (January-December) and rows for each day of the month. Includes sunrise/sunset times and shadow reduction percentages.

Table layout: For each day in each month the following matrix apply

Matrix with 4 columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time).

Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-171 - R-171 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

Table with 13 columns: N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum. Values range from 438 to 7,884.

Main shadow calculation table with columns for months (January-December) and rows for each day (1-31). Includes a summary section at the bottom for 'Potential sun hours', 'Total, worst case', 'Sun reduction', 'Oper. time red.', 'Wind dir. red.', 'Total reduction', and 'Total, real'.

Table layout: For each day in each month the following matrix apply

Matrix with 4 columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-172 - R-172
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:10	06:18	05:45	05:45	06:13	06:49	19:33 (T-39)	07:24	07:04	07:43	
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	9	19:42 (T-39)	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	19:33 (T-39)	07:26	07:06	07:45	
	16:58	17:37	18:14	19:54	20:31	21:05	21:16	20:54	20:05	8	19:41 (T-39)	19:09	17:16	16:48
3	08:04	07:45	07:03	07:06	06:16	05:44	05:47	06:15	06:51	19:33 (T-39)	07:27	07:07	07:46	
	16:59	17:38	18:16	19:55	20:32	21:06	21:16	20:53	20:03	6	19:39 (T-39)	19:07	17:14	16:48
4	08:04	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	19:33 (T-39)	07:28	07:08	07:47	
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	4	19:37 (T-39)	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:44	05:48	06:17	06:54	19:34 (T-39)	07:29	07:10	07:48	
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	1	19:35 (T-39)	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55		07:30	07:11	07:49	
	17:02	17:42	18:20	19:59	20:36	21:08	21:15	20:49	19:58		19:02	17:10	16:47	
7	08:04	07:40	06:56	06:59	19:38 (T-39)	06:10	05:43	05:49	06:56		07:32	07:12	07:50	
	17:03	17:44	18:21	20:00	1	19:39 (T-39)	20:37	21:09	21:15		19:00	17:09	16:47	
8	08:04	07:38	07:54	06:57	19:36 (T-39)	06:09	05:42	05:50	06:21		06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	4	19:40 (T-39)	20:39	21:10	21:15		19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	19:35 (T-39)	06:07	05:42	05:51	06:22		06:58	07:34	07:15	07:52
	17:05	17:47	19:24	20:03	6	19:41 (T-39)	20:40	21:10	21:14		19:52	18:55	17:07	16:47
10	08:03	07:36	07:50	06:53	19:34 (T-39)	06:06	05:42	05:51	06:23		06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	8	19:42 (T-39)	20:41	21:11	21:14		19:51	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	19:34 (T-39)	06:05	05:42	05:52	06:24		07:01	07:37	07:18	07:54
	17:08	17:49	19:26	20:05	10	19:44 (T-39)	20:42	21:12	21:13		19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	19:34 (T-39)	06:04	05:42	05:53	06:25		07:02	07:38	07:19	07:55
	17:09	17:51	19:27	20:06	10	19:44 (T-39)	20:43	21:12	21:13		19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	19:34 (T-39)	06:02	05:41	05:54	06:27		07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:08	11	19:45 (T-39)	20:44	21:13	21:12		19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	19:34 (T-39)	06:01	05:41	05:55	06:28		07:04	07:40	07:22	07:56
	17:11	17:54	19:30	20:09	12	19:46 (T-39)	20:46	21:13	21:12		19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	19:35 (T-39)	06:00	05:41	05:55	06:29		07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	13	19:48 (T-39)	20:47	21:14	21:11		19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	19:35 (T-39)	05:59	05:41	05:56	06:30		07:06	07:43	07:24	07:58
	17:14	17:56	19:33	20:11	14	19:49 (T-39)	20:48	21:14	21:10		19:39	18:42	16:59	16:48
17	08:00	07:26	07:37	06:41	19:36 (T-39)	05:58	05:41	05:57	06:31		07:08	07:44	07:26	07:58
	17:15	17:58	19:34	20:13	13	19:49 (T-39)	20:49	21:15	21:10		19:37	18:41	16:58	16:48
18	08:00	07:24	07:36	06:39	19:39 (T-39)	05:57	05:41	05:58	06:32		07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	8	19:47 (T-39)	20:50	21:15	21:09		19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:38	05:56	05:41	05:59	06:34	07:10		07:10	07:47	07:28	08:00
	17:17	18:01	19:36	20:15	20:51	21:15	21:08	20:29	19:34		07:11	18:37	16:56	16:49
20	07:58	07:21	07:32	06:36	05:55	05:42	06:00	06:35	07:11		07:11	07:48	07:30	08:00
	17:19	18:01	19:38	20:16	20:52	21:16	21:07	20:28	19:32		07:12	18:36	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12		07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:18	20:53	21:16	21:06	20:26	19:30		07:14	18:34	16:55	16:49
22	07:57	07:18	07:28	06:33	05:53	05:42	06:02	06:37	07:14		07:14	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:06	20:24	19:28		07:15	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15		07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:16	21:05	20:23	19:26		07:16	18:31	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16		07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:57	21:16	21:04	20:21	19:24		07:17	18:29	16:52	16:51
25	07:54	07:13	07:23	06:28	05:50	05:43	06:05	06:41	07:17		07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	8	19:50 (T-39)	19:22	18:28	16:52	16:52
26	07:53	07:11	07:21	06:26	05:50	05:43	06:06	06:42	07:18		07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	13	19:52 (T-39)	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:25	05:49	05:44	06:07	06:43	07:19		07:19	07:57	07:39	08:03
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	14	19:51 (T-39)	19:19	18:24	16:51	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21		07:21	07:59	07:40	08:04
	17:30	18:12	19:48	20:26	21:00	21:17	21:00	20:14	13	19:49 (T-39)	19:17	18:23	16:50	16:54
29	07:50	07:15	07:21	06:21	05:47	05:44	06:09	06:45	07:22		07:22	08:00	07:41	08:04
	17:31	18:14	19:49	20:28	21:01	21:17	20:58	20:12	13	19:47 (T-39)	19:15	18:21	16:50	16:54
30	07:49	07:13	07:20	06:20	05:47	05:45	06:11	06:47	07:23		07:23	08:01	07:42	08:04
	17:32	18:15	19:50	20:29	21:02	21:17	20:57	20:11	11	19:45 (T-39)	19:13	18:20	16:49	16:55
31	07:48	07:11	07:18	06:19	05:46	05:44	06:12	06:48	07:24		07:24	08:03	07:43	08:04
	17:34	18:17	19:52	20:31	21:03	21:18	20:56	20:09	10	19:44 (T-39)	19:12	18:19	16:48	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377		341	289	275	
Total, worst case				110					82		28			
Sun reduction				0.63					0.72		0.67			
Oper. time red.				0.90					0.90		0.90			
Wind dir. red.				0.60					0.60		0.60			
Total reduction				0.34					0.39		0.36			
Total, real				37					32		10			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-173 - R-173

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June		
1	08:04	07:47	07:06	17:34 (T-39)	07:10	19:06 (T-40)	06:18	05:45
	16:57	17:35	18:13	11 17:45 (T-39)	19:53	26 19:32 (T-40)	20:30	21:04
2	08:05	07:46	07:04		07:08	19:05 (T-40)	06:17	05:45
	16:58	17:37	18:14		19:54	28 19:33 (T-40)	20:31	21:05
3	08:05	07:45	07:03		07:06	19:04 (T-40)	06:16	05:44
	16:59	17:38	18:16		19:55	30 19:34 (T-40)	20:32	21:06
4	08:04	07:44	07:01		07:04	19:03 (T-40)	06:14	05:44
	17:00	17:39	18:17		19:57	32 19:35 (T-40)	20:34	21:07
5	08:04	07:42	06:59		07:02	19:03 (T-40)	06:13	05:44
	17:01	17:41	18:18		19:58	33 19:36 (T-40)	20:35	21:07
6	08:04	07:41	06:57		07:00	19:03 (T-40)	06:11	05:43
	17:02	17:42	18:20		19:59	35 19:38 (T-40)	20:36	21:08
7	08:04	07:40	06:56		06:59	19:03 (T-40)	06:10	05:43
	17:03	17:44	18:21		20:00	36 19:39 (T-40)	20:37	21:09
8	08:04	07:39	07:54		06:57	19:03 (T-40)	06:09	05:42
	17:04	17:45	18:22		20:02	37 19:40 (T-40)	20:39	21:10
9	08:04	07:37	07:52		06:55	19:03 (T-40)	06:07	05:42
	17:05	17:47	19:24		20:03	38 19:41 (T-40)	20:40	21:10
10	08:03	07:36	07:50		06:53	19:03 (T-40)	06:06	05:42
	17:06	17:48	19:25		20:04	37 19:40 (T-40)	20:41	21:11
11	08:03	07:34	07:48		06:51	19:04 (T-40)	06:05	05:42
	17:08	17:49	19:26		20:05	36 19:40 (T-40)	20:42	21:12
12	08:03	07:33	07:47		06:50	19:04 (T-40)	06:04	05:42
	17:09	17:51	19:27		20:06	34 19:38 (T-40)	20:43	21:12
13	08:02	07:32	07:45		06:48	19:04 (T-40)	06:02	05:41
	17:10	17:52	19:29		20:08	33 19:37 (T-40)	20:44	21:13
14	08:02	07:30	07:43		06:46	19:05 (T-40)	06:01	05:41
	17:11	17:54	19:30		20:09	30 19:35 (T-40)	20:46	21:13
15	08:01	07:29	07:41		06:44	19:07 (T-40)	06:00	05:41
	17:12	17:55	19:31		20:10	27 19:34 (T-40)	20:47	21:14
16	08:01	07:27	07:39		06:43	19:08 (T-40)	05:59	05:41
	17:14	17:56	19:33		20:11	24 19:32 (T-40)	20:48	21:14
17	08:00	07:26	17:31 (T-39)	07:37	06:41	19:09 (T-40)	05:58	05:41
	17:15	17:58	3 17:34 (T-39)	19:34	20:13	20 19:29 (T-40)	20:49	21:15
18	08:00	07:24	17:30 (T-39)	07:36	06:39	19:13 (T-40)	05:57	05:41
	17:16	17:59	5 17:35 (T-39)	19:35	20:14	14 19:27 (T-40)	20:50	21:15
19	07:59	07:23	17:30 (T-39)	07:34	06:38		05:56	05:41
	17:17	18:01	7 17:37 (T-39)	19:36	20:15		20:51	21:15
20	07:58	07:21	17:29 (T-39)	07:32	06:36		05:55	05:42
	17:19	18:01	9 17:38 (T-39)	19:38	20:16		20:52	21:16
21	07:58	07:19	17:28 (T-39)	07:30	06:34		05:54	05:42
	17:20	18:02	11 17:39 (T-39)	19:39	20:18		20:53	21:16
22	07:57	07:18	17:28 (T-39)	07:28	06:33		05:53	05:42
	17:21	18:03	13 17:41 (T-39)	19:40	20:19		20:54	21:16
23	07:56	07:16	17:28 (T-39)	07:26	06:31		05:52	05:42
	17:23	18:05	15 17:43 (T-39)	19:41	20:20		20:56	21:16
24	07:55	07:15	17:28 (T-39)	07:24	06:29		05:51	05:42
	17:24	18:06	16 17:44 (T-39)	19:43	20:21		20:57	21:17
25	07:54	07:13	17:29 (T-39)	07:23	19:18 (T-40)	06:28	05:50	05:43
	17:25	18:07	17 17:46 (T-39)	19:44	5 19:23 (T-40)	20:23	20:58	21:17
26	07:53	07:11	17:29 (T-39)	07:21	19:15 (T-40)	06:26	05:50	05:43
	17:27	18:09	18 17:47 (T-39)	19:45	9 19:24 (T-40)	20:24	20:59	21:17
27	07:52	07:09	17:30 (T-39)	07:19	19:12 (T-40)	06:25	05:49	05:44
	17:28	18:10	18 17:48 (T-39)	19:47	13 19:25 (T-40)	20:25	21:00	21:17
28	07:51	07:08	17:31 (T-39)	07:17	19:10 (T-40)	06:23	05:48	05:44
	17:30	18:12	15 17:46 (T-39)	19:48	16 19:26 (T-40)	20:26	21:01	21:17
29	07:50		07:15	19:09 (T-40)	06:21		05:47	05:44
	17:31		19:49	18 19:27 (T-40)	20:28		21:01	21:17
30	07:49		07:13	19:07 (T-40)	06:20		05:47	05:45
	17:32		19:50	21 19:28 (T-40)	20:29		21:02	21:17
31	07:48		07:11	19:07 (T-40)			05:46	
	17:34		19:52	23 19:30 (T-40)			21:03	
Potential sun hours	287	292	369	403	458	465		
Total, worst case				550				
Sun reduction		0.58	0.59	0.63				
Oper. time red.		0.90	0.90	0.90				
Wind dir. red.		0.59	0.59	0.60				
Total reduction		0.31	0.32	0.34				
Total, real		45	37	186				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-173 - R-173
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December		
1	05:45	06:13	06:49	19:03 (T-40)	07:24	07:04	07:43	
	21:17	20:55	20:07	36 19:39 (T-40)	19:11	17:17	16:49	
2	05:46	06:14	06:50	19:02 (T-40)	07:26	07:06	07:45	
	21:16	20:54	20:05	37 19:39 (T-40)	19:09	17:16	16:48	
3	05:46	06:15	06:51	19:01 (T-40)	07:27	07:07	07:46	
	21:16	20:53	20:03	38 19:39 (T-40)	19:07	17:14	16:48	
4	05:47	06:16	06:52	19:00 (T-40)	07:28	07:08	07:47	
	21:16	20:51	20:02	37 19:37 (T-40)	19:06	17:13	16:48	
5	05:48	06:17	06:54	18:59 (T-40)	07:29	07:10	07:48	
	21:16	20:50	20:00	36 19:35 (T-40)	19:04	17:12	16:47	
6	05:48	06:18	06:55	18:58 (T-40)	07:30	07:11	07:49	
	21:16	20:49	19:58	35 19:33 (T-40)	19:02	17:10	16:47	
7	05:49	06:20	06:56	18:58 (T-40)	07:32	07:12	07:50	
	21:15	20:47	19:56	33 19:31 (T-40)	19:00	17:09	16:47	
8	05:50	06:21	06:57	18:58 (T-40)	07:33	07:14	07:51	
	21:15	20:46	19:54	32 19:30 (T-40)	18:56	17:08	16:47	
9	05:51	06:22	06:58	18:58 (T-40)	07:34	07:15	07:52	
	21:14	20:44	19:52	30 19:28 (T-40)	18:55	17:07	16:47	
10	05:51	06:23	06:59	18:58 (T-40)	07:35	07:16	07:53	
	21:14	20:43	19:51	28 19:26 (T-40)	18:53	17:05	16:47	
11	05:52	06:24	07:01	18:58 (T-40)	07:37	07:18	07:54	
	21:13	20:42	19:49	26 19:24 (T-40)	18:51	17:04	16:47	
12	05:53	06:25	07:02	18:58 (T-40)	07:38	8 18:08 (T-39)	07:19	07:55
	21:13	20:40	19:47	24 19:22 (T-40)	18:49	8 18:16 (T-39)	17:03	16:47
13	05:54	06:27	07:03	18:58 (T-40)	07:39	13 18:06 (T-39)	07:20	07:55
	21:12	20:39	19:45	22 19:20 (T-40)	18:47	13 18:19 (T-39)	17:02	16:47
14	05:55	06:28	07:04	18:59 (T-40)	07:40	16 18:04 (T-39)	07:22	07:56
	21:12	20:37	19:43	19 19:18 (T-40)	18:46	16 18:20 (T-39)	17:01	16:47
15	05:55	06:29	07:05	19:00 (T-40)	07:42	18 18:02 (T-39)	07:23	07:57
	21:11	20:36	19:41	17 19:17 (T-40)	18:44	18 18:20 (T-39)	17:00	16:47
16	05:56	06:30	07:06	19:01 (T-40)	07:43	18 18:01 (T-39)	07:25	07:58
	21:10	20:34	19:39	14 19:15 (T-40)	18:42	18 18:19 (T-39)	16:59	16:48
17	05:57	06:31	07:08	19:03 (T-40)	07:44	17 18:00 (T-39)	07:26	07:58
	21:10	20:32	19:37	10 19:13 (T-40)	18:41	17 18:17 (T-39)	16:58	16:48
18	05:58	06:32	07:09	19:05 (T-40)	07:46	16 17:59 (T-39)	07:27	07:59
	21:09	20:31	19:36	6 19:11 (T-40)	18:39	16 18:15 (T-39)	16:57	16:48
19	05:59	06:34	07:10	19:08 (T-40)	07:47	15 17:59 (T-39)	07:28	08:00
	21:08	20:29	19:34	1 19:09 (T-40)	18:37	15 18:14 (T-39)	16:56	16:49
20	06:00	06:35	07:11	07:48	17:59 (T-39)	07:30	08:00	08:00
	21:07	20:28	19:32	12 18:36	12 18:11 (T-39)	16:55	16:49	16:49
21	06:01	06:36	07:12	07:49	17:58 (T-39)	07:31	08:01	08:01
	21:07	20:26	19:30	11 18:34	11 18:09 (T-39)	16:55	16:49	16:49
22	06:02	06:37	07:14	07:51	17:59 (T-39)	07:32	08:01	08:01
	21:06	20:24	19:28	9 18:32	9 18:08 (T-39)	16:54	16:50	16:50
23	06:03	06:38	07:15	07:52	17:59 (T-39)	07:34	08:02	08:02
	21:05	20:23	19:26	7 18:31	7 18:06 (T-39)	16:53	16:50	16:50
24	06:04	06:39	19:21 (T-40)	07:16	07:53	18:01 (T-39)	07:35	08:02
	21:04	20:21	5 19:26 (T-40)	19:24	18:29	4 18:05 (T-39)	16:52	16:51
25	06:05	06:41	19:15 (T-40)	07:17	07:55	18:01 (T-39)	07:36	08:03
	21:03	20:19	15 19:30 (T-40)	19:22	18:28	2 18:03 (T-39)	16:52	16:52
26	06:06	06:42	19:12 (T-40)	07:18	07:56	07:37	08:03	08:03
	21:02	20:18	21 19:33 (T-40)	19:20	18:26	16:51	16:52	16:52
27	06:07	06:43	19:10 (T-40)	07:19	07:57	07:39	08:03	08:03
	21:01	20:16	24 19:34 (T-40)	19:19	18:24	16:51	16:53	16:53
28	06:08	06:44	19:08 (T-40)	07:21	07:59	07:40	08:04	08:04
	21:00	20:14	27 19:35 (T-40)	19:17	18:23	16:50	16:54	16:54
29	06:09	06:45	19:06 (T-40)	07:22	08:00	07:41	08:04	08:04
	20:59	20:12	30 19:36 (T-40)	19:15	18:21	16:50	16:54	16:54
30	06:11	06:47	19:04 (T-40)	07:23	08:01	07:42	08:04	08:04
	20:57	20:11	33 19:37 (T-40)	19:13	18:20	16:49	16:55	16:55
31	06:12	06:48	19:04 (T-40)	07:23	08:03	07:42	08:04	08:04
	20:56	20:09	34 19:38 (T-40)	19:13	18:19	16:49	16:56	16:56
Potential sun hours	471	436	377	341	289	275		
Total, worst case			189	481	166			
Sun reduction			0.72	0.67	0.56			
Oper. time red.			0.90	0.90	0.90			
Wind dir. red.			0.60	0.60	0.59			
Total reduction			0.39	0.36	0.29			
Total, real			73	173	49			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invenergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-174 - R-174 Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum and corresponding values.

Main calendar table with columns for months (January-December) and rows for each day of the month, including start/end times and potential sun hours.

Table layout: For each day in each month the following matrix apply

Matrix table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-175 - R-175
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:09	06:18	20:00 (T-83)	05:45	05:45	06:13	20:13 (T-83)	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	6 20:06 (T-83)	21:04	21:17	20:55	13 20:26 (T-83)	20:07	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	20:00 (T-83)	05:45	05:46	06:14	20:11 (T-83)	06:50	07:25	07:05	07:44
	16:58	17:37	18:14	19:54	20:31	8 20:08 (T-83)	21:05	21:16	20:54	16 20:27 (T-83)	20:05	19:09	17:16	16:48
3	08:04	07:45	07:03	07:06	06:15	20:00 (T-83)	05:44	05:46	06:15	20:10 (T-83)	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:32	9 20:09 (T-83)	21:06	21:16	20:52	16 20:26 (T-83)	20:03	19:07	17:14	16:46
4	08:04	07:44	07:01	07:04	06:14	19:59 (T-83)	05:44	05:47	06:16	20:10 (T-83)	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	11 20:10 (T-83)	21:07	21:16	20:51	15 20:25 (T-83)	20:02	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	19:59 (T-83)	05:43	05:48	06:17	20:10 (T-83)	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	12 20:11 (T-83)	21:07	21:16	20:50	14 20:24 (T-83)	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	19:59 (T-83)	05:43	05:48	06:18	20:09 (T-83)	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	13 20:12 (T-83)	21:08	21:15	20:49	14 20:23 (T-83)	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:59	06:10	19:59 (T-83)	05:43	05:49	06:20	20:09 (T-83)	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	14 20:13 (T-83)	21:09	21:15	20:47	13 20:22 (T-83)	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:09	19:59 (T-83)	05:42	05:50	06:21	20:08 (T-83)	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:38	15 20:14 (T-83)	21:10	21:15	20:46	12 20:20 (T-83)	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	20:00 (T-83)	05:42	05:50	06:22	20:08 (T-83)	06:58	07:34	07:15	07:52
	17:05	17:47	19:23	20:03	20:40	16 20:16 (T-83)	21:10	21:14	20:44	11 20:19 (T-83)	19:52	18:55	17:07	16:47
10	08:03	07:36	07:50	06:53	06:06	20:01 (T-83)	05:42	05:51	06:23	20:08 (T-83)	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	16 20:17 (T-83)	21:11	21:14	20:43	9 20:17 (T-83)	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	20:01 (T-83)	05:42	05:52	06:24	20:08 (T-83)	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	15 20:16 (T-83)	21:12	21:13	20:42	8 20:16 (T-83)	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:50	06:04	20:03 (T-83)	05:41	05:53	06:25	20:08 (T-83)	07:02	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	12 20:15 (T-83)	21:12	21:13	20:40	6 20:14 (T-83)	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	20:04 (T-83)	05:41	05:54	06:26	20:09 (T-83)	07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:08	20:44	9 20:13 (T-83)	21:13	21:12	20:39	4 20:13 (T-83)	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	20:05 (T-83)	05:41	05:55	06:28	20:10 (T-83)	07:04	07:40	07:22	07:56
	17:11	17:54	19:30	20:09	20:46	21:13	21:12	21:12	20:37	1 20:11 (T-83)	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	20:05 (T-83)	05:41	05:55	06:29	20:07 (T-83)	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	21:11	20:36		19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	06:00	20:05 (T-83)	05:41	05:56	06:30	20:06 (T-83)	07:06	07:43	07:24	07:58
	17:14	17:56	19:33	20:11	20:48	21:14	21:10	21:10	20:34		19:39	18:42	16:59	16:48
17	08:00	07:26	07:37	06:41	06:00	20:05 (T-83)	05:41	05:57	06:31	20:07 (T-83)	07:08	07:44	07:26	07:58
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	21:10	20:32		19:37	18:41	16:58	16:48
18	08:00	07:24	07:35	06:39	06:00	20:05 (T-83)	05:41	05:58	06:32	20:07 (T-83)	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	21:09	20:31		19:35	18:39	16:57	16:48
19	07:59	07:22	07:34	06:37	06:00	20:05 (T-83)	05:41	05:59	06:34	20:06 (T-83)	07:10	07:47	07:28	08:00
	17:17	18:01	19:36	20:15	20:51	21:15	21:08	21:08	20:29		19:34	18:37	16:56	16:49
20	07:58	07:21	07:32	06:36	06:00	20:05 (T-83)	05:42	06:00	06:35	20:06 (T-83)	07:11	07:48	07:30	08:00
	17:19	18:01	19:38	20:16	20:52	21:16	21:07	21:07	20:28		19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	06:00	20:05 (T-83)	05:42	06:01	06:36	20:06 (T-83)	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:18	20:53	21:16	21:06	21:06	20:26		19:30	18:34	16:55	16:49
22	07:57	07:18	07:28	06:32	06:00	20:05 (T-83)	05:42	06:02	06:37	20:06 (T-83)	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:06	21:06	20:24		19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	06:00	20:05 (T-83)	05:42	06:03	06:38	20:06 (T-83)	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:55	21:16	21:05	21:05	20:23		19:26	18:31	16:53	16:50
24	07:55	07:14	07:24	06:29	06:00	20:05 (T-83)	05:42	06:04	06:39	20:06 (T-83)	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:56	21:16	21:04	21:04	20:21		19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	06:00	20:05 (T-83)	05:43	06:05	06:41	20:06 (T-83)	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	21:03	20:19		19:22	18:27	16:52	16:52
26	07:53	07:11	07:21	06:26	06:00	20:05 (T-83)	05:43	06:06	06:42	20:06 (T-83)	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	21:02	20:17		19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	06:00	20:05 (T-83)	05:43	06:07	06:43	20:06 (T-83)	07:19	07:57	07:39	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:01	21:01	20:16		19:18	18:24	16:51	16:53
28	07:51	07:08	07:17	06:23	06:00	20:05 (T-83)	05:44	06:08	06:44	20:06 (T-83)	07:21	07:59	07:40	08:04
	17:30	18:11	19:48	20:26	21:00	21:17	21:00	21:00	20:14		19:17	18:23	16:50	16:54
29	07:50	07:15	06:21	06:20	06:20 (T-83)	05:44	06:09	06:09	06:45	20:06 (T-83)	07:22	08:00	07:41	08:04
	17:31	19:49	20:28	2 20:04 (T-83)	21:01	21:17	20:58	20:58	20:12		19:15	18:21	16:49	16:54
30	07:49	07:13	06:20	06:20	06:20 (T-83)	05:45	06:10	20:17 (T-83)	06:46	20:06 (T-83)	07:23	08:01	07:42	08:04
	17:32	19:50	20:29	4 20:05 (T-83)	21:02	21:17	20:57	5 20:22 (T-83)	20:11		19:13	18:20	16:49	16:55
31	07:48	07:11	06:21	06:21	06:21 (T-83)	05:46	06:12	20:14 (T-83)	06:48	20:06 (T-83)	07:24	08:03	07:43	08:04
	17:34	19:51	20:30	20:29	21:03	20:56	11 20:25 (T-83)	20:09	20:09		18:18	17:25	16:49	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275		
Total, worst case				6	156		16	152						
Sun reduction				0.63	0.66		0.75	0.72						
Oper. time red.				0.90	0.90		0.90	0.90						
Wind dir. red.				0.62	0.62		0.62	0.62						
Total reduction				0.35	0.37		0.42	0.40						
Total, real				2	58		7	61						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-176 - R-176
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:37	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48
3	08:04	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:15	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:20	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:07	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:13	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:50	06:04	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:08	20:44	21:13	21:12	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	19:07 (T-83)	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22
	17:11	17:54	19:30	2	19:09 (T-83)	20:09	20:46	21:13	21:12	20:37	19:43	18:46
15	08:01	07:29	07:41	19:05 (T-83)	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23
	17:12	17:55	19:31	5	19:10 (T-83)	20:10	20:47	21:14	21:11	20:36	19:41	18:44
16	08:01	07:27	07:39	19:04 (T-83)	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:24
	17:13	17:56	19:33	7	19:11 (T-83)	20:11	20:48	21:14	21:10	20:34	19:39	18:42
17	08:00	07:26	07:37	19:04 (T-83)	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26
	17:15	17:58	19:34	9	19:13 (T-83)	20:13	20:49	21:15	21:10	20:32	19:37	18:40
18	08:00	07:24	07:35	19:04 (T-83)	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27
	17:16	17:59	19:35	10	19:14 (T-83)	20:14	20:50	21:15	21:09	20:31	19:35	18:39
19	07:59	07:22	07:34	19:04 (T-83)	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28
	17:17	18:01	19:36	11	19:15 (T-83)	20:15	20:51	21:15	21:08	20:29	19:34	18:37
20	07:58	07:21	07:32	19:04 (T-83)	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30
	17:19	18:01	19:38	12	19:16 (T-83)	20:16	20:52	21:16	21:07	20:28	19:32	10
21	07:57	07:19	07:30	19:04 (T-83)	06:34	05:54	05:42	06:01	06:36	07:12	18:51 (T-83)	18:35
	17:20	18:02	19:39	14	19:18 (T-83)	20:18	20:53	21:16	21:06	20:26	19:30	13
22	07:57	07:18	07:28	19:05 (T-83)	06:32	05:53	05:42	06:02	06:37	07:13	18:50 (T-83)	18:34
	17:21	18:03	19:40	14	19:19 (T-83)	20:19	20:54	21:16	21:06	20:24	19:28	13
23	07:56	07:16	07:26	19:06 (T-83)	06:31	05:52	05:42	06:03	06:38	07:15	18:48 (T-83)	18:32
	17:23	18:05	19:41	11	19:17 (T-83)	20:20	20:55	21:16	21:05	20:23	19:26	13
24	07:55	07:14	07:24	19:10 (T-83)	06:29	05:51	05:42	06:04	06:39	07:16	18:47 (T-83)	18:31
	17:24	18:06	19:43	3	19:13 (T-83)	20:21	20:57	21:16	21:04	20:21	19:24	12
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:41	07:17	07:17	18:47 (T-83)	18:29
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	10	18:57 (T-83)	18:27
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:18	18:46 (T-83)	18:26
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	9	18:55 (T-83)	18:26
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:19	18:46 (T-83)	18:26
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	7	18:53 (T-83)	18:24
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:21	18:47 (T-83)	18:24
	17:30	18:11	19:48	20:26	21:00	21:17	21:00	20:14	19:17	5	18:52 (T-83)	18:23
29	07:50	07:15	07:25	06:21	05:47	05:44	06:09	06:45	07:22	07:22	18:47 (T-83)	18:23
	17:31	18:13	19:49	20:28	21:01	21:17	20:58	20:12	19:15	3	18:50 (T-83)	18:21
30	07:49	07:13	07:23	06:20	05:47	05:45	06:10	06:46	07:23	07:23	18:47 (T-83)	18:21
	17:32	18:15	19:50	20:29	21:02	21:17	20:57	20:11	19:13	1	18:48 (T-83)	18:20
31	07:48	07:11	07:21	05:46	05:46	06:12	06:48	06:48	07:24	07:24	18:48 (T-83)	18:20
	17:34	18:17	19:51	21:03	20:56	20:56	20:09	20:09	18:18	18:18	18:18	18:18
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction			98						96			
Oper. time red.			0.59						0.67			
Wind dir. red.			0.90						0.90			
Total reduction			0.58						0.58			
Total, real			0.31						0.35			
			30						34			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-177 - R-177
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June										
1	08:05	07:47	07:06	07:10	19:11 (T-34)	06:18	05:45	19:59 (T-24)								
	16:57	17:35	18:13	19:53	21	19:32 (T-34)	20:30	21:04	39	20:38 (T-24)						
2	08:05	07:46	07:04	07:08	19:11 (T-34)	06:17	05:45	19:58 (T-24)								
	16:58	17:37	18:14	19:54	22	19:33 (T-34)	20:31	21:05	41	20:39 (T-24)						
3	08:05	07:45	07:03	07:06	19:11 (T-34)	06:16	05:44	19:59 (T-24)								
	16:59	17:38	18:16	19:55	23	19:34 (T-34)	20:33	21:06	41	20:40 (T-24)						
4	08:05	07:44	07:01	07:04	19:11 (T-34)	06:14	05:44	20:00 (T-24)								
	17:00	17:39	18:17	19:57	24	19:35 (T-34)	20:34	21:07	41	20:41 (T-24)						
5	08:04	07:42	06:59	07:02	19:11 (T-34)	06:13	05:44	20:00 (T-24)								
	17:01	17:41	18:18	19:58	24	19:35 (T-34)	20:35	3	20:11 (T-24)	21:08	40	20:40 (T-24)				
6	08:04	07:41	06:57	07:00	19:13 (T-34)	06:11	05:43	20:00 (T-24)								
	17:02	17:42	18:20	19:59	22	19:35 (T-34)	20:36	7	20:13 (T-24)	21:08	40	20:40 (T-24)				
7	08:04	07:40	06:56	06:59	19:14 (T-34)	06:10	05:43	20:01 (T-24)								
	17:03	17:44	18:21	20:00	19	19:33 (T-34)	20:37	9	20:13 (T-24)	21:09	40	20:41 (T-24)				
8	08:04	07:39	07:54	06:57	19:15 (T-34)	06:09	05:42	20:01 (T-24)								
	17:04	17:45	18:22	20:02	16	19:31 (T-34)	20:39	11	20:14 (T-24)	21:10	39	20:40 (T-24)				
9	08:04	07:37	07:52	06:55	19:17 (T-34)	06:07	05:42	20:01 (T-24)								
	17:05	17:47	19:24	20:03	10	19:27 (T-34)	20:40	14	20:16 (T-24)	21:10	39	20:40 (T-24)				
10	08:03	07:36	07:50	06:53	06:06	06:06	05:42	20:02 (T-24)								
	17:06	17:48	19:25	20:04	20:41	16	20:17 (T-24)	21:11	38	20:40 (T-24)						
11	08:03	07:34	07:48	06:51	06:05	20:01 (T-24)	05:42	20:02 (T-24)								
	17:08	17:49	19:26	20:05	20:42	17	20:18 (T-24)	21:12	39	20:41 (T-24)						
12	08:03	07:33	07:47	06:50	06:04	19:59 (T-24)	05:42	20:03 (T-24)								
	17:09	17:51	19:27	20:07	20:43	19	20:18 (T-24)	21:12	38	20:41 (T-24)						
13	08:02	07:32	07:45	06:48	06:02	19:59 (T-24)	05:41	20:02 (T-24)								
	17:10	17:52	19:29	20:08	20:45	21	20:20 (T-24)	21:13	38	20:40 (T-24)						
14	08:02	07:30	07:43	06:46	06:01	19:58 (T-24)	05:41	20:03 (T-24)								
	17:11	17:54	19:30	20:09	20:46	23	20:21 (T-24)	21:13	37	20:40 (T-24)						
15	08:01	07:29	07:41	06:44	06:00	19:58 (T-24)	05:41	20:03 (T-24)								
	17:12	17:55	19:31	20:10	20:47	24	20:22 (T-24)	21:14	37	20:40 (T-24)						
16	08:01	07:27	07:39	06:43	05:59	19:57 (T-24)	05:41	20:03 (T-24)								
	17:14	17:56	19:33	20:12	20:48	26	20:23 (T-24)	21:14	37	20:40 (T-24)						
17	08:00	07:26	07:37	06:41	05:58	19:57 (T-24)	05:41	20:04 (T-24)								
	17:15	17:58	19:34	20:13	20:49	27	20:24 (T-24)	21:15	36	20:40 (T-24)						
18	08:00	07:24	07:36	06:39	05:57	19:57 (T-24)	05:41	20:05 (T-24)								
	17:16	17:59	19:35	20:14	20:50	28	20:25 (T-24)	21:15	36	20:41 (T-24)						
19	07:59	07:23	07:34	06:38	05:56	19:57 (T-24)	05:41	20:05 (T-24)								
	17:17	18:01	19:36	20:15	20:51	29	20:26 (T-24)	21:15	36	20:41 (T-24)						
20	07:58	07:21	07:32	06:36	05:55	19:56 (T-24)	05:42	20:05 (T-24)								
	17:19	18:01	19:38	20:16	20:52	31	20:27 (T-24)	21:16	36	20:41 (T-24)						
21	07:58	07:19	07:30	06:34	05:54	19:56 (T-24)	05:42	20:05 (T-24)								
	17:20	18:02	19:39	20:18	20:53	32	20:28 (T-24)	21:16	36	20:41 (T-24)						
22	07:57	07:18	07:28	06:33	05:53	19:57 (T-24)	05:42	20:05 (T-24)								
	17:21	18:03	19:40	20:19	20:55	33	20:30 (T-24)	21:16	36	20:41 (T-24)						
23	07:56	07:16	07:26	06:31	05:52	19:57 (T-24)	05:42	20:06 (T-24)								
	17:23	18:05	19:42	20:20	20:56	34	20:31 (T-24)	21:16	36	20:42 (T-24)						
24	07:55	07:15	07:24	19:20 (T-34)	06:29	05:51	19:57 (T-24)	05:42	20:06 (T-24)							
	17:24	18:06	19:43	2	19:22 (T-34)	20:21	20:57	34	20:31 (T-24)	21:17	36	20:42 (T-24)				
25	07:54	07:13	07:23	19:17 (T-34)	06:28	05:50	19:57 (T-24)	05:43	20:06 (T-24)							
	17:25	18:08	19:44	6	19:23 (T-34)	20:23	20:58	35	20:32 (T-24)	21:17	36	20:42 (T-24)				
26	07:53	07:11	07:21	19:16 (T-34)	06:26	05:49	19:57 (T-24)	05:43	20:07 (T-24)							
	17:27	18:09	19:45	8	19:24 (T-34)	20:24	20:59	36	20:33 (T-24)	21:17	36	20:43 (T-24)				
27	07:52	07:10	07:19	19:14 (T-34)	06:25	05:49	19:57 (T-24)	05:43	20:06 (T-24)							
	17:28	18:10	19:47	11	19:25 (T-34)	20:25	21:00	37	20:34 (T-24)	21:17	37	20:43 (T-24)				
28	07:51	07:08	07:17	19:13 (T-34)	06:23	05:48	19:57 (T-24)	05:44	20:06 (T-24)							
	17:30	18:12	19:48	13	19:26 (T-34)	20:26	21:01	38	20:35 (T-24)	21:17	37	20:43 (T-24)				
29	07:50		07:15	19:12 (T-34)	06:21	05:47	19:57 (T-24)	05:44	20:07 (T-24)							
	17:31		19:49	15	19:27 (T-34)	20:28	21:02	38	20:35 (T-24)	21:17	37	20:44 (T-24)				
30	07:49		07:13	19:11 (T-34)	06:20	05:47	19:58 (T-24)	05:45	20:06 (T-24)							
	17:32		19:50	17	19:28 (T-34)	20:29	21:02	39	20:37 (T-24)	21:17	38	20:44 (T-24)				
31	07:48		07:11	19:11 (T-34)		05:46	19:58 (T-24)									
	17:34		19:52	19	19:30 (T-34)		21:03	39	20:37 (T-24)							
Potential sun hours	287	292	369	403	458	465	1133									
Total, worst case			91	181	700	1133										
Sun reduction			0.59	0.63	0.66	0.73										
Oper. time red.			0.90	0.90	0.90	0.90										
Wind dir. red.			0.59	0.59	0.63	0.63										
Total reduction			0.32	0.34	0.38	0.42										
Total, real			29	61	264	472										

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-177 - R-177

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December		
1	05:45	20:07 (T-24)	06:13	20:10 (T-24)	06:49	07:24	07:04	07:43
	21:17	38 20:45 (T-24)	20:55	19 20:29 (T-24)	20:07	19:11	17:17	16:49
2	05:46	20:06 (T-24)	06:14	20:10 (T-24)	06:50	07:26	07:06	07:45
	21:17	38 20:44 (T-24)	20:54	17 20:27 (T-24)	20:05	19:09	17:16	16:48
3	05:46	20:07 (T-24)	06:15	20:11 (T-24)	06:51	19:15 (T-34)	07:27	07:07
	21:16	38 20:45 (T-24)	20:53	15 20:26 (T-24)	20:03	10 19:25 (T-34)	19:07	17:14
4	05:47	20:06 (T-24)	06:16	20:12 (T-24)	06:52	19:12 (T-34)	07:28	07:08
	21:16	39 20:45 (T-24)	20:51	13 20:25 (T-24)	20:02	16 19:28 (T-34)	19:06	17:13
5	05:48	20:06 (T-24)	06:17	20:14 (T-24)	06:54	19:10 (T-34)	07:29	07:10
	21:16	40 20:46 (T-24)	20:50	10 20:24 (T-24)	20:00	19 19:29 (T-34)	19:04	17:12
6	05:48	20:07 (T-24)	06:18	20:15 (T-24)	06:55	19:08 (T-34)	07:30	07:11
	21:16	39 20:46 (T-24)	20:49	8 20:23 (T-24)	19:58	22 19:30 (T-34)	19:02	17:10
7	05:49	20:06 (T-24)	06:20	20:17 (T-24)	06:56	19:07 (T-34)	07:32	07:12
	21:15	40 20:46 (T-24)	20:47	5 20:22 (T-24)	19:56	25 19:32 (T-34)	19:00	17:09
8	05:50	20:06 (T-24)	06:21	20:18 (T-24)	06:57	19:06 (T-34)	07:33	07:14
	21:15	41 20:47 (T-24)	20:46	2 20:20 (T-24)	19:54	24 19:30 (T-34)	18:56	17:08
9	05:51	20:07 (T-24)	06:22	20:19 (T-24)	06:58	19:05 (T-34)	07:34	07:15
	21:14	40 20:47 (T-24)	20:45	19:52	23 19:28 (T-34)	18:55	17:07	16:47
10	05:51	20:07 (T-24)	06:23	20:20 (T-24)	06:59	19:04 (T-34)	07:35	07:16
	21:14	40 20:47 (T-24)	20:43	19:51	22 19:26 (T-34)	18:53	17:05	16:47
11	05:52	20:06 (T-24)	06:24	20:21 (T-24)	07:01	19:03 (T-34)	07:37	07:18
	21:14	40 20:46 (T-24)	20:42	19:49	21 19:24 (T-34)	18:51	17:04	16:47
12	05:53	20:06 (T-24)	06:25	20:22 (T-24)	07:02	19:03 (T-34)	07:38	07:19
	21:13	40 20:46 (T-24)	20:40	19:47	19 19:22 (T-34)	18:49	17:03	16:47
13	05:54	20:06 (T-24)	06:27	20:23 (T-24)	07:03	19:02 (T-34)	07:39	07:21
	21:12	39 20:45 (T-24)	20:39	19:45	18 19:20 (T-34)	18:47	17:02	16:47
14	05:55	20:07 (T-24)	06:28	20:24 (T-24)	07:04	19:02 (T-34)	07:41	07:22
	21:12	38 20:45 (T-24)	20:37	19:43	16 19:18 (T-34)	18:46	17:01	16:47
15	05:55	20:07 (T-24)	06:29	20:25 (T-24)	07:05	19:03 (T-34)	07:42	07:23
	21:11	37 20:44 (T-24)	20:36	19:41	14 19:17 (T-34)	18:44	17:00	16:47
16	05:56	20:07 (T-24)	06:30	20:26 (T-24)	07:06	19:03 (T-34)	07:43	07:25
	21:11	37 20:44 (T-24)	20:34	19:39	12 19:15 (T-34)	18:42	16:59	16:48
17	05:57	20:06 (T-24)	06:31	20:27 (T-24)	07:08	19:04 (T-34)	07:44	07:26
	21:10	36 20:42 (T-24)	20:33	19:37	9 19:13 (T-34)	18:41	16:58	16:48
18	05:58	20:06 (T-24)	06:32	20:28 (T-24)	07:09	19:04 (T-34)	07:46	07:27
	21:09	36 20:42 (T-24)	20:31	19:36	7 19:11 (T-34)	18:39	16:57	16:48
19	05:59	20:06 (T-24)	06:34	20:29 (T-24)	07:10	19:05 (T-34)	07:47	07:29
	21:08	35 20:41 (T-24)	20:29	19:34	4 19:09 (T-34)	18:37	16:56	16:49
20	06:00	20:06 (T-24)	06:35	20:30 (T-24)	07:11	19:06 (T-34)	07:48	07:30
	21:07	34 20:40 (T-24)	20:28	19:32	18:36	16:55	16:49	
21	06:01	20:07 (T-24)	06:36	20:31 (T-24)	07:12	19:07 (T-34)	07:49	07:31
	21:07	33 20:40 (T-24)	20:26	19:30	18:34	16:55	16:49	
22	06:02	20:07 (T-24)	06:37	20:32 (T-24)	07:14	19:08 (T-34)	07:51	07:32
	21:06	32 20:39 (T-24)	20:24	19:28	18:32	16:54	16:50	
23	06:03	20:07 (T-24)	06:38	20:33 (T-24)	07:15	19:09 (T-34)	07:52	07:34
	21:05	31 20:38 (T-24)	20:23	19:26	18:31	16:53	16:50	
24	06:04	20:07 (T-24)	06:39	20:34 (T-24)	07:16	19:10 (T-34)	07:53	07:35
	21:04	30 20:37 (T-24)	20:21	19:24	18:29	16:52	16:51	
25	06:05	20:07 (T-24)	06:41	20:35 (T-24)	07:17	19:11 (T-34)	07:55	07:36
	21:03	29 20:36 (T-24)	20:19	19:22	18:28	16:52	16:52	
26	06:06	20:08 (T-24)	06:42	20:36 (T-24)	07:18	19:12 (T-34)	07:56	07:38
	21:02	27 20:35 (T-24)	20:18	19:20	18:26	16:51	16:52	
27	06:07	20:08 (T-24)	06:43	20:37 (T-24)	07:20	19:13 (T-34)	07:57	07:39
	21:01	26 20:34 (T-24)	20:16	19:19	18:24	16:51	16:53	
28	06:08	20:08 (T-24)	06:44	20:38 (T-24)	07:21	19:14 (T-34)	07:59	07:40
	21:00	25 20:33 (T-24)	20:14	19:17	18:23	16:50	16:54	
29	06:09	20:08 (T-24)	06:45	20:39 (T-24)	07:22	19:15 (T-34)	08:00	07:41
	20:59	24 20:32 (T-24)	20:12	19:15	18:21	16:50	16:54	
30	06:11	20:09 (T-24)	06:47	20:40 (T-24)	07:23	19:16 (T-34)	08:02	07:42
	20:57	22 20:31 (T-24)	20:11	19:13	18:20	16:49	16:55	
31	06:12	20:09 (T-24)	06:48	20:41 (T-24)	07:24	19:17 (T-34)	08:03	08:04
	20:56	21 20:30 (T-24)	20:09	19:12	18:19	16:48	16:56	
Potential sun hours	471	436	377	341	289	275		
Total, worst case	1065	89	281					
Sun reduction	0.75	0.72	0.67					
Oper. time red.	0.90	0.90	0.90					
Wind dir. red.	0.63	0.63	0.59					
Total reduction	0.43	0.41	0.36					
Total, real	456	37	101					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-178 - R-178
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	17:41 (T-83)	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43	
	16:57	17:35	18:13	10 17:51 (T-83)	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:49	
2	08:04	07:46	07:04	17:41 (T-83)	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:45	
	16:58	17:37	18:14	12 17:53 (T-83)	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48	
3	08:04	07:45	07:03	17:40 (T-83)	07:06	06:15	05:44	05:46	06:15	06:51	07:27	18:23 (T-83)	07:07	07:46
	16:59	17:38	18:16	14 17:54 (T-83)	19:55	20:32	21:06	21:16	20:52	20:03	19:07	12 18:35 (T-83)	17:14	16:48
4	08:04	07:44	07:01	17:40 (T-83)	07:04	06:14	05:44	05:47	06:16	06:52	07:28	18:20 (T-83)	07:08	07:47
	17:00	17:39	18:17	15 17:55 (T-83)	19:56	20:34	21:07	21:16	20:51	20:02	19:05	16 18:36 (T-83)	17:13	16:48
5	08:04	07:42	06:59	17:40 (T-83)	07:02	06:13	05:43	05:48	06:17	06:53	07:29	18:18 (T-83)	07:10	07:48
	17:01	17:41	18:18	17 17:57 (T-83)	19:58	20:35	21:07	21:16	20:50	20:00	19:04	19 18:37 (T-83)	17:12	16:47
6	08:04	07:41	06:57	17:40 (T-83)	07:00	06:11	05:43	05:48	06:18	06:55	07:30	18:18 (T-83)	07:11	07:49
	17:02	17:42	18:20	18 17:58 (T-83)	19:59	20:36	21:08	21:15	20:49	19:58	19:02	19 18:37 (T-83)	17:10	16:47
7	08:04	07:40	06:56	17:40 (T-83)	06:59	06:10	05:43	05:49	06:20	06:56	07:32	18:16 (T-83)	07:12	07:50
	17:03	17:44	18:21	19 17:59 (T-83)	20:00	20:37	21:09	21:15	20:47	19:56	19:00	19 18:35 (T-83)	17:09	16:47
8	08:04	07:38	07:54	18:41 (T-83)	06:57	06:09	05:42	05:50	06:21	06:57	07:33	18:15 (T-83)	07:14	07:51
	17:04	17:45	18:22	20 19:01 (T-83)	20:01	20:39	21:10	21:15	20:46	19:54	18:56	18 18:33 (T-83)	17:08	16:47
9	08:04	07:37	07:52	18:42 (T-83)	06:55	06:07	05:42	05:50	06:22	06:58	07:34	18:14 (T-83)	07:15	07:52
	17:05	17:47	19:23	17 18:59 (T-83)	20:03	20:40	21:10	21:14	20:44	19:52	18:55	17 18:31 (T-83)	17:07	16:47
10	08:03	07:36	07:50	18:44 (T-83)	06:53	06:06	05:42	05:51	06:23	06:59	07:35	18:15 (T-83)	07:16	07:53
	17:06	17:48	19:25	14 18:58 (T-83)	20:04	20:41	21:11	21:14	20:43	19:51	18:53	14 18:29 (T-83)	17:05	16:47
11	08:03	07:34	07:48	18:47 (T-83)	06:51	06:05	05:42	05:52	06:24	07:01	07:37	18:14 (T-83)	07:18	07:54
	17:07	17:49	19:26	7 18:54 (T-83)	20:05	20:42	21:12	21:13	20:42	19:49	18:51	13 18:25 (T-83)	17:04	16:47
12	08:03	07:33	07:46		06:50	06:04	05:41	05:53	06:25	07:02	07:38	18:14 (T-83)	07:19	07:55
	17:09	17:51	19:27		20:06	20:43	21:12	21:13	20:40	19:47	18:49	11 18:25 (T-83)	17:03	16:47
13	08:02	07:32	07:45		06:48	06:02	05:41	05:54	06:26	07:03	07:39	18:15 (T-83)	07:20	07:55
	17:10	17:52	19:29		20:08	20:44	21:13	21:12	20:39	19:45	18:47	9 18:24 (T-83)	17:02	16:47
14	08:02	07:30	07:43		06:46	06:01	05:41	05:55	06:28	07:04	07:40	18:15 (T-83)	07:22	07:56
	17:11	17:54	19:30		20:09	20:46	21:13	21:12	20:37	19:43	18:46	7 18:22 (T-83)	17:01	16:47
15	08:01	07:29	07:41		06:44	06:00	05:41	05:55	06:29	07:05	07:42	18:16 (T-83)	07:23	07:57
	17:12	17:55	19:31		20:10	20:47	21:14	21:11	20:36	19:41	18:44	4 18:20 (T-83)	17:00	16:47
16	08:01	07:27	07:39		06:43	05:59	05:41	05:56	06:30	07:06	07:43	18:18 (T-83)	07:24	07:58
	17:14	17:56	19:33		20:11	20:48	21:14	21:10	20:34	19:39	18:42	1 18:19 (T-83)	16:59	16:48
17	08:00	07:26	07:37		06:41	05:58	05:41	05:57	06:31	07:08	07:44		07:26	07:58
	17:15	17:58	19:34		20:13	20:49	21:15	21:10	20:32	19:37	18:41		16:58	16:48
18	08:00	07:24	07:35		06:39	05:57	05:41	05:58	06:32	07:09	07:46		07:27	07:59
	17:16	17:59	19:35		20:14	20:50	21:15	21:09	20:31	19:35	18:39		16:57	16:48
19	07:59	07:23	07:34		06:37	05:56	05:41	05:59	06:34	07:10	07:47		07:28	08:00
	17:17	18:01	19:36		20:15	20:51	21:15	21:08	20:29	19:34	18:37		16:56	16:48
20	07:58	07:21	07:32		06:36	05:55	05:41	06:00	06:35	07:11	07:48		07:30	08:00
	17:19	18:01	19:38		20:16	20:52	21:16	21:07	20:28	19:32	18:35		16:55	16:49
21	07:57	07:19	07:30		06:34	05:54	05:42	06:01	06:36	07:12	07:49		07:31	08:01
	17:20	18:02	19:39		20:18	20:53	21:16	21:06	20:26	19:30	18:34		16:55	16:49
22	07:57	07:18	07:28		06:32	05:53	05:42	06:02	06:37	07:13	07:51		07:32	08:01
	17:21	18:03	19:40		20:19	20:54	21:16	21:06	20:24	19:28	18:32		16:54	16:50
23	07:56	07:16	07:26		06:31	05:52	05:42	06:03	06:38	07:15	07:52		07:34	08:02
	17:23	18:05	19:41		20:20	20:55	21:16	21:05	20:23	19:26	18:31		16:53	16:50
24	07:55	07:14	07:24		06:29	05:51	05:42	06:04	06:39	07:16	07:53		07:35	08:02
	17:24	18:06	19:43		20:21	20:57	21:16	21:04	20:21	19:24	18:29		16:52	16:51
25	07:54	07:13	07:22		06:28	05:50	05:43	06:05	06:41	07:17	07:55		07:36	08:03
	17:25	18:07	19:44		20:23	20:58	21:17	21:03	20:19	19:22	18:27		16:52	16:52
26	07:53	07:11	17:45 (T-83)		06:26	05:49	05:43	06:06	06:42	07:18	07:56		07:37	08:03
	17:27	18:09	2 17:47 (T-83)		20:24	20:59	21:17	21:02	20:18	19:20	18:26		16:51	16:52
27	07:52	07:09	17:43 (T-83)		06:24	05:49	05:43	06:07	06:43	07:19	07:57		07:39	08:03
	17:28	18:10	5 17:48 (T-83)		20:25	21:00	21:17	21:01	20:16	19:18	18:24		16:50	16:53
28	07:51	07:08	17:41 (T-83)		06:23	05:48	05:44	06:08	06:44	07:21	07:59		07:40	08:04
	17:30	18:11	8 17:49 (T-83)		20:26	21:00	21:17	21:00	20:14	19:17	18:23		16:50	16:54
29	07:50				06:21	05:47	05:44	06:09	06:45	07:22	08:00		07:41	08:04
	17:31				20:28	21:01	21:17	20:58	20:12	19:15	18:21		16:49	16:54
30	07:49				06:20	05:47	05:45	06:10	06:46	07:23	08:01		07:42	08:04
	17:32				20:29	21:02	21:17	20:57	20:11	19:13	18:20		16:49	16:55
31	07:48				07:11			06:12	06:48		08:03		07:42	08:04
	17:34				19:51			21:03	20:56	20:09	18:18		16:49	16:56
Potential sun hours	287	292	369		403	458	465	471	436	377	341		289	275
Total, worst case				15							179			
Sun reduction		0.58		0.59							0.56			
Oper. time red.		0.90		0.90							0.90			
Wind dir. red.		0.58		0.58							0.58			
Total reduction		0.30		0.31							0.29			
Total, real		5		50							52			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-179 - R-179
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:09	06:18	05:45
	16:57	17:35	18:13	19:53	20:30	21:04
2	08:05	07:46	07:04	07:08	06:17	05:45
	16:58	17:37	18:14	19:54	20:31	21:05
3	08:05	07:45	07:03	07:06	06:16	05:44
	16:59	17:38	18:16	19:55	20:32	21:06
4	08:04	07:44	07:01	07:04	06:14	05:44
	17:00	17:39	18:17	19:56	20:34	21:07
5	08:04	07:42	06:59	07:02	06:13	05:43
	17:01	17:41	18:18	19:58	20:35	21:07
6	08:04	07:41	06:57	07:00	06:11	05:43
	17:02	17:42	18:20	19:59	20:36	21:08
7	08:04	07:40	06:56	06:59	06:10	05:43
	17:03	17:44	18:21	20:00	20:37	21:09
8	08:04	07:38	07:54	06:57	06:09	05:42
	17:04	17:45	18:22	20:01	20:39	21:10
9	08:04	07:37	07:52	06:55	06:07	05:42
	17:05	17:47	19:23	20:03	20:40	21:10
10	08:03	07:36	17:20 (T-83)	07:50	06:53	06:06
	17:06	17:48	17:23 (T-83)	19:25	20:04	20:41
11	08:03	07:34	17:19 (T-83)	07:48	06:51	06:05
	17:07	17:49	17:25 (T-83)	19:26	20:05	20:42
12	08:03	07:33	17:17 (T-83)	07:47	06:50	06:04
	17:09	17:51	17:26 (T-83)	19:27	20:06	20:43
13	08:02	07:32	17:17 (T-83)	07:45	06:48	06:02
	17:10	17:52	17:28 (T-83)	19:29	20:08	20:44
14	08:02	07:30	17:15 (T-83)	07:43	06:46	06:01
	17:11	17:54	17:29 (T-83)	19:30	20:09	20:46
15	08:01	07:29	17:15 (T-83)	07:41	06:44	06:00
	17:12	17:55	17:31 (T-83)	19:31	20:10	20:47
16	08:01	07:27	17:14 (T-83)	07:39	06:43	05:59
	17:14	17:56	17:32 (T-83)	19:33	20:11	20:48
17	08:00	07:26	17:15 (T-83)	07:37	06:41	05:58
	17:15	17:58	17:34 (T-83)	19:34	20:13	20:49
18	08:00	07:24	17:14 (T-83)	07:35	06:39	05:57
	17:16	17:59	17:35 (T-83)	19:35	20:14	20:50
19	07:59	07:23	17:14 (T-83)	07:34	06:37	05:56
	17:17	18:01	17:37 (T-83)	19:36	20:15	20:51
20	07:58	07:21	17:14 (T-83)	07:32	06:36	05:55
	17:19	18:01	17:38 (T-83)	19:38	20:16	20:52
21	07:57	07:19	17:14 (T-83)	07:30	06:34	05:54
	17:20	18:02	17:39 (T-83)	19:39	20:18	20:53
22	07:57	07:18	17:15 (T-83)	07:28	06:32	05:53
	17:21	18:03	17:41 (T-83)	19:40	20:19	20:54
23	07:56	07:16	17:15 (T-83)	07:26	06:31	05:52
	17:23	18:05	17:43 (T-83)	19:41	20:20	20:56
24	07:55	07:14	17:15 (T-83)	07:24	06:29	05:51
	17:24	18:06	17:42 (T-83)	19:43	20:21	20:57
25	07:54	07:13	17:17 (T-83)	07:22	06:28	05:50
	17:25	18:07	17:41 (T-83)	19:44	20:23	20:58
26	07:53	07:11	17:18 (T-83)	07:21	06:26	05:49
	17:27	18:09	17:40 (T-83)	19:45	20:24	20:59
27	07:52	07:09	17:19 (T-83)	07:19	06:24	05:49
	17:28	18:10	17:37 (T-83)	19:46	20:25	21:00
28	07:51	07:08	17:21 (T-83)	07:17	06:23	05:48
	17:30	18:12	17:34 (T-83)	19:48	20:26	21:01
29	07:50			07:15	06:21	05:47
	17:31			19:49	20:28	21:01
30	07:49			07:13	06:20	05:47
	17:32			19:50	20:29	21:02
31	07:48			07:11	06:19	05:46
	17:34			19:51	21:03	21:03
Potential sun hours	287	292	369	403	458	465
Total, worst case			347			491
Sun reduction			0.58			0.66
Oper. time red.			0.90			0.90
Wind dir. red.			0.59			0.59
Total reduction			0.31			0.35
Total, real			107			172

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
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1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-179 - R-179

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December			
1	05:45	06:10 (T-37)	06:13	06:36 (T-38)	06:49	07:24	07:04	16:50 (T-83)	07:43
	21:17	42 06:52 (T-37)	20:55	11 06:47 (T-38)	20:07	19:11	17:17	2 16:52 (T-83)	16:49
2	05:46	06:10 (T-37)	06:14	06:37 (T-38)	06:50	07:26	07:06		07:45
	21:16	41 06:51 (T-37)	20:54	9 06:46 (T-38)	20:05	19:09	17:16		16:48
3	05:46	06:11 (T-37)	06:15	06:38 (T-38)	06:51	07:27	07:07		07:46
	21:16	41 06:52 (T-37)	20:53	7 06:45 (T-38)	20:03	19:07	17:14		16:48
4	05:47	06:11 (T-37)	06:16	06:39 (T-38)	06:52	07:28	07:08		07:47
	21:16	40 06:51 (T-37)	20:51	5 06:44 (T-38)	20:02	19:05	17:13		16:48
5	05:48	06:12 (T-37)	06:17	06:41 (T-38)	06:54	07:29	07:10		07:48
	21:16	40 06:52 (T-37)	20:50	3 06:44 (T-38)	20:00	19:04	17:12		16:47
6	05:48	06:13 (T-37)	06:18	06:42 (T-38)	06:55	07:30	07:11		07:49
	21:16	39 06:52 (T-37)	20:49	1 06:43 (T-38)	19:58	19:02	17:10		16:47
7	05:49	06:13 (T-37)	06:20	06:56	07:32	07:12	17:12		07:50
	21:15	39 06:52 (T-37)	20:47	19:56	19:00	17:09	17:09		16:47
8	05:50	06:14 (T-37)	06:21	06:57	07:33	07:14	17:14		07:51
	21:15	38 06:52 (T-37)	20:46	19:54	18:56	17:08	17:08		16:47
9	05:50	06:15 (T-37)	06:22	06:58	07:34	07:15	17:15		07:52
	21:14	37 06:52 (T-37)	20:44	19:52	18:55	17:07	17:07		16:47
10	05:51	06:16 (T-37)	06:23	06:59	07:35	07:16	17:16		07:53
	21:14	36 06:52 (T-37)	20:43	19:51	18:53	17:05	17:05		16:47
11	05:52	06:16 (T-37)	06:24	07:01	07:37	07:18	17:18		07:54
	21:13	36 06:52 (T-37)	20:42	19:49	18:51	17:04	17:04		16:47
12	05:53	06:17 (T-37)	06:25	07:02	07:38	07:19	17:19		07:55
	21:13	35 06:52 (T-37)	20:40	19:47	18:49	17:03	17:03		16:47
13	05:54	06:18 (T-37)	06:26	07:03	07:39	07:20	17:58 (T-83)	07:20	07:55
	21:12	34 06:52 (T-37)	20:39	19:45	18:47	8 18:06 (T-83)	17:02	17:02	16:47
14	05:55	06:19 (T-37)	06:28	07:04	07:40	07:22	17:54 (T-83)	07:22	07:56
	21:12	33 06:52 (T-37)	20:37	19:43	18:46	15 18:09 (T-83)	17:01	17:01	16:47
15	05:55	06:20 (T-37)	06:29	07:05	07:42	07:23	17:51 (T-83)	07:23	07:57
	21:11	32 06:52 (T-37)	20:36	19:41	18:44	19 18:10 (T-83)	17:00	17:00	16:47
16	05:56	06:20 (T-37)	06:30	07:06	07:43	07:24	17:50 (T-83)	07:24	07:58
	21:10	31 06:51 (T-37)	20:34	19:39	18:42	22 18:12 (T-83)	16:59	16:59	16:48
17	05:57	06:21 (T-37)	06:31	07:08	07:44	07:26	17:48 (T-83)	07:26	07:58
	21:10	29 06:50 (T-37)	20:32	19:37	18:41	25 18:13 (T-83)	16:58	16:58	16:48
18	05:58	06:22 (T-37)	06:32	07:09	07:46	07:27	17:47 (T-83)	07:27	07:59
	21:09	28 06:50 (T-37)	20:31	19:35	18:39	26 18:13 (T-83)	16:57	16:57	16:48
19	05:59	06:23 (T-37)	06:34	07:10	07:47	07:28	17:46 (T-83)	07:28	08:00
	21:08	27 06:50 (T-37)	20:29	19:34	18:37	27 18:13 (T-83)	16:56	16:56	16:49
20	06:00	06:24 (T-37)	06:35	07:11	07:48	07:30	17:45 (T-83)	07:30	08:00
	21:07	25 06:49 (T-37)	20:28	19:32	18:35	26 18:11 (T-83)	16:55	16:55	16:49
21	06:01	06:25 (T-37)	06:36	07:12	07:49	07:31	17:44 (T-83)	07:31	08:01
	21:06	24 06:49 (T-37)	20:26	19:30	18:34	25 18:09 (T-83)	16:55	16:55	16:49
22	06:02	06:26 (T-37)	06:37	07:13	07:51	07:32	17:45 (T-83)	07:32	08:01
	21:06	22 06:48 (T-37)	20:24	19:28	18:32	23 18:08 (T-83)	16:54	16:54	16:50
23	06:03	06:27 (T-37)	06:38	07:15	07:52	07:34	17:44 (T-83)	07:34	08:02
	21:05	21 06:48 (T-38)	20:23	19:26	18:31	22 18:06 (T-83)	16:53	16:53	16:50
24	06:04	06:28 (T-37)	06:39	07:16	07:53	07:35	17:45 (T-83)	07:35	08:02
	21:04	21 06:49 (T-38)	20:21	19:24	18:29	20 18:05 (T-83)	16:52	16:52	16:51
25	06:05	06:29 (T-37)	06:41	07:17	07:55	07:36	17:44 (T-83)	07:36	08:03
	21:03	20 06:49 (T-38)	20:19	19:22	18:27	19 18:03 (T-83)	16:52	16:52	16:52
26	06:06	06:30 (T-37)	06:42	07:18	07:56	07:37	17:44 (T-83)	07:37	08:03
	21:02	19 06:49 (T-38)	20:18	19:20	18:26	17 18:01 (T-83)	16:51	16:51	16:52
27	06:07	06:31 (T-37)	06:43	07:19	07:57	07:39	17:45 (T-83)	07:39	08:03
	21:01	18 06:49 (T-38)	20:16	19:19	18:24	15 18:00 (T-83)	16:51	16:51	16:53
28	06:08	06:32 (T-37)	06:44	07:21	07:59	07:40	17:45 (T-83)	07:40	08:04
	21:00	16 06:48 (T-38)	20:14	19:17	18:23	13 17:58 (T-83)	16:50	16:50	16:54
29	06:09	06:33 (T-37)	06:45	07:22	08:00	07:41	17:47 (T-83)	07:41	08:04
	20:58	15 06:48 (T-38)	20:12	19:15	18:21	10 17:57 (T-83)	16:49	16:49	16:54
30	06:10	06:34 (T-37)	06:46	07:23	08:01	07:42	17:47 (T-83)	07:42	08:04
	20:57	14 06:48 (T-38)	20:11	19:13	18:20	8 17:55 (T-83)	16:49	16:49	16:55
31	06:12	06:35 (T-38)	06:48	08:03	08:03	08:04	17:48 (T-83)	08:04	08:04
	20:56	12 06:47 (T-38)	20:09	18:18	18:18	5 17:53 (T-83)	16:56	16:56	16:56
Potential sun hours	471	436	377	341	289	275			
Total, worst case	905	36	345	2					
Sun reduction	0.75	0.72	0.56	0.48					
Oper. time red.	0.90	0.90	0.90	0.90					
Wind dir. red.	0.59	0.59	0.59	0.59					
Total reduction	0.40	0.38	0.30	0.25					
Total, real	360	14	102	1					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-180 - R-180
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June			
1	08:05	07:47	07:06	07:33 (T-37)	07:10	19:08 (T-24)	06:18	19:19 (T-25)	05:45
	16:57	17:35	18:13	5 07:38 (T-37)	19:53	23 19:31 (T-24)	20:30	44 20:03 (T-25)	21:04
2	08:05	07:46	07:04	17:50 (T-34)	07:08	19:09 (T-24)	06:17	19:19 (T-25)	05:45
	16:58	17:37	18:14	3 17:53 (T-34)	19:54	20 19:29 (T-24)	20:31	43 20:02 (T-25)	21:05
3	08:05	07:45	07:03	17:48 (T-34)	07:06	19:10 (T-24)	06:16	19:20 (T-25)	05:44
	16:59	17:38	18:16	6 17:54 (T-34)	19:55	17 19:27 (T-24)	20:33	41 20:01 (T-25)	21:06
4	08:05	07:44	07:01	17:48 (T-34)	07:04	19:12 (T-24)	06:14	19:20 (T-25)	05:44
	17:00	17:39	18:17	7 17:55 (T-34)	19:57	12 19:24 (T-24)	20:34	40 20:00 (T-25)	21:07
5	08:04	07:42	06:59	17:48 (T-34)	07:02		06:13	19:21 (T-25)	05:43
	17:01	17:41	18:18	9 17:57 (T-34)	19:58		20:35	38 19:59 (T-25)	21:08
6	08:04	07:41	06:57	17:47 (T-34)	07:00		06:11	19:22 (T-25)	05:43
	17:02	17:42	18:20	11 17:58 (T-34)	19:59		20:36	37 19:59 (T-25)	21:08
7	08:04	07:40	06:56	17:47 (T-34)	06:59		06:10	19:22 (T-25)	05:43
	17:03	17:44	18:21	12 17:59 (T-34)	20:00		20:37	35 19:57 (T-25)	21:09
8	08:04	07:39	07:54	18:47 (T-34)	06:57		06:09	19:23 (T-25)	05:42
	17:04	17:45	18:22	14 19:01 (T-34)	20:02		20:39	33 19:56 (T-25)	21:10
9	08:04	07:37	07:52	18:48 (T-34)	06:55	19:37 (T-25)	06:07	19:25 (T-25)	05:42
	17:05	17:47	19:24	14 19:02 (T-34)	20:03	4 19:41 (T-25)	20:40	30 19:55 (T-25)	21:10
10	08:03	07:36	07:50	18:50 (T-34)	06:53	19:33 (T-25)	06:06	19:26 (T-25)	05:42
	17:06	17:48	19:25	14 19:04 (T-34)	20:04	9 19:42 (T-25)	20:41	28 19:54 (T-25)	21:11
11	08:03	07:34	07:48	18:51 (T-34)	06:51	19:31 (T-25)	06:05	19:28 (T-25)	05:42
	17:07	17:49	19:26	12 19:03 (T-34)	20:05	13 19:44 (T-25)	20:42	24 19:52 (T-25)	21:12
12	08:03	07:33	07:47	18:54 (T-34)	06:50	19:29 (T-25)	06:04	19:29 (T-25)	05:41
	17:09	17:51	19:27	6 19:00 (T-34)	20:07	16 19:45 (T-25)	20:43	21 19:50 (T-25)	21:12
13	08:02	07:32	07:45		06:48	19:27 (T-25)	06:02	19:32 (T-25)	05:41
	17:10	17:52	19:29		20:08	18 19:45 (T-25)	20:45	15 19:47 (T-25)	21:13
14	08:02	07:30	07:43		06:46	19:25 (T-25)	06:01	19:36 (T-25)	05:41
	17:11	17:54	19:30		20:09	21 19:46 (T-25)	20:46	8 19:44 (T-25)	21:13
15	08:01	07:29	07:41		06:44	19:24 (T-25)	06:00		05:41
	17:12	17:55	19:31		20:10	24 19:48 (T-25)	20:47		21:14
16	08:01	07:27	07:39		06:43	19:23 (T-25)	05:59		05:41
	17:14	17:56	19:33		20:11	26 19:49 (T-25)	20:48		21:14
17	08:00	07:26	07:37		06:41	19:21 (T-25)	05:58		05:41
	17:15	17:58	19:34		20:13	29 19:50 (T-25)	20:49		21:15
18	08:00	07:24	07:36		06:39	19:21 (T-25)	05:57		05:41
	17:16	17:59	19:35		20:14	31 19:52 (T-25)	20:50		21:15
19	07:59	07:23	07:44 (T-37)	07:34	19:13 (T-24)	06:38	19:20 (T-25)	05:56	05:41
	17:17	18:01	3 07:47 (T-37)	19:36	2 19:15 (T-24)	20:15	33 19:53 (T-25)	20:51	21:15
20	07:58	07:21	07:42 (T-37)	07:32	19:11 (T-24)	06:36	19:19 (T-25)	05:55	05:42
	17:19	18:01	5 07:47 (T-37)	19:38	5 19:16 (T-24)	20:16	34 19:53 (T-25)	20:52	21:16
21	07:58	07:19	07:40 (T-37)	07:30	19:10 (T-24)	06:34	19:19 (T-25)	05:54	05:42
	17:20	18:02	7 07:47 (T-37)	19:39	8 19:18 (T-24)	20:18	36 19:55 (T-25)	20:53	21:16
22	07:57	07:18	07:39 (T-37)	07:28	19:08 (T-24)	06:33	19:18 (T-25)	05:53	05:42
	17:21	18:03	8 07:47 (T-37)	19:40	11 19:19 (T-24)	20:19	38 19:56 (T-25)	20:55	21:16
23	07:56	07:16	07:37 (T-37)	07:26	19:07 (T-24)	06:31	19:19 (T-25)	05:52	05:42
	17:23	18:05	10 07:47 (T-37)	19:42	13 19:20 (T-24)	20:20	39 19:58 (T-25)	20:56	21:16
24	07:55	07:15	07:35 (T-37)	07:24	19:07 (T-24)	06:29	19:18 (T-25)	05:51	05:42
	17:24	18:06	11 07:46 (T-37)	19:43	15 19:22 (T-24)	20:21	41 19:59 (T-25)	20:57	21:17
25	07:54	07:13	07:34 (T-37)	07:23	19:07 (T-24)	06:28	19:17 (T-25)	05:50	05:43
	17:25	18:07	12 07:46 (T-37)	19:44	16 19:23 (T-24)	20:23	42 19:59 (T-25)	20:58	21:17
26	07:53	07:11	07:32 (T-37)	07:21	19:06 (T-24)	06:26	19:18 (T-25)	05:49	05:43
	17:27	18:09	13 07:45 (T-37)	19:45	18 19:24 (T-24)	20:24	43 20:01 (T-25)	20:59	21:17
27	07:52	07:10	07:30 (T-37)	07:19	19:06 (T-24)	06:25	19:17 (T-25)	05:49	05:43
	17:28	18:10	13 07:43 (T-37)	19:47	19 19:25 (T-24)	20:25	45 20:02 (T-25)	21:00	21:17
28	07:51	07:08	07:30 (T-37)	07:17	19:06 (T-24)	06:23	19:18 (T-25)	05:48	05:44
	17:30	18:12	12 07:42 (T-37)	19:48	20 19:26 (T-24)	20:26	45 20:03 (T-25)	21:01	21:17
29	07:50		07:15	07:15	19:06 (T-24)	06:21	19:18 (T-25)	05:47	05:44
	17:31		19:49	21 19:27 (T-24)	20:28	45 20:03 (T-25)	21:02		21:17
30	07:49		07:13	19:06 (T-24)	06:20	19:18 (T-25)	05:47		05:45
	17:32		19:50	22 19:28 (T-24)	20:29	45 20:03 (T-25)	21:02		21:17
31	07:48		07:11	19:07 (T-24)			05:46		
	17:34		19:52	23 19:30 (T-24)			21:03		
Potential sun hours	287	292	369	403	459	465			
Total, worst case									
Sun reduction		94	306	749	437				
Oper. time red.		0.58	0.59	0.63	0.66				
Wind dir. red.		0.90	0.90	0.90	0.90				
Total reduction		0.61	0.58	0.60	0.60				
Total, real		0.32	0.31	0.34	0.35				
		30	95	253	155				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-180 - R-180

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December				
1	05:45	06:13	19:39 (T-25)	06:49	19:30 (T-25)	07:24	07:04	07:43		
	21:17	20:55	22 20:01 (T-25)	20:07	13 19:43 (T-25)	19:11	17:17	16:49		
2	05:46	06:14	19:37 (T-25)	06:50	19:32 (T-25)	07:26	18:31 (T-34)	07:06	07:45	
	21:17	20:54	26 20:03 (T-25)	20:05	9 19:41 (T-25)	19:09	10 18:41 (T-34)	17:16	16:48	
3	05:46	06:15	19:35 (T-25)	06:51	19:35 (T-25)	07:27	18:28 (T-34)	07:07	07:46	
	21:16	20:53	29 20:04 (T-25)	20:03	4 19:39 (T-25)	19:07	14 18:42 (T-34)	17:14	16:48	
4	05:47	06:16	19:34 (T-25)	06:52		07:28	18:26 (T-34)	07:08	07:47	
	21:16	20:51	31 20:05 (T-25)	20:02		19:06	14 18:40 (T-34)	17:13	16:48	
5	05:48	06:17	19:34 (T-25)	06:54		07:29	18:25 (T-34)	07:10	07:48	
	21:16	20:50	33 20:07 (T-25)	20:00		19:04	13 18:38 (T-34)	17:12	16:47	
6	05:48	06:18	19:32 (T-25)	06:55		07:30	18:24 (T-34)	07:11	07:49	
	21:16	20:49	36 20:08 (T-25)	19:58		19:02	13 18:37 (T-34)	17:10	16:47	
7	05:49	06:20	19:31 (T-25)	06:56		07:32	18:23 (T-34)	07:12	07:50	
	21:15	20:47	38 20:09 (T-25)	19:56		19:00	12 18:35 (T-34)	17:09	16:47	
8	05:50	06:21	19:30 (T-25)	06:57	19:08 (T-24)	07:33	18:23 (T-34)	07:14	07:51	
	21:15	20:46	39 20:09 (T-25)	19:54	11 19:19 (T-24)	18:56	10 18:33 (T-34)	17:08	16:47	
9	05:50	06:22	19:29 (T-25)	06:58	19:04 (T-24)	07:34	18:22 (T-34)	07:15	07:52	
	21:14	20:45	41 20:10 (T-25)	19:52	17 19:21 (T-24)	18:55	8 18:30 (T-34)	17:07	16:47	
10	05:51	06:23	19:28 (T-25)	06:59	19:02 (T-24)	07:35	18:23 (T-34)	07:16	07:53	
	21:14	20:43	42 20:10 (T-25)	19:51	20 19:22 (T-24)	18:53	6 18:29 (T-34)	17:05	16:47	
11	05:52	06:24	19:27 (T-25)	07:01	19:00 (T-24)	07:37	18:23 (T-34)	07:18	07:54	
	21:14	20:42	43 20:10 (T-25)	19:49	23 19:23 (T-24)	18:51	4 18:27 (T-34)	17:04	16:47	
12	05:53	06:25	19:26 (T-25)	07:02	18:58 (T-24)	07:38	18:23 (T-34)	07:19	07:55	
	21:13	20:40	45 20:11 (T-25)	19:47	24 19:22 (T-24)	18:49	2 18:25 (T-34)	17:03	16:47	
13	05:54	06:27	19:26 (T-25)	07:03	18:57 (T-24)	07:39	08:05 (T-37)	07:21	07:55	
	21:12	20:39	45 20:11 (T-25)	19:45	23 19:20 (T-24)	18:47	8 08:13 (T-37)	17:02	16:47	
14	05:55	06:28	19:26 (T-25)	07:04	18:56 (T-24)	07:40	08:02 (T-37)	07:22	07:56	
	21:12	20:37	46 20:12 (T-25)	19:43	22 19:18 (T-24)	18:46	13 08:15 (T-37)	17:01	16:47	
15	05:55	06:29	19:25 (T-25)	07:05	18:56 (T-24)	07:42	08:03 (T-37)	07:23	07:57	
	21:11	20:36	46 20:11 (T-25)	19:41	21 19:17 (T-24)	18:44	13 08:16 (T-37)	17:00	16:47	
16	05:56	06:30	19:25 (T-25)	07:06	18:55 (T-24)	07:43	08:05 (T-37)	07:25	07:58	
	21:11	20:34	44 20:09 (T-25)	19:39	20 19:15 (T-24)	18:42	12 08:17 (T-37)	16:59	16:48	
17	05:57	06:31	19:24 (T-25)	07:08	18:54 (T-24)	07:44	08:06 (T-37)	07:26	07:58	
	21:10	20:33	43 20:07 (T-25)	19:37	19 19:13 (T-24)	18:41	12 08:18 (T-37)	16:58	16:48	
18	05:58	06:32	19:24 (T-25)	07:09	18:54 (T-24)	07:46	08:07 (T-37)	07:27	07:59	
	21:09	20:31	42 20:06 (T-25)	19:36	17 19:11 (T-24)	18:39	11 08:18 (T-37)	16:57	16:48	
19	05:59	06:34	19:24 (T-25)	07:10	18:54 (T-24)	07:47	08:09 (T-37)	07:29	08:00	
	21:08	20:29	40 20:04 (T-25)	19:34	15 19:09 (T-24)	18:37	9 08:18 (T-37)	16:56	16:49	
20	06:00	06:35	19:23 (T-25)	07:11	18:53 (T-24)	07:48	08:10 (T-37)	07:30	08:00	
	21:07	20:28	39 20:02 (T-25)	19:32	14 19:07 (T-24)	18:36	8 08:18 (T-37)	16:55	16:49	
21	06:01	06:36	19:23 (T-25)	07:12	18:54 (T-24)	07:50	08:11 (T-37)	07:31	08:01	
	21:07	20:26	38 20:01 (T-25)	19:30	10 19:04 (T-24)	18:34	6 08:17 (T-37)	16:55	16:49	
22	06:02	06:37	19:23 (T-25)	07:14	18:55 (T-24)	07:51	08:13 (T-37)	07:32	08:01	
	21:06	20:24	36 19:59 (T-25)	19:28	8 19:03 (T-24)	18:32	4 08:17 (T-37)	16:54	16:50	
23	06:03	06:38	19:24 (T-25)	07:15	18:55 (T-24)	07:52	08:14 (T-37)	07:34	08:02	
	21:05	20:23	34 19:58 (T-25)	19:26	6 19:01 (T-24)	18:31	2 08:16 (T-37)	16:53	16:50	
24	06:04	06:39	19:24 (T-25)	07:16	18:56 (T-24)	07:53		07:35	08:02	
	21:04	20:21	32 19:56 (T-25)	19:24	3 18:59 (T-24)	18:29		16:52	16:51	
25	06:05	06:41	19:24 (T-25)	07:17		07:55		07:36	08:03	
	21:03	20:19	31 19:55 (T-25)	19:22		18:28		16:52	16:52	
26	06:06	06:42	19:24 (T-25)	07:18		07:56		07:37	08:03	
	21:02	20:18	29 19:53 (T-25)	19:20		18:26		16:51	16:52	
27	06:07	06:43	19:25 (T-25)	07:20		07:57		07:39	08:03	
	21:01	20:16	26 19:51 (T-25)	19:19		18:24		16:51	16:53	
28	06:08	06:44	19:25 (T-25)	07:21		07:59		07:40	08:04	
	21:00	20:14	24 19:49 (T-25)	19:17		18:23		16:50	16:54	
29	06:09	06:45	19:26 (T-25)	07:22		08:00		07:41	08:04	
	20:59	20:12	21 19:47 (T-25)	19:15		18:21		16:49	16:54	
30	06:11	19:44 (T-25)	06:47	19:27 (T-25)	07:23	08:02		07:42	08:04	
	20:57	12 19:56 (T-25)	20:11	18 19:45 (T-25)	19:13	18:20		16:49	16:55	
31	06:12	19:41 (T-25)	06:48	19:29 (T-25)		08:03		08:04	08:04	
	20:56	18 19:59 (T-25)	20:09	15 19:44 (T-25)		18:19		16:56	16:56	
Potential sun hours	471		436		377		341		289	275
Total, worst case	30		1074		299		204			
Sun reduction	0.75		0.72		0.67		0.56			
Oper. time red.	0.90		0.90		0.90		0.90			
Wind dir. red.	0.60		0.60		0.59		0.59			
Total reduction	0.40		0.39		0.36		0.30			
Total, real	12		415		107		61			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-181 - R-181
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	
1	08:04	08:29 (T-37)	07:47		07:09	06:18	05:45
	16:57	35 09:04 (T-37)	17:35		19:53	20:30	21:04
2	08:05	08:30 (T-37)	07:46		07:08	06:17	05:45
	16:58	35 09:05 (T-37)	17:37		19:54	20:31	21:05
3	08:05	08:30 (T-37)	07:45		07:06	06:15	05:44
	16:59	35 09:05 (T-37)	17:38		19:55	20:33	21:06
4	08:05	08:31 (T-37)	07:44		07:04	06:14	05:44
	17:00	34 09:05 (T-37)	17:39		19:56	20:34	21:07
5	08:04	08:32 (T-37)	07:42	08:04 (T-38)	06:59		
	17:01	34 09:06 (T-37)	17:41	1 08:05 (T-38)	18:18		
6	08:04	08:32 (T-37)	07:41	08:03 (T-38)	06:57		
	17:02	33 09:05 (T-37)	17:42	3 08:06 (T-38)	18:20		
7	08:04	08:32 (T-37)	07:40	08:01 (T-38)	06:56		
	17:03	34 09:06 (T-37)	17:44	6 08:07 (T-38)	18:21		
8	08:04	08:33 (T-37)	07:39	08:00 (T-38)	07:54		
	17:04	33 09:06 (T-37)	17:45	8 08:08 (T-38)	18:22		
9	08:04	08:35 (T-37)	07:37	07:59 (T-38)	07:52		
	17:05	32 09:07 (T-37)	17:47	10 08:09 (T-38)	19:23		
10	08:03	08:35 (T-37)	07:36	07:57 (T-38)	07:50		
	17:06	31 09:06 (T-37)	17:48	12 08:09 (T-38)	19:25		
11	08:03	08:36 (T-37)	07:34	07:56 (T-38)	07:48		
	17:07	30 09:06 (T-37)	17:49	13 08:09 (T-38)	19:26		
12	08:03	08:36 (T-37)	07:33	07:54 (T-38)	07:47		
	17:09	30 09:06 (T-37)	17:51	15 08:09 (T-38)	19:27		
13	08:02	08:38 (T-37)	07:32	07:53 (T-38)	07:45		
	17:10	28 09:06 (T-37)	17:52	17 08:10 (T-38)	19:29		
14	08:02	08:38 (T-37)	07:30	07:51 (T-38)	07:43		
	17:11	27 09:05 (T-37)	17:54	18 08:09 (T-38)	19:30		
15	08:01	08:40 (T-37)	07:29	07:50 (T-38)	07:41		
	17:12	25 09:05 (T-37)	17:55	19 08:09 (T-38)	19:31		
16	08:01	08:41 (T-37)	07:27	07:48 (T-38)	07:39		
	17:13	23 09:04 (T-37)	17:56	20 08:08 (T-38)	19:33		
17	08:00	08:42 (T-37)	07:26	07:47 (T-38)	07:37		
	17:15	21 09:03 (T-37)	17:58	21 08:08 (T-38)	19:34		
18	08:00	08:44 (T-37)	07:24	07:45 (T-38)	07:35		
	17:16	19 09:03 (T-37)	17:59	21 08:06 (T-38)	19:35		
19	07:59	08:46 (T-37)	07:23	07:47 (T-38)	07:34	19:14 (T-25)	06:37
	17:17	16 09:02 (T-37)	18:01	18 08:05 (T-38)	19:36	1 19:15 (T-25)	20:15
20	07:58	08:48 (T-37)	07:21	07:49 (T-38)	07:32	07:52 (T-82)	06:36
	17:19	11 08:59 (T-37)	18:01	14 08:03 (T-38)	19:38	6 19:16 (T-25)	20:16
21	07:58		07:19	07:51 (T-38)	07:30	07:50 (T-82)	06:34
	17:20		18:02	9 08:00 (T-38)	19:39	12 19:18 (T-25)	20:18
22	07:57		07:18	07:28	07:28	07:48 (T-82)	06:32
	17:21		18:03		19:40	16 19:19 (T-25)	20:19
23	07:56		07:16	07:26	07:26	07:46 (T-82)	06:31
	17:23		18:05	19:41	20	19:20 (T-25)	20:20
24	07:55		07:14	07:24	07:24	07:45 (T-82)	06:29
	17:24		18:06	19:43	22	19:22 (T-25)	20:21
25	07:54		07:13	07:22	07:22	07:43 (T-82)	06:28
	17:25		18:07	19:44	24	19:23 (T-25)	20:23
26	07:53		07:11	07:21	07:21	07:41 (T-82)	06:26
	17:27		18:09	19:45	28	19:24 (T-25)	20:24
27	07:52		07:09	07:19	07:19	07:39 (T-82)	06:24
	17:28		18:10	19:46	29	19:25 (T-25)	20:25
28	07:51		07:08	07:17	07:17	07:37 (T-82)	06:23
	17:30		18:12	19:48	30	19:26 (T-25)	20:26
29	07:50			07:15	07:15	07:35 (T-82)	06:21
	17:31			19:49	30	19:27 (T-25)	20:28
30	07:49			07:13	07:13	07:36 (T-82)	06:20
	17:32			19:50	23	19:25 (T-25)	20:29
31	07:48			07:11	07:11	19:15 (T-25)	05:46
	17:34			19:51	6	19:21 (T-25)	21:03
Potential sun hours	287	292	369		403	459	465
Total, worst case	566	225	247			98	
Sun reduction	0.58	0.58	0.59			0.66	
Oper. time red.	0.90	0.90	0.90			0.90	
Wind dir. red.	0.67	0.63	0.59			0.59	
Total reduction	0.35	0.33	0.32			0.35	
Total, real	198	74	78			34	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
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1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-181 - R-181
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:36 (T-93) 06:47 (T-93)	06:49 20:07	07:24 19:11	07:04 17:17
2	05:46 21:17	06:14 20:54	06:37 (T-93) 06:47 (T-93)	06:50 20:05	07:26 19:09	07:06 17:16
3	05:46 21:16	06:15 20:53	06:38 (T-93) 06:48 (T-93)	06:51 20:03	07:27 19:07	07:07 17:14
4	05:47 21:16	06:16 20:51	06:39 (T-93) 06:48 (T-93)	06:52 20:02	07:28 19:05	07:08 17:13
5	05:48 21:16	06:17 20:50	06:41 (T-93) 06:49 (T-93)	06:54 20:00	07:29 19:04	07:10 17:12
6	05:48 21:16	06:18 20:49	06:42 (T-93) 06:49 (T-93)	06:55 19:58	07:30 19:02	07:11 17:10
7	05:49 21:15	06:20 20:47	06:43 (T-93) 06:49 (T-93)	06:56 19:56	07:32 19:00	07:12 17:09
8	05:50 21:15	06:21 20:46	06:44 (T-93) 06:49 (T-93)	06:57 19:54	07:33 18:56	07:14 17:08
9	05:50 21:14	06:22 20:44	06:45 (T-93) 06:48 (T-93)	06:58 19:52	07:34 18:55	07:15 17:07
10	05:51 21:14	06:23 20:43	06:46 (T-93) 06:48 (T-93)	06:59 19:51	07:35 18:53	07:16 17:05
11	05:52 21:13	06:24 20:42	06:49 (T-93) 07:02	07:01 19:49	07:37 18:51	07:18 17:04
12	05:53 21:13	06:25 20:40	07:02 19:47	19:08 (T-25) 19:13 (T-25)	07:38 18:49	07:19 17:03
13	05:54 21:12	06:26 20:39	07:03 19:45	07:39 19:16 (T-25)	07:39 18:47	07:20 17:02
14	05:54 21:12	06:28 20:37	07:04 19:43	07:25 (T-82) 19:17 (T-25)	07:40 18:46	07:22 17:01
15	05:55 21:11	06:29 20:36	07:05 19:41	07:27 (T-82) 19:17 (T-25)	07:42 18:44	07:23 17:00
16	05:56 21:10	06:30 20:34	07:06 19:39	07:28 (T-82) 19:15 (T-25)	07:43 18:42	07:25 16:59
17	05:57 21:10	06:31 20:32	07:08 19:37	07:29 (T-82) 19:13 (T-25)	07:44 18:41	07:26 16:58
18	05:58 21:09	06:32 20:31	07:09 19:36	07:30 (T-82) 19:11 (T-25)	07:46 18:39	07:27 16:57
19	05:59 21:08	06:34 20:29	07:10 19:34	07:31 (T-82) 19:09 (T-25)	07:47 18:37	07:28 16:56
20	06:00 21:07	06:35 20:28	07:11 19:32	07:32 (T-82) 19:07 (T-25)	07:48 18:35	07:30 16:55
21	06:01 21:07	06:36 20:26	07:12 19:30	07:33 (T-82) 19:04 (T-25)	07:49 18:34	07:31 16:55
22	06:02 21:06	06:37 20:24	07:13 19:28	07:35 (T-82) 19:03 (T-25)	07:51 18:32	07:32 16:54
23	06:03 21:05	06:38 20:23	07:15 19:26	07:36 (T-82) 19:01 (T-25)	07:52 18:31	07:34 16:53
24	06:04 21:04	06:39 20:21	07:16 19:24	07:37 (T-82) 18:59 (T-25)	07:53 18:29	07:35 16:52
25	06:05 21:03	06:41 20:19	07:17 19:22	07:55 18:27	07:55 18:27	07:36 16:52
26	06:06 21:02	06:42 20:18	07:18 19:20	07:56 18:26	07:56 18:26	07:37 16:51
27	06:07 21:01	06:43 20:16	07:19 19:19	07:57 18:24	07:57 18:24	07:39 16:50
28	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23	07:59 18:23	07:40 16:50
29	06:09 20:59	06:35 (T-93) 06:42 (T-93)	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49
30	06:10 20:57	06:34 (T-93) 06:44 (T-93)	06:46 20:11	07:23 19:13	08:01 18:20	07:42 16:49
31	06:12 20:56	06:35 (T-93) 06:46 (T-93)	06:48 20:09	07:24 19:13	08:02 18:18	07:43 16:49
Potential sun hours	471	436	377	341	289	275
Total, worst case	28	71	249	187	237	1042
Sun reduction	0.75	0.72	0.67	0.56	0.48	0.52
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90
Wind dir. red.	0.59	0.59	0.59	0.63	0.66	0.67
Total reduction	0.40	0.38	0.36	0.32	0.29	0.31
Total, real	11	27	89	60	68	326

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project: South Deuel Wind Project	Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024	Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366
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SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-183 - R-183
 Assumptions for shadow calculations Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December					
1	08:05	08:29 (T-93)	07:47	16:44 (T-27)	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43		16:20 (T-27)	
1	16:57	08:43 (T-93)	17:35	16:46 (T-27)	17:00 (T-27)	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:49	2	16:22 (T-27)
2	08:05	08:29 (T-93)	07:46	16:46 (T-27)	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45			07:45
31	07:48	16:42 (T-27)	07:11	07:11	06:20	05:47	05:45	06:10	06:46	07:23	08:01	07:42	08:04	08:29			08:29 (T-93)
17:34	19	17:01 (T-27)			19:51	21:03	20:56	20:09			18:18			16:56	14		08:23 (T-93)
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289			275			354
Total, worst case	393	37										336					0.52
Sun reduction	0.58	0.58									0.48						0.90
Oper. time red.	0.90	0.90									0.90						0.66
Wind dir. red.	0.60	0.59									0.59						0.31
Total reduction	0.32	0.31									0.25						0.31
Total, real	124	11									85						109

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-184 - R-184

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum		
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-82) 07:47	08:20 (T-82) 07:06	07:27 (T-31) 07:09	06:18	06:45 (T-93) 05:45
2	16:57 17 08:46 (T-82) 17:35 35 08:55 (T-82) 18:13 4 07:31 (T-31) 19:53	08:29 (T-82) 07:46	08:22 (T-82) 07:04	07:25 (T-31) 07:08	20:30 49 20:06 (T-28) 21:04	06:17 06:46 (T-93) 05:45
3	16:58 17 08:46 (T-82) 17:37 33 08:55 (T-82) 18:14 6 07:31 (T-31) 19:54	08:29 (T-82) 07:45	08:23 (T-82) 07:03	07:23 (T-31) 07:06	20:31 50 20:08 (T-28) 21:05	06:15 06:48 (T-93) 05:44
4	16:59 18 08:47 (T-82) 17:38 31 08:54 (T-82) 18:15 8 07:31 (T-31) 19:55	08:29 (T-82) 07:44	08:24 (T-82) 07:01	07:21 (T-31) 07:04	20:32 48 20:09 (T-28) 21:06	06:14 06:48 (T-93) 05:44
5	17:00 19 08:48 (T-82) 17:39 28 08:52 (T-82) 18:17 10 07:31 (T-31) 19:56	08:29 (T-82) 07:42	08:26 (T-82) 06:59	07:20 (T-31) 07:02	20:34 48 20:10 (T-28) 21:07	06:13 06:49 (T-93) 05:43
6	17:01 20 08:49 (T-82) 17:41 25 08:51 (T-82) 18:18 11 07:31 (T-31) 19:58	08:29 (T-82) 07:41	08:28 (T-82) 06:57	07:18 (T-31) 07:00	20:35 47 20:11 (T-28) 21:07	06:12 06:51 (T-93) 05:43
7	17:02 21 08:49 (T-82) 17:42 21 08:49 (T-82) 18:19 12 07:30 (T-31) 19:59	08:28 (T-82) 07:40	08:30 (T-82) 06:55	07:16 (T-31) 06:58	20:36 46 20:13 (T-28) 21:08	06:11 06:52 (T-93) 05:43
8	17:03 22 08:50 (T-82) 17:44 16 08:46 (T-82) 18:21 13 07:29 (T-31) 20:00	08:28 (T-82) 07:38	08:35 (T-82) 07:54	08:14 (T-31) 06:57	20:37 44 20:13 (T-28) 21:09	06:10 06:54 (T-93) 05:42
9	17:04 23 08:51 (T-82) 17:45 7 08:42 (T-82) 18:22 14 08:28 (T-31) 20:01	08:28 (T-82) 07:37	08:42 (T-82) 18:22	08:13 (T-31) 06:55	20:39 41 20:14 (T-28) 21:10	06:09 06:57 (T-93) 05:42
10	17:05 24 08:52 (T-82) 17:46 12 08:25 (T-31) 20:03 5 07:20 (T-93) 20:40 37 20:16 (T-28) 21:10	08:27 (T-82) 07:36	19:23 12 08:25 (T-31) 20:03 5 07:20 (T-93) 20:40 37 20:16 (T-28) 21:10	08:17 (T-31) 06:53	20:41 25 20:17 (T-28) 21:11	06:08 19:52 (T-28) 05:42
11	17:06 25 08:52 (T-82) 17:48 11 08:03 08:27 (T-82) 07:34 17:07 26 08:53 (T-82) 17:49	08:26 (T-82) 07:33	19:25 6 08:23 (T-31) 20:04 9 07:22 (T-93) 20:41 25 20:17 (T-28) 21:11	08:23 (T-31) 20:04 9 07:22 (T-93) 20:41 25 20:17 (T-28) 21:11	20:42 25 20:17 (T-28) 21:12	06:07 19:52 (T-28) 05:42
12	17:07 26 08:53 (T-82) 17:49 12 08:03 08:26 (T-82) 07:33 17:09 27 08:53 (T-82) 17:51	07:33	07:46 12 08:25 (T-31) 20:03 5 07:20 (T-93) 20:40 37 20:16 (T-28) 21:10	20:05 12 07:24 (T-93) 20:42 25 20:17 (T-28) 21:12	20:43 27 20:19 (T-28) 21:12	06:06 19:52 (T-28) 05:41
13	17:08 28 08:54 (T-82) 17:52 14 08:02 08:25 (T-82) 07:30 17:11 29 08:54 (T-82) 17:54	07:32	07:45 18 07:26 (T-93) 20:44 27 20:20 (T-28) 21:13	20:06 15 07:25 (T-93) 20:43 27 20:19 (T-28) 21:12	20:44 27 20:20 (T-28) 21:13	06:05 19:53 (T-28) 05:41
14	17:09 29 08:55 (T-82) 17:55 15 08:01 08:25 (T-82) 07:29 17:12 30 08:55 (T-82) 17:55	07:30	07:43 20 07:26 (T-93) 20:46 27 20:20 (T-28) 21:13	20:07 18 07:26 (T-93) 20:46 27 20:20 (T-28) 21:13	20:45 26 20:20 (T-28) 21:14	06:04 19:54 (T-28) 05:41
15	17:10 31 08:56 (T-82) 17:56 16 08:02 08:23 (T-82) 07:26 17:13 32 08:55 (T-82) 17:58	07:29	07:41 23 07:28 (T-93) 20:47 26 20:20 (T-28) 21:14	20:08 20 07:26 (T-93) 20:46 27 20:20 (T-28) 21:13	20:46 26 20:20 (T-28) 21:14	06:03 19:55 (T-28) 05:41
16	17:11 32 08:56 (T-82) 17:59 17 08:00 08:23 (T-82) 07:26 17:14 33 08:56 (T-82) 17:59	07:27	07:39 25 07:28 (T-93) 20:49 23 20:18 (T-28) 21:15	20:09 20 07:26 (T-93) 20:46 27 20:20 (T-28) 21:13	20:47 26 20:20 (T-28) 21:14	06:02 19:55 (T-28) 05:41
17	17:12 33 08:57 (T-82) 17:59 18 08:01 08:23 (T-82) 07:26 17:15 34 08:57 (T-82) 17:59	07:26	07:38 27 07:28 (T-93) 20:49 23 20:18 (T-28) 21:15	20:10 23 07:28 (T-93) 20:47 26 20:20 (T-28) 21:14	20:48 24 20:19 (T-28) 21:14	06:01 19:55 (T-28) 05:41
18	17:13 34 08:57 (T-82) 17:59 19 07:59 08:22 (T-82) 07:23 17:17 35 08:57 (T-82) 18:01	07:25	07:37 29 07:29 (T-93) 20:50 22 20:18 (T-28) 21:15	20:11 25 07:28 (T-93) 20:49 23 20:18 (T-28) 21:15	20:49 23 20:18 (T-28) 21:15	06:00 19:56 (T-28) 05:41
19	17:14 35 08:57 (T-82) 18:01 20 07:58 08:21 (T-82) 07:21 17:19 36 08:57 (T-82) 18:01	07:24	07:36 30 07:28 (T-93) 20:51 20 20:17 (T-28) 21:15	20:12 27 07:28 (T-93) 20:49 23 20:18 (T-28) 21:15	20:50 22 20:18 (T-28) 21:15	06:00 19:57 (T-28) 05:41
20	17:15 36 08:57 (T-82) 18:01 21 07:57 08:20 (T-82) 07:19 17:20 37 08:57 (T-82) 18:02	07:23	07:35 31 07:28 (T-93) 20:52 18 20:16 (T-28) 21:16	20:13 27 07:28 (T-93) 20:49 23 20:18 (T-28) 21:15	20:51 20 20:17 (T-28) 21:15	06:00 19:58 (T-28) 05:41
21	17:16 37 08:57 (T-82) 18:02 22 07:57 08:19 (T-82) 07:18 17:21 38 08:57 (T-82) 18:03	07:22	07:34 32 07:28 (T-93) 20:52 18 20:16 (T-28) 21:16	20:14 29 07:29 (T-93) 20:50 22 20:18 (T-28) 21:15	20:52 18 20:16 (T-28) 21:16	06:00 20:00 (T-28) 05:42
22	17:17 38 08:57 (T-82) 18:03 23 07:56 08:19 (T-82) 07:16 17:22 39 08:58 (T-82) 18:05	07:21	07:33 34 07:29 (T-93) 20:53 14 20:14 (T-28) 21:16	20:15 30 07:28 (T-93) 20:51 20 20:17 (T-28) 21:15	20:53 14 20:14 (T-28) 21:16	06:00 20:01 (T-28) 05:42
23	17:18 39 08:58 (T-82) 18:05 24 07:55 08:18 (T-82) 07:14 17:23 40 08:58 (T-82) 18:06	07:20	07:32 35 07:28 (T-93) 20:54 11 20:12 (T-28) 21:16	20:16 32 07:28 (T-93) 20:52 18 20:16 (T-28) 21:16	20:54 11 20:12 (T-28) 21:16	06:00 20:05 (T-28) 05:42
24	17:19 40 08:58 (T-82) 18:06 25 07:54 08:17 (T-82) 07:13 17:24 41 08:58 (T-82) 18:07	07:19	07:31 36 07:27 (T-93) 20:56 5 20:10 (T-28) 21:16	20:17 33 07:29 (T-93) 20:53 14 20:14 (T-28) 21:16	20:55 5 20:10 (T-28) 21:16	06:00 20:10 (T-28) 05:42
25	17:20 41 08:58 (T-82) 18:07 26 07:53 08:16 (T-82) 07:11 17:25 42 08:58 (T-82) 18:09	07:18	07:30 37 07:28 (T-93) 20:57 21:17	20:18 34 07:29 (T-93) 20:53 14 20:14 (T-28) 21:16	20:56 5 20:10 (T-28) 21:16	06:00 20:11 (T-28) 05:43
26	17:21 42 08:58 (T-82) 18:09 27 07:52 08:17 (T-82) 07:09 17:26 43 08:58 (T-82) 18:10	07:17	07:29 38 07:28 (T-93) 20:57 21:17	20:19 35 07:28 (T-93) 20:54 11 20:12 (T-28) 21:16	20:57 21:17	06:00 20:12 (T-28) 05:43
27	17:22 43 08:58 (T-82) 18:10 28 07:51 08:18 (T-82) 07:08 17:27 44 08:58 (T-82) 18:11	07:16	07:28 39 07:27 (T-93) 20:58 21:17	20:20 36 07:27 (T-93) 20:56 5 20:10 (T-28) 21:16	20:58 21:17	06:00 20:13 (T-28) 05:44
28	17:23 44 08:58 (T-82) 18:11 29 07:50 08:17 (T-82) 07:15 17:28 45 08:58 (T-82) 18:12	07:15	07:27 40 06:47 (T-93) 05:49 21:17	20:21 37 07:28 (T-93) 20:57 21:17	20:59 21:17	06:00 20:14 (T-28) 05:44
29	17:24 45 08:58 (T-82) 18:12 30 07:49 08:18 (T-82) 07:13 17:29 46 08:58 (T-82) 18:13	07:14	07:26 41 06:45 (T-93) 05:49 21:17	20:22 38 06:48 (T-93) 05:50 05:43	20:60 49 20:06 (T-28) 21:02 21:02	06:00 20:15 (T-28) 05:45
30	17:25 46 08:58 (T-82) 18:13 31 07:48 08:19 (T-82) 07:11 17:30 47 08:58 (T-82) 18:14	07:13	07:25 42 20:02 (T-28) 21:00 21:17	20:23 39 07:27 (T-93) 20:58 21:17	20:61 50 20:07 (T-28) 21:03 21:03	06:00 20:16 (T-28) 05:45
31	17:31 47 08:57 (T-82) 18:14 32 07:47 08:19 (T-82) 07:10 17:32 48 08:57 (T-82) 18:15	07:12	07:24 43 06:45 (T-93) 05:48 21:17	20:24 40 06:47 (T-93) 05:49 21:17	20:62 51 20:08 (T-28) 21:04 21:04	06:00 20:17 (T-28) 05:45
Potential sun hours	287	292	369	403	459	465
Total, worst case	947	198	96	649	704	
Sun reduction	0.58	0.58	0.59	0.63	0.66	
Oper. time red.	0.90	0.90	0.90	0.90	0.90	
Wind dir. red.	0.65	0.65	0.60	0.58	0.61	
Total reduction	0.34	0.34	0.32	0.33	0.36	
Total, real	323	67	31	213	255	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-184 - R-184

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December	
1	05:45	06:13	20:03 (T-28) 06:49	07:11 (T-93) 07:24	07:04	07:43	
	21:17	20:55	26 20:29 (T-28) 20:07	12 07:23 (T-93) 19:11	17:17	16:49	
2	05:46	06:14	20:02 (T-28) 06:50	07:12 (T-93) 07:25	07:05	07:45	
	21:16	20:54	25 20:27 (T-28) 20:05	9 07:21 (T-93) 19:09	17:16	16:48	
3	05:46	06:15	07:10 (T-93) 06:51	07:13 (T-93) 07:27	07:07	07:46	
	21:16	20:53	31 20:26 (T-28) 20:03	5 07:18 (T-93) 19:07	17:14	16:48	
4	05:47	06:16	07:06 (T-93) 06:52	07:28	9 08:13 (T-82) 16:48	24 08:35 (T-82)	
	21:16	20:51	38 20:25 (T-28) 20:02	19:05	17:14	16:48	
5	05:48	06:17	07:03 (T-93) 06:53	10 08:02 (T-31) 17:13	17 08:16 (T-82) 16:48	23 08:35 (T-82)	
	21:16	20:50	42 20:24 (T-28) 20:00	07:29	17:10	16:48	
6	05:48	06:18	07:02 (T-93) 06:55	14 08:04 (T-31) 17:12	21 08:19 (T-82) 16:47	22 08:35 (T-82)	
	21:16	20:49	45 20:23 (T-28) 19:58	07:30	17:11	16:47	
7	05:49	06:19	07:00 (T-93) 06:56	13 08:05 (T-31) 17:10	26 08:21 (T-82) 16:47	21 08:35 (T-82)	
	21:15	20:47	47 20:22 (T-28) 19:56	19:02	17:10	16:47	
8	05:50	06:21	06:59 (T-93) 06:57	13 07:53 (T-31) 07:12	29 08:23 (T-82) 16:47	20 08:35 (T-82)	
	21:15	20:46	47 20:20 (T-28) 19:54	07:32	17:09	16:47	
9	05:50	06:22	06:57 (T-93) 06:58	12 07:54 (T-31) 07:14	31 08:24 (T-82) 16:47	19 08:35 (T-82)	
	21:14	20:44	48 20:19 (T-28) 19:52	18:56	17:08	16:47	
10	05:51	06:23	06:56 (T-93) 06:59	11 07:55 (T-31) 07:15	34 08:26 (T-82) 16:47	18 08:35 (T-82)	
	21:14	20:43	48 20:17 (T-28) 19:50	18:54	17:07	16:47	
11	05:52	06:24	06:55 (T-93) 07:00	9 08:06 (T-31) 17:05	35 08:26 (T-82) 16:47	17 08:35 (T-82)	
	21:13	20:42	49 20:16 (T-28) 19:49	07:37	17:18	16:47	
12	05:53	06:25	06:54 (T-93) 07:02	7 08:05 (T-31) 17:04	37 08:28 (T-82) 16:47	17 08:36 (T-82)	
	21:13	20:40	47 20:14 (T-28) 19:47	07:38	17:19	16:47	
13	05:54	06:26	06:53 (T-93) 07:03	6 08:05 (T-31) 17:03	38 08:28 (T-82) 16:47	16 08:36 (T-82)	
	21:12	20:39	48 20:13 (T-28) 19:45	07:39	17:20	16:47	
14	05:54	06:28	06:52 (T-93) 07:04	3 08:04 (T-31) 17:02	40 08:29 (T-82) 16:47	15 08:36 (T-82)	
	21:12	20:37	46 20:11 (T-28) 19:43	07:40	17:22	16:47	
15	05:55	06:29	06:52 (T-93) 07:05	1 08:03 (T-31) 17:01	41 08:30 (T-82) 16:47	15 08:37 (T-82)	
	21:11	20:36	44 20:11 (T-28) 19:41	18:46	17:01	16:47	
16	05:56	06:30	06:53 (T-93) 07:06	07:42	41 08:30 (T-82) 16:47	14 08:37 (T-82)	
	21:10	20:34	40 07:33 (T-93) 19:39	07:43	17:00	16:47	
17	05:57	06:31	06:54 (T-93) 07:08	07:43	42 08:31 (T-82) 16:47	14 08:37 (T-82)	
	21:10	20:32	40 07:34 (T-93) 19:37	07:44	17:02	16:47	
18	05:58	06:32	06:55 (T-93) 07:09	07:44	41 08:31 (T-82) 16:48	13 08:37 (T-82)	
	21:09	20:31	38 07:33 (T-93) 19:35	18:40	17:02	16:48	
19	05:59	06:33	06:56 (T-93) 07:10	07:46	40 08:32 (T-82) 16:48	13 08:38 (T-82)	
	21:08	20:29	37 07:33 (T-93) 19:34	18:39	17:02	16:48	
20	06:00	06:35	06:57 (T-93) 07:11	07:47	39 08:32 (T-82) 16:48	13 08:38 (T-82)	
	21:07	20:28	36 07:33 (T-93) 19:32	18:37	17:03	16:48	
21	06:01	20:13 (T-28)	06:36	06:58 (T-93) 07:12	18:35	38 08:32 (T-82) 16:49	13 08:39 (T-82)
	21:07	9 20:22 (T-28)	06:36	07:12	18:35	38 08:32 (T-82) 16:49	13 08:39 (T-82)
22	06:02	20:11 (T-28)	06:37	06:59 (T-93) 07:13	18:34	37 08:33 (T-82) 16:49	13 08:39 (T-82)
	21:06	13 20:24 (T-28)	06:37	07:13	18:34	37 08:33 (T-82) 16:49	13 08:39 (T-82)
23	06:03	20:09 (T-28)	06:38	07:01 (T-93) 07:15	18:33	36 08:33 (T-82) 16:50	13 08:40 (T-82)
	21:05	16 20:25 (T-28)	06:38	07:15	18:32	36 08:33 (T-82) 16:50	13 08:40 (T-82)
24	06:04	20:08 (T-28)	06:39	07:02 (T-93) 07:16	18:31	35 08:34 (T-82) 16:50	13 08:40 (T-82)
	21:04	19 20:27 (T-28)	06:39	07:16	18:31	35 08:34 (T-82) 16:50	13 08:40 (T-82)
25	06:05	20:07 (T-28)	06:41	07:03 (T-93) 07:17	18:30	34 08:34 (T-82) 16:51	13 08:41 (T-82)
	21:03	21 20:28 (T-28)	06:41	07:17	18:29	34 08:34 (T-82) 16:51	13 08:41 (T-82)
26	06:06	20:06 (T-28)	06:42	07:04 (T-93) 07:18	18:28	33 08:34 (T-82) 16:51	13 08:41 (T-82)
	21:02	23 20:29 (T-28)	06:42	07:18	18:27	33 08:34 (T-82) 16:51	13 08:41 (T-82)
27	06:07	20:06 (T-28)	06:43	07:05 (T-93) 07:19	18:26	31 08:34 (T-82) 16:52	13 08:41 (T-82)
	21:01	23 20:29 (T-28)	06:43	07:19	18:25	31 08:34 (T-82) 16:52	13 08:41 (T-82)
28	06:08	20:05 (T-28)	06:44	07:06 (T-93) 07:21	18:24	30 08:34 (T-82) 16:53	14 08:42 (T-82)
	21:00	25 20:30 (T-28)	06:44	07:21	18:23	30 08:34 (T-82) 16:53	14 08:42 (T-82)
29	06:09	20:04 (T-28)	06:45	07:07 (T-93) 07:22	18:22	29 08:34 (T-82) 16:54	14 08:43 (T-82)
	20:58	27 20:31 (T-28)	06:45	07:22	18:21	29 08:34 (T-82) 16:54	14 08:43 (T-82)
30	06:10	20:04 (T-28)	06:46	07:08 (T-93) 07:23	18:20	28 08:34 (T-82) 16:54	15 08:44 (T-82)
	20:57	27 20:31 (T-28)	06:46	07:23	18:20	28 08:34 (T-82) 16:54	15 08:44 (T-82)
31	06:12	20:03 (T-28)	06:48	07:10 (T-93) 19:13	18:19	27 08:35 (T-82) 16:55	15 08:44 (T-82)
	20:56	27 20:30 (T-28)	06:48	19:13	18:18	27 08:35 (T-82) 16:55	15 08:44 (T-82)
Potential sun hours	471	436	377	341	289	275	
Total, worst case	230	1107	26	99	919	510	
Sun reduction	0.75	0.72	0.67	0.56	0.48	0.52	
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90	
Wind dir. red.	0.62	0.59	0.57	0.60	0.65	0.65	
Total reduction	0.42	0.38	0.35	0.30	0.28	0.31	
Total, real	97	422	9	30	259	156	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-185 - R-185
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January			February			March			April			May		June	
1	08:05		08:35 (T-82)	07:47			07:06		07:27 (T-93)	07:09		18:30 (T-28)	06:18		05:45	
	16:57	16	08:51 (T-82)	17:35			18:13	19	07:46 (T-93)	19:53	59	19:30 (T-27)	20:30		21:04	
2	08:05		08:36 (T-82)	07:46			07:04		07:25 (T-93)	07:08		18:31 (T-28)	06:17		05:45	
	16:58	15	08:51 (T-82)	17:37			18:14	20	07:45 (T-93)	19:54	54	19:29 (T-27)	20:31		21:05	
3	08:05		08:37 (T-82)	07:45			07:03		07:23 (T-93)	07:06		18:33 (T-28)	06:15		05:44	
	16:59	14	08:51 (T-82)	17:38			18:16	22	07:45 (T-93)	19:55	47	19:27 (T-27)	20:33		21:06	
4	08:05		08:38 (T-82)	07:44			07:01		07:21 (T-93)	07:04		18:35 (T-28)	06:14		05:44	
	17:00	13	08:51 (T-82)	17:39			18:17	22	07:43 (T-93)	19:56	39	19:25 (T-27)	20:34		21:07	
5	08:04		08:39 (T-82)	07:42			06:59		07:21 (T-93)	07:02		18:38 (T-28)	06:13		05:43	
	17:01	11	08:50 (T-82)	17:41			18:18	22	07:43 (T-93)	19:58	27	19:22 (T-27)	20:35		21:08	
6	08:04		08:40 (T-82)	07:41			06:57		07:22 (T-93)	07:00			06:11		05:43	
	17:02	9	08:49 (T-82)	17:42			18:20	29	17:58 (T-28)	19:59			20:36		21:08	
7	08:04		08:43 (T-82)	07:40			06:56		07:23 (T-93)	06:58			06:10		05:43	
	17:03	5	08:48 (T-82)	17:44			18:21	31	17:59 (T-28)	20:00			20:37		21:09	
8	08:04			07:39			07:54		08:26 (T-93)	06:57			06:09		05:42	
	17:04			17:45			18:22	30	19:00 (T-28)	20:01			20:39		21:10	
9	08:04			07:37			07:52		18:38 (T-28)	06:55			06:07		05:42	
	17:05			17:46			19:23	24	19:02 (T-28)	20:03			20:40		21:10	
10	08:03			07:36			07:50		18:37 (T-28)	06:53			06:06		05:42	
	17:06			17:48			19:25	27	19:04 (T-28)	20:04			20:41		21:11	
11	08:03			07:34			07:48		18:35 (T-28)	06:51			06:05		05:42	
	17:07			17:49			19:26	30	19:05 (T-28)	20:05			20:42		21:12	
12	08:03			07:33			07:46		18:33 (T-28)	06:50			06:03		05:41	
	17:09			17:51			19:27	33	19:06 (T-28)	20:06			20:43		21:12	
13	08:02			07:32			07:45		18:32 (T-28)	06:48			06:02		05:41	
	17:10			17:52			19:29	35	19:07 (T-28)	20:08			20:44		21:13	
14	08:02			07:30			07:43		18:30 (T-28)	06:46			06:01		05:41	
	17:11			17:54			19:30	38	19:08 (T-28)	20:09			20:46		21:13	
15	08:01			07:29			07:41		18:29 (T-28)	06:44			06:00		05:41	
	17:12			17:55			19:31	41	19:10 (T-28)	20:10			20:47		21:14	
16	08:01			07:27			07:39		18:28 (T-28)	06:43			05:59		05:41	
	17:13			17:56			19:33	43	19:11 (T-28)	20:11			20:48		21:14	
17	08:00			07:26			07:37		18:28 (T-28)	06:41			05:58		05:41	
	17:15			17:58			19:34	45	19:13 (T-28)	20:13			20:49		21:15	
18	08:00			07:24			07:35		18:27 (T-28)	06:39			05:57		05:41	
	17:16			17:59			19:35	47	19:14 (T-28)	20:14			20:50		21:15	
19	07:59			07:23			07:34		18:27 (T-28)	06:37			05:56		05:41	
	17:17			18:01			19:36	48	19:15 (T-28)	20:15			20:51		21:15	
20	07:58			07:21			07:32		18:26 (T-28)	06:36			05:55		05:41	
	17:19			18:01			19:38	49	19:15 (T-28)	20:16			20:52		21:16	
21	07:58			07:19		07:40 (T-93)	07:30		18:26 (T-28)	06:34			05:54		05:42	
	17:20			18:02	2	07:42 (T-93)	19:39	51	19:17 (T-27)	20:18			20:53		21:16	
22	07:57			07:18		07:39 (T-93)	07:28		18:25 (T-28)	06:32			05:53		05:42	
	17:21			18:03	5	07:44 (T-93)	19:40	54	19:19 (T-27)	20:19			20:55		21:16	
23	07:56			07:16		07:37 (T-93)	07:26		18:25 (T-28)	06:31			05:52		05:42	
	17:23			18:05	8	07:45 (T-93)	19:41	55	19:20 (T-27)	20:20			20:56		21:16	
24	07:55			07:14		07:35 (T-93)	07:24		18:25 (T-28)	06:29			05:51		05:42	
	17:24			18:06	10	07:45 (T-93)	19:43	56	19:21 (T-27)	20:21			20:57		21:17	
25	07:54			07:13		07:34 (T-93)	07:22		18:26 (T-28)	06:28			05:50		05:43	
	17:25			18:07	12	07:46 (T-93)	19:44	57	19:23 (T-27)	20:23			20:58		21:17	
26	07:53			07:11		07:32 (T-93)	07:21		18:26 (T-28)	06:26			05:49		05:43	
	17:27			18:09	14	07:46 (T-93)	19:45	58	19:24 (T-27)	20:24			20:59		21:17	
27	07:52			07:09		07:30 (T-93)	07:19		18:26 (T-28)	06:24			05:49		05:43	
	17:28			18:10	16	07:46 (T-93)	19:46	59	19:25 (T-27)	20:25			21:00		21:17	
28	07:51			07:08		07:28 (T-93)	07:17		18:27 (T-28)	06:23			05:48		05:44	
	17:29			18:11	18	07:46 (T-93)	19:48	59	19:26 (T-27)	20:26			21:01		21:17	
29	07:50						07:15		18:27 (T-28)	06:21			05:47		05:44	
	17:31						19:49	60	19:27 (T-27)	20:28			21:02		21:17	
30	07:49						07:13		18:28 (T-28)	06:20			05:47		05:45	
	17:32						19:50	60	19:28 (T-27)	20:29			21:02		21:17	
31	07:48						07:11		18:28 (T-28)				05:46			
	17:34						19:51	61	19:29 (T-27)				21:03			
Potential sun hours	287			292			369			403			459		465	
Total, worst case	83			85			1285			226						
Sun reduction	0.58			0.58			0.59			0.63						
Oper. time red.	0.90			0.90			0.90			0.90						
Wind dir. red.	0.67			0.61			0.58			0.58						
Total reduction	0.35			0.32			0.31			0.33						
Total, real	29			27			397			75						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-185 - R-185
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December		
1	05:45 21:17	06:13 20:55	06:49 20:07	07:24 19:11	18:11 (T-28) 18:45 (T-28)	07:04 17:17	07:43 16:49	
2	05:46 21:17	06:14 20:54	06:50 20:05	07:26 19:09	18:13 (T-28) 18:44 (T-28)	07:06 17:16	07:45 16:48	
3	05:46 21:16	06:15 20:53	06:51 20:03	07:27 19:07	18:14 (T-28) 18:42 (T-28)	07:07 17:14	07:46 16:48	
4	05:47 21:16	06:16 20:51	06:52 20:02	07:28 19:05	18:15 (T-28) 18:40 (T-28)	07:08 17:13	07:47 16:48	
5	05:48 21:16	06:17 20:50	06:53 20:00	07:29 19:04	08:05 (T-93) 18:38 (T-28)	07:10 17:12	07:48 16:47	08:28 (T-82) 08:33 (T-82)
6	05:48 21:16	06:18 20:49	06:55 19:58	07:30 19:02	08:01 (T-93) 18:37 (T-28)	07:11 17:10	07:49 16:47	08:26 (T-82) 08:35 (T-82)
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:17 (T-27)	07:58 (T-93) 18:35 (T-28)	07:12 17:09	07:50 16:47	08:25 (T-82) 08:36 (T-82)
8	05:50 21:15	06:21 20:46	06:57 19:54	07:33 19:20 (T-27)	18:30 (T-28) 18:56 (T-93)	07:14 17:08	07:51 16:47	08:25 (T-82) 08:38 (T-82)
9	05:50 21:14	06:22 20:44	06:58 19:52	07:34 19:21 (T-27)	18:27 (T-28) 18:54 (T-93)	07:15 17:07	07:52 16:47	08:25 (T-82) 08:39 (T-82)
10	05:51 21:14	06:23 20:43	06:59 19:51	07:35 19:22 (T-27)	18:25 (T-28) 18:53 (T-93)	07:16 17:05	07:53 16:47	08:25 (T-82) 08:40 (T-82)
11	05:52 21:13	06:24 20:42	07:01 19:49	07:37 19:22 (T-27)	18:23 (T-28) 18:51 (T-93)	07:18 17:04	07:54 16:47	08:25 (T-82) 08:41 (T-82)
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 19:22 (T-27)	18:21 (T-28) 18:49 (T-93)	07:19 17:03	07:55 16:47	08:25 (T-82) 08:42 (T-82)
13	05:54 21:12	06:26 20:39	07:03 19:45	07:39 19:20 (T-27)	18:19 (T-28) 18:47 (T-93)	07:20 17:02	07:55 16:47	08:25 (T-82) 08:43 (T-82)
14	05:54 21:12	06:28 20:37	07:04 19:43	07:40 19:18 (T-27)	18:17 (T-28) 18:46 (T-93)	07:22 17:01	07:56 16:47	08:25 (T-82) 08:44 (T-82)
15	05:55 21:11	06:29 20:36	07:05 19:41	07:42 19:16 (T-27)	18:16 (T-28) 18:44 (T-93)	07:23 17:00	07:57 16:47	08:26 (T-82) 08:45 (T-82)
16	05:56 21:10	06:30 20:34	07:06 19:39	07:43 19:15 (T-27)	18:16 (T-28) 18:42 (T-93)	07:25 16:59	07:58 16:47	08:25 (T-82) 08:45 (T-82)
17	05:57 21:10	06:31 20:32	07:08 19:37	07:44 19:13 (T-27)	18:14 (T-28) 18:40 (T-93)	07:26 16:58	07:58 16:48	08:26 (T-82) 08:45 (T-82)
18	05:58 21:09	06:32 20:31	07:09 19:35	07:46 19:11 (T-27)	18:13 (T-28) 18:39 (T-93)	07:27 16:57	07:59 16:48	08:27 (T-82) 08:46 (T-82)
19	05:59 21:08	06:33 20:29	07:10 19:34	07:47 19:09 (T-27)	18:12 (T-28) 18:37 (T-93)	07:29 16:56	08:00 16:48	08:27 (T-82) 08:46 (T-82)
20	06:00 21:07	06:35 20:28	07:11 19:32	07:48 19:07 (T-27)	18:12 (T-28) 18:35 (T-93)	07:30 16:55	08:00 16:49	08:27 (T-82) 08:47 (T-82)
21	06:01 21:07	06:36 20:26	07:12 19:30	07:49 19:04 (T-27)	18:11 (T-28) 18:34 (T-93)	07:31 16:54	08:01 16:49	08:27 (T-82) 08:47 (T-82)
22	06:02 21:06	06:37 20:24	07:13 19:28	07:51 19:03 (T-27)	18:11 (T-28) 18:32 (T-93)	07:32 16:54	08:01 16:50	08:28 (T-82) 08:48 (T-82)
23	06:03 21:05	06:38 20:23	07:15 19:26	07:52 19:00 (T-28)	18:11 (T-28) 18:31 (T-93)	07:34 16:53	08:02 16:50	08:28 (T-82) 08:48 (T-82)
24	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:59 (T-28)	18:10 (T-28) 18:29 (T-93)	07:35 16:52	08:02 16:51	08:30 (T-82) 08:49 (T-82)
25	06:05 21:03	06:41 20:19	07:17 19:22	07:55 18:57 (T-28)	18:10 (T-28) 18:27 (T-93)	07:36 16:52	08:03 16:51	08:30 (T-82) 08:49 (T-82)
26	06:06 21:02	06:42 20:18	07:18 19:20	07:56 18:55 (T-28)	18:10 (T-28) 18:26 (T-93)	07:37 16:51	08:03 16:52	08:30 (T-82) 08:49 (T-82)
27	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:11 (T-28)	18:11 (T-28) 18:24 (T-93)	07:39 16:50	08:03 16:53	08:31 (T-82) 08:51 (T-82)
28	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:11 (T-28)	18:11 (T-28) 18:23 (T-93)	07:40 16:50	08:04 16:54	08:32 (T-82) 08:51 (T-82)
29	06:09 20:59	06:45 20:12	07:22 19:15	08:00 18:50 (T-28)	18:11 (T-28) 18:21 (T-93)	07:41 16:49	08:04 16:54	08:32 (T-82) 08:51 (T-82)
30	06:10 20:57	06:46 20:11	07:23 19:13	08:01 18:11 (T-28)	18:21 (T-28) 18:20 (T-93)	07:42 16:49	08:04 16:55	08:33 (T-82) 08:51 (T-82)
31	06:12 20:56	06:48 20:09	08:03 18:18	08:03 18:18	18:20 (T-28) 18:18	08:04 16:56	08:34 (T-82) 17	08:51 (T-82)
Potential sun hours	471	436	377	341	289	275		
Total, worst case			1209	415		463		
Sun reduction			0.67	0.56		0.52		
Oper. time red.			0.90	0.90		0.90		
Wind dir. red.			0.58	0.59		0.67		
Total reduction			0.35	0.30		0.31		
Total, real			423	124		145		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-186 - R-186

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05	15:55 (T-28) 07:47	17:02 (T-27) 07:06	07:09	06:18	05:45
	16:57 17	16:12 (T-28) 17:35 7	17:09 (T-27) 18:13	19:53	20:30	21:04
2	08:05	15:56 (T-28) 07:46	17:02 (T-27) 07:04	07:08	06:17	05:45
	16:58 16	16:12 (T-28) 17:36 9	17:11 (T-27) 18:14	19:54	20:31	21:05
3	08:05	15:57 (T-28) 07:45	17:02 (T-27) 07:03	07:06	06:15	05:44
	16:59 15	16:12 (T-28) 17:38 11	17:13 (T-27) 18:15	19:55	20:33	21:06
4	08:05	15:58 (T-28) 07:44	17:02 (T-27) 07:01	07:04	06:14	05:44
	17:00 14	16:12 (T-28) 17:39 11	17:13 (T-27) 18:17	19:56	20:34	21:07
5	08:04	16:00 (T-28) 07:42	17:02 (T-27) 06:59	07:02	06:13	05:43
	17:01 12	16:12 (T-28) 17:41 13	17:15 (T-27) 18:18	19:58	20:35	21:08
6	08:04	16:02 (T-28) 07:41	17:03 (T-27) 06:57	07:00	06:11	05:43
	17:02 9	16:11 (T-28) 17:42 14	17:17 (T-27) 18:19	19:59	20:36	21:08
7	08:04	16:04 (T-28) 07:40	17:03 (T-27) 06:56	06:58	07:19 (T-29)	06:10 05:43
	17:03 4	16:08 (T-28) 17:44 15	17:18 (T-27) 18:21	20:00	1 07:20 (T-29)	20:37 21:09
8	08:04	07:39	17:04 (T-27) 07:54	06:57	07:17 (T-29)	06:09 05:42
	17:04	17:45 16	17:20 (T-27) 18:22	20:01	3 07:20 (T-29)	20:39 21:10
9	08:04	07:37	17:05 (T-27) 07:52	06:55	07:15 (T-29)	06:07 05:42
	17:05	17:46 16	17:21 (T-27) 19:23	20:03	6 07:21 (T-29)	20:40 21:10
10	08:03	07:36	17:06 (T-27) 07:50	06:53	07:13 (T-29)	06:06 05:42
	17:06	17:48 13	17:19 (T-27) 19:25	20:04	7 07:20 (T-29)	20:41 21:11
11	08:03	07:34	17:08 (T-27) 07:48	06:51	07:12 (T-29)	06:05 05:42
	17:07	17:49 10	17:18 (T-27) 19:26	20:05	9 07:21 (T-29)	20:42 21:12
12	08:03	07:33	07:46	06:50	07:10 (T-29)	06:03 05:41
	17:09	17:51	19:27	20:06	10 07:20 (T-29)	20:43 21:12
13	08:02	07:32	07:45	06:48	07:08 (T-29)	06:02 05:41
	17:10	17:52	19:29	20:08	11 07:19 (T-29)	20:44 21:13
14	08:02	07:30	07:43	06:46	07:06 (T-29)	06:01 05:41
	17:11	17:54	19:30	20:09	12 07:18 (T-29)	20:46 21:13
15	08:01	07:29	07:41	06:44	07:05 (T-29)	06:00 05:41
	17:12	17:55	19:31	20:10	13 07:18 (T-29)	20:47 21:14
16	08:01	07:27	07:39	06:43	07:03 (T-29)	05:59 05:41
	17:13	17:56	19:33	20:11	13 07:16 (T-29)	20:48 21:14
17	08:00	07:26	07:37	06:41	07:03 (T-29)	05:58 05:41
	17:15	17:58	19:34	20:13	11 07:14 (T-29)	20:49 21:15
18	08:00	07:24	07:35	06:39	07:06 (T-29)	05:57 05:41
	17:16	17:59	19:35	20:14	5 07:11 (T-29)	20:50 21:15
19	07:59	07:23	07:34	06:37	05:56	05:41
	17:17	18:00	19:36	20:15	20:51	21:15
20	07:58	07:21	07:32	06:36	05:55	05:41
	17:19	18:00	19:38	20:16	20:52	21:16
21	07:58	07:19	07:30	06:34	05:54	05:42
	17:20	18:02	19:39	20:18	20:53	21:16
22	07:57	07:18	07:28	06:32	05:53	05:42
	17:21	18:03	19:40	20:19	20:55	21:16
23	07:56	07:16	07:26	06:31	05:52	05:42
	17:23	18:05	19:41	20:20	20:56	21:16
24	07:55	07:14	07:24	06:29	05:51	05:42
	17:24	18:06	19:43	20:21	20:57	21:17
25	07:54	07:13	07:22	06:28	05:50	05:43
	17:25	18:07	19:44	20:23	20:58	21:17
26	07:53	07:11	07:21	06:26	05:49	05:43
	17:27	18:09	19:45	20:24	20:59	21:17
27	07:52	07:09	07:19	06:24	05:49	05:43
	17:28	18:10	19:46	20:25	21:00	21:17
28	07:51	07:08	07:17	06:23	05:48	05:44
	17:29	18:11	19:48	20:26	21:01	21:17
29	07:50		07:15	06:21	05:47	05:44
	17:31		19:49	20:28	21:02	21:17
30	07:49	17:03 (T-27)	07:13	06:20	05:46	05:45
	17:32 3	17:06 (T-27)	19:50	20:29	21:02	21:17
31	07:48	17:02 (T-27)	07:11		05:46	
	17:34 5	17:07 (T-27)	19:51		21:03	
Potential sun hours	287	292	369	403	459	465
Total, worst case	95	135		101		
Sun reduction	0.58	0.58		0.63		
Oper. time red.	0.90	0.90		0.90		
Wind dir. red.	0.61	0.59		0.57		
Total reduction	0.32	0.31		0.32		
Total, real	30	42		33		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user: Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-186 - R-186
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

July		August		September		October		November		December	
1	05:45	06:13		06:49	07:11 (T-29)	07:24		07:04	16:35 (T-27)	07:43	
	21:17	20:55		20:07	9 07:20 (T-29)	19:11		17:17	14 16:49 (T-27)	16:48	
2	05:46	06:14		06:50	07:12 (T-29)	07:25		07:06	16:34 (T-27)	07:45	
	21:17	20:54		20:05	7 07:19 (T-29)	19:09		17:16	16 16:50 (T-27)	16:48	
3	05:48	06:15		06:51	07:13 (T-29)	07:27		07:07	16:33 (T-27)	07:46	
	21:16	20:53		20:03	6 07:19 (T-29)	19:07		17:14	16 16:49 (T-27)	16:48	
4	05:47	06:16		06:52	07:14 (T-29)	07:28		07:08	16:32 (T-27)	07:47	
	21:16	20:51		20:02	3 07:17 (T-29)	19:05		17:13	16 16:48 (T-27)	16:47	
5	05:48	06:17		06:53	07:15 (T-29)	07:29		07:10	16:33 (T-27)	07:48	15:49 (T-28)
	21:16	20:50		20:00	1 07:16 (T-29)	19:04		17:12	14 16:47 (T-27)	16:47	4 15:53 (T-28)
6	05:48	06:18		06:55		07:30		07:11	16:32 (T-27)	07:49	15:47 (T-28)
	21:16	20:49		19:58		19:02		17:10	13 16:45 (T-27)	16:47	9 15:56 (T-28)
7	05:49	06:19		06:56		07:32		07:12	16:32 (T-27)	07:50	15:47 (T-28)
	21:15	20:47		19:56		19:00		17:09	12 16:44 (T-27)	16:47	12 15:59 (T-28)
8	05:50	06:21		06:57		07:33		07:14	16:32 (T-27)	07:51	15:47 (T-28)
	21:15	20:46		19:54		18:56		17:08	10 16:42 (T-27)	16:47	13 16:00 (T-28)
9	05:50	06:22		06:58		07:34		07:15	16:33 (T-27)	07:52	15:45 (T-28)
	21:14	20:45		19:52		18:54		17:07	9 16:42 (T-27)	16:47	15 16:00 (T-28)
10	05:51	06:23		06:59		07:35		07:16	16:33 (T-27)	07:53	15:45 (T-28)
	21:14	20:43		19:51		18:53		17:05	7 16:40 (T-27)	16:47	16 16:01 (T-28)
11	05:52	06:24		07:00		07:37		07:18	16:34 (T-27)	07:54	15:45 (T-28)
	21:14	20:42		19:49		18:51		17:04	5 16:39 (T-27)	16:47	17 16:02 (T-28)
12	05:53	06:25		07:02		07:38		07:19	16:35 (T-27)	07:55	15:45 (T-28)
	21:13	20:40		19:47		18:49		17:03	3 16:38 (T-27)	16:47	18 16:03 (T-28)
13	05:54	06:26		07:03		07:39		07:20		07:55	15:45 (T-28)
	21:12	20:39		19:45		18:47		17:02		16:47	19 16:04 (T-28)
14	05:54	06:28		07:04		07:40		07:22		07:56	15:46 (T-28)
	21:12	20:37		19:43		18:46		17:01		16:47	19 16:05 (T-28)
15	05:55	06:29		07:05		07:42		07:23		07:57	15:46 (T-28)
	21:11	20:36		19:41		18:44		17:00		16:47	20 16:06 (T-28)
16	05:56	06:30		07:06		07:43		07:25		07:58	15:46 (T-28)
	21:10	20:34		19:39		18:42		16:59		16:47	20 16:06 (T-28)
17	05:57	06:31		07:08		07:44		07:26		07:58	15:46 (T-28)
	21:10	20:32		19:37		18:40		16:58		16:48	21 16:07 (T-28)
18	05:58	06:32		07:09		07:46		07:27		07:59	15:47 (T-28)
	21:09	20:31		19:35		18:39		16:57		16:48	21 16:08 (T-28)
19	05:59	06:33		07:10		07:47		07:29		08:00	15:47 (T-28)
	21:08	20:29		19:34		18:37		16:56		16:48	21 16:08 (T-28)
20	06:00	06:35		07:11		07:48		07:30		08:00	15:47 (T-28)
	21:07	20:28		19:32		18:35		16:55		16:49	22 16:09 (T-28)
21	06:01	06:36		07:12		07:49		07:31		08:01	15:47 (T-28)
	21:07	20:26		19:30		18:34		16:54		16:49	22 16:09 (T-28)
22	06:02	06:37		07:13		07:51		07:32		08:01	15:48 (T-28)
	21:06	20:24		19:28		18:32		16:54		16:50	22 16:10 (T-28)
23	06:03	06:38		07:15		07:52		07:34		08:02	15:48 (T-28)
	21:05	20:23		19:26		18:31		16:53		16:50	22 16:10 (T-28)
24	06:04	06:39		07:16		07:53		07:35		08:02	15:49 (T-28)
	21:04	20:21		19:24		18:29		16:52		16:51	22 16:11 (T-28)
25	06:05	06:41	07:09 (T-29)	07:17		07:55		07:36		08:03	15:50 (T-28)
	21:03	20:19	5 07:14 (T-29)	19:22		18:22		16:52		16:51	21 16:11 (T-28)
26	06:06	06:42	07:05 (T-29)	07:18		07:56		07:37		08:03	15:50 (T-28)
	21:02	20:18	12 07:17 (T-29)	19:20		18:26		16:51		16:52	21 16:11 (T-28)
27	06:07	06:43	07:05 (T-29)	07:19		07:57		07:39		08:03	15:51 (T-28)
	21:01	20:16	13 07:18 (T-29)	19:18		18:24		16:50		16:53	21 16:12 (T-28)
28	06:08	06:44	07:06 (T-29)	07:21		07:59		07:40		08:04	15:52 (T-28)
	21:00	20:14	13 07:19 (T-29)	19:17		18:23		16:50		16:53	20 16:12 (T-28)
29	06:09	06:45	07:07 (T-29)	07:22		08:00		07:41		08:04	15:52 (T-28)
	20:59	20:12	12 07:19 (T-29)	19:15		18:21		16:49		16:54	20 16:12 (T-28)
30	06:10	06:46	07:08 (T-29)	07:23		08:01		07:42	17:40 (T-27)	08:04	15:53 (T-28)
	20:57	20:11	11 07:19 (T-29)	19:13		18:20	4 17:44 (T-27)	16:49		16:55	19 16:12 (T-28)
31	06:11	06:48	07:10 (T-29)			08:03		17:37 (T-27)		08:04	15:54 (T-28)
	20:56	20:09	10 07:20 (T-29)			18:18	11 17:48 (T-27)			16:56	18 16:12 (T-28)
Potential sun hours	471	436		377		341		289		275	
Total, worst case				26		15		135		495	
Sun reduction		0.72		0.67		0.56		0.48		0.52	
Oper. time red.		0.90		0.90		0.90		0.90		0.90	
Wind dir. red.		0.57		0.57		0.59		0.59		0.61	
Total reduction		0.37		0.34		0.30		0.26		0.29	
Total, real		28		9		4		35		143	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
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Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-187 - R-187

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:10	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:49
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:37	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:48
5	08:05	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:54	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:59	06:10	05:43	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:47	19:24	20:03	20:40	21:10	21:15	20:45	19:52	18:55	17:07	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:42	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:09	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:12	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:41	07:22	07:56
	17:11	17:54	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:41	16:58	16:48
18	08:00	07:24	07:36	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:34	07:10	07:47	07:29	08:00
	17:17	18:01	19:36	20:15	20:51	21:15	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:19	18:01	19:38	20:16	20:52	21:16	21:07	20:28	19:32	18:36	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:55	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:14	07:51	07:32	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:16	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:23	06:28	05:50	05:43	06:05	06:41	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:30	18:12	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:54
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:47	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:57	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:12	06:48		08:03		08:04
	17:34		19:52	21:03			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:05 16:57	07:47 17:35	07:06 18:13	17:41 (T-23) 17:51 (T-23)	07:10 19:53	06:18 19:57 (T-06)
2	08:05 16:58	07:46 17:37	07:04 18:14	17:41 (T-23) 17:52 (T-23)	07:08 19:54	06:17 20:31
3	08:05 16:59	07:45 17:38	07:03 18:16	17:41 (T-23) 17:54 (T-23)	07:06 19:55	06:16 20:33
4	08:05 17:00	07:44 17:39	07:01 18:17	17:43 (T-23) 17:56 (T-23)	07:04 19:57	06:14 20:34
5	08:05 17:01	07:42 17:41	06:59 18:18	17:45 (T-23) 17:55 (T-23)	07:02 19:58	06:13 20:35
6	08:04 17:02	07:41 17:42	06:57 18:20	07:00 19:59	06:11 20:36	19:55 (T-06) 20:13 (T-06)
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	06:10 20:37	19:54 (T-06) 20:13 (T-06)
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	06:09 20:39	19:54 (T-06) 20:14 (T-06)
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 20:03	06:07 20:40	19:54 (T-06) 20:16 (T-06)
10	08:04 17:06	07:36 17:48	07:50 19:25	06:53 20:04	06:06 20:41	19:54 (T-06) 20:17 (T-06)
11	08:03 17:07	07:35 17:49	07:48 19:26	06:51 20:05	06:05 20:42	19:55 (T-06) 20:18 (T-06)
12	08:03 17:09	07:33 17:51	07:47 19:27	06:50 20:07	06:04 20:43	19:54 (T-06) 20:19 (T-06)
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	06:02 20:45	19:54 (T-06) 20:20 (T-06)
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	06:01 20:46	19:55 (T-06) 20:21 (T-06)
15	08:01 17:12	07:29 17:55	07:41 19:31	06:44 20:10	06:00 20:47	19:56 (T-06) 20:20 (T-06)
16	08:01 17:14	07:27 17:56	07:39 19:33	06:43 20:12	05:59 20:48	19:56 (T-06) 20:20 (T-06)
17	08:00 17:15	07:26 17:58	07:37 19:34	06:41 20:13	05:58 20:49	19:57 (T-06) 20:19 (T-06)
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 20:14	05:57 20:50	19:58 (T-06) 20:18 (T-06)
19	07:59 17:17	07:23 18:01	07:34 19:36	06:38 20:15	05:56 20:51	19:59 (T-06) 20:17 (T-06)
20	07:58 17:19	07:21 18:01	07:32 19:38	06:36 20:17	05:55 20:52	20:00 (T-06) 20:16 (T-06)
21	07:58 17:20	07:19 18:02	07:30 19:39	06:34 20:18	05:54 20:54	20:02 (T-06) 20:14 (T-06)
22	07:57 17:21	07:18 18:03	07:28 19:40	06:33 20:19	05:53 20:55	20:04 (T-06) 20:12 (T-06)
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 20:20	05:52 20:56	05:42 21:17
24	07:55 17:24	07:15 18:06	17:41 (T-23) 17:44 (T-23)	07:24 19:43	06:29 20:21	05:51 20:57
25	07:54 17:25	07:13 18:07	17:41 (T-23) 17:46 (T-23)	07:23 19:44	06:28 20:23	05:50 20:58
26	07:53 17:27	07:11 18:09	17:41 (T-23) 17:47 (T-23)	07:21 19:45	06:26 20:24	05:49 20:59
27	07:52 17:28	07:10 18:10	17:40 (T-23) 17:48 (T-23)	07:19 19:47	06:25 20:25	05:49 21:00
28	07:51 17:30	07:08 18:12	17:41 (T-23) 17:50 (T-23)	07:17 19:48	06:23 20:26	20:02 (T-06) 20:03 (T-06)
29	07:50 17:31		07:15 19:49	06:21 20:28	20:00 (T-06) 20:04 (T-06)	05:47 21:02
30	07:49 17:32		07:13 19:50	06:20 20:29	19:59 (T-06) 20:06 (T-06)	05:47 21:03
31	07:48 17:34		07:11 19:52	06:19 20:30	20:05 21:04	05:46 21:03
Potential sun hours	287	292	369	403	459	465
Total, worst case						
Sun reduction		31		57	12	411
Oper. time red.		0.58		0.59	0.63	0.66
Wind dir. red.		0.90		0.90	0.90	0.90
Total reduction		0.58		0.58	0.62	0.62
Total, real		0.30		0.31	0.35	0.37
		9		18	4	152

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
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Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-188 - R-188
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	20:04 (T-06)	06:49 20:07	07:24 19:11	07:04 16:49
2	05:46 21:17	06:14 20:54	20:04 (T-06)	06:50 20:05	07:26 19:09	07:06 16:48
3	05:46 21:16	06:15 20:53	20:04 (T-06)	06:51 20:04	07:27 19:07	07:07 16:48
4	05:47 21:16	06:16 20:51	20:03 (T-06)	06:52 20:02	07:28 19:06	07:08 16:48
5	05:48 21:16	06:17 20:50	20:04 (T-06)	06:54 20:00	07:29 19:04	07:10 16:47
6	05:48 21:16	06:18 20:49	20:04 (T-06)	06:55 19:58	07:31 19:02	07:11 16:47
7	05:49 21:15	06:20 20:47	20:04 (T-06)	06:56 19:56	07:32 19:00	07:12 16:47
8	05:50 21:15	06:21 20:46	20:04 (T-06)	06:57 19:54	07:33 18:56	18:21 (T-23) 17:08
9	05:50 21:15	06:22 20:45	20:04 (T-06)	06:58 19:52	07:34 18:55	18:18 (T-23) 17:07
10	05:51 21:14	06:23 20:43	20:05 (T-06)	06:59 19:51	07:35 18:53	18:30 (T-23) 17:05
11	05:52 21:14	06:24 20:42	20:05 (T-06)	07:01 19:49	07:37 18:51	18:17 (T-23) 17:04
12	05:53 21:13	06:25 20:40	20:06 (T-06)	07:02 19:47	07:38 18:49	18:15 (T-23) 17:03
13	05:54 21:13	06:26 20:39	20:07 (T-06)	07:03 19:45	07:39 18:47	18:14 (T-23) 17:02
14	05:54 21:12	06:28 20:37	20:09 (T-06)	07:04 19:43	07:41 18:46	18:24 (T-23) 17:01
15	05:55 21:11	06:29 20:36	20:10 (T-06)	07:05 19:41	07:42 18:44	18:13 (T-23) 17:00
16	05:56 21:11	06:30 20:34	20:11 (T-06)	07:06 19:39	07:43 18:42	18:20 (T-23) 16:59
17	05:57 21:10	06:31 20:33		07:08 19:37	07:44 18:41	18:13 (T-23) 16:58
18	05:58 21:09	06:32 20:31		07:09 19:36	07:46 18:39	18:17 (T-23) 16:57
19	05:59 21:08	06:34 20:29		07:10 19:34	07:47 18:37	18:13 (T-23) 16:56
20	06:00 21:08	06:35 20:28		07:11 19:32	07:48 18:36	18:14 (T-23) 16:55
21	06:01 21:07	20:16 (T-06) 20:26		07:12 19:30	07:50 18:34	18:13 (T-23) 16:54
22	06:02 21:06	20:13 (T-06) 20:24		07:14 19:28	07:51 18:32	18:13 (T-23) 16:53
23	06:03 21:05	20:11 (T-06) 20:23		07:15 19:26	07:52 18:31	18:13 (T-23) 16:52
24	06:04 21:04	20:10 (T-06) 20:21		07:16 19:24	07:54 18:29	18:13 (T-23) 16:51
25	06:05 21:03	20:09 (T-06) 20:19		07:17 19:22	07:55 18:27	18:13 (T-23) 16:50
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28	06:08 21:00	20:07 (T-06) 20:14		07:21 19:17	07:59 18:23	18:13 (T-23) 16:47
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30	06:10 20:58	20:05 (T-06) 20:11		07:23 19:13	08:02 18:20	18:13 (T-23) 16:45
31	06:12 20:56	20:05 (T-06) 20:09		07:23 19:13	08:02 18:20	18:13 (T-23) 16:45
Potential sun hours	471	436		377	341	288
Total, worst case		223			93	
Sun reduction	0.75	0.72			0.56	
Oper. time red.	0.90	0.90			0.90	
Wind dir. red.	0.62	0.62			0.58	
Total reduction	0.42	0.40			0.29	
Total, real	89	90			27	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05 07:47 07:06 16:57 17:35 18:13			07:10 19:53	06:18 20:30	05:45 21:04	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-11) 07:24	18:32 (T-07) 17:17	07:04 16:49
2	08:05 07:46 07:04 16:58 17:37 18:14			07:08 19:54	06:17 20:31	05:45 21:05	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-11) 07:26	18:33 (T-07) 17:16	07:06 16:48
3	08:05 07:45 07:03 16:59 17:38 18:16			07:06 19:55	06:15 20:33	05:44 21:06	05:46 21:16	06:15 20:53	06:51 20:03	07:13 (T-11) 07:27	18:33 (T-07) 17:14	07:07 16:48
4	08:05 07:44 07:01 17:00 17:39 18:17			07:04 19:57	06:14 20:34	05:44 21:07	05:47 21:16	06:16 20:51	06:52 20:02	07:28 19:05	18:34 (T-07) 17:13	07:08 16:48
5	08:05 07:42 06:59 17:01 17:41 18:18			07:02 19:58	06:13 20:35	05:43 21:08	05:48 21:16	06:17 20:50	06:54 20:00	07:29 19:04	18:36 (T-07) 17:12	07:10 16:47
6	08:04 07:41 06:57 17:02 17:42 18:20			07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:16	06:18 20:49	06:55 19:58	07:30 19:02	18:38 (T-07) 17:11	07:11 16:47
7	08:04 07:40 06:56 17:03 17:44 18:21			06:59 20:00	06:10 20:37	05:43 21:09	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	17:10 16:47	07:12 16:47
8	08:04 07:39 07:54 17:04 17:45 18:22			06:57 20:02	06:09 20:39	05:42 21:10	05:50 21:15	06:21 20:46	06:57 19:54	07:33 19:00	17:14 16:47	07:14 16:47
9	08:04 07:37 07:52 17:05 17:46 19:24			06:55 20:03	06:07 20:40	05:42 21:11	05:50 21:15	06:22 20:45	06:58 19:52	07:34 19:00	17:15 16:47	07:15 16:47
10	08:04 07:36 07:50 17:06 17:48 19:25			06:53 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	17:17 16:47	07:17 16:47
11	08:03 07:35 07:48 17:07 17:49 19:26			06:51 20:05	06:05 20:42	05:42 21:12	05:52 21:14	06:24 20:42	07:01 19:49	07:37 18:51	17:18 16:47	07:18 16:47
12	08:03 07:33 07:47 17:09 17:51 19:27			06:50 20:07	06:03 20:43	05:41 21:12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	17:19 16:47	07:19 16:47
13	08:02 07:32 07:45 17:10 17:52 19:29			06:48 20:08	06:08 20:45	05:41 21:13	05:54 21:13	06:26 20:39	07:03 19:45	07:39 18:47	17:21 16:47	07:21 16:47
14	08:02 07:30 07:43 17:11 17:54 19:30			06:46 20:09	06:01 20:46	05:41 21:13	05:54 21:12	06:28 20:37	07:04 19:43	07:40 18:46	17:22 16:47	07:22 16:47
15	08:01 07:29 07:41 17:12 17:55 19:31			06:44 20:10	06:00 20:47	05:41 21:14	05:55 21:11	06:29 20:36	07:05 19:41	07:41 18:44	17:23 16:47	07:23 16:47
16	08:01 07:27 07:39 17:13 17:56 19:33			06:43 20:12	05:59 20:48	05:41 21:15	05:56 21:11	06:30 20:34	07:06 19:39	07:42 18:42	17:24 16:47	07:24 16:47
17	08:00 07:26 07:37 17:15 17:58 19:34			06:41 20:13	07:01 (T-11) 20:49	05:41 21:15	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:41	17:25 16:48	07:25 16:48
18	08:00 07:24 07:36 17:16 17:59 19:35			06:39 20:14	07:00 (T-11) 20:57	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:36	07:46 18:39	17:27 16:48	07:27 16:48
19	07:59 07:23 07:34 17:17 18:01 19:36			06:37 20:15	06:58 (T-11) 20:51	05:41 21:16	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37	17:29 16:48	07:29 16:48
20	07:58 07:21 07:32 17:19 18:01 19:38			06:36 20:17	06:56 (T-11) 20:53	05:41 21:16	06:00 21:08	06:35 20:28	07:11 19:32	07:48 18:53	17:30 16:49	07:30 16:49
21	07:58 07:19 07:30 17:20 18:02 19:39			06:34 20:18	06:56 (T-11) 20:54	05:42 21:16	06:01 21:07	06:36 20:26	07:12 19:30	07:49 18:40	17:31 16:49	07:31 16:49
22	07:57 07:18 07:28 17:21 18:03 19:40			06:32 20:19	06:57 (T-11) 20:55	05:42 21:16	06:02 21:06	06:37 20:24	07:13 19:28	07:50 18:58	17:32 16:50	07:32 16:50
23	07:56 07:16 07:26 17:23 18:05 19:42			06:31 20:20	07:07 (T-11) 20:52	05:42 21:17	06:03 21:03	06:38 20:23	07:14 19:25	07:51 18:37	17:33 16:50	07:33 16:50
24	07:55 07:15 07:24 17:24 18:06 19:43			06:29 20:21	06:58 (T-07) 20:51	05:42 21:17	06:04 21:04	06:39 20:21	07:15 19:24	07:52 18:35	17:34 16:51	07:34 16:51
25	07:54 07:13 07:23 17:25 18:07 19:44			06:28 20:23	06:59 (T-07) 20:52	05:43 21:17	06:05 21:03	06:41 20:19	07:16 19:22	07:53 18:57	17:35 16:51	07:35 16:51
26	07:53 07:11 07:21 17:27 18:09 19:45			06:26 20:24	06:54 (T-07) 20:50	05:43 21:17	06:06 21:02	06:42 20:18	07:17 19:20	07:54 18:53	17:36 16:51	07:36 16:51
27	07:52 07:10 07:19 17:28 18:10 19:47			06:24 20:25	06:52 (T-07) 20:49	05:43 21:17	06:07 21:01	06:43 20:16	07:18 19:22	07:56 18:57	17:37 16:51	07:37 16:51
28	07:51 07:08 07:17 17:29 18:12 19:48			06:23 20:26	06:51 (T-11) 20:48	05:44 21:17	06:08 21:04	06:44 20:14	07:19 19:23	07:57 18:52	17:38 16:51	07:38 16:51
29	07:50 07:15 07:25 17:31 18:01 19:49			06:21 20:28	06:49 (T-11) 20:47	05:44 21:17	06:09 21:02	06:45 20:12	07:20 19:25	07:58 18:52	17:39 16:51	07:39 16:51
30	07:49 07:13 07:23 17:32 18:00 19:50			06:20 20:29	06:48 (T-11) 20:46	05:45 21:17	06:10 21:01	06:46 20:11	07:21 19:13	07:59 18:48	17:40 16:51	07:40 16:51
31	07:48 07:11 07:21 17:34 18:02 19:52			06:19 20:30	06:47 (T-11) 20:45	05:46 21:18	06:12 21:00	06:48 20:10	07:22 19:13	08:00 18:48	17:41 16:51	07:41 16:51
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case				243	131				212		41	
Sun reduction				0.59	0.63				0.72		0.56	
Oper. time red.				0.90	0.90				0.90		0.90	
Wind dir. red.				0.58	0.57				0.58		0.58	
Total reduction				0.31	0.32				0.37		0.29	
Total, real				74	42				74		12	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-190 - R-190

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:05 16:57 9	16:19 (T-06) 16:28 (T-06) 17:35	07:47 17:35	07:06 18:13 26	17:25 (T-07) 17:51 (T-07) 19:53	07:10 20:30 21:04
2	08:05 16:58 10	16:19 (T-06) 16:29 (T-06) 17:37	07:46 17:37	07:04 18:14 29	17:23 (T-07) 17:52 (T-07) 19:54	07:08 20:31 21:05
3	08:05 16:59 10	16:20 (T-06) 16:30 (T-06) 17:38	07:45 17:38	07:03 18:16 32	17:22 (T-07) 17:54 (T-07) 19:55	07:06 20:33 21:06
4	08:05 17:00 12	16:20 (T-06) 16:32 (T-06) 17:39	07:44 17:39	07:01 18:17 34	17:22 (T-07) 17:56 (T-07) 19:57	07:04 20:34 21:07
5	08:05 17:01 13	16:20 (T-06) 16:33 (T-06) 17:41	07:43 17:41	06:59 18:18 36	17:21 (T-07) 17:57 (T-07) 19:58	07:02 20:35 21:08
6	08:05 17:02 13	16:21 (T-06) 16:34 (T-06) 17:42	07:41 17:42	06:57 18:20 38	17:20 (T-07) 17:58 (T-07) 19:59	07:00 20:36 21:08
7	08:04 17:03 14	16:20 (T-06) 16:34 (T-06) 17:44	07:40 17:44	06:56 18:21 40	17:19 (T-07) 17:59 (T-07) 20:00	06:59 20:38 21:09
8	08:04 17:04 15	16:21 (T-06) 16:36 (T-06) 17:45	07:39 17:45	07:54 18:22 42	18:18 (T-07) 19:00 (T-07) 20:02	06:57 20:39 21:10
9	08:04 17:05 15	16:22 (T-06) 16:37 (T-06) 17:47	07:37 17:47	07:52 19:24 44	18:19 (T-07) 19:03 (T-07) 20:03	06:55 20:40 21:11
10	08:04 17:06 17	16:21 (T-06) 16:38 (T-06) 17:48	07:36 17:48	07:50 19:25 45	18:19 (T-07) 19:04 (T-07) 20:04	06:53 20:41 21:11
11	08:03 17:07 17	16:22 (T-06) 16:39 (T-06) 17:49	07:35 17:49	07:48 19:26 45	18:18 (T-07) 19:03 (T-07) 20:05	06:51 20:42 21:12
12	08:03 17:09 18	16:23 (T-06) 16:41 (T-06) 17:51	07:33 17:51	07:47 19:27 45	18:18 (T-07) 19:03 (T-07) 20:07	06:50 20:43 21:12
13	08:02 17:10 19	16:23 (T-06) 16:42 (T-06) 17:52	07:32 17:52	07:45 19:29 44	18:18 (T-07) 19:02 (T-07) 20:08	06:48 20:45 21:13
14	08:02 17:11 20	16:23 (T-06) 16:43 (T-06) 17:54	07:30 17:54	07:43 19:30 43	18:18 (T-07) 19:01 (T-07) 20:09	06:46 20:46 21:13
15	08:02 17:12 21	16:24 (T-06) 16:45 (T-06) 17:55	07:29 17:55	07:41 19:31 42	18:18 (T-07) 19:00 (T-07) 20:10	06:44 20:47 21:14
16	08:01 17:13 22	16:24 (T-06) 16:46 (T-06) 17:56	07:27 17:56	07:39 19:33 40	18:20 (T-07) 19:00 (T-07) 20:12	06:43 20:48 21:14
17	08:00 17:15 23	16:25 (T-06) 16:48 (T-06) 17:58	07:26 17:58	07:37 19:34 39	18:20 (T-07) 18:59 (T-07) 20:13	06:41 20:49 21:15
18	08:00 17:16 24	16:25 (T-06) 16:49 (T-06) 17:59	07:24 17:59	07:36 19:35 36	18:21 (T-07) 18:57 (T-07) 20:14	06:39 20:50 21:15
19	07:59 17:17 25	16:25 (T-06) 16:50 (T-06) 18:01	07:23 18:01	07:34 19:36 34	18:22 (T-07) 18:56 (T-07) 20:15	06:37 20:51 21:16
20	07:58 17:19 25	16:26 (T-06) 16:51 (T-06) 18:01	07:21 18:01	07:32 19:38 31	18:23 (T-07) 18:54 (T-07) 20:17	06:36 20:53 21:16
21	07:58 17:20 26	16:26 (T-06) 16:52 (T-06) 18:02	07:19 18:02	07:30 19:39 28	18:24 (T-07) 18:52 (T-07) 20:18	06:34 20:54 21:16
22	07:57 17:21 24	16:28 (T-06) 16:52 (T-06) 18:03	07:18 18:03	07:28 19:40 23	18:26 (T-07) 18:49 (T-07) 20:19	06:32 20:55 21:16
23	07:56 17:23 23	16:29 (T-06) 16:52 (T-06) 18:05	07:16 18:05	07:26 19:42 16	18:29 (T-07) 18:45 (T-07) 20:20	06:31 20:56 21:17
24	07:55 17:24 21	16:30 (T-06) 16:51 (T-06) 18:06	07:15 18:06	07:24 19:43 2	18:37 (T-07) 18:39 (T-07) 20:22	06:29 20:57 21:17
25	07:54 17:25 19	16:31 (T-06) 16:50 (T-06) 18:07	07:13 18:07	07:23 19:44 14	18:39 (T-07) 19:45 (T-07) 20:23	06:28 20:58 21:17
26	07:53 17:27 16	16:33 (T-06) 16:49 (T-06) 18:09	07:11 18:09	07:21 19:45 18	17:29 (T-07) 17:47 (T-07) 19:45	06:26 20:24 21:17
27	07:53 17:28 13	16:35 (T-06) 16:48 (T-06) 18:10	07:10 18:10	07:19 19:47 21	17:27 (T-07) 17:48 (T-07) 19:47	06:24 20:25 21:17
28	07:52 17:30 7	16:38 (T-06) 16:45 (T-06) 18:12	07:08 18:12	07:17 19:48 24	17:26 (T-07) 17:50 (T-07) 19:48	06:23 20:26 21:07
29	07:51 17:31			07:15 19:49	06:21 20:28	05:47 21:02
30	07:49 17:32			07:13 19:50	06:20 20:29	05:47 21:03
31	07:48 17:34			07:11 19:52		05:46 21:04
Potential sun hours	287	292	369	404	459	465
Total, worst case	491	89	834	124		
Sun reduction	0.58	0.58	0.59	0.63		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.60	0.58	0.58	0.60		
Total reduction	0.31	0.30	0.31	0.34		
Total, real	153	27	256	42		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-190 - R-190
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:13	06:49	07:24	17:57 (T-07)	07:04
	21:17	20:55	20:07	19:11	44 18:41 (T-07)	17:17
2	05:46	06:14	06:50	07:26	17:57 (T-07)	07:06
	21:17	20:54	20:05	19:09	45 18:42 (T-07)	17:16
3	05:46	06:15	06:51	07:27	17:56 (T-07)	07:07
	21:17	20:53	20:04	19:07	46 18:42 (T-07)	17:14
4	05:47	06:16	06:52	07:28	17:56 (T-07)	07:08
	21:16	20:51	20:02	19:06	44 18:40 (T-07)	17:13
5	05:48	06:17	06:54	07:29	17:55 (T-07)	07:10
	21:16	20:50	20:00	19:04	43 18:38 (T-07)	17:12
6	05:48	06:18	06:55	07:31	17:56 (T-07)	07:11
	21:16	20:49	19:58	19:02	41 18:37 (T-07)	17:10
7	05:49	06:20	06:56	07:32	17:55 (T-07)	07:12
	21:15	20:47	19:56	19:00	40 18:35 (T-07)	17:09
8	05:50	06:21	06:57	07:33	17:55 (T-07)	07:14
	21:15	20:46	19:54	18:56	38 18:33 (T-07)	17:08
9	05:50	06:22	06:58	07:34	17:55 (T-07)	07:15
	21:15	20:45	19:52	18:55	35 18:30 (T-07)	17:07
10	05:51	06:23	06:59	07:36	17:56 (T-07)	07:17
	21:14	20:43	19:51	18:53	33 18:29 (T-07)	17:05
11	05:52	06:24	07:01	07:37	17:56 (T-07)	07:18
	21:14	20:42	19:49	18:51	31 18:27 (T-07)	17:04
12	05:53	06:25	07:02	07:38	17:57 (T-07)	07:19
	21:13	20:40	19:47	18:49	28 18:25 (T-07)	17:03
13	05:54	06:26	07:03	07:39	17:58 (T-07)	07:21
	21:13	20:39	19:45	18:47	26 18:24 (T-07)	17:02
14	05:54	06:28	07:04	07:41	17:59 (T-07)	07:22
	21:12	20:37	19:43	18:46	23 18:22 (T-07)	17:01
15	05:55	06:29	07:05	07:42	18:00 (T-07)	07:23
	21:11	20:36	19:41	18:44	20 18:20 (T-07)	17:00
16	05:56	06:30	07:06	07:43	18:02 (T-07)	07:25
	21:11	20:34	19:39	18:42	17 18:19 (T-07)	16:59
17	05:57	06:31	19:55 (T-35)	07:08	07:44	18:04 (T-07)
	21:10	20:33	5 20:00 (T-35)	19:37	18:41	13 18:17 (T-07)
18	05:58	06:32	19:52 (T-35)	07:09	07:46	18:07 (T-07)
	21:09	20:31	11 20:03 (T-35)	19:36	18:39	7 18:14 (T-07)
19	05:59	06:34	19:49 (T-35)	07:10	07:47	16:57
	21:08	20:29	15 20:04 (T-35)	19:34	18:37	7 16:56
20	06:00	06:35	19:48 (T-35)	07:11	07:48	16:56
	21:08	20:28	14 20:02 (T-35)	19:32	15 18:31 (T-07)	18:36
21	06:01	06:36	19:47 (T-35)	07:12	07:50	16:55
	21:07	20:26	14 20:01 (T-35)	19:30	22 18:35 (T-07)	18:34
22	06:02	06:37	19:46 (T-35)	07:14	07:51	16:55
	21:06	20:24	13 19:59 (T-35)	19:28	26 18:36 (T-07)	18:32
23	06:03	06:38	19:46 (T-35)	07:15	07:52	16:54
	21:05	20:23	12 19:58 (T-35)	19:26	30 18:38 (T-07)	18:31
24	06:04	06:39	19:45 (T-35)	07:16	07:54	16:53
	21:04	20:21	11 19:56 (T-35)	19:24	33 18:39 (T-07)	18:29
25	06:05	06:41	19:45 (T-35)	07:17	07:55	16:52
	21:03	20:19	10 19:55 (T-35)	19:22	35 18:39 (T-07)	18:27
26	06:06	06:42	19:44 (T-35)	07:18	07:56	16:52
	21:02	20:18	9 19:53 (T-35)	19:20	38 18:40 (T-07)	18:26
27	06:07	06:43	19:44 (T-35)	07:20	07:58	16:51
	21:01	20:16	7 19:51 (T-35)	19:19	40 18:41 (T-07)	18:24
28	06:08	06:44	19:44 (T-35)	07:21	07:59	16:50
	21:00	20:14	5 19:49 (T-35)	19:17	42 18:42 (T-07)	18:23
29	06:09	06:45	19:45 (T-35)	07:22	08:00	16:50
	20:59	20:12	2 19:47 (T-35)	19:15	43 18:42 (T-07)	18:21
30	06:10	06:46	07:23	17:58 (T-07)	08:02	16:49
	20:58	20:11	19:13	18:41 (T-07)	18:20	16:49
31	06:12	06:48	08:03	18:18	08:03	16:49
	20:56	20:09	18:18	16:56	8 16:27 (T-06)	08:05
Potential sun hours	471	436	377	341	288	275
Total, worst case						
Sun reduction		128	367	574	347	284
Oper. time red.		0.72	0.67	0.56	0.48	0.52
Wind dir. red.		0.90	0.90	0.90	0.90	0.90
Wind dir. red.		0.60	0.58	0.58	0.60	0.60
Total reduction		0.39	0.35	0.29	0.26	0.28
Total, real		49	128	167	90	79

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-191 - R-191

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:05	07:47	16:46 (T-06)	07:06	17:35 (T-07)	07:10
	16:57	17:35	8 16:54 (T-06)	18:13	16 17:51 (T-07)	19:53
2	08:05	07:46		07:04	17:33 (T-07)	07:08
	16:58	17:37		18:14	19 17:52 (T-07)	19:54
3	08:05	07:45		07:03	17:32 (T-07)	07:06
	16:59	17:38		18:16	22 17:54 (T-07)	19:55
4	08:05	07:44		07:01	17:31 (T-07)	07:04
	17:00	17:39		18:17	25 17:56 (T-07)	19:57
5	08:05	07:43		06:59	17:30 (T-07)	07:02
	17:01	17:41		18:18	27 17:57 (T-07)	19:58
6	08:05	07:41		06:57	17:29 (T-07)	07:00
	17:02	17:42		18:20	29 17:58 (T-07)	19:59
7	08:04	16:33 (T-06)	07:40	06:56	17:28 (T-07)	06:59
	17:03	1 16:34 (T-06)	17:44	18:21	31 17:59 (T-07)	20:00
8	08:04	16:33 (T-06)	07:39	07:54	18:27 (T-07)	06:57
	17:04	3 16:36 (T-06)	17:45	18:22	33 19:00 (T-07)	20:02
9	08:04	16:33 (T-06)	07:37	07:52	18:27 (T-07)	06:55
	17:05	4 16:37 (T-06)	17:47	19:24	36 19:03 (T-07)	20:03
10	08:04	16:33 (T-06)	07:36	07:50	18:27 (T-07)	06:53
	17:06	5 16:38 (T-06)	17:48	19:25	37 19:04 (T-07)	20:04
11	08:03	16:33 (T-06)	07:35	07:48	18:26 (T-07)	06:51
	17:07	6 16:39 (T-06)	17:49	19:26	39 19:05 (T-07)	20:05
12	08:03	16:33 (T-06)	07:33	07:47	18:26 (T-07)	06:50
	17:09	8 16:41 (T-06)	17:51	19:27	40 19:06 (T-07)	20:07
13	08:02	16:33 (T-06)	07:32	07:45	18:26 (T-07)	06:48
	17:10	9 16:42 (T-06)	17:52	19:29	39 19:05 (T-07)	20:08
14	08:02	16:33 (T-06)	07:30	07:43	18:26 (T-07)	06:46
	17:11	10 16:43 (T-06)	17:54	19:30	39 19:05 (T-07)	20:09
15	08:02	16:33 (T-06)	07:29	07:41	18:26 (T-07)	06:44
	17:12	12 16:45 (T-06)	17:55	19:31	38 19:04 (T-07)	20:10
16	08:01	16:33 (T-06)	07:27	07:39	18:27 (T-07)	06:43
	17:13	13 16:46 (T-06)	17:56	19:33	37 19:04 (T-07)	20:12
17	08:00	16:34 (T-06)	07:26	07:37	18:28 (T-07)	06:41
	17:15	14 16:48 (T-06)	17:58	19:34	35 19:03 (T-07)	20:13
18	08:00	16:34 (T-06)	07:24	07:36	18:28 (T-07)	06:39
	17:16	15 16:49 (T-06)	17:59	19:35	33 19:01 (T-07)	20:14
19	07:59	16:34 (T-06)	07:23	07:34	18:29 (T-07)	06:37
	17:17	16 16:50 (T-06)	18:01	19:36	30 18:59 (T-07)	20:15
20	07:58	16:34 (T-06)	07:21	07:32	18:30 (T-07)	06:36
	17:19	17 16:51 (T-06)	18:01	19:38	28 18:58 (T-07)	20:17
21	07:58	16:34 (T-06)	07:19	07:30	18:32 (T-07)	06:34
	17:20	18 16:52 (T-06)	18:02	19:39	23 18:55 (T-07)	20:18
22	07:57	16:35 (T-06)	07:18	07:28	18:34 (T-07)	06:32
	17:21	20 16:55 (T-06)	18:03	19:40	18 18:52 (T-07)	20:19
23	07:56	16:35 (T-06)	07:16	07:26	18:37 (T-07)	06:31
	17:23	21 16:56 (T-06)	18:05	19:42	11 18:48 (T-07)	20:20
24	07:55	16:36 (T-06)	07:15	07:24		06:29
	17:24	21 16:57 (T-06)	18:06	19:43		20:22
25	07:54	16:37 (T-06)	07:13	07:23		06:28
	17:25	22 16:59 (T-06)	18:07	19:44		20:23
26	07:53	16:37 (T-06)	07:11	17:45 (T-07)	07:21	06:26
	17:27	23 17:00 (T-06)	18:09	2 17:47 (T-07)	19:45	20:24
27	07:53	16:38 (T-06)	07:10	17:40 (T-07)	07:19	06:24
	17:28	23 17:01 (T-06)	18:10	8 17:48 (T-07)	19:47	20:25
28	07:52	16:39 (T-06)	07:08	17:38 (T-07)	07:17	06:23
	17:30	21 17:00 (T-06)	18:12	12 17:50 (T-07)	19:48	20:26
29	07:51	16:40 (T-06)		07:15		06:21
	17:31	19 16:59 (T-06)		19:49		20:28
30	07:49	16:42 (T-06)		07:13		06:20
	17:32	16 16:58 (T-06)		19:50		20:29
31	07:48	16:43 (T-06)		07:11		
	17:34	13 16:56 (T-06)		19:52		
Potential sun hours	287	292	369		404	459
Total, worst case	350	30	685		105	465
Sun reduction	0.58	0.58	0.59		0.63	
Oper. time red.	0.90	0.90	0.90		0.90	
Wind dir. red.	0.59	0.58	0.57		0.60	
Total reduction	0.31	0.30	0.30		0.34	
Total, real	108	9	209		36	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-191 - R-191
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December		
1	05:45	06:13	06:49	07:24	18:05 (T-07)	07:04	07:44	16:15 (T-06)
	21:17	20:55	20:07	19:11	40 18:45 (T-07)	17:17	16:49	7 16:22 (T-06)
2	05:46	06:14	06:50	07:26	18:05 (T-07)	07:06	07:45	16:16 (T-06)
	21:17	20:54	20:05	19:09	39 18:44 (T-07)	17:16	16:48	5 16:21 (T-06)
3	05:46	06:15	06:51	07:27	18:04 (T-07)	07:07	07:46	16:16 (T-06)
	21:17	20:53	20:04	19:07	38 18:42 (T-07)	17:14	16:48	4 16:20 (T-06)
4	05:47	06:16	06:52	07:28	18:04 (T-07)	07:08	07:47	16:17 (T-06)
	21:16	20:51	20:02	19:06	36 18:40 (T-07)	17:13	16:48	3 16:20 (T-06)
5	05:48	06:17	06:54	07:29	18:04 (T-07)	07:10	07:48	16:19 (T-06)
	21:16	20:50	20:00	19:04	34 18:38 (T-07)	17:12	16:47	1 16:20 (T-06)
6	05:48	06:18	06:55	07:31	18:04 (T-07)	07:11	07:49	
	21:16	20:49	19:58	19:02	33 18:37 (T-07)	17:10	16:47	
7	05:49	06:19	06:56	07:32	18:04 (T-07)	07:12	07:50	
	21:15	20:47	19:56	19:00	31 18:35 (T-07)	17:09	16:47	
8	05:50	06:21	06:57	07:33	18:04 (T-07)	07:14	07:51	
	21:15	20:46	19:54	18:56	29 18:33 (T-07)	17:08	16:47	
9	05:50	06:22	06:58	07:34	18:04 (T-07)	07:15	07:52	
	21:15	20:45	19:52	18:55	26 18:30 (T-07)	17:07	16:47	
10	05:51	06:23	06:59	07:35	18:06 (T-07)	07:17	07:53	
	21:14	20:43	19:51	18:53	23 18:29 (T-07)	17:05	8 16:25 (T-06)	16:47
11	05:52	06:24	07:01	07:37	18:06 (T-07)	07:18	16:15 (T-06)	07:54
	21:14	20:42	19:49	18:51	21 18:27 (T-07)	17:04	13 16:28 (T-06)	16:47
12	05:53	06:25	07:02	07:38	18:07 (T-07)	07:19	16:13 (T-06)	07:55
	21:13	20:40	19:47	18:49	18 18:25 (T-07)	17:03	16 16:29 (T-06)	16:47
13	05:54	06:26	07:03	07:39	18:09 (T-07)	07:21	16:12 (T-06)	07:56
	21:13	20:39	19:45	18:47	15 18:24 (T-07)	17:02	19 16:31 (T-06)	16:47
14	05:54	06:28	07:04	07:41	18:11 (T-07)	07:22	16:11 (T-06)	07:56
	21:12	20:37	19:43	18:46	11 18:22 (T-07)	17:01	21 16:32 (T-06)	16:47
15	05:55	06:29	07:05	07:42	18:14 (T-07)	07:23	16:11 (T-06)	07:57
	21:11	20:36	19:41	18:44	6 18:20 (T-07)	17:00	22 16:33 (T-06)	16:47
16	05:56	06:30	07:06	07:43		07:25	16:10 (T-06)	07:58
	21:11	20:34	19:39	18:42		16:59	23 16:33 (T-06)	16:47
17	05:57	06:31	07:08	07:44		07:26	16:09 (T-06)	07:59
	21:10	20:33	19:37	18:41		16:58	23 16:32 (T-06)	16:48
18	05:58	06:32	07:09	07:46		07:27	16:10 (T-06)	07:59
	21:09	20:31	19:36	18:39		16:57	21 16:31 (T-06)	16:48
19	05:59	06:34	07:10	07:47		07:29	16:09 (T-06)	08:00
	21:08	20:29	19:34	18:37		16:56	21 16:30 (T-06)	16:48
20	06:00	06:35	19:50 (T-35)	07:11	18:25 (T-07)	07:48	07:30	16:10 (T-06)
	21:08	20:28	9 19:59 (T-35)	19:32	8 18:33 (T-07)	18:36	16:55	20 16:30 (T-06)
21	06:01	06:36	19:48 (T-35)	07:12	18:21 (T-07)	07:50	07:31	16:10 (T-06)
	21:07	20:26	13 20:01 (T-35)	19:30	17 18:38 (T-07)	18:34	16:55	18 16:28 (T-06)
22	06:02	06:37	19:46 (T-35)	07:14	18:18 (T-07)	07:51	07:33	16:10 (T-06)
	21:06	20:24	13 19:59 (T-35)	19:28	22 18:40 (T-07)	18:32	16:54	17 16:27 (T-06)
23	06:03	06:38	19:46 (T-35)	07:15	18:15 (T-07)	07:52	07:34	16:11 (T-06)
	21:05	20:23	12 19:58 (T-35)	19:26	27 18:42 (T-07)	18:31	16:53	16 16:27 (T-06)
24	06:04	06:39	19:44 (T-35)	07:16	18:13 (T-07)	07:54	07:35	16:11 (T-06)
	21:04	20:21	12 19:56 (T-35)	19:24	30 18:43 (T-07)	18:29	16:52	15 16:26 (T-06)
25	06:05	06:41	19:44 (T-35)	07:17	18:11 (T-07)	07:55	07:36	16:11 (T-06)
	21:03	20:19	11 19:55 (T-35)	19:22	32 18:43 (T-07)	18:27	16:52	14 16:25 (T-06)
26	06:06	06:42	19:43 (T-35)	07:18	18:10 (T-07)	07:56	07:38	16:12 (T-06)
	21:02	20:18	10 19:53 (T-35)	19:20	34 18:44 (T-07)	18:26	16:51	13 16:25 (T-06)
27	06:07	06:43	19:43 (T-35)	07:20	18:09 (T-07)	07:58	07:39	16:12 (T-06)
	21:01	20:16	8 19:51 (T-35)	19:19	36 18:45 (T-07)	18:24	16:50	12 16:24 (T-06)
28	06:08	06:44	19:42 (T-35)	07:21	18:08 (T-07)	07:59	07:40	16:13 (T-06)
	21:00	20:14	7 19:49 (T-35)	19:17	37 18:45 (T-07)	18:23	16:50	10 16:23 (T-06)
29	06:09	06:45	19:42 (T-35)	07:22	18:07 (T-07)	08:00	07:41	16:14 (T-06)
	20:59	20:12	5 19:47 (T-35)	19:15	38 18:45 (T-07)	18:21	16:49	9 16:23 (T-06)
30	06:10	06:46	19:42 (T-35)	07:23	18:06 (T-07)	08:02	07:42	16:15 (T-06)
	20:58	20:11	3 19:45 (T-35)	19:13	39 18:45 (T-07)	18:20	16:49	7 16:22 (T-06)
31	06:12	06:48				08:03		08:04
	20:56	20:09				18:18		16:56
Potential sun hours	471	436	377	341	288		275	
Total, worst case			320	400	338		20	
Sun reduction		103	0.72	0.67	0.56		0.52	
Oper. time red.		0.90	0.90	0.90	0.90		0.90	
Wind dir. red.		0.60	0.57	0.57	0.59		0.59	
Total reduction		0.39	0.35	0.29	0.25		0.28	
Total, real		40	111	116	86		6	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-192 - R-192 Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with 12 columns for months (January-December) and multiple rows for times of day (08:05-17:34). Includes summary rows for 'Potential sun hours', 'Total, worst case', 'Sun reduction', 'Oper. time red.', 'Wind dir. red.', 'Total reduction', and 'Total, real'.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
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1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-193 - R-193

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:05 16:57 49	09:25 (T-11) 10:14 (T-11) 17:35	07:47 18:13	07:06 19:53	07:09 20:30	06:18 21:04	05:45 21:17	05:45 20:55	06:13 20:07	06:49 19:11	07:24 17:17	07:04 16:48	09:18 (T-11) 35 09:53 (T-11)
2	08:05 16:58 48	09:26 (T-11) 10:14 (T-11) 17:36	07:46 18:14	07:04 19:54	07:08 20:31	06:17 21:05	05:45 21:17	05:46 20:54	06:14 20:05	06:50 19:09	07:26 17:16	07:06 16:48	09:17 (T-11) 37 09:54 (T-11)
3	08:05 16:59 47	09:27 (T-11) 10:14 (T-11) 17:38	07:45 18:15	07:03 19:55	07:06 20:33	06:15 21:06	05:44 21:16	05:46 20:53	06:15 20:03	06:51 19:07	07:27 17:14	07:07 16:48	09:17 (T-11) 39 09:56 (T-11)
4	08:05 17:00 46	09:28 (T-11) 10:14 (T-11) 17:39	07:44 18:17	07:01 19:57	07:04 20:34	06:14 21:07	05:44 21:16	05:47 20:51	06:16 20:02	06:52 19:05	07:28 17:13	07:08 16:47	09:16 (T-11) 41 09:57 (T-11)
5	08:05 17:01 45	09:29 (T-11) 10:14 (T-11) 17:41	07:42 18:18	06:59 19:58	07:02 20:35	06:13 21:08	05:43 21:16	05:47 20:50	06:17 20:00	06:53 19:04	07:29 17:11	07:10 16:47	09:16 (T-11) 42 09:58 (T-11)
6	08:04 17:02 44	09:30 (T-11) 10:14 (T-11) 17:42	07:41 18:19	06:57 19:59	07:00 20:36	06:11 21:08	05:43 21:16	05:48 20:49	06:18 19:58	06:55 19:02	07:30 17:10	07:11 16:47	09:16 (T-11) 44 10:00 (T-11)
7	08:04 17:03 43	09:30 (T-11) 10:13 (T-11) 17:44	07:40 18:21	06:56 20:00	06:58 20:37	06:10 21:09	05:42 21:15	05:49 20:47	06:19 19:56	06:56 19:00	07:32 17:09	07:12 16:47	09:16 (T-11) 45 10:01 (T-11)
8	08:04 17:04 41	09:32 (T-11) 10:13 (T-11) 17:45	07:39 18:22	06:57 20:02	06:57 20:39	06:08 21:10	05:42 21:15	05:50 20:46	06:21 19:54	06:57 18:56	07:33 17:08	07:14 16:47	09:16 (T-11) 46 10:02 (T-11)
9	08:04 17:05 40	09:33 (T-11) 10:13 (T-11) 17:46	07:37 19:23	06:55 20:03	06:07 20:40	05:42 21:11	05:50 21:15	06:22 20:45	06:58 19:52	07:34 18:54	07:15 17:06	07:15 16:47	09:16 (T-11) 47 10:03 (T-11)
10	08:04 17:06 37	09:34 (T-11) 10:11 (T-11) 17:48	07:36 19:25	06:50 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:16 17:05	07:16 16:47	09:16 (T-11) 48 10:04 (T-11)
11	08:03 17:07 35	09:36 (T-11) 10:11 (T-11) 17:49	07:34 19:26	06:51 20:05	06:05 20:42	05:41 21:12	05:52 21:14	06:24 20:42	07:00 19:49	07:37 18:51	07:18 17:04	07:18 16:47	09:15 (T-11) 49 10:04 (T-11)
12	08:03 17:08 33	09:37 (T-11) 10:10 (T-11) 17:51	07:33 19:27	06:50 20:07	06:03 20:43	05:41 21:12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:19 16:47	09:15 (T-11) 50 10:05 (T-11)
13	08:02 17:10 30	09:39 (T-11) 10:09 (T-11) 17:52	07:32 19:29	06:48 20:08	06:02 20:45	05:41 21:13	05:53 21:13	06:26 20:39	07:03 19:45	07:39 18:47	07:21 17:02	07:21 16:47	09:16 (T-11) 50 10:06 (T-11)
14	08:02 17:11 26	09:41 (T-11) 10:07 (T-11) 17:53	07:30 19:30	06:43 20:09	06:01 20:46	05:41 21:13	05:54 21:12	06:28 20:37	07:04 19:43	07:40 18:46	07:22 17:01	07:22 16:47	09:16 (T-11) 51 10:07 (T-11)
15	08:01 17:12 22	09:44 (T-11) 10:06 (T-11) 17:55	07:29 19:31	06:44 20:10	06:00 20:47	05:41 21:14	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	07:23 16:47	09:17 (T-11) 50 10:07 (T-11)
16	08:01 17:13 18	09:46 (T-11) 10:04 (T-11) 17:56	07:27 19:33	06:43 20:11	05:59 20:48	05:41 21:14	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42	07:25 16:59	07:25 16:47	09:16 (T-11) 51 10:07 (T-11)
17	08:00 17:15 9	09:50 (T-11) 09:59 (T-11) 17:58	07:26 19:34	06:41 20:13	05:58 20:49	05:41 21:15	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:40	07:26 16:58	07:26 16:48	09:17 (T-11) 51 10:08 (T-11)
18	08:00 17:16	07:24 17:59	07:35 19:35	06:39 20:14	05:57 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:35	07:46 18:39	07:27 16:57	07:27 16:48	09:18 (T-11) 51 10:09 (T-11)
19	07:59 17:17	07:23 18:00	07:34 19:36	06:37 20:15	05:56 20:51	05:41 21:16	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37	07:29 16:56	07:29 16:48	09:19 (T-11) 52 10:09 (T-11)
20	07:58 17:19	07:21 18:00	07:32 19:38	06:36 20:16	05:55 20:52	05:41 21:16	06:00 21:08	06:35 20:28	07:11 19:32	07:48 18:35	07:30 16:55	07:30 16:49	09:18 (T-11) 52 10:10 (T-11)
21	07:58 17:20	07:19 18:02	07:30 19:39	06:34 20:18	05:54 20:54	05:41 21:16	06:01 21:07	06:36 20:26	07:12 19:30	07:50 18:34	07:31 16:54	07:31 16:49	09:18 (T-11) 52 10:10 (T-11)
22	07:57 17:21	07:18 18:03	07:28 19:40	06:32 20:19	05:53 20:55	05:42 21:16	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:54	07:32 16:50	09:19 (T-11) 52 10:11 (T-11)
23	07:56 17:23	07:16 18:05	07:26 19:41	06:31 20:20	05:52 20:56	05:42 21:17	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53	07:34 16:50	09:19 (T-11) 52 10:11 (T-11)
24	07:55 17:24	07:15 18:06	07:24 19:43	06:29 20:21	05:51 20:57	05:42 21:17	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	07:35 16:51	09:20 (T-11) 52 10:12 (T-11)
25	07:54 17:25	07:13 18:07	07:22 19:44	06:28 20:23	05:50 20:58	05:42 21:17	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	07:36 16:52	07:36 16:52	09:20 (T-11) 52 10:12 (T-11)
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27	07:52 17:28	07:09 18:10	07:19 19:46	06:24 20:25	05:48 21:00	05:43 21:17	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	07:39 16:50	07:39 16:50	09:22 (T-11) 51 10:13 (T-11)
28	07:51 17:29	07:08 18:11	07:17 19:48	06:23 20:26	05:48 21:01	05:44 21:17	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50	07:40 16:50	09:21 (T-11) 51 10:13 (T-11)
29	07:50 17:31	07:07 18:12	07:15 19:49	06:21 20:28	05:47 21:02	05:44 21:17	06:09 20:59	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	07:41 16:49	09:23 (T-11) 50 10:13 (T-11)
30	07:49 17:32	07:06 18:13	07:13 19:50	06:20 20:29	05:46 21:03	05:45 21:17	06:10 20:57	06:46 20:11	07:23 19:13	08:02 18:20	07:42 16:49	07:42 16:49	09:24 (T-11) 50 10:14 (T-11)
31	07:48 17:34	07:05 18:14	07:11 19:52	06:19 21:03	05:46 21:03	05:45 21:17	06:11 20:56	06:48 20:09	08:03 18:18	08:04 16:56	08:04 16:56	08:04 16:56	09:24 (T-11) 50 10:14 (T-11)
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275	
Total, worst case	613										138		1494
Sun reduction	0.58										0.48		0.52
Oper. time red.	0.90										0.90		0.90
Wind dir. red.	0.68										0.68		0.68
Total reduction	0.36										0.29		0.32
Total, real	218										41		476

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-195 - R-195

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
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10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
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13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
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14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
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15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
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19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
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	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:03			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-196 - R-196
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05 16:57	07:47 17:35	07:06 18:13	07:09 19:53	06:18 20:30	05:45 21:04	05:45 21:17	06:13 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:44 16:48
2	08:05 16:58	07:46 17:36	07:04 18:14	07:08 19:54	06:17 20:31	05:45 21:05	05:46 21:17	06:14 20:54	06:50 20:05	07:25 19:09	07:06 17:15	07:45 16:48
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5	08:05 17:01	07:42 17:41	06:59 18:18	07:02 19:58	06:12 20:35	05:43 21:08	05:47 21:16	06:17 20:50	06:53 20:00	07:29 19:04	07:10 17:11	07:48 16:47
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10	08:04 17:06	07:36 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:16 17:05	07:53 16:47
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:05 20:42	05:41 21:12	05:52 21:14	06:24 20:42	07:00 19:49	07:37 18:51	07:18 17:04	07:54 16:47
12	08:03 17:08	07:33 17:51	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:55 16:47
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	06:02 20:45	05:41 21:13	05:53 21:13	06:26 20:39	07:03 19:45	07:39 18:47	07:21 17:02	07:56 16:47
14	08:02 17:11	07:30 17:53	07:43 19:30	06:46 20:09	06:01 20:46	05:41 21:13	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:46	07:22 17:01	07:56 16:47
15	08:01 17:12	07:29 17:55	07:41 19:31	06:44 20:10	06:00 20:47	05:41 21:14	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	07:57 16:47
16	08:01 17:13	07:27 17:56	07:39 19:33	06:42 20:11	05:59 20:48	05:41 21:14	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42	07:25 16:59	07:58 16:47
17	08:00 17:15	07:26 17:58	07:37 19:34	06:41 20:13	05:58 20:49	05:41 21:15	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:40	07:26 16:58	07:59 16:48
18	08:00 17:16	07:24 17:59	07:35 19:35	06:39 20:14	05:57 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:35	07:46 18:39	07:27 16:57	07:59 16:48
19	07:59 17:17	07:23 18:00	07:34 19:36	06:37 20:15	05:56 20:51	05:41 21:16	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37	07:29 16:56	08:00 16:48
20	07:58 17:18	07:21 18:00	07:32 19:38	06:36 20:16	05:55 20:52	05:41 21:16	06:00 21:07	06:35 20:28	07:11 19:32	07:48 18:35	07:30 16:55	08:00 16:49
21	07:58 17:20	07:19 18:02	07:30 19:39	06:34 20:18	05:54 20:54	05:41 21:16	06:01 21:07	06:36 20:26	07:12 19:30	07:49 18:34	07:31 16:54	08:01 16:49
22	07:57 17:21	07:18 18:03	07:28 19:40	06:32 20:19	05:53 20:55	05:42 21:16	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:54	08:02 16:50
23	07:56 17:22	07:16 18:05	07:26 19:41	06:31 20:20	05:52 20:56	05:42 21:17	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:30	07:34 16:53	08:02 16:50
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28	07:51 17:29	07:08 18:11	07:17 19:48	06:23 20:26	05:48 21:01	05:44 21:17	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50	08:04 16:53
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30	07:49 17:32		07:13 19:50	06:20 20:29	05:46 21:03	05:45 21:17	06:10 20:57	06:46 20:11	07:23 19:13	08:02 18:20	07:42 16:49	08:04 16:55
31	07:48 17:34		07:11 19:51	06:19 21:03	05:45 21:03	05:46 21:03	06:11 20:56	06:48 20:09	08:03 18:18	08:03 18:18	08:04 18:18	08:04 16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-197 - R-197

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
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	17:02	17:42	18:20	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
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11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:01	07:37	07:18	07:54
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15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
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	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
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24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
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28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
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31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:04			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-198 - R-198
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
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16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
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	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46	05:45	06:11	06:48		08:03	08:04	08:04
	17:34		19:52	21:04	20:56	20:56	20:09			18:18	16:56	16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-200 - R-200

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ESE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:05 16:57	07:47 17:35	07:06 18:13	07:10 18:13	06:18 17:51	05:45 20:30	05:45 21:04	06:13 21:17	06:49 20:07	07:24 19:11	17:53 (T-35) 18:46 (T-05)	07:04 17:17	07:44 16:49
2	08:05 16:58	07:46 17:37	07:04 18:14	07:08 18:14	06:17 17:52	05:45 20:31	05:45 21:05	06:14 20:54	06:50 20:05	07:26 19:09	17:52 (T-35) 18:44 (T-05)	07:06 17:16	07:45 16:48
3	08:05 16:59	07:45 17:38	07:03 18:16	07:06 18:16	06:16 17:54	05:44 20:33	05:44 21:06	06:15 20:53	06:51 20:04	07:27 19:07	17:50 (T-35) 18:42 (T-05)	07:07 17:14	07:46 16:48
4	08:05 17:00	07:44 17:39	07:01 18:17	07:04 18:17	06:14 17:56	05:44 20:34	05:44 21:07	06:16 20:51	06:52 20:02	07:28 19:06	17:49 (T-35) 18:40 (T-05)	07:08 17:13	07:47 16:48
5	08:05 17:01	07:43 17:41	06:59 18:18	07:02 18:18	06:13 17:57	05:43 20:35	05:43 21:08	06:17 20:50	06:54 20:00	07:29 19:29	17:48 (T-35) 18:33 (T-05)	07:10 17:12	07:48 16:47
6	08:05 17:02	07:41 17:42	06:57 18:20	07:00 18:20	06:11 17:58	05:43 20:36	05:43 21:09	06:18 20:49	06:55 19:58	07:31 19:02	17:48 (T-35) 18:37 (T-05)	07:11 17:10	07:49 16:47
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 18:21	06:10 17:59	05:43 20:38	05:43 21:09	06:20 20:47	06:56 19:56	07:32 19:00	17:47 (T-35) 18:35 (T-05)	07:13 17:09	07:50 16:47
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 18:22	06:09 19:00	05:42 20:39	05:42 21:10	06:21 20:46	06:57 19:54	07:33 18:56	17:46 (T-35) 18:33 (T-05)	07:14 17:08	07:51 16:47
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 19:24	06:07 20:03	05:42 20:40	05:42 21:11	06:22 20:45	06:58 19:53	07:34 18:55	17:47 (T-35) 18:31 (T-05)	07:15 17:07	07:52 16:47
10	08:04 17:06	07:36 17:48	07:50 19:25	06:53 19:25	06:06 20:04	05:42 20:41	05:42 21:11	06:23 20:43	06:59 19:51	07:36 18:53	17:46 (T-35) 18:29 (T-35)	07:17 17:05	07:53 16:47
11	08:03 17:07	07:35 17:49	07:48 19:26	06:51 19:26	06:05 20:05	05:42 20:42	05:42 21:12	06:24 20:42	07:01 19:49	07:37 18:51	17:45 (T-35) 18:27 (T-35)	07:18 17:04	07:54 16:47
12	08:03 17:09	07:33 17:51	07:47 19:28	06:50 19:28	06:04 20:07	05:41 20:44	05:41 21:12	06:25 20:40	07:02 19:47	07:38 18:49	17:45 (T-35) 18:25 (T-35)	07:19 17:03	07:55 16:47
13	08:03 17:10	07:32 17:52	07:45 19:29	06:48 19:29	06:02 20:08	05:41 20:45	05:41 21:13	06:27 20:39	07:03 19:45	07:39 18:48	17:46 (T-35) 18:24 (T-35)	07:21 17:02	07:56 16:47
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 19:30	06:01 20:09	05:41 21:14	05:41 21:12	06:28 20:37	07:04 19:43	07:41 18:46	17:46 (T-35) 18:22 (T-35)	07:22 17:01	07:56 16:47
15	08:02 17:12	07:29 17:55	07:41 19:31	06:44 19:31	06:00 20:10	05:41 20:47	05:41 21:11	06:29 20:36	07:05 19:41	07:42 18:44	17:46 (T-35) 18:20 (T-35)	07:23 17:00	07:57 16:47
16	08:01 17:14	07:27 17:56	07:39 19:33	06:43 19:33	05:59 20:12	05:41 20:48	05:41 21:11	06:30 20:34	07:07 19:39	07:43 18:42	18:20 (T-35) 18:19 (T-35)	07:25 16:59	07:58 16:48
17	08:00 17:15	07:26 17:58	07:37 19:34	06:41 19:34	05:58 20:13	05:41 20:49	05:41 21:15	06:31 20:33	07:08 19:38	07:44 18:41	17:47 (T-35) 18:17 (T-35)	07:26 16:58	07:59 16:48
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 19:35	05:57 20:14	05:41 20:50	05:41 21:15	06:32 20:31	07:09 19:36	07:46 18:39	17:47 (T-35) 18:14 (T-35)	07:27 16:57	07:59 16:48
19	07:59 17:17	07:23 18:01	07:34 19:37	06:38 19:37	05:56 20:15	05:41 20:52	05:41 21:16	06:34 20:29	07:10 19:34	07:47 18:37	17:49 (T-35) 18:13 (T-35)	07:29 16:56	08:00 16:48
20	07:58 17:19	07:21 18:01	07:32 19:38	06:36 19:38	05:55 20:17	05:41 20:53	05:41 21:16	06:35 20:28	07:11 19:32	07:48 18:36	17:50 (T-35) 18:11 (T-35)	07:30 16:55	08:01 16:49
21	07:58 17:20	07:20 18:02	07:30 19:39	06:34 19:39	05:54 20:18	05:42 20:54	05:42 21:16	06:36 20:26	07:12 19:30	07:12 18:34	17:51 (T-35) 18:10 (T-35)	07:31 16:55	08:01 16:49
22	07:57 17:21	07:18 18:03	07:28 19:40	06:33 19:40	05:53 20:19	05:42 20:55	05:42 21:16	06:37 20:25	07:14 19:28	07:14 18:49	17:53 (T-35) 18:08 (T-35)	07:33 16:54	08:02 16:50
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 19:42	05:52 20:20	05:42 20:56	05:42 21:17	06:38 20:23	07:15 19:26	07:15 18:51	18:36 (T-05) 18:14 (T-35)	07:52 07:54	08:02 16:50
24	07:55 17:24	07:15 18:06	07:24 19:43	06:29 19:43	05:51 20:22	05:42 20:57	05:42 21:17	06:39 20:21	07:16 19:24	07:16 18:53	18:14 (T-35) 18:05 (T-05)	07:54 16:52	08:03 16:51
25	07:54 17:25	07:13 18:08	07:23 19:44	06:28 19:44	05:50 20:23	05:43 20:58	05:43 21:17	06:05 21:03	06:41 19:22	07:17 18:54	18:06 (T-35) 18:54 (T-05)	07:55 18:28	08:03 16:52
26	07:54 17:27	07:11 18:09	07:21 19:45	06:26 19:45	05:49 20:24	05:43 20:59	05:43 21:17	06:42 20:18	07:18 19:21	07:18 18:54	18:02 (T-35) 18:54 (T-05)	07:56 18:26	08:03 16:51
27	07:53 17:28	07:10 18:10	07:19 19:47	06:25 19:47	05:49 20:25	05:43 21:00	05:43 21:17	06:43 20:16	07:20 19:19	07:20 18:00	18:00 (T-35) 18:54 (T-05)	07:58 18:24	08:04 16:50
28	07:52 17:30	07:08 18:12	07:17 19:48	06:23 19:48	05:48 20:27	05:44 21:01	05:44 21:17	06:44 20:14	07:21 19:17	07:21 17:58	17:58 (T-35) 18:52 (T-05)	07:59 18:29	08:04 16:50
29	07:51 17:31	07:07 19:49	07:15 19:49	06:21 19:49	05:47 20:28	05:44 21:02	05:44 21:17	06:45 20:13	07:22 19:15	07:22 18:50	17:56 (T-35) 18:50 (T-05)	08:00 18:21	08:04 16:49
30	07:50 17:32	07:05 19:50	07:13 19:50	06:20 19:50	05:47 20:29	05:45 21:03	05:45 21:17	06:47 20:11	07:23 19:13	07:23 17:54	17:54 (T-35) 18:48 (T-05)	08:02 18:20	08:04 16:55
31	07:48 17:34	07:09 19:52	07:11 19:52	06:19 19:52	05:46 21:04	05:44 21:04	05:44 20:56	06:48 20:09	08:03 18:19	08:03 18:19	18:03 (T-05)	08:05 16:56	08:05 16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275	
Total, worst case		273	927					346		869			
Sun reduction		0.58	0.59					0.67		0.56			
Oper. time red.		0.90	0.90					0.90		0.90			
Wind dir. red.		0.58	0.58					0.58		0.58			
Total reduction		0.30	0.31					0.35		0.29			
Total, real		83	285					120		254			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-201 - R-201

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05 16:57	07:47 17:35	07:06 18:13	07:36 (T-06) 18:13	07:10 19:53	06:19 20:30
2	08:05 16:58	07:46 17:37	07:05 18:14	07:37 (T-06) 18:14	07:08 19:54	06:17 20:32
3	08:05 16:59	07:45 17:38	07:03 18:16	07:39 (T-06) 18:16	07:06 19:55	06:16 20:33
4	08:05 17:00	07:44 17:40	07:01 18:17	07:43 (T-06) 18:17	07:04 19:57	06:14 20:34
5	08:05 17:01	07:43 17:41	06:59 18:18	07:02 18:18	07:02 19:58	06:13 20:35
6	08:05 17:02	07:41 17:42	06:58 18:20	07:01 19:59	06:11 20:36	05:43 21:09
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	06:10 20:38	05:43 21:09
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	07:17 (T-07) 4 07:21 (T-07)	06:09 20:39
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 20:03	07:15 (T-07) 7 07:22 (T-07)	06:07 20:40
10	08:04 17:06	07:36 17:48	07:50 19:25	06:53 20:04	07:13 (T-07) 10 07:23 (T-07)	06:06 20:41
11	08:03 17:08	07:35 17:49	07:49 19:26	06:52 20:05	07:12 (T-07) 12 07:24 (T-07)	06:05 20:42
12	08:03 17:09	07:33 17:51	07:55 (T-06) 3 07:58 (T-06)	07:47 19:28	06:50 20:07	06:04 20:44
13	08:03 17:10	07:32 17:52	07:53 (T-06) 6 07:59 (T-06)	07:45 19:29	06:48 20:08	06:02 20:45
14	08:02 17:11	07:30 17:54	07:52 (T-06) 9 08:01 (T-06)	07:43 19:30	06:46 20:09	06:01 20:46
15	08:02 17:12	07:29 17:55	07:50 (T-06) 12 08:02 (T-06)	07:41 19:31	06:44 20:10	06:00 20:47
16	08:01 17:14	07:27 17:57	07:49 (T-06) 15 08:04 (T-06)	07:39 19:33	06:43 20:12	05:59 20:48
17	08:01 17:15	07:26 17:58	07:47 (T-06) 17 08:04 (T-06)	07:38 19:34	06:41 20:13	05:58 20:49
18	08:00 17:16	07:24 17:59	07:45 (T-06) 19 08:04 (T-06)	07:36 19:35	06:39 20:14	05:57 20:50
19	07:59 17:17	07:23 18:01	07:44 (T-06) 21 08:05 (T-06)	07:34 19:37	06:38 20:15	05:56 20:52
20	07:59 17:19	07:21 18:01	07:42 (T-06) 23 08:05 (T-06)	07:32 19:38	06:36 20:17	05:55 20:53
21	07:58 17:20	07:20 18:02	07:41 (T-06) 25 08:06 (T-06)	07:30 19:39	06:34 20:18	05:54 20:54
22	07:57 17:21	07:18 18:03	07:39 (T-06) 26 08:05 (T-06)	07:28 19:40	06:33 20:19	05:53 20:55
23	07:56 17:23	07:16 18:05	07:37 (T-06) 28 08:05 (T-06)	07:26 19:42	06:31 20:20	05:52 20:56
24	07:55 17:24	07:15 18:06	07:36 (T-06) 29 08:05 (T-06)	07:25 19:43	06:29 20:22	05:51 20:57
25	07:54 17:26	07:13 18:08	07:34 (T-06) 30 08:04 (T-06)	07:23 19:44	06:28 20:23	05:50 20:58
26	07:54 17:27	07:11 18:09	07:34 (T-06) 29 08:03 (T-06)	07:21 19:45	06:26 20:24	05:50 20:59
27	07:53 17:28	07:10 18:10	07:34 (T-06) 28 08:02 (T-06)	07:19 19:47	06:25 20:25	05:49 21:00
28	07:52 17:30	07:08 18:12	07:35 (T-06) 27 08:02 (T-06)	07:17 19:48	06:23 20:27	05:48 21:01
29	07:51 17:31		07:15 19:49	07:15 19:49	06:22 20:28	05:47 21:02
30	07:50 17:32		07:13 19:50	07:13 19:50	06:20 20:29	05:47 21:03
31	07:48 17:34		07:12 19:52	07:12 19:52	06:19 20:30	05:46 21:04
Potential sun hours	287	292	347	369	404	465
Total, worst case			72	72	244	244
Sun reduction			0.58	0.59	0.63	0.63
Oper. time red.			0.90	0.90	0.90	0.90
Wind dir. red.			0.62	0.62	0.57	0.57
Total reduction			0.33	0.33	0.32	0.32
Total, real		113	24	24	79	79

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-201 - R-201
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-07) 20:07	07:24 19:11	07:04 17:17
2	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-07) 20:07	07:26 19:09	07:06 17:16
3	05:46 21:17	06:15 20:53	06:51 20:04	07:13 (T-07) 20:07	07:27 19:07	07:07 17:14
4	05:47 21:16	06:16 20:52	06:52 20:02	07:14 (T-07) 20:07	07:28 19:06	07:09 17:13
5	05:48 21:16	06:17 20:50	06:54 20:00	07:15 (T-07) 20:07	07:29 19:04	07:10 17:12
6	05:48 21:16	06:18 20:49	06:55 19:58	07:16 (T-07) 20:07	07:31 19:02	07:11 17:10
7	05:49 21:16	06:20 20:48	06:56 19:56	07:17 (T-07) 20:07	07:32 19:00	07:13 17:09
8	05:50 21:15	06:21 20:46	06:57 19:54	07:18 (T-07) 20:07	07:33 18:56	07:14 17:08
9	05:51 21:15	06:22 20:45	06:58 19:53	07:19 (T-07) 20:07	07:34 18:55	07:15 17:07
10	05:51 21:14	06:23 20:43	07:00 19:51	07:20 (T-07) 20:07	07:36 18:53	07:17 17:06
11	05:52 21:14	06:24 20:42	07:01 19:49	07:21 (T-07) 20:07	07:37 18:51	07:18 17:04
12	05:53 21:13	06:25 20:40	07:02 19:47	07:22 (T-07) 20:07	07:38 18:49	07:19 17:03
13	05:54 21:13	06:27 20:39	07:03 19:45	07:23 (T-07) 20:07	07:39 18:48	07:21 17:02
14	05:55 21:12	06:28 20:37	07:04 19:43	07:24 (T-07) 20:07	07:41 18:46	07:22 17:01
15	05:55 21:11	06:29 20:36	07:05 19:41	07:25 (T-07) 20:07	07:42 18:44	07:23 17:00
16	05:56 21:11	06:30 20:34	07:07 19:39	07:26 (T-07) 20:07	07:43 18:42	07:25 16:59
17	05:57 21:10	06:31 20:33	07:08 19:38	07:27 (T-07) 20:07	07:45 18:41	07:26 16:58
18	05:58 21:09	06:32 20:31	07:09 19:36	07:28 (T-07) 20:07	07:46 18:39	07:27 16:57
19	05:59 21:08	06:34 20:30	07:10 19:34	07:29 (T-07) 20:07	07:47 18:37	07:29 16:56
20	06:00 21:08	06:35 20:28	07:11 19:32	07:30 (T-07) 20:07	07:48 18:36	07:30 16:55
21	06:01 21:07	06:36 20:26	07:12 19:30	07:31 (T-07) 20:07	07:50 18:34	07:31 16:55
22	06:02 21:06	06:37 20:25	07:14 19:28	07:32 (T-07) 20:07	07:51 18:32	07:33 16:54
23	06:03 21:05	06:38 20:23	07:15 19:26	07:33 (T-07) 20:07	07:52 18:31	07:34 16:53
24	06:04 21:04	06:40 20:21	07:16 19:24	07:34 (T-07) 20:07	07:54 18:29	07:35 16:52
25	06:05 21:03	06:41 20:20	07:17 19:22	07:35 (T-07) 20:07	07:55 18:28	07:36 16:52
26	06:06 21:02	06:42 20:18	07:18 19:21	07:36 (T-07) 20:07	07:56 18:26	07:38 16:51
27	06:07 21:01	06:43 20:16	07:20 19:19	07:37 (T-07) 20:07	07:58 18:25	07:39 16:51
28	06:08 21:00	06:44 20:14	07:21 19:17	07:38 (T-07) 20:07	07:59 18:23	07:40 16:50
29	06:09 20:59	06:45 20:13	07:22 19:15	07:39 (T-07) 20:07	08:00 18:22	07:41 16:50
30	06:11 20:58	06:47 20:11	07:23 19:13	07:40 (T-07) 20:07	08:02 18:20	07:43 16:50
31	06:12 20:56	06:48 20:09	07:24 (T-07) 20:07	07:41 (T-07) 20:07	08:03 18:19	07:44 16:50
Potential sun hours	471	436	377	341	288	275
Total, worst case						
Sun reduction		0.72	0.67	0.56		
Oper. time red.		0.90	0.90	0.90		
Wind dir. red.		0.57	0.57	0.62		
Total reduction		0.37	0.34	0.31		
Total, real		80	12	134		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-203 - R-203

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05 16:57	07:47 17:35	07:06 18:13	07:37 (T-83) 18:13	07:10 19:53	05:46 21:04
2	08:05 16:58	07:46 17:37	07:04 18:14	07:40 (T-83) 07:49 (T-83)	07:08 19:54	05:45 21:05
3	08:05 16:59	07:45 17:38	07:03 18:16		07:06 19:55	05:44 21:06
4	08:05 17:00	07:44 17:40	07:01 18:17		07:04 19:57	05:44 21:07
5	08:05 17:01	07:42 17:41	06:59 18:18		07:02 19:58	05:44 21:08
6	08:04 17:02	07:41 17:42	06:57 18:20		07:00 19:59	05:43 21:08
7	08:04 17:03	07:40 17:44	06:56 18:21		06:59 20:00	05:43 21:09
8	08:04 17:04	07:39 17:45	07:54 18:22		06:57 20:02	05:42 21:10
9	08:04 17:05	07:37 17:47	07:52 19:24		06:55 20:03	05:42 21:10
10	08:04 17:06	07:36 17:48	07:50 19:25		06:53 20:04	05:42 21:11
11	08:03 17:08	07:35 17:49	07:48 19:26		06:51 20:05	05:42 21:12
12	08:03 17:09	07:33 17:51	07:47 19:28		06:50 20:07	05:42 21:12
13	08:02 17:10	07:32 17:52	07:53 (T-83) 19:29		06:48 20:08	05:41 21:13
14	08:02 17:11	07:30 17:54	07:51 (T-83) 19:30		06:46 20:09	05:41 21:13
15	08:01 17:12	07:29 17:55	07:50 (T-83) 19:31		06:44 20:10	05:41 21:14
16	08:01 17:14	07:27 17:57	07:48 (T-83) 19:33		06:43 20:12	05:41 21:14
17	08:00 17:15	07:26 17:58	07:47 (T-83) 19:34		06:41 20:13	05:41 21:15
18	08:00 17:16	07:24 17:59	07:45 (T-83) 19:35		06:39 20:14	05:41 21:15
19	07:59 17:17	07:23 18:01	07:44 (T-83) 19:37		06:38 20:15	05:41 21:15
20	07:58 17:19	07:21 18:01	07:42 (T-83) 19:38		06:36 20:17	05:42 21:16
21	07:58 17:20	07:19 18:02	07:40 (T-83) 19:39		06:34 20:18	05:42 21:16
22	07:57 17:21	07:18 18:03	07:39 (T-83) 19:40		06:33 20:19	05:42 21:16
23	07:56 17:23	07:16 18:05	07:37 (T-83) 19:42		06:31 20:20	05:42 21:16
24	07:55 17:24	07:15 18:06	07:35 (T-83) 19:43		06:29 20:21	05:43 21:17
25	07:54 17:26	07:13 18:08	07:34 (T-83) 19:44		06:28 20:23	05:43 21:17
26	07:53 17:27	07:11 18:09	07:33 (T-83) 19:45		06:26 20:24	05:43 21:17
27	07:52 17:28	07:10 18:10	07:34 (T-83) 19:47		06:25 20:25	05:44 21:17
28	07:51 17:30	07:08 18:12	07:36 (T-83) 19:48		06:23 20:26	05:44 21:17
29	07:50 17:31		07:15 19:49		06:22 20:28	05:44 21:17
30	07:49 17:32		07:13 19:50		06:20 21:03	05:45 21:17
31	07:48 17:34		07:11 19:52		05:46 21:03	20:36 (T-33)
Potential sun hours	287	292	369	403	458	465
Total, worst case						814
Sun reduction		0.58	0.59		0.66	0.73
Oper. time red.		0.90	0.90		0.90	0.90
Wind dir. red.		0.62	0.62		0.63	0.63
Total reduction		0.32	0.33		0.38	0.42
Total, real		83	8		236	339

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-203 - R-203

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December			
1	05:45	20:12 (T-33)	06:13	20:12 (T-33)	06:49	07:24	07:04	07:44	
	21:17	27 20:39 (T-33)	20:55	17 20:29 (T-33)	20:07	19:11	17:17	16:49	
2	05:46	20:11 (T-33)	06:14	20:12 (T-33)	06:50	07:26	07:06	07:45	
	21:17	28 20:39 (T-33)	20:54	15 20:27 (T-33)	20:05	19:09	17:16	16:48	
3	05:47	20:11 (T-33)	06:15	20:13 (T-33)	06:51	07:27	07:07	07:46	
	21:16	29 20:40 (T-33)	20:53	13 20:26 (T-33)	20:04	19:07	17:14	16:48	
4	05:47	20:12 (T-33)	06:16	20:15 (T-33)	06:52	07:28	07:08	07:47	
	21:16	29 20:41 (T-33)	20:51	11 20:26 (T-33)	20:02	19:06	17:13	16:48	
5	05:48	20:11 (T-33)	06:17	20:16 (T-33)	06:54	07:29	07:10	07:48	
	21:16	30 20:41 (T-33)	20:50	8 20:24 (T-33)	20:00	19:04	17:12	16:47	
6	05:48	20:11 (T-33)	06:19	20:17 (T-33)	06:55	07:31	07:11	07:49	
	21:16	30 20:41 (T-33)	20:49	6 20:23 (T-33)	19:58	19:02	17:10	16:47	
7	05:49	20:11 (T-33)	06:20	20:18 (T-33)	06:56	07:32	07:12	07:50	
	21:15	31 20:42 (T-33)	20:47	4 20:22 (T-33)	19:56	19:00	17:09	16:47	
8	05:50	20:11 (T-33)	06:21		06:57	07:33	07:14	07:51	
	21:15	31 20:42 (T-33)	20:46		19:54	18:56	17:08	16:47	
9	05:51	20:11 (T-33)	06:22		06:58	07:34	07:15	07:52	
	21:15	32 20:43 (T-33)	20:45		19:53	18:55	17:07	16:47	
10	05:51	20:11 (T-33)	06:23		06:59	07:36	07:17	07:53	
	21:14	33 20:44 (T-33)	20:43		19:51	18:53	17:06	16:47	
11	05:52	20:10 (T-33)	06:24		07:01	07:37	07:18	07:54	
	21:14	33 20:43 (T-33)	20:42		19:49	18:51	17:04	16:47	
12	05:53	20:10 (T-33)	06:25		07:02	07:38	08:12 (T-83)	07:19	07:55
	21:13	34 20:44 (T-33)	20:40		19:47	18:49	12 08:24 (T-83)	17:03	16:47
13	05:54	20:10 (T-33)	06:27		07:03	07:39	08:10 (T-83)	07:21	07:55
	21:12	34 20:44 (T-33)	20:39		19:45	18:48	17 08:27 (T-83)	17:02	16:47
14	05:55	20:10 (T-33)	06:28		07:04	07:41	08:07 (T-83)	07:22	07:56
	21:12	35 20:45 (T-33)	20:37		19:43	18:46	21 08:28 (T-83)	17:01	16:47
15	05:56	20:10 (T-33)	06:29		07:05	07:42	08:06 (T-83)	07:23	07:57
	21:11	34 20:44 (T-33)	20:36		19:41	18:44	22 08:28 (T-83)	17:00	16:47
16	05:56	20:10 (T-33)	06:30		07:07	07:43	08:05 (T-83)	07:25	07:58
	21:11	34 20:44 (T-33)	20:34		19:39	18:42	25 08:30 (T-83)	16:59	16:48
17	05:57	20:09 (T-33)	06:31		07:08	07:44	08:06 (T-83)	07:26	07:59
	21:10	33 20:42 (T-33)	20:33		19:38	18:41	24 08:30 (T-83)	16:58	16:48
18	05:58	20:09 (T-33)	06:32		07:09	07:46	08:07 (T-83)	07:27	07:59
	21:09	33 20:42 (T-33)	20:31		19:36	18:39	23 08:30 (T-83)	16:57	16:48
19	05:59	20:09 (T-33)	06:34		07:10	07:47	08:09 (T-83)	07:29	08:00
	21:08	32 20:41 (T-33)	20:29		19:34	18:37	22 08:31 (T-83)	16:56	16:49
20	06:00	20:09 (T-33)	06:35		07:11	07:48	08:10 (T-83)	07:30	08:00
	21:07	31 20:40 (T-33)	20:28		19:32	18:36	20 08:30 (T-83)	16:56	16:49
21	06:01	20:09 (T-33)	06:36		07:12	07:50	08:11 (T-83)	07:31	08:01
	21:07	31 20:40 (T-33)	20:26		19:30	18:34	19 08:30 (T-83)	16:55	16:49
22	06:02	20:09 (T-33)	06:37		07:14	07:51	08:13 (T-83)	07:32	08:02
	21:06	30 20:39 (T-33)	20:24		19:28	18:32	17 08:30 (T-83)	16:54	16:50
23	06:03	20:10 (T-33)	06:38		07:15	07:52	08:14 (T-83)	07:34	08:02
	21:05	28 20:38 (T-33)	20:23		19:26	18:31	16 08:30 (T-83)	16:53	16:50
24	06:04	20:10 (T-33)	06:40		07:16	07:54	08:16 (T-83)	07:35	08:02
	21:04	27 20:37 (T-33)	20:21		19:24	18:29	14 08:30 (T-83)	16:52	16:51
25	06:05	20:10 (T-33)	06:41		07:17	07:55	08:17 (T-83)	07:36	08:03
	21:03	26 20:36 (T-33)	20:19		19:22	18:28	11 08:28 (T-83)	16:52	16:52
26	06:06	20:10 (T-33)	06:42		07:18	07:56	08:18 (T-83)	07:38	08:03
	21:02	25 20:35 (T-33)	20:18		19:21	18:26	9 08:27 (T-83)	16:51	16:52
27	06:07	20:10 (T-33)	06:43		07:20	07:58	08:20 (T-83)	07:39	08:04
	21:01	24 20:34 (T-33)	20:16		19:19	18:25	7 08:27 (T-83)	16:51	16:53
28	06:08	20:10 (T-33)	06:44		07:21	07:59	08:21 (T-83)	07:40	08:04
	21:00	23 20:33 (T-33)	20:14		19:17	18:23	4 08:25 (T-83)	16:50	16:54
29	06:10	20:11 (T-33)	06:45		07:22	08:00	08:23 (T-83)	07:41	08:04
	20:59	21 20:32 (T-33)	20:12		19:15	18:22	1 08:24 (T-83)	16:50	16:54
30	06:11	20:11 (T-33)	06:47		07:23	08:02		07:42	08:04
	20:57	20 20:31 (T-33)	20:11		19:13	18:20		16:49	16:55
31	06:12	20:11 (T-33)	06:48			08:03			08:04
	20:56	19 20:30 (T-33)	20:09			18:19			16:56
Potential sun hours	471		436		377	341		289	275
Total, worst case	907		74		284				
Sun reduction	0.75		0.72		0.56				
Oper. time red.	0.90		0.90		0.90				
Wind dir. red.	0.63		0.63		0.62				
Total reduction	0.43		0.41		0.31				
Total, real	388		30		89				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD
 Greenhouse Shadow Flicker Study
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 L086 71 SG4.4-164 WTGs on 97.5m HH
 June 14, 2024

Licensed user: Stantec Consulting Services Inc.
 1165 Scheuring Road
 US-DE PERE WI 54115
 920 278 3215
 Christiana Jansen / christiana.jansen@stantec.com
 Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-204 - R-204
 Assumptions for shadow calculations
 Sunshine probability S/S0 (Sun hours/Possible sun hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
 N NNE NE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

		January	February	March	April	May	June	July	August	September	October	November	December	
1	08:05 16:57	07:47 17:35	07:06 18:13	07:10 19:53	07:30 (T-33) 20:30	06:19 21:04	05:46 21:17	05:46 20:55	06:13 20:55	06:49 20:07	07:11 (T-33) 43 07:54 (T-33)	07:25 19:11	07:04 17:17	07:44 16:49
2	08:05 16:58	07:46 17:37	07:05 18:14	07:08 19:54	07:28 (T-33) 20:31	06:17 21:05	05:45 21:17	05:46 20:54	06:14 20:54	06:50 20:05	07:12 (T-33) 42 07:54 (T-33)	07:26 19:09	07:06 17:16	07:45 16:48
3	08:05 16:59	07:45 17:38	07:03 18:16	07:06 19:55	07:26 (T-33) 20:33	06:16 21:06	05:45 21:17	05:47 20:53	06:15 20:53	06:51 20:04	07:13 (T-33) 40 07:53 (T-33)	07:27 19:08	07:07 17:14	07:46 16:48
4	08:05 17:00	07:44 17:40	07:01 18:17	07:04 19:57	07:24 (T-33) 20:34	06:14 21:07	05:44 21:16	05:47 20:51	06:16 20:51	06:53 20:02	07:14 (T-33) 39 07:53 (T-33)	07:28 19:06	07:08 17:13	07:47 16:48
5	08:05 17:01	07:43 17:41	06:59 18:18	07:02 19:58	07:23 (T-33) 20:35	06:13 21:08	05:44 21:16	05:48 20:50	06:17 20:50	06:54 20:00	07:15 (T-33) 37 07:52 (T-33)	07:29 19:04	07:10 17:12	07:48 16:48
6	08:05 17:02	07:41 17:42	06:58 18:20	07:01 19:59	07:21 (T-33) 20:36	06:12 21:08	05:43 21:16	05:49 20:49	06:19 20:49	06:55 20:00	07:17 (T-33) 35 07:52 (T-33)	07:31 19:02	07:11 17:11	07:49 16:47
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	07:19 (T-33) 20:38	06:10 21:09	05:43 21:15	05:49 20:47	06:20 20:47	06:56 19:54	07:18 (T-33) 33 07:51 (T-33)	07:32 19:00	07:13 17:09	07:50 16:47
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	07:17 (T-33) 20:39	06:09 21:10	05:43 21:15	05:50 20:46	06:21 20:46	06:57 20:00	07:19 (T-33) 31 07:50 (T-33)	07:33 18:57	07:14 17:08	07:51 16:47
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 20:03	07:15 (T-33) 20:40	06:08 21:11	05:42 21:15	05:51 20:45	06:22 20:45	06:58 19:53	07:20 (T-33) 29 07:49 (T-33)	07:34 18:55	07:15 17:07	07:52 16:47
10	08:04 17:07	07:36 17:48	07:50 19:25	06:53 20:04	07:14 (T-33) 20:41	06:06 21:11	05:42 21:14	05:51 20:43	06:23 20:43	07:00 19:51	07:21 (T-33) 27 07:48 (T-33)	07:36 18:53	07:17 17:06	07:53 16:47
11	08:03 17:08	07:35 17:50	07:49 19:26	06:52 20:05	07:12 (T-33) 20:42	06:05 21:12	05:42 21:14	05:52 20:42	06:24 20:42	07:01 19:49	07:22 (T-33) 24 07:46 (T-33)	07:37 18:51	07:18 17:04	07:54 16:47
12	08:03 17:09	07:33 17:51	07:47 19:28	06:50 20:07	07:10 (T-33) 20:44	06:04 21:12	05:42 21:13	05:53 20:40	06:26 20:40	07:02 19:47	07:23 (T-33) 22 07:45 (T-33)	07:38 18:49	07:19 17:03	07:55 16:47
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	07:08 (T-33) 20:45	06:03 21:13	05:42 21:13	05:54 20:39	06:27 20:39	07:03 19:45	07:24 (T-33) 19 07:43 (T-33)	07:39 18:48	07:21 17:02	07:56 16:47
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	07:07 (T-33) 20:46	06:01 21:13	05:41 21:12	05:55 20:37	06:28 20:37	07:04 19:43	07:26 (T-33) 16 07:42 (T-33)	07:41 18:46	07:22 17:01	07:56 16:47
15	08:02 17:12	07:29 17:55	07:41 19:31	06:45 20:10	07:06 (T-33) 20:47	06:00 21:14	05:41 21:11	05:56 20:36	06:29 2 07:35 (T-33)	07:05 19:41	07:27 (T-33) 12 07:39 (T-33)	07:42 18:44	07:23 17:00	07:57 16:48
16	08:01 17:14	07:27 17:57	07:39 19:33	06:43 20:12	07:06 (T-33) 20:48	05:59 21:14	05:41 21:11	05:56 20:34	06:30 16 07:42 (T-33)	07:07 19:39	07:28 (T-33) 8 07:36 (T-33)	07:43 18:42	07:25 16:59	07:58 16:48
17	08:00 17:15	07:26 17:58	07:38 19:34	06:41 20:13	07:06 (T-33) 20:49	05:58 21:15	05:41 21:10	05:57 20:33	06:31 21 07:44 (T-33)	07:08 19:38	07:29 (T-33) 3 07:32 (T-33)	07:44 18:41	07:26 16:58	07:59 16:48
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 20:14	07:07 (T-33) 20:50	05:57 21:15	05:41 21:09	05:58 20:31	06:33 26 07:46 (T-33)	07:09 19:36	07:30 (T-33) 3 07:32 (T-33)	07:46 18:39	07:27 16:57	07:59 16:48
19	07:59 17:18	07:23 18:01	07:34 19:37	06:38 20:15	07:07 (T-33) 20:51	05:56 21:16	05:42 21:08	05:59 20:29	06:34 30 07:48 (T-33)	07:10 19:34	07:18 (T-33) 07:11	07:47 18:37	07:29 16:56	08:00 16:49
20	07:58 17:19	07:21 18:01	07:32 19:38	06:36 20:17	07:08 (T-33) 20:53	05:55 21:16	05:42 21:08	06:00 20:28	06:35 33 07:49 (T-33)	07:11 19:32	07:16 (T-33) 07:13	07:48 18:36	07:30 16:56	08:01 16:49
21	07:58 17:20	07:20 18:02	07:30 19:39	06:34 20:18	07:09 (T-33) 20:54	05:54 21:16	05:42 21:07	06:01 20:26	06:36 36 07:51 (T-33)	07:13 19:30	07:15 (T-33) 07:14	07:50 18:34	07:31 16:55	08:01 16:50
22	07:57 17:22	07:18 18:04	07:28 19:40	06:33 20:19	07:10 (T-33) 20:55	05:53 21:16	05:42 21:06	06:02 20:25	06:37 38 07:52 (T-33)	07:14 19:28	07:14 (T-33) 07:15	07:51 18:32	07:33 16:54	08:02 16:50
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 20:20	07:11 (T-33) 20:56	05:52 21:17	05:42 21:05	06:03 20:23	06:38 41 07:53 (T-33)	07:15 19:26	07:12 (T-33) 07:16	07:52 18:31	07:34 16:53	08:02 16:51
24	07:55 17:24	07:15 18:06	07:25 19:43	06:29 20:22	07:12 (T-33) 20:57	05:51 21:17	05:43 21:04	06:04 20:21	06:40 42 07:53 (T-33)	07:16 19:24	07:11 (T-33) 07:17	07:54 18:29	07:35 16:53	08:03 16:51
25	07:54 17:26	07:13 18:08	07:23 19:44	06:28 20:23	07:15 (T-33) 20:58	05:50 21:17	05:43 21:03	06:05 20:19	06:41 43 07:53 (T-33)	07:17 19:22	07:10 (T-33) 07:18	07:55 18:28	07:36 16:52	08:03 16:52
26	07:53 17:27	07:11 18:09	07:21 19:45	06:26 20:24	07:16 (T-33) 20:59	05:50 21:17	05:43 21:02	06:06 20:18	06:42 45 07:54 (T-33)	07:18 19:21	07:09 (T-33) 07:20	07:56 18:26	07:38 16:51	08:03 16:52
27	07:53 17:28	07:10 18:10	07:19 19:47	06:25 20:25	07:39 (T-33) 20:25	05:49 21:17	05:44 21:01	06:07 20:16	06:43 46 07:54 (T-33)	07:20 19:19	07:08 (T-33) 07:21	07:58 18:25	07:39 16:51	08:04 16:53
28	07:52 17:30	07:08 18:12	07:17 19:48	06:23 20:27	07:37 (T-33) 20:27	05:48 21:01	05:44 21:17	06:09 20:14	06:44 47 07:54 (T-33)	07:21 19:14	07:07 (T-33) 07:22	07:59 18:23	07:40 16:50	08:04 16:54
29	07:51 17:31	07:07 18:15	07:15 19:49	06:22 20:28	07:49 (T-33) 20:28	05:47 21:02	05:45 21:17	06:10 20:59	06:45 20:13	07:22 47 07:55 (T-33)	07:23 19:15	08:00 18:22	07:41 16:50	08:04 16:55
30	07:49 17:33	07:05 18:13	07:13 19:50	06:20 20:29	07:52 (T-33) 20:29	05:47 21:03	05:45 21:17	06:11 20:58	06:47 20:11	07:23 46 07:55 (T-33)	07:23 19:13	08:02 18:20	07:42 16:49	08:04 16:55
31	07:48 17:34	07:04 18:12	07:12 19:52	06:19 21 07:53 (T-33)	07:32 (T-33) 20:29	05:46 21:04	05:44 20:56	06:12 20:09	06:48 45 07:55 (T-33)	07:23 19:13	07:23 (T-33) 07:10	08:03 18:19	07:42 16:56	08:04 16:56
Potential sun hours	287	292	369		403	458	465	471	436	377	341	289	275	
Total, worst case				75	978				604	460				
Sun reduction				0.59	0.63				0.72	0.67				
Oper. time red.				0.90	0.90				0.90	0.90				
Wind dir. red.				0.58	0.58				0.58	0.58				
Total reduction				0.31	0.33				0.38	0.35				
Total, real				23	322				227	161				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project: South Deuel Wind Project

Description: Invenery Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-205 - R-205 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum and values 561, 438, 311, 293, 309, 330, 363, 461, 788, 773, 462, 449, 509, 600, 629, 608, 7,884

Main calendar table with columns for months (January to December) and rows for each day (1-31) showing start and end times for shadow events. Includes summary rows at the bottom for 'Potential sun hours', 'Total, worst case', and 'Total, real'.

Table layout: For each day in each month the following matrix apply

Matrix table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-209 - R-209
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:05	07:47	07:06	07:10	06:19	05:46	05:46	06:13	06:49	07:25	07:04	07:44		
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:49		
2	08:05	07:46	07:05	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45		
	16:58	17:37	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48		
3	08:05	07:45	07:03	07:06	06:16	05:45	05:47	06:15	06:51	07:27	07:07	07:46		
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:04	19:08	17:15	16:48		
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:53	07:28	07:08	07:47		
	17:00	17:40	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:06	17:13	16:48		
5	08:05	07:43	06:59	07:02	06:13	05:44	05:48	06:17	06:54	07:29	07:10	07:48		
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:48		
6	08:05	07:41	06:58	07:01	06:12	05:43	05:49	06:19	06:55	07:31	07:11	07:49		
	17:02	17:43	18:20	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:11	16:47		
7	08:04	07:40	06:56	06:59	06:10	05:43	05:49	06:20	06:56	07:32	07:13	07:50		
	17:03	17:44	18:21	20:00	20:38	21:09	21:15	20:47	19:56	19:00	17:09	16:47		
8	08:04	07:39	07:54	06:57	06:09	05:43	05:50	06:21	06:57	07:33	07:14	07:51		
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:57	17:08	16:47		
9	08:04	07:37	07:52	06:55	06:08	05:42	05:51	06:22	06:58	07:34	07:15	07:52		
	17:05	17:47	19:24	20:03	20:40	21:11	21:15	20:45	19:53	18:55	17:07	16:47		
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	07:00	07:36	07:17	07:53		
	17:07	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:06	16:47		
11	08:03	07:35	07:49	06:52	06:05	05:42	05:52	06:24	07:01	07:37	07:18	07:54		
	17:08	17:50	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:05	16:47		
12	08:03	07:33	07:47	06:50	06:04	05:42	05:53	06:26	07:02	07:38	07:19	07:55		
	17:09	17:51	19:28	20:07	20:44	21:12	21:13	20:40	19:47	18:49	17:03	16:47		
13	08:02	07:32	07:45	06:48	06:03	05:42	05:54	06:27	07:03	07:39	07:21	07:56		
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:48	17:02	16:47		
14	08:02	07:30	07:43	06:46	06:01	05:41	05:55	06:28	07:04	07:41	07:22	07:56		
	17:11	17:54	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47		
15	08:02	07:29	07:41	06:45	06:00	05:41	05:56	06:29	07:05	07:42	07:23	07:57		
	17:13	17:55	19:32	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:48		
16	08:01	07:27	07:39	06:43	05:59	05:41	06:06 (T-33)	05:57	06:30	07:07	07:43	07:25	07:58	
	17:14	17:57	19:33	20:12	20:48	21:14	1	06:07 (T-33)	21:11	20:34	19:40	18:42	16:59	16:48
17	08:00	07:26	07:38	06:41	05:58	05:41	06:06 (T-33)	05:57	06:31	07:08	07:45	07:26	07:59	
	17:15	17:58	19:34	20:13	20:49	21:15	1	06:07 (T-33)	21:10	20:33	19:38	18:41	16:58	16:48
18	08:00	07:24	07:36	06:39	05:57	05:42	06:06 (T-33)	05:58	06:33	07:09	07:46	07:27	07:59	
	17:16	17:59	19:35	20:14	20:50	21:15	1	06:07 (T-33)	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:38	05:56	05:42	06:06 (T-33)	05:59	06:34	07:10	07:47	07:29	08:00	
	17:18	18:01	19:37	20:15	20:51	21:16	1	06:07 (T-33)	21:08	20:29	19:34	18:37	16:56	16:49
20	07:58	07:21	07:32	06:36	05:55	05:42	06:06 (T-33)	06:00	06:35	07:11	07:48	07:30	08:01	
	17:19	18:01	19:38	20:17	20:53	21:16	1	06:07 (T-33)	21:08	20:28	19:32	18:36	16:56	16:49
21	07:58	07:20	07:30	06:34	05:54	05:42	06:06 (T-33)	06:01	06:36	07:13	07:50	07:31	08:01	
	17:20	18:02	19:39	20:18	20:54	21:16	2	06:08 (T-33)	21:07	20:26	19:30	18:34	16:55	16:50
22	07:57	07:18	07:28	06:33	05:53	05:42	06:06 (T-33)	06:02	06:37	07:14	07:51	07:33	08:02	
	17:22	18:04	19:40	20:19	20:55	21:16	2	06:08 (T-33)	21:06	20:25	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:07 (T-33)	06:03	06:38	07:15	07:52	07:34	08:02	
	17:23	18:05	19:42	20:20	20:56	21:17	1	06:08 (T-33)	21:05	20:23	19:26	18:31	16:53	16:51
24	07:55	07:15	07:25	06:29	05:51	05:43	06:07 (T-33)	06:04	06:40	07:16	07:54	07:35	08:03	
	17:24	18:06	19:43	20:22	20:57	21:17	1	06:08 (T-33)	21:04	20:21	19:24	18:29	16:53	16:51
25	07:54	07:13	07:23	06:28	05:50	05:43	06:07 (T-33)	06:05	06:41	07:17	07:55	07:36	08:03	
	17:26	18:08	19:44	20:23	20:58	21:17	1	06:08 (T-33)	21:03	20:19	19:23	18:28	16:52	16:52
26	07:53	07:11	07:21	06:26	05:50	05:43	06:08 (T-33)	06:06	06:42	07:18	07:56	07:38	08:03	
	17:27	18:09	19:45	20:24	20:59	21:17	1	06:09 (T-33)	21:02	20:18	19:21	18:26	16:51	16:52
27	07:53	07:10	07:19	06:25	05:49	05:44	06:07	06:43	07:20	07:58	07:39	08:04		
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:25	16:51	16:53		
28	07:52	07:08	07:17	06:23	05:48	05:44	06:09	06:44	07:21	07:59	07:40	08:04		
	17:30	18:12	19:48	20:27	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:54		
29	07:51		07:15	06:22	05:48	05:45	06:10	06:46	07:22	08:00	07:41	08:04		
	17:31		19:49	20:28	21:02	21:17	20:59	20:13	19:15	18:22	16:50	16:55		
30	07:49		07:13	06:20	05:47	05:45	06:11	06:47	07:23	08:02	07:42	08:04		
	17:33		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55		
31	07:48		07:12		05:46		06:12	06:48		08:03		08:04		
	17:34		19:52		21:04		20:56	20:09		18:19		16:56		
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275		
Total, worst case														
Sun reduction												13		
Oper. time red.												0.73		
Wind dir. red.												0.90		
Total reduction												0.59		
Total, real												0.39		
												5		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-212 - R-212

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:05	07:47	07:06	07:10	06:19	05:46	05:46	06:13	06:49	07:25	07:46 (T-33)	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	13 07:59 (T-33)	17:17	16:49
2	08:05	07:46	07:05	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:47 (T-33)	07:06	07:45
	16:58	17:37	18:14	19:54	20:32	21:05	21:17	20:54	20:05	19:09	11 07:58 (T-33)	17:16	16:48
3	08:05	07:45	07:03	07:06	06:16	05:45	05:47	06:15	06:51	07:27	07:48 (T-33)	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:04	19:08	9 07:57 (T-33)	17:15	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:53	07:28	07:49 (T-33)	07:08	07:47
	17:00	17:40	18:17	19:57	20:34	21:07	21:16	20:52	20:02	19:06	8 07:57 (T-33)	17:13	16:48
5	08:05	07:43	06:59	07:02	06:13	05:44	05:48	06:17	06:54	07:29	07:49 (T-33)	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	5 07:56 (T-33)	17:12	16:48
6	08:05	07:41	06:58	07:01	06:12	05:43	05:49	06:19	06:55	07:31	07:52 (T-33)	07:11	07:49
	17:02	17:43	18:20	19:59	20:36	21:09	21:16	20:49	19:58	19:02	3 07:55 (T-33)	17:11	16:47
7	08:04	07:40	06:56	07:16 (T-33)	06:59	06:10	05:43	05:49	06:20	06:56	07:32	07:13	07:50
	17:03	17:44	18:21	2 07:18 (T-33)	20:00	20:38	21:09	21:15	20:48	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	08:14 (T-33)	06:57	06:09	05:43	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	4 08:18 (T-33)	20:02	20:39	21:10	21:15	20:46	19:54	18:57	17:08	16:47
9	08:04	07:37	07:52	08:13 (T-33)	06:55	06:08	05:42	05:51	06:22	06:58	07:34	07:15	07:52
	17:05	17:47	19:24	7 08:20 (T-33)	20:03	20:40	21:11	21:15	20:45	19:53	18:55	17:07	16:47
10	08:04	07:36	07:50	08:11 (T-33)	06:53	06:06	05:42	05:51	06:23	07:00	07:36	07:17	07:53
	17:07	17:48	19:25	9 08:20 (T-33)	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:06	16:47
11	08:03	07:35	07:49	08:09 (T-33)	06:52	06:05	05:42	05:52	06:24	07:01	07:37	07:18	07:54
	17:08	17:50	19:26	10 08:19 (T-33)	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:05	16:49
12	08:03	07:33	07:47	08:07 (T-33)	06:50	06:04	05:42	05:53	06:26	07:02	07:38	07:19	07:55
	17:09	17:51	19:28	12 08:19 (T-33)	20:07	20:44	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:03	07:32	07:45	08:05 (T-33)	06:48	06:03	05:42	05:54	06:27	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	13 08:18 (T-33)	20:08	20:45	21:13	21:13	20:39	19:45	18:48	17:02	16:47
14	08:02	07:30	07:43	08:03 (T-33)	06:46	06:01	05:41	05:55	06:28	07:04	07:41	07:22	07:56
	17:11	17:54	19:30	15 08:18 (T-33)	20:09	20:46	21:14	21:12	20:37	19:43	18:46	17:01	16:47
15	08:02	07:29	07:41	08:02 (T-33)	06:45	06:00	05:41	05:56	06:29	07:05	07:42	07:23	07:57
	17:13	17:55	19:32	15 08:17 (T-33)	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:48
16	08:01	07:27	07:39	08:00 (T-33)	06:43	05:59	05:41	05:57	06:30	07:07	07:43	07:25	07:58
	17:14	17:57	19:33	16 08:16 (T-33)	20:12	20:48	21:14	21:11	20:34	19:40	18:42	16:59	16:48
17	08:00	07:26	07:38	07:59 (T-33)	06:41	05:58	05:41	05:57	06:31	07:08	07:45	07:26	07:59
	17:15	17:58	19:34	15 08:14 (T-33)	20:13	20:49	21:15	21:10	20:33	19:38	18:41	16:58	16:48
18	08:00	07:24	07:36	08:01 (T-33)	06:39	05:57	05:41	05:58	06:33	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	10 08:11 (T-33)	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:38	05:56	05:42	05:59	06:34	07:10	07:47	07:29	08:00	
	17:18	18:01	19:37	20:15	20:52	21:16	21:08	20:30	19:34	18:37	16:56	16:49	
20	07:58	07:21	07:32	06:36	05:55	05:42	06:00	06:35	07:11	07:48	07:30	08:01	
	17:19	18:01	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:36	16:56	16:49	
21	07:58	07:20	07:30	06:34	05:54	05:42	06:01	06:36	07:13	07:50	07:31	08:01	
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:55	16:50	
22	07:57	07:18	07:28	06:33	05:53	05:42	06:02	06:37	07:14	07:51	07:33	08:02	
	17:22	18:04	19:40	20:19	20:55	21:16	21:06	20:25	19:28	18:32	16:54	16:50	
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02	
	17:23	18:05	19:42	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:51	
24	07:55	07:15	07:25	06:29	05:51	05:43	06:04	06:40	07:16	07:54	07:35	08:03	
	17:24	18:06	19:43	20:22	20:57	21:17	21:04	20:21	19:24	18:29	16:53	16:51	
25	07:54	07:13	07:23	06:28	05:50	05:43	06:05	06:41	07:17	07:55	07:36	08:03	
	17:26	18:08	19:44	20:23	20:58	21:17	21:03	20:20	19:23	8 07:53 (T-33)	18:28	16:52	16:52
26	07:54	07:11	07:21	06:26	05:50	05:43	06:06	06:42	07:19	07:56	07:38	08:03	
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:21	14 07:56 (T-33)	18:26	16:51	16:52
27	07:53	07:10	07:19	06:25	05:49	05:44	06:07	06:43	07:20	07:57	07:39	08:04	
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	16 07:41 (T-33)	18:25	16:51	16:53
28	07:52	07:08	07:17	06:23	05:48	05:44	06:09	06:44	07:21	07:59	07:40	08:04	
	17:30	18:12	19:48	20:27	21:01	21:17	21:00	20:14	19:17	16 07:58 (T-33)	18:23	16:50	16:54
29	07:51	07:15	07:25	06:22	05:47	05:45	06:10	06:46	07:22	07:43 (T-33)	08:00	07:41	08:04
	17:31	19:49		20:28	21:02	21:17	20:59	20:13	19:15	15 07:58 (T-33)	18:22	16:50	16:55
30	07:50	07:13	07:23	06:20	05:47	05:45	06:11	06:47	07:23	07:44 (T-33)	08:02	07:43	08:04
	17:33	19:50		20:29	21:03	21:17	20:58	20:11	19:13	14 07:58 (T-33)	18:20	16:49	16:55
31	07:48	07:12	07:22		05:46		06:12	06:48			08:03		08:05
	17:34	19:52			21:04		20:56	20:09			18:19		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	
Total, worst case			128					83			49		
Sun reduction			0.59					0.67			0.56		
Oper. time red.			0.90					0.90			0.90		
Wind dir. red.			0.60					0.60			0.60		
Total reduction			0.32					0.36			0.30		
Total, real			41					30			15		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-215 - R-215

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:10	06:19	05:46	05:45	06:13	06:49	07:25	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:05	21:17	20:55	20:07	19:11	17:17	16:49
2	08:05	07:46	07:05	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:37	18:14	19:54	20:32	21:05	21:17	20:54	20:06	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:16	05:45	05:47	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:56	20:33	21:06	21:17	20:53	20:04	19:08	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:53	07:28	07:09	07:47
	17:00	17:40	18:17	19:57	20:34	21:07	21:16	20:52	20:02	19:06	17:13	16:48
5	08:05	07:43	06:59	07:02	06:13	05:44	05:48	06:17	06:54	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:48
6	08:05	07:41	06:58	07:01	06:11	05:43	05:48	06:19	06:55	07:31	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:09	21:16	20:49	19:58	19:02	17:11	16:47
7	08:05	07:40	06:56	06:59	06:10	05:43	05:49	06:20	06:56	07:32	07:13	07:50
	17:03	17:44	18:21	20:01	20:38	21:09	21:16	20:48	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:09	05:43	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:55	18:57	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:51	06:22	06:58	07:34	07:15	07:52
	17:05	17:47	19:24	20:03	20:40	21:11	21:15	20:45	19:53	18:55	17:07	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	07:00	07:36	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:06	16:47
11	08:03	07:35	07:49	06:52	06:05	05:42	05:52	06:24	07:01	07:37	07:18	07:54
	17:08	17:50	19:26	20:06	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:04	05:42	05:53	06:26	07:02	07:38	07:19	07:55
	17:09	17:51	19:28	20:07	20:44	21:13	21:13	20:40	19:47	18:49	17:03	16:47
13	08:03	07:32	07:45	06:48	06:03	05:41	05:54	06:27	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:48	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:55	06:28	07:04	07:41	07:22	07:57
	17:11	17:54	19:30	20:09	20:46	21:14	21:12	20:37	19:43	18:46	17:01	16:47
15	08:02	07:29	07:41	06:45	06:00	05:41	05:56	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:32	20:11	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:07	07:43	07:25	07:58
	17:14	17:57	19:33	20:12	20:48	21:15	21:11	20:34	19:40	18:42	16:59	16:48
17	08:01	07:26	07:38	06:41	05:58	05:41	05:57	06:31	07:08	07:45	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:38	18:41	16:58	16:48
18	08:00	07:24	07:36	06:39	05:57	05:41	05:58	06:33	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:51	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:38	05:56	05:42	05:59	06:34	07:10	07:47	07:29	08:00
	17:18	18:01	19:37	20:15	20:52	21:16	21:09	20:30	19:34	18:37	16:56	16:49
20	07:59	07:21	07:32	06:36	05:55	05:42	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:01	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:36	16:56	16:49
21	07:58	07:20	07:30	06:34	05:54	05:42	06:01	06:36	07:13	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:55	16:50
22	07:57	07:18	07:28	06:33	05:53	05:42	06:02	06:37	07:14	07:51	07:33	08:02
	17:22	18:04	19:40	20:19	20:55	21:17	21:06	20:25	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:42	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:51
24	07:55	07:15	07:25	06:29	05:51	05:43	06:04	06:40	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:22	20:57	21:17	21:04	20:21	19:24	18:29	16:53	16:51
25	07:55	07:13	07:23	06:28	05:50	05:43	06:05	06:41	07:17	07:55	07:37	08:03
	17:26	18:08	19:44	20:23	20:58	21:17	21:03	20:20	19:23	18:28	16:52	16:52
26	07:54	07:11	07:21	06:26	05:50	05:43	06:06	06:42	07:19	07:56	07:38	08:03
	17:27	18:09	19:46	20:24	20:59	21:17	21:02	20:18	19:21	18:26	16:51	16:52
27	07:53	07:10	07:19	06:25	05:49	05:44	06:07	06:43	07:20	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:25	16:51	16:53
28	07:52	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:30	18:12	19:48	20:27	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:54
29	07:51		07:15	06:22	05:47	05:44	06:10	06:46	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:13	19:15	18:22	16:50	16:55
30	07:50		07:13	06:20	05:47	05:45	06:11	06:47	07:23	08:02	07:43	08:05
	17:33		19:51	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:49		07:12		05:46		06:12	06:48		08:03		08:05
	17:34		19:52		21:04		20:57	20:09		18:19		16:56
Potential sun hours	287	292	369	403	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-216 - R-216

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:05 16:57	07:47 17:35	07:06 18:13	07:10 19:53	07:30 (T-05) 08:12 (T-04)	06:19 20:30	05:46 21:05	05:45 21:17	06:13 20:55	06:49 20:07	07:31 (T-05) 19:11	07:05 17:17	07:44 16:49
2	08:05 16:58	07:46 17:37	07:05 18:14	07:08 19:54	07:28 (T-05) 08:11 (T-04)	06:17 20:32	05:45 21:05	05:46 21:17	06:14 20:54	06:50 20:06	07:27 (T-05) 19:09	07:26 17:16	07:45 16:48
3	08:05 16:59	07:45 17:38	07:03 18:16	07:06 19:56	07:26 (T-05) 08:09 (T-04)	06:16 20:33	05:44 21:06	05:47 21:17	06:15 20:53	06:51 20:04	07:25 (T-05) 19:08	07:27 17:14	07:46 16:48
4	08:05 17:00	07:44 17:40	06:59 18:17	07:04 19:57	07:25 (T-05) 08:08 (T-04)	06:14 20:34	05:44 21:07	05:47 21:17	06:16 20:52	06:53 20:02	07:23 (T-05) 19:06	07:28 17:13	07:47 16:48
5	08:05 17:01	07:43 17:41	06:59 18:18	07:02 19:58	07:26 (T-05) 08:07 (T-04)	06:13 20:35	05:44 21:08	05:48 21:16	06:17 20:50	06:54 20:00	07:22 (T-05) 19:04	07:29 17:12	07:48 16:47
6	08:05 17:02	07:41 17:42	06:58 18:20	07:01 19:59	07:26 (T-05) 08:05 (T-04)	06:11 20:37	05:43 21:09	05:48 21:16	06:19 20:49	06:55 19:58	07:22 (T-05) 19:01	07:31 17:11	07:49 16:47
7	08:05 17:03	07:40 17:44	06:56 18:21	06:59 20:01	07:26 (T-05) 08:03 (T-04)	06:10 20:38	05:43 21:09	05:49 21:16	06:20 20:48	06:56 19:56	07:21 (T-05) 19:00	07:32 17:09	07:50 16:47
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	07:26 (T-05) 08:00 (T-04)	06:09 20:39	05:42 21:10	05:50 21:15	06:21 20:46	06:57 19:55	07:20 (T-05) 18:57	07:33 17:08	07:51 16:47
9	08:04 17:05	07:38 17:47	07:52 19:24	06:55 20:03	07:27 (T-05) 07:43 (T-05)	06:07 20:40	05:42 21:11	05:51 21:15	06:22 20:45	06:58 19:53	07:20 (T-05) 18:55	07:34 17:07	07:52 16:47
10	08:04 17:06	07:36 17:48	07:50 19:25	06:53 20:04	07:29 (T-05) 07:42 (T-05)	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	07:00 19:51	07:21 (T-05) 18:53	07:36 17:06	07:53 16:47
11	08:03 17:08	07:35 17:50	07:49 19:26	06:52 20:06	07:32 (T-05) 07:38 (T-05)	06:05 20:43	05:42 21:12	05:52 21:14	06:24 20:42	07:01 19:49	07:22 (T-05) 18:51	07:37 17:04	07:54 16:47
12	08:03 17:09	07:33 17:51	07:47 19:28	06:50 20:07	06:04 20:44	06:04 21:13	05:42 21:13	05:53 21:13	06:26 20:40	07:02 19:47	07:23 (T-05) 18:49	07:38 17:03	07:55 16:47
13	08:03 17:10	07:32 17:52	07:45 19:29	06:48 20:08	06:02 20:45	05:41 21:13	05:54 21:13	06:27 20:39	07:03 19:45	07:03 18:48	07:24 (T-05) 18:48	07:39 17:02	07:56 16:47
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	06:01 20:46	05:41 21:14	05:55 21:12	06:28 20:37	07:04 19:43	07:04 18:38	07:26 (T-05) 18:46	07:41 17:01	07:57 16:47
15	08:02 17:12	07:29 17:55	07:41 19:32	06:45 20:11	06:00 20:47	05:41 21:14	05:56 21:12	06:29 20:36	07:05 19:41	07:05 18:44	07:27 (T-05) 18:44	07:42 17:00	07:57 16:47
16	08:01 17:14	07:27 17:57	07:39 19:33	06:43 20:12	06:59 20:48	05:41 21:15	05:56 21:11	06:30 20:34	07:07 19:40	07:07 18:42	07:28 (T-05) 18:42	07:43 16:59	07:58 16:48
17	08:01 17:15	07:26 17:58	07:38 19:34	06:41 20:13	05:58 20:49	05:41 21:15	05:57 21:10	06:31 20:33	07:08 19:38	07:08 18:41	07:30 (T-04) 18:41	07:45 16:58	07:59 16:48
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 20:14	05:57 20:51	05:41 21:15	05:58 21:09	06:33 20:31	07:09 19:36	07:09 18:30	07:30 (T-04) 18:39	07:46 16:57	08:00 16:48
19	07:59 17:18	07:23 18:01	07:34 19:37	06:38 20:16	05:56 20:52	05:41 21:16	05:59 21:09	06:34 20:30	07:10 19:34	07:10 18:28	07:31 (T-04) 18:37	07:47 16:56	08:00 16:49
20	07:59 17:19	07:21 18:01	07:32 19:38	06:36 20:17	05:55 20:53	05:42 21:16	06:00 21:08	06:35 20:28	07:11 19:32	07:11 18:26	07:33 (T-04) 18:36	07:48 16:56	08:01 16:49
21	07:58 17:20	07:20 18:02	07:30 19:39	06:34 20:18	05:54 20:54	05:42 21:16	06:01 21:07	06:36 20:26	07:13 19:30	07:13 18:23	07:34 (T-04) 18:34	07:50 16:55	08:01 16:49
22	07:57 17:21	07:18 18:04	07:28 19:40	06:33 20:19	05:53 20:55	05:42 21:17	06:02 21:06	06:37 20:25	07:14 19:28	07:14 18:20	07:35 (T-04) 18:32	07:51 16:54	08:02 16:50
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 20:20	05:52 20:56	05:42 21:17	06:03 21:05	06:38 20:23	07:15 19:26	07:15 18:16	07:36 (T-04) 18:31	07:52 16:53	08:02 16:50
24	07:55 17:24	07:15 18:06	07:25 19:43	06:29 20:22	05:51 20:57	05:42 21:17	06:04 21:04	06:40 20:21	07:16 19:24	07:16 18:10	07:38 (T-04) 18:29	07:54 16:53	08:03 16:51
25	07:55 17:26	07:13 18:08	07:23 19:44	06:28 20:23	05:50 20:58	05:43 21:17	06:05 21:03	06:41 20:20	07:17 19:23	07:17 18:23	07:48 (T-04) 18:29	07:55 16:52	08:03 16:52
26	07:54 17:27	07:11 18:09	07:21 19:46	06:26 20:24	05:50 20:59	05:43 21:17	06:06 21:02	06:42 20:18	07:19 19:21	07:19 18:26	07:49 (T-04) 18:41	07:56 16:51	08:04 16:52
27	07:53 17:28	07:10 18:10	07:19 19:47	06:25 20:25	05:49 21:00	05:44 21:17	06:07 21:01	06:43 20:16	07:20 19:19	07:20 18:25	07:50 (T-04) 18:48	07:58 16:51	08:04 16:53
28	07:52 17:30	07:08 18:12	07:17 19:48	06:23 20:27	05:48 21:01	05:44 21:17	06:08 21:00	06:44 20:14	07:21 19:17	07:21 18:23	07:59 (T-04) 18:41	07:59 16:50	08:04 16:54
29	07:51 17:31	07:15 19:49	07:15 19:49	06:22 20:28	05:47 21:02	05:44 21:17	06:10 20:59	06:46 20:13	07:22 19:15	07:22 18:22	08:00 (T-04) 18:41	08:00 16:50	08:04 16:54
30	07:50 17:33	07:13 19:51	07:13 19:51	06:20 20:29	05:47 21:03	05:45 21:17	06:11 20:58	06:47 20:11	07:23 19:13	07:23 18:20	08:02 (T-04) 18:49	08:02 16:49	08:05 16:55
31	07:49 17:34	07:12 19:52	07:12 19:52	06:18 20:29	05:46 21:04	05:46 21:17	06:12 20:57	06:48 20:09	07:24 19:13	07:24 18:29	08:03 (T-04) 18:49	08:03 16:49	08:05 16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	260	341	288	275
Total, worst case			360	355					728				
Sun reduction			0.59	0.63					0.67				
Oper. time red.			0.90	0.90					0.90				
Wind dir. red.			0.59	0.59					0.59				
Total reduction			0.31	0.33					0.36				
Total, real			113	119					260				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-228 - R-228

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:13	07:51
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	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
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13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
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14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
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15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
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16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
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	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
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24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
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	17:32		19:50	20:29	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:12	06:48		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-229 - R-229

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:48
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	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
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14	08:01	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:08	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:30	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:31	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:29	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:00
	17:20	18:02	19:39	20:17	20:53	21:15	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56	07:17	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:01
	17:23	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:18	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:03
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:02		08:04
	17:34		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-231 - R-231
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43		
	16:57	17:35	18:13	19:52	20:29	21:04	21:16	20:54	20:07	19:11	17:17	16:48		
2	08:04	07:45	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44		
	16:58	17:36	18:14	19:54	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48		
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45		
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:48		
4	08:04	07:43	07:00	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46		
	17:00	17:39	18:17	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:13	16:47		
5	08:04	07:42	06:59	07:02	06:12	05:43	05:48	06:17	06:53	07:29	07:09	07:47		
	17:01	17:41	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47		
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48		
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:57	19:01	17:10	16:47		
7	08:04	07:39	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:49		
	17:03	17:43	18:21	20:00	20:37	21:08	21:15	20:47	19:56	19:00	17:09	16:47		
8	08:03	07:38	07:53	06:56	06:08	05:42	05:50	06:20	06:57	07:32	07:13	07:50		
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:08	16:47		
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:14	07:51		
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47		
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52		
	17:06	17:48	19:24	20:04	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:47		
11	08:02	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:17	07:53		
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47		
12	08:02	07:32	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:37	07:19	07:54		
	17:08	17:50	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:47		
13	08:02	07:31	07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55		
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	16:47		
14	08:01	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56		
	17:11	17:53	19:30	20:08	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47		
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:56		
	17:12	17:55	19:31	20:10	20:46	21:13	21:10	20:35	19:41	18:44	17:00	16:47		
16	08:00	07:27	07:39	06:42	7 07:03 (T-65)	05:59	05:41	05:56	06:30	7 06:58 (T-65)	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	3 07:06 (T-65)	20:47	21:14	21:10	20:34	6 07:04 (T-65)	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	5 07:01 (T-65)	05:58	05:41	05:57	06:31	6 06:56 (T-65)	07:07	07:44	07:25	07:58
	17:15	17:57	19:33	20:12	5 07:06 (T-65)	20:48	21:14	21:09	20:32	11 07:07 (T-65)	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	6 06:59 (T-65)	05:57	05:41	05:58	06:32	6 06:55 (T-65)	07:08	07:45	07:27	07:58
	17:16	17:59	19:35	20:13	7 07:06 (T-65)	20:50	21:14	21:08	20:30	14 07:09 (T-65)	19:35	18:39	16:57	16:48
19	07:58	07:22	07:33	06:37	8 06:58 (T-65)	05:56	05:41	05:59	06:33	6 06:56 (T-65)	07:10	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	8 07:06 (T-65)	20:51	21:15	21:08	20:29	13 07:09 (T-65)	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:36	6 06:56 (T-65)	05:55	05:41	06:00	06:34	6 06:57 (T-65)	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	10 07:06 (T-65)	20:52	21:15	21:07	20:27	13 07:10 (T-65)	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	6 06:54 (T-65)	05:54	05:42	06:01	06:36	6 06:58 (T-65)	07:12	07:49	07:31	08:00
	17:20	18:02	19:39	20:17	11 07:05 (T-65)	20:53	21:15	21:06	20:25	12 07:10 (T-65)	19:29	18:34	16:54	16:49
22	07:56	07:17	07:28	06:32	6 06:53 (T-65)	05:53	05:42	06:02	06:37	6 06:59 (T-65)	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	12 07:05 (T-65)	20:54	21:16	21:05	20:24	11 07:10 (T-65)	19:28	18:32	16:54	16:50
23	07:55	07:16	07:26	06:31	6 06:51 (T-65)	05:52	05:42	06:03	06:38	6 07:00 (T-65)	07:14	07:52	07:33	08:01
	17:22	18:04	19:41	20:20	13 07:04 (T-65)	20:55	21:16	21:04	20:22	10 07:10 (T-65)	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	6 06:50 (T-65)	05:51	05:42	06:04	06:39	6 07:01 (T-65)	07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	13 07:03 (T-65)	20:56	21:16	21:03	20:20	8 07:09 (T-65)	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	6 06:48 (T-65)	05:50	05:43	06:05	06:40	6 07:03 (T-65)	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	14 07:02 (T-65)	20:57	21:16	21:02	20:19	7 07:10 (T-65)	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	6 06:49 (T-65)	05:49	05:43	06:06	06:41	5 07:04 (T-65)	07:18	07:56	07:37	08:02
	17:27	18:08	19:45	20:23	11 07:00 (T-65)	20:58	21:16	21:01	20:17	5 07:09 (T-65)	19:20	18:26	16:51	16:52
27	07:52	07:09	07:18	06:24	6 06:52 (T-65)	05:49	05:43	06:07	06:43	6 07:05 (T-65)	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	4 06:56 (T-65)	20:59	21:16	21:00	20:15	3 07:08 (T-65)	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	6 06:53 (T-65)	05:48	05:44	06:08	06:44	6 07:20 (T-65)	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53	16:53	16:53
29	07:50		07:15	06:21	6 06:54 (T-65)	05:47	05:44	06:09	06:45	6 07:21 (T-65)	08:00	07:40	08:03	08:03
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54	16:54	16:54
30	07:49		07:13	06:20	6 06:54 (T-65)	05:46	06:10	06:46	07:23	08:01	07:42	08:04	08:04	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55	16:55	16:55
31	07:48		07:11	06:19	6 06:54 (T-65)	05:46	06:11	06:47		08:02		08:04	08:04	08:04
	17:34		19:51	20:29	21:03	20:56	20:08	20:08		18:18		16:56	16:56	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276		
Total, worst case				111				113						
Sun reduction				0.63				0.72						
Oper. time red.				0.90				0.90						
Wind dir. red.				0.58				0.58						
Total reduction				0.33				0.37						
Total, real				36				42						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker (WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Assumptions for shadow calculations

Shadow receptor: R-241 - R-241

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with columns for months (January to December) and rows for days (1 to 31). Each cell contains a time range (e.g., 08:04 | 07:46 | 07:05 | 07:09 | 06:18 | 05:45 | 05:45 | 06:12 | 06:48 | 07:24 | 07:03 | 07:43). Summary rows at the bottom include Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, and Total, real.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time).

Project: South Deuel Wind Project

Description: Invenery Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-242 - R-242

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with columns for months (January to December) and rows for each day (1 to 31) showing sun rise/set times and shadow reduction percentages. Includes summary rows for 'Potential sun hours' and 'Total, real'.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-243 - R-243
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04 16:57	07:46 17:35	07:05 18:12	17:10 (T-72) 17:38 (T-72)	07:09 19:52	06:18 20:29
2	08:04 16:58	07:45 17:36	07:04 18:14	17:11 (T-72) 17:36 (T-72)	07:07 19:53	06:17 20:31
3	08:04 16:59	07:44 17:38	07:02 18:15	17:13 (T-72) 17:35 (T-72)	07:05 19:55	06:15 20:32
4	08:04 17:00	07:43 17:39	07:00 18:16	17:15 (T-72) 17:32 (T-72)	07:03 19:56	06:14 20:33
5	08:04 17:01	07:42 17:40	06:58 18:18	17:19 (T-72) 17:28 (T-72)	07:02 19:57	06:12 20:34
6	08:03 17:02	07:40 17:42	06:57 18:19	07:00 19:58	06:11 20:35	06:32 (T-75) 21:07
7	08:03 17:03	07:39 17:43	06:55 18:20	06:58 20:00	06:10 20:37	06:31 (T-75) 21:08
8	08:03 17:04	07:38 17:45	07:53 18:22	06:56 20:01	06:08 20:38	06:30 (T-75) 21:09
9	08:03 17:05	07:36 17:46	17:19 (T-72) 17:21 (T-72)	07:51 19:23	06:54 20:02	06:28 (T-75) 21:10
10	08:03 17:06	07:35 17:48	17:15 (T-72) 17:22 (T-72)	07:50 19:24	06:06 20:03	06:29 (T-75) 21:10
11	08:02 17:07	07:34 17:49	17:14 (T-72) 17:24 (T-72)	07:48 19:26	06:51 20:05	06:30 (T-75) 21:11
12	08:02 17:08	07:32 17:50	17:13 (T-72) 17:26 (T-72)	07:46 19:27	06:49 20:06	06:31 (T-75) 21:11
13	08:01 17:09	07:31 17:52	17:11 (T-72) 17:27 (T-72)	07:44 19:28	06:47 20:07	06:32 (T-75) 21:12
14	08:01 17:11	07:29 17:53	17:10 (T-72) 17:29 (T-72)	07:42 19:29	06:46 20:08	06:33 (T-75) 21:12
15	08:01 17:12	07:28 17:55	17:09 (T-72) 17:30 (T-72)	07:40 19:31	06:00 20:10	06:35 (T-75) 21:13
16	08:00 17:13	07:26 17:56	17:09 (T-72) 17:32 (T-72)	07:39 19:32	06:42 20:11	06:37 (T-75) 21:13
17	07:59 17:14	07:25 17:57	17:08 (T-72) 17:33 (T-72)	07:37 19:33	06:40 20:12	05:57 20:48
18	07:59 17:16	07:23 17:59	17:07 (T-72) 17:34 (T-72)	07:35 19:35	06:39 20:13	05:56 20:49
19	07:58 17:17	07:22 18:00	17:07 (T-72) 17:36 (T-72)	07:33 19:36	06:37 20:14	05:55 20:50
20	07:57 17:18	07:20 18:00	17:06 (T-72) 17:37 (T-72)	07:31 19:37	06:35 20:16	05:54 20:52
21	07:57 17:20	07:19 18:01	17:07 (T-72) 17:40 (T-72)	07:29 19:38	06:34 20:17	05:53 20:53
22	07:56 17:21	07:17 18:03	17:06 (T-72) 17:41 (T-72)	07:27 19:40	06:32 20:18	05:52 20:54
23	07:55 17:22	07:15 18:04	17:06 (T-72) 17:42 (T-72)	07:26 19:41	06:30 20:19	05:52 20:55
24	07:54 17:24	07:14 18:06	17:07 (T-72) 17:43 (T-72)	07:24 19:42	06:29 20:21	06:49 (T-75) 20:56
25	07:53 17:25	07:12 18:07	17:07 (T-72) 17:42 (T-72)	07:22 19:43	06:27 20:22	06:48 (T-75) 20:57
26	07:53 17:26	07:11 18:08	17:07 (T-72) 17:41 (T-72)	07:20 19:45	06:26 20:23	06:46 (T-75) 20:58
27	07:52 17:28	07:09 18:10	17:09 (T-72) 17:41 (T-72)	07:18 19:46	06:24 20:24	06:45 (T-75) 20:59
28	07:51 17:29	07:07 18:11	17:09 (T-72) 17:40 (T-72)	07:16 19:47	06:23 20:26	06:43 (T-75) 21:00
29	07:50 17:31		07:15 19:48	06:21 19:48	06:21 20:27	06:42 (T-75) 21:01
30	07:49 17:32		07:13 19:50	06:19 19:50	06:19 20:28	06:40 (T-75) 21:02
31	07:47 17:33		07:11 19:51	06:17 19:51	06:17 20:28	06:38 (T-75) 21:02
Potential sun hours	287	292	369	403	458	465
Total, worst case		495	101	70	334	260
Sun reduction		0.58	0.59	0.63	0.66	0.73
Oper. time red.		0.90	0.90	0.90	0.90	0.90
Wind dir. red.		0.59	0.59	0.59	0.59	0.65
Total reduction		0.31	0.31	0.33	0.35	0.42
Total, real		152	32	23	116	110

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-243 - R-243

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December			
1	05:45	20:39 (T-65)	06:12	06:41 (T-75)	06:48	07:24	07:03	16:45 (T-72)	07:43
	21:16	9 20:48 (T-65)	20:54	22 07:03 (T-75)	20:06	19:10	17:17	7 16:52 (T-72)	16:48
2	05:46	20:40 (T-65)	06:13	06:40 (T-75)	06:50	07:25	07:05	16:49 (T-72)	07:44
	21:16	8 20:48 (T-65)	20:53	24 07:04 (T-75)	20:05	19:09	17:15	2 16:51 (T-72)	16:48
3	05:46	20:39 (T-65)	06:15	06:39 (T-75)	06:51	07:26	07:06		07:45
	21:15	9 20:48 (T-65)	20:52	26 07:05 (T-75)	20:03	19:07	17:14		16:48
4	05:47	20:40 (T-65)	06:16	06:39 (T-75)	06:52	07:27	07:08		07:46
	21:15	8 20:48 (T-65)	20:50	26 07:05 (T-75)	20:01	19:05	17:13		16:47
5	05:47	20:41 (T-65)	06:17	06:40 (T-75)	06:53	07:29	07:09		07:47
	21:15	7 20:48 (T-65)	20:49	25 07:05 (T-75)	19:59	19:03	17:11		16:47
6	05:48	20:40 (T-65)	06:18	06:41 (T-75)	06:54	07:30	07:10		07:48
	21:15	7 20:47 (T-65)	20:48	25 07:06 (T-75)	19:57	19:01	17:10		16:47
7	05:49	20:41 (T-65)	06:19	06:42 (T-75)	06:55	07:31	07:12		07:49
	21:14	6 20:47 (T-65)	20:47	24 07:06 (T-75)	19:55	18:58	17:09		16:47
8	05:49	20:42 (T-65)	06:20	06:43 (T-75)	06:57	07:32	07:13		07:50
	21:14	5 20:47 (T-65)	20:45	23 07:06 (T-75)	19:54	18:56	17:07		16:47
9	05:50	20:41 (T-65)	06:21	06:44 (T-75)	06:58	07:34	17:52 (T-72)	07:14	07:51
	21:14	5 20:46 (T-65)	20:44	21 07:05 (T-75)	19:52	18:54	13 18:05 (T-72)	17:06	16:46
10	05:51	20:42 (T-65)	06:23	06:46 (T-75)	06:59	07:35	17:48 (T-72)	07:16	07:52
	21:13	4 20:46 (T-65)	20:42	20 07:06 (T-75)	19:50	18:52	20 18:08 (T-72)	17:05	16:46
11	05:52	20:43 (T-65)	06:24	06:47 (T-75)	07:00	07:36	17:46 (T-72)	07:17	07:53
	21:13	2 20:45 (T-65)	20:41	19 07:06 (T-75)	19:48	18:50	23 18:09 (T-72)	17:04	16:46
12	05:53	20:44 (T-65)	06:25	06:48 (T-75)	07:01	07:37	17:44 (T-72)	07:18	07:54
	21:12	1 20:45 (T-65)	20:39	17 07:05 (T-75)	19:46	18:49	27 18:11 (T-72)	17:03	16:47
13	05:53		06:26	06:49 (T-75)	07:02	07:39	17:43 (T-72)	07:20	07:55
	21:12		20:38	16 07:05 (T-75)	19:44	18:47	29 18:12 (T-72)	17:02	16:47
14	05:54		06:27	06:50 (T-75)	07:04	07:40	17:41 (T-72)	07:21	07:55
	21:11		20:36	14 07:04 (T-75)	19:42	18:45	31 18:12 (T-72)	17:01	16:47
15	05:55		06:28	06:51 (T-75)	07:05	07:41	17:41 (T-72)	07:22	07:56
	21:10		20:35	12 07:03 (T-75)	19:41	18:43	33 18:14 (T-72)	17:00	16:47
16	05:56		06:30	06:52 (T-75)	07:06	07:42	17:39 (T-72)	07:24	07:57
	21:10		20:33	10 07:02 (T-75)	19:39	18:42	35 18:14 (T-72)	16:59	16:47
17	05:57		06:31	06:53 (T-75)	07:07	07:44	17:38 (T-72)	07:25	07:58
	21:09		20:32	8 07:01 (T-75)	19:37	18:40	36 18:14 (T-72)	16:58	16:47
18	05:58		06:32	06:54 (T-75)	07:08	07:45	17:38 (T-72)	07:26	07:58
	21:08		20:30	5 06:59 (T-75)	19:35	18:38	37 18:15 (T-72)	16:57	16:48
19	05:59		06:33	06:56 (T-75)	07:09	07:46	17:38 (T-72)	07:28	07:59
	21:07		20:29	2 06:58 (T-75)	19:33	18:37	35 18:13 (T-72)	16:56	16:48
20	06:00		06:34		07:11	07:48	17:37 (T-72)	07:29	08:00
	21:07		20:27		19:31	18:35	34 18:11 (T-72)	16:55	16:49
21	06:01		06:35		07:12	07:49	17:37 (T-72)	07:30	08:00
	21:06		20:25		19:29	18:33	33 18:10 (T-72)	16:54	16:49
22	06:02		06:37		07:13	07:50	17:37 (T-72)	07:32	08:01
	21:05		20:24		19:27	18:32	31 18:08 (T-72)	16:53	16:50
23	06:03		06:38		07:14	07:51	17:37 (T-72)	07:33	08:01
	21:04		20:22		19:25	18:30	28 18:05 (T-72)	16:53	16:50
24	06:04		06:39		07:15	07:53	17:38 (T-72)	07:34	08:02
	21:03		20:20		19:24	18:29	26 18:04 (T-72)	16:52	16:51
25	06:05		06:40		07:16	07:54	17:37 (T-72)	07:35	08:02
	21:02		20:19		19:22	18:27	25 18:02 (T-72)	16:51	16:51
26	06:06		06:41		07:18	07:55	17:39 (T-72)	07:37	08:02
	21:01		20:17		19:20	18:25	22 18:01 (T-72)	16:51	16:52
27	06:07	06:49 (T-75)	06:42		07:19	07:57	17:39 (T-72)	07:38	08:03
	21:00	6 06:55 (T-75)	20:15		19:18	18:24	20 17:59 (T-72)	16:50	16:53
28	06:08	06:46 (T-75)	06:44		07:20	07:58	17:39 (T-72)	07:39	08:03
	20:59	12 06:58 (T-75)	20:13		19:16	18:22	18 17:57 (T-72)	16:50	16:53
29	06:09	06:44 (T-75)	06:45		07:21	07:59	17:41 (T-72)	07:40	08:03
	20:58	16 07:00 (T-75)	20:12		19:14	18:21	15 17:56 (T-72)	16:49	16:54
30	06:10	06:43 (T-75)	06:46		07:22	08:01	17:42 (T-72)	07:41	08:03
	20:57	18 07:01 (T-75)	20:10		19:12	18:19	13 17:55 (T-72)	16:49	16:55
31	06:11	06:42 (T-75)	06:47			08:02	17:44 (T-72)		08:03
	20:55	20 07:02 (T-75)	20:08			18:18	10 17:54 (T-72)		16:56
Potential sun hours	471		436		377	341	289		276
Total, worst case		143		339		594		9	
Sun reduction		0.75		0.72		0.56		0.48	
Oper. time red.		0.90		0.90		0.90		0.90	
Wind dir. red.		0.62		0.59		0.59		0.59	
Total reduction		0.41		0.38		0.30		0.25	
Total, real		59		128		176		2	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-244 - R-244
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04 16:57	07:46 17:35	07:05 18:12	07:26 (T-75) 08:05 (T-74)	07:09 19:52	06:18 20:29
2	08:04 16:58	07:45 17:36	07:04 18:14	07:24 (T-75) 08:04 (T-74)	07:07 19:53	19:28 (T-65) 20:31
3	08:04 16:59	07:44 17:38	07:02 18:15	07:23 (T-75) 08:04 (T-74)	07:05 19:55	19:26 (T-65) 20:32
4	08:04 17:00	07:43 17:39	07:00 18:16	07:21 (T-75) 08:03 (T-74)	07:03 19:56	19:25 (T-65) 20:33
5	08:04 17:01	07:42 17:40	06:58 18:18	07:19 (T-75) 08:01 (T-74)	07:02 19:57	19:23 (T-65) 20:34
6	08:04 17:02	07:40 17:42	06:57 18:19	07:17 (T-75) 08:00 (T-74)	07:00 19:58	19:22 (T-65) 20:35
7	08:03 17:03	07:39 17:43	06:55 18:20	07:18 (T-75) 07:58 (T-74)	06:58 20:00	19:21 (T-65) 20:37
8	08:03 17:04	07:38 17:45	07:53 18:22	08:21 (T-75) 08:57 (T-74)	06:56 20:01	19:20 (T-65) 20:38
9	08:03 17:05	07:36 17:46	07:51 19:23	08:34 (T-74) 08:54 (T-74)	06:54 20:02	19:20 (T-65) 20:39
10	08:03 17:06	07:35 17:48	07:50 19:24	08:37 (T-74) 08:50 (T-74)	06:53 20:03	19:19 (T-65) 20:40
11	08:02 17:07	07:34 17:49	07:48 19:26	08:50 (T-74)	06:51 20:05	19:19 (T-65) 20:41
12	08:02 17:08	07:32 17:50	07:46 19:27		06:49 20:06	19:19 (T-65) 20:43
13	08:02 17:09	07:31 17:52	07:52 (T-74) 07:53 (T-74)	07:44 19:28	06:47 20:07	19:19 (T-65) 20:44
14	08:01 17:11	07:29 17:53	07:51 (T-74) 07:57 (T-74)	07:42 19:29	06:46 20:08	19:19 (T-65) 20:45
15	08:01 17:12	07:28 17:55	07:49 (T-74) 07:59 (T-74)	07:40 19:31	06:44 20:10	19:20 (T-65) 20:46
16	08:00 17:13	07:26 17:56	07:48 (T-74) 08:01 (T-74)	07:39 19:32	06:42 20:11	19:20 (T-65) 20:47
17	07:59 17:14	07:25 17:57	07:46 (T-74) 08:02 (T-74)	07:37 19:33	06:40 20:12	19:22 (T-65) 20:48
18	07:59 17:16	07:23 17:59	07:44 (T-74) 08:02 (T-74)	07:35 19:35	06:39 20:13	19:23 (T-65) 20:49
19	07:58 17:17	07:22 18:00	07:43 (T-74) 08:04 (T-74)	07:33 19:36	06:37 20:15	19:24 (T-65) 20:51
20	07:58 17:18	07:20 18:00	07:41 (T-74) 08:04 (T-74)	07:31 19:37	06:35 20:16	19:28 (T-65) 20:52
21	07:57 17:20	07:19 18:01	07:40 (T-74) 08:05 (T-74)	07:29 19:38	06:34 20:17	19:34 (T-65) 20:53
22	07:56 17:21	07:17 18:03	07:38 (T-74) 08:06 (T-74)	07:28 19:40	06:32 20:18	05:52 20:54
23	07:55 17:22	07:15 18:04	07:36 (T-74) 08:05 (T-74)	07:26 19:41	06:30 20:19	05:52 20:55
24	07:54 17:24	07:14 18:06	07:35 (T-75) 08:06 (T-74)	07:24 19:42	06:29 20:21	05:51 20:56
25	07:53 17:25	07:12 18:07	07:33 (T-75) 08:06 (T-74)	07:22 19:43	06:27 20:22	05:50 20:57
26	07:53 17:26	07:11 18:08	07:31 (T-75) 08:06 (T-74)	07:20 19:45	06:26 20:23	05:49 20:58
27	07:52 17:28	07:09 18:10	07:30 (T-75) 08:06 (T-74)	07:18 19:46	06:24 20:24	05:48 20:59
28	07:51 17:29	07:07 18:11	07:28 (T-75) 08:05 (T-74)	07:16 19:47	06:23 20:26	05:48 21:00
29	07:50 17:31		07:15 19:48		06:21 20:27	05:47 21:01
30	07:49 17:32		07:13 19:50		06:19 20:28	05:46 21:02
31	07:47 17:33		07:11 19:51			05:46 21:03
Potential sun hours	287	292	369	403	458	465
Total, worst case		362	355	336		
Sun reduction		0.58	0.59	0.63		
Oper. time red.		0.90	0.90	0.90		
Wind dir. red.		0.61	0.61	0.60		
Total reduction		0.32	0.32	0.34		
Total, real		116	115	114		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-244 - R-244
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December		
1	05:45	06:12	06:48	19:18 (T-65)	07:24	07:03	07:43	
	21:16	20:54	20:06	23 19:41 (T-65)	19:10	17:17	16:48	
2	05:46	06:13	06:50	19:17 (T-65)	07:25	07:05	07:44	
	21:16	20:53	20:05	22 19:39 (T-65)	19:09	17:15	16:48	
3	05:46	06:15	06:51	19:17 (T-65)	07:26	08:17 (T-74)	07:06	07:45
	21:16	20:52	20:03	21 19:38 (T-65)	19:07	9 08:26 (T-74)	17:14	16:48
4	05:47	06:16	06:52	19:18 (T-65)	07:27	08:12 (T-74)	07:08	07:46
	21:15	20:51	20:01	19 19:37 (T-65)	19:05	17 08:29 (T-74)	17:13	16:47
5	05:47	06:17	06:53	19:18 (T-65)	07:29	07:59 (T-75)	07:09	07:47
	21:15	20:49	19:59	17 19:35 (T-65)	19:03	29 08:32 (T-74)	17:11	16:47
6	05:48	06:18	06:54	19:18 (T-65)	07:30	07:56 (T-75)	07:10	07:48
	21:15	20:48	19:57	15 19:33 (T-65)	19:01	38 08:34 (T-74)	17:10	16:47
7	05:49	06:19	06:55	19:18 (T-65)	07:31	07:53 (T-75)	07:12	07:49
	21:14	20:47	19:55	13 19:31 (T-65)	18:58	42 08:35 (T-74)	17:09	16:47
8	05:49	06:20	06:57	19:19 (T-65)	07:32	07:53 (T-75)	07:13	07:50
	21:14	20:45	19:54	10 19:29 (T-65)	18:56	42 08:35 (T-74)	17:07	16:47
9	05:50	06:21	06:58	19:20 (T-65)	07:34	07:55 (T-75)	07:14	07:51
	21:14	20:44	19:52	7 19:27 (T-65)	18:54	42 08:37 (T-74)	17:06	16:46
10	05:51	06:23	06:59	19:21 (T-65)	07:35	07:56 (T-75)	07:16	07:52
	21:13	20:42	19:50	4 19:25 (T-65)	18:52	41 08:37 (T-74)	17:05	16:46
11	05:52	06:24	07:00		07:36	07:57 (T-75)	07:17	07:53
	21:13	20:41	19:48		18:50	40 08:37 (T-74)	17:04	16:46
12	05:53	06:25	07:01		07:37	07:59 (T-75)	07:18	07:54
	21:12	20:39	19:46		18:49	39 08:38 (T-74)	17:03	16:47
13	05:53	06:26	07:02		07:39	08:00 (T-75)	07:20	07:55
	21:12	20:38	19:44		18:47	38 08:38 (T-74)	17:02	16:47
14	05:54	06:27	07:04		07:40	08:01 (T-75)	07:21	07:55
	21:11	20:36	19:42		18:45	37 08:38 (T-74)	17:01	16:47
15	05:55	06:28	07:05		07:41	08:03 (T-75)	07:22	07:56
	21:10	20:35	19:41		18:43	36 08:39 (T-74)	17:00	16:47
16	05:56	06:30	07:06		07:42	08:04 (T-75)	07:24	07:57
	21:10	20:33	19:39		18:42	34 08:38 (T-74)	16:59	16:47
17	05:57	06:31	07:07		07:44	08:05 (T-75)	07:25	07:58
	21:09	20:32	19:37		18:40	32 08:37 (T-74)	16:58	16:47
18	05:58	06:32	07:08		07:45	08:07 (T-74)	07:26	07:58
	21:08	20:30	19:35		18:38	31 08:38 (T-74)	16:57	16:48
19	05:59	06:33	07:09		07:46	08:08 (T-74)	07:28	07:59
	21:07	20:29	19:33		18:37	29 08:37 (T-74)	16:56	16:48
20	06:00	06:34	07:11		07:48	08:09 (T-74)	07:29	08:00
	21:07	20:27	19:31		18:35	27 08:36 (T-74)	16:55	16:49
21	06:01	06:35	07:12		07:49	08:11 (T-74)	07:30	08:00
	21:06	20:25	19:29		18:33	25 08:36 (T-74)	16:54	16:49
22	06:02	06:37	07:13		07:50	08:12 (T-74)	07:32	08:01
	21:05	20:24	19:27		18:32	23 08:35 (T-74)	16:53	16:50
23	06:03	06:38	19:31 (T-65)	07:14	07:51	08:13 (T-74)	07:33	08:01
	21:04	20:22	8 19:39 (T-65)	19:25	18:30	20 08:33 (T-74)	16:53	16:50
24	06:04	06:39	19:28 (T-65)	07:15	07:53	08:15 (T-74)	07:34	08:02
	21:03	20:20	14 19:42 (T-65)	19:24	18:29	18 08:33 (T-74)	16:52	16:51
25	06:05	06:40	19:25 (T-65)	07:17	07:54	08:16 (T-74)	07:35	08:02
	21:02	20:19	19 19:44 (T-65)	19:22	18:27	15 08:31 (T-74)	16:51	16:51
26	06:06	06:41	19:23 (T-65)	07:18	07:55	08:18 (T-74)	07:37	08:02
	21:01	20:17	22 19:45 (T-65)	19:20	18:25	12 08:30 (T-74)	16:51	16:52
27	06:07	06:42	19:23 (T-65)	07:19	07:57	08:19 (T-74)	07:38	08:03
	21:00	20:15	23 19:46 (T-65)	19:18	18:24	9 08:28 (T-74)	16:50	16:53
28	06:08	06:44	19:21 (T-65)	07:20	07:58	08:20 (T-74)	07:39	08:03
	20:59	20:13	26 19:47 (T-65)	19:16	18:22	5 08:25 (T-74)	16:50	16:53
29	06:09	06:45	19:20 (T-65)	07:21	07:59		07:40	08:03
	20:58	20:12	27 19:47 (T-65)	19:14	18:21		16:49	16:54
30	06:10	06:46	19:19 (T-65)	07:23	08:01		07:41	08:03
	20:57	20:10	26 19:45 (T-65)	19:12	18:19		16:49	16:55
31	06:11	06:47	19:19 (T-65)	07:24	08:02			08:04
	20:55	20:08	24 19:43 (T-65)		18:18			16:56
Potential sun hours	471	436	377	341	289	276		
Total, worst case								
Sun reduction		189	151	730				
Oper. time red.		0.72	0.67	0.56				
Wind dir. red.		0.90	0.90	0.90				
Total reduction		0.60	0.60	0.61				
Total, real		0.39	0.36	0.31				
		73	54	226				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-245 - R-245
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	15:17 (T-74)	07:46	07:05	07:09	06:18
	16:57	58 16:15 (T-74)	17:35	18:12	19:52	10 19:47 (T-67)
2	08:04	15:17 (T-74)	07:45	07:04	07:07	21:03
	16:58	59 16:16 (T-74)	17:36	18:14	19:53	20 06:28 (T-71)
3	08:04	15:18 (T-74)	07:44	07:02	07:05	05:44
	16:59	58 16:16 (T-74)	17:38	18:15	19:55	21:05
4	08:04	15:19 (T-74)	07:43	07:00	07:03	06:09 (T-71)
	17:00	57 16:16 (T-74)	17:39	18:16	19:56	18 06:27 (T-71)
5	08:04	15:19 (T-74)	07:42	06:58	07:02	05:43
	17:01	58 16:17 (T-74)	17:40	18:18	19:57	21:07
6	08:03	15:20 (T-74)	07:40	06:57	07:00	06:10 (T-71)
	17:02	57 16:17 (T-74)	17:42	18:19	19:58	16 06:26 (T-71)
7	08:03	15:20 (T-74)	07:39	06:55	06:58	05:42
	17:03	57 16:17 (T-74)	17:43	18:20	20:00	06:11 (T-71)
8	08:03	15:21 (T-74)	07:38	07:53	06:56	21:08
	17:04	56 16:17 (T-74)	17:45	18:22	20:01	15 06:26 (T-71)
9	08:03	15:22 (T-74)	07:36	07:51	06:54	05:42
	17:05	56 16:18 (T-74)	17:46	19:23	20:02	14 06:26 (T-71)
10	08:03	15:22 (T-74)	07:35	07:49	06:53	05:41
	17:06	55 16:17 (T-74)	17:47	19:24	20:03	13 06:13 (T-71)
11	08:02	15:23 (T-74)	07:34	07:48	06:51	21:10
	17:07	55 16:18 (T-74)	17:49	19:26	20:05	12 06:25 (T-71)
12	08:02	15:24 (T-74)	07:32	07:46	06:49	05:41
	17:08	53 16:17 (T-74)	17:50	19:27	20:06	10 06:14 (T-71)
13	08:01	15:25 (T-74)	07:31	07:44	06:47	21:11
	17:09	53 16:18 (T-74)	17:52	19:28	20:07	10 06:24 (T-71)
14	08:01	15:25 (T-74)	07:29	07:42	06:46	2 06:26 (T-71)
	17:11	52 16:17 (T-74)	17:53	19:29	20:08	21:12
15	08:01	15:27 (T-74)	07:28	07:40	06:44	4 06:27 (T-71)
	17:12	51 16:18 (T-74)	17:54	19:31	20:09	8 06:24 (T-71)
16	08:00	15:27 (T-74)	07:26	07:39	06:42	6 06:28 (T-71)
	17:13	50 16:17 (T-74)	17:56	19:32	20:11	21:13
17	07:59	15:28 (T-74)	07:25	07:37	06:40	7 06:21 (T-71)
	17:14	49 16:17 (T-74)	17:57	19:33	20:12	5 06:29 (T-71)
18	07:59	15:30 (T-74)	07:23	07:35	06:39	9 06:20 (T-71)
	17:16	47 16:17 (T-74)	17:59	19:35	20:13	8 06:19 (T-71)
19	07:58	15:30 (T-74)	07:22	07:33	06:37	10 06:29 (T-71)
	17:17	47 16:17 (T-74)	18:00	19:36	20:14	9 06:18 (T-71)
20	07:57	15:31 (T-74)	07:20	07:31	06:35	11 06:29 (T-71)
	17:18	45 16:16 (T-74)	18:00	19:37	20:16	11 06:17 (T-71)
21	07:57	15:32 (T-74)	07:19	07:29	06:34	12 06:29 (T-71)
	17:20	43 16:15 (T-74)	18:01	19:38	20:17	12 06:16 (T-71)
22	07:56	15:35 (T-74)	07:17	07:27	06:32	13 06:29 (T-71)
	17:21	41 16:16 (T-74)	18:03	19:40	20:18	13 06:15 (T-71)
23	07:55	15:36 (T-74)	07:15	07:26	06:30	14 06:29 (T-71)
	17:22	39 16:15 (T-74)	18:04	19:41	20:19	14 06:14 (T-71)
24	07:54	15:37 (T-74)	07:14	07:24	06:29	15 06:29 (T-71)
	17:24	37 16:14 (T-74)	18:06	19:42	20:21	15 06:13 (T-71)
25	07:53	15:39 (T-74)	07:12	07:22	06:27	16 06:29 (T-71)
	17:25	33 16:12 (T-74)	18:07	19:43	20:22	16 06:13 (T-71)
26	07:52	15:41 (T-74)	07:10	07:20	06:26	17 06:30 (T-71)
	17:26	30 16:11 (T-74)	18:08	19:45	20:23	17 06:12 (T-71)
27	07:52	15:44 (T-74)	07:09	07:18	06:24	17 06:29 (T-71)
	17:28	25 16:09 (T-74)	18:10	19:46	20:24	17 06:11 (T-71)
28	07:51	15:46 (T-74)	07:07	07:16	06:22	18 06:29 (T-71)
	17:29	21 16:07 (T-74)	18:11	19:47	20:26	18 06:11 (T-71)
29	07:50	15:51 (T-74)		07:14	06:21	20 06:29 (T-71)
	17:30	13 16:04 (T-74)		19:48	20:27	18 06:10 (T-71)
30	07:49			07:13	06:19	19 06:29 (T-71)
	17:32			19:50	20:28	19 06:09 (T-71)
31	07:47			07:11		20 06:28 (T-71)
	17:33			19:51		19 06:09 (T-71)
Potential sun hours	287	292	369	403	458	465
Total, worst case	1355			205		257
Sun reduction	0.58			0.63		0.73
Oper. time red.	0.90			0.90		0.90
Wind dir. red.	0.62			0.60		0.59
Total reduction	0.32			0.34		0.39
Total, real	438			70		95

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project: South Deuel Wind Project
 Description: Invenergy Deuel Harvest Wind in Deuel County, SD
 Greenhouse Shadow Flicker Study
 Project Turbines Only
 L086 71 SG4.4-164 WTGs on 97.5m HH
 June 14, 2024
 Licensed user: Stantec Consulting Services Inc.
 1165 Scheuring Road
 US-DE PERE WI 54115
 920 278 3215
 Christiana Jansen / christiana.jansen@stantec.com
 Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-245 - R-245
 Assumptions for shadow calculations
 Sunshine probability S/S0 (Sun hours/Possible sun hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time			N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum																
			561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884
July	August	September	October	November	December														
1 05:45	06:18 (T-71)	06:12	06:48	07:24	07:03	07:43	15:05 (T-74)												
21:16	11 06:29 (T-71)	20:54	20:06	19:10	17:17	16:48	55	16:00 (T-74)											
2 05:45	06:18 (T-71)	06:13	06:49	07:25	07:05	07:44	15:05 (T-74)												
21:16	12 06:30 (T-71)	20:53	20:05	19:09	17:15	16:48	55	16:00 (T-74)											
3 05:46	06:17 (T-71)	06:15	06:51	07:26	07:06	07:45	15:05 (T-74)												
21:15	13 06:30 (T-71)	20:52	20:03	19:07	17:14	16:47	56	16:01 (T-74)											
4 05:47	06:17 (T-71)	06:16	06:52	07:27	07:07	07:46	15:05 (T-74)												
21:15	14 06:31 (T-71)	20:50	20:01	19:05	17:12	16:47	56	16:01 (T-74)											
5 05:47	06:17 (T-71)	06:17	06:53	07:29	07:09	07:47	15:05 (T-74)												
21:15	15 06:32 (T-71)	20:49	19:59	19:03	17:11	16:47	57	16:02 (T-74)											
6 05:48	06:16 (T-71)	06:18	06:54	07:30	07:10	07:48	15:06 (T-74)												
21:15	16 06:32 (T-71)	20:48	19:57	19:01	17:10	16:47	57	16:03 (T-74)											
7 05:49	06:16 (T-71)	06:19	06:55	07:31	07:12	07:49	15:07 (T-74)												
21:14	17 06:33 (T-71)	20:46	19:55	18:58	17:09	16:47	57	16:04 (T-74)											
8 05:49	06:16 (T-71)	06:20	06:56	07:32	07:13	07:50	15:07 (T-74)												
21:14	18 06:34 (T-71)	20:45	19:54	18:56	17:07	16:46	58	16:05 (T-74)											
9 05:50	06:15 (T-71)	06:21	06:58	07:33	07:14	07:51	15:07 (T-74)												
21:14	19 06:34 (T-71)	20:44	19:52	18:54	17:06	16:46	58	16:05 (T-74)											
10 05:51	06:15 (T-71)	06:23	06:59	07:35	07:16	07:52	15:06 (T-74)												
21:13	20 06:35 (T-71)	20:42	19:50	18:52	17:05	16:46	59	16:05 (T-74)											
11 05:52	06:16 (T-71)	06:24	19:59 (T-67)	07:00	07:36	07:17	15:07 (T-74)												
21:13	20 06:36 (T-71)	20:41	4 20:03 (T-67)	19:48	18:50	17:04	58	16:05 (T-74)											
12 05:52	06:17 (T-71)	06:25	19:55 (T-67)	07:01	07:37	07:18	15:07 (T-74)												
21:12	20 06:37 (T-71)	20:39	12 20:07 (T-67)	19:46	18:49	17:03	59	16:06 (T-74)											
13 05:53	06:17 (T-71)	06:26	19:53 (T-67)	07:02	07:38	07:20	15:08 (T-74)												
21:12	19 06:36 (T-71)	20:38	15 20:08 (T-67)	19:44	18:47	17:02	14	15:36 (T-74)	16:47	59 16:07 (T-74)									
14 05:54	06:18 (T-71)	06:27	19:51 (T-67)	07:03	07:40	07:21	15:18 (T-74)												
21:11	19 06:37 (T-71)	20:36	19 20:10 (T-67)	19:42	18:45	17:01	21	15:39 (T-74)	16:47	59 16:07 (T-74)									
15 05:55	06:19 (T-71)	06:28	19:50 (T-67)	07:05	07:41	07:22	15:15 (T-74)												
21:10	19 06:38 (T-71)	20:35	19 20:09 (T-67)	19:41	18:43	17:00	26	15:41 (T-74)	16:47	59 16:08 (T-74)									
16 05:56	06:20 (T-71)	06:30	19:49 (T-67)	07:06	07:42	07:24	15:14 (T-74)												
21:10	18 06:38 (T-71)	20:33	19 20:08 (T-67)	19:39	18:42	16:59	30	15:44 (T-74)	16:47	59 16:08 (T-74)									
17 05:57	06:21 (T-71)	06:31	19:48 (T-67)	07:07	07:44	07:25	15:12 (T-74)												
21:09	18 06:39 (T-71)	20:32	18 20:06 (T-67)	19:37	18:40	16:58	33	15:45 (T-74)	16:47	60 16:09 (T-74)									
18 05:58	06:22 (T-71)	06:32	19:47 (T-67)	07:08	07:45	07:26	15:11 (T-74)												
21:08	17 06:39 (T-71)	20:30	18 20:05 (T-67)	19:35	18:38	16:57	37	15:48 (T-74)	16:48	60 16:10 (T-74)									
19 05:59	06:23 (T-71)	06:33	19:47 (T-67)	07:09	07:46	07:28	15:10 (T-74)												
21:07	16 06:39 (T-71)	20:29	17 20:04 (T-67)	19:33	18:37	16:56	39	15:49 (T-74)	16:48	59 16:09 (T-74)									
20 06:00	06:24 (T-71)	06:34	19:47 (T-67)	07:11	07:47	07:29	15:10 (T-74)												
21:07	16 06:40 (T-71)	20:27	15 20:02 (T-67)	19:31	18:35	16:55	41	15:51 (T-74)	16:48	59 16:10 (T-74)									
21 06:01	06:25 (T-71)	06:35	19:46 (T-67)	07:12	07:49	07:30	15:08 (T-74)												
21:06	15 06:40 (T-71)	20:25	14 20:00 (T-67)	19:29	18:33	16:54	43	15:51 (T-74)	16:49	59 16:10 (T-74)									
22 06:02	06:26 (T-71)	06:37	19:46 (T-67)	07:13	07:50	07:32	15:07 (T-74)												
21:05	14 06:40 (T-71)	20:24	13 19:59 (T-67)	19:27	18:32	16:53	45	15:52 (T-74)	16:49	59 16:11 (T-74)									
23 06:03	06:26 (T-71)	06:38	19:46 (T-67)	07:14	07:51	07:33	15:07 (T-74)												
21:04	13 06:39 (T-71)	20:22	11 19:57 (T-67)	19:25	18:30	16:53	47	15:54 (T-74)	16:50	59 16:11 (T-74)									
24 06:04	06:27 (T-71)	06:39	19:46 (T-67)	07:15	07:53	07:34	15:07 (T-74)												
21:03	12 06:39 (T-71)	20:20	9 19:55 (T-67)	19:24	18:29	16:52	47	15:54 (T-74)	16:51	59 16:12 (T-74)									
25 06:05	06:28 (T-71)	06:40	19:46 (T-67)	07:16	07:54	07:35	15:06 (T-74)												
21:02	11 06:39 (T-71)	20:19	7 19:53 (T-67)	19:22	18:27	16:51	49	15:55 (T-74)	16:51	59 16:12 (T-74)									
26 06:06	06:29 (T-71)	06:41	19:47 (T-67)	07:18	07:55	07:37	15:06 (T-74)												
21:01	9 06:38 (T-71)	20:17	5 19:52 (T-67)	19:20	18:25	16:51	50	15:56 (T-74)	16:52	60 16:13 (T-74)									
27 06:07	06:30 (T-71)	06:42	19:48 (T-67)	07:19	07:57	07:38	15:06 (T-74)												
21:00	8 06:38 (T-71)	20:15	3 19:51 (T-67)	19:18	18:24	16:50	51	15:57 (T-74)	16:52	59 16:14 (T-74)									
28 06:08	06:32 (T-71)	06:44	07:20	07:58	07:39	15:05 (T-74)													
20:59	6 06:38 (T-71)	20:13	19:16	18:22	16:50	52	15:57 (T-74)	16:53	59 16:14 (T-74)										
29 06:09	06:33 (T-71)	06:45	07:21	07:59	07:40	15:05 (T-74)													
20:58	5 06:38 (T-71)	20:12	19:14	18:21	16:49	53	15:58 (T-74)	16:54	59 16:14 (T-74)										
30 06:10	06:34 (T-71)	06:46	07:22	08:01	07:41	15:06 (T-74)													
20:57	3 06:37 (T-71)	20:10	19:12	18:19	16:49	53	15:59 (T-74)	16:55	59 16:15 (T-74)										
31 06:11	06:35 (T-71)	06:47	08:02	08:02	08:03	15:16 (T-74)													
20:55	1 06:36 (T-71)	20:08	18:18	18:18	16:56	59	16:15 (T-74)												
Potential sun hours	471	436	377	341	289	276	1809												
Total, worst case	434	218	731	1809															
Sun reduction	0.75	0.72	0.48	0.52															
Oper. time red.	0.90	0.90	0.90	0.90															
Wind dir. red.	0.59	0.60	0.62	0.62															
Total reduction	0.40	0.39	0.27	0.29															
Total, real	173	85	195	524															

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-246 - R-246

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

January		February		March		April		May		June						
1	08:04	15:43 (T-67)	07:46	16:51 (T-66)	07:05	07:09	07:31 (T-70)	06:18		05:45	20:22 (T-85)					
	16:57	18	16:01 (T-67)	17:35	18	17:09 (T-66)	18:12		19:52	37	08:08 (T-70)	20:29	21:03	15	20:37 (T-85)	
2	08:04	15:45 (T-67)	07:45	16:52 (T-66)	07:04	07:07	07:31 (T-70)	06:16		05:44	20:22 (T-85)					
	16:58	16	16:01 (T-67)	17:36	18	17:10 (T-66)	18:14		19:53	36	08:07 (T-70)	20:31	21:04	16	20:38 (T-85)	
3	08:04	15:46 (T-67)	07:44	16:52 (T-66)	07:02	07:05	07:31 (T-70)	06:15		05:44	20:22 (T-85)					
	16:59	15	16:01 (T-67)	17:38	20	17:12 (T-66)	18:15		19:55	34	08:05 (T-70)	20:32	21:05	16	20:38 (T-85)	
4	08:04	15:48 (T-67)	07:43	16:53 (T-66)	07:00	07:03	07:33 (T-70)	06:14		05:43	20:22 (T-85)					
	17:00	12	16:00 (T-67)	17:39	21	17:14 (T-66)	18:16		19:56	32	08:05 (T-70)	20:33	21:06	18	20:40 (T-85)	
5	08:04	15:50 (T-67)	07:42	16:53 (T-66)	06:58	07:02	07:33 (T-70)	06:12		05:43	20:22 (T-85)					
	17:01	9	15:59 (T-67)	17:40	22	17:15 (T-66)	18:18		19:57	30	08:03 (T-70)	20:34	21:07	19	20:41 (T-85)	
6	08:04		07:40	16:54 (T-66)	06:57	07:00	07:34 (T-70)	06:11		05:43	20:22 (T-85)					
	17:02		17:42	22	17:16 (T-66)	18:19		19:58	27	08:01 (T-70)	20:35	21:07	19	20:41 (T-85)		
7	08:03		07:39	16:55 (T-66)	06:55	06:58	07:36 (T-70)	06:09		05:42	20:22 (T-85)					
	17:03		17:43	21	17:16 (T-66)	18:20		20:00	23	07:59 (T-70)	20:37	21:08	20	20:42 (T-85)		
8	08:03		07:38	16:56 (T-66)	07:53	06:56	07:37 (T-70)	06:08		05:42	20:23 (T-85)					
	17:04		17:45	18	17:14 (T-66)	18:22		20:01	19	07:56 (T-70)	20:38	21:09	19	20:42 (T-85)		
9	08:03		07:36	16:58 (T-66)	07:51	06:54	07:41 (T-70)	06:07		05:42	20:23 (T-85)					
	17:05		17:46	15	17:13 (T-66)	19:23		20:02	12	07:53 (T-70)	20:39	21:10	20	20:43 (T-85)		
10	08:03		07:35	17:01 (T-66)	07:50	06:53		06:06		05:41	20:22 (T-85)					
	17:06		17:47	10	17:11 (T-66)	19:24		20:03		05:41	20:43 (T-85)					
11	08:02		07:34		07:48	06:51		06:04		05:41	20:23 (T-85)					
	17:07		17:49		19:26	20:05		20:41		21:11	21	20:44 (T-85)				
12	08:02		07:32		07:46	06:49		06:03		05:41	20:23 (T-85)					
	17:08		17:50		19:27	20:06		20:43		21:11	21	20:44 (T-85)				
13	08:02		07:31		07:44	06:47		06:02		05:41	20:23 (T-85)					
	17:09		17:52		19:28	20:07		20:44		21:12	22	20:45 (T-85)				
14	08:01		07:29		07:42	06:46		06:01		05:41	20:24 (T-85)					
	17:11		17:53		19:29	20:08		20:45		21:12	22	20:46 (T-85)				
15	08:01		07:28		07:40	06:44		06:00		05:41	20:24 (T-85)					
	17:12		17:54		19:31	20:10		20:46		21:13	22	20:46 (T-85)				
16	08:00		07:26		07:39	06:42		06:02		05:41	20:24 (T-85)					
	17:13		17:56		19:32	2	08:01 (T-70)	20:11		21:13	22	20:46 (T-85)				
17	07:59		07:25		07:37	06:40		06:00		05:41	20:24 (T-85)					
	17:14		17:57		19:33	7	08:04 (T-70)	20:12		21:14	23	20:47 (T-85)				
18	07:59		07:23		07:35	06:39		06:00		05:41	20:24 (T-85)					
	17:16		17:59		19:35	11	08:06 (T-70)	20:13		21:14	23	20:47 (T-85)				
19	07:58		07:22		07:33	06:37		06:00		05:41	20:24 (T-85)					
	17:17		18:00		19:36	14	08:07 (T-70)	20:15		21:15	23	20:47 (T-85)				
20	07:58		07:20		07:31	06:35		06:00		05:41	20:24 (T-85)					
	17:18		18:00		19:37	17	08:08 (T-70)	20:16		21:15	23	20:47 (T-85)				
21	07:57		07:19		07:29	06:34		06:00		05:41	20:25 (T-85)					
	17:20		18:01		19:38	20	08:10 (T-70)	20:17		21:15	23	20:48 (T-85)				
22	07:56		07:17		07:27	06:32		06:00		05:41	20:25 (T-85)					
	17:21		18:03		19:40	22	08:10 (T-70)	20:18		21:15	23	20:48 (T-85)				
23	07:55	16:53 (T-66)	07:15		07:26	06:30		06:00		05:42	20:25 (T-85)					
	17:22	3	16:56 (T-66)	18:04		19:41	25	08:11 (T-70)	20:19	20:55	4	20:29 (T-85)	21:16	23	20:48 (T-85)	
24	07:54	16:53 (T-66)	07:14		07:24	06:29		06:00		05:51	20:24 (T-85)					
	17:24	4	16:57 (T-66)	18:06		19:42	27	08:11 (T-70)	20:21	20:56	6	20:30 (T-85)	21:16	23	20:48 (T-85)	
25	07:53	16:52 (T-66)	07:12		07:22	06:27		06:00		05:50	20:24 (T-85)					
	17:25	6	16:58 (T-66)	18:07		19:43	29	08:11 (T-70)	20:22	20:57	8	20:32 (T-85)	21:16	23	20:49 (T-85)	
26	07:53	16:52 (T-66)	07:11		07:20	06:26		06:00		05:49	20:23 (T-85)					
	17:26	8	17:00 (T-66)	18:08		19:45	31	08:11 (T-70)	20:23	20:58	9	20:32 (T-85)	21:16	22	20:48 (T-85)	
27	07:52	16:52 (T-66)	07:09		07:18	06:24		06:00		05:48	20:23 (T-85)					
	17:28	9	17:01 (T-66)	18:10		19:46	32	08:10 (T-70)	20:24	20:59	10	20:33 (T-85)	21:16	22	20:48 (T-85)	
28	07:51	16:51 (T-66)	07:07		07:16	06:22		06:00		05:48	20:23 (T-85)					
	17:29	12	17:03 (T-66)	18:11		19:47	34	08:10 (T-70)	20:26	21:00	11	20:34 (T-85)	21:16	22	20:49 (T-85)	
29	07:50	16:51 (T-66)			07:14	06:21		06:00		05:47	20:22 (T-85)					
	17:30	14	17:05 (T-66)		19:48	35	08:10 (T-70)	20:27		21:01	13	20:35 (T-85)	21:16	22	20:48 (T-85)	
30	07:49	16:52 (T-66)			07:13	06:19		06:00		05:46	20:22 (T-85)					
	17:32	14	17:06 (T-66)		19:50	37	08:10 (T-70)	20:28		21:02	13	20:35 (T-85)	21:16	22	20:49 (T-85)	
31	07:47	16:51 (T-66)			07:11	06:18		06:00		05:46	20:22 (T-85)					
	17:33	16	17:07 (T-66)		19:51	38	08:09 (T-70)	20:29		21:03	15	20:37 (T-85)				
Potential sun hours	287		292		369		403		458		465					
Total, worst case	156		185		381		250		91		630					
Sun reduction	0.58		0.58		0.59		0.63		0.66		0.73					
Oper. time red.	0.90		0.90		0.90		0.90		0.90		0.90					
Wind dir. red.	0.60		0.59		0.59		0.59		0.64		0.64					
Total reduction	0.31		0.31		0.34		0.34		0.38		0.42					
Total, real	49		57		120		84		35		266					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
	Sun set (hh:mm)					



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-246 - R-246
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	20:27 (T-85) 20:48 (T-85)	06:12 20:54	06:48 20:06	07:24 19:10	07:03 17:17
2	05:45 21:16	20:28 (T-85) 20:48 (T-85)	06:13 20:53	06:49 20:05	07:25 19:09	07:05 17:15
3	05:46 21:16	20:27 (T-85) 20:48 (T-85)	06:15 20:52	06:51 20:03	07:26 19:07	07:06 17:14
4	05:47 21:15	20:28 (T-85) 20:48 (T-85)	06:16 20:51	06:52 20:01	07:27 19:05	07:08 17:12
5	05:47 21:15	20:28 (T-85) 20:48 (T-85)	06:17 20:49	06:53 19:59	07:29 19:03	07:09 17:11
6	05:48 21:15	20:28 (T-85) 20:47 (T-85)	06:18 20:48	06:54 19:57	07:30 19:01	07:10 17:10
7	05:49 21:14	20:29 (T-85) 20:47 (T-85)	06:19 20:47	06:55 19:55	07:31 18:58	07:12 17:09
8	05:49 21:14	20:29 (T-85) 20:47 (T-85)	06:20 20:45	06:56 19:54	07:32 18:56	07:13 17:07
9	05:50 21:14	20:29 (T-85) 20:46 (T-85)	06:21 20:44	06:58 19:52	07:34 18:54	07:14 17:06
10	05:51 21:13	20:29 (T-85) 20:46 (T-85)	06:23 20:42	06:59 19:50	07:35 18:52	07:16 17:05
11	05:52 21:13	20:30 (T-85) 20:46 (T-85)	06:24 20:41	07:00 19:48	07:36 18:50	07:17 17:04
12	05:52 21:12	20:30 (T-85) 20:45 (T-85)	06:25 20:39	07:01 19:46	07:37 18:49	07:18 17:03
13	05:53 21:12	20:30 (T-85) 20:44 (T-85)	06:26 20:38	07:02 19:44	07:39 18:47	07:20 17:02
14	05:54 21:11	20:31 (T-85) 20:44 (T-85)	06:27 20:36	07:04 19:42	07:40 18:45	07:21 17:01
15	05:55 21:10	20:31 (T-85) 20:43 (T-85)	06:28 20:35	07:05 19:41	07:41 18:43	07:22 17:00
16	05:56 21:10	20:32 (T-85) 20:43 (T-85)	06:30 20:33	07:06 19:39	07:42 18:42	07:24 16:59
17	05:57 21:09	20:33 (T-85) 20:42 (T-85)	06:31 20:32	07:07 19:37	07:44 18:40	07:25 16:58
18	05:58 21:08	20:33 (T-85) 20:41 (T-85)	06:32 20:30	07:08 19:35	07:45 18:38	07:26 16:57
19	05:59 21:07	20:34 (T-85) 20:41 (T-85)	06:33 20:29	07:09 19:33	07:46 18:37	07:28 16:56
20	06:00 21:07	20:35 (T-85) 20:40 (T-85)	06:34 20:27	07:11 19:31	07:48 18:35	07:29 16:55
21	06:01 21:06	20:36 (T-85) 20:39 (T-85)	06:35 20:25	07:12 19:29	07:49 18:33	07:30 16:54
22	06:02 21:05	20:37 (T-85) 20:39 (T-85)	06:37 20:24	07:13 19:27	07:50 18:32	07:32 16:53
23	06:03 21:04	20:38 (T-85) 20:39 (T-85)	06:38 20:22	07:14 19:25	07:51 18:30	07:33 16:53
24	06:04 21:03	20:39 (T-85) 20:40 (T-85)	06:39 20:20	07:15 19:24	07:53 18:29	07:34 16:52
25	06:05 21:02	20:40 (T-85) 20:41 (T-85)	06:40 20:19	07:16 19:22	07:54 18:27	07:35 16:51
26	06:06 21:01	20:41 (T-85) 20:42 (T-85)	06:41 20:17	07:18 19:20	07:55 18:25	07:37 16:51
27	06:07 21:00	20:42 (T-85) 20:43 (T-85)	06:42 20:15	07:19 19:18	07:57 18:24	07:38 16:50
28	06:08 20:59	20:43 (T-85) 20:44 (T-85)	06:44 20:13	07:20 19:16	07:58 18:22	07:39 16:50
29	06:09 20:58	20:44 (T-85) 20:45 (T-85)	06:45 20:12	07:21 19:14	07:59 18:21	07:40 16:49
30	06:10 20:57	20:45 (T-85) 20:46 (T-85)	06:46 20:11	07:22 19:12	08:01 18:19	07:41 16:49
31	06:11 20:55	20:46 (T-85) 20:47 (T-85)	06:47 20:08	07:23 19:11	08:02 18:18	07:42 16:48
Potential sun hours	471	436	377	341	289	276
Total, worst case	306		640		271	514
Sun reduction	0.75		0.67		0.48	0.52
Oper. time red.	0.90		0.90		0.90	0.90
Wind dir. red.	0.64		0.59		0.59	0.62
Total reduction	0.43		0.36		0.25	0.29
Total, real	133		228		69	148

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-251 - R-251

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Table with 12 columns (Jan-Dec) and 2 rows of sunshine probability values.

Operational time

Table with 14 columns (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum) and 2 rows of operational time values.

Main calendar table with columns for months (January-December) and rows for each day of the month, including sunrise/set times and shadow reduction percentages.

Table layout: For each day in each month the following matrix apply

Matrix table with 2 rows: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time).



Exhibit 1-58

Project: South Deuel Wind Project
 Description: Invenergy Deuel Harvest Wind in Deuel County, SD
 Greenhouse Shadow Flicker Study
 Project Turbines Only
 L086 71 SG4.4-164 WTGs on 97.5m HH
 June 14, 2024
 Licensed user: Stantec Consulting Services Inc.
 1165 Scheuring Road
 US-DE PERE WI 54115
 920 278 3215
 Christiana Jansen / christianajansen@stantec.com
 Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-252 - R-252
 Assumptions for shadow calculations
 Sunshine probability S/S0 (Sun hours/Possible sun hours) []
 Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	07:46 17:35	07:05 18:12	07:09 19:52	06:18 20:29	19:39 (T-80) 20:29	05:45 21:03	05:45 21:16	06:12 20:54	19:59 (T-80) 20:06	07:24 19:10	07:03 17:16	07:43 16:48
2	08:04 16:58	07:45 17:36	07:04 18:14	07:07 19:53	06:16 20:30	19:38 (T-80) 20:06 (T-80)	05:44 21:04	05:45 21:16	06:13 20:53	19:56 (T-80) 20:04	07:25 19:09	07:05 17:15	07:44 16:48
3	08:04 16:58	07:44 17:37	07:02 18:15	07:05 19:55	06:15 20:32	19:39 (T-80) 20:08 (T-80)	05:44 21:05	05:46 21:15	06:14 20:52	19:55 (T-80) 20:03	07:26 19:07	07:06 17:14	07:45 16:47
4	08:04 16:59	07:43 17:39	07:00 18:16	07:03 19:56	06:14 20:33	19:40 (T-80) 20:09 (T-80)	05:43 21:06	05:47 21:15	06:16 20:50	19:53 (T-80) 20:01	07:27 19:05	07:07 17:12	07:46 16:47
5	08:04 17:00	07:42 17:40	06:58 18:18	07:02 19:57	06:12 20:34	19:39 (T-80) 20:08 (T-80)	05:43 21:07	05:47 21:15	06:17 20:49	19:52 (T-80) 20:06	07:28 19:03	07:09 17:11	07:47 16:47
6	08:03 17:01	07:40 17:42	06:57 18:19	07:00 19:58	06:11 20:35	19:40 (T-80) 20:07 (T-80)	05:43 21:07	05:48 21:15	06:18 20:48	19:51 (T-80) 20:06	07:30 19:01	07:10 17:10	07:48 16:47
7	08:03 17:02	07:39 17:43	06:55 18:20	06:58 20:00	06:09 20:37	19:41 (T-80) 20:07 (T-80)	05:42 21:08	05:49 21:14	06:19 20:46	19:50 (T-80) 19:55	07:31 18:58	07:12 17:08	07:49 16:46
8	08:03 17:04	07:38 17:45	07:53 18:23	06:56 20:01	06:08 20:38	19:43 (T-80) 20:06 (T-80)	05:42 21:09	05:49 21:14	06:20 20:45	19:49 (T-80) 19:54	07:32 18:56	07:13 17:07	07:50 16:46
9	08:03 17:05	07:36 17:46	07:51 19:23	06:54 20:02	06:07 20:39	19:43 (T-80) 20:04 (T-80)	05:42 21:10	05:50 21:14	06:21 20:44	19:48 (T-80) 19:52	07:33 18:54	07:14 17:06	07:51 16:46
10	08:03 17:06	07:35 17:47	07:49 19:24	06:53 20:03	06:05 20:40	19:45 (T-80) 20:03 (T-80)	05:41 21:10	05:51 21:13	06:22 20:42	19:47 (T-80) 19:50	07:35 18:52	07:16 17:05	07:52 16:46
11	08:02 17:07	07:34 17:49	07:48 19:25	06:51 20:05	06:04 20:41	19:47 (T-80) 20:01 (T-80)	05:41 21:11	05:52 21:13	06:24 20:41	19:48 (T-80) 19:48	07:36 18:50	07:17 17:04	07:53 16:46
12	08:02 17:08	07:32 17:50	07:46 19:27	06:49 20:06	06:03 20:43	19:49 (T-80) 20:09 (T-80)	05:41 21:11	05:52 21:12	06:25 20:39	19:47 (T-80) 19:46	07:37 18:49	07:18 17:03	07:54 16:46
13	08:01 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	19:59 (T-80) 20:07	05:41 21:12	05:53 21:12	06:26 20:38	19:47 (T-80) 19:44	07:38 18:47	07:20 17:02	07:55 16:46
14	08:01 17:11	07:29 17:53	07:42 19:29	06:45 20:08	06:01 20:45	19:47 (T-80) 20:05	05:41 21:12	05:54 21:11	06:27 20:36	19:47 (T-80) 19:42	07:40 18:45	07:21 17:00	07:55 16:47
15	08:01 17:12	07:28 17:54	07:40 19:31	06:44 20:09	05:59 20:46	19:46 (T-80) 20:04	05:41 21:13	05:55 21:10	06:28 20:35	19:46 (T-80) 19:40	07:41 18:43	07:22 16:59	07:56 16:47
16	08:00 17:13	07:26 17:56	07:39 19:32	06:42 20:11	05:58 20:47	19:46 (T-80) 20:03	05:41 21:13	05:56 21:10	06:29 20:33	19:46 (T-80) 19:39	07:42 18:42	07:24 16:58	07:57 16:47
17	07:59 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:48	19:46 (T-80) 20:02	05:41 21:14	05:57 21:09	06:31 20:32	19:46 (T-80) 19:37	07:44 18:40	07:25 16:57	07:58 16:47
18	07:59 17:16	07:23 17:59	07:35 19:34	06:39 20:13	19:50 (T-80) 19:51 (T-80)	20:06 (T-80) 20:09	05:41 21:14	05:58 21:08	06:32 20:30	19:46 (T-80) 19:35	07:45 18:38	07:26 16:57	07:58 16:48
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:14	19:47 (T-80) 19:52 (T-80)	20:05 (T-80) 20:50	05:41 21:15	05:59 21:07	06:33 20:29	19:46 (T-80) 20:03 (T-80)	07:46 18:37	07:28 16:56	07:59 16:48
20	07:57 17:18	07:20 18:00	07:31 19:37	06:35 20:16	19:46 (T-80) 19:53 (T-80)	20:04 (T-80) 20:52	05:41 21:15	06:00 21:07	06:34 20:27	19:48 (T-80) 20:02 (T-80)	07:47 18:35	07:29 16:55	08:00 16:48
21	07:57 17:19	07:19 18:01	07:29 19:38	06:34 20:17	19:44 (T-80) 19:54 (T-80)	20:03 (T-80) 20:53	05:41 21:15	06:01 21:06	06:35 20:25	19:48 (T-80) 20:00 (T-80)	07:49 18:33	07:30 16:54	08:00 16:49
22	07:56 17:21	07:17 18:03	07:27 19:40	06:32 20:18	19:42 (T-80) 19:55 (T-80)	20:02 (T-80) 20:54	05:41 21:15	06:02 21:05	06:36 20:24	19:49 (T-80) 19:59 (T-80)	07:50 18:32	07:32 16:53	08:01 16:49
23	07:55 17:22	07:15 18:04	07:26 19:41	06:30 20:19	19:42 (T-80) 19:57 (T-80)	20:01 (T-80) 20:55	05:42 21:16	06:03 21:04	06:38 20:22	19:50 (T-80) 19:57 (T-80)	07:51 18:30	07:33 16:53	08:01 16:50
24	07:54 17:23	07:14 18:05	07:24 19:42	06:29 20:21	19:41 (T-80) 19:57 (T-80)	20:00 (T-80) 20:56	05:42 21:16	06:04 21:03	06:39 20:20	19:51 (T-80) 19:55 (T-80)	07:53 18:28	07:34 16:52	08:02 16:50
25	07:53 17:25	07:12 18:07	07:22 19:43	06:27 20:22	19:40 (T-80) 19:59 (T-80)	20:00 (T-80) 20:57	05:42 21:16	06:05 21:02	06:40 20:19	07:16 19:22	07:54 18:27	07:35 16:51	08:02 16:51
26	07:52 17:26	07:10 18:08	07:20 19:45	06:25 20:23	19:39 (T-80) 20:00 (T-80)	20:05 (T-80) 20:58	05:43 21:16	06:06 21:01	06:41 20:17	07:18 19:20	07:55 18:25	07:37 16:51	08:02 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:24	19:39 (T-80) 20:01 (T-80)	20:04 (T-80) 20:59	05:43 21:16	06:07 21:00	06:42 20:15	07:19 19:18	07:57 18:24	07:38 16:50	08:03 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47	06:22 20:26	19:39 (T-80) 20:02 (T-80)	20:03 (T-80) 21:00	05:43 21:16	06:08 20:59	06:44 20:13	07:20 19:16	07:58 18:22	07:39 16:49	08:03 16:53
29	07:50 17:30	07:06 18:14	07:14 19:48	06:21 20:27	19:39 (T-80) 20:04 (T-80)	20:02 (T-80) 21:01	05:44 21:16	06:09 20:58	06:45 20:12	07:21 19:14	07:59 18:21	07:40 16:49	08:03 16:54
30	07:49 17:32	07:05 18:15	07:13 19:50	06:19 20:28	19:38 (T-80) 20:04 (T-80)	20:01 (T-80) 21:02	05:44 21:16	06:10 20:57	06:46 20:10	07:22 19:12	08:01 18:19	07:41 16:48	08:03 16:55
31	07:47 17:33	07:11 18:11	07:15 19:51	06:17 20:02	19:37 (T-80) 20:04 (T-80)	20:00 (T-80) 21:02	05:45 21:16	06:11 20:55	06:47 20:08	19:12 18:18	08:02 18:18	07:42 16:55	08:03 16:55
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	
Total, worst case				203	281			486					
Sun reduction				0.63	0.66			0.72					
Oper. time red.				0.90	0.90			0.90					
Wind dir. red.				0.61	0.61			0.61					
Total reduction				0.34	0.36			0.39					
Total, real				70	101		1	191					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-253 - R-253
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January		February		March		April		May		June		July		August		September		October		November		December					
1	08:04		15:53 (T-71)	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:03												07:43	15:42 (T-71)		
2	16:57	35	16:28 (T-71)	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	19:10	17:16												16:48	33	16:15 (T-71)	
	08:04		15:54 (T-71)	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05												07:44	15:41 (T-71)		
	16:57	35	16:29 (T-71)	17:36	18:14	19:53	20:30	21:04	21:16	20:53	20:04	19:08	17:15												16:48	35	16:16 (T-71)	
3	08:04		15:54 (T-71)	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:50	07:26	07:06												07:45	15:41 (T-71)		
	16:58	36	16:30 (T-71)	17:37	18:15	19:54	20:32	21:05	21:15	20:52	20:03	19:07	17:14												16:47	35	16:16 (T-71)	
4	08:04		15:55 (T-71)	07:43	07:00	07:03	06:13	05:43	05:46	06:15	06:52	07:27	07:07												07:46	15:41 (T-71)		
	16:59	36	16:31 (T-71)	17:39	18:16	19:56	20:33	21:06	21:15	20:50	20:01	19:05	17:12												16:47	36	16:17 (T-71)	
5	08:04		15:56 (T-71)	07:42	06:58	07:01	06:12	05:43	05:47	06:17	06:53	07:28	07:09												07:47	15:41 (T-71)		
	17:00	36	16:32 (T-71)	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11												16:47	36	16:17 (T-71)	
6	08:03		15:57 (T-71)	07:40	06:57	07:00	06:11	05:42	05:48	06:18	06:54	07:30	07:10												07:48	15:42 (T-71)		
	17:01	36	16:33 (T-71)	17:42	18:19	19:58	20:35	21:07	21:15	20:48	19:57	19:01	17:10												16:47	36	16:18 (T-71)	
7	08:03		15:58 (T-71)	07:39	06:55	06:58	06:09	05:42	05:48	06:19	06:55	07:31	07:11												07:49	15:43 (T-71)		
	17:02	36	16:32 (T-71)	17:43	18:20	19:59	20:36	21:08	21:14	20:46	19:55	18:57	17:08												16:46	36	16:19 (T-71)	
8	08:03		15:57 (T-71)	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13												07:50	15:43 (T-71)		
	17:03	36	16:33 (T-71)	17:44	18:21	20:01	20:38	21:09	21:14	20:45	19:53	18:56	17:07												16:46	36	16:19 (T-71)	
9	08:03		15:58 (T-71)	07:36	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:33	07:14												07:51	15:42 (T-71)		
	17:05	35	16:33 (T-71)	17:46	19:23	20:02	20:39	21:09	21:13	20:44	19:52	18:54	17:06												16:46	36	16:18 (T-71)	
10	08:03		15:58 (T-71)	07:35	07:49	06:52	06:05	05:41	05:51	06:22	06:59	07:35	07:16												07:52	15:43 (T-71)		
	17:06	35	16:33 (T-71)	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05												16:46	35	16:18 (T-71)	
11	08:02		16:00 (T-71)	07:34	07:48	06:51	06:04	05:41	05:51	06:24	07:00	07:36	07:17												07:53	15:43 (T-71)		
	17:07	33	16:33 (T-71)	17:49	19:25	20:04	20:41	21:11	21:13	20:41	19:48	18:50	17:04												16:46	35	16:18 (T-71)	
12	08:02		16:00 (T-71)	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:18												07:54	15:44 (T-71)		
	17:08	33	16:33 (T-71)	17:50	19:27	20:06	20:42	21:11	21:12	20:39	19:46	18:48	17:03												16:46	34	16:18 (T-71)	
13	08:01		16:01 (T-71)	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:38	07:20												07:54	15:44 (T-71)		
	17:09	32	16:33 (T-71)	17:52	19:28	20:07	20:44	21:12	21:11	20:38	19:44	18:47	17:01												16:46	35	16:19 (T-71)	
14	08:01		16:01 (T-71)	07:29	07:42	06:45	06:01	05:41	05:54	06:27	07:03	07:40	07:21												07:55	15:45 (T-71)		
	17:10	32	16:33 (T-71)	17:53	19:29	20:08	20:45	21:12	21:11	20:36	19:42	18:45	17:00												16:47	34	16:19 (T-71)	
15	08:00		16:03 (T-71)	07:28	07:40	06:44	05:59	05:41	05:55	06:28	07:05	07:41	07:22												07:56	15:46 (T-71)		
	17:12	30	16:33 (T-71)	17:54	19:31	20:09	20:46	21:13	21:10	20:35	19:40	18:43	16:59												16:47	33	16:19 (T-71)	
16	08:00		16:04 (T-71)	07:26	07:38	06:42	05:58	05:41	05:56	06:29	07:06	07:42	07:24												07:57	15:45 (T-71)		
	17:13	28	16:32 (T-71)	17:56	19:32	20:11	20:47	21:13	21:10	20:33	19:39	18:42	16:58												16:47	34	16:19 (T-71)	
17	07:59		16:04 (T-71)	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:43	07:25												07:58	15:46 (T-71)		
	17:14	28	16:32 (T-71)	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:57												16:47	33	16:19 (T-71)	
18	07:59		16:06 (T-71)	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:26												07:58	15:47 (T-71)		
	17:15	26	16:32 (T-71)	17:59	19:34	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16:57												16:48	33	16:20 (T-71)	
19	07:58		16:07 (T-71)	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28												15:51 (T-71)	07:59	15:47 (T-71)	
	17:17	24	16:31 (T-71)	18:00	19:36	20:14	20:50	21:14	21:07	20:28	19:33	18:36	16:56	8											15:59 (T-71)	16:48	33	16:20 (T-71)
20	07:57		16:09 (T-71)	07:20	07:31	06:35	05:54	05:41	05:59	06:34	07:10	07:47	07:29												15:48 (T-71)	07:59	15:48 (T-71)	
	17:18	21	16:30 (T-71)	18:00	19:37	20:16	20:51	21:15	21:06	20:27	19:31	18:35	16:55	14											16:02 (T-71)	16:48	32	16:20 (T-71)
21	07:57		16:10 (T-71)	07:19	07:29	06:33	05:53	05:41	06:00	06:35	07:12	07:49	07:30												15:46 (T-71)	08:00	15:48 (T-71)	
	17:19	18	16:28 (T-71)	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	18											16:04 (T-71)	16:49	32	16:20 (T-71)
22	07:56		16:14 (T-71)	07:17	07:27	06:32	05:52	05:41	06:01	06:36	07:13	07:50	07:32												15:45 (T-71)	08:01	15:49 (T-71)	
	17:21	14	16:28 (T-71)	18:03	19:39	20:18	20:54	21:15	21:05	20:24	19:27	18:32	16:53	21											16:06 (T-71)	16:49	32	16:21 (T-71)
23	07:55		16:17 (T-71)	07:15	07:25	06:30	05:51	05:42	06:02	06:38	07:14	07:51	07:33												15:44 (T-71)	08:01	15:49 (T-71)	
	17:22	8	16:25 (T-71)	18:04	19:41	20:19	20:55	21:15	21:04	20:22	19:25	18:30	16:52	24											16:08 (T-71)	16:50	32	16:21 (T-71)
24	07:54			07:14	07:24	06:29	05:50	05:42	06:03	06:39	07:15	07:53	07:34												15:43 (T-71)	08:01	15:50 (T-71)	
	17:23			18:05	19:42	20:21	20:56	21:16	21:03	20:20	19:23	18:28	16:52	26											16:09 (T-71)	16:50	33	16:23 (T-71)
25	07:53			07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:35												15:42 (T-71)	08:02	15:50 (T-71)	
	17:25			18:07	19:43	20:22	20:57	21:16	21:02	20:18	19:22	18:27	16:51	28											16:10 (T-71)	16:51	33	16:23 (T-71)
26	07:52			07:10	07:20	06:25	05:49	05:42	06:06	06:41	07:18	07:55	07:37												15:43 (T-71)	08:02	15:50 (T-71)	
	17:26			18:08	19:44	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:50	28											16:11 (T-71)	16:52	33	16:23 (T-71)
27	07:51																											

Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-255 - R-255

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Table with columns for months: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec. Values range from 0.48 to 0.75.

Operational time

Table with columns for wind directions: N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum. Values range from 293 to 7884.

Main calendar table with columns for months (January-December) and rows for each hour of the day. Includes summary rows for potential sun hours and various reduction factors.

Table layout: For each day in each month the following matrix apply

Matrix defining Day in month, Sun rise/set (hh:mm), Minutes with flicker, First/Last time (hh:mm) with flicker, and (WTG causing flicker first/last time).

Project: South Deuel Wind Project

Description: Invenery Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-256 - R-256 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum and values 561, 438, 311, 293, 309, 330, 363, 461, 788, 773, 462, 449, 509, 600, 629, 608, 7,884

Main calendar table with columns for months (January to December) and rows for each day (1-31) showing sunrise and sunset times, and a summary section at the bottom for sun hours and reductions.

Table layout: For each day in each month the following matrix apply

Matrix table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-257 - R-257
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	07:46 17:35	07:05 18:12	07:09 19:52	19:00 (T-75) 20:29	06:18 21:03	05:45 21:16	06:12 20:54	06:48 20:06	18:53 (T-75) 19:10	07:24 17:17	07:43 16:48	
2	08:04 16:58	07:45 17:36	07:04 18:14	07:07 19:53	18:59 (T-75) 20:30	06:16 21:04	05:44 21:16	06:13 20:53	06:49 20:04	18:53 (T-75) 19:09	07:25 17:15	07:44 16:48	
3	08:04 16:59	07:44 17:37	07:02 18:15	07:05 19:55	18:58 (T-75) 20:32	06:15 21:05	05:44 21:15	06:14 20:52	06:51 20:03	18:52 (T-75) 19:07	07:26 17:14	07:45 16:47	
4	08:04 16:59	07:43 17:39	07:00 18:16	07:03 19:56	18:57 (T-75) 20:33	06:14 21:06	05:43 21:15	06:16 20:50	06:52 20:01	18:52 (T-75) 19:05	07:27 17:12	07:46 16:47	
5	08:04 17:00	07:42 17:40	06:58 18:18	07:02 19:57	18:57 (T-75) 20:34	06:12 21:07	05:43 21:15	06:17 20:49	06:53 19:59	18:52 (T-75) 19:03	07:28 17:11	07:47 16:47	
6	08:03 17:01	07:40 17:42	06:57 18:19	07:00 19:58	18:56 (T-75) 20:35	06:11 21:07	05:43 21:15	06:18 20:48	06:54 19:57	18:52 (T-75) 19:01	07:30 17:10	07:48 16:47	
7	08:03 17:03	07:39 17:43	06:55 18:20	06:58 19:59	18:55 (T-75) 20:37	06:09 21:08	05:42 21:14	06:19 20:46	06:55 19:55	18:52 (T-75) 19:03	07:31 17:11	07:49 16:47	
8	08:03 17:04	07:38 17:45	06:53 18:22	06:56 20:01	18:55 (T-75) 20:38	06:08 21:09	05:42 21:14	06:20 20:45	06:56 19:54	18:52 (T-75) 18:56	07:32 17:13	07:50 16:46	
9	08:03 17:05	07:36 17:46	07:51 19:23	06:54 20:02	18:54 (T-75) 20:39	06:07 21:09	05:42 21:13	06:21 20:44	06:58 19:52	18:52 (T-75) 18:54	07:33 17:14	07:51 16:46	
10	08:03 17:06	07:35 17:47	07:49 19:24	06:53 20:03	18:55 (T-75) 20:40	06:06 21:10	05:41 21:13	06:22 20:42	06:59 19:50	18:52 (T-75) 18:52	07:35 17:05	07:52 16:46	
11	08:02 17:07	07:34 17:49	07:48 19:25	06:51 20:04	18:54 (T-75) 20:41	06:04 21:11	05:41 21:13	06:24 20:41	07:00 19:48	18:52 (T-75) 19:23	07:36 17:07	07:53 16:46	
12	08:02 17:08	07:32 17:50	07:46 19:27	06:49 20:06	18:54 (T-75) 20:42	06:03 21:11	05:41 21:12	06:25 20:39	07:01 19:46	18:52 (T-75) 19:21	07:37 17:03	07:54 16:46	
13	08:01 17:09	07:31 17:52	07:44 19:28	06:47 20:07	18:54 (T-75) 20:44	06:02 21:12	05:41 21:11	06:26 20:38	07:02 19:44	18:54 (T-75) 19:20	07:38 17:02	07:54 16:47	
14	08:01 17:11	07:29 17:53	07:42 19:29	06:45 20:08	18:55 (T-75) 20:45	06:01 21:12	05:41 21:11	06:27 20:36	07:03 19:42	18:55 (T-75) 19:18	07:40 17:01	07:55 16:47	
15	08:00 17:12	07:28 17:54	07:40 19:31	06:44 20:09	18:55 (T-75) 20:46	06:00 21:13	05:41 21:10	06:28 20:35	07:05 19:40	18:56 (T-75) 18:43	07:41 16:59	07:56 16:47	
16	08:00 17:13	07:26 17:56	07:38 19:32	06:42 20:11	18:55 (T-75) 20:47	05:58 21:13	05:41 21:10	06:29 20:33	07:06 19:39	18:57 (T-75) 18:42	07:42 16:58	07:57 16:47	
17	07:59 17:14	07:25 17:57	07:37 19:33	06:40 20:12	18:56 (T-75) 20:48	05:57 21:14	05:41 21:09	06:31 20:32	07:07 19:37	18:59 (T-75) 19:12	07:44 16:58	07:58 16:47	
18	07:59 17:16	07:23 17:59	07:35 19:34	06:39 20:13	18:57 (T-75) 20:49	05:56 21:14	05:41 21:08	06:32 20:30	07:08 19:35	19:02 (T-75) 19:07	07:45 16:57	07:58 16:48	
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:14	18:57 (T-75) 20:50	05:55 21:14	05:41 21:07	06:33 20:28	07:09 19:32	19:07 (T-75) 19:08	07:46 16:56	07:59 16:48	
20	07:57 17:18	07:20 18:01	07:31 19:37	06:35 20:16	18:59 (T-75) 20:51	05:54 21:15	05:41 21:06	06:34 20:25	07:10 19:34	19:08 (T-75) 19:11	07:47 16:55	07:59 16:48	
21	07:57 17:20	07:19 18:03	07:29 19:38	06:34 20:17	19:00 (T-75) 20:53	05:53 21:15	05:41 21:06	06:35 20:25	07:07 19:04	18:59 (T-75) 19:13	07:48 16:54	07:58 16:49	
22	07:56 17:21	07:17 18:03	07:27 19:40	06:32 20:18	19:01 (T-75) 20:54	05:52 21:15	05:41 21:05	06:36 20:24	07:08 19:03	19:03 (T-75) 19:14	07:50 16:53	07:58 16:49	
23	07:55 17:22	07:15 18:04	07:26 19:41	06:30 20:19	19:03 (T-75) 20:55	05:51 21:15	05:42 21:04	06:38 20:22	07:09 19:07	18:59 (T-75) 19:15	07:51 16:53	07:59 16:50	
24	07:54 17:24	07:14 18:05	07:24 19:42	06:29 20:21	19:05 (T-75) 20:56	05:51 21:16	05:42 21:03	06:39 20:20	07:10 19:08	19:01 (T-75) 19:23	07:52 16:52	07:59 16:51	
25	07:53 17:25	07:12 18:07	07:22 19:43	06:27 20:22	19:24 (T-75) 20:57	05:50 21:16	05:42 21:02	06:40 20:18	07:11 19:09	19:00 (T-75) 19:22	07:53 16:51	07:59 16:51	
26	07:52 17:26	07:10 18:08	07:20 19:45	06:26 20:23	19:11 (T-75) 20:23	05:49 20:58	05:43 21:01	06:41 20:17	07:12 19:08	18:58 (T-75) 19:20	07:54 16:51	07:59 16:52	
27	07:51 17:28	07:09 18:09	07:18 19:46	06:24 20:24	19:23 (T-75) 20:24	05:48 20:59	05:43 21:00	06:42 20:15	07:13 19:07	18:57 (T-75) 19:18	07:55 16:50	07:59 16:52	
28	07:51 17:29	07:07 18:11	07:16 19:47	06:22 20:26	19:06 (T-75) 20:26	05:48 21:00	05:43 21:09	06:44 20:13	07:14 19:06	18:57 (T-75) 19:16	07:56 16:50	07:59 16:53	
29	07:49 17:30	07:14 18:11	07:14 19:48	06:21 20:27	19:25 (T-75) 20:27	05:47 21:01	05:44 21:08	06:45 20:12	07:15 19:05	18:56 (T-75) 19:14	07:57 16:49	07:59 16:54	
30	07:48 17:32	07:13 18:07	07:13 19:50	06:19 20:28	19:03 (T-75) 20:28	05:46 21:01	05:44 21:16	06:46 20:10	07:16 19:04	18:55 (T-75) 19:12	07:58 16:49	08:00 16:55	
31	07:47 17:33	07:11 18:01	07:11 19:51	06:18 21:02	19:01 (T-75) 21:02	05:46 21:05	05:44 21:08	06:47 20:08	07:17 19:03	18:54 (T-75) 19:12	08:01 16:56	08:03 16:56	
Potential sun hours	287	292	369	403		458	465	471	436	377	341	289	276
Total, worst case				129	935			497		580			
Sun reduction				0.59	0.63			0.72		0.67			
Oper. time red.				0.90	0.90			0.90		0.90			
Wind dir. red.				0.60	0.60			0.60		0.60			
Total reduction				0.32	0.34			0.39		0.36			
Total, real				41	316			192		208			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-258 - R-258

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:03	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:03	07:42
	16:57	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	19:10	17:16	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:30	21:04	21:15	20:53	20:04	19:08	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:54	20:32	21:05	21:15	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:14	05:43	05:47	06:16	06:52	07:27	07:07	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:50	20:01	19:05	17:12	16:47
5	08:03	07:41	06:58	07:01	06:12	05:43	05:47	06:17	06:53	07:28	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:06	21:15	20:49	19:59	19:03	17:11	16:47
6	08:03	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48
	17:01	17:42	18:19	19:58	20:35	21:07	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:09	05:42	05:49	06:19	06:55	07:31	07:11	07:49
	17:02	17:43	18:20	19:59	20:36	21:08	21:14	20:46	19:55	18:57	17:08	16:46
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50
	17:04	17:45	18:21	20:01	20:38	21:09	21:14	20:45	19:53	18:56	17:07	16:46
9	08:03	07:36	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:33	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:09	21:13	20:44	19:52	18:54	17:06	16:46
10	08:02	07:35	07:49	06:52	06:05	05:41	05:51	06:22	06:59	07:35	07:15	07:52
	17:06	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:25	20:04	20:41	21:11	21:12	20:41	19:48	18:50	17:04	16:46
12	08:02	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:42	21:11	21:12	20:39	19:46	18:49	17:03	16:46
13	08:01	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:38	07:20	07:54
	17:09	17:52	19:28	20:07	20:44	21:12	21:11	20:38	19:44	18:47	17:01	16:46
14	08:01	07:29	07:42	06:45	06:01	05:41	05:54	06:27	07:03	07:40	07:21	07:55
	17:11	17:53	19:29	20:08	20:45	21:12	21:11	20:36	19:42	18:45	17:00	16:47
15	08:00	07:28	07:40	06:44	05:59	05:41	05:55	06:28	07:05	07:41	07:22	07:56
	17:12	17:54	19:31	20:09	20:46	21:13	21:10	20:35	19:40	18:43	16:59	16:47
16	08:00	07:26	07:38	06:42	05:58	05:41	05:56	06:29	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:13	21:09	20:33	19:39	18:42	16:58	16:47
17	07:59	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:43	07:25	07:57
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:57	16:47
18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:26	07:58
	17:16	17:59	19:34	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:14	20:50	21:14	21:07	20:28	19:33	18:37	16:56	16:48
20	07:57	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:10	07:47	07:29	07:59
	17:18	18:00	19:37	20:16	20:51	21:15	21:06	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
	17:19	18:01	19:38	20:17	20:52	21:15	21:06	20:25	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:02	06:36	07:13	07:50	07:31	08:00
	17:21	18:03	19:39	20:18	20:54	21:15	21:05	20:23	19:27	18:32	16:53	16:49
23	07:55	07:15	07:25	06:30	05:51	05:42	06:03	06:38	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:19	20:55	21:15	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:01
	17:23	18:05	19:42	20:21	20:56	21:16	21:03	20:20	19:23	18:28	16:52	16:50
25	07:53	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:35	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:18	19:22	18:27	16:51	16:51
26	07:52	07:10	07:20	06:25	05:49	05:43	06:06	06:41	07:18	07:55	07:36	08:02
	17:26	18:08	19:44	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:51	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:02
	17:28	18:09	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:50	07:07	07:16	06:22	05:47	05:43	06:08	06:43	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:25	21:00	21:16	20:59	20:13	19:16	18:22	16:49	16:53
29	07:49		07:14	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03
	17:30		19:48	20:27	21:01	21:16	20:58	20:11	19:14	18:21	16:49	16:54
30	07:48		07:12	06:19	05:46	05:44	06:10	06:46	07:22	08:01	07:41	08:03
	17:32		19:49	20:28	21:01	21:16	20:56	20:10	19:12	18:19	16:48	16:55
31	07:47		07:11		05:45		06:11	06:47		08:02		08:03
	17:33		19:51		21:02		20:55	20:08		18:18		16:55
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-280 - R-280
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
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	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
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	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
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	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:01	07:37	07:18	07:54
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	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:03			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-281 - R-281
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:16	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:03			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-282 - R-282
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:56	07:47 17:35	07:05 18:12	07:09 19:52	06:18 20:29	05:45 21:04	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	18:33 (T-48)	07:04 16:48
2	08:04 16:57	07:45 17:36	07:04 18:14	07:07 19:53	06:16 20:31	05:44 21:05	05:45 21:16	06:13 20:53	06:49 20:05	07:25 19:09	18:30 (T-48)	07:05 16:48
3	08:04 16:58	07:44 17:37	07:02 18:15	07:05 19:55	06:15 20:32	05:44 21:05	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	18:28 (T-48)	07:06 17:14
4	08:04 16:59	07:43 17:39	07:00 18:16	07:03 19:56	06:13 20:33	05:43 21:06	05:46 21:16	06:15 20:51	06:52 20:01	07:27 19:05	18:26 (T-48)	07:08 17:12
5	08:04 17:00	07:42 17:40	06:59 18:18	07:02 19:57	06:12 20:34	05:43 21:07	05:47 21:15	06:17 20:49	06:53 19:59	07:29 19:03	18:26 (T-48)	07:09 17:11
6	08:04 17:01	07:41 17:42	06:57 18:19	07:00 19:58	06:11 20:36	05:42 21:08	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	18:25 (T-48)	07:10 16:47
7	08:04 17:02	07:39 17:43	06:55 18:20	06:58 20:00	06:09 20:37	05:42 21:08	05:48 21:15	06:19 20:47	06:55 19:56	07:31 18:58	18:25 (T-48)	07:12 16:46
8	08:03 17:03	07:38 17:44	07:53 18:22	06:56 20:01	06:08 20:38	05:42 21:09	05:49 21:14	06:20 20:45	06:56 19:54	07:32 18:56	18:25 (T-48)	07:13 16:46
9	08:03 17:05	07:37 17:46	07:51 19:23	06:54 20:02	06:07 20:39	05:41 21:10	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	18:25 (T-48)	07:15 16:46
10	08:03 17:06	07:35 17:47	07:50 19:24	06:53 20:03	06:05 20:40	05:41 21:10	05:51 21:13	06:22 20:43	06:59 19:50	07:35 18:52	18:25 (T-48)	07:16 16:46
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:42	05:41 21:11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:50	18:25 (T-48)	07:17 16:46
12	08:02 17:08	07:32 17:50	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:52 21:12	06:25 20:40	07:01 19:46	07:37 18:49	18:25 (T-48)	07:19 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	05:41 21:12	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	18:25 (T-48)	07:20 16:46
14	08:01 17:10	07:30 17:53	07:42 19:29	06:45 20:08	06:01 20:45	05:41 21:13	05:54 21:11	06:27 20:37	07:03 19:42	07:40 18:45	18:25 (T-48)	07:21 16:46
15	08:01 17:12	07:28 17:54	07:40 19:31	06:44 20:10	05:59 20:46	05:41 21:13	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:43	18:25 (T-48)	07:23 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:58 20:47	05:41 21:14	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	18:25 (T-48)	07:24 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:49	05:41 21:14	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	18:25 (T-48)	07:25 16:47
18	07:59 17:15	07:24 17:59	07:35 19:35	06:39 20:13	05:56 20:50	05:41 21:14	05:58 21:08	06:32 20:30	07:08 19:35	07:45 18:38	18:25 (T-48)	07:27 16:47
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	05:41 21:15	05:58 21:08	06:33 20:29	07:09 19:33	07:46 18:37	18:25 (T-48)	07:28 16:48
20	07:58 17:18	07:20 18:00	07:31 19:37	06:35 20:16	05:54 20:52	05:41 21:15	05:59 21:07	06:34 20:27	07:11 19:31	07:48 18:35	18:25 (T-48)	07:29 16:48
21	07:57 17:19	07:19 18:01	07:29 19:38	06:34 20:17	05:53 20:53	05:41 21:15	06:00 21:06	06:35 20:25	07:12 19:29	07:49 18:33	18:25 (T-48)	07:31 16:49
22	07:56 17:21	07:17 18:03	07:27 19:40	06:32 20:18	05:52 20:54	05:41 21:16	06:01 21:05	06:36 20:24	07:13 19:27	07:50 18:32	18:25 (T-48)	07:32 16:49
23	07:55 17:22	07:16 18:04	07:26 19:41	06:30 20:20	05:51 20:55	05:41 21:16	06:02 21:04	06:38 20:22	07:14 19:25	07:52 18:30	18:25 (T-48)	07:33 16:50
24	07:55 17:23	07:14 18:05	07:24 19:42	06:29 20:21	05:50 20:56	05:42 21:16	06:03 21:03	06:39 20:20	07:15 19:24	07:53 18:28	18:25 (T-48)	07:34 16:50
25	07:54 17:25	07:12 18:07	07:22 19:43	06:27 20:22	05:50 20:57	05:42 21:16	06:04 21:02	06:40 20:19	07:16 19:22	07:54 18:27	18:25 (T-48)	07:36 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:25 20:23	05:49 20:58	05:42 21:16	06:06 21:01	06:41 20:17	07:18 19:20	07:56 18:25	18:25 (T-48)	07:37 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	05:48 20:59	05:43 21:16	06:07 21:00	06:42 20:15	07:19 19:18	07:57 18:24	18:25 (T-48)	07:38 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47	06:22 20:26	05:47 21:00	05:43 21:16	06:08 20:59	06:44 20:14	07:20 19:16	07:58 18:22	18:25 (T-48)	07:39 16:53
29	07:50 17:30	07:06 19:48	07:14 19:48	06:21 20:27	05:47 21:01	05:44 21:16	06:09 20:58	06:45 20:12	07:21 19:14	08:00 18:21	18:25 (T-48)	07:41 16:49
30	07:49 17:32	07:05 19:50	07:13 19:50	06:19 20:28	05:46 21:02	05:44 21:16	06:10 20:57	06:46 20:10	07:23 19:12	08:01 18:19	18:25 (T-48)	07:42 16:48
31	07:48 17:33	07:04 19:51	07:11 19:51	06:18 21:03	05:45 21:03	05:45 21:03	06:11 20:56	06:47 20:08	08:02 18:18	08:02 18:18	18:25 (T-48)	07:43 16:55
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275
Total, worst case			97							98		
Sun reduction			0.59							0.56		
Oper. time red.			0.90							0.90		
Wind dir. red.			0.57							0.57		
Total reduction			0.30							0.29		
Total, real			29							28		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-283 - R-283
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	
1	08:04	15:25 (T-80) 07:46	07:05	17:41 (T-62) 07:09	06:18	05:45	
	16:57	52 16:17 (T-80) 17:35	18:12	9 17:50 (T-63) 19:52	20:29	21:03	
2	08:04	15:25 (T-80) 07:45	07:04	17:40 (T-62) 07:07	06:16	05:44	
	16:58	53 16:18 (T-80) 17:36	18:14	12 17:52 (T-63) 19:53	20:31	21:04	
3	08:04	15:26 (T-80) 07:44	07:02	17:41 (T-62) 07:05	06:15	05:44	
	16:58	52 16:18 (T-80) 17:37	18:15	13 17:54 (T-63) 19:55	20:32	21:05	
4	08:04	15:27 (T-80) 07:43	07:00	17:41 (T-63) 07:03	06:14	05:43	
	16:59	52 16:19 (T-80) 17:39	18:16	14 17:55 (T-63) 19:56	20:33	21:06	
5	08:04	15:27 (T-80) 07:42	06:58	17:40 (T-63) 07:02	06:12	05:43	
	17:00	52 16:19 (T-80) 17:40	18:18	16 17:56 (T-63) 19:57	20:34	21:07	
6	08:04	15:28 (T-80) 07:40	06:57	17:39 (T-63) 07:00	06:11	05:43	
	17:01	51 16:19 (T-80) 17:42	18:19	18 17:57 (T-63) 19:58	20:35	21:07	
7	08:03	15:28 (T-80) 07:39	06:55	17:38 (T-63) 06:58	06:09	05:42	
	17:02	51 16:19 (T-80) 17:43	18:20	20 17:58 (T-63) 20:00	20:37	21:08	
8	08:03	15:29 (T-80) 07:38	07:53	18:39 (T-63) 06:56	06:08	05:42	
	17:04	50 16:19 (T-80) 17:45	18:22	22 19:01 (T-63) 20:01	20:38	21:09	
9	08:03	15:30 (T-80) 07:36	07:51	18:39 (T-63) 06:54	06:07	05:42	
	17:05	50 16:20 (T-80) 17:46	19:23	23 19:02 (T-63) 20:02	20:39	21:10	
10	08:03	15:30 (T-80) 07:35	07:49	18:39 (T-63) 06:53	06:05	05:41	
	17:06	49 16:19 (T-80) 17:47	19:24	24 19:03 (T-63) 20:03	20:40	21:10	
11	08:02	15:31 (T-80) 07:34	07:48	18:39 (T-63) 06:51	06:04	05:41	
	17:07	49 16:20 (T-80) 17:49	19:25	25 19:04 (T-63) 20:05	20:41	21:11	
12	08:02	15:32 (T-80) 07:32	07:46	18:39 (T-63) 06:49	06:03	05:41	
	17:08	48 16:20 (T-80) 17:50	19:27	26 19:05 (T-63) 20:06	20:43	21:11	
13	08:02	15:33 (T-80) 07:31	07:44	18:40 (T-63) 06:47	06:02	05:41	
	17:09	47 16:20 (T-80) 17:52	19:28	24 19:04 (T-63) 20:07	20:44	21:12	
14	08:01	15:33 (T-80) 07:29	07:42	18:42 (T-63) 06:45	06:01	05:41	
	17:11	46 16:19 (T-80) 17:53	19:29	21 19:03 (T-63) 20:08	20:45	21:12	
15	08:01	15:35 (T-80) 07:28	07:40	18:43 (T-63) 06:44	05:59	05:41	
	17:12	45 16:20 (T-80) 17:54	19:31	18 19:01 (T-63) 20:10	20:46	21:13	
16	08:00	15:35 (T-80) 07:26	07:39	18:45 (T-63) 06:42	05:58	05:41	
	17:13	44 16:19 (T-80) 17:56	19:32	13 18:58 (T-63) 20:11	20:47	21:13	
17	07:59	15:37 (T-80) 07:25	07:37		06:40	05:57	05:41
	17:14	43 16:20 (T-80) 17:57	19:33		20:12	20:48	21:14
18	07:59	15:38 (T-80) 07:23	07:35		06:39	05:56	05:41
	17:16	41 16:19 (T-80) 17:59	19:34		20:13	20:49	21:14
19	07:58	15:39 (T-80) 07:22	07:33		06:37	05:55	05:41
	17:17	39 16:18 (T-80) 18:00	19:36		20:14	20:51	21:15
20	07:57	15:40 (T-80) 07:20	07:31		06:35	05:54	05:41
	17:18	38 16:18 (T-80) 18:00	19:37		20:16	20:52	21:15
21	07:57	15:42 (T-80) 07:19	07:29		06:34	05:53	05:41
	17:19	36 16:18 (T-80) 18:01	19:38		20:17	20:53	21:15
22	07:56	15:43 (T-80) 07:17	07:27		06:32	05:52	05:41
	17:21	34 16:17 (T-80) 18:03	19:40		20:18	20:54	21:15
23	07:55	15:45 (T-80) 07:15	07:26		06:30	05:51	05:42
	17:22	31 16:16 (T-80) 18:04	19:41		20:19	20:55	21:16
24	07:54	15:46 (T-80) 07:14	07:24		06:29	05:51	05:42
	17:24	28 16:14 (T-80) 18:05	19:42		20:21	20:56	21:16
25	07:53	15:49 (T-80) 07:12	07:22	17:44 (T-62)	06:27	05:50	05:42
	17:25	24 16:13 (T-80) 18:07	19:43	1 17:45 (T-62)	20:22	20:57	21:16
26	07:53	15:51 (T-80) 07:10	07:20	17:43 (T-62)	06:25	05:49	05:43
	17:26	20 16:11 (T-80) 18:08	19:45	3 17:46 (T-62)	20:23	20:58	21:16
27	07:52	15:55 (T-80) 07:09	07:18	17:42 (T-62)	06:24	05:48	05:43
	17:28	13 16:08 (T-80) 18:10	19:46	6 17:48 (T-62)	20:24	20:59	21:16
28	07:51		07:16	17:41 (T-62)	06:22	05:47	05:43
	17:29		18:11	8 17:49 (T-63)	20:26	21:00	21:16
29	07:50		07:14		06:21	05:47	05:44
	17:30		19:48		20:27	21:01	21:16
30	07:49		07:13		06:19	05:46	05:44
	17:32		19:50		20:28	21:02	21:16
31	07:47		07:11			05:45	
	17:33		19:51			21:03	
Potential sun hours	287	292	369		403	458	465
Total, worst case	1138		18	298			
Sun reduction	0.58		0.58	0.59			
Oper. time red.	0.90		0.90	0.90			
Wind dir. red.	0.62		0.58	0.57			
Total reduction	0.32		0.30	0.31			
Total, real	366	5	91				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-283 - R-283
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December		
1	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	18:19 (T-63) 25 18:44 (T-63)	07:03 17:16	07:43 16:48	15:13 (T-80) 49 16:02 (T-80)
2	05:45 21:16	06:13 20:53	06:49 20:05	07:25 19:09	18:18 (T-63) 25 18:43 (T-63)	07:05 17:15	07:44 16:48	15:13 (T-80) 49 16:02 (T-80)
3	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	18:17 (T-63) 24 18:41 (T-63)	07:06 17:14	07:45 16:47	15:13 (T-80) 50 16:03 (T-80)
4	05:47 21:15	06:16 20:51	06:52 20:01	07:27 19:05	18:16 (T-63) 23 18:39 (T-63)	07:08 17:12	07:46 16:47	15:13 (T-80) 50 16:03 (T-80)
5	05:47 21:15	06:17 20:49	06:53 19:59	07:29 19:03	18:16 (T-63) 22 18:38 (T-63)	07:09 17:11	07:47 16:47	15:14 (T-80) 51 16:05 (T-80)
6	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	18:15 (T-63) 21 18:36 (T-63)	07:10 17:10	07:48 16:47	15:14 (T-80) 52 16:06 (T-80)
7	05:49 21:14	06:19 20:47	06:55 19:55	07:31 18:58	18:15 (T-63) 19 18:34 (T-63)	07:12 17:08	07:49 16:46	15:14 (T-80) 52 16:06 (T-80)
8	05:49 21:14	06:20 20:45	06:56 19:54	07:32 18:56	18:14 (T-63) 18 18:32 (T-63)	07:13 17:07	07:50 16:46	15:15 (T-80) 52 16:07 (T-80)
9	05:50 21:14	06:21 20:44	06:58 19:52	07:33 18:54	18:15 (T-63) 16 18:31 (T-63)	07:14 17:06	07:51 16:46	15:15 (T-80) 52 16:07 (T-80)
10	05:51 21:13	06:22 20:42	06:59 19:50	07:35 18:52	18:15 (T-63) 13 18:28 (T-63)	07:16 17:05	07:52 16:46	15:15 (T-80) 53 16:08 (T-80)
11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:50	18:14 (T-62) 12 18:26 (T-63)	07:17 17:04	07:53 16:46	15:15 (T-80) 52 16:07 (T-80)
12	05:52 21:12	06:25 20:39	07:01 19:46	07:37 18:49	18:14 (T-62) 11 18:25 (T-63)	07:18 17:03	07:54 16:46	15:15 (T-80) 53 16:08 (T-80)
13	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	18:14 (T-62) 9 18:23 (T-63)	07:20 17:02	07:55 16:46	15:16 (T-80) 53 16:09 (T-80)
14	05:54 21:11	06:27 20:36	07:03 19:42	07:40 18:45	18:14 (T-62) 7 18:21 (T-63)	07:21 17:00	07:55 16:47	15:16 (T-80) 53 16:09 (T-80)
15	05:55 21:10	06:28 20:35	07:05 19:41	07:41 18:43	18:15 (T-62) 5 18:20 (T-62)	07:22 16:59	07:56 16:47	15:17 (T-80) 13 15:41 (T-80)
16	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	18:16 (T-62) 2 18:18 (T-62)	07:24 16:58	07:57 16:47	15:17 (T-80) 20 15:44 (T-80)
17	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	18:16 (T-62) 24 15:46 (T-80)	07:25 16:57	07:58 16:47	15:17 (T-80) 24 15:46 (T-80)
18	05:58 21:08	06:32 20:30	07:08 19:35	07:45 18:38	18:16 (T-62) 28 15:48 (T-80)	07:26 16:57	07:58 16:48	15:18 (T-80) 28 15:48 (T-80)
19	05:59 21:07	06:33 20:29	07:09 19:33	07:46 18:37	18:16 (T-62) 31 15:50 (T-80)	07:28 16:56	07:59 16:48	15:18 (T-80) 31 15:50 (T-80)
20	06:00 21:07	06:34 20:27	07:10 19:31	07:47 18:35	18:16 (T-62) 34 15:52 (T-80)	07:29 16:55	08:00 16:48	15:19 (T-80) 34 15:52 (T-80)
21	06:01 21:06	06:35 20:25	07:12 19:29	07:49 18:33	18:16 (T-62) 36 15:53 (T-80)	07:30 16:54	08:00 16:49	15:19 (T-80) 36 15:53 (T-80)
22	06:02 21:05	06:36 20:24	07:13 19:27	07:50 18:32	18:16 (T-62) 38 15:54 (T-80)	07:32 16:53	08:01 16:49	15:20 (T-80) 38 15:54 (T-80)
23	06:03 21:04	06:38 20:22	07:14 19:25	07:51 18:30	18:16 (T-62) 39 15:55 (T-80)	07:33 16:53	08:01 16:50	15:20 (T-80) 39 15:55 (T-80)
24	06:04 21:03	06:39 20:20	07:15 19:24	07:53 18:28	18:16 (T-62) 41 15:56 (T-80)	07:34 16:52	08:02 16:50	15:21 (T-80) 41 15:56 (T-80)
25	06:05 21:02	06:40 20:19	07:16 19:22	07:54 18:27	18:16 (T-62) 43 15:57 (T-80)	07:35 16:51	08:02 16:51	15:21 (T-80) 43 15:57 (T-80)
26	06:06 21:01	06:41 20:17	07:18 19:20	07:55 18:25	18:16 (T-62) 44 15:58 (T-80)	07:37 16:51	08:02 16:52	15:21 (T-80) 44 15:58 (T-80)
27	06:07 21:00	06:42 20:15	07:19 19:18	07:57 18:24	18:16 (T-62) 45 15:59 (T-80)	07:38 16:50	08:03 16:52	15:22 (T-80) 45 15:59 (T-80)
28	06:08 20:59	06:44 20:13	07:20 19:16	07:58 18:22	18:16 (T-62) 46 15:59 (T-80)	07:39 16:49	08:03 16:53	15:23 (T-80) 46 15:59 (T-80)
29	06:09 20:58	06:45 20:12	07:21 19:14	07:59 18:21	18:16 (T-62) 47 16:01 (T-80)	07:40 16:49	08:03 16:54	15:23 (T-80) 47 16:01 (T-80)
30	06:10 20:57	06:46 20:10	07:22 19:12	08:01 18:19	18:16 (T-62) 47 16:01 (T-80)	07:41 16:48	08:03 16:55	15:23 (T-80) 47 16:01 (T-80)
31	06:11 20:55	06:47 20:08	07:23 19:11	08:02 18:18	18:16 (T-62) 47 16:01 (T-80)	07:42 16:48	08:04 16:55	15:24 (T-80) 47 16:01 (T-80)
Potential sun hours	471	436	377	341	289	275		1628
Total, worst case								1628
Sun reduction			0.67	0.56	0.48	0.52		0.52
Oper. time red.			0.90	0.90	0.90	0.90		0.90
Wind dir. red.			0.57	0.57	0.62	0.62		0.62
Total reduction			0.35	0.29	0.27	0.29		0.29
Total, real			24	73	153	470		470

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:

South Deuel Wind Project

Description:

Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:

Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-284 - R-284
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

Table with 14 columns: N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum. Values range from 561 to 7,884.

Main shadow flicker assessment table with 12 columns for months and 14 columns for wind directions (N to NNW, Sum). Rows show start and end times with shaded areas indicating shadow periods.

Table layout: For each day in each month the following matrix apply

Matrix table with 2 rows and 4 columns: Day in month, Sun rise (hh:mm) / Sun set (hh:mm), First time (hh:mm) with flicker / Last time (hh:mm) with flicker, (WTG causing flicker first time) / (WTG causing flicker last time).

Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user: Stantec Consulting Services Inc.
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Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-285 - R-285
Assumptions for shadow calculations Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum and values 561, 438, 311, 293, 309, 330, 363, 461, 788, 773, 462, 449, 509, 600, 629, 608, 7,884

Main calendar table with columns for months (January to December) and rows for each day from 08:00 to 17:33, including a summary table at the bottom for Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, Total, real.

Table layout: For each day in each month the following matrix apply

Matrix layout table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invenergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-286 - R-286 Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with columns for months (January to December) and rows for each day of the month (1-31), showing start and end times for shadow calculations. Includes summary rows for Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, and Total, real.

Table layout: For each day in each month the following matrix apply

Matrix layout table with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-289 - R-289

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05	08:29 (T-13)	07:47	07:06	07:09	06:18
	16:57	20 08:49 (T-13)	17:35	18:13	19:53	20:30
2	08:05	08:29 (T-13)	07:46	07:04	07:08	06:17
	16:58	21 08:50 (T-13)	17:36	18:14	19:54	20:31
3	08:05	08:29 (T-13)	07:45	07:03	07:06	06:15
	16:59	22 08:51 (T-13)	17:38	18:15	19:55	20:32
4	08:05	08:29 (T-13)	07:44	07:01	07:04	06:14
	17:00	22 08:51 (T-13)	17:39	18:17	19:56	20:34
5	08:04	08:29 (T-13)	07:42	06:59	07:02	06:12
	17:01	23 08:52 (T-13)	17:41	18:18	19:58	20:35
6	08:04	08:29 (T-13)	07:41	06:57	07:00	06:11
	17:02	24 08:53 (T-13)	17:42	18:19	19:59	20:36
7	08:04	08:28 (T-13)	07:40	06:55	06:58	06:10
	17:03	24 08:52 (T-13)	17:44	18:21	20:00	20:37
8	08:04	08:28 (T-13)	07:38	07:54	06:57	06:08
	17:04	25 08:53 (T-13)	17:45	18:22	20:01	20:39
9	08:04	08:28 (T-13)	07:37	07:52	06:55	06:07
	17:05	26 08:54 (T-13)	17:46	19:23	20:03	20:40
10	08:03	08:27 (T-13)	07:36	07:50	06:53	06:06
	17:06	27 08:54 (T-13)	17:48	19:25	20:04	20:41
11	08:03	08:27 (T-13)	07:34	07:48	06:51	06:05
	17:07	27 08:54 (T-13)	17:49	19:26	20:05	20:42
12	08:03	08:26 (T-13)	07:33	07:46	06:49	06:03
	17:08	28 08:54 (T-13)	17:51	19:27	20:06	20:43
13	08:02	08:26 (T-13)	07:32	07:45	06:48	06:02
	17:10	29 08:55 (T-13)	17:52	19:29	20:08	20:44
14	08:02	08:25 (T-13)	07:30	07:43	06:46	06:01
	17:11	30 08:55 (T-13)	17:53	19:30	20:09	20:46
15	08:01	08:26 (T-13)	07:29	07:41	06:44	06:00
	17:12	29 08:55 (T-13)	17:55	19:31	20:10	20:47
16	08:01	08:27 (T-13)	07:27	07:39	06:42	05:59
	17:13	28 08:55 (T-13)	17:56	19:32	20:11	20:48
17	08:00	08:27 (T-13)	07:26	07:37	06:41	05:58
	17:15	28 08:55 (T-13)	17:58	19:34	20:13	20:49
18	08:00	08:28 (T-13)	07:24	07:35	06:39	05:57
	17:16	27 08:55 (T-13)	17:59	19:35	20:14	20:50
19	07:59	08:29 (T-13)	07:23	07:34	06:37	05:56
	17:17	26 08:55 (T-13)	18:00	19:36	20:15	20:51
20	07:58	08:30 (T-13)	07:21	07:32	06:36	05:55
	17:18	25 08:55 (T-13)	18:00	19:38	20:16	20:52
21	07:58	08:30 (T-13)	07:19	07:30	06:34	05:54
	17:20	24 08:54 (T-13)	18:02	19:39	20:18	20:53
22	07:57	08:31 (T-13)	07:18	07:28	06:32	05:53
	17:21	22 08:53 (T-13)	18:03	19:40	20:19	20:55
23	07:56	08:34 (T-13)	07:16	07:26	06:31	05:52
	17:22	19 08:53 (T-13)	18:05	19:41	20:20	20:56
24	07:55	08:35 (T-13)	07:14	07:24	06:29	05:51
	17:24	17 08:52 (T-13)	18:06	19:43	20:21	20:57
25	07:54	08:37 (T-13)	07:13	07:22	06:27	05:50
	17:25	14 08:51 (T-13)	18:07	19:44	20:23	20:58
26	07:53	08:40 (T-13)	07:11	07:21	06:26	05:49
	17:27	8 08:48 (T-13)	18:09	19:45	20:24	20:59
27	07:52		07:09	07:19	06:24	05:48
	17:28		18:10	19:46	20:25	21:00
28	07:51		07:08	07:17	06:23	05:48
	17:29		18:11	19:48	20:26	21:01
29	07:50			07:15	06:21	05:47
	17:31			19:49	20:28	21:02
30	07:49			07:13	06:20	05:46
	17:32			19:50	20:29	21:02
31	07:48			07:11	06:18	05:46
	17:34			19:51	21:03	21:03
Potential sun hours	287	292	369	404	459	465
Total, worst case	615				595	666
Sun reduction	0.58				0.66	0.73
Oper. time red.	0.90				0.90	0.90
Wind dir. red.	0.66				0.63	0.63
Total reduction	0.34				0.38	0.42
Total, real	211				224	278

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-289 - R-289

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45	20:14 (T-11) 06:13	20:13 (T-11) 06:49	07:24	07:04	07:43 08:09 (T-13)
	21:17	22 20:36 (T-11) 20:55	16 20:29 (T-11) 20:07	19:11	17:17	16:48 27 08:36 (T-13)
2	05:46	20:13 (T-11) 06:14	20:13 (T-11) 06:50	07:25	07:06	07:45 08:10 (T-13)
	21:17	23 20:36 (T-11) 20:54	15 20:28 (T-11) 20:05	19:09	17:15	16:48 27 08:37 (T-13)
3	05:46	20:13 (T-11) 06:15	20:14 (T-11) 06:51	07:27	07:07	07:46 08:11 (T-13)
	21:16	24 20:37 (T-11) 20:53	12 20:26 (T-11) 20:03	19:07	17:14	16:48 26 08:37 (T-13)
4	05:47	20:13 (T-11) 06:16	20:15 (T-11) 06:52	07:28	07:08	07:47 08:12 (T-13)
	21:16	24 20:37 (T-11) 20:51	10 20:25 (T-11) 20:02	19:05	17:13	16:47 25 08:37 (T-13)
5	05:47	20:13 (T-11) 06:17	20:16 (T-11) 06:53	07:29	07:10	07:48 08:13 (T-13)
	21:16	25 20:38 (T-11) 20:50	8 20:24 (T-11) 20:00	19:04	17:11	16:47 24 08:37 (T-13)
6	05:48	20:12 (T-11) 06:18	20:17 (T-11) 06:55	07:30	07:11	07:49 08:14 (T-13)
	21:16	26 20:38 (T-11) 20:49	5 20:22 (T-11) 19:58	19:02	17:10	16:47 24 08:38 (T-13)
7	05:49	20:12 (T-11) 06:19	20:20 (T-11) 06:56	07:32	07:12	07:50 08:15 (T-13)
	21:15	27 20:39 (T-11) 20:47	2 20:22 (T-11) 19:56	19:00	17:09	16:47 23 08:38 (T-13)
8	05:49	20:12 (T-11) 06:20	06:57	07:33	07:14	07:51 08:17 (T-13)
	21:15	28 20:40 (T-11) 20:46	19:54	18:56	17:08	16:47 22 08:39 (T-13)
9	05:50	20:12 (T-11) 06:22	06:58	07:34	07:15	07:52 08:17 (T-13)
	21:14	28 20:40 (T-11) 20:44	19:52	18:54	17:06	16:47 22 08:39 (T-13)
10	05:51	20:11 (T-11) 06:23	06:59	07:35	07:16	07:53 08:18 (T-13)
	21:14	29 20:40 (T-11) 20:43	19:50	18:53	17:05	16:47 21 08:39 (T-13)
11	05:52	20:11 (T-11) 06:24	07:00	07:37	07:18	07:54 08:19 (T-13)
	21:14	30 20:41 (T-11) 20:42	19:49	18:51	17:04	16:47 20 08:39 (T-13)
12	05:53	20:11 (T-11) 06:25	07:02	07:38	07:19	07:55 08:20 (T-13)
	21:13	30 20:41 (T-11) 20:40	19:47	18:49	17:03	16:47 20 08:40 (T-13)
13	05:53	20:11 (T-11) 06:26	07:03	07:39	07:20	07:55 08:21 (T-13)
	21:12	31 20:42 (T-11) 20:39	19:45	18:47	17:02	16:47 19 08:40 (T-13)
14	05:54	20:11 (T-11) 06:27	07:04	07:40	07:22	07:56 08:22 (T-13)
	21:12	32 20:43 (T-11) 20:37	19:43	18:46	17:01	16:47 19 08:41 (T-13)
15	05:55	20:10 (T-11) 06:29	07:05	07:42	07:23	07:57 08:23 (T-13)
	21:11	32 20:42 (T-11) 20:36	19:41	18:44	17:00	16:47 19 08:42 (T-13)
16	05:56	20:10 (T-11) 06:30	07:06	07:43	07:25	07:58 08:23 (T-13)
	21:10	33 20:43 (T-11) 20:34	19:39	18:42	16:59	8 08:21 (T-13) 16:47 18 08:41 (T-13)
17	05:57	20:10 (T-11) 06:31	07:07	07:44	07:26	08:10 (T-13) 07:58 08:24 (T-13)
	21:10	33 20:43 (T-11) 20:32	19:37	18:40	16:58	14 08:24 (T-13) 16:48 18 08:42 (T-13)
18	05:58	20:10 (T-11) 06:32	07:09	07:46	07:27	08:09 (T-13) 07:59 08:25 (T-13)
	21:09	32 20:42 (T-11) 20:31	19:35	18:39	16:57	17 08:26 (T-13) 16:48 18 08:43 (T-13)
19	05:59	20:10 (T-11) 06:33	07:10	07:47	07:28	08:08 (T-13) 08:00 08:25 (T-13)
	21:08	31 20:41 (T-11) 20:29	19:34	18:37	16:56	19 08:27 (T-13) 16:48 17 08:42 (T-13)
20	06:00	20:10 (T-11) 06:35	07:11	07:48	07:30	08:06 (T-13) 08:00 08:26 (T-13)
	21:07	31 20:41 (T-11) 20:28	19:32	18:35	16:55	22 08:28 (T-13) 16:49 17 08:43 (T-13)
21	06:01	20:10 (T-11) 06:36	07:12	07:49	07:31	08:06 (T-13) 08:01 08:26 (T-13)
	21:07	30 20:40 (T-11) 20:26	19:30	18:34	16:54	24 08:30 (T-13) 16:49 17 08:43 (T-13)
22	06:02	20:10 (T-11) 06:37	07:13	07:51	07:32	08:06 (T-13) 08:01 08:27 (T-13)
	21:06	29 20:39 (T-11) 20:24	19:28	18:32	16:54	25 08:31 (T-13) 16:50 17 08:44 (T-13)
23	06:03	20:10 (T-11) 06:38	07:15	07:52	07:34	08:06 (T-13) 08:02 08:27 (T-13)
	21:05	28 20:38 (T-11) 20:23	19:26	18:30	16:53	26 08:32 (T-13) 16:50 17 08:44 (T-13)
24	06:04	20:10 (T-11) 06:39	07:16	07:53	07:35	08:05 (T-13) 08:02 08:28 (T-13)
	21:04	27 20:37 (T-11) 20:21	19:24	18:29	16:52	27 08:32 (T-13) 16:51 17 08:45 (T-13)
25	06:05	20:11 (T-11) 06:40	07:17	07:55	07:36	08:05 (T-13) 08:03 08:28 (T-13)
	21:03	25 20:36 (T-11) 20:19	19:22	18:27	16:51	28 08:33 (T-13) 16:51 18 08:46 (T-13)
26	06:06	20:11 (T-11) 06:42	07:18	07:56	07:37	08:06 (T-13) 08:03 08:28 (T-13)
	21:02	24 20:35 (T-11) 20:18	19:20	18:26	16:51	28 08:34 (T-13) 16:52 18 08:46 (T-13)
27	06:07	20:11 (T-11) 06:43	07:19	07:57	07:39	08:05 (T-13) 08:03 08:29 (T-13)
	21:01	23 20:34 (T-11) 20:16	19:18	18:24	16:50	29 08:34 (T-13) 16:53 18 08:47 (T-13)
28	06:08	20:11 (T-11) 06:44	07:21	07:59	07:40	08:05 (T-13) 08:04 08:29 (T-13)
	21:00	22 20:33 (T-11) 20:14	19:17	18:23	16:50	30 08:35 (T-13) 16:53 18 08:47 (T-13)
29	06:09	20:11 (T-11) 06:45	07:22	08:00	07:41	08:06 (T-13) 08:04 08:29 (T-13)
	20:59	21 20:32 (T-11) 20:12	19:15	18:21	16:49	29 08:35 (T-13) 16:54 19 08:48 (T-13)
30	06:10	20:12 (T-11) 06:46	07:23	08:01	07:42	08:08 (T-13) 08:04 08:29 (T-13)
	20:57	19 20:31 (T-11) 20:11	19:13	18:20	16:49	28 08:36 (T-13) 16:55 19 08:48 (T-13)
31	06:11	20:12 (T-11) 06:47	08:03	08:03	08:04	08:04 08:29 (T-13)
	20:56	18 20:30 (T-11) 20:09	18:18	18:18	16:56	20 08:49 (T-13)
Potential sun hours	471	436	377	341	288	275
Total, worst case	837	68			354	624
Sun reduction	0.75	0.72			0.48	0.52
Oper. time red.	0.90	0.90			0.90	0.90
Wind dir. red.	0.63	0.63			0.66	0.66
Total reduction	0.43	0.41			0.28	0.31
Total, real	359	28			101	192

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-290 - R-290

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-45)	07:47	07:06	07:09	06:18
	16:57	50 16:01 (T-42)	17:35	18:12	19:52	20:30
2	08:04	08:29 (T-45)	07:46	07:04	07:07	06:17
	16:58	49 16:01 (T-42)	17:36	18:14	19:54	20:31
3	08:04	08:29 (T-45)	07:44	07:02	07:05	06:15
	16:58	49 16:01 (T-42)	17:38	18:15	19:55	20:32
4	08:04	08:29 (T-45)	07:43	07:00	07:04	06:14
	16:59	48 16:01 (T-42)	17:39	18:16	19:56	20:33
5	08:04	08:28 (T-45)	07:42	06:59	07:02	06:12
	17:00	47 16:00 (T-42)	17:40	18:18	19:57	20:35
6	08:04	08:28 (T-45)	07:41	06:57	07:00	06:11
	17:01	46 15:59 (T-42)	17:42	18:19	19:59	20:36
7	08:04	08:28 (T-45)	07:39	06:55	06:58	06:09
	17:03	44 15:59 (T-42)	17:43	18:20	20:00	20:37
8	08:04	08:28 (T-45)	07:38	07:53	06:56	06:08
	17:04	42 15:58 (T-42)	17:45	18:22	20:01	20:38
9	08:03	08:27 (T-45)	07:37	07:52	06:55	06:07
	17:05	39 15:56 (T-42)	17:46	19:23	20:02	20:39
10	08:03	08:27 (T-45)	07:35	07:50	06:53	06:06
	17:06	30 08:57 (T-45)	17:48	19:24	20:04	20:41
11	08:03	08:26 (T-45)	07:34	07:48	06:51	06:04
	17:07	30 08:56 (T-45)	17:49	19:26	20:05	20:42
12	08:02	08:26 (T-45)	07:33	07:46	06:49	06:03
	17:08	31 08:57 (T-45)	17:50	19:27	20:06	20:43
13	08:02	08:25 (T-45)	07:31	07:44	06:47	06:02
	17:09	32 08:57 (T-45)	17:52	19:28	20:07	20:44
14	08:02	08:25 (T-45)	07:30	07:42	06:46	06:01
	17:11	33 08:58 (T-45)	17:53	19:30	20:09	20:45
15	08:01	08:25 (T-45)	07:28	07:41	06:44	06:00
	17:12	32 08:57 (T-45)	17:55	19:31	20:10	20:46
16	08:00	08:26 (T-45)	07:27	07:39	06:42	05:58
	17:13	32 08:58 (T-45)	17:56	19:32	20:11	20:48
17	08:00	08:26 (T-45)	07:25	07:37	06:40	05:57
	17:14	32 08:58 (T-45)	17:57	19:33	20:12	20:49
18	07:59	08:27 (T-45)	07:24	07:35	06:39	05:56
	17:16	31 08:58 (T-45)	17:59	19:35	20:14	20:50
19	07:59	08:28 (T-45)	07:22	07:33	06:37	05:55
	17:17	30 08:58 (T-45)	18:00	19:36	20:15	20:51
20	07:58	08:29 (T-45)	07:21	07:31	06:35	05:54
	17:18	29 08:58 (T-45)	18:00	19:37	20:16	20:52
21	07:57	08:30 (T-45)	07:19	07:30	06:34	05:53
	17:20	27 08:57 (T-45)	18:02	19:39	20:17	20:53
22	07:56	08:31 (T-45)	07:17	07:28	06:32	05:52
	17:21	26 08:57 (T-45)	18:03	19:40	20:19	20:54
23	07:56	08:32 (T-45)	07:16	07:26	06:30	05:51
	17:22	24 08:56 (T-45)	18:04	19:41	20:20	20:55
24	07:55	08:33 (T-45)	07:14	07:24	06:29	05:51
	17:24	22 08:55 (T-45)	18:06	19:42	20:21	20:56
25	07:54	08:34 (T-45)	07:12	07:22	06:27	05:50
	17:25	20 08:54 (T-45)	18:07	19:44	20:22	20:57
26	07:53	08:36 (T-45)	07:11	07:20	06:26	05:49
	17:26	16 08:52 (T-45)	18:08	19:45	20:24	20:58
27	07:52	08:39 (T-45)	07:09	07:18	06:24	05:48
	17:28	11 08:50 (T-45)	18:10	19:46	20:25	20:59
28	07:51		07:07	07:17	06:23	05:47
	17:29		18:11	19:47	20:26	21:00
29	07:50			07:15	06:21	05:47
	17:31			19:49	20:27	21:01
30	07:49			07:13	06:19	05:46
	17:32			19:50	20:28	21:02
31	07:48			07:11	06:17	05:46
	17:33			19:51	21:03	21:03
Potential sun hours	287	292	369	403	459	465
Total, worst case	902				79	627
Sun reduction	0.58				0.66	0.73
Oper. time red.	0.90				0.90	0.90
Wind dir. red.	0.65				0.64	0.64
Total reduction	0.34				0.38	0.42
Total, real	306				30	265

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-290 - R-290

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December					
1	05:45	20:27 (T-18)	06:12	06:48	07:24	07:04	07:43	08:08 (T-45)			
	21:16	22 20:49 (T-18)	20:55	20:07	19:11	17:17	16:48	30 08:38 (T-45)			
2	05:45	20:28 (T-18)	06:13	06:50	07:25	07:05	07:44	08:10 (T-45)			
	21:16	21 20:49 (T-18)	20:53	20:05	19:09	17:15	16:48	30 08:40 (T-45)			
3	05:46	20:28 (T-18)	06:15	06:51	07:26	07:07	07:45	08:11 (T-45)			
	21:16	20 20:48 (T-18)	20:52	20:03	19:07	17:14	16:47	39 15:40 (T-42)			
4	05:47	20:28 (T-18)	06:16	06:52	07:28	07:08	07:46	08:12 (T-45)			
	21:16	20 20:48 (T-18)	20:51	20:01	19:05	17:12	16:47	41 15:42 (T-42)			
5	05:47	20:29 (T-18)	06:17	06:53	07:29	07:09	07:48	08:13 (T-45)			
	21:16	19 20:48 (T-18)	20:50	19:59	19:03	17:11	16:47	45 15:44 (T-42)			
6	05:48	20:29 (T-18)	06:18	06:54	07:30	07:11	07:49	08:14 (T-45)			
	21:15	19 20:48 (T-18)	20:48	19:58	19:01	17:10	16:47	45 15:45 (T-42)			
7	05:49	20:29 (T-18)	06:19	06:55	07:31	07:12	07:50	08:15 (T-45)			
	21:15	19 20:48 (T-18)	20:47	19:56	19:00	17:09	16:47	47 15:47 (T-42)			
8	05:49	20:30 (T-18)	06:20	06:57	07:33	07:13	07:51	08:16 (T-45)			
	21:15	18 20:48 (T-18)	20:46	19:54	18:56	17:07	16:46	47 15:48 (T-42)			
9	05:50	20:30 (T-18)	06:21	06:58	07:34	07:15	07:52	08:17 (T-45)			
	21:14	16 20:46 (T-18)	20:44	19:52	18:54	17:06	16:46	49 15:49 (T-42)			
10	05:51	20:30 (T-18)	06:23	06:59	07:35	07:16	07:52	08:18 (T-45)			
	21:14	16 20:46 (T-18)	20:43	19:50	18:52	17:05	16:46	49 15:50 (T-42)			
11	05:52	20:31 (T-18)	06:24	07:00	07:36	07:17	07:53	08:19 (T-45)			
	21:13	15 20:46 (T-18)	20:41	19:48	18:51	17:04	16:46	50 15:51 (T-42)			
12	05:52	20:31 (T-18)	06:25	07:01	07:38	07:19	07:54	08:20 (T-45)			
	21:13	15 20:46 (T-18)	20:40	19:46	18:49	17:03	16:46	50 15:52 (T-42)			
13	05:53	20:31 (T-18)	06:26	07:02	07:39	07:20	07:55	08:21 (T-45)			
	21:12	13 20:44 (T-18)	20:38	19:45	18:47	17:02	16:46	50 15:53 (T-42)			
14	05:54	20:32 (T-18)	06:27	07:04	07:40	07:21	07:56	08:22 (T-45)			
	21:11	12 20:44 (T-18)	20:37	19:43	18:45	17:01	16:47	50 15:54 (T-42)			
15	05:55	20:33 (T-18)	06:28	07:05	07:41	07:23	07:57	08:22 (T-45)			
	21:11	11 20:44 (T-18)	20:35	19:41	18:44	17:00	16:47	51 15:54 (T-42)			
16	05:56	20:33 (T-18)	06:30	07:06	07:43	07:24	08:09 (T-45)	07:57	08:23 (T-45)		
	21:10	10 20:43 (T-18)	20:34	19:39	18:42	16:59	16	08:25 (T-45)	16:47	51	15:55 (T-42)
17	05:57	20:34 (T-18)	06:31	07:07	07:44	07:26	08:08 (T-45)	07:58	08:24 (T-45)		
	21:09	8 20:42 (T-18)	20:32	19:37	18:40	16:58	20	08:28 (T-45)	16:47	51	15:56 (T-42)
18	05:58	20:35 (T-18)	06:32	07:08	07:45	07:27	08:07 (T-45)	07:59	08:24 (T-45)		
	21:09	7 20:42 (T-18)	20:31	19:35	18:38	16:57	22	08:29 (T-45)	16:48	51	15:56 (T-42)
19	05:59	20:36 (T-18)	06:33	07:10	07:47	07:28	08:07 (T-45)	07:59	08:25 (T-45)		
	21:08	5 20:41 (T-18)	20:29	19:33	18:37	16:56	24	08:31 (T-45)	16:48	51	15:57 (T-42)
20	06:00	20:37 (T-18)	06:34	07:11	07:48	07:29	08:06 (T-45)	08:00	08:25 (T-45)		
	21:07	4 20:41 (T-18)	20:27	19:31	18:35	16:55	26	08:32 (T-45)	16:48	51	15:57 (T-42)
21	06:01	20:39 (T-18)	06:35	07:12	07:49	07:31	08:05 (T-45)	08:01	08:26 (T-45)		
	21:06	1 20:40 (T-18)	20:26	19:29	18:33	16:54	27	08:32 (T-45)	16:49	52	15:58 (T-42)
22	06:02	06:37	07:13	07:50	07:32	07:50	08:05 (T-45)	08:01	08:26 (T-45)		
	21:05	20:24	19:28	18:32	16:53	29	08:34 (T-45)	16:49	52	15:58 (T-42)	
23	06:03	06:38	07:14	07:52	07:33	08:04 (T-45)	08:02	08:27 (T-45)			
	21:04	20:22	19:26	18:30	16:53	30	08:34 (T-45)	16:50	51	15:59 (T-42)	
24	06:04	06:39	07:15	07:53	07:35	08:05 (T-45)	08:02	08:27 (T-45)			
	21:03	20:21	19:24	18:29	16:52	31	08:36 (T-45)	16:50	51	15:59 (T-42)	
25	06:05	06:40	07:17	07:54	07:36	08:05 (T-45)	08:02	08:28 (T-45)			
	21:02	20:19	19:22	18:27	16:51	31	08:36 (T-45)	16:51	51	16:00 (T-42)	
26	06:06	06:41	07:18	07:56	07:37	08:04 (T-45)	08:03	08:28 (T-45)			
	21:01	20:17	19:20	18:25	16:51	32	08:36 (T-45)	16:52	51	16:00 (T-42)	
27	06:07	06:43	07:19	07:57	07:38	08:05 (T-45)	08:03	08:28 (T-45)			
	21:00	20:15	19:18	18:24	16:50	32	08:37 (T-45)	16:52	50	16:00 (T-42)	
28	06:08	06:44	07:20	07:58	07:40	08:05 (T-45)	08:03	08:28 (T-45)			
	20:59	20:14	19:16	18:22	16:49	33	08:38 (T-45)	16:53	51	16:00 (T-42)	
29	06:09	06:45	07:21	08:00	07:41	08:06 (T-45)	08:04	08:29 (T-45)			
	20:58	20:12	19:14	18:21	16:49	32	08:38 (T-45)	16:54	50	16:01 (T-42)	
30	06:10	06:46	07:23	08:01	07:42	08:07 (T-45)	08:04	08:29 (T-45)			
	20:57	20:10	19:13	18:19	16:49	31	08:38 (T-45)	16:55	51	16:01 (T-42)	
31	06:11	06:47	08:02	08:02	08:04	08:04	08:04	08:29 (T-45)			
	20:56	20:08	18:18	18:18	16:56	50	16:01 (T-42)				
Potential sun hours	471	436	377	341	289	275					
Total, worst case					427						1488
Sun reduction	0.291				0.48						0.52
Oper. time red.	0.90				0.90						0.90
Wind dir. red.	0.64				0.66						0.64
Total reduction	0.43				0.28						0.30
Total, real	127				121						444

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-291 - R-291

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:13	07:51
	17:04	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02
	17:23	18:05	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40	08:03
	17:29	18:11	19:48	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invenergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-294 - R-294 Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with columns for months (January to December) and rows for time slots (08:00 to 17:34). Includes summary rows for Potential sun hours, Total, worst case, Sun reduction, Oper. time red., Wind dir. red., Total reduction, and Total, real.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) First time (hh:mm) with flicker (WTG causing flicker first time) Last time (hh:mm) with flicker (WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-305 - R-305

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:47
	17:01	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:49
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:01	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:29	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:00
	17:20	18:02	19:39	20:17	20:53	21:15	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56	07:17	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:01
	17:23	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:54
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:02		08:04
	17:34		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-306 - R-306
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	07:47 17:35	07:06 18:13	07:09 19:52	06:18 20:30	05:45 21:04	05:45 21:16	06:13 20:55	06:36 (T-J) 06:44 (T-J)	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:48
2	08:04 16:58	07:46 17:36	07:04 18:14	07:07 19:54	06:17 20:31	05:45 21:05	05:46 21:16	06:14 20:53	06:37 (T-J) 06:44 (T-J)	06:50 20:05	07:25 19:09	07:05 17:16	07:44 16:48
3	08:04 16:59	07:44 17:38	07:02 18:15	07:06 19:55	06:15 20:32	05:44 21:05	05:46 21:16	06:15 20:52	06:38 (T-J) 06:43 (T-J)	06:51 20:03	07:26 19:07	07:07 17:14	07:45 16:48
4	08:04 17:00	07:43 17:39	07:01 18:17	07:04 19:56	06:14 20:33	05:44 21:06	05:47 21:16	06:16 20:51	06:39 (T-J) 06:43 (T-J)	06:52 20:01	07:28 19:05	07:08 17:13	07:46 16:48
5	08:04 17:01	07:42 17:41	06:59 18:18	07:02 19:57	06:13 20:35	05:43 21:07	05:48 21:15	06:17 20:50	06:40 (T-J) 06:42 (T-J)	06:53 19:59	07:29 19:03	07:09 17:11	07:47 16:47
6	08:04 17:02	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:18 20:48	06:54 19:58	07:30 19:02	07:11 17:10	07:48 16:47
7	08:04 17:03	07:39 17:44	06:55 18:21	06:58 20:00	06:10 20:37	05:43 21:09	05:49 21:15	06:19 20:47	06:19 20:47	06:56 19:56	07:31 19:00	07:12 17:09	07:49 16:47
8	08:04 17:04	07:38 17:45	07:53 18:22	06:57 20:01	06:08 20:38	05:42 21:09	05:50 21:14	06:21 20:46	06:21 20:46	06:57 19:54	07:33 18:56	07:13 17:08	07:50 16:47
9	08:03 17:05	07:37 17:46	07:52 19:23	06:55 20:02	06:07 20:39	05:42 21:10	05:50 21:14	06:22 20:44	06:22 20:44	06:58 19:52	07:34 18:54	07:15 17:06	07:51 16:47
10	08:03 17:06	07:35 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:23 20:43	06:59 19:50	07:35 18:53	07:16 17:05	07:52 16:47
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:05 20:42	05:42 21:11	05:52 21:13	06:24 20:41	06:24 20:41	07:00 19:48	07:36 18:51	07:17 17:04	07:53 16:47
12	08:02 17:09	07:33 17:51	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:53 21:13	06:25 20:40	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:54 16:47
13	08:02 17:10	07:31 17:52	07:44 19:28	06:48 20:07	06:02 20:44	05:41 21:12	05:54 21:12	06:26 20:38	06:26 20:38	07:03 19:45	07:39 18:47	07:20 17:02	07:55 16:47
14	08:01 17:11	07:30 17:53	07:43 19:30	06:46 20:09	06:01 20:45	05:41 21:13	05:54 21:11	06:28 20:37	06:28 20:37	07:04 19:43	07:40 18:45	07:21 17:01	07:56 16:47
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	06:00 20:46	05:41 21:13	05:55 21:11	06:29 20:35	06:29 20:35	07:05 19:41	07:41 18:44	07:23 17:00	07:57 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:59 20:48	05:41 21:14	05:56 21:10	06:30 (T-J) 06:33 (T-J)	06:30 (T-J) 06:33 (T-J)	07:06 19:39	07:43 18:42	07:24 16:59	07:57 16:47
17	08:00 17:15	07:25 17:58	07:37 19:34	06:41 20:12	05:58 20:49	05:41 21:14	05:57 21:09	06:31 (T-J) 06:36 (T-J)	06:31 (T-J) 06:36 (T-J)	07:07 19:37	07:44 18:40	07:25 16:58	07:58 16:48
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:14	05:57 20:50	05:41 21:15	05:58 21:09	06:25 (T-J) 06:37 (T-J)	06:25 (T-J) 06:37 (T-J)	07:09 19:35	07:45 18:39	07:27 16:57	07:59 16:48
19	07:59 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:56 20:51	05:41 21:15	05:59 21:08	06:24 (T-J) 06:39 (T-J)	06:24 (T-J) 06:39 (T-J)	07:10 19:33	07:47 18:37	07:28 16:56	07:59 16:48
20	07:58 17:19	07:21 18:00	07:32 19:37	06:36 20:16	05:55 20:52	05:41 21:15	06:00 21:07	06:24 (T-J) 06:40 (T-J)	06:24 (T-J) 06:40 (T-J)	07:11 19:31	07:48 18:35	07:29 16:55	08:00 16:49
21	07:57 17:20	07:19 18:02	07:30 19:39	06:34 20:17	05:54 20:53	05:42 21:16	06:01 21:06	06:25 (T-J) 06:41 (T-J)	06:25 (T-J) 06:41 (T-J)	07:12 19:30	07:49 18:34	07:31 16:54	08:00 16:49
22	07:56 17:21	07:17 18:03	07:28 19:40	06:32 20:19	05:53 20:54	05:42 21:16	06:02 21:05	06:26 (T-J) 06:42 (T-J)	06:26 (T-J) 06:42 (T-J)	07:13 19:28	07:50 18:32	07:32 16:54	08:01 16:50
23	07:56 17:23	07:16 18:05	07:26 19:41	06:31 20:20	05:52 20:55	05:42 21:16	06:03 21:04	06:27 (T-J) 06:42 (T-J)	06:27 (T-J) 06:42 (T-J)	07:14 19:26	07:52 18:30	07:33 16:53	08:01 16:50
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	05:51 20:56	05:42 21:16	06:04 21:03	06:28 (T-J) 06:43 (T-J)	06:28 (T-J) 06:43 (T-J)	07:16 19:24	07:53 18:29	07:35 16:52	08:02 16:51
25	07:54 17:25	07:13 18:07	07:22 19:44	06:27 20:22	05:50 20:57	05:43 21:16	06:05 21:02	06:29 (T-J) 06:43 (T-J)	06:29 (T-J) 06:43 (T-J)	07:17 19:22	07:54 18:27	07:36 16:52	08:02 16:51
26	07:53 17:27	07:11 18:09	07:20 19:45	06:26 20:24	05:49 20:58	05:43 21:16	06:06 21:01	06:30 (T-J) 06:44 (T-J)	06:30 (T-J) 06:44 (T-J)	07:18 19:20	07:56 18:26	07:37 16:51	08:03 16:52
27	07:52 17:28	07:09 18:10	07:19 19:46	06:24 20:25	05:49 20:59	05:43 21:16	06:07 21:00	06:31 (T-J) 06:44 (T-J)	06:31 (T-J) 06:44 (T-J)	07:19 19:18	07:57 18:24	07:38 16:50	08:03 16:53
28	07:51 17:29	07:07 18:11	07:17 19:47	06:23 20:26	05:48 21:00	05:44 21:16	06:08 20:59	06:32 (T-J) 06:44 (T-J)	06:32 (T-J) 06:44 (T-J)	07:20 19:16	07:58 18:23	07:39 16:50	08:03 16:54
29	07:50 17:31	07:05 18:19	07:15 19:49	06:21 20:27	05:47 21:01	05:44 21:16	06:09 20:58	06:33 (T-J) 06:44 (T-J)	06:33 (T-J) 06:44 (T-J)	07:22 19:15	08:00 18:21	07:41 16:49	08:04 16:54
30	07:49 17:32	07:13 18:07	07:20 19:50	06:20 20:28	05:47 21:02	05:45 21:16	06:10 20:57	06:34 (T-J) 06:44 (T-J)	06:34 (T-J) 06:44 (T-J)	07:23 19:13	08:01 18:20	07:42 16:49	08:04 16:55
31	07:48 17:34	07:11 19:51	07:11 19:51	05:46 21:03	05:46 21:03	06:11 20:56	06:11 20:56	06:35 (T-J) 06:44 (T-J)	06:35 (T-J) 06:44 (T-J)	07:47 20:08	08:02 18:18	07:42 16:49	08:04 16:56
Potential sun hours	287	292	369	403	458	465	471	436		377	341	289	275
Total, worst case					224				26				
Sun reduction					0.66				0.72				
Oper. time red.					0.90				0.90				
Wind dir. red.					0.59				0.59				
Total reduction					0.35				0.38				
Total, real					79				10				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-314 - R-314
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December							
1	08:04	07:47	07:06	07:09	06:18	06:39 (T-48)	05:45	20:20 (T-43)	05:45	20:23 (T-43)	06:12	06:37 (T-48)	06:48	07:24	07:04	07:43			
	16:57	17:35	18:12	19:52	20:30	20:59 (T-48)	21:04	17	20:37 (T-42)	21:16	25	20:48 (T-42)	20:55	32	07:09 (T-48)	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:16	06:38 (T-48)	05:44	20:20 (T-43)	05:45	20:24 (T-43)	06:13	06:37 (T-48)	06:50	07:25	07:05	07:44			
	16:58	17:36	18:14	19:54	20:31	21:06	21:05	19	20:39 (T-42)	21:16	25	20:49 (T-42)	20:53	32	07:09 (T-48)	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	06:36 (T-48)	05:44	20:19 (T-43)	05:46	20:24 (T-43)	06:15	06:38 (T-48)	06:51	07:26	07:06	07:45			
	16:58	17:38	18:15	19:55	20:32	21:06	21:05	20	20:39 (T-42)	21:16	24	20:48 (T-42)	20:52	31	07:09 (T-48)	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:04	06:14	06:35 (T-48)	05:43	20:20 (T-43)	05:47	20:25 (T-43)	06:16	06:39 (T-48)	06:52	07:28	07:08	07:46			
	16:59	17:39	18:16	19:56	20:33	21:07	21:06	20	20:40 (T-42)	21:16	23	20:48 (T-42)	20:51	30	07:09 (T-48)	20:01	19:05	17:12	16:47
5	08:04	07:42	06:59	07:02	06:12	06:34 (T-48)	05:43	20:20 (T-43)	05:47	20:25 (T-43)	06:17	06:40 (T-48)	06:53	07:29	07:09	07:47			
	17:00	17:40	18:18	19:57	20:35	21:07	21:07	21	20:41 (T-42)	21:15	23	20:48 (T-42)	20:50	29	07:09 (T-48)	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	06:32 (T-48)	05:43	20:19 (T-43)	05:48	20:25 (T-43)	06:18	06:41 (T-48)	06:54	07:30	07:11	07:48			
	17:01	17:42	18:19	19:59	20:36	21:08	21:08	22	20:41 (T-42)	21:15	22	20:47 (T-42)	20:48	28	07:09 (T-48)	19:58	19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	06:09	06:31 (T-48)	05:42	20:19 (T-43)	05:49	20:26 (T-43)	06:19	06:42 (T-48)	06:55	07:31	07:12	07:49			
	17:03	17:43	18:20	20:00	20:37	21:09	21:09	23	20:42 (T-42)	21:15	21	20:47 (T-42)	20:47	27	07:09 (T-48)	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:56	06:08	06:30 (T-48)	05:42	20:19 (T-43)	05:49	20:27 (T-43)	06:20	06:43 (T-48)	06:57	07:32	07:13	07:50			
	17:04	17:45	18:22	20:01	20:38	21:09	21:09	24	20:43 (T-42)	21:14	20	20:47 (T-42)	20:45	25	07:08 (T-48)	19:54	18:56	17:07	16:46
9	08:03	07:37	07:52	06:54	06:07	06:28 (T-48)	05:42	20:19 (T-43)	05:50	20:26 (T-43)	06:21	06:44 (T-48)	06:58	07:34	07:15	07:51			
	17:05	17:46	19:23	20:02	20:39	21:10	21:10	24	20:43 (T-42)	21:14	20	20:46 (T-42)	20:44	24	07:08 (T-48)	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:06	06:27 (T-48)	05:41	20:19 (T-43)	05:51	20:27 (T-43)	06:23	06:46 (T-48)	06:59	07:35	07:16	07:52			
	17:06	17:47	19:24	20:04	20:41	21:11	21:11	24	20:43 (T-42)	21:14	19	20:46 (T-42)	20:43	23	07:09 (T-48)	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	06:26 (T-48)	05:41	20:19 (T-43)	05:52	20:28 (T-43)	06:24	06:47 (T-48)	07:00	07:36	07:17	07:53			
	17:07	17:49	19:26	20:05	20:42	21:11	21:11	25	20:44 (T-42)	21:13	18	20:46 (T-42)	20:41	21	07:08 (T-48)	19:48	18:51	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	06:27 (T-48)	05:41	20:19 (T-43)	05:52	20:29 (T-43)	06:25	06:48 (T-48)	07:01	07:37	07:19	07:54			
	17:08	17:50	19:27	20:06	20:43	21:12	21:12	26	20:45 (T-42)	21:13	17	20:46 (T-42)	20:40	19	07:07 (T-48)	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02	06:27 (T-48)	05:41	20:19 (T-43)	05:53	20:29 (T-43)	06:26	06:49 (T-48)	07:02	07:39	07:20	07:55			
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	26	20:45 (T-42)	21:12	15	20:44 (T-42)	20:38	17	06:49 (T-48)	19:44	18:47	17:02	16:46
14	08:01	07:30	07:42	06:46	06:01	06:28 (T-48)	05:41	20:20 (T-43)	05:54	20:30 (T-43)	06:27	06:50 (T-48)	07:04	07:40	07:21	07:56			
	17:11	17:53	19:30	20:09	20:45	21:13	21:13	26	20:46 (T-42)	21:11	14	20:44 (T-42)	20:37	15	07:05 (T-48)	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	06:29 (T-48)	05:41	20:20 (T-43)	05:55	20:31 (T-43)	06:28	06:51 (T-48)	07:05	07:41	07:23	07:57			
	17:12	17:55	19:31	20:10	20:46	21:13	21:13	26	20:46 (T-42)	21:11	12	20:43 (T-42)	20:35	13	07:04 (T-48)	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:58	06:26 (T-48)	05:41	20:20 (T-43)	05:56	20:32 (T-43)	06:30	06:52 (T-48)	07:06	07:43	07:24	07:57			
	17:13	17:56	19:32	20:11	20:48	21:14	21:14	27	20:47 (T-42)	21:10	11	20:43 (T-42)	20:34	11	07:03 (T-48)	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:40	05:57	06:30 (T-48)	05:41	20:20 (T-43)	05:57	20:33 (T-43)	06:31	06:53 (T-48)	07:07	07:44	07:25	07:58			
	17:14	17:57	19:33	20:12	20:49	21:14	21:14	27	20:47 (T-42)	21:09	9	20:42 (T-42)	20:32	8	07:01 (T-48)	19:37	18:40	16:58	16:47
18	07:59	07:24	07:35	06:39	05:56	06:31 (T-48)	05:41	20:20 (T-43)	05:58	20:35 (T-43)	06:32	06:55 (T-48)	07:08	07:45	07:27	07:59			
	17:16	17:59	19:35	20:14	20:50	21:15	21:15	27	20:47 (T-42)	21:09	7	20:42 (T-42)	20:30	5	07:00 (T-48)	19:35	18:38	16:57	16:48
19	07:59	07:22	07:33	06:37	05:55	06:32 (T-48)	05:41	20:20 (T-43)	05:59	20:36 (T-43)	06:33	06:58 (T-48)	07:09	07:46	07:28	07:59			
	17:17	18:00	19:36	20:15	20:51	21:15	21:15	27	20:47 (T-42)	21:08	5	20:41 (T-42)	20:29	19	07:04 (T-48)	19:33	18:37	16:56	16:48
20	07:58	07:21	07:31	06:35	05:54	06:34 (T-48)	05:41	20:20 (T-43)	06:00	20:37 (T-42)	06:34	07:00 (T-48)	07:11	07:48	07:29	08:00			
	17:18	18:00	19:37	20:16	20:52	21:15	21:15	28	20:48 (T-42)	21:07	3	20:40 (T-42)	20:27	19	07:04 (T-48)	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	06:35 (T-48)	05:41	20:21 (T-43)	06:01	20:49 (T-48)	06:35	07:05 (T-48)	07:12	07:49	07:31	08:00			
	17:20	18:01	19:38	20:17	20:53	21:16	21:16	28	20:49 (T-42)	21:06	10	20:40 (T-42)	20:26	19	07:04 (T-48)	19:29	18:33	16:54	16:49
22	07:56	07:17	07:28	06:32	05:52	06:37 (T-48)	05:41	20:21 (T-43)	06:02	20:46 (T-48)	06:37	07:06 (T-48)	07:13	07:50	07:32	08:01			
	17:21	18:03	19:40	20:18	20:54	21:16	21:16	28	20:49 (T-42)	21:05	13	06:59 (T-48)	07:04	19	07:05 (T-48)	19:28	18:32	16:53	16:49
23	07:56	07:16	07:26	06:30	05:51	06:41 (T-48)	05:42	20:21 (T-43)	06:03	20:44 (T-48)	06:38	07:07 (T-48)	07:14	07:52	07:33	08:02			
	17:22	18:04	19:41	20:20	20:55	21:16	21:16	28	20:49 (T-42)	21:04	16	07:00 (T-48)	07:02	22	07:05 (T-48)	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:49	06:49 (T-48)	05:41	20:22 (T-43)	06:04	20:43 (T-48)	06:39	07:08 (T-48)	07:15	07:53	07:35	08:02			
	17:24	18:06	19:42	20:21	20:56	21:16	21:16	27	20:48 (T-42)	21:03	19	07:02 (T-48)	07:02	21	07:06 (T-48)	19:24	18:29	16:52	16:50
25	07:54	07:12	07:22	06:27	05:50	06:48 (T-48)	05:42	20:22 (T-43)	06:05	20:41 (T-48)	06:40	07:09 (T-48)	07:17	07:54	07:36	08:02			
	17:25	18:07	19:44	20:22	20:57	21:16	21:16	27	20:49 (T-42)	21:02	22	07:03 (T-48)	07:02	21	07:06 (T-48)	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:46	06:46 (T-48)	05:43	20:22 (T-43)	06:06	20:40 (T-48)	06:41	07:09 (T-48)	07:18	07:56	07:37	08:03			
	17:26	18:08	19:45	20:23	20:58	21:16	21:16	27	20:49 (T-42)	21:01	24	07:04 (T-48)	07:01	20	07:06 (T-48)	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:45	06:45 (T-48)	05:43	20:22 (T-43)	06:07	20:41 (T-48)	06:42	07:10 (T-48)	07:19	07:57	07:38	08:03			
	17:28	18:10	19:46	20:25	20:59	21:16	21:16	27	20:49 (T-42)	21:00	25	07:06 (T-48)	07:02	19	07:06 (T-48)	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:43	06:43 (T-48)	05:47	20:23 (T-43)	06:08	20:40 (T-48)	06:44	07:11 (T-48)	07:20	07:58	07:39	08:03			
	17:29	18:11	19:47	20:26	20:59	21:16	21:16	26	20:49 (T-42)	21:08	27	07:07 (T-48)	07:04	20	07:07 (T-48)	19:16	18:22	16:49	16:53
29	07:50	07:07	07:15	06:21	05:42	06:42 (T-48)	05:47	20:22 (T-43)	06:09	20:39 (T-48)	06:45	07:12 (T-48)	07:21	08:00	07:41	08:04			
	17:30	18:12	19:49	20:27	20:5														

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-320 - R-320

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:18	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:45	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:08	20:44	21:13	21:12	20:38	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:58
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:15	17:58	19:34	20:13	20:49	21:14	21:10	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:19	18:00	19:38	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:33	08:02
	17:23	18:05	19:41	20:20	20:55	21:16	21:05	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:22	20:57	21:16	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:17	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-321 - R-321
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04 16:57 46	08:39 (T-89) 09:25 (T-89)	07:47 17:35	07:06 18:13	07:09 19:53	06:18 20:30	05:45 21:04	05:45 21:16	06:13 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:48 43	08:26 (T-89) 09:09 (T-89)
2	08:04 16:58 46	08:39 (T-89) 09:25 (T-89)	07:46 17:36	07:04 18:14	07:07 19:54	06:17 20:31	05:45 21:05	05:46 21:16	06:14 20:54	06:50 20:05	07:25 19:09	07:05 17:16	07:44 16:48 43	08:27 (T-89) 09:10 (T-89)
3	08:04 16:59 46	08:40 (T-89) 09:26 (T-89)	07:45 17:38	07:02 18:15	07:06 19:55	06:15 20:32	05:44 21:06	05:46 21:16	06:15 20:52	06:51 20:03	07:27 19:07	07:07 17:14	07:45 16:48 44	08:27 (T-89) 09:11 (T-89)
4	08:04 17:00 46	08:40 (T-89) 09:26 (T-89)	07:43 17:39	07:01 18:17	07:04 19:56	06:14 20:33	05:44 21:06	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	07:46 16:48 44	08:27 (T-89) 09:11 (T-89)
5	08:04 17:01 46	08:40 (T-89) 09:26 (T-89)	07:42 17:41	06:59 18:18	07:02 19:58	06:13 20:35	05:43 21:07	05:48 21:16	06:17 20:50	06:53 20:00	07:29 19:03	07:09 17:11	07:48 16:47 45	08:27 (T-89) 09:12 (T-89)
6	08:04 17:02 45	08:41 (T-89) 09:26 (T-89)	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:55 19:58	07:30 19:02	07:11 17:10	07:49 16:47 45	08:27 (T-89) 09:12 (T-89)
7	08:04 17:03 45	08:42 (T-89) 09:27 (T-89)	07:40 17:44	06:55 18:21	06:58 20:00	06:10 20:37	05:43 21:09	05:49 21:15	06:19 20:47	06:56 19:56	07:31 19:00	07:12 17:09	07:50 16:47 46	08:27 (T-89) 09:13 (T-89)
8	08:04 17:04 44	08:43 (T-89) 09:27 (T-89)	07:38 17:45	07:54 18:22	06:57 20:01	06:08 20:38	05:42 21:09	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	07:13 17:08	07:51 16:47 45	08:28 (T-89) 09:13 (T-89)
9	08:03 17:05 44	08:43 (T-89) 09:27 (T-89)	07:37 17:46	07:52 19:23	06:55 20:03	06:07 20:40	05:42 21:10	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54	07:15 17:06	07:52 16:47 46	08:28 (T-89) 09:14 (T-89)
10	08:03 17:06 43	08:44 (T-89) 09:27 (T-89)	07:36 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:53	07:16 17:05	07:53 16:47 47	08:28 (T-89) 09:15 (T-89)
11	08:03 17:07 43	08:44 (T-89) 09:27 (T-89)	07:34 17:49	07:48 19:26	06:51 20:05	06:05 20:42	05:42 21:11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51	07:18 17:04	07:53 16:47 46	08:29 (T-89) 09:15 (T-89)
12	08:02 17:09 42	08:45 (T-89) 09:27 (T-89)	07:33 17:51	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:54 16:47 47	08:29 (T-89) 09:16 (T-89)
13	08:02 17:10 42	08:46 (T-89) 09:28 (T-89)	07:31 17:52	07:44 19:29	06:48 20:07	06:02 20:44	05:41 21:12	05:54 21:12	06:26 20:38	07:03 19:45	07:39 18:47	07:20 17:02	07:55 16:47 46	08:30 (T-89) 09:16 (T-89)
14	08:02 17:11 40	08:47 (T-89) 09:27 (T-89)	07:30 17:53	07:43 19:30	06:46 20:09	06:01 20:45	05:41 21:13	05:54 21:11	06:28 20:37	07:04 19:43	07:40 18:46	07:22 17:01	07:56 16:47 47	08:30 (T-89) 09:17 (T-89)
15	08:01 17:12 39	08:47 (T-89) 09:26 (T-89)	07:28 17:55	07:41 19:31	06:44 20:10	06:00 20:47	05:41 21:13	05:55 21:11	06:29 20:35	07:05 19:41	07:42 18:44	07:23 17:00	07:57 16:47 47	08:30 (T-89) 09:17 (T-89)
16	08:01 17:13 38	08:49 (T-89) 09:27 (T-89)	07:27 17:56	07:39 19:32	06:42 20:11	05:59 20:48	05:41 21:14	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59 2	07:57 16:47 47	08:31 (T-89) 09:18 (T-89)
17	08:00 17:15 37	08:49 (T-89) 09:26 (T-89)	07:25 17:58	07:37 19:34	06:41 20:12	05:58 20:49	05:41 21:14	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	07:26 16:58 13	07:57 16:48 48	08:31 (T-89) 09:19 (T-89)
18	07:59 17:16 35	08:50 (T-89) 09:25 (T-89)	07:24 17:59	07:35 19:35	06:39 20:14	05:57 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:35	07:45 18:39	07:27 16:57 19	07:59 16:48 47	08:31 (T-89) 09:18 (T-89)
19	07:59 17:17 34	08:52 (T-89) 09:26 (T-89)	07:22 18:00	07:33 19:36	06:37 20:15	05:56 20:51	05:41 21:15	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	07:28 16:56 23	07:59 16:48 47	08:32 (T-89) 09:19 (T-89)
20	07:58 17:19 32	08:53 (T-89) 09:25 (T-89)	07:21 18:00	07:32 19:37	06:36 20:16	05:55 20:52	05:41 21:15	06:00 21:07	06:35 20:27	07:11 19:32	07:48 18:35	07:30 16:55 26	08:00 16:49 47	08:32 (T-89) 09:19 (T-89)
21	07:57 17:20 30	08:54 (T-89) 09:24 (T-89)	07:19 18:02	07:30 19:39	06:34 20:17	05:54 20:53	05:42 21:16	06:01 21:06	06:36 20:26	07:12 19:30	07:49 18:34	07:31 16:54 30	08:01 16:49 47	08:33 (T-89) 09:20 (T-89)
22	07:56 17:21 26	08:56 (T-89) 09:22 (T-89)	07:18 18:03	07:28 19:40	06:32 20:19	05:53 20:54	05:42 21:16	06:02 21:05	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:54 32	08:01 16:50 47	08:33 (T-89) 09:20 (T-89)
23	07:56 17:23 23	08:58 (T-89) 09:21 (T-89)	07:16 18:05	07:26 19:41	06:31 20:20	05:52 20:55	05:42 21:16	06:03 21:04	06:38 20:22	07:14 19:26	07:52 18:30	07:33 16:53 34	08:02 16:50 47	08:34 (T-89) 09:21 (T-89)
24	07:55 17:24 19	09:00 (T-89) 09:19 (T-89)	07:14 18:06	07:24 19:43	06:29 20:21	05:51 20:56	05:42 21:16	06:04 21:03	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52 35	08:02 16:51 47	08:34 (T-89) 09:21 (T-89)
25	07:54 17:25 13	09:03 (T-89) 09:16 (T-89)	07:13 18:07	07:22 19:44	06:28 20:22	05:50 20:57	05:43 21:16	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	07:36 16:52 36	08:02 16:51 47	08:35 (T-89) 09:22 (T-89)
26	07:53 17:27 13	09:04 (T-89) 09:17 (T-89)	07:12 18:09	07:20 19:45	06:26 20:24	05:49 20:58	05:43 21:16	06:06 21:01	06:42 20:17	07:18 19:20	07:56 18:26	07:37 16:51 38	08:03 16:52 47	08:35 (T-89) 09:22 (T-89)
27	07:52 17:28 13	09:05 (T-89) 09:18 (T-89)	07:11 18:10	07:19 19:46	06:24 20:25	05:49 20:59	05:43 21:17	06:07 21:00	06:43 20:16	07:19 19:18	07:57 18:24	07:38 16:50 39	08:03 16:53 48	08:35 (T-89) 09:23 (T-89)
28	07:51 17:29 13	09:06 (T-89) 09:19 (T-89)	07:10 18:11	07:17 19:48	06:23 20:26	05:48 21:00	05:44 21:17	06:08 20:59	06:44 20:14	07:20 19:16	07:59 18:23	07:40 16:50 40	08:03 16:54 47	08:36 (T-89) 09:23 (T-89)
29	07:50 17:31 13	09:07 (T-89) 09:22 (T-89)	07:09 18:12	07:15 19:49	06:21 20:27	05:47 21:01	05:44 21:17	06:09 20:58	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49 41	08:04 16:54 47	08:37 (T-89) 09:24 (T-89)
30	07:49 17:32 13	09:08 (T-89) 09:23 (T-89)	07:08 18:13	07:13 19:50	06:20 20:29	05:47 21:02	05:45 21:16	06:10 20:57	06:46 20:10	07:23 19:13	08:01 18:20	07:42 16:49 42	08:04 16:55 47	08:37 (T-89) 09:24 (T-89)
31	07:48 17:34 13	09:09 (T-89) 09:24 (T-89)	07:07 18:14	07:11 19:51	06:19 21:03	05:46 21:03	05:44 21:16	06:11 20:56	06:47 20:09	07:24 19:14	08:02 18:18	07:43 16:56 47	08:04 16:56 47	08:38 (T-89) 09:25 (T-89)
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	1435	
Total, worst case	944										450		1435	
Sun reduction	0.58										0.48		0.52	
Oper. time red.	0.90										0.90		0.90	
Wind dir. red.	0.67										0.67		0.67	
Total reduction	0.35										0.29		0.31	
Total, real	331										131		452	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-322 - R-322
Assumptions for shadow calculations Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:45 (T-H)	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	10 07:55 (T-H)	17:17	16:49
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:46 (T-H)	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	9 07:55 (T-H)	17:16	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:48 (T-H)	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	8 07:56 (T-H)	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:49 (T-H)	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	7 07:56 (T-H)	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:49 (T-H)	07:09	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:15	20:50	20:00	19:03	5 07:55 (T-H)	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:51 (T-H)	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	3 07:54 (T-H)	17:10	16:47
7	08:04	07:40	06:55	07:16 (T-H)	06:58	06:10	05:43	05:49	06:19	06:56	07:53 (T-H)	07:12	07:50
	17:03	17:44	18:21	2 07:18 (T-H)	20:00	20:37	21:09	21:15	20:47	19:56	1 07:54 (T-H)	17:09	16:47
8	08:04	07:38	07:54	08:14 (T-H)	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:13	07:51
	17:04	17:45	18:22	4 08:18 (T-H)	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	08:12 (T-H)	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	6 08:18 (T-H)	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	08:10 (T-H)	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	8 08:18 (T-H)	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	08:09 (T-H)	06:51	06:05	05:42	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	9 08:18 (T-H)	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	08:07 (T-H)	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:09	17:51	19:27	10 08:17 (T-H)	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:44	08:05 (T-H)	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:29	11 08:16 (T-H)	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	08:03 (T-H)	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	11 08:14 (T-H)	20:09	20:45	21:13	21:11	20:37	19:43	18:46	17:01	16:47
15	08:01	07:28	07:41	08:01 (T-H)	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	11 08:12 (T-H)	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	08:03 (T-H)	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	5 08:08 (T-H)	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58	
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48	
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59	
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48	
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59	
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48	
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:29	08:00	
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55	16:49	
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01	
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49	
22	07:56	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01	
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50	
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02	
	17:23	18:05	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50	
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02	
	17:24	18:06	19:43	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51	
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:40	07:17	07:55	07:36	08:02	
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	16:51	
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03	
	17:27	18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52	
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03	
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:16	19:18	18:24	16:50	16:53	
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40	08:03	
	17:29	18:11	19:48	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:54	
29	07:50	07:15	07:25	06:21	05:47	05:44	06:09	06:45	07:22	07:43 (T-H)	08:00	07:41	08:04
	17:31	19:49	20:27	21:01	21:16	21:16	20:58	20:12	19:15	11 07:54 (T-H)	18:21	16:49	16:54
30	07:49	07:13	07:23	06:20	05:47	05:45	06:10	06:46	07:23	07:44 (T-H)	08:01	07:42	08:04
	17:32	19:50	20:29	21:02	21:16	21:16	20:57	20:10	19:13	11 07:55 (T-H)	18:20	16:49	16:55
31	07:48	07:11	07:21	06:19	05:46	06:12	06:47	07:24	08:03	08:03	07:43	08:04	
	17:34	19:51	21:03	21:03	20:56	20:09	20:09	18:18	18:18	18:18	16:56	16:56	
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	
Total, worst case			77										
Sun reduction			0.59					0.67		0.56			
Oper. time red.			0.90					0.90		0.90			
Wind dir. red.			0.60					0.60		0.60			
Total reduction			0.32					0.36		0.30			
Total, real			24					12		13			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project: South Deuel Wind Project

Description: Invenery Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 SG4.4-164 WTGs on 97.5m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-323 - R-323

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Calendar table with columns for months (January to December) and rows for times of day (08:00 to 17:33). Includes summary rows for 'Potential sun hours', 'Total, worst case', 'Sun reduction', 'Oper. time red.', 'Wind dir. red.', 'Total reduction', and 'Total, real'.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-324 - R-324
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-45)	07:47	07:06	07:09	06:18
	16:57	12 08:41 (T-45)	17:35	18:12	19:52	20:30
2	08:04	08:29 (T-45)	07:46	07:04	07:07	06:17
	16:58	13 08:42 (T-45)	17:36	18:14	19:54	20:31
3	08:04	08:29 (T-45)	07:44	07:02	07:05	06:15
	16:58	13 08:42 (T-45)	17:38	18:15	19:55	20:32
4	08:04	08:29 (T-45)	07:43	07:00	07:04	06:14
	16:59	14 08:43 (T-45)	17:39	18:16	19:56	20:33
5	08:04	08:28 (T-45)	07:42	06:59	07:02	06:12
	17:00	15 08:43 (T-45)	17:40	18:18	19:57	20:35
6	08:04	08:28 (T-45)	07:41	06:57	07:00	06:11
	17:01	15 08:43 (T-45)	17:42	18:19	19:59	20:36
7	08:04	08:28 (T-45)	07:39	06:55	06:58	06:09
	17:03	16 08:44 (T-45)	17:43	18:20	20:00	20:37
8	08:04	08:28 (T-45)	07:38	07:53	06:56	06:08
	17:04	17 08:45 (T-45)	17:45	18:22	20:01	20:38
9	08:03	08:27 (T-45)	07:37	07:52	06:55	06:07
	17:05	18 08:45 (T-45)	17:46	19:23	20:02	20:39
10	08:03	08:27 (T-45)	07:35	07:50	06:53	06:06
	17:06	19 08:46 (T-45)	17:48	19:24	20:04	20:41
11	08:03	08:26 (T-45)	07:34	07:48	06:51	06:04
	17:07	20 08:46 (T-45)	17:49	19:26	20:05	20:42
12	08:02	08:26 (T-45)	07:33	07:46	06:49	06:03
	17:08	20 08:46 (T-45)	17:50	19:27	20:06	20:43
13	08:02	08:26 (T-45)	07:31	07:44	06:47	06:02
	17:09	21 08:47 (T-45)	17:52	19:28	20:07	20:44
14	08:02	08:25 (T-45)	07:30	07:42	06:46	06:01
	17:11	22 08:47 (T-45)	17:53	19:30	20:09	20:45
15	08:01	08:24 (T-45)	07:28	07:41	06:44	06:00
	17:12	23 08:47 (T-45)	17:55	19:31	20:10	20:46
16	08:01	08:24 (T-45)	07:27	07:39	06:42	05:58
	17:13	24 08:48 (T-45)	17:56	19:32	20:11	20:48
17	08:00	08:23 (T-45)	07:25	07:37	06:40	05:57
	17:14	24 08:47 (T-45)	17:57	19:33	20:12	20:49
18	07:59	08:22 (T-45)	07:24	07:35	06:39	05:56
	17:16	25 08:47 (T-45)	17:59	19:35	20:14	20:50
19	07:59	08:23 (T-45)	07:22	07:33	06:37	05:55
	17:17	25 08:48 (T-45)	18:00	19:36	20:15	20:51
20	07:58	08:23 (T-45)	07:21	07:31	06:35	05:54
	17:18	24 08:47 (T-45)	18:00	19:37	20:16	20:52
21	07:57	08:24 (T-45)	07:19	07:30	06:34	05:53
	17:20	23 08:47 (T-45)	18:02	19:39	20:17	20:53
22	07:56	08:25 (T-45)	07:17	07:28	06:32	05:52
	17:21	21 08:46 (T-45)	18:03	19:40	20:19	20:54
23	07:56	08:26 (T-45)	07:16	07:26	06:30	05:51
	17:22	20 08:46 (T-45)	18:04	19:41	20:20	20:55
24	07:55	08:27 (T-45)	07:14	07:24	06:29	05:51
	17:24	18 08:45 (T-45)	18:06	19:42	20:21	20:56
25	07:54	08:29 (T-45)	07:12	07:22	06:27	05:50
	17:25	14 08:43 (T-45)	18:07	19:44	20:22	20:57
26	07:53	08:31 (T-45)	07:11	07:20	06:26	05:49
	17:26	11 08:42 (T-45)	18:08	19:45	20:24	20:58
27	07:52		07:09	07:18	06:24	05:48
	17:28		18:10	19:46	20:25	20:59
28	07:51		07:07	07:17	06:23	05:47
	17:29		18:11	19:47	20:26	21:00
29	07:50			07:15	06:21	05:47
	17:31			19:49	20:27	21:01
30	07:49			07:13	06:19	05:46
	17:32			19:50	20:28	21:02
31	07:48			07:11	06:17	05:46
	17:33			19:51	21:03	21:03
Potential sun hours	287	292	369	403	459	465
Total, worst case	487					773
Sun reduction	0.58					0.66
Oper. time red.	0.90					0.90
Wind dir. red.	0.65					0.64
Total reduction	0.34					0.42
Total, real	166					40

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-324 - R-324

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45	20:22 (T-18)	06:12	06:48	07:24	07:04
	21:16	27 20:49 (T-18)	20:55	20:07	19:11	17:17
2	05:45	20:23 (T-18)	06:13	06:50	07:25	07:05
	21:16	26 20:49 (T-18)	20:53	20:05	19:09	17:15
3	05:46	20:23 (T-18)	06:15	06:51	07:26	07:07
	21:16	25 20:48 (T-18)	20:52	20:03	19:07	17:14
4	05:47	20:24 (T-18)	06:16	06:52	07:28	07:08
	21:16	24 20:48 (T-18)	20:51	20:01	19:05	17:13
5	05:47	20:25 (T-18)	06:17	06:53	07:29	07:09
	21:16	23 20:48 (T-18)	20:50	19:59	19:03	17:11
6	05:48	20:24 (T-18)	06:18	06:54	07:30	07:11
	21:15	24 20:48 (T-18)	20:48	19:58	19:01	17:10
7	05:49	20:25 (T-18)	06:19	06:55	07:31	07:12
	21:15	23 20:48 (T-18)	20:47	19:56	19:00	17:09
8	05:49	20:26 (T-18)	06:20	06:57	07:33	07:13
	21:15	22 20:48 (T-18)	20:46	19:54	18:56	17:07
9	05:50	20:25 (T-18)	06:21	06:58	07:34	07:15
	21:14	21 20:46 (T-18)	20:44	19:52	18:54	17:06
10	05:51	20:26 (T-18)	06:23	06:59	07:35	07:16
	21:14	20 20:46 (T-18)	20:43	19:50	18:52	17:05
11	05:52	20:27 (T-18)	06:24	07:00	07:36	07:17
	21:13	19 20:46 (T-18)	20:41	19:48	18:51	17:04
12	05:52	20:28 (T-18)	06:25	07:01	07:38	07:19
	21:13	18 20:46 (T-18)	20:40	19:46	18:49	17:03
13	05:53	20:28 (T-18)	06:26	07:02	07:39	07:20
	21:12	16 20:44 (T-18)	20:38	19:45	18:47	17:02
14	05:54	20:28 (T-18)	06:27	07:04	07:40	07:22
	21:11	16 20:44 (T-18)	20:37	19:43	18:45	17:01
15	05:55	20:29 (T-18)	06:28	07:05	07:41	07:23
	21:11	15 20:44 (T-18)	20:35	19:41	18:44	17:00
16	05:56	20:30 (T-18)	06:30	07:06	07:43	07:24
	21:10	13 20:43 (T-18)	20:34	19:39	18:42	16:59
17	05:57	20:31 (T-18)	06:31	07:07	07:44	07:26
	21:09	11 20:42 (T-18)	20:32	19:37	18:40	16:58
18	05:58	20:32 (T-18)	06:32	07:08	07:45	07:27
	21:09	10 20:42 (T-18)	20:31	19:35	18:38	16:57
19	05:59	20:34 (T-18)	06:33	07:10	07:47	07:28
	21:08	7 20:41 (T-18)	20:29	19:33	18:37	16:56
20	06:00	20:35 (T-18)	06:34	07:11	07:48	07:29
	21:07	6 20:41 (T-18)	20:27	19:31	18:35	16:55
21	06:01	20:37 (T-18)	06:35	07:12	07:49	07:31
	21:06	3 20:40 (T-18)	20:26	19:29	18:33	16:54
22	06:02		06:37	07:13	07:50	07:32
	21:05		20:24	19:28	18:32	16:53
23	06:03		06:38	07:14	07:52	07:33
	21:04		20:22	19:26	18:30	16:53
24	06:04		06:39	07:15	07:53	07:35
	21:03		20:21	19:24	18:29	16:52
25	06:05		06:40	07:17	07:54	07:36
	21:02		20:19	19:22	18:27	16:51
26	06:06		06:41	07:18	07:56	07:37
	21:01		20:17	19:20	18:25	16:51
27	06:07		06:43	07:19	07:57	07:38
	21:00		20:15	19:18	18:24	16:50
28	06:08		06:44	07:20	07:58	07:40
	20:59		20:14	19:16	18:22	16:50
29	06:09		06:45	07:22	08:00	07:41
	20:58		20:12	19:14	18:21	16:49
30	06:10		06:46	07:23	08:01	07:42
	20:57		20:10	19:13	18:19	16:49
31	06:11		06:47	07:24	08:02	07:43
	20:56		20:08	19:11	18:18	16:48
Potential sun hours	471	436	377	341	288	275
Total, worst case	369				315	366
Sun reduction	0.75				0.48	0.52
Oper. time red.	0.90				0.90	0.90
Wind dir. red.	0.64				0.65	0.65
Total reduction	0.44				0.28	0.31
Total, real	161				89	112

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-325 - R-325

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:46	07:05	17:31 (T-75)	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:03	07:42	
	16:57	17:35	18:12	15 17:46 (T-75)	19:52	20:29	21:03	21:16	20:54	20:06	19:10	17:16	16:48	
2	08:04	07:45	07:04	17:34 (T-75)	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44	
	16:58	17:36	18:14	9 17:43 (T-75)	19:53	20:30	21:04	21:16	20:53	20:04	19:08	17:15	16:48	
3	08:04	07:44	07:02		07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45	
	16:58	17:37	18:15		19:54	20:32	21:05	21:15	20:52	20:03	19:07	17:14	16:47	
4	08:04	07:43	07:00		07:03	06:14	05:43	05:47	06:16	06:52	07:27	07:07	07:46	
	16:59	17:39	18:16		19:56	20:33	21:06	21:15	20:50	20:01	19:05	17:12	16:47	
5	08:04	07:42	06:58		07:02	06:12	05:43	05:47	06:17	06:53	07:28	07:09	07:47	
	17:00	17:40	18:18		19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47	
6	08:03	07:40	06:57		07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48	
	17:01	17:42	18:19		19:58	20:35	21:07	21:15	20:48	19:57	19:01	17:10	16:47	
7	08:03	07:39	06:55		06:58	06:09	05:42	05:49	06:19	06:55	07:31	07:11	07:49	
	17:02	17:43	18:20		19:59	20:36	21:08	21:14	20:46	19:55	18:57	17:08	16:47	
8	08:03	07:38	07:53		06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50	
	17:04	17:45	18:22		20:01	20:38	21:09	21:14	20:45	19:53	18:56	17:07	16:46	
9	08:03	07:36	07:51		06:54	06:07	05:42	05:50	06:21	06:58	07:33	07:14	07:51	
	17:05	17:46	19:23		20:02	20:39	21:09	21:13	20:44	19:52	18:54	17:06	16:46	
10	08:02	07:35	07:49		06:53	06:05	05:41	05:51	06:22	06:59	07:35	07:16	07:52	
	17:06	17:47	19:24		20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46	
11	08:02	07:34	07:48		06:51	06:04	05:41	05:52	06:24	07:00	07:36	18:11 (T-75)	07:17	07:53
	17:07	17:49	19:25		20:04	20:41	21:11	21:13	20:41	19:48	18:50	3 18:14 (T-75)	17:04	16:46
12	08:02	07:32	07:46		06:49	06:03	05:41	05:52	06:25	07:01	07:37	18:06 (T-75)	07:18	07:54
	17:08	17:50	19:27		20:06	20:42	21:11	21:12	20:39	19:46	18:49	11 18:17 (T-75)	17:03	16:46
13	08:01	07:31	07:44		06:47	06:02	05:41	05:53	06:26	07:02	07:38	18:04 (T-75)	07:20	07:54
	17:09	17:52	19:28		20:07	20:44	21:12	21:11	20:38	19:44	18:47	16 18:20 (T-75)	17:02	16:46
14	08:01	07:29	07:42		06:45	06:01	05:41	05:54	06:27	07:03	07:40	18:02 (T-75)	07:21	07:55
	17:11	17:53	19:29		20:08	20:45	21:12	21:11	20:36	19:42	18:45	19 18:21 (T-75)	17:00	16:47
15	08:00	07:28	07:40		06:44	05:59	05:41	05:55	06:28	07:05	07:41	18:00 (T-75)	07:22	07:56
	17:12	17:54	19:31		20:09	20:46	21:13	21:10	20:35	19:40	18:43	19 18:19 (T-75)	16:59	16:47
16	08:00	07:26	07:38		06:42	05:58	05:41	05:56	06:29	07:06	07:42	18 18:00 (T-75)	07:24	07:57
	17:13	17:56	19:32		20:11	20:47	21:13	21:10	20:33	19:39	18:42	18 18:18 (T-75)	16:58	16:47
17	07:59	07:25	17:31 (T-75)	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:43	17:59 (T-75)	07:25	07:57
	17:14	17:57	2 17:33 (T-75)	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	17 18:16 (T-75)	16:57	16:47
18	07:59	07:23	17:29 (T-75)	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	17:58 (T-75)	07:26	07:58
	17:16	17:59	5 17:34 (T-75)	19:34	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16 18:14 (T-75)	16:57	16:48
19	07:58	07:22	17:29 (T-75)	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	17:59 (T-75)	07:28	07:59
	17:17	18:00	7 17:36 (T-75)	19:36	20:14	20:50	21:14	21:07	20:28	19:33	18:37	14 18:13 (T-75)	16:56	16:48
20	07:57	07:20	17:28 (T-75)	07:31	06:35	05:54	05:41	06:00	06:34	07:10	07:47	17:58 (T-75)	07:29	07:59
	17:18	18:00	9 17:37 (T-75)	19:37	20:16	20:51	21:15	21:06	20:27	19:31	18:35	13 18:11 (T-75)	16:55	16:48
21	07:57	07:19	17:27 (T-75)	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	17:59 (T-75)	07:30	08:00
	17:19	18:01	12 17:39 (T-75)	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	11 18:10 (T-75)	16:54	16:49
22	07:56	07:17	17:28 (T-75)	07:27	06:32	05:52	05:41	06:02	06:36	07:13	07:50	17:59 (T-75)	07:31	08:00
	17:21	18:03	13 17:41 (T-75)	19:39	20:18	20:54	21:15	21:05	20:24	19:27	18:32	9 18:08 (T-75)	16:53	16:49
23	07:55	07:15	17:27 (T-75)	07:25	06:30	05:51	05:42	06:03	06:38	07:14	07:51	17:59 (T-75)	07:33	08:01
	17:22	18:04	15 17:42 (T-75)	19:41	20:19	20:55	21:15	21:04	20:22	19:25	18:30	6 18:05 (T-75)	16:53	16:50
24	07:54	07:14	17:28 (T-75)	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	18:00 (T-75)	07:34	08:01
	17:24	18:05	16 17:44 (T-75)	19:42	20:21	20:56	21:16	21:03	20:20	19:23	18:28	4 18:04 (T-75)	16:52	16:50
25	07:53	07:12	17:28 (T-75)	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	18:01 (T-75)	07:35	08:02
	17:25	18:07	17 17:45 (T-75)	19:43	20:22	20:57	21:16	21:02	20:18	19:22	18:27	1 18:02 (T-75)	16:51	16:51
26	07:52	07:10	17:28 (T-75)	07:20	06:25	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02	
	17:26	18:08	18 17:46 (T-75)	19:44	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52	
27	07:51	07:09	17:28 (T-75)	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:02	
	17:28	18:10	19 17:47 (T-75)	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52	
28	07:50	07:07	17:30 (T-75)	07:16	06:22	05:47	05:43	06:08	06:43	07:20	07:58	07:39	08:03	
	17:29	18:11	18 17:48 (T-75)	19:47	20:25	21:00	21:16	20:59	20:13	19:16	18:22	16:49	16:53	
29	07:49			07:14	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03	
	17:30			19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54	
30	07:48			07:13	06:19	05:46	05:44	06:10	06:46	07:22	08:01	07:41	08:03	
	17:32			19:49	20:28	21:01	21:16	20:56	20:10	19:12	18:19	16:48	16:55	
31	07:47			07:11		05:45		06:11	06:47		08:02		08:03	
	17:33			19:51		21:02		20:55	20:08		18:18		16:55	
Potential sun hours	287	292	369		403	458	465	471	436	377	341	289	276	
Total, worst case		151		24							177			
Sun reduction		0.58		0.59							0.56			
Oper. time red.		0.90		0.90							0.90			
Wind dir. red.		0.59		0.59							0.59			
Total reduction		0.31		0.31							0.30			
Total, real		46		7							52			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-326 - R-326
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	08:29 (T-42) 07:47	08:24 (T-42) 07:06	07:09 06:18	05:45 05:45	06:12 06:48	07:24 07:04	07:43 08:09 (T-42)				
1	16:57	08:42 (T-42) 17:35	08:52 (T-42) 18:13	19:52 20:30	21:04 21:16	20:55 20:07	19:11 17:17	16:48 23 08:32 (T-42)				
2	08:04	08:29 (T-42) 07:46	08:26 (T-42) 07:04	07:07 06:17	05:44 05:45	06:13 06:50	07:25 07:05	07:44 08:10 (T-42)				
2	16:58	08:43 (T-42) 17:36	08:51 (T-42) 18:14	19:54 20:31	21:05 21:16	20:54 20:05	19:09 17:15	16:48 22 08:32 (T-42)				
3	08:04	08:29 (T-42) 07:45	08:27 (T-42) 07:02	07:05 06:15	05:44 05:46	06:15 06:51	07:26 07:07	07:45 08:11 (T-42)				
3	16:59	08:44 (T-42) 17:38	08:49 (T-42) 18:15	19:55 20:32	21:06 21:16	20:52 20:03	19:07 17:14	16:48 21 08:32 (T-42)				
4	08:04	08:29 (T-42) 07:43	08:29 (T-42) 07:01	07:04 06:14	05:43 05:47	06:16 06:52	07:28 07:08	07:47 08:12 (T-42)				
4	17:00	08:45 (T-42) 17:39	08:48 (T-42) 18:17	19:56 20:33	21:06 21:16	20:51 20:01	19:05 17:13	16:47 20 08:32 (T-42)				
5	08:04	08:28 (T-42) 07:42	08:32 (T-42) 06:59	07:02 06:12	05:43 05:47	06:17 06:53	07:29 07:09	07:48 08:13 (T-42)				
5	17:01	08:45 (T-42) 17:40	08:46 (T-42) 18:18	19:57 20:35	21:07 21:16	20:50 19:59	19:03 17:11	6 08:12 (T-42) 16:47 19 08:32 (T-42)				
6	08:04	08:28 (T-42) 07:41	08:36 (T-42) 06:57	07:00 06:11	05:43 05:48	06:18 06:54	07:30 07:11	08:01 (T-42) 07:49 08:14 (T-42)				
6	17:02	08:46 (T-42) 17:42	08:40 (T-42) 18:19	19:59 20:36	21:08 21:15	20:48 19:58	19:01 17:10	15 08:21 (T-42) 16:47 18 08:32 (T-42)				
7	08:04	08:28 (T-42) 07:40	06:55 06:58	06:10 05:42	05:49 06:19	06:56 07:31	07:12 07:58 (T-42)	07:50 08:15 (T-42)				
7	17:03	08:47 (T-42) 17:43	18:21 20:00	20:37 21:09	21:15 20:47	19:56 19:00	17:09 20 08:21 (T-42)	16:47 17 08:32 (T-42)				
8	08:04	08:28 (T-42) 07:38	07:53 06:56	06:08 05:42	05:49 06:20	06:57 07:33	07:13 07:57 (T-42)	07:51 08:16 (T-42)				
8	17:04	08:48 (T-42) 17:45	18:22 20:01	20:38 21:09	21:15 20:46	19:54 18:56	17:07 23 08:20 (T-42)	16:46 16 08:32 (T-42)				
9	08:03	08:27 (T-42) 07:37	07:52 06:55	06:07 05:42	05:50 06:21	06:58 07:34	07:15 07:55 (T-42)	07:52 08:17 (T-42)				
9	17:05	08:48 (T-42) 17:46	19:23 20:02	20:40 21:10	21:14 20:44	19:52 18:54	17:06 26 08:21 (T-42)	16:46 15 08:32 (T-42)				
10	08:03	08:27 (T-42) 07:36	07:50 06:53	06:06 05:41	05:51 06:23	06:59 07:35	07:16 07:55 (T-42)	07:53 08:18 (T-42)				
10	17:06	08:49 (T-42) 17:48	19:24 20:04	20:41 21:11	21:14 20:43	19:50 18:52	17:05 28 08:23 (T-42)	16:46 14 08:32 (T-42)				
11	08:03	08:27 (T-42) 07:34	07:48 06:51	06:04 05:41	05:52 06:24	07:00 07:36	07:18 07:54 (T-42)	07:53 08:19 (T-42)				
11	17:07	08:50 (T-42) 17:49	19:26 20:05	20:42 21:11	21:13 20:41	19:48 18:51	17:04 30 08:24 (T-42)	16:46 14 08:33 (T-42)				
12	08:02	08:26 (T-42) 07:33	07:46 06:49	06:03 05:41	05:52 06:25	07:01 07:38	07:19 07:54 (T-42)	07:54 08:20 (T-42)				
12	17:08	08:50 (T-42) 17:50	19:27 20:06	20:43 21:12	21:13 20:40	19:47 18:49	17:03 31 08:25 (T-42)	16:46 13 08:33 (T-42)				
13	08:02	08:26 (T-42) 07:31	07:44 06:47	06:02 05:41	05:53 06:26	07:03 07:39	07:20 07:53 (T-42)	07:55 08:21 (T-42)				
13	17:09	08:51 (T-42) 17:52	19:28 20:07	20:44 21:13	21:12 20:38	19:45 18:47	17:02 33 08:26 (T-42)	16:47 12 08:33 (T-42)				
14	08:02	08:25 (T-42) 07:30	07:43 06:46	06:01 05:41	05:54 06:27	07:04 07:40	07:22 07:53 (T-42)	07:56 08:22 (T-42)				
14	17:11	08:52 (T-42) 17:53	19:30 20:09	20:45 21:13	21:12 20:37	19:43 18:45	17:01 34 08:27 (T-42)	16:47 12 08:34 (T-42)				
15	08:01	08:24 (T-42) 07:28	07:41 06:44	06:00 05:41	05:55 06:28	07:05 07:41	07:23 07:52 (T-42)	07:57 08:22 (T-42)				
15	17:12	08:52 (T-42) 17:55	19:31 20:10	20:47 21:14	21:11 20:35	19:41 18:44	17:00 35 08:27 (T-42)	16:47 11 08:33 (T-42)				
16	08:01	08:24 (T-42) 07:27	07:39 06:42	05:59 05:41	05:56 06:30	07:06 07:43	07:24 07:52 (T-42)	07:57 08:23 (T-42)				
16	17:13	08:53 (T-42) 17:56	19:32 20:11	20:48 21:14	21:10 20:34	19:39 18:42	16:59 36 08:28 (T-42)	16:47 10 08:33 (T-42)				
17	08:00	08:23 (T-42) 07:25	07:37 06:41	05:57 05:41	05:57 06:31	07:07 07:44	07:26 07:52 (T-42)	07:58 08:24 (T-42)				
17	17:14	08:53 (T-42) 17:57	19:34 20:12	20:49 21:14	21:09 20:32	19:37 18:40	16:58 37 08:29 (T-42)	16:47 10 08:34 (T-42)				
18	07:59	08:22 (T-42) 07:24	07:35 06:39	05:56 05:41	05:58 06:32	07:08 07:45	07:27 07:51 (T-42)	07:59 08:24 (T-42)				
18	17:16	08:53 (T-42) 17:59	19:35 20:14	20:50 21:15	21:09 20:31	19:35 18:38	16:57 38 08:29 (T-42)	16:48 10 08:34 (T-42)				
19	07:59	08:22 (T-42) 07:22	07:33 06:37	05:55 05:41	05:59 06:33	07:10 07:47	07:28 07:53 (T-42)	08:00 08:25 (T-42)				
19	17:17	08:54 (T-42) 18:00	19:36 20:15	20:51 21:15	21:08 20:29	19:33 18:37	16:56 37 08:30 (T-42)	16:48 9 08:34 (T-42)				
20	07:58	08:21 (T-42) 07:21	07:31 06:35	05:54 05:41	06:00 06:34	07:11 07:48	07:30 07:54 (T-42)	08:00 08:26 (T-42)				
20	17:18	08:54 (T-42) 18:00	19:37 20:16	20:52 21:15	21:07 20:27	19:31 18:35	16:55 36 08:30 (T-42)	16:49 9 08:35 (T-42)				
21	07:57	08:20 (T-42) 07:19	07:30 06:34	05:53 05:41	06:01 06:36	07:12 07:49	07:31 07:56 (T-42)	08:01 08:26 (T-42)				
21	17:20	08:55 (T-42) 18:02	19:39 20:17	20:53 21:16	21:06 20:26	19:30 18:34	16:54 35 08:31 (T-42)	16:49 9 08:35 (T-42)				
22	07:56	08:19 (T-42) 07:17	07:28 06:32	05:52 05:41	06:02 06:37	07:13 07:50	07:32 07:57 (T-42)	08:01 08:27 (T-42)				
22	17:21	08:55 (T-42) 18:03	19:40 20:19	20:54 21:16	21:05 20:24	19:28 18:32	16:53 33 08:31 (T-42)	16:49 9 08:36 (T-42)				
23	07:56	08:18 (T-42) 07:16	07:26 06:31	05:52 05:42	06:03 06:38	07:14 07:52	07:33 07:58 (T-42)	08:02 08:27 (T-42)				
23	17:22	08:55 (T-42) 18:04	19:41 20:20	20:55 21:16	21:04 20:22	19:26 18:30	16:53 32 08:30 (T-42)	16:50 9 08:36 (T-42)				
24	07:55	08:17 (T-42) 07:14	07:24 06:29	05:51 05:42	06:04 06:39	07:16 07:53	07:35 08:00 (T-42)	08:02 08:27 (T-42)				
24	17:24	08:55 (T-42) 18:06	19:42 20:21	20:56 21:16	21:04 20:21	19:24 18:29	16:52 31 08:31 (T-42)	16:51 9 08:36 (T-42)				
25	07:54	08:18 (T-42) 07:13	07:22 06:27	05:50 05:42	06:05 06:40	07:17 07:54	07:36 08:01 (T-42)	08:03 08:28 (T-42)				
25	17:25	08:55 (T-42) 18:07	19:44 20:22	20:57 21:16	21:03 20:19	19:22 18:27	16:51 30 08:31 (T-42)	16:51 10 08:38 (T-42)				
26	07:53	08:18 (T-42) 07:11	07:20 06:26	05:49 05:43	06:06 06:41	07:18 07:56	07:37 08:02 (T-42)	08:03 08:28 (T-42)				
26	17:26	08:55 (T-42) 18:08	19:45 20:24	20:58 21:17	21:02 20:17	19:20 18:26	16:51 29 08:31 (T-42)	16:52 10 08:38 (T-42)				
27	07:52	08:19 (T-42) 07:09	07:18 06:24	05:48 05:43	06:07 06:43	07:19 07:57	07:38 08:04 (T-42)	08:03 08:28 (T-42)				
27	17:28	08:54 (T-42) 18:10	19:46 20:25	20:59 21:17	21:00 20:16	19:18 18:24	16:50 28 08:32 (T-42)	16:52 10 08:38 (T-42)				
28	07:51	08:20 (T-42) 07:07	07:17 06:23	05:48 05:43	06:08 06:44	07:20 07:58	07:40 08:05 (T-42)	08:03 08:28 (T-42)				
28	17:29	08:54 (T-42) 18:11	19:47 20:26	21:00 21:17	20:59 20:14	19:16 18:23	16:50 27 08:32 (T-42)	16:53 11 08:39 (T-42)				
29	07:50	08:21 (T-42)	07:15 06:21	05:47 05:44	06:09 06:45	07:22 08:00	07:41 08:06 (T-42)	08:04 08:29 (T-42)				
29	17:31	08:54 (T-42)	19:49 20:27	21:01 21:17	20:58 20:12	19:14 18:21	16:49 26 08:32 (T-42)	16:54 11 08:40 (T-42)				
30	07:49	08:22 (T-42)	07:13 06:20	05:46 05:44	06:10 06:46	07:23 08:01	07:42 08:07 (T-42)	08:04 08:29 (T-42)				
30	17:32	08:53 (T-42)	19:50 20:29	21:02 21:17	20:57 20:10	19:13 18:20	16:49 24 08:31 (T-42)	16:55 12 08:41 (T-42)				
31	07:48	08:23 (T-42)	07:11 06:18	05:46 05:41	06:11 06:47	08:03 18:18		08:04 08:29 (T-42)				
31	17:33	08:53 (T-42)	19:51 20:30	21:03 20:56	20:09 18:18			16:56 13 08:42 (T-42)				
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275
Total, worst case	840	112									760	408
Sun reduction	0.58	0.58									0.48	0.52
Oper. time red.	0.90	0.90									0.90	0.90
Wind dir. red.	0.65	0.65									0.65	0.65
Total reduction	0.34	0.34									0.28	0.30
Total, real	285	38									213	124

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-327 - R-327
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:05 16:57	07:47 17:35	07:06 18:13	07:10 19:53	07:30 (T-33) 20:30	06:19 21:04	05:46 21:17	06:13 20:55	06:49 20:07	07:11 (T-33) 37	07:25 19:11	07:04 17:17	07:44 16:49
2	08:05 16:58	07:46 17:37	07:05 18:14	07:08 19:54	07:28 (T-33) 20:31	06:17 21:05	05:45 21:17	06:14 20:54	06:50 20:05	07:12 (T-33) 36	07:26 19:09	07:06 17:16	07:45 16:48
3	08:05 16:59	07:45 17:38	07:03 18:16	07:06 19:55	07:26 (T-33) 20:33	06:16 21:06	05:45 21:17	06:15 20:53	06:51 20:04	07:13 (T-33) 34	07:27 19:08	07:07 17:14	07:46 16:48
4	08:05 17:00	07:44 17:40	07:01 18:17	07:04 19:57	07:24 (T-33) 20:34	06:14 21:07	05:44 21:16	06:16 20:51	06:53 20:02	07:14 (T-33) 33	07:28 19:06	07:08 17:13	07:47 16:48
5	08:05 17:01	07:43 17:41	06:59 18:18	07:02 19:58	07:23 (T-33) 20:35	06:13 21:08	05:44 21:16	06:17 20:50	06:54 20:00	07:15 (T-33) 31	07:29 19:04	07:10 17:12	07:48 16:48
6	08:05 17:02	07:41 17:42	06:58 18:20	07:01 19:59	07:21 (T-33) 20:36	06:12 21:08	05:43 21:16	06:19 20:49	06:55 19:58	07:17 (T-33) 29	07:31 19:02	07:11 17:11	07:49 16:47
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	07:19 (T-33) 20:38	06:10 21:09	05:43 21:15	06:20 20:47	06:56 19:56	07:18 (T-33) 28	07:32 19:00	07:13 17:09	07:50 16:47
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	07:17 (T-33) 20:39	06:09 21:10	05:43 21:15	06:21 20:46	06:57 19:54	07:19 (T-33) 26	07:33 18:57	07:14 17:08	07:51 16:47
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 20:03	07:15 (T-33) 20:40	06:08 21:11	05:42 21:15	06:22 20:45	06:58 19:53	07:20 (T-33) 23	07:34 18:55	07:15 17:07	07:52 16:47
10	08:04 17:07	07:36 17:48	07:50 19:25	06:53 20:04	07:14 (T-33) 20:41	06:06 21:11	05:42 21:14	06:23 20:43	07:00 19:51	07:21 (T-33) 21	07:36 18:53	07:17 17:06	07:53 16:47
11	08:03 17:08	07:35 17:50	07:49 19:26	06:52 20:05	07:12 (T-33) 20:42	06:05 21:12	05:42 21:14	06:24 20:42	07:01 19:49	07:22 (T-33) 19	07:37 18:51	07:18 17:04	07:54 16:47
12	08:03 17:09	07:33 17:51	07:47 19:28	06:50 20:07	07:10 (T-33) 20:44	06:04 21:12	05:53 21:13	06:26 20:40	07:02 19:47	07:23 (T-33) 16	07:38 18:49	07:19 17:03	07:55 16:47
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	07:08 (T-33) 20:45	06:03 21:13	05:42 21:13	06:27 20:39	07:03 19:45	07:24 (T-33) 13	07:39 18:48	07:21 17:02	07:56 16:47
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	07:08 (T-33) 20:46	06:01 21:13	05:41 21:12	06:28 20:37	07:04 19:43	07:26 (T-33) 10	07:41 18:46	07:22 17:01	07:56 16:47
15	08:02 17:12	07:29 17:55	07:41 19:31	06:45 20:10	07:08 (T-33) 20:47	06:00 21:14	05:41 21:11	06:29 20:36	07:05 19:41	07:27 (T-33) 6	07:42 18:44	07:23 17:00	07:57 16:48
16	08:01 17:14	07:27 17:57	07:39 19:33	06:43 20:12	07:08 (T-33) 20:48	05:59 21:14	05:41 21:11	06:30 20:34	07:07 19:39	07:33 (T-33) 1	07:43 18:42	07:25 16:59	07:58 16:48
17	08:00 17:15	07:26 17:58	07:38 19:34	06:41 20:13	07:08 (T-33) 20:49	05:58 21:15	05:41 21:10	06:31 20:33	07:08 19:38	07:29 (T-33) 1	07:44 18:41	07:26 16:58	07:59 16:48
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 20:14	07:09 (T-33) 20:50	05:57 21:15	05:41 21:09	06:33 20:31	07:09 19:36	07:30 (T-33) 1	07:46 18:39	07:27 16:57	07:59 16:48
19	07:59 17:18	07:23 18:01	07:34 19:37	06:38 20:15	07:10 (T-33) 20:51	05:56 21:16	05:42 21:16	06:34 20:29	07:10 19:34	07:27 (T-33) 6	07:47 18:37	07:29 16:56	08:00 16:49
20	07:58 17:19	07:21 18:01	07:32 19:38	06:36 20:17	07:12 (T-33) 20:53	05:55 21:16	05:42 21:08	06:35 20:28	07:11 19:32	07:22 (T-33) 16	07:48 18:36	07:30 16:56	08:01 16:49
21	07:58 17:20	07:20 18:02	07:30 19:39	06:34 20:18	07:13 (T-33) 20:54	05:54 21:16	05:42 21:07	06:36 20:26	07:13 19:30	07:23 (T-33) 21	07:50 18:34	07:31 16:55	08:01 16:50
22	07:57 17:22	07:18 18:04	07:28 19:40	06:33 20:19	07:14 (T-33) 20:55	05:53 21:16	05:42 21:06	06:37 20:25	07:14 19:28	07:17 (T-33) 26	07:51 18:32	07:33 16:54	08:02 16:50
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 20:20	07:18 (T-33) 20:56	05:52 21:17	05:42 21:05	06:38 20:23	07:15 19:26	07:15 (T-33) 29	07:52 18:31	07:34 16:53	08:02 16:51
24	07:55 17:24	07:15 18:06	07:25 19:43	06:29 20:22	07:24 (T-33) 20:57	05:51 21:17	05:43 21:04	06:31 20:21	07:16 19:24	07:14 (T-33) 31	07:54 18:29	07:35 16:53	08:03 16:51
25	07:54 17:26	07:13 18:08	07:23 19:44	06:28 20:23	07:25 (T-33) 20:58	05:50 21:17	05:43 21:03	06:41 20:19	07:17 19:22	07:12 (T-33) 34	07:55 18:28	07:36 16:52	08:03 16:52
26	07:53 17:27	07:11 18:09	07:21 19:45	06:26 20:24	07:26 (T-33) 20:59	05:50 21:17	05:43 21:02	06:42 20:18	07:18 19:21	07:11 (T-33) 35	07:56 18:26	07:38 16:51	08:03 16:52
27	07:53 17:28	07:10 18:10	07:19 19:47	06:25 20:25	07:27 (T-33) 21:00	05:49 21:17	05:44 21:01	06:43 20:16	07:19 19:19	07:10 (T-33) 37	07:58 18:25	07:39 16:51	08:04 16:53
28	07:52 17:30	07:08 18:12	07:17 19:48	06:23 20:27	07:28 (T-33) 21:01	05:48 21:17	05:44 21:00	06:44 19:14	07:21 19:17	07:08 (T-33) 39	07:59 18:23	07:40 16:50	08:04 16:54
29	07:51 17:31	07:07 18:15	07:15 19:49	06:22 20:28	07:29 (T-33) 21:02	05:47 21:17	05:45 20:59	06:46 20:13	07:22 19:15	07:09 (T-34) 40	07:59 18:22	07:41 16:50	08:04 16:55
30	07:49 17:33	07:06 18:23	07:13 19:50	06:20 20:29	07:30 (T-33) 21:03	05:47 21:17	05:45 20:58	06:47 20:11	07:23 19:13	07:10 (T-33) 39	07:59 18:20	07:42 16:49	08:04 16:55
31	07:48 17:34	07:05 18:25	07:12 19:57	06:19 20:30	07:31 (T-33) 21:04	05:46 21:18	05:44 20:56	06:48 20:09	07:24 19:13	07:11 (T-33) 38	08:03 18:19	07:43 16:56	08:05 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	
Total, worst case			41	694					363				
Sun reduction			0.59	0.63					0.67				
Oper. time red.			0.90	0.90					0.90				
Wind dir. red.			0.58	0.58					0.58				
Total reduction			0.31	0.33					0.35				
Total, real			13	228				147	127				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-328 - R-328

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:29	21:04	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:14	05:43	05:47	06:16	06:52	07:27	07:08	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:12	16:47
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
6	08:04	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48
	17:01	17:42	18:19	19:58	20:36	21:08	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:09	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:02	17:43	18:20	20:00	20:37	21:08	21:15	20:47	19:55	18:58	17:09	16:46
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:05	05:41	05:51	06:22	06:59	07:35	07:16	07:52
	17:06	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:41	21:11	21:13	20:41	19:48	18:50	17:04	16:46
12	08:02	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	16:46
14	08:01	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:03	07:40	07:21	07:56
	17:11	17:53	19:29	20:08	20:45	21:13	21:11	20:36	19:42	18:45	17:00	16:47
15	08:01	07:28	07:40	06:44	05:59	05:41	05:55	06:28	07:05	07:41	07:23	07:56
	17:12	17:54	19:31	20:10	20:46	21:13	21:10	20:35	19:41	18:43	16:59	16:47
16	08:00	07:27	07:39	06:42	05:58	05:41	05:56	06:29	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:33	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:58	16:47
18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27	07:58
	17:16	17:59	19:35	20:13	20:50	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
	17:19	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:16	21:05	20:24	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	05:51	05:42	06:03	06:38	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:28	16:52	16:50
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:13	19:16	18:22	16:49	16:53
29	07:50		07:14	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:22	08:01	07:42	08:03
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:48	16:55
31	07:48		07:11		05:45		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:55
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-329 - R-329
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June			
1	08:04	15:14 (T-74) 07:46	15:51 (T-74)	07:05	07:09	06:18	19:46 (T-67) 05:45	06:08 (T-71)	
	16:57	63 16:17 (T-74) 17:35	11 16:02 (T-74)	18:12	19:52	20:29	20:06 (T-67) 21:03	19 06:27 (T-71)	
2	08:04	15:15 (T-74) 07:45		07:04	07:07	06:16	19:47 (T-67) 05:44	06:08 (T-71)	
	16:58	62 16:17 (T-74) 17:36		18:14	19:53	20:30	20:05 (T-67) 21:04	19 06:27 (T-71)	
3	08:04	15:16 (T-74) 07:44		07:02	07:05	06:15	19:48 (T-67) 05:44	06:07 (T-71)	
	16:59	62 16:18 (T-74) 17:38		18:15	19:55	20:32	20:03 (T-67) 21:05	19 06:26 (T-71)	
4	08:04	15:16 (T-74) 07:43		07:00	07:03	06:14	19:50 (T-67) 05:43	06:07 (T-71)	
	17:00	62 16:18 (T-74) 17:39		18:16	19:56	20:33	20:01 (T-67) 21:06	19 06:26 (T-71)	
5	08:04	15:17 (T-74) 07:42		06:58	07:02	06:12		05:43	06:07 (T-71)
	17:01	62 16:19 (T-74) 17:40		18:18	19:57	20:34		21:07	19 06:26 (T-71)
6	08:03	15:18 (T-74) 07:40		06:57	07:00	06:11		05:43	06:07 (T-71)
	17:02	61 16:19 (T-74) 17:42		18:19	19:58	20:35		21:07	19 06:26 (T-71)
7	08:03	15:18 (T-74) 07:39		06:55	06:58	06:09		05:42	06:08 (T-71)
	17:03	61 16:19 (T-74) 17:43		18:20	20:00	20:37		21:08	18 06:26 (T-71)
8	08:03	15:18 (T-74) 07:38		07:53	06:56	06:08		05:42	06:09 (T-71)
	17:04	61 16:19 (T-74) 17:45		18:22	20:01	20:38		21:09	17 06:26 (T-71)
9	08:03	15:19 (T-74) 07:36		07:51	06:54	06:07		05:42	06:10 (T-71)
	17:05	61 16:20 (T-74) 17:46		19:23	20:02	20:39		21:09	16 06:26 (T-71)
10	08:03	15:19 (T-74) 07:35		07:49	06:53	06:06		05:41	06:09 (T-71)
	17:06	60 16:19 (T-74) 17:47		19:24	20:03	20:40		21:10	16 06:25 (T-71)
11	08:02	15:21 (T-74) 07:34		07:48	06:51	06:04		05:41	06:10 (T-71)
	17:07	59 16:20 (T-74) 17:49		19:26	20:05	20:41		21:11	15 06:25 (T-71)
12	08:02	15:21 (T-74) 07:32		07:46	06:49	06:03		05:41	06:11 (T-71)
	17:08	59 16:20 (T-74) 17:50		19:27	20:06	20:43		21:11	13 06:24 (T-71)
13	08:01	15:22 (T-74) 07:31		07:44	06:47	06:02		05:41	06:12 (T-71)
	17:09	58 16:20 (T-74) 17:52		19:28	20:07	20:44		21:12	12 06:24 (T-71)
14	08:01	15:22 (T-74) 07:29		07:42	06:46	06:01	06:23 (T-71)	05:41	06:12 (T-71)
	17:11	58 16:20 (T-74) 17:53		19:29	20:08	20:45	1 06:24 (T-71)	21:12	12 06:24 (T-71)
15	08:01	15:24 (T-74) 07:28		07:40	06:44	06:00	06:22 (T-71)	05:41	06:13 (T-71)
	17:12	56 16:20 (T-74) 17:54		19:31	20:09	20:46	3 06:25 (T-71)	21:13	11 06:24 (T-71)
16	08:00	15:24 (T-74) 07:26		07:39	06:42	05:58	06:21 (T-71)	05:41	06:13 (T-71)
	17:13	56 16:20 (T-74) 17:56		19:32	20:11	20:47	4 06:25 (T-71)	21:13	11 06:24 (T-71)
17	07:59	15:24 (T-74) 07:25		07:37	06:40	05:57	06:20 (T-71)	05:41	06:14 (T-71)
	17:14	56 16:20 (T-74) 17:57		19:33	20:12	20:48	6 06:26 (T-71)	21:14	10 06:24 (T-71)
18	07:59	15:26 (T-74) 07:23		07:35	06:39	05:56	06:19 (T-71)	05:41	06:14 (T-71)
	17:16	54 16:20 (T-74) 17:59		19:35	20:13	2 19:49 (T-67) 20:49	7 06:26 (T-71) 21:14	10 06:24 (T-71)	
19	07:58	15:27 (T-74) 07:22		07:33	06:37	05:55	06:18 (T-71)	05:41	06:15 (T-71)
	17:17	53 16:20 (T-74) 18:00		19:36	20:14	4 19:51 (T-67) 20:50	9 06:27 (T-71) 21:14	8 06:23 (T-71)	
20	07:57	15:28 (T-74) 07:20		07:31	06:35	05:54	19:47 (T-67) 05:54	05:41	06:15 (T-71)
	17:18	51 16:19 (T-74) 18:00		19:37	20:16	6 19:53 (T-67) 20:52	10 06:27 (T-71) 21:15	8 06:23 (T-71)	
21	07:57	15:28 (T-74) 07:19		07:29	06:34	05:53	19:45 (T-67) 05:53	05:41	06:16 (T-71)
	17:20	50 16:18 (T-74) 18:01		19:38	20:17	9 19:54 (T-67) 20:53	11 06:27 (T-71) 21:15	8 06:24 (T-71)	
22	07:56	15:30 (T-74) 07:17		07:27	06:32	05:52	19:45 (T-67) 05:52	05:41	06:16 (T-71)
	17:21	49 16:19 (T-74) 18:03		19:40	20:18	11 19:56 (T-67) 20:54	12 06:27 (T-71) 21:15	8 06:24 (T-71)	
23	07:55	15:31 (T-74) 07:15		07:26	06:30	05:52	19:44 (T-67) 05:52	05:41	06:16 (T-71)
	17:22	47 16:18 (T-74) 18:04		19:41	20:19	13 19:57 (T-67) 20:55	13 06:27 (T-71) 21:16	8 06:24 (T-71)	
24	07:54	15:33 (T-74) 07:14		07:24	06:29	05:51	19:43 (T-67) 05:51	05:42	06:15 (T-71)
	17:24	45 16:18 (T-74) 18:06		19:42	20:21	14 19:57 (T-67) 20:56	14 06:27 (T-71) 21:16	9 06:24 (T-71)	
25	07:53	15:34 (T-74) 07:12		07:22	06:27	05:50	19:44 (T-67) 05:50	05:42	06:16 (T-71)
	17:25	43 16:17 (T-74) 18:07		19:43	20:22	15 19:59 (T-67) 20:57	15 06:28 (T-71) 21:16	10 06:26 (T-71)	
26	07:52	15:36 (T-74) 07:10		07:20	06:26	05:49	19:43 (T-67) 05:49	05:43	06:16 (T-71)
	17:26	40 16:16 (T-74) 18:08		19:45	20:23	17 20:00 (T-67) 20:58	16 06:28 (T-71) 21:16	10 06:26 (T-71)	
27	07:52	15:37 (T-74) 07:09		07:18	06:24	05:48	19:44 (T-67) 05:48	05:43	06:15 (T-71)
	17:28	38 16:15 (T-74) 18:10		19:46	20:24	17 20:01 (T-67) 20:59	16 06:27 (T-71) 21:16	11 06:26 (T-71)	
28	07:51	15:39 (T-74) 07:07		07:16	06:22	05:48	19:44 (T-67) 05:48	05:43	06:15 (T-71)
	17:29	34 16:13 (T-74) 18:11		19:47	20:26	18 20:02 (T-67) 21:00	17 06:28 (T-71) 21:16	12 06:27 (T-71)	
29	07:50	15:41 (T-74) 07:06		07:14	06:21	05:47	19:44 (T-67) 05:47	05:44	06:15 (T-71)
	17:30	31 16:12 (T-74) 18:09		19:48	20:27	20 20:04 (T-67) 21:01	17 06:27 (T-71) 21:16	12 06:27 (T-71)	
30	07:49	15:44 (T-74) 07:05		07:13	06:19	05:46	19:44 (T-67) 05:46	05:44	06:15 (T-71)
	17:32	26 16:10 (T-74) 18:06		19:50	20:28	20 20:04 (T-67) 21:02	18 06:27 (T-71) 21:16	13 06:28 (T-71)	
31	07:47	15:46 (T-74) 07:04		07:11	06:18	05:46	06:09 (T-71)	05:44	
	17:33	21 16:07 (T-74) 18:07		19:51	20:29	21 21:02	18 06:27 (T-71)	21:16	
Potential sun hours	287	292	369	403	458		465	392	
Total, worst case	1599	11		166		271		392	
Sun reduction	0.58	0.58		0.63		0.66		0.73	
Oper. time red.	0.90	0.90		0.90		0.90		0.90	
Wind dir. red.	0.62	0.62		0.60		0.59		0.59	
Total reduction	0.32	0.32		0.34		0.35		0.39	
Total, real	516	4		57		96		152	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 SG4.4-164 WTGs on 97.5m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 4:45 PM/3.6.366

SHADOW - Calendar

Calculation: L086_SG Shadow Flicker Assessment Shadow receptor: R-329 - R-329
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December				
1	05:45	06:14 (T-71)	06:12	06:48	07:24	07:03	07:43	15:03 (T-74)		
	21:16	14 06:28 (T-71)	20:54	20:06	19:10	17:17	16:48	59 16:02 (T-74)		
2	05:45	06:15 (T-71)	06:13	06:49	07:25	07:05	07:44	15:03 (T-74)		
	21:16	15 06:30 (T-71)	20:53	20:05	19:09	17:15	16:48	59 16:02 (T-74)		
3	05:46	06:14 (T-71)	06:15	06:51	07:26	07:06	07:45	15:03 (T-74)		
	21:15	16 06:30 (T-71)	20:52	20:03	19:07	17:14	16:47	60 16:03 (T-74)		
4	05:47	06:14 (T-71)	06:16	06:52	07:27	07:07	07:46	15:03 (T-74)		
	21:15	17 06:31 (T-71)	20:50	20:01	19:05	17:12	16:47	60 16:03 (T-74)		
5	05:47	06:14 (T-71)	06:17	06:53	07:29	07:09	07:47	15:03 (T-74)		
	21:15	18 06:32 (T-71)	20:49	19:59	19:03	17:11	16:47	61 16:04 (T-74)		
6	05:48	06:13 (T-71)	06:18	06:54	07:30	07:10	07:48	15:04 (T-74)		
	21:15	19 06:32 (T-71)	20:48	19:57	19:01	17:10	16:47	61 16:05 (T-74)		
7	05:49	06:13 (T-71)	06:19	06:55	07:31	07:12	07:49	15:04 (T-74)		
	21:14	20 06:33 (T-71)	20:46	19:55	18:58	17:09	16:47	62 16:06 (T-74)		
8	05:49	06:14 (T-71)	06:20	20:01 (T-67)	06:56	07:32	07:13	07:50	15:04 (T-74)	
	21:14	19 06:33 (T-71)	20:45	6 20:07 (T-67)	19:54	18:56	17:07	16:46	62 16:06 (T-74)	
9	05:50	06:14 (T-71)	06:21	19:58 (T-67)	06:58	07:33	07:14	07:51	15:05 (T-74)	
	21:14	19 06:33 (T-71)	20:44	12 20:10 (T-67)	19:52	18:54	17:06	16:46	62 16:07 (T-74)	
10	05:51	06:15 (T-71)	06:23	19:57 (T-67)	06:59	07:35	07:16	15:22 (T-74)	07:52	15:04 (T-74)
	21:13	19 06:34 (T-71)	20:42	16 20:13 (T-67)	19:50	18:52	17:05	12 15:34 (T-74)	16:46	62 16:06 (T-74)
11	05:52	06:16 (T-71)	06:24	19:55 (T-67)	07:00	07:36	07:17	15:18 (T-74)	07:53	15:04 (T-74)
	21:13	19 06:35 (T-71)	20:41	19 20:14 (T-67)	19:48	18:50	17:04	21 15:39 (T-74)	16:46	63 16:07 (T-74)
12	05:52	06:17 (T-71)	06:25	19:54 (T-67)	07:01	07:37	07:18	15:15 (T-74)	07:54	15:05 (T-74)
	21:12	18 06:35 (T-71)	20:39	20 20:14 (T-67)	19:46	18:49	17:03	26 15:41 (T-74)	16:46	63 16:08 (T-74)
13	05:53	06:17 (T-71)	06:26	19:53 (T-67)	07:02	07:38	07:20	15:13 (T-74)	07:55	15:05 (T-74)
	21:12	18 06:35 (T-71)	20:38	20 20:13 (T-67)	19:44	18:47	17:02	31 15:44 (T-74)	16:47	63 16:08 (T-74)
14	05:54	06:18 (T-71)	06:27	19:52 (T-67)	07:03	07:40	07:21	15:11 (T-74)	07:55	15:06 (T-74)
	21:11	18 06:36 (T-71)	20:36	19 20:11 (T-67)	19:42	18:45	17:01	34 15:45 (T-74)	16:47	63 16:09 (T-74)
15	05:55	06:19 (T-71)	06:28	19:51 (T-67)	07:05	07:41	07:22	15:10 (T-74)	07:56	15:07 (T-74)
	21:10	17 06:36 (T-71)	20:35	18 20:09 (T-67)	19:41	18:43	17:00	38 15:48 (T-74)	16:47	63 16:10 (T-74)
16	05:56	06:20 (T-71)	06:30	19:50 (T-67)	07:06	07:42	07:24	15:08 (T-74)	07:57	15:06 (T-74)
	21:10	16 06:36 (T-71)	20:33	18 20:08 (T-67)	19:39	18:42	16:59	41 15:49 (T-74)	16:47	63 16:09 (T-74)
17	05:57	06:21 (T-71)	06:31	19:50 (T-67)	07:07	07:44	07:25	15:07 (T-74)	07:58	15:07 (T-74)
	21:09	16 06:37 (T-71)	20:32	16 20:06 (T-67)	19:37	18:40	16:58	43 15:50 (T-74)	16:47	63 16:10 (T-74)
18	05:58	06:22 (T-71)	06:32	19:50 (T-67)	07:08	07:45	07:26	15:07 (T-74)	07:58	15:08 (T-74)
	21:08	15 06:37 (T-71)	20:30	15 20:05 (T-67)	19:35	18:38	16:57	45 15:52 (T-74)	16:48	63 16:11 (T-74)
19	05:59	06:23 (T-71)	06:33	19:50 (T-67)	07:09	07:46	07:28	15:05 (T-74)	07:59	15:08 (T-74)
	21:07	14 06:37 (T-71)	20:29	14 20:04 (T-67)	19:33	18:37	16:56	47 15:52 (T-74)	16:48	63 16:11 (T-74)
20	06:00	06:24 (T-71)	06:34	19:50 (T-67)	07:11	07:47	07:29	15:05 (T-74)	07:59	15:09 (T-74)
	21:07	14 06:38 (T-71)	20:27	12 20:02 (T-67)	19:31	18:35	16:55	49 15:54 (T-74)	16:49	63 16:12 (T-74)
21	06:01	06:25 (T-71)	06:35	19:50 (T-67)	07:12	07:49	07:30	15:04 (T-74)	08:00	15:09 (T-74)
	21:06	13 06:38 (T-71)	20:25	10 20:00 (T-67)	19:29	18:33	16:54	50 15:54 (T-74)	16:49	63 16:12 (T-74)
22	06:02	06:26 (T-71)	06:37	19:50 (T-67)	07:13	07:50	07:32	15:04 (T-74)	08:01	15:10 (T-74)
	21:05	12 06:38 (T-71)	20:24	9 19:59 (T-67)	19:27	18:32	16:53	51 15:55 (T-74)	16:49	63 16:13 (T-74)
23	06:03	06:26 (T-71)	06:38	19:51 (T-67)	07:14	07:51	07:33	15:04 (T-74)	08:01	15:10 (T-74)
	21:04	11 06:37 (T-71)	20:22	6 19:57 (T-67)	19:25	18:30	16:53	53 15:57 (T-74)	16:50	63 16:13 (T-74)
24	06:04	06:27 (T-71)	06:39	19:51 (T-67)	07:15	07:53	07:34	15:03 (T-74)	08:01	15:11 (T-74)
	21:03	9 06:36 (T-71)	20:20	4 19:55 (T-67)	19:24	18:29	16:52	54 15:57 (T-74)	16:51	63 16:14 (T-74)
25	06:05	06:28 (T-71)	06:40	19:52 (T-67)	07:16	07:54	07:35	15:03 (T-74)	08:02	15:11 (T-74)
	21:02	8 06:36 (T-71)	20:19	1 19:53 (T-67)	19:22	18:27	16:51	55 15:58 (T-74)	16:51	63 16:14 (T-74)
26	06:06	06:29 (T-71)	06:41	07:18	07:55	07:37	15:03 (T-74)	08:02	15:11 (T-74)	63 16:14 (T-74)
	21:01	7 06:36 (T-71)	20:17	19:20	18:25	16:51	56 15:59 (T-74)	16:52	63 16:14 (T-74)	
27	06:07	06:30 (T-71)	06:42	07:19	07:57	07:38	15:03 (T-74)	08:03	15:12 (T-74)	63 16:15 (T-74)
	21:00	5 06:35 (T-71)	20:15	19:18	18:24	16:50	56 15:59 (T-74)	16:52	63 16:15 (T-74)	
28	06:08	06:32 (T-71)	06:44	07:20	07:58	07:39	15:02 (T-74)	08:03	15:13 (T-74)	63 16:16 (T-74)
	20:59	4 06:36 (T-71)	20:13	19:16	18:22	16:50	58 16:00 (T-74)	16:53	63 16:16 (T-74)	
29	06:09	06:33 (T-71)	06:45	07:21	07:59	07:40	15:02 (T-74)	08:03	15:13 (T-74)	63 16:16 (T-74)
	20:58	2 06:35 (T-71)	20:12	19:14	18:21	16:49	58 16:00 (T-74)	16:54	63 16:16 (T-74)	
30	06:10	06:46	07:22	08:01	07:41	15:03 (T-74)	08:03	15:13 (T-74)	63 16:16 (T-74)	
	20:57	20:10	19:12	18:19	16:49	59 16:02 (T-74)	16:55	63 16:16 (T-74)		
31	06:11	06:47	08:02	08:02	08:03	15:14 (T-74)	16:56	62 16:16 (T-74)		
	20:55	20:08	18:18	16:56	62 16:16 (T-74)					
Potential sun hours	471	436	377	341	289	276	1930			
Total, worst case			235		937		0.52			
Sun reduction	0.75		0.72		0.48		0.90			
Oper. time red.	0.90		0.90		0.62		0.29			
Wind dir. red.	0.59		0.60		0.27		0.59			
Total reduction	0.40		0.39		0.27		0.59			
Total, real	165	92	250		559					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-006 - R-006
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:47
6	08:05	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:59	06:10	05:43	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:38	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:55	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
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14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:41	07:22	07:56
	17:11	17:54	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:36	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:01	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:01	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:14	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:22	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:41	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:52	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:05
	17:34		19:52	21:04			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-007 - R-007

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:47
6	08:05	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
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10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
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	17:11	17:54	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:41	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:52	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:48		08:03		08:04
	17:34		19:52		21:04		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
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Total reduction												
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Table layout: For each day in each month the following matrix apply

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Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
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1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-021 - R-021

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	07:06 18:12	17:36 (T-90) 18:24	07:09 19:52	06:18 20:30	05:45 21:04	05:45 21:16	06:12 20:55	06:48 20:07	07:24 19:11	07:43 17:17
2	08:04 16:57	07:46 17:36	07:04 18:14	17:38 (T-90) 17:51 (T-90)	07:07 19:54	06:16 20:31	05:44 21:05	05:45 21:16	06:13 20:54	06:50 20:05	07:25 19:09	07:44 17:15
3	08:04 16:58	07:45 17:37	07:02 18:15	17:40 (T-90) 17:48 (T-90)	07:05 19:55	06:15 20:32	05:44 21:06	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	07:45 17:14
4	08:04 16:59	07:43 17:39	07:00 18:16	07:04 19:56	07:04 19:56	06:14 20:33	05:43 21:06	05:46 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:47 17:12
5	08:04 17:00	07:42 17:40	06:59 18:18	07:02 19:57	06:12 20:35	05:43 21:07	05:47 21:16	06:17 20:50	06:53 19:59	07:29 19:03	07:29 19:03	07:48 17:11
6	08:04 17:01	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:42 21:08	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:01	07:30 19:01	07:49 17:10
7	08:04 17:02	07:40 17:43	06:55 18:20	06:58 20:00	06:09 20:37	05:42 21:09	05:48 21:15	06:19 20:47	06:55 19:56	07:31 19:00	07:31 19:00	07:50 17:09
8	08:04 17:03	07:38 17:45	07:53 18:22	06:56 20:01	06:08 20:38	05:42 21:09	05:49 21:15	06:20 20:46	06:57 19:54	07:33 18:56	07:33 18:56	07:51 17:07
9	08:03 17:05	07:37 17:46	07:52 19:23	06:54 20:02	06:07 20:39	05:41 21:10	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	07:34 18:54	07:52 17:06
10	08:03 17:06	07:36 17:47	07:50 19:24	06:53 20:04	06:05 20:41	05:41 21:11	05:51 21:14	06:22 20:43	06:59 19:50	07:35 18:52	18:18 (T-90) 18:19 (T-90)	07:16 17:05
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:42	05:41 21:11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:51	18:13 (T-90) 18:24 (T-90)	07:17 17:04
12	08:02 17:08	07:33 17:50	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:52 21:13	06:25 20:40	07:01 19:46	07:38 18:49	18:11 (T-90) 18:25 (T-90)	07:19 17:03
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	05:41 21:13	05:53 21:12	06:26 20:38	07:02 19:45	07:39 18:47	18:09 (T-90) 18:23 (T-90)	07:20 17:02
14	08:02 17:10	07:30 17:53	07:42 19:30	06:46 20:09	06:01 20:45	05:41 21:13	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	18:09 (T-90) 18:24 (T-90)	07:22 17:00
15	08:01 17:12	07:28 17:54	07:41 19:31	06:44 20:10	05:59 20:47	05:41 21:14	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:43	18:08 (T-90) 18:20 (T-90)	07:23 16:59
16	08:01 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:58 20:48	05:41 21:14	05:56 21:10	06:29 20:34	07:06 19:39	07:43 18:42	18:07 (T-90) 18:18 (T-90)	07:24 16:58
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:49	05:41 21:14	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40	18:07 (T-90) 18:16 (T-90)	07:26 16:57
18	07:59 17:15	07:24 17:59	07:35 19:35	06:39 20:14	05:56 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:08 19:35	07:45 18:38	18:07 (T-90) 18:14 (T-90)	07:27 16:57
19	07:59 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	05:41 21:15	05:58 21:08	06:33 20:29	07:10 19:33	07:47 18:37	18:07 (T-90) 18:12 (T-90)	07:28 16:56
20	07:58 17:18	07:21 18:00	07:31 19:37	06:35 20:16	05:54 20:52	05:41 21:15	05:59 21:07	06:34 20:27	07:11 19:31	07:48 18:35	18:08 (T-90) 18:11 (T-90)	07:30 16:55
21	07:57 17:19	07:19 18:01	17:38 (T-90) 17:39 (T-90)	06:34 20:17	05:53 20:53	05:41 21:16	06:00 21:06	06:35 20:26	07:12 19:29	07:49 18:33	18:08 (T-90) 18:09 (T-90)	07:31 16:54
22	07:56 17:21	07:17 18:03	17:36 (T-90) 17:40 (T-90)	06:32 20:19	05:52 20:54	05:41 21:16	06:01 21:05	06:37 20:24	07:13 19:28	07:50 18:32	18:09 (T-90) 18:22 (T-90)	07:32 16:53
23	07:56 17:22	07:16 18:04	17:36 (T-90) 17:42 (T-90)	06:30 20:20	05:51 20:55	05:41 21:16	06:02 21:04	06:38 20:22	07:14 19:26	07:52 18:30	18:22 (T-90) 18:35 (T-90)	07:33 16:52
24	07:55 17:23	07:14 18:06	17:35 (T-90) 17:43 (T-90)	06:29 20:21	05:50 20:56	05:42 21:16	06:03 21:04	06:39 20:21	07:15 19:24	07:53 18:29	18:20 (T-90) 18:32 (T-90)	07:35 16:50
25	07:54 17:25	07:12 18:07	17:35 (T-90) 17:45 (T-90)	06:27 20:22	05:50 20:57	05:42 21:16	06:05 21:03	06:40 20:19	07:17 19:22	07:54 18:27	18:07 (T-90) 18:18 (T-90)	07:36 16:51
26	07:53 17:26	07:11 18:08	17:36 (T-90) 17:47 (T-90)	06:26 20:24	05:49 20:58	05:42 21:17	06:06 21:02	06:41 20:17	07:18 19:20	07:56 18:25	18:07 (T-90) 18:16 (T-90)	07:37 16:51
27	07:52 17:28	07:09 18:10	17:36 (T-90) 17:48 (T-90)	06:24 20:25	05:48 20:59	05:43 21:17	06:07 21:00	06:42 20:16	07:19 19:18	07:57 18:24	18:13 (T-90) 18:24 (T-90)	07:38 16:50
28	07:51 17:29	07:07 18:11	17:36 (T-90) 17:49 (T-90)	06:22 20:26	05:47 21:00	05:43 21:17	06:08 20:59	06:44 20:14	07:20 19:16	07:58 18:22	18:08 (T-90) 18:19 (T-90)	07:40 16:49
29	07:50 17:30		07:15 19:49	06:21 20:27	05:47 21:01	05:44 21:17	06:09 20:58	06:45 20:12	07:21 19:21	08:00 18:21	18:09 (T-90) 18:20 (T-90)	07:41 16:49
30	07:49 17:32		07:13 19:50	06:19 20:29	05:46 21:02	05:44 21:17	06:10 20:57	06:46 20:10	07:23 19:12	08:01 18:19	18:09 (T-90) 18:20 (T-90)	07:42 16:55
31	07:48 17:33		07:11 19:51	06:17 21:03	05:45 21:03	05:45 21:03	06:11 20:56	06:47 20:08	08:03 18:18	08:03 18:18	18:09 (T-90) 18:20 (T-90)	07:43 16:55
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case		65	35							101		
Sun reduction		0.58	0.59							0.56		
Oper. time red.		0.90	0.90							0.90		
Wind dir. red.		0.58	0.58							0.58		
Total reduction		0.30	0.31							0.29		
Total, real		20	11							30		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 V163-4.5 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-022 - R-022

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Table with 12 columns (Jan-Dec) and 2 rows of sunshine probability values.

Operational time

Table with 13 columns (N-NW) and 2 rows of operational time values.

Main shadow calculation table with columns for months (January-December) and rows for time intervals (08:00-17:33) and summary statistics.

Table layout: For each day in each month the following matrix apply

Matrix table with 4 columns: Day in month, Sun rise/set, First/Last time with flicker, and (WTG causing flicker first/last time).



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-023 - R-023

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	08:46 (T-16)	07:47	07:06		07:09	06:18	05:45	05:45	06:12	06:49	07:24
	16:57	09:08 (T-16)	17:35	18:13		19:53	20:30	21:04	21:17	20:55	20:07	19:11
2	08:04	08:47 (T-16)	07:46	07:04		07:07	06:17	05:44	05:45	06:13	06:50	07:25
	16:58	09:08 (T-16)	17:36	18:14		19:54	20:31	21:05	21:16	20:54	20:05	19:09
3	08:04	08:48 (T-16)	07:45	07:02		07:23 (T-90)	07:06	06:15	05:44	05:46	06:15	06:51
	16:59	09:08 (T-16)	17:38	18:15	1	07:24 (T-90)	19:55	20:32	21:06	21:16	20:52	20:03
4	08:04	08:49 (T-16)	07:43	07:01		07:21 (T-90)	07:04	06:14	05:43	05:47	06:16	06:52
	16:59	09:08 (T-16)	17:39	18:17	5	07:26 (T-90)	19:56	20:34	21:07	21:16	20:51	20:01
5	08:04	08:50 (T-16)	07:42	06:59		07:19 (T-90)	07:02	06:12	05:43	05:47	06:17	06:53
	17:00	09:08 (T-16)	17:40	18:18	8	07:27 (T-90)	19:58	20:35	21:07	21:16	20:50	20:00
6	08:04	08:51 (T-16)	07:41	06:57		07:18 (T-90)	07:00	06:11	05:43	05:48	06:18	06:54
	17:02	09:07 (T-16)	17:42	18:19	10	07:28 (T-90)	19:59	20:36	21:08	21:15	20:49	19:58
7	08:04	08:52 (T-16)	07:40	06:55		07:16 (T-90)	06:58	06:10	05:42	05:49	06:19	06:56
	17:03	09:06 (T-16)	17:43	18:21	12	07:28 (T-90)	20:00	20:37	21:09	21:15	20:47	19:56
8	08:04	08:55 (T-16)	07:38	07:54		08:14 (T-90)	06:56	06:08	05:42	05:49	06:20	06:57
	17:04	09:06 (T-16)	17:45	18:22	14	08:28 (T-90)	20:01	20:38	21:10	21:15	20:46	19:54
9	08:04	08:57 (T-16)	07:37	07:52		08:12 (T-90)	06:55	06:07	05:42	05:50	06:21	06:58
	17:05	09:04 (T-16)	17:46	19:23	16	08:28 (T-90)	20:03	20:40	21:10	21:14	20:44	19:52
10	08:03		07:36	07:50		08:10 (T-90)	06:53	06:06	05:41	05:51	06:23	06:59
	17:06		17:48	19:25	18	08:28 (T-90)	20:04	20:41	21:11	21:14	20:43	19:50
11	08:03		07:34	07:48		08:09 (T-90)	06:51	06:04	05:41	05:52	06:24	07:00
	17:07		17:49	19:26	19	08:28 (T-90)	20:05	20:42	21:12	21:13	20:41	19:48
12	08:03		07:33	07:46		08:07 (T-90)	06:49	06:03	05:41	05:52	06:25	07:01
	17:08		17:50	19:27	20	08:27 (T-90)	20:06	20:43	21:12	21:13	20:40	19:47
13	08:02		07:31	07:44		08:05 (T-90)	06:48	06:02	05:41	05:53	06:26	07:03
	17:09		17:52	19:28	21	08:26 (T-90)	20:08	20:44	21:13	21:12	20:39	19:45
14	08:02		07:30	07:43		08:04 (T-90)	06:46	06:01	05:41	05:54	06:27	07:04
	17:11		17:53	19:30	21	08:25 (T-90)	20:09	20:46	21:13	21:12	20:37	19:43
15	08:01		07:28	07:41		08:05 (T-90)	06:44	06:00	05:41	05:55	06:28	07:05
	17:12		17:55	19:31	18	08:23 (T-90)	20:10	20:47	21:14	21:11	20:35	19:41
16	08:01		07:27	07:39		08:07 (T-90)	06:42	05:58	05:41	05:56	06:30	07:06
	17:13		17:56	19:32	13	08:20 (T-90)	20:11	20:48	21:14	21:10	20:34	19:39
17	08:00		07:25	07:37		08:10 (T-90)	06:41	05:57	05:41	05:57	06:31	07:07
	17:14		17:57	19:34	7	08:17 (T-90)	20:13	20:49	21:15	21:10	20:32	19:37
18	08:00		07:24	07:35			06:39	05:56	05:41	05:58	06:32	07:09
	17:16		17:59	19:35			20:14	20:50	21:15	21:09	20:31	19:35
19	07:59		07:22	07:33			06:37	05:55	05:41	05:59	06:33	07:10
	17:17		18:00	19:36			20:15	20:51	21:15	21:08	20:29	19:33
20	07:58		07:21	07:32			06:35	05:54	05:41	06:00	06:34	07:11
	17:18		18:00	19:37			20:16	20:52	21:16	21:07	20:27	19:31
21	07:57		07:19	07:30			06:34	05:53	05:41	06:01	06:36	07:12
	17:20		18:02	19:39			20:18	20:53	21:16	21:06	20:26	19:30
22	07:57		07:18	07:28			06:32	05:52	05:41	06:02	06:37	07:13
	17:21		18:03	19:40			20:19	20:54	21:16	21:06	20:24	19:28
23	07:56		07:16	07:26			06:31	05:52	05:42	06:03	06:38	07:14
	17:22		18:04	19:41			20:20	20:55	21:16	21:05	20:23	19:26
24	07:55		07:14	07:24			06:29	05:51	05:42	06:04	06:39	07:16
	17:24		18:06	19:42			20:21	20:57	21:16	21:04	20:21	19:24
25	07:54		07:13	07:22			06:27	05:50	05:42	06:05	06:40	07:17
	17:25		18:07	19:44			20:22	20:58	21:17	21:03	20:19	19:22
26	07:53		07:11	07:20			06:26	05:49	05:43	06:06	06:41	07:18
	17:26		18:08	19:45			20:24	20:59	21:17	21:02	20:17	19:20
27	07:52		07:09	07:18			06:24	05:48	05:43	06:07	06:43	07:19
	17:28		18:10	19:46			20:25	21:00	21:17	21:01	20:16	19:18
28	07:51		07:08	07:17			06:23	05:48	05:43	06:08	06:44	07:20
	17:29		18:11	19:48			20:26	21:00	21:17	21:00	20:14	19:16
29	07:50			07:15			06:21	05:47	05:44	06:09	06:45	07:22
	17:31			19:49			20:27	21:01	21:17	20:58	20:12	19:15
30	07:49			07:13			06:20	05:46	05:44	06:10	06:46	07:23
	17:32			19:50			20:29	21:02	21:17	20:57	20:10	19:13
31	07:48			07:11				05:46		06:11	06:47	
	17:33			19:51				21:03		20:56	20:09	
Potential sun hours	287	292	369		404	459	465	471	436	377	69	131
Total, worst case	148		203									635
Sun reduction	0.58		0.59								0.67	0.56
Oper. time red.	0.90		0.90								0.90	0.90
Wind dir. red.	0.67		0.60								0.60	0.67
Total reduction	0.35		0.32								0.36	0.30
Total, real	52		65								25	40

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-024 - R-024
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	07:47 17:35	07:06 18:12	07:09 19:52	06:18 20:30	05:45 21:04	05:45 21:16	06:12 20:55	06:48 20:07	07:24 19:11	18:34 (T-90) 11 18:45 (T-90)	07:04 17:17	07:43 16:48
2	08:04 16:57	07:46 17:36	07:04 18:14	07:07 19:54	06:16 20:31	05:44 21:05	05:45 21:16	06:13 20:54	06:50 20:05	07:25 19:09	18:32 (T-90) 11 18:43 (T-90)	07:05 17:15	07:44 16:48
3	08:04 16:58	07:44 17:37	07:02 18:15	07:05 19:55	06:15 20:32	05:44 21:06	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	18:31 (T-90) 10 18:41 (T-90)	07:07 17:14	07:45 16:47
4	08:04 16:59	07:43 17:39	07:00 18:16	07:04 19:56	06:14 20:33	05:43 21:06	05:46 21:16	06:16 20:51	06:52 20:01	07:28 19:05	18:30 (T-90) 10 18:40 (T-90)	07:08 17:12	07:47 16:47
5	08:04 17:00	07:42 17:40	06:59 18:18	07:02 19:57	06:12 20:35	05:43 21:07	05:47 21:16	06:17 20:50	06:53 19:59	07:29 19:03	18:30 (T-90) 8 18:38 (T-90)	07:09 17:11	07:48 16:47
6	08:04 17:01	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:42 21:08	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:01	18:30 (T-90) 7 18:36 (T-90)	07:11 17:10	07:49 16:47
7	08:04 17:02	07:40 17:43	06:55 18:20	06:58 20:00	06:09 20:37	05:42 21:09	05:48 21:15	06:19 20:47	06:55 19:56	07:31 19:00	18:30 (T-90) 5 18:34 (T-90)	07:12 17:09	07:50 16:46
8	08:04 17:03	07:38 17:45	07:53 18:22	06:56 19:00	06:08 20:38	05:42 21:09	05:49 21:15	06:20 20:46	06:57 19:54	07:33 18:56	18:29 (T-90) 4 18:33 (T-90)	07:13 17:07	07:51 16:46
9	08:03 17:05	07:37 17:46	07:52 19:23	06:54 20:02	06:07 20:39	05:41 21:10	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	18:33 (T-90)	07:15 17:06	07:52 16:46
10	08:03 17:06	07:35 17:47	07:50 19:24	06:53 20:04	06:05 20:41	05:41 21:11	05:51 21:14	06:22 20:43	06:59 19:50	07:35 18:52	18:32 (T-90)	07:16 17:05	07:53 16:46
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:42	05:41 21:11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:50	18:31 (T-90)	07:17 17:04	07:53 16:46
12	08:02 17:08	07:33 17:50	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:52 21:13	06:25 20:40	07:01 19:46	07:38 18:49	18:29 (T-90)	07:19 17:03	07:54 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	05:41 21:13	05:53 21:12	06:26 20:38	07:02 19:45	07:39 18:47	18:27 (T-90)	07:20 17:02	07:55 16:46
14	08:02 17:10	07:30 17:53	07:42 19:30	06:46 20:09	06:01 20:45	05:41 21:13	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	18:26 (T-90)	07:22 17:00	07:56 16:46
15	08:01 17:12	07:28 17:54	07:41 19:31	06:44 20:10	05:59 20:47	05:41 21:14	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:43	18:25 (T-90)	07:23 16:59	07:57 16:47
16	08:01 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:58 20:48	05:41 21:14	05:56 21:10	06:29 20:34	07:06 19:39	07:43 18:42	18:24 (T-90)	07:24 16:58	07:57 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:49	05:41 21:14	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	18:23 (T-90)	07:26 16:57	07:58 16:47
18	07:59 17:15	07:24 17:59	07:35 19:35	06:39 20:14	05:56 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:08 19:35	07:45 18:38	18:22 (T-90)	07:27 16:57	07:59 16:48
19	07:59 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	05:41 21:15	05:58 21:08	06:33 20:29	07:10 19:33	07:47 18:37	18:21 (T-90)	07:28 16:56	08:00 16:48
20	07:58 17:18	07:21 18:00	07:31 19:37	06:35 20:16	05:54 20:52	05:41 21:15	05:59 21:07	06:34 20:27	07:11 19:31	07:48 18:35	18:20 (T-90)	07:30 16:55	08:00 16:48
21	07:57 17:19	07:19 18:01	07:29 19:39	06:34 20:17	05:53 20:53	05:41 21:16	06:00 21:06	06:35 20:26	07:12 19:29	07:49 18:33	18:19 (T-90)	07:31 16:54	08:01 16:49
22	07:56 17:21	07:17 18:03	07:28 19:40	06:32 20:19	05:52 20:54	05:41 21:16	06:01 21:05	06:37 20:24	07:13 19:28	07:50 18:32	18:18 (T-90)	07:32 16:53	08:01 16:49
23	07:56 17:22	07:16 18:04	07:26 19:41	06:30 20:20	05:51 20:55	05:41 21:16	06:02 21:04	06:38 20:22	07:14 19:26	07:52 18:30	18:17 (T-90)	07:33 16:52	08:02 16:50
24	07:55 17:23	07:14 18:06	07:24 19:42	06:29 20:21	05:50 20:56	05:42 21:16	06:03 21:03	06:39 20:21	07:15 19:24	07:53 18:29	18:16 (T-90)	07:35 16:52	08:02 16:50
25	07:54 17:25	07:12 18:07	07:22 19:44	06:27 20:22	05:50 20:57	05:42 21:16	06:05 21:03	06:40 20:19	07:17 19:22	07:54 18:27	18:15 (T-90)	07:36 16:51	08:03 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:24	05:49 20:58	05:42 21:17	06:06 21:01	06:41 20:17	07:18 19:20	07:56 18:25	18:14 (T-90)	07:37 16:50	08:03 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	05:48 20:59	05:43 21:17	06:07 21:00	06:42 20:15	07:19 19:18	07:57 18:24	18:13 (T-90)	07:38 16:50	08:03 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47	06:22 20:26	05:47 21:00	05:43 21:17	06:08 20:59	06:44 20:14	07:20 19:16	07:58 18:22	18:12 (T-90)	07:40 16:49	08:03 16:53
29	07:50 17:30		07:15 19:49	06:21 20:27	05:47 21:01	05:44 21:17	06:09 20:58	06:45 20:12	07:21 19:14	08:00 18:21	18:11 (T-90)	07:41 16:49	08:04 16:54
30	07:49 17:32		07:13 19:50	06:19 20:28	05:46 21:02	05:44 21:17	06:10 20:57	06:46 20:10	07:23 19:12	08:01 18:19	18:10 (T-90)	07:42 16:48	08:04 16:55
31	07:48 17:33		07:11 19:51		05:45 21:03		06:11 20:56	06:47 20:08		08:02 18:18		07:43 16:55	08:04 16:55
Potential sun hours	287	292	369	404	459	465	471	436	377	341		288	275
Total, worst case			69						5			66	
Sun reduction			0.59						0.67			0.56	
Oper. time red.			0.90						0.90			0.90	
Wind dir. red.			0.57						0.57			0.57	
Total reduction			0.30						0.34			0.29	
Total, real			21					2				19	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Last time (hh:mm) with flicker	(WTG causing flicker last time)
	Minutes with flicker		



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-025 - R-025

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June					
1	08:04	07:47	16:59 (T-17)	07:06	07:09	19:26 (T-15)	06:18	06:39 (T-41)	05:45	06:08 (T-19)	
	16:57	17:35	10 17:09 (T-17)	18:12	19:52	5 19:31 (T-15)	20:30	31 20:06 (T-16)	21:04	18 06:26 (T-19)	
2	08:04	07:46	17:00 (T-17)	07:04	07:07	07:27 (T-20)	06:16	06:39 (T-41)	05:44	06:08 (T-19)	
	16:58	17:36	11 17:11 (T-17)	18:14	19:54	11 19:32 (T-15)	20:31	32 20:08 (T-16)	21:05	19 06:27 (T-19)	
3	08:04	07:45	17:00 (T-17)	07:02	07:05	07:26 (T-20)	06:15	06:40 (T-41)	05:44	06:07 (T-19)	
	16:58	17:38	12 17:12 (T-17)	18:15	19:55	17 19:34 (T-15)	20:32	29 20:08 (T-16)	21:06	20 06:27 (T-19)	
4	08:04	07:43	17:02 (T-17)	07:01	07:04	07:24 (T-20)	06:14	06:43 (T-41)	05:43	06:07 (T-19)	
	16:59	17:39	11 17:13 (T-17)	18:16	19:56	20 19:35 (T-15)	20:33	25 20:10 (T-16)	21:06	22 06:29 (T-19)	
5	08:04	07:42	17:05 (T-17)	06:59	07:02	07:22 (T-20)	06:12	19:53 (T-16)	05:43	06:07 (T-19)	
	17:00	17:40	6 17:11 (T-17)	18:18	19:57	24 19:36 (T-15)	20:35	18 20:11 (T-16)	21:07	23 06:30 (T-19)	
6	08:04	07:41		06:57	07:00	07:20 (T-20)	06:11	19:53 (T-16)	05:43	06:06 (T-19)	
	17:01	17:42		18:19	19:59	27 19:37 (T-15)	20:36	19 20:12 (T-16)	21:08	24 06:30 (T-19)	
7	08:04	07:40		06:55	06:58	07:18 (T-20)	06:09	19:54 (T-16)	05:42	06:06 (T-19)	
	17:02	17:43		18:20	20:00	29 19:38 (T-15)	20:37	17 20:11 (T-16)	21:09	25 06:31 (T-19)	
8	08:04	07:38		07:53	06:56	07:16 (T-20)	06:08	19:55 (T-16)	05:42	06:06 (T-19)	
	17:04	17:45		18:22	20:01	31 19:39 (T-15)	20:38	15 20:10 (T-16)	21:09	26 06:32 (T-19)	
9	08:03	07:37		07:52	06:55	07:15 (T-20)	06:07	19:56 (T-16)	05:42	06:05 (T-19)	
	17:05	17:46		19:23	20:02	27 19:37 (T-15)	20:39	11 20:07 (T-16)	21:10	26 06:31 (T-19)	
10	08:03	07:36		07:50	06:53	07:13 (T-20)	06:06	20:00 (T-16)	05:41	06:05 (T-19)	
	17:06	17:47		19:24	20:04	22 07:35 (T-20)	20:41	4 20:04 (T-16)	21:11	27 06:32 (T-19)	
11	08:03	07:34		07:48	06:51	07:11 (T-20)	06:04		05:41	06:05 (T-19)	
	17:07	17:49		19:26	20:05	23 07:34 (T-20)	20:42		21:11	28 06:33 (T-19)	
12	08:02	07:33		07:46	06:49	07:09 (T-20)	06:03		05:41	06:05 (T-19)	
	17:08	17:50		19:27	20:06	24 07:33 (T-20)	20:43		21:12	28 06:33 (T-19)	
13	08:02	07:31		07:44	06:47	07:08 (T-20)	06:02		05:41	06:05 (T-19)	
	17:09	17:52		19:28	20:07	25 07:33 (T-20)	20:44		21:13	29 06:34 (T-19)	
14	08:02	07:30		07:43	06:46	07:07 (T-20)	06:01		05:41	06:05 (T-19)	
	17:11	17:53		19:30	20:09	25 07:32 (T-20)	20:45		21:13	29 06:34 (T-19)	
15	08:01	07:28		07:41	06:44	07:07 (T-20)	06:00		05:41	06:05 (T-19)	
	17:12	17:55		19:31	20:10	24 07:31 (T-20)	20:47		21:14	30 06:35 (T-19)	
16	08:01	07:27		07:39	06:42	07:08 (T-20)	05:58		05:41	06:05 (T-19)	
	17:13	17:56		19:32	20:11	22 07:30 (T-20)	20:48		21:14	30 06:35 (T-19)	
17	08:00	07:25		07:37	06:40	07:09 (T-20)	05:57		05:41	06:05 (T-19)	
	17:14	17:57		19:33	20:12	19 07:28 (T-20)	20:49		21:14	30 06:35 (T-19)	
18	07:59	07:24		07:35	06:39	07:11 (T-20)	05:56		05:41	06:05 (T-19)	
	17:16	17:59		19:35	20:14	14 07:25 (T-20)	20:50		21:15	31 06:36 (T-19)	
19	07:59	07:22		07:33	06:37	07:14 (T-20)	05:55		05:41	06:05 (T-19)	
	17:17	18:00		19:36	20:15	9 07:23 (T-20)	20:51		21:15	31 06:36 (T-19)	
20	07:58	07:21		07:31	06:35	06:56 (T-41)	05:54		05:41	06:05 (T-19)	
	17:18	18:00		19:37	20:16	1 06:57 (T-41)	20:52		21:15	31 06:36 (T-19)	
21	07:57	07:19		07:30	06:34	06:54 (T-41)	05:53		05:41	06:06 (T-19)	
	17:20	18:02		19:39	20:17	3 06:57 (T-41)	20:53		21:16	31 06:37 (T-19)	
22	07:56	07:17	07:38 (T-21)	07:28	06:32	06:53 (T-41)	05:52		05:41	06:06 (T-19)	
	17:21	18:03	2 07:40 (T-21)	19:40	20:19	5 06:58 (T-41)	20:54		21:16	31 06:37 (T-19)	
23	07:56	07:16	07:37 (T-21)	07:26	06:30	06:51 (T-41)	05:51		05:42	06:06 (T-19)	
	17:22	18:04	4 07:41 (T-21)	19:41	20:20	8 19:57 (T-16)	20:55		21:16	31 06:37 (T-19)	
24	07:55	07:14	07:35 (T-21)	07:24	06:29	06:49 (T-41)	05:51		05:42	06:06 (T-19)	
	17:24	18:06	5 07:40 (T-21)	19:42	20:21	13 19:58 (T-16)	20:56		21:16	31 06:37 (T-19)	
25	07:54	16:57 (T-17)	07:13	07:22	06:27	06:48 (T-41)	05:50		05:42	06:07 (T-19)	
	17:25	16:58 (T-17)	18:07	19:44	20:22	16 19:59 (T-16)	20:57		21:16	31 06:38 (T-19)	
26	07:53	16:57 (T-17)	07:11	07:20	06:26	06:46 (T-41)	05:49	06:12 (T-19)	05:43	06:07 (T-19)	
	17:26	16:59 (T-17)	18:08	19:45	20:24	20 20:00 (T-16)	20:58	2 06:14 (T-19)	21:17	30 06:37 (T-19)	
27	07:52	16:57 (T-17)	07:09	07:18	06:24	06:45 (T-41)	05:48	06:11 (T-19)	05:43	06:07 (T-19)	
	17:28	17:01 (T-17)	18:10	19:46	20:25	23 20:02 (T-16)	20:59	7 06:18 (T-19)	21:17	30 06:37 (T-19)	
28	07:51	16:57 (T-17)	07:07	07:17	06:22	06:43 (T-41)	05:47	06:11 (T-19)	05:43	06:08 (T-19)	
	17:29	17:02 (T-17)	18:11	19:47	20:26	25 20:02 (T-16)	21:00	10 06:21 (T-19)	21:17	30 06:38 (T-19)	
29	07:50	16:57 (T-17)		07:15	06:21	06:42 (T-41)	05:47	06:10 (T-19)	05:44	06:08 (T-19)	
	17:30	17:04 (T-17)		19:49	20:27	28 20:04 (T-16)	21:01	12 06:22 (T-19)	21:17	29 06:37 (T-19)	
30	07:49	16:58 (T-17)		07:13	06:19	06:40 (T-41)	05:46	06:09 (T-19)	05:44	06:09 (T-19)	
	17:32	17:06 (T-17)		19:50	20:29	31 20:05 (T-16)	21:02	14 06:23 (T-19)	21:17	29 06:38 (T-19)	
31	07:48	16:58 (T-17)		07:11			05:45	06:09 (T-19)			
	17:33	17:07 (T-17)		19:51	3 19:30 (T-15)		21:03	16 06:25 (T-19)			
Potential sun hours	287	292		369		404		459		465	
Total, worst case	36	88		3	571		262		830		
Sun reduction	0.58	0.58		0.59	0.63		0.66		0.73		
Oper. time red.	0.90	0.90		0.90	0.90		0.90		0.90		
Wind dir. red.	0.59	0.60		0.60	0.59		0.60		0.59		
Total reduction	0.31	0.31		0.32	0.33		0.36		0.39		
Total, real	11	27		1	189		94		320		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-025 - R-025

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:09 (T-19) 06:37 (T-19)	06:12 20:55	06:48 20:07	07:10 (T-20) 07:33 (T-20)	07:24 17:17
2	05:45 21:16	06:10 (T-19) 06:37 (T-19)	06:13 20:54	06:50 20:05	07:11 (T-20) 07:33 (T-20)	07:25 17:15
3	05:46 21:16	06:10 (T-19) 06:37 (T-19)	06:14 20:52	06:51 20:03	07:13 (T-20) 19:35 (T-15)	07:26 19:07
4	05:47 21:16	06:11 (T-19) 06:37 (T-19)	06:16 20:51	06:52 20:01	07:14 (T-20) 19:37 (T-15)	07:28 19:05
5	05:47 21:16	06:12 (T-19) 06:37 (T-19)	06:17 20:50	06:53 20:20	07:15 (T-20) 19:35 (T-15)	07:29 19:03
6	05:48 21:15	06:12 (T-19) 06:36 (T-19)	06:18 20:48	06:54 19:58	07:16 (T-20) 19:33 (T-15)	07:30 19:01
7	05:48 21:15	06:13 (T-19) 06:36 (T-19)	06:19 20:47	06:55 19:56	07:17 (T-20) 19:31 (T-15)	07:31 19:00
8	05:49 21:15	06:14 (T-19) 06:36 (T-19)	06:20 20:46	06:57 19:54	07:18 (T-20) 19:29 (T-15)	07:33 18:56
9	05:50 21:14	06:14 (T-19) 06:35 (T-19)	06:21 20:44	06:58 19:52	07:19 (T-20) 19:27 (T-15)	07:34 18:54
10	05:51 21:14	06:15 (T-19) 06:35 (T-19)	06:23 20:43	06:59 19:50	07:20 (T-20) 19:25 (T-15)	07:35 18:52
11	05:52 21:13	06:16 (T-19) 06:34 (T-19)	06:24 20:41	07:00 19:48	07:22 (T-20) 19:24 (T-15)	07:36 18:51
12	05:52 21:13	06:17 (T-19) 06:34 (T-19)	06:25 20:40	07:01 19:46	07:23 (T-20) 19:22 (T-15)	07:38 18:49
13	05:53 21:12	06:17 (T-19) 06:32 (T-19)	06:26 20:38	07:02 19:45	07:24 (T-20) 18:47	07:39 17:02
14	05:54 21:12	06:18 (T-19) 06:31 (T-19)	06:27 20:37	07:04 19:43	07:25 (T-20) 18:45	07:40 17:01
15	05:55 21:11	06:19 (T-19) 06:30 (T-19)	06:28 20:35	07:05 19:41	07:26 (T-20) 18:44	07:41 17:00
16	05:56 21:10	06:20 (T-19) 06:28 (T-19)	06:30 20:34	07:06 19:39	07:27 (T-20) 18:42	07:42 17:01
17	05:57 21:09	06:21 (T-19) 06:26 (T-19)	06:31 20:32	07:07 19:37	07:28 (T-20) 18:40	07:43 16:58
18	05:58 21:09	06:22 (T-19) 06:33 (T-19)	06:32 20:31	07:08 19:35	07:29 (T-20) 18:38	07:44 16:57
19	05:59 21:08	06:23 (T-19) 06:34 (T-19)	06:33 20:29	07:10 19:33	07:30 (T-20) 18:37	07:45 16:56
20	06:00 21:07	06:24 (T-19) 06:35 (T-19)	06:34 20:27	07:11 19:31	07:31 (T-20) 18:35	07:46 16:55
21	06:01 21:06	06:25 (T-19) 06:36 (T-19)	06:35 20:26	07:12 19:29	07:32 (T-20) 18:33	07:47 16:54
22	06:02 21:05	06:26 (T-19) 06:37 (T-19)	06:36 20:24	07:13 19:28	07:33 (T-20) 18:32	07:48 16:53
23	06:03 21:04	06:27 (T-19) 06:38 (T-19)	06:37 20:22	07:14 19:26	07:34 (T-20) 18:30	07:49 16:53
24	06:04 21:04	06:28 (T-19) 06:39 (T-19)	06:38 20:21	07:15 19:24	07:35 (T-20) 18:29	07:50 16:52
25	06:05 21:03	06:29 (T-19) 06:40 (T-19)	06:39 20:19	07:16 19:22	07:36 (T-20) 18:27	07:51 16:51
26	06:06 21:02	06:30 (T-19) 06:41 (T-19)	06:40 20:17	07:17 19:20	07:37 (T-20) 18:25	07:52 16:51
27	06:07 21:00	06:31 (T-19) 06:42 (T-19)	06:41 20:16	07:18 19:18	07:38 (T-20) 18:24	07:53 16:50
28	06:08 20:59	06:32 (T-19) 06:43 (T-19)	06:42 20:14	07:19 19:16	07:39 (T-20) 18:22	07:54 16:49
29	06:09 20:58	06:33 (T-19) 06:44 (T-19)	06:43 20:12	07:20 19:14	07:40 (T-20) 18:21	07:55 16:49
30	06:10 20:57	06:34 (T-19) 06:45 (T-19)	06:44 20:10	07:21 19:13	07:41 (T-20) 18:20	07:56 16:48
31	06:11 20:56	06:35 (T-19) 06:46 (T-19)	06:45 20:08	07:22 19:11	07:42 (T-20) 18:18	07:57 16:47
Potential sun hours	471	436	377	341	288	275
Total, worst case	330	542	241	36	85	
Sun reduction	0.75	0.72	0.67	0.56	0.48	
Oper. time red.	0.90	0.90	0.90	0.90	0.90	
Wind dir. red.	0.59	0.59	0.58	0.61	0.59	
Total reduction	0.40	0.38	0.35	0.31	0.25	
Total, real	131	208	85	11	22	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-026 - R-026
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June			
1	08:04	07:47	07:06	17:36 (T-30)	07:09	19:22 (T-29)	06:18	06:39 (T-18)	05:45
	16:57	17:35	18:13	15 17:51 (T-30)	19:53	7 19:29 (T-29)	20:30	13 06:52 (T-18)	21:04
2	08:04	07:46	07:04	07:04	07:07		06:17	06:38 (T-18)	05:45
	16:58	17:36	18:14	16 17:52 (T-30)	19:54		20:31	13 06:51 (T-18)	21:05
3	08:04	07:45	07:02	07:06	07:06		06:15	06:36 (T-18)	05:44
	16:59	17:38	18:15	18 17:54 (T-30)	19:55		20:32	14 06:50 (T-18)	21:06
4	08:04	07:43	07:01	07:04	07:04		06:14	06:35 (T-18)	05:44
	17:00	17:39	18:17	19 17:55 (T-30)	19:56		20:34	14 06:49 (T-18)	21:07
5	08:04	07:42	06:59	07:02	07:02		06:12	06:35 (T-18)	05:43
	17:01	17:41	18:18	20 17:56 (T-30)	19:58		20:35	13 06:48 (T-18)	21:07
6	08:04	07:41	06:57	07:00	07:00		06:11	06:37 (T-18)	05:43
	17:02	17:42	18:19	18 17:56 (T-30)	19:59		20:36	8 06:45 (T-18)	21:08
7	08:04	07:40	06:55	06:58	06:58		06:10		05:42
	17:03	17:43	18:21	15 17:54 (T-30)	20:00		20:37		21:09
8	08:04	07:38	07:54	06:56	06:56		06:08		05:42
	17:04	17:45	18:22	9 18:51 (T-30)	20:01		20:38		21:10
9	08:04	07:37	07:52	06:55	06:55		06:07		05:42
	17:05	17:46	19:23		20:03		20:40		21:10
10	08:03	07:36	07:50	06:53	06:53		06:06		05:41
	17:06	17:48	19:25		20:04		20:41		21:11
11	08:03	07:34	07:56 (T-42)	07:48	06:51	19:42 (T-13)	06:04		05:41
	17:07	17:49	2 07:58 (T-42)	19:26	20:05	1 19:43 (T-13)	20:42		21:11
12	08:03	07:33	07:54 (T-42)	07:46	06:49		19:41 (T-13)	06:03	05:41
	17:08	17:50	3 07:57 (T-42)	19:27	20:06	4 19:45 (T-13)	20:43		21:12
13	08:02	07:31	07:53 (T-42)	07:44	06:48		19:40 (T-13)	06:02	05:41
	17:09	17:52	4 07:57 (T-42)	19:28	20:08	5 19:45 (T-13)	20:44		21:13
14	08:02	07:30	07:51 (T-42)	07:43	06:46		19:38 (T-13)	06:01	05:41
	17:11	17:53	5 07:56 (T-42)	19:30	20:09	8 19:46 (T-13)	20:45		21:13
15	08:01	07:28	07:50 (T-42)	07:41	06:44		19:38 (T-13)	06:00	05:41
	17:12	17:55	6 07:56 (T-42)	19:31	20:10	9 19:47 (T-13)	20:47		21:14
16	08:01	07:27	07:48 (T-42)	07:39	06:42		19:38 (T-13)	05:59	05:41
	17:13	17:56	7 07:55 (T-42)	19:32	20:11	11 19:49 (T-13)	20:48		21:14
17	08:00	07:25	07:47 (T-42)	07:37	06:41		19:37 (T-13)	05:57	05:41
	17:14	17:57	6 07:53 (T-42)	19:34	20:12	13 19:50 (T-13)	20:49		21:14
18	07:59	07:24		07:35	06:39		19:37 (T-13)	05:56	05:41
	17:16	17:59		19:35	20:14	14 19:51 (T-13)	20:50		21:15
19	07:59	07:22		07:33	06:37		19:38 (T-13)	05:55	05:41
	17:17	18:00		19:36	20:15	15 19:53 (T-13)	20:51		21:15
20	07:58	07:21		07:32	06:36		19:38 (T-13)	05:54	05:41
	17:18	18:00		19:37	20:16	16 19:54 (T-13)	20:52		21:16
21	07:57	07:19		07:30	06:34		19:38 (T-13)	05:53	05:41
	17:20	18:02		19:39	20:17	15 19:53 (T-13)	20:53		21:16
22	07:57	07:18		07:28	06:32		19:40 (T-13)	05:53	05:42
	17:21	18:03		19:40	20:19	12 19:52 (T-13)	20:54		21:16
23	07:56	07:16	17:41 (T-30)	07:26	06:31		06:51 (T-18)	05:52	05:42
	17:22	18:04	1 17:42 (T-30)	19:41	20:20	6 19:48 (T-13)	20:55		21:16
24	07:55	07:14	17:39 (T-30)	07:24	06:29		06:50 (T-18)	05:51	05:42
	17:24	18:06	5 17:44 (T-30)	19:42	20:21	3 06:53 (T-18)	20:56		21:16
25	07:54	07:13	17:37 (T-30)	07:22	19:20 (T-29)	06:27	06:48 (T-18)	05:50	05:42
	17:25	18:07	8 17:45 (T-30)	19:44	2 19:22 (T-29)	20:22	5 06:53 (T-18)	20:57	21:17
26	07:53	07:11	17:37 (T-30)	07:20	19:20 (T-29)	06:26	06:47 (T-18)	05:49	05:43
	17:26	18:09	10 17:47 (T-30)	19:45	4 19:24 (T-29)	20:24	7 06:54 (T-18)	20:58	21:17
27	07:52	07:09	17:36 (T-30)	07:19	19:20 (T-29)	06:24	06:45 (T-18)	05:48	05:43
	17:28	18:10	12 17:48 (T-30)	19:46	5 19:25 (T-29)	20:25	8 06:53 (T-18)	20:59	21:17
28	07:51	07:08	17:36 (T-30)	07:17	19:19 (T-29)	06:23	06:44 (T-18)	05:48	05:44
	17:29	18:11	13 17:49 (T-30)	19:48	7 19:26 (T-29)	20:26	10 06:54 (T-18)	21:00	21:17
29	07:50			07:15	19:19 (T-29)	06:21	06:42 (T-18)	05:47	05:44
	17:31			19:49	8 19:27 (T-29)	20:27	11 06:53 (T-18)	21:01	21:17
30	07:49			07:13	19:19 (T-29)	06:20	06:41 (T-18)	05:46	05:44
	17:32			19:50	9 19:28 (T-29)	20:29	12 06:53 (T-18)	21:02	21:17
31	07:48			07:11	19:20 (T-29)			05:46	
	17:33			19:51	10 19:30 (T-29)			21:03	
Potential sun hours	287	292	369	403	459	465			
Total, worst case									
Sun reduction		82	175	192	75				
Oper. time red.		0.58	0.59	0.63	0.66				
Wind dir. red.		0.90	0.90	0.90	0.90				
Total reduction		0.60	0.58	0.59	0.58				
Total, real		0.31	0.31	0.34	0.35				
		26	54	65	26				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-026 - R-026
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	06:49 20:07	19:41 (T-13) 19:42 (T-13)	07:24 19:11	07:04 17:17
2	05:45 21:16	06:14 20:54	06:50 20:05		07:25 19:09	07:05 17:15
3	05:46 21:16	06:15 20:52	06:51 20:03		07:27 19:07	07:07 17:14
4	05:47 21:16	06:16 20:51	06:52 20:01		07:28 19:05	07:08 17:13
5	05:47 21:16	06:17 20:50	06:53 20:00		07:29 19:03	07:09 18:21 (T-30)
6	05:48 21:15	06:18 20:48	06:54 19:58		07:30 19:02	07:11 18:25 (T-30)
7	05:49 21:15	06:19 20:47	06:56 19:56		07:31 19:00	07:12 18:16 (T-30)
8	05:49 21:15	06:20 20:46	06:57 19:54		07:33 18:56	07:14 18:15 (T-30)
9	05:50 21:14	06:22 20:44	06:58 19:52		07:34 18:54	07:15 18:31 (T-30)
10	05:51 21:14	06:23 20:43	06:59 19:50		07:35 18:52	07:16 18:11 (T-30)
11	05:52 21:13	06:24 20:41	07:00 19:48	19:15 (T-29) 19:22 (T-29)	07:36 18:51	07:18 18:10 (T-30)
12	05:52 21:13	06:25 20:40	07:01 19:47	19:13 (T-29) 19:22 (T-29)	07:38 18:49	07:19 18:09 (T-30)
13	05:53 21:12	06:26 20:38	07:03 19:45	19:11 (T-29) 19:20 (T-29)	07:39 18:47	07:20 18:25 (T-30)
14	05:54 21:12	06:27 20:37	07:04 19:43	19:10 (T-29) 19:18 (T-29)	07:40 18:45	07:22 18:08 (T-30)
15	05:55 21:11	06:29 20:35	07:05 19:41	19:09 (T-29) 19:16 (T-29)	07:42 18:44	07:23 18:09 (T-30)
16	05:56 21:10	06:30 20:34	07:06 19:39	19:08 (T-29) 19:14 (T-29)	07:43 18:42	07:24 18:09 (T-30)
17	05:57 21:10	06:31 20:32	07:07 19:37	19:09 (T-29) 19:13 (T-29)	07:44 18:40	07:26 18:17 (T-30)
18	05:58 21:09	06:32 20:31	07:09 19:35	19:09 (T-29) 19:11 (T-29)	07:45 18:39	07:27 18:11 (T-30)
19	05:59 21:08	06:33 20:29	07:10 19:33	19:11 (T-29) 19:18 (T-29)	07:47 18:37	08:00 18:14 (T-30)
20	06:00 21:07	06:34 20:27	07:11 19:31	19:15 (T-29) 19:22 (T-29)	07:48 18:35	08:00 18:08 (T-30)
21	06:01 21:06	06:36 20:26	07:12 19:30	19:15 (T-29) 19:22 (T-29)	07:49 18:34	08:01 18:09 (T-30)
22	06:02 21:05	06:37 20:24	07:13 19:28	19:15 (T-29) 19:22 (T-29)	07:51 18:32	08:01 18:11 (T-30)
23	06:03 21:05	06:38 20:22	07:14 19:26	19:15 (T-29) 19:22 (T-29)	07:52 18:30	08:02 18:11 (T-30)
24	06:04 21:04	06:39 20:21	07:16 19:24	19:15 (T-29) 19:22 (T-29)	07:53 18:29	08:02 18:11 (T-30)
25	06:05 21:03	06:40 20:19	07:17 19:22	19:15 (T-29) 19:22 (T-29)	07:55 18:27	08:03 18:11 (T-30)
26	06:06 21:02	06:41 20:17	07:18 19:20	19:15 (T-29) 19:22 (T-29)	07:56 18:26	08:03 18:11 (T-30)
27	06:07 21:01	06:43 20:16	07:19 19:18	19:15 (T-29) 19:22 (T-29)	07:57 18:24	08:03 18:11 (T-30)
28	06:08 20:59	06:44 20:14	07:20 19:16	19:15 (T-29) 19:22 (T-29)	07:59 18:23	08:04 18:11 (T-30)
29	06:09 20:58	06:45 20:12	07:22 19:15	19:15 (T-29) 19:22 (T-29)	08:00 18:21	08:04 18:11 (T-30)
30	06:10 20:57	06:46 20:10	07:23 19:13	19:15 (T-29) 19:22 (T-29)	08:01 18:20	08:04 18:11 (T-30)
31	06:11 20:56	06:47 20:09	07:23 19:13	19:15 (T-29) 19:22 (T-29)	08:03 18:18	08:04 18:11 (T-30)
Potential sun hours	471	436	377	341	288	275
Total, worst case			53	211		
Sun reduction		0.72	0.67	0.56		
Oper. time red.		0.90	0.90	0.90		
Wind dir. red.		0.59	0.59	0.59		
Total reduction		0.38	0.36	0.30		
Total, real		99	19	62		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-027 - R-027
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	08:09 (T-18)	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04
	16:57	17:35	28 08:37 (T-18)	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17
2	08:04	07:46	08:08 (T-18)	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05
	16:58	17:36	29 08:37 (T-18)	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15
3	08:04	07:45	08:06 (T-18)	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07
	16:59	17:38	30 08:36 (T-18)	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14
4	08:04	07:43	08:07 (T-18)	07:01	07:04	06:14	05:43	05:47	06:16	06:52	07:28	07:08
	17:00	17:39	29 08:36 (T-18)	18:17	19:56	20:34	21:07	21:16	20:51	20:01	19:05	17:13
5	08:04	07:42	08:08 (T-18)	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09
	17:01	17:40	28 08:36 (T-18)	18:18	19:57	20:35	21:07	21:16	20:50	20:00	19:03	17:11
6	08:04	07:41	08:09 (T-18)	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11
	17:02	17:42	26 08:35 (T-18)	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10
7	08:04	07:40	08:09 (T-18)	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12
	17:03	17:43	25 08:34 (T-18)	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09
8	08:04	07:38	08:11 (T-18)	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13
	17:04	17:45	22 08:33 (T-18)	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:07
9	08:04	07:37	08:12 (T-18)	07:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15
	17:05	17:46	19 08:31 (T-18)	19:23	20:02	20:40	21:10	21:14	20:44	19:52	18:54	17:06
10	08:03	07:36	08:15 (T-18)	07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16
	17:06	17:48	14 08:29 (T-18)	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05
11	08:03	07:34	08:19 (T-18)	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:18
	17:07	17:49	7 08:26 (T-18)	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04
12	08:03	07:33		07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19
	17:08	17:50		19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03
13	08:02	07:31		06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:39	07:20
	17:09	17:52		19:28	20:07	20:44	21:13	21:12	20:38	19:45	18:47	17:02
14	08:02	07:30		07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22
	17:11	17:53		19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	17:01
15	08:01	07:28		07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:23
	17:12	17:55		19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00
16	08:01	08:24 (T-18)	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24
	17:13	2 08:26 (T-18)	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59
17	08:00	08:23 (T-18)	07:25	07:37	06:41	05:57	05:41	05:57	06:31	07:07	07:44	07:26
	17:14	4 08:27 (T-18)	17:57	19:34	20:12	20:49	21:14	21:10	20:32	19:37	18:40	16:58
18	07:59	08:22 (T-18)	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27
	17:16	6 08:28 (T-18)	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57
19	07:59	08:22 (T-18)	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:28
	17:17	8 08:30 (T-18)	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56
20	07:58	08:21 (T-18)	07:21	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:30
	17:18	10 08:31 (T-18)	18:00	19:37	20:16	20:52	21:16	21:07	20:27	19:31	18:35	16:55
21	07:57	08:20 (T-18)	07:19	07:30	06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31
	17:20	12 08:32 (T-18)	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54
22	07:57	08:19 (T-18)	07:18	07:28	06:32	05:52	05:41	06:02	06:37	07:13	07:51	07:32
	17:21	13 08:32 (T-18)	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:53
23	07:56	08:18 (T-18)	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33
	17:22	15 08:33 (T-18)	18:04	19:41	20:20	20:55	21:16	21:05	20:22	19:26	18:30	16:53
24	07:55	08:17 (T-18)	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35
	17:24	17 08:34 (T-18)	18:06	19:42	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52
25	07:54	08:17 (T-18)	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:55	07:36
	17:25	18 08:35 (T-18)	18:07	19:44	20:22	20:57	21:17	21:03	20:19	19:22	18:27	16:51
26	07:53	08:16 (T-18)	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37
	17:26	20 08:36 (T-18)	18:08	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51
27	07:52	08:14 (T-18)	07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39
	17:28	21 08:35 (T-18)	18:10	19:46	20:25	20:59	21:17	21:01	20:16	19:18	18:24	16:50
28	07:51	08:13 (T-18)	07:08	07:17	06:23	05:48	05:43	06:08	06:44	07:20	07:59	07:40
	17:29	23 08:36 (T-18)	18:11	19:47	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50
29	07:50	08:12 (T-18)		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41
	17:31	24 08:36 (T-18)		19:49	20:27	21:01	21:17	20:58	20:12	19:14	18:21	16:49
30	07:49	08:11 (T-18)		07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42
	17:32	25 08:36 (T-18)		19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49
31	07:48	08:10 (T-18)		07:11		05:46		06:11	06:47		08:03	08:04
	17:33	27 08:37 (T-18)		19:51	21:03			20:56	20:09		18:18	16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case	245	257								8	499	
Sun reduction	0.58	0.58								0.56	0.48	
Oper. time red.	0.90	0.90								0.90	0.90	
Wind dir. red.	0.65	0.65								0.65	0.65	
Total reduction	0.34	0.34								0.33	0.28	
Total, real	83	87								3	139	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-028 - R-028

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	09:10 (T-44)	07:47	08:18 (T-45)	07:06	07:09
	16:57	8 09:18 (T-44)	17:35	19 08:37 (T-45)	18:12	19:52
2	08:04	09:14 (T-44)	07:46	08:20 (T-45)	07:04	07:07
	16:58	1 09:15 (T-44)	17:36	16 08:36 (T-45)	18:14	19:54
3	08:04		07:44	08:21 (T-45)	07:02	07:05
	16:58		17:38	12 08:33 (T-45)	18:15	19:55
4	08:04		07:43	08:25 (T-45)	07:00	07:04
	16:59		17:39	5 08:30 (T-45)	18:16	19:56
5	08:04		07:42		06:59	07:02
	17:00		17:40		18:18	19:57
6	08:04		07:41		06:57	07:00
	17:01		17:42		18:19	19:59
7	08:04		07:39		06:55	06:58
	17:03		17:43		18:20	20:00
8	08:04		07:38		07:53	06:56
	17:04		17:45		18:22	20:01
9	08:03	08:27 (T-45)	07:37		07:52	06:55
	17:05	2 08:29 (T-45)	17:46		19:23	20:02
10	08:03	08:27 (T-45)	07:35		07:50	06:53
	17:06	3 08:30 (T-45)	17:48		19:24	20:04
11	08:03	08:26 (T-45)	07:34		07:48	06:51
	17:07	5 08:31 (T-45)	17:49		19:26	20:05
12	08:02	08:26 (T-45)	07:33		07:46	06:49
	17:08	6 08:32 (T-45)	17:50		19:27	20:06
13	08:02	08:26 (T-45)	07:31		07:44	06:47
	17:09	8 08:34 (T-45)	17:52		19:28	20:07
14	08:02	08:25 (T-45)	07:30		07:42	06:46
	17:11	9 08:34 (T-45)	17:53		19:30	20:09
15	08:01	08:24 (T-45)	07:28		07:41	06:44
	17:12	11 08:35 (T-45)	17:55		19:31	20:10
16	08:01	08:24 (T-45)	07:27		07:39	06:42
	17:13	12 08:36 (T-45)	17:56		19:32	20:11
17	08:00	08:23 (T-45)	07:25		07:37	06:40
	17:14	13 08:36 (T-45)	17:57		19:33	20:12
18	07:59	08:22 (T-45)	07:24		07:35	06:39
	17:16	15 08:37 (T-45)	17:59		19:35	20:14
19	07:59	08:22 (T-45)	07:22		07:33	06:37
	17:17	16 08:38 (T-45)	18:00		19:36	20:15
20	07:58	08:21 (T-45)	07:21		07:31	06:35
	17:18	17 08:38 (T-45)	18:00		19:37	20:16
21	07:57	08:20 (T-45)	07:19		07:30	06:34
	17:20	19 08:39 (T-45)	18:02		19:39	20:17
22	07:56	08:19 (T-45)	07:17		07:28	06:32
	17:21	20 08:39 (T-45)	18:03		19:40	20:19
23	07:56	08:18 (T-45)	07:16		07:26	06:30
	17:22	21 08:39 (T-45)	18:04		19:41	20:20
24	07:55	08:17 (T-45)	07:14		07:24	06:29
	17:24	22 08:39 (T-45)	18:06		19:42	20:21
25	07:54	08:16 (T-45)	07:12		07:22	06:27
	17:25	23 08:39 (T-45)	18:07		19:44	20:22
26	07:53	08:15 (T-45)	07:11		07:20	06:26
	17:26	24 08:39 (T-45)	18:08		19:45	20:24
27	07:52	08:14 (T-45)	07:09		07:18	06:24
	17:28	25 08:39 (T-45)	18:10		19:46	20:25
28	07:51	08:13 (T-45)	07:07		07:17	06:23
	17:29	26 08:39 (T-45)	18:11		19:47	20:26
29	07:50	08:14 (T-45)			07:15	06:21
	17:31	25 08:39 (T-45)			19:49	20:27
30	07:49	08:15 (T-45)			07:13	06:19
	17:32	23 08:38 (T-45)			19:50	20:28
31	07:48	08:16 (T-45)			07:11	
	17:33	22 08:38 (T-45)			19:51	
Potential sun hours	287	292	369	403	459	465
Total, worst case	376	52		61		105
Sun reduction	0.58	0.58		0.63		0.66
Oper. time red.	0.90	0.90		0.90		0.90
Wind dir. red.	0.65	0.65		0.61		0.60
Total reduction	0.34	0.34		0.35		0.36
Total, real	128	18		21		37

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-028 - R-028
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	06:36 (T-21) 20:07 (T-21)	06:48 20:07	07:24 19:11	07:43 17:17
2	05:45 21:16	06:13 20:53		06:50 20:05	07:25 19:09	07:44 17:15
3	05:46 21:16	06:15 20:52		06:51 20:03	07:26 19:07	07:45 17:14
4	05:47 21:16	06:16 20:51		06:52 20:01	07:28 19:05	07:46 17:13
5	05:47 21:16	06:17 20:50		06:53 19:59	07:29 19:03	07:48 17:11
6	05:48 21:15	06:18 20:48		06:54 19:58	07:30 19:01	07:49 17:10
7	05:49 21:15	06:19 20:47		06:55 19:56	07:31 19:00	07:50 17:09
8	05:49 21:15	06:20 20:46		06:57 19:54	07:33 18:56	07:51 17:07
9	05:50 21:14	06:21 20:44		06:58 19:52	07:34 18:54	07:52 17:06
10	05:51 21:14	06:23 20:43	20:07 (T-17)	06:59 19:50	07:35 18:52	07:52 17:05
11	05:52 21:13	06:24 20:41	20:04 (T-17) 20:16 (T-17)	07:00 19:48	07:36 18:51	07:53 17:04
12	05:52 21:13	06:25 20:40	20:03 (T-17) 20:14 (T-17)	07:01 19:46	07:38 18:49	07:54 17:03
13	05:53 21:12	06:26 20:38	20:02 (T-17) 20:13 (T-17)	07:03 19:45	07:39 18:47	07:55 17:02
14	05:54 21:11	06:27 20:37	20:01 (T-17) 20:11 (T-17)	07:04 19:43	07:40 18:45	07:56 17:01
15	05:55 21:11	06:28 20:35	20:00 (T-17) 20:10 (T-17)	07:05 19:41	07:41 18:44	07:57 17:00
16	05:56 21:10	06:30 20:34	20:00 (T-17) 20:08 (T-17)	07:06 19:39	07:43 18:42	07:57 16:59
17	05:57 21:09	06:31 20:32	19:59 (T-17) 20:06 (T-17)	07:07 19:37	07:44 18:40	07:58 16:58
18	05:58 21:09	06:32 20:31	20:00 (T-17) 20:06 (T-17)	07:08 19:35	07:45 18:38	07:59 16:57
19	05:59 21:08	06:33 20:29	20:00 (T-17) 20:04 (T-17)	07:10 19:33	07:47 18:37	07:59 16:56
20	06:00 21:07	06:34 20:27	20:01 (T-17) 20:02 (T-17)	07:11 19:31	07:48 18:35	07:59 16:55
21	06:01 21:06	06:35 20:26	07:12 19:29	07:49 18:33	07:50 16:54	08:00 16:54
22	06:02 21:05	06:36 20:24	06:26 (T-21) 06:35 (T-21)	07:13 19:28	07:50 18:32	08:01 16:53
23	06:03 21:04	06:37 20:22	06:33 (T-21) 06:36 (T-21)	07:14 19:26	07:51 18:30	08:02 16:52
24	06:04 21:03	06:38 20:21	06:37 (T-21) 06:38 (T-21)	07:15 19:24	07:52 18:29	08:03 16:51
25	06:05 21:02	06:39 20:19	06:38 (T-21) 06:36 (T-21)	07:16 19:22	07:53 18:27	08:04 16:51
26	06:06 21:01	06:40 20:17	06:39 (T-21) 06:38 (T-21)	07:17 19:20	07:54 18:25	08:05 16:50
27	06:07 21:00	06:41 20:15	06:39 (T-21) 06:37 (T-21)	07:18 19:18	07:55 18:24	08:06 16:50
28	06:08 20:59	06:42 20:14	06:38 (T-21) 06:36 (T-21)	07:19 19:16	07:56 18:22	08:07 16:50
29	06:09 20:58	06:43 20:12	06:39 (T-21) 06:37 (T-21)	07:20 19:14	07:57 18:21	08:08 16:49
30	06:10 20:57	06:44 20:10	06:38 (T-21) 06:36 (T-21)	07:21 19:13	07:58 18:19	08:09 16:49
31	06:11 20:56	06:45 20:08	06:39 (T-21) 06:37 (T-21)	07:22 18:18	07:59 18:18	08:10 16:56
Potential sun hours	471	436		377	341	288
Total, worst case	80	89				415
Sun reduction	0.75	0.72				0.48
Oper. time red.	0.90	0.90				0.90
Wind dir. red.	0.59	0.61				0.68
Total reduction	0.40	0.40				0.28
Total, real	32	35				109

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

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L086 71 V163-4.5 WTGs on 98m HH
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-054 - R-054

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:56	17:34	18:12	19:52	20:30	21:04	21:16	20:55	20:06	19:10	17:16	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:57	17:36	18:14	19:53	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:47
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:13	05:43	05:46	06:15	06:52	07:27	07:08	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:12	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:42	05:48	06:18	06:54	07:30	07:10	07:48
	17:01	17:42	18:19	19:58	20:36	21:08	21:15	20:48	19:57	19:01	17:10	16:46
7	08:04	07:39	06:55	06:58	06:09	05:42	05:48	06:19	06:55	07:31	07:12	07:49
	17:02	17:43	18:20	20:00	20:37	21:09	21:15	20:47	19:56	18:58	17:08	16:46
8	08:04	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50
	17:03	17:44	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	06:07	05:41	05:50	06:21	06:58	07:34	07:15	07:51
	17:04	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:05	05:41	05:50	06:22	06:59	07:35	07:16	07:52
	17:06	17:47	19:24	20:03	20:40	21:11	21:14	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	05:51	06:23	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:50	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:19	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:02	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:01	16:46
14	08:01	07:30	07:42	06:45	06:00	05:40	05:54	06:27	07:03	07:40	07:21	07:56
	17:10	17:53	19:29	20:08	20:45	21:13	21:11	20:37	19:42	18:45	17:00	16:46
15	08:01	07:28	07:40	06:44	05:59	05:40	05:55	06:28	07:05	07:41	07:23	07:57
	17:12	17:54	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:43	16:59	16:47
16	08:00	07:27	07:39	06:42	05:58	05:40	05:56	06:29	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57	05:40	05:56	06:30	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:57	16:47
18	07:59	07:24	07:35	06:39	05:56	05:40	05:57	06:32	07:08	07:45	07:27	07:59
	17:15	17:59	19:35	20:13	20:50	21:15	21:09	20:30	19:35	18:38	16:56	16:47
19	07:59	07:22	07:33	06:37	05:55	05:41	05:58	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	05:59	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:33	05:53	05:41	06:00	06:35	07:12	07:49	07:31	08:00
	17:19	18:01	19:38	20:17	20:53	21:16	21:06	20:26	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:01	06:36	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:16	21:05	20:24	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	05:51	05:41	06:02	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:52	16:50
24	07:55	07:14	07:24	06:29	05:50	05:42	06:03	06:39	07:15	07:53	07:35	08:02
	17:23	18:05	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:28	16:52	16:50
25	07:54	07:12	07:22	06:27	05:49	05:42	06:04	06:40	07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:25	05:49	05:42	06:05	06:41	07:18	07:56	07:37	08:03
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:50	16:51
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:27	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:43	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:22	16:49	16:53
29	07:50		07:14	06:21	05:47	05:44	06:09	06:45	07:21	08:00	07:41	08:04
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:48	16:54
31	07:48		07:11		05:45		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:55
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-055 - R-055
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	17:42 (T-21)	07:09	06:18	05:45	05:45	06:12	06:48				
	16:56	17:34	18:12	8 17:50 (T-22)	19:52	20:30	21:04	21:16	20:55	20:06	07:24	18:23 (T-22)	07:04	07:43
2	08:04	07:45	07:04	17:42 (T-21)	07:07	06:16	05:44	05:45	06:13	06:49	19:10	21 18:44 (T-22)	17:16	16:48
	16:57	17:36	18:14	9 17:51 (T-22)	19:53	20:31	21:05	21:16	20:53	20:05	07:25	18:21 (T-22)	07:05	07:44
3	08:04	07:44	07:02	17:44 (T-21)	07:05	06:15	05:44	05:46	06:14	06:51	19:09	22 18:43 (T-22)	17:15	16:48
	16:58	17:37	18:15	10 17:54 (T-22)	19:55	20:32	21:05	21:16	20:52	20:03	07:26	18:20 (T-22)	07:06	07:45
4	08:04	07:43	07:00	17:44 (T-22)	07:03	06:13	05:43	05:46	06:15	06:52	19:07	21 18:41 (T-22)	17:14	16:47
	16:59	17:39	18:16	11 17:55 (T-22)	19:56	20:33	21:06	21:16	20:51	20:01	07:27	18:20 (T-22)	07:08	07:46
5	08:04	07:42	06:59	17:43 (T-22)	07:02	06:12	05:43	05:47	06:17	06:53	19:05	20 18:40 (T-22)	17:12	16:47
	17:00	17:40	18:18	13 17:56 (T-22)	19:57	20:34	21:07	21:15	20:49	19:59	07:29	18:19 (T-22)	07:09	07:47
6	08:04	07:41	06:57	17:42 (T-22)	07:00	06:11	05:42	05:48	06:18	06:54	19:03	19 18:38 (T-22)	17:11	16:47
	17:01	17:42	18:19	15 17:57 (T-22)	19:58	20:36	21:08	21:15	20:48	19:57	07:30	18:18 (T-22)	07:10	07:48
7	08:04	07:39	06:55	17:42 (T-22)	06:58	06:09	05:42	05:48	06:19	06:55	19:01	18 18:36 (T-22)	17:10	16:46
	17:02	17:43	18:20	16 17:58 (T-22)	20:00	20:37	21:09	21:15	20:47	19:56	07:31	18:18 (T-22)	07:12	07:49
8	08:03	07:38	07:53	18:42 (T-22)	06:56	06:08	05:42	05:49	06:20	06:56	19:01	18 18:34 (T-22)	17:08	16:46
	17:03	17:44	18:22	18 19:00 (T-22)	20:01	20:38	21:09	21:14	20:45	19:54	07:32	18:19 (T-22)	07:13	07:50
9	08:03	07:37	07:51	18:42 (T-22)	06:54	06:07	05:41	05:50	06:21	06:58	19:01	18 18:33 (T-22)	17:07	16:46
	17:04	17:46	19:23	20 19:02 (T-22)	20:02	20:39	21:10	21:14	20:44	19:52	07:34	18:19 (T-22)	07:15	07:51
10	08:03	07:35	07:50	18:42 (T-22)	06:53	06:05	05:41	05:51	06:22	06:59	19:01	18 18:30 (T-22)	17:06	16:46
	17:06	17:47	19:24	21 19:03 (T-22)	20:03	20:40	21:11	21:14	20:43	19:50	07:35	18:19 (T-22)	07:16	07:52
11	08:03	07:34	07:48	18:42 (T-22)	06:51	06:04	05:41	05:51	06:23	07:00	19:01	18 18:28 (T-22)	17:05	16:46
	17:07	17:49	19:26	22 19:04 (T-22)	20:05	20:42	21:11	21:13	20:41	19:48	07:36	18:16 (T-21)	07:17	07:53
12	08:02	07:33	07:46	18:43 (T-22)	06:49	06:03	05:41	05:52	06:25	07:01	19:01	18 18:26 (T-22)	17:04	16:46
	17:08	17:50	19:27	22 19:05 (T-22)	20:06	20:43	21:12	21:12	20:40	19:46	07:37	18:16 (T-21)	07:19	07:54
13	08:02	07:31	07:44	18:43 (T-22)	06:47	06:02	05:41	05:53	06:26	07:02	19:01	18 18:25 (T-22)	17:02	16:46
	17:09	17:52	19:28	20 19:03 (T-22)	20:07	20:44	21:12	21:12	20:38	19:44	07:39	18:15 (T-21)	07:20	07:55
14	08:01	07:30	07:42	18:46 (T-22)	06:45	06:00	05:41	05:54	06:27	07:03	19:01	18 18:23 (T-22)	17:01	16:46
	17:10	17:53	19:29	16 19:02 (T-22)	20:08	20:45	21:13	21:11	20:37	19:42	07:40	18:14 (T-21)	07:21	07:56
15	08:01	07:28	07:40	18:48 (T-22)	06:44	05:59	05:40	05:55	06:28	07:05	19:01	18 18:21 (T-21)	17:00	16:46
	17:12	17:54	19:31	11 18:59 (T-22)	20:10	20:46	21:13	21:11	20:35	19:41	07:41	18:14 (T-21)	07:23	07:57
16	08:00	07:27	07:39	06:42	05:58	05:40	05:56	06:29	07:06	07:42	19:01	18 18:20 (T-21)	16:59	16:47
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	07:42	18:14 (T-21)	07:24	07:57
17	08:00	07:25	07:37	06:40	05:57	05:40	05:56	06:31	07:07	07:44	19:01	18 18:18 (T-21)	16:58	16:47
	17:14	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	07:44	18:14 (T-21)	07:25	07:58
18	07:59	07:24	07:35	06:39	05:56	05:41	05:57	06:32	07:08	07:45	19:01	2 18:16 (T-21)	16:57	16:47
	17:15	17:59	19:35	20:13	20:50	21:15	21:09	20:30	19:35	18:38	07:45	18:16 (T-21)	07:27	07:59
19	07:58	07:22	07:33	06:37	05:55	05:41	05:58	06:33	07:09	07:46	19:01	18 18:16 (T-21)	16:57	16:47
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	07:46	18:16 (T-21)	07:28	07:59
20	07:58	07:20	07:31	06:35	05:54	05:41	05:59	06:34	07:11	07:48	19:01	18 18:16 (T-21)	16:56	16:48
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:37	07:48	18:16 (T-21)	07:29	08:00
21	07:57	07:19	07:29	06:33	05:53	05:41	06:00	06:35	07:12	07:49	19:01	18 18:16 (T-21)	16:55	16:48
	17:19	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	07:49	18:16 (T-21)	07:31	08:00
22	07:56	07:17	07:27	06:32	05:52	05:41	06:01	06:36	07:13	07:50	19:01	18 18:16 (T-21)	16:54	16:49
	17:21	18:03	19:40	20:18	20:54	21:16	21:05	20:24	19:27	18:32	07:50	18:16 (T-21)	07:32	08:01
23	07:55	07:16	07:26	06:30	05:51	05:41	06:02	06:38	07:14	07:52	19:01	18 18:16 (T-21)	16:53	16:49
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	07:52	18:16 (T-21)	07:33	08:01
24	07:55	07:14	17:43 (T-21)	07:24	06:29	05:50	05:42	06:03	06:39	07:15	19:01	18 18:16 (T-21)	16:52	16:50
	17:23	18:05	1 17:44 (T-21)	19:42	20:21	20:56	21:16	21:03	20:20	19:24	07:53	18:16 (T-21)	07:34	08:02
25	07:54	07:12	17:42 (T-21)	07:22	06:27	05:50	05:42	06:04	06:40	07:16	19:01	18 18:16 (T-21)	16:52	16:50
	17:25	18:07	3 17:45 (T-21)	19:43	20:22	20:57	21:16	21:02	20:19	19:22	07:54	18:16 (T-21)	07:36	08:02
26	07:53	07:11	17:42 (T-21)	07:20	06:25	05:49	05:42	06:05	06:41	07:18	19:01	18 18:16 (T-21)	16:51	16:51
	17:26	18:08	4 17:46 (T-21)	19:45	20:23	20:58	21:16	21:01	20:17	19:20	07:56	18:16 (T-21)	07:37	08:03
27	07:52	07:09	17:42 (T-21)	07:18	06:24	05:48	05:43	06:07	06:42	07:19	19:01	18 18:16 (T-21)	16:50	16:51
	17:27	18:10	6 17:48 (T-21)	19:46	20:25	20:59	21:16	21:00	20:15	19:18	07:57	18:16 (T-21)	07:38	08:03
28	07:51	07:07	17:42 (T-21)	07:16	06:22	05:47	05:43	06:08	06:43	07:20	19:01	18 18:29 (T-22)	16:50	16:52
	17:29	18:11	7 17:49 (T-21)	19:47	20:26	21:00	21:16	20:59	20:14	19:16	07:57	18:26 (T-22)	16:49	16:53
29	07:50		07:14	06:21	05:47	05:44	06:09	06:45	07:21	08:00	19:01	18 18:26 (T-22)	16:49	16:54
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	15 18:41 (T-22)	07:57	18:26 (T-22)	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:23	08:01	19:01	18 18:25 (T-22)	16:48	16:54
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18 18:43 (T-22)	07:57	18:25 (T-22)	16:48	16:54
31	07:48		07:11	05:45			06:11	06:47			19:01	18 18:25 (T-22)	16:48	16:54
	17:33		19:51	21:03			20:56	20:08			19:01	18 18:25 (T-22)	16:48	16:54
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275		
Total, worst case		21	232						42		217			
Sun reduction		0.58	0.59						0.67		0.56			
Oper. time red.		0.90	0.90						0.90		0.90			
Wind dir. red.		0.58	0.57						0.57		0.57			
Total reduction		0.30	0.30						0.35		0.29			
Total, real		6	71						15		63			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-061 - R-061
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	16:25 (T-53) 07:47	17:05 (T-52) 07:05	07:09 06:18	05:45	05:45	06:12	06:48	07:24	07:04	16:42 (T-52) 07:43	16:09 (T-53)
2	08:04	16:25 (T-53) 07:45	17:05 (T-52) 07:04	07:07 06:16	05:44	05:45	06:13	06:49	07:25	07:05	16:40 (T-52) 07:44	16:10 (T-53)
3	08:04	16:26 (T-53) 07:44	17:06 (T-52) 07:02	07:05 06:15	05:44	05:46	06:14	06:51	07:26	07:06	16:38 (T-52) 07:45	16:11 (T-53)
4	08:04	16:26 (T-53) 07:43	17:06 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
5	08:04	16:31 (T-53) 07:39	17:14 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
6	08:04	16:32 (T-53) 07:40	17:14 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
7	08:04	16:32 (T-53) 07:39	17:14 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
8	08:03	16:35 (T-53) 07:38	17:18 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
9	08:03	16:35 (T-53) 07:37	17:17 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
10	08:03	16:38 (T-53) 07:35	17:14 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
11	08:03	16:39 (T-53) 07:34	17:17 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
12	08:02	16:39 (T-53) 07:32	17:17 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
13	08:02	16:41 (T-53) 07:31	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
14	08:02	16:41 (T-53) 07:31	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
15	08:01	16:42 (T-53) 07:30	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
16	08:01	16:42 (T-53) 07:28	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
17	08:00	16:44 (T-53) 07:27	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
18	08:00	16:45 (T-53) 07:25	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
19	07:58	16:47 (T-53) 07:22	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
20	07:58	16:48 (T-53) 07:20	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
21	07:57	16:49 (T-53) 07:19	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
22	07:56	16:51 (T-53) 07:17	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
23	07:55	16:53 (T-53) 07:16	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
24	07:55	16:53 (T-53) 07:14	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
25	07:54	16:55 (T-53) 07:12	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
26	07:53	16:57 (T-53) 07:11	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
27	07:52	16:59 (T-53) 07:09	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
28	07:51	17:01 (T-52) 07:07	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
29	07:50	17:03 (T-52) 07:05	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
30	07:49	17:05 (T-52) 07:03	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
31	07:48	17:07 (T-52) 07:01	17:15 (T-52) 07:00	07:03 06:14	05:43	05:47	06:16	06:52	07:27	07:08	16:37 (T-52) 07:46	16:11 (T-53)
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case	329	73									329	84
Sun reduction	0.58	0.58									0.48	0.52
Oper. time red.	0.90	0.90									0.90	0.90
Wind dir. red.	0.60	0.59									0.59	0.60
Total reduction	0.31	0.31									0.26	0.28
Total, real	102	22									84	23

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-062 - R-062
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:46	07:05	07:09	06:18	19:56 (T-53)	05:45	05:45	06:12	06:48	07:24	07:04	07:43	
	16:57	17:35	18:12	19:52	20:29	7 20:03 (T-53)	21:04	21:16	20:54	20:06	19:10	17:17	16:48	
2	08:04	07:45	07:04	07:07	06:16		05:44	05:45	06:13	06:49	07:25	07:05	07:44	
	16:58	17:36	18:14	19:53	20:31		21:04	21:16	20:53	20:05	19:09	17:15	16:48	
3	08:04	07:44	07:02	07:05	06:15		05:44	05:46	06:14	06:51	07:26	07:06	07:45	
	16:58	17:37	18:15	19:55	20:32		21:05	21:16	20:52	20:03	19:07	17:14	16:47	
4	08:04	07:43	07:00	07:03	06:14		05:43	05:47	06:16	06:52	07:27	07:08	07:46	
	16:59	17:39	18:16	19:56	20:33		21:06	21:15	20:51	20:01	19:05	17:12	16:47	
5	08:04	07:42	06:58	07:02	06:12		05:43	05:47	06:17	06:53	07:29	07:09	07:47	
	17:00	17:40	18:18	19:57	20:34		21:07	21:15	20:49	19:59	19:03	17:11	16:47	
6	08:04	07:40	06:57	07:00	06:11		05:43	05:48	06:18	06:54	07:30	07:10	07:48	
	17:01	17:42	18:19	19:58	20:36		21:08	21:15	20:48	19:57	19:01	17:10	16:47	
7	08:03	07:39	06:55	06:58	06:09		05:42	05:49	06:19	06:55	07:31	07:12	07:49	
	17:02	17:43	18:20	20:00	20:37		21:08	21:15	20:47	19:55	18:58	17:09	16:46	
8	08:03	07:38	07:53	06:56	06:08		05:42	05:49	06:20	06:56	07:32	07:13	07:50	
	17:04	17:45	18:22	20:01	20:38		21:09	21:14	20:45	19:54	18:56	17:07	16:46	
9	08:03	07:37	07:51	06:54	06:07		05:42	05:50	06:21	06:58	07:34	07:14	07:51	
	17:05	17:46	19:23	20:02	20:39		21:10	21:14	20:44	19:52	18:54	17:06	16:46	
10	08:03	07:35	07:50	06:53	06:06		05:41	05:51	06:22	06:59	07:35	07:16	07:52	
	17:06	17:47	19:24	20:03	20:40		21:10	21:13	20:42	19:50	18:52	17:05	16:46	
11	08:02	07:34	07:48	06:51	06:04		05:41	05:52	06:24	07:00	07:36	07:17	07:53	
	17:07	17:49	19:26	20:05	20:41		21:11	21:13	20:41	19:48	18:50	17:04	16:46	
12	08:02	07:32	07:46	06:49	06:03		05:41	05:52	06:25	20:04 (T-53)	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:43		21:12	21:12	20:40	8 20:12 (T-53)	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02		05:41	05:53	06:26	20:01 (T-53)	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44		21:12	21:12	20:38	12 20:13 (T-53)	19:44	18:47	17:02	16:46
14	08:01	07:30	07:42	06:46	06:01		05:41	05:54	06:27	20:00 (T-53)	07:03	07:40	07:21	07:56
	17:11	17:53	19:29	20:08	20:45		21:13	21:11	20:36	11 20:11 (T-53)	19:42	18:45	17:00	16:47
15	08:01	07:28	07:40	06:44	06:00		05:41	05:55	06:28	19:59 (T-53)	07:05	07:41	07:23	07:56
	17:12	17:54	19:31	20:10	20:46		21:13	21:10	20:35	11 20:10 (T-53)	19:41	18:43	16:59	16:47
16	08:00	07:27	07:39	06:42	05:58		05:41	05:56	06:29	19:58 (T-53)	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47		21:14	21:10	20:33	10 20:08 (T-53)	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57		05:41	05:57	06:31	19:57 (T-53)	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48		21:14	21:09	20:32	9 20:06 (T-53)	19:37	18:40	16:58	16:47
18	07:59	07:23	07:35	06:39	05:56		05:41	05:58	06:32	19:57 (T-53)	07:08	07:45	07:27	07:58
	17:16	17:59	19:35	20:13	20:50		21:14	21:08	20:30	8 20:05 (T-53)	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55		05:41	05:59	06:33	19:57 (T-53)	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51		21:15	21:08	20:29	7 20:04 (T-53)	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54		05:41	06:00	06:34	19:57 (T-53)	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52		21:15	21:07	20:27	5 20:02 (T-53)	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	19:52 (T-53)	05:53	05:41	06:01	06:35	19:57 (T-53)	07:12	07:49	07:30	08:00
	17:19	18:01	19:38	20:17	2 19:54 (T-53)	20:53	21:15	21:06	20:25	4 20:01 (T-53)	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	19:52 (T-53)	05:52	05:41	06:02	06:37	19:57 (T-53)	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	4 19:56 (T-53)	20:54	21:16	21:05	20:24	2 19:59 (T-53)	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	19:51 (T-53)	05:51	05:42	06:03	06:38		07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:20	6 19:57 (T-53)	20:55	21:16	21:04	20:22		19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	19:50 (T-53)	05:51	05:42	06:04	06:39		07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	7 19:57 (T-53)	20:56	21:16	21:03	20:20		19:24	18:28	16:52	16:50
25	07:54	07:12	07:22	06:27	19:51 (T-53)	05:50	05:42	06:05	06:40		07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	8 19:59 (T-53)	20:57	21:16	21:02	20:19		19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	19:50 (T-53)	05:49	05:43	06:06	06:41		07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	10 20:00 (T-53)	20:58	21:16	21:01	20:17		19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	19:51 (T-53)	05:48	05:43	06:07	06:42		07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	11 20:02 (T-53)	20:59	21:16	21:00	20:15		19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	19:51 (T-53)	05:47	05:43	06:08	06:44		07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	11 20:02 (T-53)	21:00	21:16	20:59	20:13		19:16	18:22	16:49	16:53
29	07:50		07:14	06:21	19:53 (T-53)	05:47	05:44	06:09	06:45		07:21	07:59	07:40	08:03
	17:30		19:48	20:27	11 20:04 (T-53)	21:01	21:16	20:58	20:12		19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	19:53 (T-53)	05:46	05:44	06:10	06:46		07:23	08:01	07:42	08:03
	17:32		19:50	20:28	11 20:04 (T-53)	21:02	21:16	20:57	20:10		19:12	18:19	16:49	16:55
31	07:48		07:11		05:45			06:11	06:47			08:02		08:04
	17:33		19:51		21:03			20:56	20:08			18:18		16:55
Potential sun hours	287	292	369	403	458	465	471	436		377	341	289	275	
Total, worst case				81	7				87					
Sun reduction				0.63	0.66				0.72					
Oper. time red.				0.90	0.90				0.90					
Wind dir. red.				0.61	0.61				0.61					
Total reduction				0.34	0.36				0.39					
Total, real				28	3			34						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-064 - R-064

Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:46 17:35	07:05 18:12	07:09 19:52	06:18 20:29	05:45 21:03	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	07:04 17:17	07:43 16:48
2	08:04 16:58	07:45 17:36	07:04 18:14	07:07 19:53	06:16 20:31	05:44 21:04	05:45 21:16	06:13 20:53	06:49 20:05	07:25 19:09	07:05 17:15	07:44 16:48
3	08:04 16:58	07:44 17:37	07:02 18:15	07:05 19:55	06:15 20:32	05:44 21:05	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	07:06 17:14	07:45 16:47
4	08:04 16:59	07:43 17:39	07:00 18:16	07:03 19:56	06:14 20:33	05:43 21:06	05:47 21:15	06:16 20:51	06:52 20:01	07:27 19:05	07:08 17:12	07:46 16:47
5	08:04 17:00	07:42 17:40	06:58 18:18	07:02 19:57	06:12 20:34	05:43 21:07	05:47 21:15	06:17 20:49	06:53 19:59	07:29 19:03	07:09 17:11	07:47 16:47
6	08:04 17:01	07:40 17:42	06:57 18:19	07:00 19:58	06:11 20:35	05:43 21:08	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	07:10 17:10	07:48 16:47
7	08:03 17:03	07:39 17:43	06:55 18:20	06:58 20:00	06:09 20:37	05:42 21:08	05:49 21:14	06:19 20:47	06:55 19:55	07:31 18:58	07:12 17:09	07:49 16:47
8	08:03 17:04	07:38 17:45	07:53 18:22	06:56 20:01	06:08 20:38	05:42 21:09	05:49 21:14	06:20 20:45	06:56 19:54	07:32 18:56	07:13 17:07	07:50 16:46
9	08:03 17:05	07:37 17:46	07:51 19:23	06:54 20:02	06:07 20:39	05:42 21:10	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	07:14 17:06	07:51 16:46
10	08:03 17:06	07:35 17:47	07:50 19:24	06:53 20:03	06:06 20:40	05:41 21:10	05:51 21:13	06:22 20:42	06:59 19:50	07:35 18:52	07:16 17:05	07:52 16:46
11	08:02 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:41	05:41 21:11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:50	07:17 17:04	07:53 16:46
12	08:02 17:08	07:32 17:50	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:11	05:52 21:12	06:25 20:39	07:01 19:46	07:37 18:49	07:18 17:03	07:54 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	05:41 21:12	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	07:20 17:02	07:55 16:46
14	08:01 17:11	07:29 17:53	07:42 19:29	06:46 20:08	06:01 20:45	05:41 21:13	05:54 21:11	06:27 20:36	07:03 19:42	07:40 18:45	07:21 17:01	07:56 16:47
15	08:01 17:12	07:28 17:54	07:40 19:31	06:44 20:10	06:00 20:46	05:41 21:13	05:55 21:10	06:28 20:35	07:05 19:41	07:41 18:43	07:22 16:59	07:56 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:58 20:47	05:41 21:13	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	07:24 16:58	07:57 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:48	05:41 21:14	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	07:25 16:58	07:58 16:47
18	07:59 17:16	07:23 17:59	07:35 19:35	06:39 20:13	05:56 20:49	05:41 21:14	05:58 21:08	06:32 20:30	07:08 19:35	07:45 18:38	07:26 16:57	07:58 16:48
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	05:41 21:15	05:59 21:08	06:33 20:29	07:09 19:33	07:46 18:37	07:28 16:56	07:59 16:48
20	07:58 17:18	07:20 18:00	07:31 19:37	06:35 20:16	05:54 20:52	05:41 21:15	06:00 21:07	06:34 20:27	07:11 19:31	07:48 18:35	07:29 16:55	08:00 16:48
21	07:57 17:20	07:19 18:01	07:29 19:38	06:34 20:17	05:53 20:53	05:41 21:15	06:01 21:06	06:35 20:25	07:12 19:29	07:49 18:33	07:30 16:54	08:00 16:49
22	07:56 17:21	07:17 18:03	07:27 19:40	06:32 20:18	05:52 20:54	05:41 21:15	06:02 21:05	06:37 20:24	07:13 19:27	07:50 18:32	07:32 16:53	08:01 16:49
23	07:55 17:22	07:16 18:04	07:26 19:41	06:30 20:20	05:51 20:55	05:42 21:16	06:03 21:04	06:38 20:22	07:14 19:25	07:51 18:30	07:33 16:53	08:01 16:50
24	07:54 17:24	07:14 18:06	07:24 19:42	06:29 20:21	05:51 20:56	05:42 21:16	06:04 21:03	06:39 20:20	07:15 19:24	07:53 18:29	07:34 16:52	08:02 16:50
25	07:54 17:25	07:12 18:07	07:22 19:43	06:27 20:22	05:50 20:57	05:42 21:16	06:05 21:02	06:40 20:19	07:16 19:22	07:54 18:27	07:36 16:51	08:02 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:23	05:49 20:58	05:43 21:16	06:06 21:01	06:41 20:17	07:18 19:20	07:55 18:25	07:37 16:51	08:02 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:24	05:48 20:59	05:43 21:16	06:07 21:00	06:42 20:15	07:19 19:18	07:57 18:24	07:38 16:50	08:03 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47	06:22 20:26	05:47 21:00	05:43 21:16	06:08 20:59	06:44 20:13	07:20 19:16	07:58 18:22	07:39 16:49	08:03 16:53
29	07:50 17:30		07:14 19:48	06:21 20:27	05:47 21:01	05:44 21:16	06:09 20:58	06:45 20:12	07:21 19:14	07:59 18:21	07:40 16:49	08:03 16:54
30	07:49 17:32		07:13 19:50	06:19 20:28	05:46 21:02	05:44 21:16	06:10 20:57	06:46 20:10	07:22 19:12	08:01 18:19	07:42 16:49	08:03 16:55
31	07:48 17:33		07:11 19:51		05:46 21:03		06:11 20:56	06:47 20:08		08:02 18:18		08:04 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-065 - R-065
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:29	21:04	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	06:14	05:43	05:47	06:16	06:52	07:27	07:08	07:46
	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:12	16:47
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
6	08:04	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48
	17:01	17:42	18:19	19:58	20:35	21:08	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:09	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:08	21:14	20:47	19:55	18:58	17:09	16:47
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:06	05:41	05:51	06:22	06:59	07:35	07:16	07:52
	17:06	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:41	21:11	21:13	20:41	19:48	18:50	17:04	16:46
12	08:02	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:43	21:11	21:12	20:39	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	16:46
14	08:01	07:29	07:42	06:46	06:01	05:41	05:54	06:27	07:03	07:40	07:21	07:56
	17:11	17:53	19:29	20:08	20:45	21:13	21:11	20:36	19:42	18:45	17:01	16:47
15	08:01	07:28	07:40	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:22	07:56
	17:12	17:54	19:31	20:10	20:46	21:13	21:10	20:35	19:41	18:43	16:59	16:47
16	08:00	07:27	07:39	06:42	05:58	05:41	05:56	06:29	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:13	21:10	20:33	19:39	18:42	16:58	16:47
17	08:00	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:58	16:47
18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:26	07:58
	17:16	17:59	19:35	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
	17:20	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:52	05:41	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:15	21:05	20:24	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	05:51	05:42	06:03	06:38	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52	16:50
25	07:54	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:36	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:13	19:16	18:22	16:49	16:53
29	07:50		07:14	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:19	05:46	05:44	06:10	06:46	07:22	08:01	07:42	08:03
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55
31	07:48		07:11	06:17	05:46		06:11	06:47		08:02		08:04
	17:33		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-066 - R-066
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:47	07:05	07:09	19:11 (T-53)	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43			
	16:57	17:35	18:12	19:52	20	19:31 (T-53)	20:29	21:04	21:16	20:54	20:06	19:10	17:17	16:48		
2	08:04	07:45	07:04	07:07	19:11 (T-53)	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44			
	16:58	17:36	18:14	19:53	21	19:32 (T-53)	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48		
3	08:04	07:44	07:02	07:05	19:11 (T-53)	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45			
	16:58	17:37	18:15	19:55	22	19:33 (T-53)	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47		
4	08:04	07:43	07:00	07:03	19:12 (T-53)	06:14	05:43	05:47	06:16	06:52	19:17 (T-53)	07:27	07:08	07:46		
	16:59	17:39	18:16	19:56	23	19:35 (T-53)	20:33	21:06	21:15	20:51	20:01	19:22 (T-53)	19:05	17:12	16:47	
5	08:04	07:42	06:59	07:02	19:13 (T-53)	06:12	05:43	05:47	06:17	06:53	19:12 (T-53)	07:29	07:09	07:47		
	17:00	17:40	18:18	19:57	20	19:33 (T-53)	20:34	21:07	21:15	20:49	19:59	13	19:25 (T-53)	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	19:14 (T-53)	06:11	05:43	05:48	06:18	06:54	19:10 (T-53)	07:30	07:10	07:48		
	17:01	17:42	18:19	19:58	17	19:31 (T-53)	20:36	21:08	21:15	20:48	19:57	17	19:27 (T-53)	19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	19:15 (T-53)	06:09	05:42	05:49	06:19	06:55	19:08 (T-53)	07:31	07:12	07:49		
	17:03	17:43	18:20	20:00	13	19:28 (T-53)	20:37	21:08	21:15	20:47	19:56	20	19:28 (T-53)	18:58	17:09	16:47
8	08:03	07:38	07:53	06:56	19:19 (T-53)	06:08	05:42	05:49	06:20	06:56	19:06 (T-53)	07:32	07:13	07:50		
	17:04	17:45	18:22	20:01	5	19:24 (T-53)	20:38	21:09	21:14	20:45	19:54	23	19:29 (T-53)	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	19:19	06:07	05:42	05:50	06:21	06:58	19:05 (T-53)	07:34	07:14	07:51		
	17:05	17:46	18:23	20:02	20:39	21:10	21:14	20:44	20:44	19:52	22	19:27 (T-53)	18:54	17:06	16:46	
10	08:03	07:35	07:50	06:53	19:14	06:06	05:41	05:51	06:22	06:59	19:04 (T-53)	07:35	07:16	07:52		
	17:06	17:47	18:24	20:03	20:40	21:10	21:13	20:42	20:42	19:50	21	19:25 (T-53)	18:52	17:05	16:46	
11	08:02	07:34	07:48	06:51	19:14	06:04	05:41	05:52	06:24	07:00	19:03 (T-53)	07:36	07:17	07:53		
	17:07	17:49	18:26	20:05	20:42	21:11	21:13	20:41	20:41	19:48	20	19:23 (T-53)	18:50	17:04	16:46	
12	08:02	07:32	07:46	06:49	19:15	06:03	05:41	05:52	06:25	07:01	19:03 (T-53)	07:37	07:19	07:54		
	17:08	17:50	18:27	20:06	20:43	21:12	21:12	20:40	20:40	19:46	19	19:22 (T-53)	18:49	17:03	16:46	
13	08:02	07:31	07:44	06:47	19:16	06:02	05:41	05:53	06:26	07:02	19:03 (T-53)	07:39	07:20	07:55		
	17:09	17:52	18:29	20:07	20:44	21:12	21:12	20:38	20:38	19:44	17	19:20 (T-53)	18:47	17:02	16:46	
14	08:01	07:30	07:42	06:46	19:17	06:01	05:41	05:54	06:27	07:04	19:02 (T-53)	07:40	07:21	07:56		
	17:11	17:53	18:30	20:08	20:45	21:13	21:11	20:37	20:37	19:42	16	19:18 (T-53)	18:45	17:00	16:47	
15	08:01	07:28	07:40	06:44	19:18	06:00	05:41	05:55	06:28	07:05	19:02 (T-53)	07:41	07:23	07:56		
	17:12	17:54	18:31	20:10	20:46	21:13	21:11	20:35	20:35	19:41	14	19:16 (T-53)	18:43	16:59	16:47	
16	08:00	07:27	07:39	06:42	19:19	05:58	05:41	05:56	06:29	07:06	19:02 (T-53)	07:42	07:24	07:57		
	17:13	17:56	18:33	20:11	20:47	21:14	21:14	20:33	20:33	19:39	12	19:14 (T-53)	18:42	16:58	16:47	
17	08:00	07:25	07:37	06:40	19:20	05:57	05:41	05:57	06:31	07:07	19:02 (T-52)	07:44	07:25	07:58		
	17:14	17:57	18:34	20:12	20:48	21:14	21:09	20:32	20:32	19:37	10	19:12 (T-53)	18:40	16:58	16:47	
18	07:59	07:24	07:35	06:39	19:21	05:56	05:41	05:58	06:32	07:08	19:01 (T-52)	07:45	07:27	07:58		
	17:16	17:59	18:36	20:13	20:50	21:14	21:08	20:30	20:30	19:35	9	19:10 (T-53)	18:38	16:57	16:48	
19	07:58	07:22	07:33	06:37	19:22	05:55	05:41	05:59	06:33	07:09	19:01 (T-52)	07:46	07:28	07:59		
	17:17	18:00	18:37	20:15	20:51	21:15	21:08	20:29	20:29	19:33	8	19:09 (T-53)	18:37	16:56	16:48	
20	07:58	07:20	07:31	06:35	19:23	05:54	05:41	06:00	06:34	07:11	19:01 (T-52)	07:48	07:29	08:00		
	17:18	18:00	18:37	20:16	20:52	21:15	21:07	20:27	20:27	19:31	6	19:07 (T-52)	18:35	16:55	16:48	
21	07:57	07:19	07:29	19:17 (T-52)	06:34	05:53	05:41	06:01	06:35	07:12	19:01 (T-52)	07:49	07:30	08:00		
	17:20	18:01	18:38	1	19:18 (T-52)	20:17	20:53	21:15	21:06	20:25	19:29	3	19:04 (T-52)	18:33	16:54	16:49
22	07:56	07:17	07:28	19:16 (T-52)	06:32	05:52	05:41	06:02	06:37	07:13	19:01 (T-52)	07:50	07:32	08:01		
	17:21	18:03	18:40	3	19:19 (T-52)	20:18	20:54	21:16	21:05	20:24	19:27	1	19:02 (T-52)	18:32	16:53	16:49
23	07:55	07:16	07:26	19:15 (T-52)	06:30	05:51	05:42	06:03	06:38	07:14	19:01 (T-52)	07:52	07:33	08:01		
	17:22	18:04	18:41	5	19:20 (T-52)	20:20	20:55	21:16	21:04	20:22	19:26		18:30	16:53	16:50	
24	07:54	07:14	07:24	19:14 (T-52)	06:29	05:51	05:42	06:04	06:39	07:15	19:01 (T-52)	07:53	07:34	08:02		
	17:24	18:06	18:42	7	19:21 (T-53)	20:21	20:56	21:16	21:03	20:20	19:24		18:29	16:52	16:50	
25	07:54	07:12	07:22	19:13 (T-52)	06:27	05:50	05:42	06:05	06:40	07:17	19:01 (T-52)	07:54	07:36	08:02		
	17:25	18:07	18:43	9	19:22 (T-53)	20:22	20:57	21:16	21:02	20:19	19:22		18:27	16:51	16:51	
26	07:53	07:11	07:20	19:13 (T-52)	06:26	05:49	05:43	06:06	06:41	07:18	19:01 (T-52)	07:56	07:37	08:02		
	17:26	18:08	18:44	10	19:23 (T-53)	20:23	20:58	21:16	21:01	20:17	19:20		18:25	16:51	16:52	
27	07:52	07:09	07:18	19:13 (T-53)	06:24	05:48	05:43	06:07	06:42	07:19	19:01 (T-52)	07:57	07:38	08:03		
	17:28	18:10	18:46	11	19:24 (T-53)	20:25	20:59	21:16	21:00	20:15	19:18		18:24	16:50	16:52	
28	07:51	07:07	07:16	19:12 (T-53)	06:22	05:47	05:43	06:08	06:44	07:20	19:01 (T-52)	07:58	07:39	08:03		
	17:29	18:11	18:47	13	19:25 (T-53)	20:26	21:00	21:16	20:59	20:14	19:16		18:22	16:49	16:53	
29	07:50	07:15	07:24	19:12 (T-53)	06:21	05:47	05:44	06:09	06:45	07:21	19:01 (T-52)	08:00	07:40	08:03		
	17:30	18:11	18:47	15	19:27 (T-53)	20:27	21:01	21:16	20:58	20:12	19:14		18:21	16:49	16:54	
30	07:49	07:13	07:22	19:12 (T-53)	06:19	05:46	05:44	06:10	06:46	07:23	19:01 (T-52)	08:01	07:42	08:04		
	17:32	18:13	18:49	16	19:28 (T-53)	20:28	21:02	21:16	20:57	20:10	19:12		18:19	16:49	16:55	
31	07:48	07:11	07:20	19:11 (T-53)	06:18	05:45	05:44	06:11	06:47	07:24	19:01 (T-52)	08:02	07:43	08:04		
	17:33	18:14	18:50	18	19:29 (T-53)	20:29	21:03	20:56	20:08	19:12	19:12		18:18	16:49	16:55	
Potential sun hours	287	292	369	403	458	465	471	436	377	256	341	289	275			
Total, worst case			108	141						256						
Sun reduction			0.59	0.63						0.67						
Oper. time red.			0.90	0.90						0.90						
Wind dir. red.			0.59	0.59						0.59						
Total reduction			0.31	0.34						0.36						
Total, real			34	47						92						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-067 - R-067
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June				
1	08:04	16:15 (T-92)	07:47	07:06	17:45 (T-77)	07:09	06:18	05:45	20:25 (T-52)	
	16:57	13 16:28 (T-92)	17:35	18:12	5 17:50 (T-77)	19:52	20:29	21:04	12 20:37 (T-52)	
2	08:04	16:16 (T-92)	07:45	07:04	17:45 (T-77)	07:07	06:16	05:44	20:26 (T-52)	
	16:58	12 16:28 (T-92)	17:36	18:14	7 17:52 (T-77)	19:53	20:31	21:04	12 20:38 (T-52)	
3	08:04	16:17 (T-92)	07:44	07:02	17:45 (T-77)	07:05	06:15	05:44	20:25 (T-52)	
	16:59	11 16:28 (T-92)	17:38	18:15	9 17:54 (T-77)	19:55	20:32	21:05	14 20:39 (T-52)	
4	08:04	16:19 (T-92)	07:43	07:00	17:45 (T-77)	07:03	06:14	05:43	20:26 (T-52)	
	16:59	9 16:28 (T-92)	17:39	18:16	10 17:55 (T-77)	19:56	20:33	21:06	14 20:40 (T-52)	
5	08:04	16:20 (T-92)	07:42	06:59	17:46 (T-77)	07:02	06:12	05:43	20:26 (T-52)	
	17:00	8 16:28 (T-92)	17:40	18:18	10 17:56 (T-77)	19:57	20:34	21:07	15 20:41 (T-52)	
6	08:04	16:22 (T-92)	07:41	17:14 (T-58)	06:57	17:46 (T-77)	07:00	06:11	05:43	20:26 (T-52)
	17:02	5 16:27 (T-92)	17:42	2 17:16 (T-58)	18:19	11 17:57 (T-77)	19:58	20:36	15 21:08	20:41 (T-52)
7	08:04	07:39	17:13 (T-58)	06:55	17:48 (T-77)	06:58	06:09	05:42	20:26 (T-52)	
	17:03	5 17:43	18:20	8 17:56 (T-77)	20:00	20:37	21:08	16 20:42 (T-52)		
8	08:03	07:38	17:11 (T-58)	07:53	06:56	06:08	05:42	20:27 (T-52)		
	17:04	8 17:45	18:22	20:01	20:38	21:09	16 20:43 (T-52)			
9	08:03	07:37	17:11 (T-58)	07:51	06:54	06:07	05:42	20:27 (T-52)		
	17:05	10 17:46	19:23	20:02	20:39	21:10	16 20:43 (T-52)			
10	08:03	07:35	17:11 (T-58)	07:50	06:53	06:06	05:41	20:27 (T-52)		
	17:06	12 17:47	19:24	20:03	20:40	21:10	16 20:43 (T-52)			
11	08:02	07:34	17:10 (T-58)	07:48	06:51	06:04	05:41	20:27 (T-52)		
	17:07	14 17:49	19:26	20:05	20:42	21:11	17 20:44 (T-52)			
12	08:02	07:32	17:10 (T-58)	07:46	06:49	06:03	05:41	20:28 (T-52)		
	17:08	16 17:50	19:27	20:06	20:43	21:12	17 20:45 (T-52)			
13	08:02	07:31	17:10 (T-58)	07:44	06:47	06:02	05:41	20:28 (T-52)		
	17:09	17 17:52	19:28	20:07	20:44	21:12	17 20:45 (T-52)			
14	08:01	07:30	17:10 (T-58)	07:42	06:46	06:01	05:41	20:28 (T-52)		
	17:11	19 17:53	19:29	20:08	20:45	21:13	18 20:46 (T-52)			
15	08:01	07:28	17:10 (T-58)	07:40	06:44	06:00	05:41	20:28 (T-52)		
	17:12	20 17:55	19:31	20:10	20:46	21:13	18 20:46 (T-52)			
16	08:00	07:27	17:11 (T-58)	07:39	06:42	05:58	05:41	20:29 (T-52)		
	17:13	21 17:56	19:32	20:11	20:47	21:14	18 20:47 (T-52)			
17	08:00	07:25	17:11 (T-58)	07:37	06:40	05:57	05:41	20:29 (T-52)		
	17:14	22 17:57	19:33	20:12	20:48	21:14	18 20:47 (T-52)			
18	07:59	07:24	17:12 (T-58)	07:35	06:39	05:56	05:41	20:29 (T-52)		
	17:16	21 17:59	19:35	20:13	20:50	21:14	18 20:47 (T-52)			
19	07:58	07:22	17:13 (T-58)	07:33	06:37	05:55	05:41	20:29 (T-52)		
	17:17	18 18:00	19:36	20:15	20:51	21:15	18 20:47 (T-52)			
20	07:58	07:20	17:14 (T-58)	07:31	06:35	05:54	05:41	20:29 (T-52)		
	17:18	15 18:00	19:37	20:16	20:52	21:15	18 20:47 (T-52)			
21	07:57	07:19	17:18 (T-58)	07:29	06:34	05:53	05:41	20:30 (T-52)		
	17:20	9 18:01	19:38	20:17	20:53	21:15	18 20:48 (T-52)			
22	07:56	07:17	07:28	06:32	05:52	05:41	20:30 (T-52)			
	17:21	18 18:03	19:40	20:18	20:54	21:16	18 20:48 (T-52)			
23	07:55	07:16	07:26	06:30	05:51	05:42	20:30 (T-52)			
	17:22	18 18:04	19:41	20:20	20:55	1 20:29 (T-52)	21:16	18 20:48 (T-52)		
24	07:54	07:14	07:24	06:29	05:51	20:27 (T-52)	05:42	20:30 (T-52)		
	17:24	18 18:06	19:42	20:21	20:56	3 20:30 (T-52)	21:16	18 20:48 (T-52)		
25	07:54	07:12	07:22	06:27	05:50	20:27 (T-52)	05:42	20:31 (T-52)		
	17:25	18 18:07	19:43	20:22	20:57	5 20:32 (T-52)	21:16	18 20:49 (T-52)		
26	07:53	07:11	07:20	06:26	05:49	20:27 (T-52)	05:43	20:31 (T-52)		
	17:26	18 18:08	19:45	20:23	20:58	5 20:32 (T-52)	21:16	18 20:49 (T-52)		
27	07:52	07:09	17:47 (T-77)	07:18	06:24	05:48	05:43	20:31 (T-52)		
	17:28	1 18:10	19:46	20:25	20:59	7 20:33 (T-52)	21:16	17 20:48 (T-52)		
28	07:51	07:07	17:46 (T-77)	07:16	06:22	05:48	05:43	20:31 (T-52)		
	17:29	3 18:11	19:47	20:26	21:00	9 20:35 (T-52)	21:16	18 20:49 (T-52)		
29	07:50	07:15	07:15	06:21	05:47	20:26 (T-52)	05:44	20:31 (T-52)		
	17:30	18 18:09	19:48	20:27	21:01	9 20:35 (T-52)	21:16	17 20:48 (T-52)		
30	07:49	07:13	07:13	06:19	05:46	20:25 (T-52)	05:44	20:32 (T-52)		
	17:32	18 18:07	19:50	20:28	21:02	10 20:35 (T-52)	21:16	17 20:49 (T-52)		
31	07:48	07:11	07:11	06:18	05:46	20:26 (T-52)	05:44	20:32 (T-52)		
	17:33	18 18:08	19:51	21:03	21:03	11 20:37 (T-52)	21:16	17 20:49 (T-52)		
Potential sun hours	287	292	369	403	458	465	500			
Total, worst case	58	233	60	60	60	500	73			
Sun reduction	0.58	0.58	0.59	0.66	0.90	0.90	0.64			
Oper. time red.	0.90	0.90	0.90	0.90	0.64	0.42	0.42			
Wind dir. red.	0.61	0.59	0.58	0.38	0.38	0.42	0.210			
Total reduction	0.31	0.31	0.30	0.38	0.38	0.42	0.210			
Total, real	18	71	18	23	210	210	210			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-067 - R-067

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	20:31 (T-52)	06:12	06:48	07:24	07:04
	21:16	17 20:48 (T-52)	20:54	20:06	19:11	17:17
2	05:45	20:32 (T-52)	06:13	06:50	07:25	07:05
	21:16	17 20:49 (T-52)	20:53	20:05	19:09	17:15
3	05:46	20:32 (T-52)	06:15	06:51	07:26	07:06
	21:16	16 20:48 (T-52)	20:52	20:03	19:07	17:14
4	05:47	20:32 (T-52)	06:16	06:52	07:27	07:08
	21:15	16 20:48 (T-52)	20:51	20:01	19:05	17:12
5	05:47	20:33 (T-52)	06:17	06:53	07:29	07:09
	21:15	15 20:48 (T-52)	20:49	19:59	19:03	17:11
6	05:48	20:32 (T-52)	06:18	06:54	07:30	07:10
	21:15	15 20:47 (T-52)	20:48	19:57	19:01	17:10
7	05:49	20:33 (T-52)	06:19	06:55	07:31	07:12
	21:15	14 20:47 (T-52)	20:47	19:56	18:58	17:09
8	05:49	20:33 (T-52)	06:20	06:57	07:32	07:13
	21:14	14 20:47 (T-52)	20:45	19:54	18:56	17:07
9	05:50	20:33 (T-52)	06:21	06:58	07:34	07:14
	21:14	13 20:46 (T-52)	20:44	19:52	18:54	17:06
10	05:51	20:33 (T-52)	06:23	06:59	07:35	07:16
	21:13	13 20:46 (T-52)	20:42	19:50	18:52	17:05
11	05:52	20:34 (T-52)	06:24	07:00	07:36	07:17
	21:13	12 20:46 (T-52)	20:41	19:48	18:50	17:04
12	05:52	20:34 (T-52)	06:25	07:01	07:37	07:19
	21:12	11 20:45 (T-52)	20:40	19:46	18:49	17:03
13	05:53	20:34 (T-52)	06:26	07:02	07:39	07:20
	21:12	10 20:44 (T-52)	20:38	19:44	18:47	17:02
14	05:54	20:34 (T-52)	06:27	07:04	07:40	07:21
	21:11	10 20:44 (T-52)	20:37	19:43	18:45	17:01
15	05:55	20:35 (T-52)	06:28	07:05	07:41	07:23
	21:11	8 20:43 (T-52)	20:35	19:41	18:43	17:00
16	05:56	20:35 (T-52)	06:30	07:06	07:42	07:24
	21:10	8 20:43 (T-52)	20:33	19:39	18:42	16:59
17	05:57	20:36 (T-52)	06:31	07:07	07:44	07:25
	21:09	6 20:42 (T-52)	20:32	19:37	18:40	16:58
18	05:58	20:37 (T-52)	06:32	07:08	07:45	07:27
	21:08	5 20:42 (T-52)	20:30	19:35	18:38	16:57
19	05:59	20:37 (T-52)	06:33	07:09	07:46	07:28
	21:08	4 20:41 (T-52)	20:29	19:33	18:37	16:56
20	06:00	20:38 (T-52)	06:34	07:11	07:48	07:29
	21:07	2 20:40 (T-52)	20:27	19:31	18:35	16:55
21	06:01	20:39 (T-52)	06:35	07:12	07:49	07:30
	21:06	1 20:40 (T-52)	20:25	19:29	18:33	16:54
22	06:02	06:37	07:13	07:50	17:44 (T-58)	07:32
	21:05	20:24	19:27	18:32	16 18:00 (T-58)	16:53
23	06:03	06:38	07:14	07:52	17:43 (T-58)	07:33
	21:04	20:22	19:26	18:30	19 18:02 (T-58)	16:53
24	06:04	06:39	07:15	07:53	17:42 (T-58)	07:34
	21:03	20:20	19:24	18:29	20 18:02 (T-58)	16:52
25	06:05	06:40	07:17	07:54	17:40 (T-58)	07:36
	21:02	20:19	19:22	18:27	22 18:02 (T-58)	16:51
26	06:06	06:41	07:18	07:56	17:40 (T-58)	07:37
	21:01	20:17	19:20	18:25	21 18:01 (T-58)	16:51
27	06:07	06:42	07:19	07:57	17:40 (T-58)	07:38
	21:00	20:15	19:18	18:24	19 17:59 (T-58)	16:50
28	06:08	06:44	07:20	07:58	17:40 (T-58)	07:39
	20:59	20:14	19:16	18:22	18 17:58 (T-58)	16:50
29	06:09	06:45	07:21	08:00	17:39 (T-58)	07:40
	20:58	20:12	19:14	18:21	17 17:56 (T-58)	16:49
30	06:10	06:46	07:23	08:01	17:39 (T-58)	07:42
	20:57	20:10	19:12	18:19	15 17:54 (T-58)	16:49
31	06:11	06:47	08:02	08:02	17:40 (T-58)	08:04
	20:56	20:08	18:18	13 17:53 (T-58)	16:56	13 16:27 (T-92)
Potential sun hours	471	436	377	341	289	275
Total, worst case				258		298
Sun reduction	0.75			0.56		0.52
Oper. time red.	0.90			0.90		0.90
Wind dir. red.	0.64			0.59		0.61
Total reduction	0.43			0.29		0.28
Total, real	98			76		84

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-068 - R-068
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:04	07:47	07:06	07:09	18:54 (T-53)	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43		
	16:57	17:35	18:12	19:52	35	19:29 (T-53)	20:29	21:04	21:16	20:54	20:06	19:11	17:17	16:48	
2	08:04	07:45	07:04	07:07	18:54 (T-53)	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44		
	16:58	17:36	18:14	19:53	33	19:27 (T-53)	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48	
3	08:04	07:44	07:02	07:05	18:55 (T-53)	06:15	05:44	05:46	06:14	06:51	19:05 (T-53)	07:26	07:06	07:45	
	16:58	17:38	18:15	19:55	31	19:26 (T-53)	20:32	21:05	21:16	20:52	20:03	19:08 (T-53)	19:07	17:14	16:47
4	08:04	07:43	07:00	07:03	18:56 (T-53)	06:14	05:43	05:47	06:16	06:52	19:00 (T-53)	07:27	07:08	07:46	
	16:59	17:39	18:16	19:56	30	19:26 (T-53)	20:33	21:06	21:15	20:51	20:01	19:14 (T-53)	19:05	17:12	16:47
5	08:04	07:42	06:59	07:02	18:57 (T-53)	06:12	05:43	05:47	06:17	06:53	18:57 (T-53)	07:29	07:09	07:47	
	17:00	17:40	18:18	19:57	27	19:24 (T-53)	20:34	21:07	21:15	20:49	19:59	19:16 (T-53)	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	18:58 (T-53)	06:11	05:43	05:48	06:18	06:54	18:54 (T-53)	07:30	07:10	07:48	
	17:01	17:42	18:19	19:58	24	19:22 (T-53)	20:36	21:08	21:15	20:48	19:57	19:18 (T-53)	19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	18:59 (T-53)	06:09	05:42	05:49	06:19	06:55	18:52 (T-53)	07:31	07:12	07:49	
	17:03	17:43	18:20	20:00	21	19:20 (T-53)	20:37	21:08	21:15	20:47	19:56	19:19 (T-53)	18:58	17:09	16:47
8	08:03	07:38	07:53	06:56	19:02 (T-53)	06:08	05:42	05:49	06:20	06:57	18:50 (T-53)	07:32	07:13	07:50	
	17:04	17:45	18:22	20:01	14	19:16 (T-53)	20:38	21:09	21:14	20:45	19:54	19:20 (T-53)	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	19:08 (T-53)	06:07	05:42	05:50	06:21	06:58	18:49 (T-53)	07:34	07:14	07:51	
	17:05	17:46	19:23	20:02	3	19:11 (T-53)	20:39	21:10	21:14	20:44	19:52	19:20 (T-53)	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	19:02 (T-53)	06:06	05:41	05:51	06:23	06:59	18:47 (T-53)	07:35	07:16	07:52	
	17:06	17:47	19:24	20:03	20	19:20	20:40	21:10	21:13	20:42	19:50	19:21 (T-53)	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	19:04	06:04	05:41	05:52	06:24	07:00	18:46 (T-53)	07:36	07:17	07:53	
	17:07	17:49	19:26	20:05	20	19:22	20:42	21:11	21:13	20:41	19:48	19:21 (T-53)	18:50	17:04	16:46
12	08:02	07:32	07:46	06:49	19:03	06:03	05:41	05:52	06:25	07:01	18:46 (T-53)	07:37	07:19	07:54	
	17:08	17:50	19:27	20:06	20	19:24	20:43	21:12	21:12	20:40	19:46	19:22 (T-53)	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	19:04	06:02	05:41	05:53	06:26	07:02	18:45 (T-53)	07:39	07:20	07:55	
	17:09	17:52	19:28	20:07	20	19:24	20:44	21:12	21:12	20:38	19:42	19:20 (T-53)	18:47	17:02	16:46
14	08:01	07:30	07:42	06:46	19:05	06:01	05:41	05:54	06:27	07:04	18:45 (T-53)	07:40	07:21	07:56	
	17:11	17:53	19:29	20:08	20	19:25	20:45	21:13	21:11	20:37	19:43	19:18 (T-53)	18:45	17:01	16:47
15	08:01	07:28	07:40	06:44	19:06	06:00	05:41	05:55	06:28	07:05	18:44 (T-53)	07:41	07:23	07:56	
	17:12	17:54	19:31	20:10	20	19:26	20:46	21:13	21:11	20:35	19:41	19:16 (T-53)	18:43	16:59	16:47
16	08:00	07:27	07:39	06:42	19:10 (T-52)	06:42	05:58	05:41	05:56	06:30	07:06	18:43 (T-53)	07:42	07:24	07:57
	17:13	17:56	19:32	1	19:11 (T-52)	20:11	20:47	21:14	21:10	20:33	19:39	19:14 (T-53)	18:42	16:59	16:47
17	08:00	07:25	07:37	06:40	19:08 (T-52)	06:40	05:57	05:41	05:57	06:31	07:07	18:43 (T-53)	07:44	07:25	07:58
	17:14	17:57	19:33	4	19:12 (T-53)	20:12	20:48	21:14	21:09	20:32	19:37	19:12 (T-53)	18:40	16:58	16:47
18	07:59	07:24	07:35	06:39	19:06 (T-53)	06:39	05:56	05:41	05:58	06:32	07:08	18:43 (T-53)	07:45	07:27	07:59
	17:16	17:59	19:35	7	19:13 (T-53)	20:13	20:50	21:14	21:08	20:30	19:35	19:10 (T-53)	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	19:03 (T-53)	06:37	05:55	05:41	05:59	06:33	07:09	18:44 (T-53)	07:46	07:28	07:59
	17:17	18:00	19:36	11	19:14 (T-53)	20:15	20:51	21:15	21:08	20:29	19:33	19:09 (T-53)	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	19:01 (T-53)	06:35	05:54	05:41	06:00	06:34	07:11	18:44 (T-53)	07:48	07:29	08:00
	17:18	18:00	19:37	14	19:15 (T-53)	20:16	20:52	21:15	21:07	20:27	19:31	19:07 (T-53)	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	19:00 (T-53)	06:34	05:53	05:41	06:01	06:35	07:12	18:44 (T-53)	07:49	07:31	08:00
	17:20	18:01	19:38	18	19:18 (T-53)	20:17	20:53	21:15	21:06	20:25	19:29	19:04 (T-53)	18:33	16:54	16:49
22	07:56	07:17	07:28	06:32	18:59 (T-53)	06:32	05:52	05:41	06:02	06:37	07:13	18:45 (T-53)	07:50	07:32	08:01
	17:21	18:03	19:40	20	19:19 (T-53)	20:18	20:54	21:16	21:05	20:24	19:27	19:02 (T-53)	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	18:58 (T-53)	06:30	05:51	05:42	06:03	06:38	07:14	18:45 (T-53)	07:52	07:33	08:01
	17:22	18:04	19:41	22	19:20 (T-53)	20:20	20:55	21:16	21:04	20:22	19:26	19:00 (T-53)	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	18:57 (T-53)	06:29	05:51	05:42	06:04	06:39	07:15	18:46 (T-53)	07:53	07:34	08:02
	17:24	18:06	19:42	24	19:21 (T-53)	20:21	20:56	21:16	21:03	20:20	19:24	18:58 (T-53)	18:29	16:52	16:50
25	07:54	07:12	07:22	06:27	18:56 (T-53)	06:27	05:50	05:42	06:05	06:40	07:17	18:49 (T-53)	07:54	07:36	08:02
	17:25	18:07	19:43	26	19:22 (T-53)	20:22	20:57	21:16	21:02	20:19	19:22	18:57 (T-53)	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	18:55 (T-53)	06:26	05:49	05:43	06:06	06:41	07:18	18:50 (T-52)	07:56	07:37	08:03
	17:26	18:08	19:45	28	19:23 (T-53)	20:23	20:58	21:16	21:01	20:17	19:20	18:55 (T-53)	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	18:54 (T-53)	06:24	05:48	05:43	06:07	06:42	07:19	18:51 (T-52)	07:57	07:38	08:03
	17:28	18:10	19:46	30	19:24 (T-53)	20:25	20:59	21:16	21:00	20:15	19:18	18:53 (T-52)	18:24	16:50	16:52
28	07:51	07:07	07:16	06:22	18:55 (T-53)	06:22	05:47	05:43	06:08	06:44	07:20	07:58	07:39	08:03	
	17:29	18:11	19:47	31	19:26 (T-53)	20:26	21:00	21:16	20:59	20:14	19:16	18:22	16:49	16:53	
29	07:50	07:15	07:25	06:21	18:54 (T-53)	06:21	05:47	05:44	06:09	06:45	07:21	08:00	07:40	08:03	
	17:30	18:12	19:48	33	19:27 (T-53)	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54	
30	07:49	07:13	07:23	06:19	18:54 (T-53)	06:19	05:46	05:44	06:10	06:46	07:23	08:01	07:42	08:04	
	17:32	18:14	19:50	34	19:28 (T-53)	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55	
31	07:48	07:11	07:21	06:18	18:54 (T-53)	06:18	05:46	05:41	06:11	06:47	07:24	08:02	07:43	08:04	
	17:33	18:15	19:51	35	19:29 (T-53)	20:29	21:03	20:56	20:08	20:08	07:25	18:18	16:49	16:56	
Potential sun hours	287	292	369	403			458	465	471	436	377	341	289	275	
Total, worst case			338	218							567				
Sun reduction			0.59	0.63							0.67				
Oper. time red.			0.90	0.90							0.90				
Wind dir. red.			0.59	0.59							0.59				
Total reduction			0.31	0.33							0.35				
Total, real			106	73							201				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-069 - R-069
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:04	07:47	07:06	07:09	06:18	05:45	06:08 (T-51)	05:45	06:09 (T-51)	06:12	06:48	07:24	07:04	07:43	
	16:57	17:35	18:12	19:52	20:30	21:04	06:16 (T-51)	21:16	12	06:21 (T-51)	20:55	20:07	19:11	17:17	16:48
2	08:04	07:45	07:04	07:07	06:17	05:44	06:08 (T-51)	05:45	06:10 (T-51)	06:13	06:50	07:25	07:05	07:44	
	16:58	17:36	18:14	19:54	20:31	21:05	06:16 (T-51)	21:16	12	06:22 (T-51)	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	06:07 (T-51)	05:46	06:10 (T-51)	06:15	06:51	07:26	07:06	07:45	
	16:59	17:38	18:15	19:55	20:32	21:05	06:16 (T-51)	21:16	12	06:22 (T-51)	20:52	20:03	19:07	17:14	16:47
4	08:04	07:43	07:00	07:04	06:14	05:43	06:07 (T-51)	05:47	06:11 (T-51)	06:16	06:52	07:28	07:08	07:46	
	17:00	17:39	18:16	19:56	20:33	21:06	06:17 (T-51)	21:16	11	06:22 (T-51)	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	06:07 (T-51)	05:47	06:12 (T-51)	06:17	06:53	07:29	07:09	07:47	
	17:01	17:40	18:18	19:57	20:34	21:07	06:17 (T-51)	21:15	11	06:23 (T-51)	20:49	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	06:12 (T-51)	05:48	06:12 (T-51)	06:18	06:54	07:30	07:10	07:48	
	17:02	17:42	18:19	19:59	20:36	21:08	06:16 (T-51)	21:15	11	06:23 (T-51)	20:48	19:57	19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:42	06:06 (T-51)	05:49	06:13 (T-51)	06:19	06:55	07:31	07:12	07:49	
	17:03	17:43	18:20	20:00	20:37	21:08	06:17 (T-51)	21:15	10	06:23 (T-51)	20:47	19:56	19:00	17:09	16:47
8	08:03	07:38	07:53	06:56	06:08	05:42	06:06 (T-51)	05:49	06:14 (T-51)	06:20	06:57	07:32	07:13	07:50	
	17:04	17:45	18:22	20:01	20:38	21:09	06:17 (T-51)	21:14	10	06:24 (T-51)	20:45	19:54	18:56	17:07	16:46
9	08:03	07:37	07:51	06:54	06:07	05:42	06:06 (T-51)	05:50	06:14 (T-51)	06:21	06:58	07:34	07:15	07:51	
	17:05	17:46	19:23	20:02	20:39	21:10	06:18 (T-51)	21:14	9	06:23 (T-51)	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:06	05:41	06:05 (T-51)	05:51	06:15 (T-51)	06:23	06:59	07:35	07:16	07:52	
	17:06	17:48	19:24	20:04	20:40	21:11	06:17 (T-51)	21:13	9	06:24 (T-51)	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	06:05 (T-51)	05:52	06:16 (T-51)	06:24	07:00	07:36	07:17	07:53	
	17:07	17:49	19:26	20:05	20:42	21:11	06:17 (T-51)	21:13	8	06:24 (T-51)	20:41	19:48	18:51	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	05:41	06:05 (T-51)	05:52	06:17 (T-51)	06:25	07:01	07:37	07:19	07:54	
	17:08	17:50	19:27	20:06	20:43	21:12	06:17 (T-51)	21:12	7	06:24 (T-51)	20:40	19:46	18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	06:02	05:41	06:05 (T-51)	05:53	06:17 (T-51)	06:26	07:02	07:39	07:20	07:55	
	17:09	17:52	19:28	20:07	20:44	21:12	06:17 (T-51)	21:12	7	06:24 (T-51)	20:38	19:44	18:47	17:02	16:47
14	08:01	07:30	07:42	06:46	06:01	05:41	06:05 (T-51)	05:54	06:18 (T-51)	06:27	07:04	07:40	07:21	07:56	
	17:11	17:53	19:30	20:08	20:45	21:13	06:18 (T-51)	21:11	6	06:24 (T-51)	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	06:05 (T-51)	05:55	06:19 (T-51)	06:28	07:05	07:41	07:23	07:56	
	17:12	17:55	19:31	20:10	20:46	21:13	06:18 (T-51)	21:11	5	06:24 (T-51)	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:58	05:41	06:05 (T-51)	05:56	06:20 (T-51)	06:30	07:06	07:43	07:24	07:57	
	17:13	17:56	19:32	20:11	20:47	21:14	06:18 (T-51)	21:10	4	06:24 (T-51)	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:40	05:57	05:41	06:05 (T-51)	05:57	06:21 (T-51)	06:31	07:07	07:44	07:25	07:58	
	17:14	17:57	19:33	20:12	20:49	21:14	06:18 (T-51)	21:09	3	06:24 (T-51)	20:32	19:37	18:40	16:58	16:47
18	07:59	07:24	07:35	06:39	05:56	05:41	06:05 (T-51)	05:58	06:22 (T-51)	06:32	07:08	07:45	07:27	07:59	
	17:16	17:59	19:35	20:13	20:50	21:15	06:18 (T-51)	21:08	2	06:24 (T-51)	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	06:05 (T-51)	05:59	06:23 (T-51)	06:33	07:09	07:46	07:28	07:59	
	17:17	18:00	19:36	20:15	20:51	21:15	06:18 (T-51)	21:08	06:24 (T-51)	06:34	07:11	07:48	07:29	08:00	
20	07:58	07:21	07:31	06:35	05:54	05:41	06:05 (T-51)	06:00	06:25 (T-51)	06:35	07:12	07:49	07:31	08:00	
	17:18	18:00	19:37	20:16	20:52	21:15	06:18 (T-51)	21:07	06:26 (T-51)	06:36	07:13	07:50	07:32	08:01	
21	07:57	07:19	07:29	06:34	05:53	05:41	06:06 (T-51)	06:01	06:27 (T-51)	06:37	07:14	07:51	07:33	08:01	
	17:20	18:02	19:38	20:17	20:53	21:15	06:19 (T-51)	21:06	06:28 (T-51)	06:38	07:15	07:52	07:34	08:01	
22	07:56	07:17	07:28	06:32	05:52	05:41	06:06 (T-51)	06:02	06:29 (T-51)	06:39	07:16	07:53	07:35	08:01	
	17:21	18:03	19:40	20:18	20:54	21:16	06:19 (T-51)	21:05	06:30 (T-51)	06:40	07:17	07:54	07:36	08:02	
23	07:55	07:16	07:26	06:30	05:52	05:42	06:06 (T-51)	06:03	06:31 (T-51)	06:41	07:18	07:55	07:37	08:03	
	17:22	18:04	19:41	20:20	20:55	21:16	06:19 (T-51)	21:04	06:32 (T-51)	06:42	07:19	07:56	07:38	08:03	
24	07:55	07:14	07:24	06:29	05:51	05:42	06:06 (T-51)	06:04	06:33 (T-51)	06:43	07:20	07:57	07:39	08:03	
	17:24	18:06	19:42	20:21	20:56	21:16	06:19 (T-51)	21:03	06:34 (T-51)	06:44	07:21	07:58	07:40	08:04	
25	07:54	07:12	07:22	06:27	05:50	05:42	06:07 (T-51)	06:05	06:35 (T-51)	06:45	07:22	07:59	07:41	08:04	
	17:25	18:07	19:44	20:22	20:57	21:17	06:20 (T-51)	21:02	06:36 (T-51)	06:46	07:23	08:00	07:42	08:04	
26	07:53	07:11	07:20	06:26	05:49	05:43	06:12 (T-51)	05:43	06:37 (T-51)	06:47	07:24	08:01	07:43	08:04	
	17:26	18:08	19:45	20:23	20:58	21:16	06:20 (T-51)	21:01	06:38 (T-51)	06:48	07:25	08:02	07:44	08:04	
27	07:52	07:09	07:18	06:24	05:48	05:43	06:11 (T-51)	05:43	06:39 (T-51)	06:49	07:26	08:03	07:45	08:04	
	17:28	18:10	19:46	20:25	20:59	21:16	06:21 (T-51)	21:00	06:40 (T-51)	06:50	07:27	08:04	07:46	08:04	
28	07:51	07:07	07:16	06:23	05:48	05:43	06:12 (T-51)	05:43	06:41 (T-51)	06:51	07:28	08:05	07:47	08:04	
	17:29	18:11	19:47	20:26	21:00	21:16	06:22 (T-51)	21:00	06:42 (T-51)	06:52	07:29	08:06	07:48	08:04	
29	07:50	07:15	07:24	06:25	05:49	05:44	06:13 (T-51)	05:44	06:43 (T-51)	06:53	07:30	08:07	07:49	08:04	
	17:31	18:13	19:49	20:27	21:01	21:16	06:23 (T-51)	21:01	06:44 (T-51)	06:54	07:31	08:08	07:50	08:04	
30	07:49	07:13	07:22	06:24	05:48	05:43	06:14 (T-51)	05:43	06:45 (T-51)	06:55	07:32	08:09	07:51	08:04	
	17:32	18:14	19:50	20:28	21:02	21:16	06:24 (T-51)	21:01	06:46 (T-51)	06:56	07:33	08:10	07:52	08:04	
31	07:48	07:11	07:20	06:25	05:49	05:44	06:15 (T-51)	05:44	06:47 (T-51)	06:57	07:34	08:11	07:53	08:04	
	17:33	18:15	19:51	21:03	21:03	21:17	06:16 (T-51)	21:02	06:48 (T-51)	06:59	07:35	08:12	07:54	08:04	
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275			
Total, worst case					28	356	149								
Sun reduction					0.66	0.73	0.75								
Oper. time red.					0.90	0.90	0.90								
Wind dir. red.					0.59	0.59	0.59								
Total reduction					0.35	0.39	0.40								
Total, real					10	138	59								

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-070 - R-070
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	07:06 18:12	07:09 19:52	06:18 20:30	05:45 21:04	06:08 (T-51) 21:16	06:13 (T-51) 20:55	06:48 20:07	07:24 19:11	07:04 17:17	07:43 16:48
2	08:04 16:58	07:45 17:36	07:04 18:14	07:07 19:54	06:17 20:31	05:44 21:05	06:08 (T-51) 21:16	06:13 (T-51) 20:53	06:50 20:05	07:25 19:09	07:05 17:15	07:44 16:48
3	08:04 16:59	07:44 17:38	07:02 18:15	07:05 19:55	06:15 20:32	05:44 21:05	06:07 (T-51) 21:16	06:12 (T-51) 20:52	06:51 20:03	07:26 19:07	07:06 17:14	07:45 16:47
4	08:04 17:00	07:43 17:39	07:00 18:16	07:04 19:56	06:14 20:33	05:43 21:06	06:07 (T-51) 21:16	06:13 (T-51) 20:51	06:52 20:01	07:28 19:05	07:08 17:13	07:46 16:47
5	08:04 17:01	07:42 17:40	06:59 18:18	07:02 19:57	06:12 20:34	05:43 21:07	06:07 (T-51) 21:15	06:13 (T-51) 20:49	06:53 19:59	07:29 19:03	07:09 17:11	07:47 16:47
6	08:04 17:02	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	06:06 (T-51) 21:15	06:12 (T-51) 20:48	06:54 19:57	07:30 19:01	07:10 17:10	07:48 16:47
7	08:04 17:03	07:39 17:43	06:55 18:20	06:58 20:00	06:10 20:37	05:42 21:08	06:06 (T-51) 21:15	06:13 (T-51) 20:47	06:55 19:56	07:31 19:00	07:12 17:09	07:49 16:47
8	08:03 17:04	07:38 17:45	07:53 18:22	06:56 20:01	06:08 20:38	05:42 21:09	06:07 (T-51) 21:14	06:14 (T-51) 20:45	06:57 19:54	07:32 18:56	07:13 17:07	07:50 16:46
9	08:03 17:05	07:37 17:46	07:51 19:23	06:54 20:02	06:07 20:39	05:42 21:10	06:08 (T-51) 21:14	06:14 (T-51) 20:44	06:58 19:52	07:34 18:54	07:15 17:06	07:51 16:46
10	08:03 17:06	07:35 17:48	07:50 19:24	06:53 20:04	06:06 20:40	05:41 21:11	06:08 (T-51) 21:13	06:15 (T-51) 20:43	06:59 19:50	07:35 18:52	07:16 17:05	07:52 16:46
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:42	05:41 21:11	06:09 (T-51) 21:13	06:16 (T-51) 20:41	07:00 19:48	07:36 18:51	07:17 17:04	07:53 16:46
12	08:02 17:08	07:33 17:50	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	06:10 (T-51) 21:12	06:17 (T-51) 20:40	07:01 19:46	07:37 18:49	07:19 17:03	07:54 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	05:41 21:12	06:10 (T-51) 21:12	06:17 (T-51) 20:38	07:02 19:44	07:39 18:47	07:20 17:02	07:55 16:47
14	08:01 17:11	07:30 17:53	07:42 19:30	06:46 20:08	06:01 20:45	05:41 21:13	06:11 (T-51) 21:11	06:18 (T-51) 20:37	07:04 19:43	07:40 18:45	07:21 17:01	07:56 16:47
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	06:00 20:46	05:41 21:13	06:12 (T-51) 21:11	06:19 (T-51) 20:35	07:05 19:41	07:41 18:44	07:23 17:00	07:56 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:58 20:47	05:41 21:14	06:13 (T-51) 21:10	06:20 (T-51) 20:34	07:06 19:39	07:43 18:42	07:24 16:59	07:57 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:49	05:41 21:14	06:14 (T-51) 21:09	06:21 (T-51) 20:32	07:07 19:37	07:44 18:40	07:25 16:58	07:58 16:47
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:13	05:56 20:50	05:41 21:15	06:18 (T-51) 21:08	06:22 (T-51) 20:30	07:08 19:35	07:45 18:38	07:27 16:57	07:59 16:48
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	05:41 21:15	06:17 (T-51) 21:08	06:23 (T-51) 20:29	07:09 19:33	07:46 18:37	07:28 16:56	07:59 16:48
20	07:58 17:18	07:21 18:00	07:31 19:37	06:35 20:16	05:54 20:52	05:41 21:15	06:17 (T-51) 21:07	06:24 (T-51) 20:27	07:11 19:31	07:48 18:35	07:29 16:55	08:00 16:48
21	07:57 17:20	07:19 18:02	07:29 19:38	06:34 20:17	05:53 20:53	05:41 21:15	06:16 (T-51) 21:06	06:25 (T-51) 20:26	07:12 19:29	07:49 18:33	07:31 16:54	08:00 16:49
22	07:56 17:21	07:17 18:03	07:28 19:40	06:32 20:18	05:52 20:54	05:41 21:16	06:15 (T-51) 21:05	06:26 (T-51) 20:24	07:13 19:27	07:50 18:32	07:32 16:53	08:01 16:49
23	07:55 17:22	07:16 18:04	07:26 19:41	06:30 20:20	05:52 20:55	05:42 21:16	06:14 (T-51) 21:04	06:27 (T-51) 20:22	07:14 19:26	07:52 18:30	07:33 16:53	08:01 16:50
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	05:51 20:56	05:42 21:16	06:13 (T-51) 21:03	06:28 (T-51) 20:21	07:15 19:24	07:53 18:29	07:34 16:52	08:02 16:51
25	07:54 17:25	07:12 18:07	07:22 19:44	06:27 20:22	05:50 20:57	05:42 21:16	06:13 (T-51) 21:02	06:29 (T-51) 20:19	07:17 19:22	07:54 18:27	07:36 16:51	08:02 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:26 20:23	05:49 20:58	05:43 21:16	06:12 (T-51) 21:01	06:30 (T-51) 20:17	07:18 19:20	07:56 18:25	07:37 16:51	08:03 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	05:48 20:59	05:43 21:16	06:11 (T-51) 21:00	06:31 (T-51) 20:15	07:19 19:18	07:57 18:24	07:38 16:50	08:03 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47	06:23 20:26	05:48 21:00	05:43 21:16	06:11 (T-51) 20:59	06:44 20:14	07:20 19:16	07:58 18:22	07:39 16:50	08:03 16:53
29	07:50 17:31	07:05 18:15	07:15 19:49	06:21 20:27	05:47 21:01	05:44 21:16	06:10 (T-51) 20:58	06:45 20:12	07:21 19:14	08:00 18:21	07:41 16:49	08:03 16:54
30	07:49 17:32	07:03 18:13	07:13 19:50	06:19 20:28	05:46 21:02	05:44 21:16	06:09 (T-51) 20:57	06:46 20:10	07:23 19:12	08:01 18:19	07:42 16:49	08:04 16:55
31	07:48 17:33	07:11 19:51	07:11 21:03	06:19 21:03	05:46 21:03	05:44 21:16	06:09 (T-51) 20:56	06:47 20:08	07:24 19:02	08:02 18:18	07:43 16:49	08:04 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case					126	235	284					
Sun reduction					0.66	0.73	0.75					
Oper. time red.					0.90	0.90	0.90					
Wind dir. red.					0.59	0.59	0.59					
Total reduction					0.35	0.39	0.40					
Total, real					44	91	113					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-071 - R-071
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:09		06:18	05:45	05:45	06:12	06:48	07:10 (T-51)	07:24	07:04	07:43
	16:57	17:35	18:12	19:52		20:30	21:04	21:16	20:55	20:07	9 07:19 (T-51)	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07		06:17	05:44	05:45	06:13	06:50	07:11 (T-51)	07:25	07:05	07:44
	16:58	17:36	18:14	19:54		20:31	21:05	21:16	20:53	20:05	8 07:19 (T-51)	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05		06:15	05:44	05:46	06:15	06:51	07:13 (T-51)	07:26	07:06	07:45
	16:59	17:38	18:15	19:55		20:32	21:05	21:16	20:52	20:03	6 07:19 (T-51)	19:07	17:14	16:47
4	08:04	07:43	07:00	07:04		06:14	05:43	05:47	06:16	06:52	07:14 (T-51)	07:28	07:08	07:46
	17:00	17:39	18:16	19:56		20:33	21:06	21:16	20:51	20:01	4 07:18 (T-51)	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02		06:12	05:43	05:47	06:17	06:53	07:15 (T-51)	07:29	07:09	07:47
	17:01	17:40	18:18	19:57		20:34	21:07	21:15	20:50	19:59	2 07:17 (T-51)	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00		06:11	05:43	05:48	06:18	06:54		07:30	07:11	07:48
	17:02	17:42	18:19	19:59		20:36	21:08	21:15	20:48	19:57		19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	07:18 (T-51)	06:10	05:42	05:49	06:19	06:55		07:31	07:12	07:49
	17:03	17:43	18:20	20:00	2 07:20 (T-51)	20:37	21:09	21:15	20:47	19:56		19:00	17:09	16:47
8	08:04	07:38	07:53	06:56	07:16 (T-51)	06:08	05:42	05:49	06:20	06:57		07:32	07:13	07:50
	17:04	17:45	18:22	20:01	4 07:20 (T-51)	20:38	21:09	21:14	20:45	19:54		18:56	17:07	16:46
9	08:03	07:37	07:52	06:55	07:15 (T-51)	06:07	05:42	05:50	06:21	06:58		07:34	07:15	07:51
	17:05	17:46	19:23	20:02	6 07:21 (T-51)	20:39	21:10	21:14	20:44	19:52		18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	07:13 (T-51)	06:06	05:41	05:51	06:23	06:59		07:35	07:16	07:52
	17:06	17:48	19:24	20:04	8 07:19 (T-51)	20:40	21:11	21:14	20:43	19:50		18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	07:11 (T-51)	06:04	05:41	05:52	06:24	07:00		07:36	07:17	07:53
	17:07	17:49	19:26	20:05	9 07:20 (T-51)	20:42	21:11	21:13	20:41	19:48		18:51	17:04	16:46
12	08:02	07:33	07:46	06:49	07:09 (T-51)	06:03	05:41	05:52	06:25	07:01		07:37	07:19	07:54
	17:08	17:50	19:27	20:06	10 07:19 (T-51)	20:43	21:12	21:12	20:40	19:46		18:49	17:03	16:46
13	08:02	07:31	07:44	06:47	07:08 (T-51)	06:02	05:41	05:53	06:26	07:02		07:39	07:20	07:55
	17:09	17:52	19:28	20:07	11 07:19 (T-51)	20:44	21:12	21:12	20:38	19:44		18:47	17:02	16:47
14	08:01	07:30	07:42	06:46	07:06 (T-51)	06:01	05:41	05:54	06:27	07:04		07:40	07:21	07:56
	17:11	17:53	19:30	20:09	12 07:18 (T-51)	20:45	21:13	21:11	20:37	19:43		18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	07:04 (T-51)	06:00	05:41	05:55	06:28	07:05		07:41	07:23	07:57
	17:12	17:55	19:31	20:10	12 07:16 (T-51)	20:46	21:13	21:11	20:35	19:41		18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	07:06 (T-51)	05:58	05:41	05:56	06:30	07:06		07:43	07:24	07:57
	17:13	17:56	19:32	20:11	8 07:14 (T-51)	20:47	21:14	21:10	20:34	19:39		18:42	16:59	16:47
17	08:00	07:25	07:37	06:40		05:57	05:41	05:57	06:31	07:07		07:44	07:25	07:58
	17:14	17:57	19:33	20:12		20:49	21:14	21:09	20:32	19:37		18:40	16:58	16:47
18	07:59	07:24	07:35	06:39		05:56	05:41	05:58	06:32	07:08		07:45	07:27	07:59
	17:16	17:59	19:35	20:13		20:50	21:15	21:09	20:30	19:35		18:38	16:57	16:48
19	07:58	07:22	07:33	06:37		05:55	05:41	05:59	06:33	07:10		07:46	07:28	07:59
	17:17	18:00	19:36	20:15		20:51	21:15	21:08	20:29	19:33		18:37	16:56	16:48
20	07:58	07:21	07:31	06:35		05:54	05:41	06:00	06:34	07:11		07:48	07:29	08:00
	17:18	18:00	19:37	20:16		20:52	21:15	21:07	20:27	19:31		18:35	16:55	16:48
21	07:57	07:19	07:29	06:34		05:53	05:41	06:01	06:35	07:12		07:49	07:31	08:00
	17:20	18:02	19:39	20:17		20:53	21:15	21:06	20:26	19:29		18:33	16:54	16:49
22	07:56	07:17	07:28	06:32		05:52	05:41	06:02	06:37	07:13		07:50	07:32	08:01
	17:21	18:03	19:40	20:18		20:54	21:16	21:05	20:24	19:28		18:32	16:53	16:49
23	07:55	07:16	07:26	06:30		05:52	05:42	06:03	06:38	07:14		07:52	07:33	08:01
	17:22	18:04	19:41	20:20		20:55	21:16	21:04	20:22	19:26		18:30	16:53	16:50
24	07:55	07:14	07:24	06:29		05:51	05:42	06:04	06:39	07:15		07:53	07:34	08:02
	17:24	18:06	19:42	20:21		20:56	21:16	21:03	20:21	19:24		18:29	16:52	16:51
25	07:54	07:12	07:22	06:27		05:50	05:42	06:05	06:40	07:17		07:54	07:36	08:02
	17:25	18:07	19:44	20:22		20:57	21:16	21:02	20:19	19:22		18:27	16:51	16:51
26	07:53	07:11	07:20	06:26		05:49	05:43	06:06	06:41	07:18		07:56	07:37	08:03
	17:26	18:08	19:45	20:23		20:58	21:16	21:01	20:17	19:20		18:25	16:51	16:52
27	07:52	07:09	07:18	06:24		05:48	05:43	06:07	06:43			07:57	07:38	08:03
	17:28	18:10	19:46	20:25		20:59	21:16	21:00	20:15	8 07:16 (T-51)		18:24	16:50	16:52
28	07:51	07:07	07:16	06:23		05:48	05:43	06:08	06:44			07:58	07:39	08:03
	17:29	18:11	19:47	20:26		21:00	21:16	20:59	20:14	12 07:18 (T-51)		18:22	16:50	16:53
29	07:50		07:15	06:21		05:47	05:44	06:09	06:45			07:59	07:41	08:04
	17:31		19:49	20:27		21:01	21:16	20:58	20:12	12 07:19 (T-51)		18:21	16:49	16:54
30	07:49		07:13	06:19		05:46	05:44	06:10	06:46			07:59	07:42	08:04
	17:32		19:50	20:28		21:02	21:16	20:57	20:10	11 07:19 (T-51)		18:19	16:49	16:55
31	07:48		07:11			05:46		06:11	06:47			08:02		08:04
	17:33		19:51			21:03		20:56	20:08	10 07:19 (T-51)		18:18		16:56
Potential sun hours	287	292	369	403		458	465	471	436	377		341	289	275
Total, worst case				82					53	29				
Sun reduction				0.63					0.72	0.67				
Oper. time red.				0.90					0.90	0.90				
Wind dir. red.				0.57					0.57	0.57				
Total reduction				0.32					0.37	0.34				
Total, real				27					20	10				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 V163-4.5 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-072 - R-072 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns for months (January-December) and directions (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum). Rows list times of day (08:00-17:33) and summary statistics for sun hours and reduction.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker (WTG causing flicker first time) Sun set (hh:mm) Minutes with flicker Last time (hh:mm) with flicker (WTG causing flicker last time)

Project: South Deuel Wind Project
Description: Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024
Licensed user: Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-073 - R-073
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with columns for months (January-December) and rows for time intervals (e.g., 08:00-09:00) containing sunrise/sunset times and shadow reduction percentages.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-074 - R-074
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:09	06:18	05:45
	16:57	17:35	18:12	19:52	20:30	21:04
2	08:04	07:46	07:04	07:07	06:16	05:44
	16:58	17:36	18:14	19:54	20:31	21:05
3	08:04	07:44	07:02	07:05	06:15	05:44
	16:58	17:38	18:15	19:55	20:32	21:05
4	08:04	07:43	07:00	07:04	06:14	05:43
	16:59	17:39	18:16	19:56	20:33	21:06
5	08:04	07:42	06:59	07:02	06:12	05:43
	17:00	17:40	18:18	19:57	20:35	21:07
6	08:04	07:41	06:57	07:00	06:11	05:43
	17:01	17:42	18:19	19:59	20:36	21:08
7	08:04	07:39	06:55	06:58	06:09	05:42
	17:03	17:43	18:20	20:00	20:37	21:09
8	08:04	07:38	07:53	06:56	06:08	05:42
	17:04	17:45	18:22	20:01	20:38	21:09
9	08:03	07:37	07:52	06:54	06:07	05:42
	17:05	17:46	19:23	20:02	20:39	21:10
10	08:03	07:35	07:50	06:53	06:06	05:41
	17:06	17:47	19:24	20:04	20:41	21:11
11	08:03	07:34	07:48	06:51	06:04	05:41
	17:07	17:49	19:26	20:05	20:42	21:11
12	08:02	07:33	07:46	06:49	06:03	05:41
	17:08	17:50	19:27	20:06	20:43	21:12
13	08:02	07:31	07:44	06:47	06:02	05:41
	17:09	17:52	19:28	20:07	20:44	21:12
14	08:01	07:30	07:42	06:46	06:01	05:41
	17:11	17:53	19:30	20:09	20:45	21:13
15	08:01	07:28	07:41	06:44	06:00	05:41
	17:12	17:55	19:31	20:10	20:46	21:13
16	08:00	07:27	07:39	06:42	05:58	05:41
	17:13	17:56	19:32	20:11	20:48	21:14
17	08:00	08:23 (T-51)	07:25	07:37	06:40	05:57
	17:14	17:57	19:33	20:12	20:49	21:14
18	07:59	08:22 (T-51)	07:24	07:35	06:39	05:56
	17:16	17:59	19:35	20:14	20:50	21:15
19	07:59	08:21 (T-51)	07:22	07:33	06:37	05:55
	17:17	18:00	19:36	20:15	20:51	21:15
20	07:58	08:21 (T-51)	07:21	07:31	06:35	05:54
	17:18	18:00	19:37	20:16	20:52	21:15
21	07:57	08:20 (T-51)	07:19	07:29	06:34	05:53
	17:20	18:02	19:39	20:17	20:53	21:16
22	07:56	08:19 (T-51)	07:17	07:28	06:32	05:52
	17:21	18:03	19:40	20:18	20:54	21:16
23	07:56	08:18 (T-51)	07:16	07:26	06:30	05:51
	17:22	18:04	19:41	20:20	20:55	21:16
24	07:55	08:17 (T-51)	07:14	07:24	06:29	05:51
	17:24	18:06	19:42	20:21	20:56	21:16
25	07:54	08:16 (T-51)	07:12	07:22	06:27	05:50
	17:25	18:07	19:44	20:22	20:57	21:16
26	07:53	08:15 (T-51)	07:11	07:20	06:26	05:49
	17:26	18:08	19:45	20:23	20:58	21:16
27	07:52	08:14 (T-51)	07:09	07:18	06:24	05:48
	17:28	18:10	19:46	20:25	20:59	21:16
28	07:51	08:15 (T-51)	07:07	07:16	06:22	05:47
	17:29	18:11	19:47	20:26	21:00	21:16
29	07:50		07:15	06:21	05:47	06:22 (T-48)
	17:30		19:49	20:27	21:01	21:16
30	07:49		07:13	06:19	05:46	06:23 (T-48)
	17:32		19:50	20:28	21:02	21:16
31	07:48		07:11	06:17	05:46	06:24 (T-48)
	17:33		19:51	21:03	21:03	21:16
Potential sun hours	287	292	369	403	459	465
Total, worst case					604	113
Sun reduction	70				0.66	0.73
Oper. time red.	0.58				0.90	0.90
Wind dir. red.	0.90				0.59	0.63
Total reduction	0.65				0.35	0.41
Total, real	0.34				212	47

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-074 - R-074

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December					
1	05:45	20:46 (T-42)	06:12	06:36 (T-48)	06:48	07:24	07:43				
	21:16	2	20:48 (T-42)	20:55	21	06:57 (T-48)	20:07	19:11	17:17	16:48	
2	05:45	20:47 (T-42)	06:13	06:37 (T-48)	06:50	07:25	07:05	07:44			
	21:16	2	20:49 (T-42)	20:53	20	06:57 (T-48)	20:05	19:09	17:15	16:48	
3	05:46	20:47 (T-42)	06:15	06:38 (T-48)	06:51	07:26	07:06	07:45			
	21:16	1	20:48 (T-42)	20:52	18	06:56 (T-48)	20:03	19:07	17:14	16:47	
4	05:47		06:16	06:39 (T-48)	06:52	07:28	07:08	07:46			
	21:16		20:51	16	06:55 (T-48)	20:01	19:05	17:12	16:47		
5	05:47		06:17	06:40 (T-48)	06:53	07:29	07:09	07:47			
	21:15		20:50	15	06:55 (T-48)	19:59	19:03	17:11	16:47		
6	05:48		06:18	06:41 (T-48)	06:54	07:30	07:11	07:48			
	21:15		20:48	13	06:54 (T-48)	19:58	19:01	17:10	16:47		
7	05:49		06:19	06:42 (T-48)	06:55	07:31	07:12	07:49			
	21:15		20:47	11	06:53 (T-48)	19:56	19:00	17:09	16:47		
8	05:49		06:20	06:43 (T-48)	06:57	07:32	07:13	07:50			
	21:14		20:45	9	06:52 (T-48)	19:54	18:56	17:07	16:46		
9	05:50	06:37 (T-48)	06:21	06:44 (T-48)	06:58	07:34	07:15	07:51			
	21:14	5	06:42 (T-48)	20:44	6	06:50 (T-48)	19:52	18:54	17:06	16:46	
10	05:51	06:35 (T-48)	06:23	06:46 (T-48)	06:59	07:35	07:16	07:52			
	21:14	10	06:45 (T-48)	20:43	3	06:49 (T-48)	19:50	18:52	17:05	16:46	
11	05:52	06:34 (T-48)	06:24		07:00	07:36	07:17	07:53			
	21:13	12	06:46 (T-48)	20:41		19:48	18:51	17:04	16:46		
12	05:52	06:33 (T-48)	06:25		07:01	07:37	07:19	07:54			
	21:13	15	06:48 (T-48)	20:40		19:46	18:49	17:03	16:46		
13	05:53	06:31 (T-48)	06:26		07:02	07:39	07:20	07:55			
	21:12	17	06:48 (T-48)	20:38		19:44	18:47	17:02	16:46		
14	05:54	06:31 (T-48)	06:27		07:04	07:40	07:21	07:56			
	21:11	18	06:49 (T-48)	20:37		19:43	18:45	17:01	8	07:54 (T-51)	16:47
15	05:55	06:30 (T-48)	06:28		07:05	07:41	07:23	07:57			
	21:11	21	06:51 (T-48)	20:35		19:41	18:44	17:00	9	07:56 (T-51)	16:47
16	05:56	06:30 (T-48)	06:30		07:06	07:43	07:24	07:57			
	21:10	22	06:52 (T-48)	20:34		19:39	18:42	16:59	9	07:57 (T-51)	16:47
17	05:57	06:29 (T-48)	06:31		07:07	07:44	07:25	07:58			
	21:09	23	06:52 (T-48)	20:32		19:37	18:40	16:58	9	07:59 (T-51)	16:47
18	05:58	06:29 (T-48)	06:32		07:08	07:45	07:27	07:59			
	21:09	24	06:53 (T-48)	20:30		19:35	18:38	16:57	8	07:59 (T-51)	16:48
19	05:59	06:29 (T-48)	06:33		07:10	07:46	07:28	07:53			
	21:08	25	06:54 (T-48)	20:29		19:33	18:37	16:56	7	08:00 (T-51)	16:48
20	06:00	06:28 (T-48)	06:34		07:11	07:48	07:29	07:54			
	21:07	27	06:55 (T-48)	20:27		19:31	18:35	16:55	7	08:01 (T-51)	16:48
21	06:01	06:28 (T-48)	06:35		07:12	07:49	07:31	07:55			
	21:06	27	06:55 (T-48)	20:26		19:29	18:33	16:54	5	08:00 (T-51)	16:49
22	06:02	06:28 (T-48)	06:37		07:13	07:50	07:32	07:57			
	21:05	28	06:56 (T-48)	20:24		19:28	18:32	16:53	4	08:01 (T-51)	16:49
23	06:03	06:26 (T-48)	06:38		07:14	07:52	07:33	07:58			
	21:04	29	06:55 (T-48)	20:22		19:26	18:30	16:53	3	08:01 (T-51)	16:50
24	06:04	06:27 (T-48)	06:39		07:15	07:53	07:35	07:59			
	21:03	29	06:56 (T-48)	20:21		19:24	18:29	16:52	2	08:01 (T-51)	16:50
25	06:05	06:28 (T-48)	06:40		07:17	07:54	07:36	08:01			
	21:02	28	06:56 (T-48)	20:19		19:22	18:27	16:51	1	08:02 (T-51)	16:51
26	06:06	06:29 (T-48)	06:41		07:18	07:56	07:37	08:03			
	21:01	27	06:56 (T-48)	20:17		19:20	18:25	16:51		16:52	
27	06:07	06:31 (T-48)	06:42		07:19	07:57	07:38	08:03			
	21:00	26	06:57 (T-48)	20:15		19:18	18:24	16:50		16:52	
28	06:08	06:32 (T-48)	06:44		07:20	07:58	07:39	08:03			
	20:59	25	06:57 (T-48)	20:14		19:16	18:22	16:50		16:53	
29	06:09	06:33 (T-48)	06:45		07:21	08:00	07:41	08:04			
	20:58	24	06:57 (T-48)	20:12		19:14	18:21	16:49		16:54	
30	06:10	06:34 (T-48)	06:46		07:23	08:01	07:42	08:04			
	20:57	23	06:57 (T-48)	20:10		19:12	18:19	16:49		16:55	
31	06:11	06:35 (T-48)	06:47			08:02		08:04			
	20:56	22	06:57 (T-48)	20:08		18:18		16:56			
Potential sun hours	471		436		377	341	289			275	
Total, worst case	512		132				72				
Sun reduction	0.75		0.72				0.48				
Oper. time red.	0.90		0.90				0.90				
Wind dir. red.	0.59		0.59				0.65				
Total reduction	0.40		0.38				0.28				
Total, real	204		51				20				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-076 - R-076

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Table with 12 columns (Jan-Dec) and 2 rows of sunshine probability values.

Operational time

Table with 16 columns (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum) and 2 rows of operational time values.

Main shadow calculation table with columns for months (January-December) and rows for each day of the year, including sunrise/sunset times, shadow reduction, and total real shadow.

Table layout: For each day in each month the following matrix apply

Matrix defining shadow calculation parameters: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time).

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-077 - R-077

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	16:05 (T-45) 07:47	16:12 (T-45) 07:06		07:09	06:18
	16:57 24	16:29 (T-45) 17:35 57	17:09 (T-43) 18:12		19:52	20:30 4
2	08:04	16:05 (T-45) 07:46	16:12 (T-45) 07:04		17:51 (T-42) 07:07	06:16
	16:57 24	16:29 (T-45) 17:36 58	17:10 (T-43) 18:14	1	17:52 (T-42) 19:54	20:31 7
3	08:04	16:06 (T-45) 07:44	16:13 (T-45) 07:02		17:51 (T-42) 07:05	06:15
	16:58 25	16:31 (T-45) 17:37 58	17:11 (T-43) 18:15	3	17:54 (T-42) 19:55	20:32 9
4	08:04	16:05 (T-45) 07:43	16:15 (T-45) 07:00		17:50 (T-42) 07:04	06:14
	16:59 26	16:31 (T-45) 17:39 52	17:10 (T-43) 18:16	5	17:55 (T-42) 19:56	20:33 12
5	08:04	16:05 (T-45) 07:42	16:16 (T-45) 06:59		17:50 (T-42) 07:02	06:12
	17:00 27	16:32 (T-45) 17:40 51	17:15 (T-44) 18:18	6	17:56 (T-42) 19:57	20:35 14
6	08:04	16:05 (T-45) 07:41	16:17 (T-45) 06:57		17:50 (T-42) 07:00	06:11
	17:01 28	16:33 (T-45) 17:42 42	17:16 (T-44) 18:19	7	17:57 (T-42) 19:59	20:36 16
7	08:04	16:06 (T-45) 07:39	16:18 (T-45) 06:55		17:52 (T-42) 06:58	06:09
	17:02 28	16:34 (T-45) 17:43 41	17:18 (T-44) 18:20	7	17:59 (T-42) 20:00	20:37 17
8	08:04	16:06 (T-45) 07:38	16:20 (T-45) 07:53		18:54 (T-42) 06:56	06:08
	17:04 30	16:36 (T-45) 17:45 40	17:20 (T-44) 18:22	6	19:00 (T-42) 20:01	20:38 19
9	08:03	16:05 (T-45) 07:37	16:22 (T-45) 07:51		06:54	06:07
	17:05 31	16:36 (T-45) 17:46 39	17:21 (T-44) 19:23		20:02	20:39 21
10	08:03	16:06 (T-45) 07:35	16:25 (T-45) 07:50		06:53	06:05
	17:06 32	16:38 (T-45) 17:47 36	17:23 (T-44) 19:24		20:04	20:41 22
11	08:03	16:05 (T-45) 07:34	16:28 (T-45) 07:48		06:51	06:04
	17:07 34	16:39 (T-45) 17:49 31	17:24 (T-44) 19:26		20:05	20:42 23
12	08:02	16:06 (T-45) 07:33	17:07 (T-44) 07:46		06:49	06:03
	17:08 34	16:40 (T-45) 17:50 19	17:26 (T-44) 19:27		20:06	20:43 24
13	08:02	16:06 (T-45) 07:31	17:06 (T-44) 07:44		06:47	06:02
	17:09 35	16:41 (T-45) 17:52 21	17:27 (T-44) 19:28		20:07	20:44 26
14	08:01	16:06 (T-45) 07:30	17:06 (T-44) 07:42		06:46	06:01
	17:10 37	16:43 (T-45) 17:53 23	17:29 (T-44) 19:30		20:09	20:45 27
15	08:01	16:06 (T-45) 07:28	17:06 (T-44) 07:41		06:44	05:59
	17:12 38	16:44 (T-45) 17:54 24	17:30 (T-44) 19:31		20:10	20:46 27
16	08:00	16:07 (T-45) 07:27	17:07 (T-44) 07:39		06:42	05:58
	17:13 39	16:46 (T-45) 17:56 25	17:32 (T-44) 19:32		20:11	20:48 28
17	08:00	16:06 (T-45) 07:25	17:06 (T-44) 07:37		06:40	05:57
	17:14 41	16:47 (T-45) 17:57 27	17:33 (T-44) 19:33		20:12	20:49 29
18	07:59	16:06 (T-45) 07:24	17:08 (T-44) 07:35		06:39	05:56
	17:16 42	16:48 (T-45) 17:59 27	17:35 (T-44) 19:35		20:14	20:50 30
19	07:59	16:07 (T-45) 07:22	17:08 (T-44) 07:33		06:37	05:55
	17:17 43	16:50 (T-45) 18:00 27	17:35 (T-44) 19:36		20:15	20:51 29
20	07:58	16:07 (T-45) 07:21	17:09 (T-44) 07:31		06:35	05:54
	17:18 44	16:51 (T-45) 18:00 25	17:34 (T-44) 19:37		20:16	20:52 29
21	07:57	16:07 (T-45) 07:19	17:10 (T-44) 07:29		06:34	05:53
	17:19 45	16:52 (T-45) 18:01 23	17:33 (T-44) 19:38		20:17	20:53 27
22	07:56	16:07 (T-45) 07:17	17:11 (T-44) 07:28		06:32	05:52
	17:21 47	16:54 (T-45) 18:03 20	17:31 (T-44) 19:40		20:18	20:54 27
23	07:56	16:07 (T-45) 07:16	17:14 (T-44) 07:26		06:30	05:51
	17:22 48	16:55 (T-45) 18:04 15	17:29 (T-44) 19:41		20:20	20:55 25
24	07:55	16:08 (T-45) 07:14	17:16 (T-44) 07:24		06:29	05:51
	17:24 48	16:56 (T-43) 18:06 10	17:26 (T-44) 19:42		20:21	20:56 24
25	07:54	16:08 (T-45) 07:12	07:22		06:27	05:50
	17:25 50	16:58 (T-43) 18:07	19:44		20:22	20:57 22
26	07:53	16:08 (T-45) 07:11	07:20		06:26	05:49
	17:26 51	16:59 (T-43) 18:08	19:45		20:23	20:58 21
27	07:52	16:09 (T-45) 07:09	07:18		06:24	05:48
	17:28 52	17:01 (T-43) 18:10	19:46		20:25	20:59 19
28	07:51	16:09 (T-45) 07:07	07:16		06:22	05:47
	17:29 53	17:02 (T-43) 18:11	19:47		20:26	21:00 17
29	07:50	16:10 (T-45)	07:15		06:21	05:47
	17:30 54	17:04 (T-43)	19:49		20:27	21:01 15
30	07:49	16:11 (T-45)	07:13		06:19	05:46
	17:32 55	17:06 (T-43)	19:50		20:28	21:02 12
31	07:48	16:11 (T-45)	07:11		05:45	06:30 (T-49)
	17:33 56	17:07 (T-43)	19:51		21:03 9	06:39 (T-49)
Potential sun hours	287	292	369	403	459	465
Total, worst case	1221	791	35			631
Sun reduction	0.58	0.58	0.59			0.66
Oper. time red.	0.90	0.90	0.90			0.90
Wind dir. red.	0.60	0.59	0.57			0.59
Total reduction	0.31	0.31	0.31			0.35
Total, real	381	245	11			221

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



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South Deuel Wind Project

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L086 71 V163-4.5 WTGs on 98m HH
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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-077 - R-077
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	06:36 (T-49) 07:00 (T-49)	06:48 20:07	07:24 19:11	07:04 17:17
2	05:45 21:16	06:13 20:53	06:37 (T-49) 07:00 (T-49)	06:49 20:05	07:25 19:09	07:05 17:15
3	05:46 21:16	06:14 20:52	06:38 (T-49) 06:59 (T-49)	06:51 20:03	07:26 19:07	07:06 17:14
4	05:46 21:16	06:16 20:51	06:39 (T-49) 06:59 (T-49)	06:52 20:01	07:28 19:05	07:08 17:12
5	05:47 21:15	06:17 20:50	06:40 (T-49) 06:59 (T-49)	06:53 19:59	07:29 19:03	07:09 18:33 (T-42)
6	05:48 21:15	06:18 20:48	06:41 (T-49) 06:58 (T-49)	06:54 19:57	07:30 19:01	07:11 18:29 (T-42)
7	05:48 21:15	06:19 20:47	06:42 (T-49) 06:57 (T-49)	06:55 19:56	07:31 18:58	07:12 18:27 (T-42)
8	05:49 21:14	06:20 20:45	06:43 (T-49) 06:56 (T-49)	06:57 19:54	07:32 18:56	07:13 18:33 (T-42)
9	05:50 21:14	06:21 20:44	06:44 (T-49) 06:55 (T-49)	06:58 19:52	07:34 18:54	07:15 18:25 (T-42)
10	05:51 21:14	06:22 20:43	06:46 (T-49) 06:55 (T-49)	06:59 19:50	07:35 18:52	07:16 18:24 (T-42)
11	05:51 21:13	06:24 20:41	06:47 (T-49) 06:53 (T-49)	07:00 19:48	07:36 18:50	07:17 18:27 (T-42)
12	05:52 21:13	06:25 20:40	06:48 (T-49) 06:51 (T-49)	07:01 19:46	07:37 18:49	07:19 17:03
13	05:53 21:12	06:26 20:38	06:49 (T-49) 06:54 (T-49)	07:02 19:44	07:39 18:47	07:20 17:02
14	05:54 21:11	06:27 20:37	06:36 (T-49) 06:49 (T-49)	06:27 19:43	07:04 18:45	07:21 17:00
15	05:55 21:11	06:28 20:35	06:35 (T-49) 06:51 (T-49)	06:28 20:35	07:05 19:41	07:23 16:59
16	05:56 21:10	06:29 20:34	06:34 (T-49) 06:52 (T-49)	06:29 20:34	07:06 19:39	07:24 16:58
17	05:57 21:09	06:30 20:32	06:33 (T-49) 06:53 (T-49)	06:31 20:32	07:07 19:37	07:25 16:58
18	05:58 21:09	06:31 20:30	06:33 (T-49) 06:54 (T-49)	06:32 20:30	07:08 19:35	07:27 17:46 (T-44)
19	05:59 21:08	06:32 20:29	06:32 (T-49) 06:55 (T-49)	06:33 20:29	07:09 19:33	07:28 18:01 (T-44)
20	06:00 21:07	06:33 20:27	06:32 (T-49) 06:56 (T-49)	06:34 20:27	07:11 19:31	07:29 18:03 (T-44)
21	06:00 21:06	06:30 20:26	06:30 (T-49) 06:56 (T-49)	06:35 20:26	07:12 19:29	07:31 18:04 (T-44)
22	06:01 21:05	06:30 20:24	06:30 (T-49) 06:57 (T-49)	06:37 20:24	07:13 19:27	07:32 18:04 (T-44)
23	06:03 21:04	06:29 20:22	06:29 (T-49) 06:57 (T-49)	06:38 20:22	07:14 19:26	07:33 18:05 (T-44)
24	06:04 21:03	06:29 20:21	06:29 (T-49) 06:58 (T-49)	06:39 20:21	07:15 19:24	07:35 18:04 (T-44)
25	06:05 21:02	06:28 20:19	06:28 (T-49) 06:58 (T-49)	06:40 20:19	07:17 19:22	07:36 18:03 (T-44)
26	06:06 21:01	06:29 20:17	06:29 (T-49) 06:58 (T-49)	06:41 20:17	07:18 19:20	07:37 18:01 (T-44)
27	06:07 21:00	06:30 20:15	06:30 (T-49) 06:59 (T-49)	06:42 20:15	07:19 19:18	07:38 17:35 (T-44)
28	06:08 20:59	06:31 20:14	06:31 (T-49) 06:59 (T-49)	06:44 20:14	07:20 19:16	07:39 17:59 (T-44)
29	06:09 20:58	06:33 20:12	06:33 (T-49) 07:00 (T-49)	06:45 20:12	07:21 19:14	07:41 17:36 (T-44)
30	06:10 20:57	06:34 20:10	06:34 (T-49) 07:00 (T-49)	06:46 20:10	07:23 19:12	07:42 17:36 (T-44)
31	06:11 20:56	06:35 20:08	06:35 (T-49) 07:00 (T-49)	06:47 20:08	07:24 18:18	07:43 17:53 (T-44)
Potential sun hours	471	436	377	341	289	275
Total, worst case	455	181	358	319	1390	715
Sun reduction	0.75	0.72	0.56	0.48	0.48	0.52
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90
Wind dir. red.	0.59	0.59	0.59	0.59	0.60	0.60
Total reduction	0.40	0.38	0.30	0.26	0.26	0.28
Total, real	181	69	106	106	358	200

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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South Deuel Wind Project

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Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
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Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-078 - R-078
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:39 (T-22)	07:09	06:18
	16:57	17:35	18:12	08:25 (T-22)	19:52	19:33 (T-20)
2	08:04	07:46	07:04	07:41 (T-22)	07:07	20:06 (T-20)
	16:57	17:36	18:14	08:25 (T-22)	19:54	19:33 (T-20)
3	08:04	07:44	07:02	07:41 (T-22)	07:05	20:08 (T-20)
	16:58	17:37	18:15	08:24 (T-22)	19:55	20:08 (T-20)
4	08:04	07:43	07:00	07:42 (T-22)	07:03	19:32 (T-20)
	16:59	17:39	18:16	08:22 (T-22)	19:56	20:10 (T-20)
5	08:04	07:42	08:04 (T-22)	07:42 (T-22)	07:02	19:32 (T-20)
	17:00	17:40	08:10 (T-22)	08:21 (T-22)	19:57	20:10 (T-20)
6	08:04	07:41	08:02 (T-22)	07:43 (T-22)	07:00	20:35
	17:01	17:42	08:13 (T-22)	08:19 (T-22)	19:59	19:32 (T-20)
7	08:04	07:39	08:01 (T-22)	07:45 (T-22)	06:58	20:12 (T-20)
	17:02	17:43	08:16 (T-22)	08:18 (T-22)	20:00	19:32 (T-20)
8	08:04	07:38	08:00 (T-22)	08:47 (T-22)	06:56	20:13 (T-20)
	17:03	17:45	08:19 (T-22)	09:15 (T-22)	20:01	19:33 (T-20)
9	08:03	07:37	07:58 (T-22)	08:49 (T-22)	06:54	20:14 (T-19)
	17:05	17:46	08:20 (T-22)	09:12 (T-22)	20:02	19:32 (T-20)
10	08:03	07:35	07:57 (T-22)	08:52 (T-22)	06:53	20:14 (T-19)
	17:06	17:47	08:22 (T-22)	09:08 (T-22)	20:04	20:12 (T-20)
11	08:03	07:34	07:55 (T-22)	06:51	06:04	19:33 (T-20)
	17:07	17:49	08:23 (T-22)	20:05	20:42	20:12 (T-20)
12	08:02	07:33	07:54 (T-22)	06:49	06:03	19:34 (T-20)
	17:08	17:50	08:24 (T-22)	20:06	20:43	20:11 (T-20)
13	08:02	07:31	07:52 (T-22)	06:47	06:02	19:35 (T-20)
	17:09	17:52	08:25 (T-22)	20:07	20:44	20:11 (T-20)
14	08:01	07:30	07:51 (T-22)	06:46	06:01	19:35 (T-20)
	17:10	17:53	08:26 (T-22)	20:09	20:45	20:10 (T-20)
15	08:01	07:28	07:49 (T-22)	06:44	06:00	19:35 (T-20)
	17:12	17:54	08:26 (T-22)	20:10	20:46	20:09 (T-20)
16	08:00	07:27	07:48 (T-22)	06:42	05:58	19:36 (T-20)
	17:13	17:56	08:28 (T-22)	20:11	20:48	20:08 (T-20)
17	08:00	07:25	07:46 (T-22)	06:40	05:57	19:37 (T-20)
	17:14	17:57	08:28 (T-22)	20:12	20:49	20:07 (T-20)
18	07:59	07:24	07:45 (T-22)	06:39	05:56	19:37 (T-20)
	17:15	17:59	08:29 (T-22)	20:14	20:50	20:07 (T-20)
19	07:59	07:22	07:43 (T-22)	06:37	05:55	19:39 (T-20)
	17:17	18:00	08:29 (T-22)	20:15	20:51	20:07 (T-20)
20	07:58	07:21	07:42 (T-22)	06:35	05:54	19:40 (T-20)
	17:18	18:00	08:29 (T-22)	20:16	6 19:48 (T-20)	20:06 (T-20)
21	07:57	07:19	07:40 (T-22)	06:34	05:53	19:42 (T-20)
	17:19	18:01	08:29 (T-22)	20:17	10 19:54 (T-20)	20:04 (T-20)
22	07:56	07:17	07:39 (T-22)	06:32	05:52	19:43 (T-20)
	17:21	18:03	08:29 (T-22)	20:18	13 19:56 (T-20)	20:03 (T-20)
23	07:56	07:16	07:39 (T-22)	06:30	05:51	19:44 (T-20)
	17:22	18:04	08:29 (T-22)	20:20	16 19:57 (T-20)	20:01 (T-20)
24	07:55	07:14	07:39 (T-22)	06:29	05:50	19:46 (T-20)
	17:23	18:06	08:29 (T-22)	20:21	19 19:58 (T-20)	20:00 (T-20)
25	07:54	07:12	07:38 (T-22)	06:27	05:50	19:50 (T-20)
	17:25	18:07	08:28 (T-22)	20:22	21 19:59 (T-20)	19:57 (T-20)
26	07:53	07:11	07:39 (T-22)	06:26	05:49	19:36 (T-20)
	17:26	18:08	08:28 (T-22)	20:23	24 20:00 (T-20)	20:58
27	07:52	07:09	07:39 (T-22)	06:24	05:48	19:36 (T-20)
	17:28	18:10	08:27 (T-22)	20:25	26 20:02 (T-20)	20:59
28	07:51	07:07	07:39 (T-22)	06:22	05:47	19:35 (T-20)
	17:29	18:11	08:27 (T-22)	20:26	27 20:02 (T-20)	21:00
29	07:50		07:15	06:21	05:47	19:34 (T-20)
	17:30		19:49	20:27	30 20:04 (T-20)	21:01
30	07:49		07:13	06:19	05:46	19:33 (T-20)
	17:32		19:50	20:28	32 20:05 (T-20)	21:02
31	07:48		07:11		05:45	
	17:33		19:51		21:03	
Potential sun hours	287	292	369	404	459	465
Total, worst case		874	348	224	786	
Sun reduction		0.58	0.59	0.63	0.66	
Oper. time red.		0.90	0.90	0.90	0.90	
Wind dir. red.		0.63	0.63	0.61	0.61	
Total reduction		0.33	0.33	0.35	0.36	
Total, real		287	116	78	286	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-078 - R-078
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

		Operational time												Sum					
		N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
		561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884	
		July		August		September		October		November		December							
1	05:45 21:16			06:12	19:44 (T-20)	06:48	07:24			07:04		07:27 (T-22)	07:43						
2	05:45 21:16			06:13	19:44 (T-20)	06:49	07:25			17:16	24	07:51 (T-22)	16:48						
3	05:46 21:16			06:14	19:43 (T-20)	06:51	07:26			17:05		07:28 (T-22)	16:44						
4	05:46 21:16			06:16	19:43 (T-20)	06:52	07:28			17:15	21	07:49 (T-22)	16:48						
5	05:47 21:15			06:17	19:42 (T-20)	06:53	07:29			08:32 (T-22)		07:29 (T-22)	16:45						
6	05:48 21:15			06:18	19:42 (T-20)	06:54	07:30			17:14	12	08:44 (T-22)	16:47						
7	05:48 21:15			06:19	19:42 (T-20)	06:55	07:31			08:28 (T-22)	07:08	07:31 (T-22)	16:46						
8	05:49 21:14			06:20	19:41 (T-20)	06:57	07:32			08:49 (T-22)	17:12	07:46 (T-22)	16:47						
9	05:50 21:14			06:21	19:41 (T-20)	06:58	07:34			08:25 (T-22)	07:09	07:32 (T-22)	16:47						
10	05:51 21:14			06:22	19:41 (T-20)	06:59	07:35			08:51 (T-22)	17:11	07:43 (T-22)	16:47						
11	05:51 21:13			06:24	19:42 (T-20)	07:00	07:36			08:22 (T-22)	07:11	07:34 (T-22)	16:49						
12	05:52 21:13			06:25	19:42 (T-20)	07:01	07:37			08:53 (T-22)	17:10	07:39 (T-22)	16:47						
13	05:53 21:12			06:26	19:42 (T-20)	07:02	07:39			08:20 (T-22)	07:12	07:12	16:50						
14	05:54 21:11			06:27	19:42 (T-20)	07:04	07:40			17:08	34	08:54 (T-22)	16:46						
15	05:55 21:11			06:28	19:42 (T-20)	07:05	07:41			08:19 (T-22)	07:13	07:13	16:51						
16	05:56 21:10			06:29	19:43 (T-20)	07:06	07:43			08:56 (T-22)	17:07	17:07	16:46						
17	05:57 21:09			06:31	19:43 (T-20)	07:07	07:44			08:17 (T-22)	07:15	07:15	16:51						
18	05:58 21:09			06:32	19:44 (T-20)	07:08	07:45			08:11 (T-22)	07:24	07:24	16:57						
19	05:58 21:08	10	19:58 (T-20)	06:33	19:46 (T-20)	07:09	07:46			09:00 (T-22)	16:59	16:59	16:48						
20	05:59 21:07	15	20:10 (T-20)	06:34	19:47 (T-20)	07:11	07:48			08:12 (T-22)	07:32	07:32	16:57						
21	06:00 21:06	19	20:12 (T-20)	06:35	19:48 (T-20)	07:12	07:49			08:11 (T-22)	07:31	07:31	16:58						
22	06:01 21:05	21	20:13 (T-20)	06:36	19:50 (T-20)	07:13	07:50			09:00 (T-22)	16:54	16:54	16:49						
23	06:02 21:04	23	20:14 (T-20)	06:38	19:52 (T-20)	07:14	07:52			08:12 (T-22)	07:32	07:32	16:51						
24	06:03 21:03	26	20:16 (T-20)	06:39	19:57 (T-20)	07:15	07:53			08:59 (T-22)	16:52	16:52	16:50						
25	06:05 21:02	28	20:17 (T-20)	06:40	19:59 (T-20)	07:17	07:54			08:15 (T-22)	07:35	07:35	16:52						
26	06:06 21:01	30	20:18 (T-20)	06:41	19:59 (T-20)	07:18	07:55			08:17 (T-22)	07:36	07:36	16:51						
27	06:07 21:00	31	20:18 (T-20)	06:42	19:59 (T-20)	07:19	07:56			08:58 (T-22)	16:51	16:51	16:51						
28	06:08 20:59	33	20:19 (T-20)	06:44	19:59 (T-20)	07:20	07:58			08:18 (T-22)	07:37	07:37	16:52						
29	06:09 20:58	35	20:20 (T-20)	06:45	19:59 (T-20)	07:21	08:00			08:19 (T-22)	07:38	07:38	16:53						
30	06:10 20:57	35	20:21 (T-20)	06:46	19:59 (T-20)	07:23	08:01			08:21 (T-22)	07:40	07:40	16:54						
31	06:11 20:56	37	20:22 (T-20)	06:47	20:00 (T-20)	07:24	08:02			08:22 (T-22)	07:41	07:41	16:54						
Potential sun hours		471		436		377	341		288				275						
Total, worst case		343		671		1150	94		94										
Sun reduction		0.75		0.72		0.56	0.48		0.48										
Oper. time red.		0.90		0.90		0.90	0.90		0.90										
Wind dir. red.		0.61		0.61		0.63	0.63		0.63										
Total reduction		0.41		0.40		0.32	0.27		0.27										
Total, real		142		267		365	26		26										

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



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L086 71 V163-4.5 WTGs on 98m HH
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-079 - R-079

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June				
1	08:04	15:52 (T-21)	07:47	07:06	07:09	06:18	05:45			
	16:56	17	16:09 (T-21)	17:35	18:12	19:52	20:30	21:04		
2	08:04	15:53 (T-21)	07:46	07:04	07:07	06:16	05:44			
	16:57	16	16:09 (T-21)	17:36	18:14	19:53	20:31	21:05		
3	08:04	15:54 (T-21)	07:44	07:02	07:05	06:15	05:44			
	16:58	15	16:09 (T-21)	17:37	18:15	19:55	20:32	21:06		
4	08:04	15:55 (T-21)	07:43	07:00	07:03	06:13	05:43			
	16:59	12	16:07 (T-21)	17:39	18:16	19:56	20:33	21:06		
5	08:04	15:57 (T-21)	07:42	06:59	07:02	06:12	05:43			
	17:00	9	16:06 (T-21)	17:40	18:18	19:57	20:35	21:07		
6	08:04	16:00 (T-21)	07:41	06:57	07:00	06:11	05:42			
	17:01	5	16:05 (T-21)	17:42	18:19	19:58	20:36	21:08		
7	08:04	07:39	06:55	06:58		19:35 (T-41)	06:09	05:42		
	17:02	17:43	18:20	20:00	3	19:38 (T-41)	20:37	21:09		
8	08:04	07:38	07:53	06:56		19:33 (T-41)	06:08	05:42		
	17:03	17:44	18:22	20:01	6	19:39 (T-41)	20:38	21:09		
9	08:03	07:37	07:51	06:54		19:33 (T-41)	06:07	05:41		
	17:05	17:46	19:23	20:02	8	19:41 (T-41)	20:39	21:10		
10	08:03	07:35	07:50	06:53		19:32 (T-41)	06:05	05:41		
	17:06	17:47	19:24	20:03	10	19:42 (T-41)	20:41	21:11		
11	08:03	07:34	07:48	06:51		19:31 (T-41)	06:04	05:41		
	17:07	17:49	19:26	20:05	12	19:43 (T-41)	20:42	21:11		
12	08:02	07:33	07:46	06:49		19:30 (T-41)	06:03	05:41		
	17:08	17:50	19:27	20:06	14	19:44 (T-41)	20:43	21:12		
13	08:02	07:31	07:44	06:47		19:30 (T-41)	06:02	05:41		
	17:09	17:52	19:28	20:07	16	19:46 (T-41)	20:44	21:12		
14	08:01	07:30	07:42	06:45		19:30 (T-41)	06:01	05:41		
	17:10	17:53	19:29	20:08	16	19:46 (T-41)	20:45	21:13		
15	08:01	07:28	07:41	06:44		19:30 (T-41)	05:59	05:41		
	17:12	17:54	19:31	20:10	17	19:47 (T-41)	20:46	21:13		
16	08:00	07:27	07:39	06:42		19:29 (T-41)	05:58	05:40		
	17:13	17:56	19:32	20:11	19	19:48 (T-41)	20:48	21:14		
17	08:00	07:25	07:37	06:40		19:30 (T-41)	05:57	05:41		
	17:14	17:57	19:33	20:12	20	19:50 (T-41)	20:49	21:14		
18	07:59	07:24	07:35	19:11 (T-20)	06:39	19:31 (T-41)	05:56	05:41		
	17:15	17:59	19:35	2	19:13 (T-20)	20:13	20	19:51 (T-41)	20:50	21:15
19	07:59	07:22	07:33	19:10 (T-20)	06:37	19:31 (T-41)	05:55	05:41		
	17:17	18:00	19:36	4	19:14 (T-20)	20:15	18	19:49 (T-41)	20:51	21:15
20	07:58	07:20	07:31	19:09 (T-20)	06:35	19:33 (T-41)	05:54	05:41		
	17:18	18:00	19:37	6	19:15 (T-20)	20:16	15	19:48 (T-41)	20:52	21:15
21	07:57	07:19	07:29	19:09 (T-20)	06:34	19:35 (T-41)	05:53	05:41		
	17:19	18:01	19:38	8	19:17 (T-20)	20:17	10	19:45 (T-41)	20:53	21:16
22	07:56	07:17	07:28	19:08 (T-20)	06:32		05:52	05:41		
	17:21	18:03	19:40	11	19:19 (T-20)	20:18		20:54	21:16	
23	07:56	07:16	07:26	19:08 (T-20)	06:30		05:51	05:41		
	17:22	18:04	19:41	12	19:20 (T-20)	20:20		20:55	21:16	
24	07:55	07:14	07:24	19:08 (T-20)	06:29		05:50	05:42		
	17:23	18:05	19:42	13	19:21 (T-20)	20:21		20:56	21:16	
25	07:54	07:12	07:22	19:09 (T-20)	06:27		05:50	05:42		
	17:25	18:07	19:43	13	19:22 (T-20)	20:22		20:57	21:16	
26	07:53	07:11	07:20	19:09 (T-20)	06:25		05:49	05:42		
	17:26	18:08	19:45	14	19:23 (T-20)	20:23		20:58	21:16	
27	07:52	07:09	07:18	19:11 (T-20)	06:24		05:48	05:43		
	17:28	18:10	19:46	11	19:22 (T-20)	20:25		20:59	21:16	
28	07:51	07:07	07:16	19:15 (T-20)	06:22		05:47	05:43		
	17:29	18:11	19:47	4	19:19 (T-20)	20:26		21:00	21:16	
29	07:50		07:14		06:21		05:47	05:44		
	17:30		19:48		20:27		21:01	21:16		
30	07:49		07:13		06:19		05:46	05:44		
	17:32		19:50		20:28		21:02	21:16		
31	07:48		07:11				05:45			
	17:33		19:51				21:03			
Potential sun hours	287	292	369	404	459	465				
Total, worst case	74		98	204						
Sun reduction	0.58		0.59	0.63						
Oper. time red.	0.90		0.90	0.90						
Wind dir. red.	0.62		0.59	0.60						
Total reduction	0.32		0.31	0.34						
Total, real	24		31	69						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-079 - R-079

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	06:48 20:07	19:30 (T-41) 19:10	07:24 17:16	07:43 16:48
2	05:45 21:16	06:13 20:53	06:49 20:05	19:30 (T-41) 19:09	07:25 17:15	07:44 16:48
3	05:46 21:16	06:14 20:52	06:51 20:03	19:30 (T-41) 19:07	07:26 17:14	07:45 16:47
4	05:46 21:16	06:15 20:51	06:52 20:01	19:31 (T-41) 19:05	07:27 17:12	07:46 16:47
5	05:47 21:15	06:17 20:50	06:53 19:59	19:32 (T-41) 19:03	07:29 17:11	07:47 16:47
6	05:48 21:15	06:18 20:48	06:54 19:57	19:35 (T-41) 19:01	07:30 17:10	07:48 16:46
7	05:48 21:15	06:19 20:47	06:55 19:56	19:01 18:58	07:11 17:08	15:46 (T-21) 15:51 (T-21)
8	05:49 21:14	06:20 20:45	06:56 19:54	07:31 18:56	07:12 17:07	5 15:51 (T-21) 9 15:53 (T-21)
9	05:49 21:14	06:20 20:44	06:56 19:52	07:32 18:54	07:13 17:06	15:43 (T-21) 12 15:55 (T-21)
10	05:50 21:14	06:21 20:43	06:58 19:50	07:34 18:52	07:15 17:05	15:43 (T-21) 13 15:56 (T-21)
11	05:51 21:13	06:22 20:41	06:59 19:48	07:35 18:50	07:16 17:04	16 15:58 (T-21) 17 15:59 (T-21)
12	05:52 21:13	06:25 20:40	07:01 19:46	07:37 18:49	07:17 17:03	17 15:42 (T-21) 18 16:00 (T-21)
13	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	07:20 17:01	19 15:42 (T-21) 19 16:01 (T-21)
14	05:54 21:11	06:27 20:37	07:04 19:43	07:40 18:45	07:21 17:00	20 15:41 (T-21) 20 16:01 (T-21)
15	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:43	07:23 16:59	20 15:42 (T-21) 20 16:02 (T-21)
16	05:56 21:10	06:29 20:34	07:06 19:39	19:00 (T-20) 19:11 (T-20)	07:24 18:42	20 15:42 (T-21) 21 16:03 (T-21)
17	05:57 21:09	06:31 20:32	07:07 19:37	18:58 (T-20) 19:12 (T-20)	07:25 18:40	21 15:43 (T-21) 21 16:04 (T-21)
18	05:57 21:09	06:32 20:30	07:08 19:35	18:56 (T-20) 19:10 (T-20)	07:27 18:38	21 15:43 (T-21) 21 16:04 (T-21)
19	05:58 21:08	06:33 20:29	07:09 19:33	18:56 (T-20) 19:09 (T-20)	07:28 18:37	22 15:43 (T-21) 22 16:05 (T-21)
20	05:59 21:07	06:34 20:27	07:11 19:31	18:55 (T-20) 19:07 (T-20)	07:29 18:35	22 15:43 (T-21) 22 16:05 (T-21)
21	06:00 21:06	06:35 20:26	07:12 19:29	18:54 (T-20) 19:04 (T-20)	07:31 18:33	22 15:44 (T-21) 22 16:06 (T-21)
22	06:01 21:05	06:36 20:24	19:40 (T-41) 19:50 (T-41)	07:13 19:27	18:53 (T-20) 19:02 (T-20)	22 15:44 (T-21) 22 16:06 (T-21)
23	06:02 21:04	06:38 20:22	19:37 (T-41) 19:52 (T-41)	07:14 19:26	18:53 (T-20) 19:00 (T-20)	22 15:45 (T-21) 22 16:07 (T-21)
24	06:03 21:03	06:39 20:21	19:35 (T-41) 19:53 (T-41)	07:15 19:24	18:53 (T-20) 18:58 (T-20)	22 15:45 (T-21) 22 16:07 (T-21)
25	06:04 21:02	06:40 20:19	19:34 (T-41) 19:54 (T-41)	07:17 19:22	18:54 (T-20) 18:57 (T-20)	22 15:46 (T-21) 22 16:08 (T-21)
26	06:06 21:01	06:41 20:17	19:32 (T-41) 19:52 (T-41)	07:18 19:20	18:27 18:25	22 16:08 (T-21) 21 16:08 (T-21)
27	06:07 21:00	06:42 20:15	19:31 (T-41) 19:50 (T-41)	07:19 19:18	07:57 18:24	21 15:47 (T-21) 21 16:08 (T-21)
28	06:08 20:59	06:44 20:14	19:31 (T-41) 19:49 (T-41)	07:20 19:16	07:58 18:22	21 15:48 (T-21) 20 16:08 (T-21)
29	06:09 20:58	06:45 20:12	19:31 (T-41) 19:47 (T-41)	07:21 19:14	08:00 18:21	21 15:48 (T-21) 20 16:08 (T-21)
30	06:10 20:57	06:46 20:10	19:30 (T-41) 19:45 (T-41)	07:23 19:12	08:01 18:19	21 15:50 (T-21) 19 16:09 (T-21)
31	06:11 20:56	06:47 20:08	19:30 (T-41) 19:43 (T-41)	07:23 19:12	08:02 18:18	19 15:51 (T-21) 18 16:09 (T-21)
Potential sun hours	471	436	377	341	288	275
Total, worst case			164	137		485
Sun reduction			0.72	0.67		0.52
Oper. time red.			0.90	0.90		0.90
Wind dir. red.			0.60	0.59		0.62
Total reduction			0.39	0.36		0.29
Total, real		64	49			140

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-080 - R-080
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 07:47 07:06 16:57 17:35 18:12	07:09 07:29 (T-20) 06:18 19:52 3 07:32 (T-20) 20:30	06:39 (T-19) 05:45 05:45 06:12 06:48 19:25 (T-15) 07:24 07:04 07:43	07:09 07:29 (T-20) 06:18 19:52 3 07:32 (T-20) 20:30	06:39 (T-19) 05:45 05:45 06:12 06:48 19:25 (T-15) 07:24 07:04 07:43	06:59 (T-19) 21:04 21:16 20:55 20:07 17 19:42 (T-15) 19:11 17:17 16:48	06:59 (T-19) 21:04 21:16 20:55 20:07 17 19:42 (T-15) 19:11 17:17 16:48	06:58 (T-19) 05:44 05:45 06:13 06:50 20:05 14 19:40 (T-15) 19:09 17:15 16:48	06:58 (T-19) 05:44 05:45 06:13 06:50 20:05 14 19:40 (T-15) 19:09 17:15 16:48	06:58 (T-19) 05:44 05:45 06:13 06:50 20:05 14 19:40 (T-15) 19:09 17:15 16:48	06:58 (T-19) 05:44 05:45 06:13 06:50 20:05 14 19:40 (T-15) 19:09 17:15 16:48	06:58 (T-19) 05:44 05:45 06:13 06:50 20:05 14 19:40 (T-15) 19:09 17:15 16:48

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-081 - R-081
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:57	07:47 17:35	08:09 (T-43) 08:41 (T-42)	07:06 18:13	07:28 (T-44) 07:34 (T-44)	07:09 19:52	06:18 20:30	05:45 21:04	05:45 21:16	06:12 20:55	06:48 20:07	07:24 19:11
2	08:04 16:58	07:46 17:36	08:08 (T-43) 08:41 (T-42)	07:04 18:14		07:07 19:54	06:17 20:31	05:44 21:05	05:45 21:16	06:13 20:54	06:50 20:05	07:25 19:09
3	08:04 16:59	07:45 17:38	08:06 (T-43) 08:40 (T-42)	07:02 18:15		07:06 19:55	06:15 20:32	05:44 21:06	05:46 21:16	06:15 20:52	06:51 20:03	07:26 19:07
4	08:04 17:00	07:43 17:39	08:06 (T-43) 08:39 (T-42)	07:01 18:17		07:04 19:56	06:14 20:33	05:43 21:06	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05
5	08:04 17:01	07:42 17:40	08:09 (T-43) 08:39 (T-42)	06:59 18:18		07:02 19:57	06:12 20:35	05:43 21:07	05:47 21:16	06:17 20:50	06:53 19:59	07:29 19:03
6	08:04 17:02	07:41 17:42	08:12 (T-42) 08:39 (T-42)	06:57 18:19		07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:01
7	08:04 17:03	07:40 17:43	08:12 (T-42) 08:37 (T-42)	06:55 18:21		06:58 20:00	06:10 20:37	05:42 21:09	05:49 21:15	06:19 20:47	06:56 19:56	07:31 19:00
8	08:04 17:04	07:38 17:45	08:14 (T-42) 08:36 (T-42)	07:53 18:22		06:56 20:01	06:08 20:38	05:42 21:09	05:49 21:15	06:20 20:46	06:57 19:54	07:33 18:56
9	08:03 17:05	07:37 17:46	08:15 (T-42) 08:34 (T-42)	07:52 18:23		06:55 20:02	06:07 20:40	05:42 21:10	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54
10	08:03 17:06	07:36 17:48	08:18 (T-42) 08:32 (T-42)	07:50 19:24		06:53 20:04	06:06 20:41	05:41 21:11	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:52
11	08:03 17:07	07:34 17:49	08:25 (T-42) 08:26 (T-42)	07:48 19:26		06:51 20:05	06:04 20:42	05:41 21:11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51
12	08:02 17:08	07:33 17:50		07:46 19:27		06:49 20:06	06:03 20:43	05:41 21:12	05:52 21:13	06:25 20:40	07:01 19:47	07:38 18:49
13	08:02 17:09	08:26 (T-42) 17:52	07:31 19:28	07:44 19:43		06:47 20:07	06:02 20:44	05:41 21:13	05:53 21:12	06:26 20:38	07:03 19:45	07:39 18:47
14	08:02 17:11	08:25 (T-42) 17:53	07:30 19:30	07:43 19:40		06:46 20:09	06:01 20:45	05:41 21:13	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45
15	08:01 17:12	08:24 (T-42) 17:55	07:28 19:31	07:41 19:30		06:44 20:10	06:00 20:47	05:41 21:14	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:44
16	08:01 17:13	08:24 (T-42) 17:56	07:27 19:32	07:39 19:32		06:42 20:11	05:59 20:48	05:41 21:14	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42
17	08:00 17:14	08:23 (T-42) 17:57	07:25 19:34	07:37 19:34		06:41 20:12	05:57 20:49	05:41 21:14	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40
18	07:59 17:16	08:22 (T-42) 17:59	07:24 19:35	07:35 19:35		06:39 20:14	05:56 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:08 19:35	07:45 18:39
19	07:59 17:17	08:22 (T-42) 18:00	07:22 19:36	07:33 19:36		06:37 20:15	05:55 20:51	05:41 21:15	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37
20	07:58 17:18	08:21 (T-42) 18:00	07:21 19:37	07:31 19:37		06:35 20:16	05:54 20:52	05:41 21:15	06:00 21:07	06:34 20:27	07:11 19:31	07:48 18:35
21	07:57 17:20	08:20 (T-42) 18:02	07:19 19:39	07:30 19:39		06:34 20:17	05:53 20:53	05:41 21:16	06:01 21:06	06:36 20:26	07:12 19:30	07:49 18:34
22	07:57 17:21	08:19 (T-42) 18:03	07:17 19:40	07:28 19:40		06:32 20:19	05:52 20:54	05:41 21:16	06:02 21:05	06:37 20:24	07:13 19:28	07:51 18:32
23	07:56 17:22	08:18 (T-42) 18:04	07:16 19:41	07:26 19:41		06:31 20:20	05:52 20:55	05:42 21:16	06:03 21:04	06:38 20:22	07:14 19:26	07:52 18:30
24	07:55 17:24	08:17 (T-43) 18:06	07:14 19:42	07:24 19:42		06:29 20:21	05:51 20:56	05:42 21:16	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29
25	07:54 17:25	08:16 (T-43) 18:07	07:13 19:44	07:22 19:44		06:27 20:22	05:50 20:57	05:42 21:16	06:05 21:03	06:40 20:19	07:17 19:22	07:54 18:27
26	07:53 17:26	08:15 (T-43) 18:08	07:11 19:45	07:20 19:45		06:26 20:24	05:49 20:58	05:43 21:17	06:06 21:02	06:41 20:17	07:18 19:20	07:56 18:26
27	07:52 17:28	08:14 (T-43) 18:10	07:09 19:46	07:18 19:46		06:24 20:25	05:48 20:59	05:43 21:17	06:07 21:00	06:43 20:16	07:19 19:18	07:57 18:24
28	07:51 17:29	08:13 (T-43) 18:11	07:07 19:47	07:17 19:47		06:23 20:26	05:48 21:00	05:43 21:17	06:08 20:59	06:44 20:14	07:20 19:16	07:59 18:23
29	07:50 17:31	08:12 (T-43) 18:00	07:15 19:49	07:25 19:49		06:21 20:27	05:47 21:01	05:44 21:17	06:09 20:58	06:45 20:12	07:22 19:14	08:00 18:21
30	07:49 17:32	08:11 (T-43) 18:06	07:13 19:50	07:23 19:50		06:20 20:29	05:46 21:02	05:44 21:17	06:10 20:57	06:46 20:10	07:23 19:13	08:01 18:20
31	07:48 17:33	08:10 (T-43) 18:04	07:11 19:51	07:21 19:51		06:19 21:03	05:45 20:56	05:47 20:09	06:11 20:56	06:47 20:09	07:24 18:18	08:03 18:18
	Potential sun hours	287	292	369	403	459	471	436	377	341	289	275
	Total, worst case	335	315	6							58	605
	Sun reduction	0.58	0.58	0.59							0.56	0.48
	Oper. time red.	0.90	0.90	0.90							0.90	0.90
	Wind dir. red.	0.65	0.64	0.61							0.61	0.65
	Total reduction	0.34	0.33	0.32							0.31	0.28
	Total, real	113	105	2							18	169

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-082 - R-082
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	08:29 (T-42) 07:47	08:34 (T-42) 07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43	08:09 (T-42)			
2	08:04	08:29 (T-42) 07:46	08:37 (T-42) 07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05	07:44	08:10 (T-42)			
3	08:04	08:29 (T-42) 07:45	08:49 (T-42) 07:14	07:02	07:05	06:15	05:44	06:15	06:51	07:26	07:07	07:45	08:11 (T-42)			
4	08:04	08:29 (T-42) 07:43	18:15 19:55 20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48	29	08:09 (T-42)	08:09 (T-42)			
5	08:04	08:29 (T-42) 07:42	18:13 19:52 20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48	29	08:09 (T-42)	08:09 (T-42)			
6	08:04	08:28 (T-42) 07:41	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
7	08:04	08:28 (T-42) 07:40	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
8	08:04	08:28 (T-42) 07:38	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
9	08:03	08:27 (T-42) 07:37	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
10	08:03	08:27 (T-42) 07:36	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
11	08:03	08:27 (T-42) 07:34	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
12	08:02	08:26 (T-42) 07:33	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
13	08:02	08:26 (T-42) 07:31	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
14	08:02	08:25 (T-42) 07:30	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
15	08:01	08:24 (T-43) 07:28	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
16	08:01	08:24 (T-43) 07:27	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
17	08:00	08:23 (T-43) 07:25	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
18	07:59	08:22 (T-43) 07:24	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
19	07:59	08:22 (T-43) 07:22	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
20	07:58	08:21 (T-43) 07:21	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
21	07:57	08:20 (T-43) 07:19	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
22	07:56	08:19 (T-43) 07:17	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
23	07:56	08:18 (T-43) 07:16	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
24	07:55	08:17 (T-43) 07:14	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
25	07:54	08:16 (T-43) 07:13	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
26	07:53	08:15 (T-43) 07:11	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
27	07:52	08:14 (T-43) 07:09	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
28	07:51	08:13 (T-43) 07:07	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
29	07:50	08:12 (T-43) 07:05	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
30	07:49	08:11 (T-43) 07:03	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
31	07:48	08:10 (T-43) 07:01	18:18 19:57 20:35	21:07	21:16	20:50	19:59	19:03	17:11	16:47	25	08:38 (T-42)	08:38 (T-42)			
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275	195			
Total, worst case	1003	98	58	0.90	0.65	0.34	0.31	0.28	0.21	0.69	0.48	0.90	0.65	0.34	0.31	195
Sun reduction	0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52	0.52	0.52	0.52	0.52
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Wind dir. red.	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Total reduction	0.34	0.33	0.33	0.33	0.33	0.33	0.31	0.28	0.21	0.69	0.48	0.90	0.65	0.34	0.31	195
Total, real	342	32	32	32	32	32	32	32	32	32	32	32	32	32	32	32

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-084 - R-084
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43
	16:57	17:35	18:12	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:44	05:45	06:13	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:00	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:01	17:40	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:33	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:07	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:21	06:58	07:34	07:15	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46
10	08:03	07:35	07:50	06:53	06:06	05:41	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:24	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:46
11	08:03	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:46
12	08:02	07:33	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:38	07:19	07:54
	17:08	17:50	19:27	20:06	20:43	21:12	21:13	20:40	19:46	18:49	17:03	16:47
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:01	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	08:24 (T-53)	07:28	07:41	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:23
	17:12	1 08:25 (T-53)	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00
16	08:00	08:24 (T-53)	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24
	17:13	2 08:26 (T-53)	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59
17	08:00	08:23 (T-53)	07:25	07:37	06:41	05:57	05:41	05:57	06:31	07:07	07:44	07:25
	17:14	3 08:26 (T-53)	17:57	19:33	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58
18	07:59	08:22 (T-53)	07:24	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:27
	17:16	4 08:26 (T-53)	17:59	19:35	20:14	20:50	21:15	21:09	20:30	19:35	18:38	16:57
19	07:59	08:22 (T-53)	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:10	07:46	07:28
	17:17	4 08:26 (T-53)	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56
20	07:58	08:21 (T-53)	07:21	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:48	07:29
	17:18	5 08:26 (T-53)	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55
21	07:57	08:20 (T-53)	07:19	07:30	06:34	05:53	05:41	06:01	06:36	07:12	07:49	07:31
	17:20	6 08:26 (T-53)	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:29	18:33	16:54
22	07:56	08:19 (T-53)	07:17	07:28	06:32	05:52	05:42	06:02	06:37	07:13	07:50	07:32
	17:21	6 08:25 (T-53)	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:53
23	07:56	08:18 (T-53)	07:16	07:26	06:30	05:52	05:42	06:03	06:38	07:14	07:52	07:33
	17:22	6 08:24 (T-53)	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53
24	07:55	08:17 (T-53)	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35
	17:24	5 08:22 (T-53)	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52
25	07:54	08:12	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:54	07:36	08:01
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	3 08:04 (T-53)
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:56	07:37	08:02
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	2 08:04 (T-53)
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	1 08:04 (T-53)
28	07:51	07:07	07:17	06:23	05:48	05:43	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50	07:15	06:21	05:47	05:44	06:09	06:45	06:45	07:22	08:00	07:41	08:04
	17:31	19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	07:42	16:54
30	07:49	07:13	06:20	05:46	05:44	06:10	06:46	07:23	08:01	07:42	07:42	08:04
	17:32	19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	07:42	16:55
31	07:48	07:11	06:17	05:46	05:46	06:11	06:47	07:24	08:02	07:42	07:42	08:04
	17:33	19:51	21:03	21:03	20:56	20:56	20:08	18:18	18:18	16:49	07:42	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction	42											42
Oper. time red.	0.58											0.48
Wind dir. red.	0.90											0.90
Total reduction	0.65											0.65
Total, real	0.34											0.28
Total, real	14											12

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-085 - R-085

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:45 (T-52)	07:04	07:43	
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	10 07:55 (T-52)	17:17	16:48	
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:46 (T-52)	07:05	07:44	
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	9 07:55 (T-52)	17:15	16:48	
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:47 (T-52)	07:07	07:45	
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	8 07:55 (T-52)	17:14	16:48	
4	08:04	07:43	07:00	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:49 (T-52)	07:08	07:46	
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	6 07:55 (T-52)	17:13	16:47	
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:50 (T-52)	07:09	07:47	
	17:01	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	5 07:55 (T-52)	17:11	16:47	
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:49 (T-52)	07:11	07:48	
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:01	3 07:54 (T-52)	17:10	16:47	
7	08:04	07:39	06:55	07:16 (T-52)	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:52 (T-52)	07:12	07:49
	17:03	17:43	18:21	2 07:18 (T-52)	20:00	20:37	21:09	21:15	20:47	19:56	19:00	1 07:53 (T-52)	17:09	16:47
8	08:04	07:38	07:53	08:14 (T-52)	06:56	06:08	05:42	05:49	06:20	06:57	07:33		07:13	07:50
	17:04	17:45	18:22	4 08:18 (T-52)	20:01	20:38	21:09	21:14	20:46	19:54	18:56		17:08	16:47
9	08:03	07:37	07:52	08:12 (T-52)	06:55	06:07	05:42	05:50	06:22	06:58	07:34		07:15	07:51
	17:05	17:46	19:23	6 08:18 (T-52)	20:02	20:39	21:10	21:14	20:44	19:52	18:54		17:06	16:47
10	08:03	07:35	07:50	08:10 (T-52)	06:53	06:06	05:42	05:51	06:23	06:59	07:35		07:16	07:52
	17:06	17:48	19:24	7 08:17 (T-52)	20:04	20:41	21:11	21:14	20:43	19:50	18:52		17:05	16:46
11	08:03	07:34	07:48	08:08 (T-52)	06:51	06:04	05:41	05:52	06:24	07:00	07:36		07:17	07:53
	17:07	17:49	19:26	9 08:17 (T-52)	20:05	20:42	21:11	21:13	20:41	19:48	18:51		17:04	16:47
12	08:02	07:33	07:46	08:07 (T-52)	06:49	06:03	05:41	05:53	06:25	07:01	07:38		07:19	07:54
	17:08	17:50	19:27	10 08:17 (T-52)	20:06	20:43	21:12	21:13	20:40	19:46	18:49		17:03	16:47
13	08:02	07:31	07:44	08:05 (T-52)	06:48	06:02	05:41	05:53	06:26	07:03	07:39		07:20	07:55
	17:10	17:52	19:28	10 08:15 (T-52)	20:07	20:44	21:12	21:12	20:38	19:45	18:47		17:02	16:47
14	08:01	07:30	07:43	08:03 (T-52)	06:46	06:01	05:41	05:54	06:27	07:04	07:40		07:21	07:56
	17:11	17:53	19:30	10 08:13 (T-52)	20:09	20:45	21:13	21:11	20:37	19:43	18:45		17:01	16:47
15	08:01	07:28	07:41	08:03 (T-52)	06:44	06:00	05:41	05:55	06:29	07:05	07:41		07:23	07:57
	17:12	17:55	19:31	7 08:10 (T-52)	20:10	20:46	21:13	21:11	20:35	19:41	18:44		17:00	16:47
16	08:00	07:27	07:39		06:42	05:59	05:41	05:56	06:30	07:06	07:43		07:24	07:57
	17:13	17:56	19:32		20:11	20:48	21:14	21:10	20:34	19:39	18:42		16:59	16:47
17	08:00	07:25	07:37		06:41	05:58	05:41	05:57	06:31	07:07	07:44		07:25	07:58
	17:14	17:57	19:34		20:12	20:49	21:14	21:09	20:32	19:37	18:40		16:58	16:48
18	07:59	07:24	07:35		06:39	05:56	05:41	05:58	06:32	07:08	07:45		07:27	07:59
	17:16	17:59	19:35		20:14	20:50	21:15	21:09	20:30	19:35	18:39		16:57	16:48
19	07:59	07:22	07:33		06:37	05:55	05:41	05:59	06:33	07:10	07:47		07:28	07:59
	17:17	18:00	19:36		20:15	20:51	21:15	21:08	20:29	19:33	18:37		16:56	16:48
20	07:58	07:21	07:31		06:35	05:54	05:41	06:00	06:34	07:11	07:48		07:29	08:00
	17:18	18:00	19:37		20:16	20:52	21:15	21:07	20:27	19:31	18:35		16:55	16:49
21	07:57	07:19	07:30		06:34	05:53	05:41	06:01	06:36	07:12	07:49		07:31	08:00
	17:20	18:02	19:39		20:17	20:53	21:16	21:06	20:26	19:29	18:34		16:54	16:49
22	07:56	07:17	07:28		06:32	05:53	05:42	06:02	06:37	07:13	07:50		07:32	08:01
	17:21	18:03	19:40		20:19	20:54	21:16	21:05	20:24	19:28	18:32		16:53	16:50
23	07:56	07:16	07:26		06:31	05:52	05:42	06:03	06:38	07:14	07:52		07:33	08:02
	17:22	18:04	19:41		20:20	20:55	21:16	21:04	20:22	19:26	18:30		16:53	16:50
24	07:55	07:14	07:24		06:29	05:51	05:42	06:04	06:39	07:16	07:53		07:35	08:02
	17:24	18:06	19:42		20:21	20:56	21:16	21:03	20:21	19:24	18:29		16:52	16:51
25	07:54	07:12	07:22		06:27	05:50	05:42	06:05	06:40	07:17	07:54		07:36	08:02
	17:25	18:07	19:44		20:22	20:57	21:16	21:02	20:19	19:22	18:27		16:51	16:51
26	07:53	07:11	07:20		06:26	05:49	05:43	06:06	06:41	07:18	07:56		07:37	08:03
	17:26	18:08	19:45		20:23	20:58	21:16	21:01	20:17	19:20	18:26		16:51	16:52
27	07:52	07:09	07:18		06:24	05:48	05:43	06:07	06:43	07:19	07:57		07:38	08:03
	17:28	18:10	19:46		20:25	20:59	21:16	21:00	20:15	19:18	18:24		16:50	16:53
28	07:51	07:07	07:17		06:23	05:48	05:44	06:08	06:44	07:20	07:58		07:39	08:03
	17:29	18:11	19:47		20:26	21:00	21:16	20:59	20:14	19:16	2 07:48 (T-52)	18:23	16:50	16:53
29	07:50		07:15		06:21	05:47	05:44	06:09	06:45	07:22	07:43 (T-52)	08:00	07:41	08:04
	17:31		19:49		20:27	21:01	21:16	20:58	20:12	19:14	10 07:53 (T-52)	18:21	16:49	16:54
30	07:49		07:13		06:20	05:46	05:44	06:10	06:46	07:23	07:44 (T-52)	08:01	07:42	08:04
	17:32		19:50		20:28	21:02	21:16	20:57	20:10	19:13	10 07:54 (T-52)	18:20	16:49	16:55
31	07:48		07:11			05:46		06:11	06:47			08:02		08:04
	17:33		19:51			21:03		20:56	20:08			18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341		289	275	
Total, worst case			65						22		42			
Sun reduction			0.59						0.67		0.56			
Oper. time red.			0.90						0.90		0.90			
Wind dir. red.			0.60						0.60		0.60			
Total reduction			0.32						0.36		0.30			
Total, real			21					8			13			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 V163-4.5 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-086 - R-086 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with 12 columns for months (January-December) and rows for time intervals (08:00-17:52) and summary rows (Potential sun hours, Total, worst case, Sun reduction, etc.).

Table layout: For each day in each month the following matrix apply

Matrix with 4 columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-087 - R-087
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	08:30 (T-58)	07:47	07:06	07:09	06:18
	16:57	32 16:29 (T-54)	17:35	18:12	19:52	20:30
2	08:04	08:31 (T-58)	07:46	07:04	07:07	06:17
	16:58	32 16:30 (T-54)	17:36	18:14	19:54	20:31
3	08:04	08:31 (T-58)	07:44	07:02	07:05	06:15
	16:59	31 16:30 (T-54)	17:38	18:15	19:55	20:32
4	08:04	08:32 (T-58)	07:43	07:00	07:04	06:14
	17:00	31 16:31 (T-54)	17:39	18:17	19:56	20:33
5	08:04	08:33 (T-58)	07:42	06:59	07:02	06:12
	17:01	31 16:32 (T-54)	17:41	18:18	19:57	20:34
6	08:04	08:34 (T-58)	07:41	06:57	07:00	06:11
	17:02	30 16:33 (T-54)	17:42	18:19	19:59	20:36
7	08:04	08:35 (T-58)	07:39	06:55	06:58	06:10
	17:03	31 16:35 (T-54)	17:43	18:20	20:00	20:37
8	08:03	08:35 (T-58)	07:38	07:53	06:56	06:08
	17:04	30 16:35 (T-54)	17:45	18:22	20:01	20:38
9	08:03	08:37 (T-58)	07:37	07:52	06:55	06:07
	17:05	29 16:37 (T-54)	17:46	19:23	20:02	20:39
10	08:03	08:38 (T-58)	07:35	07:50	06:53	06:06
	17:06	28 16:38 (T-54)	17:48	19:24	20:04	20:40
11	08:03	08:40 (T-58)	07:34	07:48	06:51	06:04
	17:07	24 16:39 (T-54)	17:49	19:26	20:05	20:42
12	08:02	08:42 (T-58)	07:33	07:46	06:49	06:03
	17:08	22 16:41 (T-54)	17:50	19:27	20:06	20:43
13	08:02	16:26 (T-54)	07:31	07:44	06:47	06:02
	17:10	15 16:41 (T-54)	17:52	19:28	20:07	20:44
14	08:01	16:28 (T-54)	07:30	07:42	06:46	06:01
	17:11	14 16:42 (T-54)	17:53	19:30	20:09	20:45
15	08:01	16:29 (T-54)	07:28	07:41	06:44	06:00
	17:12	12 16:41 (T-54)	17:55	19:31	20:10	20:46
16	08:00	16:31 (T-54)	07:27	07:39	06:42	05:59
	17:13	10 16:41 (T-54)	17:56	19:32	20:11	20:47
17	08:00	16:34 (T-54)	07:25	07:37	06:41	05:57
	17:14	4 16:38 (T-54)	17:57	19:33	20:12	20:49
18	07:59		07:24	07:35	06:39	05:56
	17:16		17:59	19:35	20:14	20:50
19	07:58		07:22	07:33	06:37	05:55
	17:17		18:00	19:36	20:15	20:51
20	07:58		07:21	07:31	06:35	05:54
	17:18		18:00	19:37	20:16	20:52
21	07:57		07:19	07:30	06:34	05:53
	17:20		18:02	19:39	20:17	20:53
22	07:56		07:17	07:28	06:32	05:53
	17:21		18:03	19:40	20:18	20:54
23	07:55		07:16	07:26	06:31	05:52
	17:22		18:04	19:41	20:20	20:55
24	07:55		07:14	07:24	06:29	05:51
	17:24		18:06	19:42	20:21	20:56
25	07:54		07:12	07:22	06:27	05:50
	17:25		18:07	19:44	20:22	20:57
26	07:53		07:11	07:20	06:26	05:49
	17:26		18:08	19:45	20:23	20:58
27	07:52		07:09	07:18	06:24	05:48
	17:28		18:10	19:46	20:25	20:59
28	07:51		07:07	07:17	06:23	05:48
	17:29		18:11	19:47	20:26	21:00
29	07:50			07:15	06:21	05:47
	17:31			19:49	20:27	21:01
30	07:49			07:13	06:20	05:46
	17:32			19:50	20:28	21:02
31	07:48			07:11		05:46
	17:33			19:51		21:03
Potential sun hours	287	292	369	403	458	465
Total, worst case	406			90		607
Sun reduction	0.58			0.63		0.66
Oper. time red.	0.90			0.90		0.90
Wind dir. red.	0.63			0.58		0.59
Total reduction	0.33			0.33		0.35
Total, real	135			30		213

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
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Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

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Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-087 - R-087
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:12	06:36 (T-52)	06:48	07:24	07:04
	21:16	20:55	25 07:01 (T-52)	20:07	19:11	17:17
2	05:46	06:14	06:37 (T-52)	06:50	07:25	07:05
	21:16	20:53	24 07:01 (T-52)	20:05	19:09	17:15
3	05:46	06:15	06:38 (T-52)	06:51	07:26	07:06
	21:16	20:52	23 07:01 (T-52)	20:03	19:07	17:14
4	05:47	06:16	06:39 (T-52)	06:52	07:28	07:08
	21:16	20:51	22 07:01 (T-52)	20:01	19:05	17:13
5	05:47	06:17	06:40 (T-52)	06:53	07:29	07:09
	21:15	20:50	21 07:01 (T-52)	19:59	19:03	17:11
6	05:48	06:18	06:41 (T-52)	06:54	07:30	07:11
	21:15	20:48	19 07:00 (T-52)	19:58	19:01	17:10
7	05:49	06:19	06:42 (T-52)	06:55	07:31	07:12
	21:15	20:47	17 06:59 (T-52)	19:56	19:00	17:09
8	05:49	06:20	06:43 (T-52)	06:57	07:32	07:13
	21:14	20:45	16 06:59 (T-52)	19:54	18:56	17:07
9	05:50	06:22	06:45 (T-52)	06:58	07:34	07:15
	21:14	20:44	14 06:59 (T-52)	19:52	18:54	17:06
10	05:51	06:23	06:46 (T-52)	06:59	07:35	07:16
	21:13	20:43	12 06:58 (T-52)	19:50	18:52	17:05
11	05:52	06:24	06:47 (T-52)	07:00	07:36	07:17
	21:13	20:41	10 06:57 (T-52)	19:48	18:51	17:04
12	05:53	06:25	06:48 (T-52)	07:01	07:38	07:19
	21:12	20:40	11 06:59 (T-53)	19:46	18:49	17:03
13	05:53	06:26	06:49 (T-53)	07:03	07:39	07:20
	21:12	20:38	12 07:01 (T-53)	19:45	18:47	17:02
14	05:54	06:27	06:50 (T-53)	07:04	07:40	07:21
	21:11	20:37	12 07:02 (T-53)	19:43	18:45	17:01
15	05:55	06:28	06:51 (T-53)	07:05	07:41	07:23
	21:11	9 06:48 (T-52)	20:35	12 07:03 (T-53)	19:41	18:44
16	05:56	06:28	06:52 (T-53)	07:06	07:43	07:24
	21:10	13 06:51 (T-52)	20:34	11 07:03 (T-53)	19:39	18:42
17	05:57	06:29	06:53 (T-53)	07:07	07:44	07:25
	21:09	15 06:52 (T-52)	20:32	10 07:03 (T-53)	19:37	18:40
18	05:58	06:30	06:54 (T-53)	07:08	07:45	07:27
	21:09	18 06:54 (T-52)	20:30	9 07:04 (T-53)	19:35	18:38
19	05:59	06:31	06:55 (T-53)	07:09	07:46	07:28
	21:08	20 06:55 (T-52)	20:29	8 07:04 (T-53)	19:33	18:37
20	06:00	06:32	06:56 (T-53)	07:10	07:47	07:29
	21:07	22 06:56 (T-52)	20:27	7 07:04 (T-53)	19:31	18:35
21	06:01	06:33	06:57 (T-53)	07:11	07:48	07:30
	21:06	24 06:57 (T-52)	20:26	5 07:03 (T-53)	19:29	18:34
22	06:02	06:34	06:58 (T-53)	07:12	07:49	07:31
	21:05	25 06:58 (T-52)	20:24	3 07:02 (T-53)	19:28	18:32
23	06:03	06:35	06:59 (T-53)	07:13	07:50	07:32
	21:04	27 06:59 (T-52)	20:22	1 07:01 (T-53)	19:26	18:30
24	06:04	06:36	07:00 (T-53)	07:14	07:51	07:33
	21:03	27 06:59 (T-52)	20:21		19:24	18:29
25	06:05	06:37	07:01 (T-53)	07:15	07:52	07:34
	21:02	29 07:00 (T-52)	20:19		19:22	18:27
26	06:06	06:38	07:02 (T-53)	07:16	07:53	07:35
	21:01	29 07:00 (T-52)	20:17		19:20	18:26
27	06:07	06:39	07:03 (T-53)	07:17	07:54	07:36
	21:00	30 07:01 (T-52)	20:15		19:18	18:24
28	06:08	06:40	07:04 (T-53)	07:18	07:55	07:37
	20:59	29 07:01 (T-52)	20:14		19:16	18:23
29	06:09	06:41	07:05 (T-53)	07:19	07:56	07:38
	20:58	28 07:01 (T-52)	20:12		19:14	18:21
30	06:10	06:42	07:06 (T-53)	07:20	07:57	07:39
	20:57	27 07:01 (T-52)	20:10		19:12	18:20
31	06:11	06:43	07:07 (T-53)	07:21	07:58	07:40
	20:56	26 07:01 (T-52)	20:08		19:10	18:18
Potential sun hours	471	436		377	341	289
Total, worst case		304				76
Sun reduction	0.75	0.72				0.48
Oper. time red.	0.90	0.90				0.90
Wind dir. red.	0.59	0.59				0.61
Total reduction	0.40	0.38				0.26
Total, real	159	116				20

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 V163-4.5 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-088 - R-088 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time table with columns N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum and values 561, 438, 311, 293, 309, 330, 363, 461, 788, 773, 462, 449, 509, 600, 629, 608, 7,884

Main shadow calculation table with columns for months (January-December) and rows for each hour of the day, showing sun rise/set times and shadow reduction percentages.

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) Sun set (hh:mm) First time (hh:mm) with flicker Last time (hh:mm) with flicker (WTG causing flicker first time) (WTG causing flicker last time)



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6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-089 - R-089

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-57)	07:47	08:09 (T-77)	07:06	07:09
	16:57	28 08:57 (T-57)	17:35	8 08:17 (T-77)	18:13	19:52
2	08:04	08:29 (T-57)	07:46	08:07 (T-77)	07:04	07:07
	16:58	29 08:58 (T-57)	17:36	10 08:17 (T-77)	18:14	19:54
3	08:04	08:29 (T-57)	07:44	08:06 (T-77)	07:02	07:06
	16:59	29 08:58 (T-57)	17:38	12 08:18 (T-77)	18:15	19:55
4	08:04	08:29 (T-57)	07:43	08:05 (T-77)	07:00	07:04
	17:00	28 08:57 (T-57)	17:39	13 08:18 (T-77)	18:17	19:56
5	08:04	08:30 (T-57)	07:42	08:04 (T-77)	06:59	07:02
	17:01	28 08:58 (T-57)	17:41	15 08:19 (T-77)	18:18	19:57
6	08:04	08:31 (T-57)	07:41	08:02 (T-77)	06:57	07:00
	17:02	27 08:58 (T-57)	17:42	16 08:18 (T-77)	18:19	19:59
7	08:04	08:32 (T-57)	07:39	08:01 (T-77)	06:55	06:58
	17:03	26 08:58 (T-57)	17:43	17 08:18 (T-77)	18:21	20:00
8	08:04	08:32 (T-57)	07:38	08:00 (T-77)	07:53	06:56
	17:04	26 08:58 (T-57)	17:45	18 08:18 (T-77)	18:22	20:01
9	08:03	08:33 (T-57)	07:37	07:58 (T-77)	07:52	06:55
	17:05	25 08:58 (T-57)	17:46	19 08:17 (T-77)	19:23	20:02
10	08:03	08:34 (T-57)	07:35	07:58 (T-77)	07:50	06:53
	17:06	24 08:58 (T-57)	17:48	18 08:16 (T-77)	19:24	20:04
11	08:03	08:35 (T-57)	07:34	07:55 (T-58)	07:48	06:51
	17:07	23 08:58 (T-57)	17:49	17 08:15 (T-77)	19:26	20:05
12	08:02	08:36 (T-57)	07:33	07:54 (T-58)	07:46	06:49
	17:08	22 08:58 (T-57)	17:50	15 08:13 (T-77)	19:27	20:06
13	08:02	08:37 (T-57)	07:31	07:52 (T-58)	07:44	06:48
	17:10	20 08:57 (T-57)	17:52	11 08:10 (T-77)	19:28	20:07
14	08:01	08:38 (T-57)	07:30	07:51 (T-58)	07:43	06:46
	17:11	19 08:57 (T-57)	17:53	6 07:57 (T-58)	19:30	20:09
15	08:01	08:40 (T-57)	07:28	07:49 (T-58)	07:41	06:44
	17:12	16 08:56 (T-57)	17:55	7 07:56 (T-58)	19:31	20:10
16	08:00	08:42 (T-57)	07:27	07:48 (T-58)	07:39	06:42
	17:13	13 08:55 (T-57)	17:56	8 07:56 (T-58)	19:32	20:11
17	08:00	08:44 (T-57)	07:25	07:46 (T-58)	07:37	06:41
	17:15	9 08:53 (T-57)	17:57	8 07:54 (T-58)	19:34	20:12
18	07:59		07:24	07:46 (T-58)	07:35	06:39
	17:16		17:59	6 07:52 (T-58)	19:35	20:14
19	07:59		07:22		07:33	06:37
	17:17		18:00		19:36	20:15
20	07:58		07:21		07:31	06:36
	17:18		18:00		19:37	20:16
21	07:57		07:19		07:30	06:34
	17:20		18:02		19:39	20:17
22	07:56		07:17		07:28	06:32
	17:21		18:03		19:40	20:19
23	07:56		07:16		07:26	06:31
	17:22		18:04		19:41	20:20
24	07:55		07:14		07:24	06:29
	17:24		18:06		19:42	20:21
25	07:54		07:12		07:22	06:27
	17:25		18:07		19:44	20:22
26	07:53		07:11		07:20	06:26
	17:27		18:08		19:45	20:23
27	07:52		07:09		07:18	06:24
	17:28		18:10		19:46	20:25
28	07:51		07:07		07:17	06:23
	17:29		18:11		19:47	20:26
29	07:50	08:12 (T-77)			07:15	06:21
	17:31	2 08:14 (T-77)			19:49	20:27
30	07:49	08:11 (T-77)			07:13	06:20
	17:32	4 08:15 (T-77)			19:50	20:28
31	07:48	08:10 (T-77)			07:11	06:18
	17:33	6 08:16 (T-77)			19:51	20:29
Potential sun hours	287	292	369	403	458	465
Total, worst case	404	224		59		
Sun reduction	0.58	0.58		0.63		
Oper. time red.	0.90	0.90		0.90		
Wind dir. red.	0.66	0.64		0.58		
Total reduction	0.35	0.33		0.33		
Total, real	140	75		19		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



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Calculated:
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SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-089 - R-089

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:28 (T-77) 07:43 08:17 (T-57)
2	05:46 21:16	06:14 20:53	06:50 20:05	07:25 19:09	07:05 17:15	18 07:46 (T-77) 16:48 23 08:40 (T-57)
3	05:46 21:16	06:15 20:52	06:51 20:03	07:26 19:07	07:06 17:14	19 07:47 (T-77) 16:48 25 08:42 (T-57)
4	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	18 07:47 (T-77) 16:48 25 08:42 (T-57)
5	05:47 21:15	06:17 20:50	06:53 19:59	07:29 19:03	07:09 17:11	17 07:48 (T-77) 16:47 26 08:43 (T-57)
6	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:01	07:11 17:10	16 07:48 (T-77) 16:47 27 08:44 (T-57)
7	05:49 21:15	06:19 20:47	06:56 19:56	07:31 19:00	07:12 17:09	15 07:49 (T-77) 16:47 27 08:44 (T-57)
8	05:49 21:14	06:20 20:45	06:57 19:54	07:33 18:56	07:13 17:08	13 07:48 (T-77) 16:47 28 08:45 (T-57)
9	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54	07:15 17:06	12 07:49 (T-77) 16:47 28 08:45 (T-57)
10	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:52	07:16 17:05	10 07:48 (T-77) 16:47 29 08:46 (T-57)
11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51	07:17 17:04	8 07:48 (T-77) 16:47 29 08:47 (T-57)
12	05:53 21:13	06:25 20:40	07:01 19:46	07:38 18:49	07:19 17:03	6 07:47 (T-77) 16:47 28 08:47 (T-57)
13	05:53 21:12	06:26 20:38	07:03 19:45	07:39 18:47	07:20 17:02	4 07:47 (T-77) 16:47 28 08:48 (T-57)
14	05:54 21:11	06:27 20:37	07:04 19:43	07:40 18:45	07:21 17:01	2 07:46 (T-77) 16:47 28 08:49 (T-57)
15	05:55 21:11	06:29 20:35	06:51 (T-52) 19:41	07:05 18:44	07:23 17:00	8 06:59 (T-52) 16:47 27 08:48 (T-57)
16	05:56 21:10	06:30 20:34	06:52 (T-52) 19:39	07:06 18:42	07:24 16:59	8 06:59 (T-52) 16:47 27 08:49 (T-57)
17	05:57 21:09	06:31 20:32	07:01 (T-52) 19:37	07:07 18:40	07:25 16:58	9 07:01 (T-52) 16:47 27 08:50 (T-57)
18	05:58 21:09	06:32 20:30	06:54 (T-52) 19:35	07:08 18:39	07:26 16:57	9 07:03 (T-52) 16:48 27 08:51 (T-57)
19	05:59 21:08	06:33 20:29	06:55 (T-52) 19:33	07:09 18:37	07:27 16:56	8 07:03 (T-52) 16:48 27 08:52 (T-57)
20	06:00 21:07	06:34 20:27	06:56 (T-52) 19:31	07:10 18:35	07:28 16:55	7 07:03 (T-52) 16:49 26 08:51 (T-57)
21	06:01 21:06	06:36 20:26	06:58 (T-52) 19:29	07:12 18:34	07:31 16:54	6 06:58 (T-52) 16:49 26 08:52 (T-57)
22	06:02 21:05	06:37 20:24	06:59 (T-52) 19:28	07:13 18:32	07:32 16:54	5 07:03 (T-52) 16:50 26 08:52 (T-57)
23	06:03 21:04	06:38 20:22	07:00 (T-52) 19:26	07:14 18:30	07:33 16:53	4 07:03 (T-52) 16:50 26 08:53 (T-57)
24	06:04 21:03	06:39 20:21	07:01 (T-52) 19:24	07:16 18:29	07:35 16:52	2 07:02 (T-52) 16:51 27 08:54 (T-57)
25	06:05 21:02	06:40 20:19	07:17 19:22	07:54 18:27	07:36 16:51	8 08:15 (T-58) 08:22 (T-57) 16:51 27 08:54 (T-57)
26	06:06 21:01	06:41 20:17	07:18 19:20	07:56 18:26	07:37 16:51	8 08:25 (T-58) 08:20 (T-57) 16:51 27 08:54 (T-57)
27	06:07 21:00	06:43 20:15	07:19 19:18	07:57 18:24	07:38 16:50	8 08:18 (T-58) 08:20 (T-57) 16:51 27 08:55 (T-57)
28	06:08 20:59	06:44 20:14	07:20 19:16	07:58 18:23	07:39 16:50	8 08:26 (T-58) 08:19 (T-57) 16:51 27 08:55 (T-57)
29	06:09 20:58	06:45 20:12	07:22 19:14	08:00 18:21	07:41 16:49	7 08:21 (T-58) 08:19 (T-57) 16:50 27 08:55 (T-57)
30	06:10 20:57	06:46 20:10	07:23 19:13	08:01 18:20	07:42 16:49	6 08:27 (T-58) 08:18 (T-57) 16:50 27 08:55 (T-57)
31	06:11 20:56	06:47 20:08	08:02 18:18	08:02 18:18	07:42 16:49	12 08:40 (T-77) 08:17 (T-57) 16:50 27 08:55 (T-57)
Potential sun hours	471	436	377	341	289	275
Total, worst case				83	256	835
Sun reduction		0.72		0.56	0.48	0.52
Oper. time red.		0.90		0.90	0.90	0.90
Wind dir. red.		0.58		0.63	0.65	0.66
Total reduction		0.38		0.32	0.28	0.31
Total, real		22		27	72	260

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project: South Deuel Wind Project

Description: Invenergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 V163-4.5 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-090 - R-090

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Table with 12 columns (Jan-Dec) and 2 rows of sunshine probability values.

Operational time

Table with 17 columns (N-Sum) and 2 rows of operational time values.

Main shadow calculation table with columns for months (January-June) and rows for each day of the month, including sunrise/set times and reduction factors.

Table layout: For each day in each month the following matrix apply

Matrix table defining columns for Day in month, Sun rise/set, First/Last time with flicker, and (WTG causing flicker first/last time).

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-090 - R-090
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December				
1	05:45 21:16	20:48 (T-H) 20:49 (T-H)	06:12 20:55	06:36 (T-92) 06:41 (T-92)	06:49 20:07	07:14 (T-60) 19:11	07:04 17:17	07:26 (T-61) 07:38 (T-61)	07:43 16:48	
2	05:46 21:16		06:14 20:53	06:37 (T-92) 06:41 (T-92)	06:50 20:05	07:12 (T-60) 07:35 (T-60)	07:25 19:09	07:05 17:15	07:28 (T-61) 07:40 (T-61)	07:44 16:48
3	05:46 21:16		06:15 20:52	06:38 (T-92) 06:41 (T-92)	06:51 20:03	07:13 (T-60) 07:37 (T-60)	07:26 19:07	07:06 17:14	07:29 (T-61) 07:40 (T-61)	07:45 16:48
4	05:47 21:16		06:16 20:51	06:39 (T-92) 06:40 (T-92)	06:52 20:01	07:14 (T-60) 07:37 (T-60)	07:28 19:05	07:08 17:13	07:31 (T-61) 07:41 (T-61)	07:46 16:47
5	05:47 21:15		06:17 20:49	06:53 19:59	07:15 (T-60) 07:37 (T-60)	07:29 19:03	07:09 17:11	07:32 (T-61) 07:41 (T-61)	07:47 16:47	
6	05:48 21:15		06:18 20:48	06:54 19:58	07:16 (T-60) 07:37 (T-60)	07:30 19:01	07:11 17:10	07:34 (T-61) 07:41 (T-61)	07:48 16:47	
7	05:49 21:15		06:19 20:47	06:56 19:56	07:17 (T-60) 07:37 (T-60)	07:31 19:00	07:12 17:09	07:35 (T-61) 07:41 (T-61)	07:49 16:47	
8	05:50 21:14		06:20 20:45	06:57 19:54	07:18 (T-60) 07:37 (T-60)	07:33 18:56	07:13 17:08	07:37 (T-61) 07:41 (T-61)	07:50 16:47	
9	05:50 21:14		06:22 20:44	06:58 19:52	07:19 (T-60) 07:36 (T-60)	07:34 18:54	07:15 17:06	07:38 (T-61) 07:40 (T-61)	07:51 16:47	
10	05:51 21:13		06:23 20:43	06:59 19:50	07:21 (T-60) 07:37 (T-60)	07:35 18:52	07:16 17:05	07:39 (T-61) 07:41 (T-61)	07:52 16:47	
11	05:52 21:13		06:24 20:41	07:00 19:48	07:22 (T-60) 07:36 (T-60)	07:36 18:51	07:17 17:04	07:40 (T-61) 07:41 (T-61)	07:53 16:47	
12	05:53 21:12		06:25 20:40	07:01 19:46	07:23 (T-60) 07:35 (T-60)	07:38 18:49	07:19 17:03	07:41 (T-61) 07:41 (T-61)	07:54 16:47	
13	05:53 21:12		06:26 20:38	07:03 19:45	07:24 (T-60) 07:33 (T-60)	07:39 18:47	07:20 17:02	07:42 (T-61) 07:41 (T-61)	07:55 16:47	
14	05:54 21:11		06:27 20:37	07:04 19:43	07:25 (T-60) 07:32 (T-60)	07:40 18:45	07:21 17:01	07:43 (T-61) 07:41 (T-61)	07:56 16:47	
15	05:55 21:11		06:29 20:35	07:05 19:41	07:26 (T-60) 07:30 (T-60)	07:41 18:44	07:23 17:00	07:44 (T-61) 07:41 (T-61)	07:56 16:47	
16	05:56 21:10		06:30 20:34	07:06 19:39	07:27 (T-60) 07:28 (T-60)	07:43 18:42	07:24 16:59	07:45 (T-61) 07:41 (T-61)	07:57 16:47	
17	05:57 21:09		06:31 20:32	07:07 19:37	07:28 (T-60) 07:32 (T-60)	07:44 18:40	07:25 16:58	07:46 (T-61) 07:41 (T-61)	07:58 16:48	
18	05:58 21:08		06:32 20:30	07:08 19:35	07:29 (T-60) 07:32 (T-60)	07:45 18:39	07:27 16:57	07:47 (T-61) 07:41 (T-61)	07:59 16:48	
19	05:59 21:08	06:29 (T-92) 06:32 (T-92)	06:33 20:29	07:10 19:33	07:33 (T-60) 07:29 (T-92)	07:46 18:37	07:28 16:56	07:48 (T-61) 07:41 (T-61)	07:59 16:48	
20	06:00 21:07	3 06:35 (T-92)	06:34 20:27	07:11 19:31	07:34 (T-60) 07:27 (T-92)	07:48 18:35	07:29 16:55	07:49 (T-61) 07:41 (T-61)	08:00 16:49	
21	06:01 21:06	8 06:37 (T-92)	06:36 20:26	07:12 19:29	07:35 (T-60) 07:28 (T-92)	07:49 18:34	07:31 16:54	07:50 (T-61) 07:41 (T-61)	08:00 16:49	
22	06:02 21:05	12 06:38 (T-92)	06:37 20:24	07:13 19:28	07:36 (T-60) 07:29 (T-92)	07:50 18:32	07:32 16:54	07:51 (T-61) 07:41 (T-61)	08:01 16:50	
23	06:03 21:04	12 06:39 (T-92)	06:38 20:22	07:14 19:26	07:37 (T-60) 07:30 (T-92)	07:52 18:30	07:33 16:53	07:52 (T-61) 07:41 (T-61)	08:01 16:50	
24	06:04 21:03	12 06:40 (T-92)	06:39 20:21	07:16 19:24	07:38 (T-60) 07:31 (T-92)	07:53 18:29	07:34 16:52	07:53 (T-61) 07:41 (T-61)	08:02 16:51	
25	06:05 21:02	11 06:41 (T-92)	06:40 20:19	07:17 19:22	07:39 (T-60) 07:32 (T-92)	07:54 18:27	07:36 16:51	07:54 (T-61) 07:41 (T-61)	08:02 16:51	
26	06:06 21:01	11 06:42 (T-92)	06:41 20:17	07:18 19:20	07:40 (T-60) 07:33 (T-92)	07:56 18:26	07:37 16:51	07:55 (T-61) 07:41 (T-61)	08:03 16:52	
27	06:07 21:00	10 06:43 (T-92)	06:43 20:15	07:19 19:18	07:41 (T-60) 07:34 (T-92)	07:57 18:24	07:38 16:50	07:56 (T-61) 07:41 (T-61)	08:03 16:53	
28	06:08 20:59	9 06:44 (T-92)	06:44 20:14	07:20 19:16	07:42 (T-60) 07:35 (T-92)	07:58 18:23	07:39 16:50	07:57 (T-61) 07:41 (T-61)	08:03 16:53	
29	06:09 20:58	9 06:45 (T-92)	06:45 20:12	07:22 19:14	07:43 (T-60) 07:36 (T-92)	08:00 18:21	07:41 16:49	07:58 (T-61) 07:41 (T-61)	08:03 16:54	
30	06:10 20:57	8 06:46 (T-92)	06:46 20:10	07:23 19:13	07:44 (T-60) 07:37 (T-92)	08:01 18:20	07:42 16:49	07:59 (T-61) 07:41 (T-61)	08:04 16:55	
31	06:11 20:56	7 06:47 (T-92)	06:47 20:08	07:24 19:12	07:45 (T-60) 07:38 (T-92)	08:02 18:18	07:43 16:48	08:00 (T-61) 07:41 (T-61)	08:04 16:56	
Potential sun hours	471		436	377		341	289		275	
Total, worst case	125		42	252		22	73			
Sun reduction	0.75		0.72	0.67		0.56	0.48			
Oper. time red.	0.90		0.90	0.90		0.90	0.90			
Wind dir. red.	0.59		0.59	0.58		0.64	0.64			
Total reduction	0.40		0.38	0.35		0.32	0.28			
Total, real	50		16	89		7	20			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-091 - R-091

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-J) 07:47	08:20 (T-J) 07:06	07:09	07:29 (T-56) 06:18	19:27 (T-89) 05:45
	16:57	1 08:30 (T-J) 17:35	23 08:43 (T-J) 18:13	19:52	51 08:24 (T-54) 20:30	20 19:47 (T-89) 21:04
2	08:04	08:29 (T-J) 07:46	08:21 (T-J) 07:04	07:07	07:28 (T-56) 06:17	19:30 (T-89) 05:45
	16:58	2 08:31 (T-J) 17:36	19 08:40 (T-J) 18:14	19:54	46 08:21 (T-54) 20:31	15 19:45 (T-89) 21:05
3	08:04	08:29 (T-J) 07:44	08:23 (T-J) 07:02	07:06	07:26 (T-56) 06:15	19:32 (T-89) 05:44
	16:59	3 08:32 (T-J) 17:38	16 08:39 (T-J) 18:15	1 07:24 (T-54) 19:55	36 08:16 (T-54) 20:32	9 19:41 (T-89) 21:06
4	08:04	08:28 (T-J) 07:43	08:26 (T-J) 07:01	07:04	07:24 (T-56) 06:14	05:44
	17:00	5 08:33 (T-J) 17:39	11 08:37 (T-J) 18:17	8 07:29 (T-54) 19:56	28 07:52 (T-55) 20:33	21:06
5	08:04	08:28 (T-J) 07:42	06:59	07:19 (T-54) 07:02	07:22 (T-56) 06:12	05:43
	17:01	6 08:34 (T-J) 17:41	18:18	13 07:32 (T-54) 19:57	27 07:49 (T-55) 20:35	21:07
6	08:04	08:28 (T-J) 07:41	06:57	07:18 (T-54) 07:00	07:20 (T-56) 06:11	05:43
	17:02	7 08:35 (T-J) 17:42	18:19	17 07:35 (T-54) 19:59	25 07:47 (T-55) 20:36	21:08
7	08:04	08:28 (T-J) 07:39	06:55	07:16 (T-54) 06:58	07:18 (T-56) 06:10	05:43
	17:03	8 08:36 (T-J) 17:43	18:21	20 07:36 (T-54) 20:00	19 07:42 (T-55) 20:37	21:09
8	08:04	08:28 (T-J) 07:38	07:53	08:14 (T-54) 06:56	07:17 (T-56) 06:08	05:42
	17:04	9 08:37 (T-J) 17:45	18:22	23 08:37 (T-54) 20:01	15 19:40 (T-89) 20:38	21:09
9	08:03	08:27 (T-J) 07:37	07:52	08:12 (T-54) 06:55	07:15 (T-56) 06:07	05:42
	17:05	10 08:37 (T-J) 17:46	19:23	26 08:38 (T-54) 20:02	20 19:41 (T-89) 20:39	21:10
10	08:03	08:27 (T-J) 07:35	07:50	08:10 (T-54) 06:53	07:13 (T-56) 06:06	05:42
	17:06	12 08:39 (T-J) 17:48	19:25	29 08:39 (T-54) 20:04	25 19:42 (T-89) 20:41	21:11
11	08:03	08:26 (T-J) 07:34	07:48	08:08 (T-54) 06:51	07:11 (T-56) 06:05	05:41
	17:07	13 08:39 (T-J) 17:49	19:26	32 08:40 (T-54) 20:05	28 19:43 (T-89) 20:42	21:11
12	08:02	08:26 (T-J) 07:33	07:46	08:07 (T-54) 06:49	07:14 (T-56) 06:03	05:41
	17:08	14 08:40 (T-J) 17:51	19:27	34 08:41 (T-54) 20:06	25 19:44 (T-89) 20:43	21:12
13	08:02	08:25 (T-J) 07:31	07:44	08:05 (T-54) 06:48	19:26 (T-89) 06:02	05:41
	17:10	15 08:40 (T-J) 17:52	19:28	36 08:41 (T-54) 20:07	19 19:45 (T-89) 20:44	21:12
14	08:01	08:25 (T-J) 07:30	07:43	08:03 (T-54) 06:46	19:25 (T-89) 06:01	05:41
	17:11	16 08:41 (T-J) 17:53	19:30	38 08:41 (T-54) 20:09	21 19:46 (T-89) 20:45	21:13
15	08:01	08:24 (T-J) 07:28	07:41	08:01 (T-54) 06:44	19:24 (T-89) 06:00	05:41
	17:12	18 08:42 (T-J) 17:55	19:31	40 08:41 (T-54) 20:10	23 19:47 (T-89) 20:46	21:13
16	08:00	08:24 (T-J) 07:27	07:39	07:59 (T-54) 06:42	19:24 (T-89) 05:59	05:41
	17:13	19 08:43 (T-J) 17:56	19:32	42 08:41 (T-54) 20:11	25 19:49 (T-89) 20:48	21:14
17	08:00	08:23 (T-J) 07:25	07:37	07:57 (T-54) 06:41	19:23 (T-89) 05:58	05:41
	17:15	20 08:43 (T-J) 17:58	19:34	44 08:41 (T-54) 20:12	27 19:50 (T-89) 20:49	21:14
18	07:59	08:22 (T-J) 07:24	07:35	07:55 (T-54) 06:39	19:22 (T-89) 05:57	05:41
	17:16	21 08:43 (T-J) 17:59	19:35	46 08:41 (T-54) 20:14	29 19:51 (T-89) 20:50	21:15
19	07:59	08:22 (T-J) 07:22	07:33	07:54 (T-54) 06:37	19:22 (T-89) 05:56	05:41
	17:17	23 08:45 (T-J) 18:00	19:36	47 08:41 (T-54) 20:15	31 19:53 (T-89) 20:51	21:15
20	07:58	08:21 (T-J) 07:21	07:32	07:52 (T-54) 06:36	19:21 (T-89) 05:55	05:41
	17:18	24 08:45 (T-J) 18:00	19:37	48 08:40 (T-54) 20:16	32 19:53 (T-89) 20:52	21:15
21	07:57	08:20 (T-J) 07:19	07:30	07:50 (T-55) 06:34	19:21 (T-89) 05:54	05:42
	17:20	25 08:45 (T-J) 18:02	19:39	50 08:40 (T-54) 20:17	33 19:54 (T-89) 20:53	21:16
22	07:56	08:19 (T-J) 07:17	07:28	07:48 (T-55) 06:32	19:22 (T-89) 05:53	05:42
	17:21	26 08:45 (T-J) 18:03	19:40	51 08:39 (T-54) 20:19	34 19:56 (T-89) 20:54	21:16
23	07:56	08:18 (T-J) 07:16	07:26	07:46 (T-55) 06:31	19:21 (T-89) 05:52	05:42
	17:23	27 08:45 (T-J) 18:04	19:41	52 08:38 (T-54) 20:20	35 19:56 (T-89) 20:55	21:16
24	07:55	08:17 (T-J) 07:14	07:24	07:44 (T-55) 06:29	19:22 (T-89) 05:51	05:42
	17:24	28 08:45 (T-J) 18:06	19:42	53 08:37 (T-54) 20:21	34 19:56 (T-89) 20:56	21:16
25	07:54	08:16 (T-J) 07:13	07:22	07:42 (T-55) 06:27	19:22 (T-89) 05:50	05:43
	17:25	29 08:45 (T-J) 18:07	19:44	54 08:36 (T-54) 20:22	33 19:55 (T-89) 20:57	21:16
26	07:53	08:15 (T-J) 07:11	07:20	07:41 (T-55) 06:26	19:23 (T-89) 05:49	05:43
	17:27	30 08:45 (T-J) 18:09	19:45	55 08:36 (T-54) 20:24	31 19:54 (T-89) 20:58	21:16
27	07:52	08:15 (T-J) 07:09	07:19	07:39 (T-55) 06:24	19:23 (T-89) 05:49	05:43
	17:28	30 08:45 (T-J) 18:10	19:46	55 08:34 (T-54) 20:25	30 19:53 (T-89) 20:59	21:16
28	07:51	08:15 (T-J) 07:07	07:17	07:37 (T-57) 06:23	19:24 (T-89) 05:48	05:44
	17:29	30 08:45 (T-J) 18:11	19:47	56 08:33 (T-54) 20:26	28 19:52 (T-89) 21:00	21:16
29	07:50	08:16 (T-J)	07:15	07:35 (T-57) 06:21	19:25 (T-89) 05:47	05:44
	17:31	28 08:44 (T-J)	19:49	56 08:31 (T-54) 20:27	26 19:51 (T-89) 21:01	21:16
30	07:49	08:17 (T-J)	07:13	07:33 (T-57) 06:20	19:26 (T-89) 05:46	05:45
	17:32	27 08:44 (T-J)	19:50	56 08:29 (T-54) 20:28	24 19:50 (T-89) 21:02	21:16
31	07:48	08:19 (T-J)	07:11	07:31 (T-57)	05:46	
	17:34	24 08:43 (T-J)	19:51	54 08:26 (T-54)	21:03	
Potential sun hours	287	292	369	403	458	465
Total, worst case	550	69	1136	860	44	
Sun reduction	0.58	0.58	0.59	0.63	0.66	
Oper. time red.	0.90	0.90	0.90	0.90	0.90	
Wind dir. red.	0.65	0.65	0.60	0.59	0.60	
Total reduction	0.34	0.34	0.32	0.34	0.36	
Total, real	187	23	361	290	16	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-091 - R-091
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December	
1	05:45 21:16	06:13 20:55	06:49 20:07	07:10 (T-56) 27 19:41 (T-89)	07:24 19:11	07:45 (T-54) 17:17	07:43 13 08:21 (T-J)
2	05:46 21:16	06:14 20:53	06:50 20:05	07:12 (T-56) 25 19:41 (T-89)	07:25 19:09	07:46 (T-54) 17:15	07:44 12 08:22 (T-J)
3	05:46 21:16	06:15 20:52	06:51 20:03	07:13 (T-56) 20 19:39 (T-89)	07:26 19:07	07:48 (T-54) 17:14	07:45 10 08:21 (T-J)
4	05:47 21:16	06:16 20:51	06:52 20:01	07:14 (T-56) 15 19:37 (T-89)	07:28 19:05	07:49 (T-54) 17:13	07:46 9 08:21 (T-J)
5	05:48 21:15	06:17 20:50	06:53 19:59	07:15 (T-56) 19 07:39 (T-55)	07:29 19:03	07:50 (T-54) 17:11	07:47 8 08:21 (T-J)
6	05:48 21:15	06:18 20:48	06:54 19:58	07:16 (T-56) 25 07:43 (T-55)	07:30 19:02	07:51 (T-54) 17:10	07:48 7 08:21 (T-J)
7	05:49 21:15	06:19 20:47	06:56 19:56	07:17 (T-56) 27 07:44 (T-55)	07:31 19:00	07:53 (T-54) 17:09	07:50 6 08:21 (T-J)
8	05:50 21:14	06:20 20:46	06:57 19:54	07:18 (T-56) 28 07:46 (T-55)	07:33 18:56	07:54 (T-54) 17:08	07:50 5 08:21 (T-J)
9	05:50 21:14	06:22 20:44	06:58 19:52	07:19 (T-56) 35 08:08 (T-54)	07:34 18:54	07:55 (T-54) 17:06	07:51 4 08:21 (T-J)
10	05:51 21:14	06:23 20:43	06:59 19:52	07:21 (T-56) 45 08:14 (T-54)	07:35 18:52	07:56 (T-54) 17:05	07:52 3 08:21 (T-J)
11	05:52 21:13	06:24 20:41	07:00 19:55	07:22 (T-56) 50 08:16 (T-54)	07:36 18:51	07:57 17:04	07:53 2 08:21 (T-J)
12	05:53 21:13	06:25 20:40	07:01 19:56	07:23 (T-57) 54 08:18 (T-54)	07:38 18:49	07:58 17:03	07:54 1 08:21 (T-J)
13	05:54 21:12	06:26 20:38	07:03 19:58	07:24 (T-57) 24 19:58 (T-89)	07:39 19:45	07:20 17:02	07:55 28 08:16 (T-J)
14	05:54 21:11	06:27 20:37	07:04 19:59	07:25 (T-54) 56 08:21 (T-54)	07:40 18:45	07:21 17:01	07:56 30 08:18 (T-J)
15	05:55 21:11	06:29 20:35	07:05 19:59	07:26 (T-57) 56 08:22 (T-54)	07:41 18:44	07:23 17:00	07:57 30 08:18 (T-J)
16	05:56 21:10	06:30 20:34	07:06 20:01	07:27 (T-55) 55 08:22 (T-54)	07:43 18:42	07:24 16:59	07:57 30 08:18 (T-J)
17	05:57 21:09	06:31 20:32	07:07 20:01	07:29 (T-55) 55 08:24 (T-54)	07:44 18:40	07:25 16:58	07:58 29 08:19 (T-J)
18	05:58 21:09	06:32 20:31	07:09 20:02	07:30 (T-55) 54 08:24 (T-54)	07:45 18:39	07:27 16:57	07:59 28 08:19 (T-J)
19	05:59 21:08	06:33 20:29	07:10 20:02	07:31 (T-55) 53 08:24 (T-54)	07:47 18:37	07:28 16:56	07:59 27 08:20 (T-J)
20	06:00 21:07	06:34 20:27	07:11 20:02	07:32 (T-55) 52 08:24 (T-54)	07:48 18:35	07:29 16:55	08:00 26 08:20 (T-J)
21	06:01 21:06	06:36 20:26	07:12 20:00	07:33 (T-55) 51 08:24 (T-54)	07:49 18:34	07:31 16:54	08:01 25 08:20 (T-J)
22	06:02 21:05	06:37 20:24	07:13 19:59	07:34 (T-55) 50 08:24 (T-54)	07:50 18:32	07:32 16:54	08:01 24 08:21 (T-J)
23	06:03 21:04	06:38 20:22	07:14 19:57	07:35 (T-54) 49 08:24 (T-54)	07:52 18:30	07:33 16:53	08:02 23 08:21 (T-J)
24	06:04 21:03	06:39 20:21	07:16 19:55	07:37 (T-54) 48 08:25 (T-54)	07:53 18:29	07:35 16:52	08:02 21 08:20 (T-J)
25	06:05 21:02	06:40 20:19	07:17 19:54	07:38 (T-54) 46 08:24 (T-54)	07:54 18:27	07:36 16:52	08:02 20 08:21 (T-J)
26	06:06 21:01	06:42 20:17	07:18 19:53	07:39 (T-54) 44 08:23 (T-54)	07:56 18:26	07:37 16:51	08:03 19 08:21 (T-J)
27	06:07 21:00	06:43 20:16	07:19 19:52	07:40 (T-54) 43 08:23 (T-54)	07:57 18:24	07:38 16:50	08:03 18 08:21 (T-J)
28	06:08 20:59	06:44 20:14	07:20 19:49	07:41 (T-54) 41 08:22 (T-54)	07:58 18:23	07:40 16:50	08:03 17 08:22 (T-J)
29	06:09 20:58	06:45 20:12	07:22 19:47	07:43 (T-54) 39 08:22 (T-54)	08:00 18:21	07:41 16:49	08:04 15 08:21 (T-J)
30	06:10 20:57	06:46 20:10	07:23 19:45	07:44 (T-54) 37 08:21 (T-54)	08:01 18:20	07:42 16:49	08:04 14 08:21 (T-J)
31	06:11 20:56	06:47 20:08	07:24 19:43	08:02 18:18	08:02 18:18	08:02 16:56	08:04 16:56
Potential sun hours	471	436	377	341	289	275	80
Total, worst case			587	1255	224	544	80
Sun reduction			0.72	0.67	0.56	0.48	0.52
Oper. time red.			0.90	0.90	0.90	0.90	0.90
Wind dir. red.			0.60	0.59	0.60	0.65	0.65
Total reduction			0.39	0.36	0.30	0.28	0.30
Total, real			228	451	68	153	24

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-092 - R-092
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	15:50 (T-89) 16:27 (T-89)	07:47 17:35	8 08:19 (T-55) 08:27 (T-55)	07:06 19:52	06:18 20:30	05:45 21:04	05:45 21:16	06:13 20:55	06:49 20:07	07:24 19:11	07:43 17:17	15:37 (T-89) 16:48 35 16:12 (T-89)
2	08:04 16:58	15:51 (T-89) 16:28 (T-89)	07:46 17:36	07:04 18:14	07:07 19:54	06:17 20:31	05:45 21:05	05:46 21:16	06:14 20:53	06:50 20:05	07:25 19:09	07:44 17:15	15:38 (T-89) 16:48 35 16:13 (T-89)
3	08:04 16:59	15:51 (T-89) 16:28 (T-89)	07:44 17:38	07:02 18:15	07:06 19:55	06:15 20:32	05:44 21:06	05:46 21:16	06:15 20:52	06:51 20:03	07:26 19:07	07:47 17:14	15:38 (T-89) 16:48 36 16:14 (T-89)
4	08:04 17:00	15:51 (T-89) 16:28 (T-89)	07:43 17:45	07:01 18:17	07:04 19:56	06:14 20:33	05:44 21:06	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	15:38 (T-89) 16:47 36 16:14 (T-89)
5	08:04 17:01	15:51 (T-89) 16:28 (T-89)	07:42 17:41	06:59 18:18	07:02 19:57	06:12 20:35	05:43 21:07	05:47 21:15	06:17 20:50	06:53 19:59	07:29 19:03	07:09 17:11	15:38 (T-89) 16:47 36 16:14 (T-89)
6	08:04 17:02	15:52 (T-89) 16:29 (T-89)	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:02	07:11 17:10	15:38 (T-89) 16:47 37 16:15 (T-89)
7	08:04 17:03	15:53 (T-89) 16:29 (T-89)	07:40 17:43	06:55 18:21	06:58 20:00	06:10 20:37	05:43 21:09	05:49 21:15	06:19 20:47	06:56 19:56	07:31 19:00	07:12 17:09	15:39 (T-89) 16:47 36 16:15 (T-89)
8	08:04 17:04	15:54 (T-89) 16:30 (T-89)	07:38 17:45	06:53 18:22	06:56 20:01	06:08 20:38	05:42 21:09	05:50 21:14	06:20 20:46	06:57 19:54	07:33 19:08	07:13 17:08	15:39 (T-89) 16:47 37 16:16 (T-89)
9	08:03 17:05	15:54 (T-89) 16:30 (T-89)	07:37 17:46	06:52 19:23	06:55 20:02	06:07 20:39	05:42 21:10	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54	07:15 17:06	15:39 (T-89) 16:47 37 16:16 (T-89)
10	08:03 17:06	15:55 (T-89) 16:30 (T-89)	07:36 17:48	06:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:53	07:16 17:05	15:40 (T-89) 16:47 37 16:17 (T-89)
11	08:03 17:07	15:55 (T-89) 16:30 (T-89)	07:34 17:49	06:51 19:26	06:05 20:05	05:41 20:42	05:41 21:11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51	07:17 17:04	15:40 (T-89) 16:47 37 16:17 (T-89)
12	08:02 17:08	15:56 (T-89) 16:30 (T-89)	07:33 17:51	06:49 19:27	06:03 20:06	05:41 20:43	05:41 21:12	05:53 21:13	06:25 20:40	07:01 19:47	07:38 18:49	07:19 17:03	15:41 (T-89) 16:47 37 16:18 (T-89)
13	08:02 17:10	15:56 (T-89) 16:30 (T-89)	07:31 17:52	06:48 19:28	06:02 20:07	05:41 20:44	05:41 21:12	05:53 21:12	06:26 20:38	07:03 19:45	07:39 18:47	07:20 17:02	15:41 (T-89) 16:47 38 16:19 (T-89)
14	08:02 17:11	15:56 (T-89) 16:30 (T-89)	07:30 17:53	06:46 19:30	06:01 20:09	05:41 20:45	05:41 21:13	05:54 21:11	06:27 20:37	07:04 19:43	07:40 18:45	07:21 17:01	15:41 (T-89) 16:47 38 16:18 (T-89)
15	08:01 17:12	15:57 (T-89) 16:30 (T-89)	07:28 17:55	06:44 19:31	06:00 20:10	05:41 20:46	05:41 21:13	05:55 21:11	06:29 20:35	07:05 19:41	07:41 18:44	07:23 17:00	15:42 (T-89) 16:47 37 16:19 (T-89)
16	08:00 17:13	15:57 (T-89) 16:30 (T-89)	07:27 17:56	06:42 19:32	06:00 20:11	05:41 20:48	05:41 21:14	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59	15:42 (T-89) 16:47 37 16:19 (T-89)
17	08:00 17:15	15:58 (T-89) 16:30 (T-89)	07:25 17:58	06:41 19:34	06:01 20:12	05:41 20:49	05:41 21:14	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	07:26 16:58	15:43 (T-89) 16:47 37 16:20 (T-89)
18	07:59 17:16	15:58 (T-89) 16:29 (T-89)	07:24 17:59	06:39 19:35	06:01 20:14	05:41 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:35	07:45 18:39	07:27 16:57	15:43 (T-89) 16:47 37 16:20 (T-89)
19	07:59 17:17	15:58 (T-89) 16:29 (T-89)	07:22 18:00	06:37 19:36	06:01 20:15	05:41 20:51	05:41 21:15	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	07:28 16:56	15:44 (T-89) 16:47 36 16:20 (T-89)
20	07:58 17:18	15:59 (T-89) 16:29 (T-89)	07:21 18:00	06:36 19:37	06:01 20:16	05:41 20:52	05:41 21:15	06:00 21:07	06:34 20:27	07:11 19:31	07:48 18:35	07:29 16:55	15:44 (T-89) 16:47 36 16:20 (T-89)
21	07:57 17:20	15:59 (T-89) 16:28 (T-89)	07:19 18:02	06:35 19:39	06:01 20:17	05:41 20:53	05:41 21:16	06:01 21:06	06:36 20:26	07:12 19:30	07:49 18:34	07:31 16:54	15:45 (T-89) 16:47 36 16:21 (T-89)
22	07:56 17:21	15:59 (T-89) 16:27 (T-89)	07:17 18:03	06:34 19:40	06:02 20:19	05:42 20:54	05:42 21:16	06:02 21:05	06:37 20:24	07:13 19:28	07:50 18:32	07:32 16:54	15:45 (T-89) 16:47 36 16:21 (T-89)
23	07:56 17:22	15:59 (T-89) 16:27 (T-89)	07:16 18:04	06:33 19:41	06:03 20:20	05:42 20:55	05:42 21:16	06:03 21:04	06:38 20:22	07:14 19:26	07:52 18:30	07:33 16:53	15:46 (T-89) 16:47 36 16:22 (T-89)
24	07:55 17:24	15:59 (T-89) 16:27 (T-89)	07:14 18:06	06:32 19:42	06:04 20:21	05:42 20:56	05:42 21:16	06:04 21:03	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	15:46 (T-89) 16:47 36 16:22 (T-89)
25	07:54 17:25	15:59 (T-89) 16:27 (T-89)	07:13 18:07	06:31 19:44	06:05 20:22	05:43 20:57	05:43 21:16	06:05 21:02	06:40 20:19	07:17 19:22	07:54 18:27	07:36 16:52	15:47 (T-89) 16:47 36 16:23 (T-89)
26	07:53 17:27	15:59 (T-89) 16:27 (T-89)	07:11 18:09	06:30 19:45	06:06 20:24	05:43 20:58	05:43 21:16	06:06 21:01	06:42 20:17	07:18 19:20	07:56 18:26	07:37 16:51	15:47 (T-89) 16:47 37 16:24 (T-89)
27	07:52 17:28	15:59 (T-89) 16:27 (T-89)	07:09 18:10	06:29 19:46	06:07 20:25	05:43 20:59	05:43 21:16	06:07 21:00	06:43 20:16	07:19 19:18	07:57 18:24	07:38 16:50	15:47 (T-89) 16:47 37 16:24 (T-89)
28	07:51 17:29	15:59 (T-89) 16:27 (T-89)	07:07 18:11	06:28 19:47	06:08 20:26	05:44 21:00	05:44 21:16	06:08 20:59	06:44 20:14	07:20 19:16	07:58 18:23	07:40 16:50	15:47 (T-89) 16:47 38 16:25 (T-89)
29	07:50 17:31	15:59 (T-89) 16:27 (T-89)	07:05 18:13	06:27 19:49	06:09 20:27	05:44 21:01	05:44 21:16	06:09 20:58	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	15:48 (T-89) 16:47 37 16:25 (T-89)
30	07:49 17:32	15:59 (T-89) 16:27 (T-89)	07:03 18:14	06:26 19:50	06:10 20:28	05:45 21:02	05:45 21:16	06:10 20:57	06:46 20:10	07:23 19:13	08:01 18:20	07:42 16:49	15:49 (T-89) 16:47 38 16:27 (T-89)
31	07:48 17:34	15:59 (T-89) 16:27 (T-89)	07:01 18:15	06:25 19:51	06:11 21:03	05:46 21:03	05:46 21:16	06:11 20:56	06:47 20:09	07:24 19:18	08:02 18:18	07:43 16:56	15:50 (T-89) 16:47 37 16:27 (T-89)
Potential sun hours	287	292	71	369	403	458	465	471	436	377	341	289	275
Total, worst case	958		71									570	1136
Sun reduction	0.58		0.58						0.56			0.48	0.52
Oper. time red.	0.90		0.90						0.90			0.90	0.90
Wind dir. red.	0.62		0.63						0.63			0.62	0.61
Total reduction	0.32		0.33						0.32			0.27	0.29
Total, real	309		23						21			154	324

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-093 - R-093

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:13	07:51
	17:04	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:18	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02
	17:23	18:05	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:55	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:00	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40	08:03
	17:29	18:11	19:48	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:17	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-096 - R-096
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	08:29 (T-56)	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:43	
	16:57	8 08:37 (T-56)	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48	
2	08:04	08:29 (T-56)	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44	
	16:58	8 08:37 (T-56)	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48	
3	08:04	08:29 (T-56)	07:44	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45	
	16:59	8 08:37 (T-56)	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48	
4	08:04	08:28 (T-56)	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46	08:14 (T-56)
	17:00	8 08:36 (T-56)	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47	5 08:21 (T-56)
5	08:04	08:28 (T-56)	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47	08:13 (T-56)
	17:01	8 08:36 (T-56)	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47	8 08:21 (T-56)
6	08:04	08:28 (T-56)	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49	08:14 (T-56)
	17:02	8 08:36 (T-56)	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47	8 08:22 (T-56)
7	08:04	08:28 (T-56)	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:50	08:15 (T-56)
	17:03	8 08:36 (T-56)	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47	8 08:23 (T-56)
8	08:04	08:30 (T-56)	07:38	07:53	06:56	06:08	05:42	05:50	06:20	06:57	07:33	07:13	07:51	08:16 (T-56)
	17:04	5 08:35 (T-56)	17:45	18:22	20:01	20:38	21:09	21:14	20:46	19:54	18:56	17:08	16:47	8 08:24 (T-56)
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52	08:17 (T-56)	
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47	8 08:25 (T-56)	
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52	08:18 (T-56)	
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:52	17:05	16:47	8 08:26 (T-56)	
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:17	07:53	08:19 (T-56)	
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47	8 08:27 (T-56)	
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54	08:20 (T-56)	
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47	7 08:27 (T-56)	
13	08:02	07:31	07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55	08:21 (T-56)	
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47	7 08:28 (T-56)	
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56	08:21 (T-56)	
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47	7 08:28 (T-56)	
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57	08:22 (T-56)	
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47	7 08:29 (T-56)	
16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57	08:23 (T-56)	
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47	7 08:30 (T-56)	
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58	08:24 (T-56)	
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48	7 08:31 (T-56)	
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59	08:24 (T-56)	
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48	7 08:31 (T-56)	
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59	08:25 (T-56)	
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48	6 08:31 (T-56)	
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:34	07:11	07:48	07:29	08:00	08:25 (T-56)	
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49	6 08:31 (T-56)	
21	07:57	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01	08:26 (T-56)	
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49	6 08:32 (T-56)	
22	07:56	07:17	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01	08:26 (T-56)	
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50	6 08:32 (T-56)	
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02	08:27 (T-56)	
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50	6 08:33 (T-56)	
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02	08:27 (T-56)	
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51	6 08:33 (T-56)	
25	07:54	07:13	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36	08:02	08:28 (T-56)	
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51	6 08:34 (T-56)	
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03	08:28 (T-56)	
	17:27	18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52	7 08:35 (T-56)	
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03	08:28 (T-56)	
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:16	19:18	18:24	16:50	16:53	7 08:35 (T-56)	
28	07:51	07:07	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:40	08:03	08:28 (T-56)	
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53	7 08:35 (T-56)	
29	07:50	07:15	07:25	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04	08:28 (T-56)	
	17:31	18:13	19:49	20:27	21:01	21:16	20:58	20:12	19:15	18:21	16:49	16:54	7 08:35 (T-56)	
30	07:49	07:13	07:23	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04	08:29 (T-56)	
	17:32	18:14	19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55	7 08:36 (T-56)	
31	07:48	07:11	07:21	06:17	05:46	05:46	06:11	06:47	07:24	08:03	07:44	08:04	08:29 (T-56)	
	17:34	18:16	19:51	21:03	21:03	20:56	20:09	20:09	18:18	18:18	16:56	16:56	7 08:36 (T-56)	
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	194	
Total, worst case	61													194
Sun reduction	0.58													0.52
Oper. time red.	0.90													0.90
Wind dir. red.	0.66													0.66
Total reduction	0.34													0.31
Total, real	21													60

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-099 - R-099

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:15	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:31	07:12	07:50
	17:03	17:43	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:08	05:42	05:50	06:20	06:57	07:33	07:13	07:51
	17:04	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:18	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:13	21:12	20:38	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:12	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:34	07:11	07:48	07:30	08:00
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:02
	17:22	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:22	20:57	21:16	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:00	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:40	08:03
	17:29	18:11	19:48	20:26	21:00	21:17	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
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31	07:48		07:11		05:46		06:11	06:47		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-100 - R-100

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:09	06:18	05:45 06:08 (T-42)
	16:57	17:35	18:13	19:52	20:30	21:04 5 06:13 (T-42)
2	08:04	07:46	07:04	07:07	06:17	05:45 06:08 (T-42)
	16:58	17:36	18:14	19:54	20:31	21:05 6 06:14 (T-42)
3	08:04	07:45	07:02	07:06	06:15	05:44 06:08 (T-42)
	16:59	17:38	18:15	19:55	20:32	21:06 6 06:14 (T-42)
4	08:04	07:43	07:01	07:04	06:14	05:44 06:07 (T-42)
	17:00	17:39	18:17	19:56	20:33	21:06 7 06:14 (T-42)
5	08:04	07:42	06:59	07:02	06:12	05:43 06:07 (T-42)
	17:01	17:41	18:18	19:57	20:35	21:07 7 06:14 (T-42)
6	08:04	07:41	06:57	07:00	06:11	05:43 06:06 (T-42)
	17:02	17:42	18:19	19:59	20:36	21:08 7 06:13 (T-42)
7	08:04	07:40	06:55	06:58	06:10	05:42 06:06 (T-42)
	17:03	17:43	18:21	20:00	20:37	21:09 8 06:14 (T-42)
8	08:04	07:38	07:53	06:56	06:08	05:42 06:06 (T-42)
	17:04	17:45	18:22	20:01	20:38	21:09 8 06:14 (T-42)
9	08:03	07:37	07:52	06:55	06:07	05:42 06:06 (T-42)
	17:05	17:46	19:23	20:02	20:40	21:10 8 06:14 (T-42)
10	08:03	07:36	07:50	06:53	19:39 (T-32) 06:06	05:42 06:05 (T-42)
	17:06	17:48	19:25	20:04	3 19:42 (T-32) 20:41	21:11 8 06:13 (T-42)
11	08:03	07:34	07:48	06:51	19:38 (T-32) 06:04	05:41 06:05 (T-42)
	17:07	17:49	19:26	20:05	5 19:43 (T-32) 20:42	21:11 8 06:13 (T-42)
12	08:02	07:33	07:46	06:49	19:38 (T-32) 06:03	05:41 06:05 (T-42)
	17:08	17:50	19:27	20:06	7 19:45 (T-32) 20:43	21:12 8 06:13 (T-42)
13	08:02	07:31	07:44	06:48	19:37 (T-32) 06:02	05:41 06:05 (T-42)
	17:10	17:52	19:28	20:07	8 19:45 (T-32) 20:44	21:13 8 06:13 (T-42)
14	08:02	07:30	07:43	06:46	19:36 (T-32) 06:01	05:41 06:05 (T-42)
	17:11	17:53	19:30	20:09	10 19:46 (T-32) 20:45	21:13 9 06:14 (T-42)
15	08:01	07:28	07:41	06:44	19:36 (T-32) 06:00	05:41 06:05 (T-42)
	17:12	17:55	19:31	20:10	11 19:47 (T-32) 20:47	21:14 9 06:14 (T-42)
16	08:01	07:27	07:39	06:42	19:37 (T-32) 05:59	05:41 06:05 (T-42)
	17:13	17:56	19:32	20:11	12 19:49 (T-32) 20:48	21:14 9 06:14 (T-42)
17	08:00	07:25	07:37	19:10 (T-31) 06:41	19:37 (T-32) 05:58	05:41 06:05 (T-42)
	17:15	17:58	19:34	2 19:12 (T-31) 20:12	13 19:50 (T-32) 20:49	21:14 9 06:14 (T-42)
18	07:59	07:24	07:35	19:09 (T-31) 06:39	19:37 (T-32) 05:56	05:41 06:05 (T-42)
	17:16	17:59	19:35	4 19:13 (T-31) 20:14	14 19:51 (T-32) 20:50	21:15 9 06:14 (T-42)
19	07:59	07:22	07:33	19:10 (T-31) 06:37	19:39 (T-32) 05:55	05:41 06:05 (T-42)
	17:17	18:00	19:36	5 19:15 (T-31) 20:15	13 19:52 (T-32) 20:51	21:15 9 06:14 (T-42)
20	07:58	07:21	07:32	19:09 (T-31) 06:36	19:40 (T-32) 05:54	05:41 06:06 (T-42)
	17:18	18:00	19:37	7 19:16 (T-31) 20:16	9 19:49 (T-32) 20:52	21:15 9 06:15 (T-42)
21	07:57	07:19	07:30	19:09 (T-31) 06:34	05:53	05:41 06:06 (T-42)
	17:20	18:02	19:39	9 19:18 (T-31) 20:17	20:53	21:16 9 06:15 (T-42)
22	07:57	07:18	07:28	19:10 (T-31) 06:32	05:53	05:42 06:06 (T-42)
	17:21	18:03	19:40	9 19:19 (T-31) 20:19	20:54	21:16 9 06:15 (T-42)
23	07:56	07:16	07:26	19:10 (T-31) 06:31	05:52	05:42 06:06 (T-42)
	17:22	18:04	19:41	10 19:20 (T-31) 20:20	20:55	21:16 9 06:15 (T-42)
24	07:55	07:14	07:24	19:13 (T-31) 06:29	05:51	05:42 06:07 (T-42)
	17:24	18:06	19:42	5 19:18 (T-31) 20:21	20:56	21:16 9 06:16 (T-42)
25	07:54	07:13	07:22	06:27	05:50	05:42 06:07 (T-42)
	17:25	18:07	19:44	20:22	20:57	21:16 9 06:16 (T-42)
26	07:53	07:11	07:20	06:26	05:49	05:43 06:07 (T-42)
	17:27	18:09	19:45	20:24	20:58	1 06:12 (T-42) 21:17 9 06:16 (T-42)
27	07:52	07:09	07:18	06:24	05:48	06:11 (T-42) 05:43 06:08 (T-42)
	17:28	18:10	19:46	20:25	20:59	2 06:13 (T-42) 21:17 9 06:17 (T-42)
28	07:51	07:08	07:17	06:23	05:48	06:11 (T-42) 05:44 06:08 (T-42)
	17:29	18:11	19:47	20:26	21:00	3 06:14 (T-42) 21:17 9 06:17 (T-42)
29	07:50		07:15	06:21	05:47	06:10 (T-42) 05:44 06:08 (T-42)
	17:31		19:49	20:27	21:01	3 06:13 (T-42) 21:17 8 06:16 (T-42)
30	07:49		07:13	06:20	05:46	06:10 (T-42) 05:44 06:09 (T-42)
	17:32		19:50	20:29	21:02	4 06:14 (T-42) 21:17 8 06:17 (T-42)
31	07:48		07:11		05:46	06:09 (T-42)
	17:33		19:51		21:03	5 06:14 (T-42)
Potential sun hours	287	292	369	403	459	465
Total, worst case				105		245
Sun reduction			0.59	0.63		0.73
Oper. time red.			0.90	0.90		0.90
Wind dir. red.			0.59	0.60		0.59
Total reduction			0.31	0.34		0.39
Total, real			16	36	6	95

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



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South Deuel Wind Project

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L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-100 - R-100

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December		
1	05:45 21:16	06:09 (T-42) 06:17 (T-42)	06:12 20:55	06:49 20:07	19:37 (T-32) 19:42 (T-32)	07:24 19:11	07:04 17:17	07:43 16:48
2	05:46 21:16	06:10 (T-42) 06:18 (T-42)	06:14 20:54	06:50 20:05	19:38 (T-32) 19:41 (T-32)	07:25 19:09	07:05 17:15	07:44 16:48
3	05:46 21:16	06:11 (T-42) 06:19 (T-42)	06:15 20:52	06:51 20:03		07:26 19:07	07:07 17:14	07:45 16:48
4	05:47 21:16	06:11 (T-42) 06:19 (T-42)	06:16 20:51	06:52 20:01		07:28 19:05	07:08 17:13	07:47 16:47
5	05:47 21:16	06:12 (T-42) 06:20 (T-42)	06:17 20:50	06:53 20:00		07:29 19:03	07:09 17:11	07:48 16:47
6	05:48 21:15	06:12 (T-42) 06:20 (T-42)	06:18 20:48	06:54 19:58		07:30 19:02	07:11 17:10	07:49 16:47
7	05:49 21:15	06:13 (T-42) 06:20 (T-42)	06:19 20:47	06:56 19:56		07:31 19:00	07:12 17:09	07:50 16:47
8	05:49 21:15	06:14 (T-42) 06:21 (T-42)	06:20 20:46	06:57 19:54		07:33 18:56	07:13 17:08	07:51 16:47
9	05:50 21:14	06:15 (T-42) 06:22 (T-42)	06:22 20:44	06:58 19:52		07:34 18:54	07:15 17:06	07:52 16:47
10	05:51 21:14	06:15 (T-42) 06:21 (T-42)	06:23 20:43	06:59 19:50		07:35 18:52	07:16 17:05	07:53 16:46
11	05:52 21:13	06:16 (T-42) 06:22 (T-42)	06:24 20:41	07:00 19:48		07:36 18:51	07:18 17:04	07:53 16:47
12	05:53 21:13	06:17 (T-42) 06:22 (T-42)	06:25 20:40	07:01 19:47		07:38 18:49	07:19 17:03	07:54 16:47
13	05:53 21:12	06:18 (T-42) 06:22 (T-42)	06:26 20:38	07:03 19:45		07:39 18:47	07:20 17:02	07:55 16:47
14	05:54 21:12	06:18 (T-42) 06:22 (T-42)	06:27 20:37	07:04 19:43		07:40 18:45	07:22 17:01	07:56 16:47
15	05:55 21:11	06:19 (T-42) 06:22 (T-42)	06:29 20:35	07:05 19:41		07:41 18:44	07:23 17:00	07:57 16:47
16	05:56 21:10	06:20 (T-42) 06:22 (T-42)	06:30 20:34	07:06 19:39		07:43 18:42	07:24 16:59	07:57 16:47
17	05:57 21:09	06:21 (T-42) 06:22 (T-42)	06:31 20:32	07:07 19:37		07:44 18:40	07:26 16:58	07:58 16:48
18	05:58 21:09		06:32 20:31	07:09 19:35		07:45 18:39	07:27 16:57	07:59 16:48
19	05:59 21:08		06:33 20:29	07:10 19:33	19:01 (T-31) 19:04 (T-31)	07:47 18:37	07:28 16:56	08:00 16:48
20	06:00 21:07		06:34 20:27	07:11 19:31	3 19:05 (T-31) 19:07 (T-31)	07:48 18:35	07:30 16:55	08:00 16:49
21	06:01 21:06		06:36 20:26	07:12 19:30	10 19:08 (T-31) 19:04 (T-31)	07:49 18:34	07:31 16:54	08:01 16:49
22	06:02 21:05		06:37 20:24	07:13 19:28	9 19:09 (T-31) 18:54 (T-31)	07:51 07:51	07:32 16:54	08:01 16:50
23	06:03 21:04		06:38 20:22	07:14 19:26	8 19:02 (T-31) 19:01 (T-31)	18:32 18:30	16:54 16:53	16:50 08:02
24	06:04 21:04		06:39 20:21	07:16 19:24	7 19:01 (T-31) 18:53 (T-31)	07:52 07:53	07:33 07:35	08:02 16:51
25	06:05 21:03		06:40 20:19	07:17 19:22	6 18:59 (T-31) 18:53 (T-31)	07:55 07:55	07:36 07:36	08:03 16:51
26	06:06 21:02		06:41 20:17	07:18 19:20	4 18:57 (T-31) 18:55 (T-31)	07:56 18:26	07:37 16:51	08:03 16:52
27	06:07 21:00		06:43 20:16	07:19 19:18	2 18:55 (T-31) 19:38 (T-32)	07:57 07:57	07:38 07:38	08:03 16:53
28	06:08 20:59		06:44 20:14	07:20 19:16	13 19:51 (T-32) 19:49 (T-32)	18:24 18:23	16:50 16:50	16:53 16:53
29	06:09 20:58		06:45 20:12	07:22 19:15	11 19:47 (T-32) 19:37 (T-32)	08:00 18:21	07:41 16:49	08:04 16:54
30	06:10 20:57		06:46 20:10	07:23 19:13	10 19:47 (T-32) 19:45 (T-32)	18:20 18:20	16:49 16:49	08:04 16:55
31	06:11 20:56		06:47 20:09		8 19:45 (T-32) 19:37 (T-32)	18:18 18:18	16:49 16:49	08:04 16:56
Potential sun hours	471	436	377	341	289	275		
Total, worst case	100	99	57					
Sun reduction	0.75	0.72	0.67					
Oper. time red.	0.90	0.90	0.90					
Wind dir. red.	0.59	0.60	0.59					
Total reduction	0.40	0.39	0.35					
Total, real	40	38	20					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-101 - R-101
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June		
1	08:04	07:47	07:06	07:09	19:27 (T-32)	06:18	05:45	06:08 (T-42)
	16:57	17:35	18:13	19:52	4 19:31 (T-32)	20:30	21:04	10 06:18 (T-42)
2	08:04	07:46	07:04	07:07	19:27 (T-32)	06:17	05:45	06:08 (T-42)
	16:58	17:36	18:14	19:54	6 19:33 (T-32)	20:31	21:05	10 06:18 (T-42)
3	08:04	07:45	07:02	07:06	19:27 (T-32)	06:15	05:44	06:08 (T-42)
	16:59	17:38	18:15	19:55	7 19:34 (T-32)	20:32	21:06	11 06:19 (T-42)
4	08:04	07:43	07:01	07:04	19:26 (T-32)	06:14	05:44	06:07 (T-42)
	17:00	17:39	18:17	19:56	9 19:35 (T-32)	20:33	21:06	11 06:18 (T-42)
5	08:04	07:42	06:59	07:02	19:26 (T-32)	06:12	05:43	06:07 (T-42)
	17:01	17:41	18:18	19:57	10 19:36 (T-32)	20:35	21:07	12 06:19 (T-42)
6	08:04	07:41	06:57	07:00	19:26 (T-32)	06:11	05:43	06:06 (T-42)
	17:02	17:42	18:19	19:59	11 19:37 (T-32)	20:36	21:08	12 06:18 (T-42)
7	08:04	07:40	06:55	06:58	19:27 (T-32)	06:10	05:42	06:06 (T-42)
	17:03	17:43	18:21	20:00	11 19:38 (T-32)	20:37	21:09	12 06:18 (T-42)
8	08:04	07:38	07:53	06:56	19:30 (T-32)	06:08	05:42	06:06 (T-42)
	17:04	17:45	18:22	20:01	8 19:38 (T-32)	20:38	21:09	12 06:18 (T-42)
9	08:03	07:37	07:52	06:55	06:07	06:07	05:42	06:06 (T-42)
	17:05	17:46	19:23	20:02	20:40	21:10	12 06:18 (T-42)	
10	08:03	07:36	07:50	06:53	06:06	05:42	06:05 (T-42)	
	17:06	17:48	19:25	20:04	20:41	21:11	13 06:18 (T-42)	
11	08:03	07:34	07:48	06:51	06:04	05:41	06:05 (T-42)	
	17:07	17:49	19:26	20:05	20:42	21:11	13 06:18 (T-42)	
12	08:02	07:33	07:46	06:49	06:03	05:41	06:05 (T-42)	
	17:08	17:50	19:27	20:06	20:43	21:12	13 06:18 (T-42)	
13	08:02	07:31	07:44	06:48	06:02	05:41	06:05 (T-42)	
	17:10	17:52	19:28	20:07	20:44	21:13	13 06:18 (T-42)	
14	08:02	07:30	07:43	06:46	07:06 (T-43)	06:01	05:41	06:05 (T-42)
	17:11	17:53	19:30	20:09	1 07:07 (T-43)	20:45	21:13	13 06:18 (T-42)
15	08:01	07:28	07:41	06:44	07:04 (T-43)	06:00	05:41	06:05 (T-42)
	17:12	17:55	19:31	20:10	2 07:06 (T-43)	20:47	21:14	13 06:18 (T-42)
16	08:01	07:27	07:39	06:42	07:03 (T-43)	05:59	05:41	06:05 (T-42)
	17:13	17:56	19:32	20:11	3 07:06 (T-43)	20:48	21:14	13 06:18 (T-42)
17	08:00	07:25	07:37	06:41	07:01 (T-43)	05:58	05:41	06:05 (T-42)
	17:14	17:57	19:34	20:12	4 07:05 (T-43)	20:49	21:14	13 06:18 (T-42)
18	07:59	07:24	07:35	06:39	06:59 (T-43)	05:56	05:41	06:05 (T-42)
	17:16	17:59	19:35	20:14	4 07:03 (T-43)	20:50	21:15	13 06:18 (T-42)
19	07:59	07:22	07:33	06:37	06:58 (T-43)	05:55	05:41	06:05 (T-42)
	17:17	18:00	19:36	20:15	3 07:01 (T-43)	20:51	21:15	13 06:18 (T-42)
20	07:58	07:21	07:32	06:36	05:54	05:41	05:41	06:06 (T-42)
	17:18	18:00	19:37	20:16	20:52	21:15	13 06:19 (T-42)	
21	07:57	07:19	07:30	06:34	05:53	05:41	05:41	06:06 (T-42)
	17:20	18:02	19:39	20:17	20:53	21:16	13 06:19 (T-42)	
22	07:56	07:18	07:28	06:32	05:53	06:15 (T-42)	05:42	06:06 (T-42)
	17:21	18:03	19:40	20:19	20:54	1 06:16 (T-42)	21:16	13 06:19 (T-42)
23	07:56	07:16	07:26	06:31	05:52	06:14 (T-42)	05:42	06:06 (T-42)
	17:22	18:04	19:41	20:20	20:55	3 06:17 (T-42)	21:16	13 06:19 (T-42)
24	07:55	07:14	07:24	06:29	05:51	06:14 (T-42)	05:42	06:06 (T-42)
	17:24	18:06	19:42	20:21	20:56	4 06:18 (T-42)	21:16	13 06:19 (T-42)
25	07:54	07:13	07:22	06:27	05:50	06:13 (T-42)	05:42	06:07 (T-42)
	17:25	18:07	19:44	20:22	20:57	5 06:18 (T-42)	21:16	13 06:20 (T-42)
26	07:53	07:11	07:20	06:26	05:49	06:12 (T-42)	05:43	06:07 (T-42)
	17:26	18:09	19:45	20:24	20:58	6 06:18 (T-42)	21:17	13 06:20 (T-42)
27	07:52	07:09	07:18	06:24	05:48	06:11 (T-42)	05:43	06:08 (T-42)
	17:28	18:10	19:46	20:25	20:59	7 06:18 (T-42)	21:17	13 06:21 (T-42)
28	07:51	07:08	07:17	06:23	05:48	06:11 (T-42)	05:44	06:08 (T-42)
	17:29	18:11	19:47	20:26	21:00	7 06:18 (T-42)	21:17	13 06:21 (T-42)
29	07:50		07:15	06:21	05:47	06:10 (T-42)	05:44	06:08 (T-42)
	17:31		19:49	20:27	21:01	8 06:18 (T-42)	21:17	13 06:21 (T-42)
30	07:49		07:13	06:20	05:46	06:10 (T-42)	05:44	06:09 (T-42)
	17:32		19:50	20:29	21:02	9 06:19 (T-42)	21:16	13 06:22 (T-42)
31	07:48		07:11	19:28 (T-32)	05:46	06:09 (T-42)		
	17:33		19:51	19:29 (T-32)	21:03	9 06:18 (T-42)		
Potential sun hours	287	292	369	403	459	465		375
Total, worst case								375
Sun reduction			1	83	59			0.73
Oper. time red.			0.59	0.63	0.66			0.90
Wind dir. red.			0.90	0.90	0.90			0.59
Total reduction			0.60	0.59	0.59			0.39
Total, real			0.32	0.34	0.35			145
			0	28	21			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-101 - R-101
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:09 (T-42)	06:12	06:49	07:24	07:43
	21:16	13 06:22 (T-42)	20:55	20:07	19:11	17:17
2	05:46	06:10 (T-42)	06:14	06:50	07:25	07:05
	21:16	13 06:23 (T-42)	20:54	20:05	19:09	17:15
3	05:46	06:11 (T-42)	06:15	06:51	07:26	07:07
	21:16	12 06:23 (T-42)	20:52	20:03	19:07	17:14
4	05:47	06:11 (T-42)	06:16	06:52	19:27 (T-32)	07:28
	21:16	12 06:23 (T-42)	20:51	20:01	8 19:35 (T-32)	19:05
5	05:47	06:12 (T-42)	06:17	06:53	19:24 (T-32)	07:29
	21:16	12 06:24 (T-42)	20:50	20:00	11 19:35 (T-32)	19:03
6	05:48	06:12 (T-42)	06:18	06:54	19:23 (T-32)	07:30
	21:15	12 06:24 (T-42)	20:48	19:58	10 19:33 (T-32)	19:02
7	05:49	06:13 (T-42)	06:19	06:56	19:21 (T-32)	07:31
	21:15	12 06:25 (T-42)	20:47	19:56	10 19:31 (T-32)	19:00
8	05:49	06:14 (T-42)	06:20	06:57	19:20 (T-32)	07:33
	21:15	11 06:25 (T-42)	20:46	19:54	9 19:29 (T-32)	18:56
9	05:50	06:14 (T-42)	06:22	06:58	19:20 (T-32)	07:34
	21:14	11 06:25 (T-42)	20:44	19:52	7 19:27 (T-32)	18:54
10	05:51	06:15 (T-42)	06:23	06:59	19:20 (T-32)	07:35
	21:14	11 06:26 (T-42)	20:43	19:50	6 19:26 (T-32)	18:52
11	05:52	06:16 (T-42)	06:24	07:00	19:20 (T-32)	07:36
	21:13	10 06:26 (T-42)	20:41	19:48	4 19:24 (T-32)	18:51
12	05:53	06:17 (T-42)	06:25	07:01	19:20 (T-32)	07:38
	21:13	10 06:27 (T-42)	20:40	19:47	2 19:22 (T-32)	18:49
13	05:53	06:18 (T-42)	06:26	07:03	07:39	07:20
	21:12	9 06:27 (T-42)	20:38	19:45	18:47	17:02
14	05:54	06:18 (T-42)	06:27	07:04	07:40	07:22
	21:12	8 06:26 (T-42)	20:37	19:43	18:45	17:01
15	05:55	06:19 (T-42)	06:29	07:05	07:41	07:23
	21:11	8 06:27 (T-42)	20:35	19:41	18:44	17:00
16	05:56	06:20 (T-42)	06:30	07:06	07:43	07:24
	21:10	7 06:27 (T-42)	20:34	19:39	18:42	16:59
17	05:57	06:21 (T-42)	06:31	07:07	07:44	07:26
	21:09	6 06:27 (T-42)	20:32	19:37	18:40	16:58
18	05:58	06:22 (T-42)	06:32	07:08	07:45	07:27
	21:09	5 06:27 (T-42)	20:31	19:35	18:39	16:57
19	05:59	06:23 (T-42)	06:33	07:10	07:47	07:28
	21:08	4 06:27 (T-42)	20:29	19:33	18:37	16:56
20	06:00	06:24 (T-42)	06:34	07:11	07:48	07:30
	21:07	3 06:27 (T-42)	20:27	19:31	18:35	16:55
21	06:01	06:25 (T-42)	06:36	07:12	07:49	07:31
	21:06	2 06:27 (T-42)	20:26	19:30	18:34	16:54
22	06:02	06:26 (T-42)	06:37	07:13	07:51	07:32
	21:05	1 06:27 (T-42)	20:24	19:28	18:32	16:53
23	06:03		06:38	07:14	07:52	07:33
	21:04		20:22	19:26	18:30	16:53
24	06:04		06:39	07:16	07:53	07:35
	21:04		20:21	4 07:05 (T-43)	19:24	18:29
25	06:05		06:40	07:17	07:55	07:36
	21:03		20:19	4 07:07 (T-43)	19:22	18:27
26	06:06		06:41	07:18	07:56	07:37
	21:02		20:17	4 07:08 (T-43)	19:20	18:26
27	06:07		06:43	07:19	07:57	07:38
	21:00		20:16	3 07:08 (T-43)	19:18	18:24
28	06:08		06:44	07:20	07:59	07:40
	20:59		20:14	2 07:08 (T-43)	19:16	18:23
29	06:09		06:45	07:22	08:00	07:41
	20:58		20:12	1 07:08 (T-43)	19:14	18:21
30	06:10		06:46	07:23	08:01	07:42
	20:57		20:10	19:13	18:20	16:49
31	06:11		06:47		08:03	08:04
	20:56		20:09		18:18	16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case						
Sun reduction	192	18	67			
Oper. time red.	0.75	0.72	0.67			
Wind dir. red.	0.90	0.90	0.90			
Total reduction	0.59	0.57	0.60			
Total, real	0.40	0.37	0.36			
	76	7	24			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

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Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-155 - R-155

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	15:37 (T-32) 07:47	17:01 (T-82)	07:06	17:44 (T-93) 07:09	06:18 05:45
	16:57 49	16:26 (T-32) 17:35	8 17:09 (T-82)	18:13	7 17:51 (T-93) 19:53	20:30 21:04
2	08:04	15:37 (T-32) 07:46	17:04 (T-82)	07:04	17:44 (T-93) 07:07	06:17 05:45
	16:58 49	16:26 (T-32) 17:36	5 17:09 (T-82)	18:14	8 17:52 (T-93) 19:54	20:31 21:05
3	08:04	15:38 (T-32) 07:45		07:02	17:44 (T-93) 07:06	06:15 05:44
	16:59 49	16:27 (T-32) 17:38		18:15	10 17:54 (T-93) 19:55	20:32 21:06
4	08:04	15:38 (T-32) 07:43		07:01	17:44 (T-93) 07:04	06:14 05:44
	17:00 49	16:27 (T-32) 17:39		18:17	11 17:55 (T-93) 19:56	20:34 21:07
5	08:04	15:39 (T-32) 07:42		06:59	17:45 (T-93) 07:02	06:12 05:43
	17:01 49	16:28 (T-32) 17:41		18:18	11 17:56 (T-93) 19:58	20:35 21:07
6	08:04	15:39 (T-32) 07:41		06:57	17:47 (T-93) 07:00	06:11 05:43
	17:02 48	16:27 (T-32) 17:42		18:19	11 17:58 (T-93) 19:59	20:36 21:08
7	08:04	15:40 (T-32) 07:40		06:55	17:50 (T-93) 06:58	06:10 05:42
	17:03 48	16:28 (T-32) 17:43		18:21	4 17:54 (T-93) 20:00	20:37 21:09
8	08:04	15:40 (T-32) 07:38		07:54		06:57 06:08
	17:04 49	16:29 (T-32) 17:45		18:22		20:01 20:38
9	08:04	15:40 (T-32) 07:37		07:52		06:55 06:07
	17:05 48	16:28 (T-32) 17:46		19:23		20:03 20:40
10	08:03	15:41 (T-32) 07:36		07:50		06:53 06:06
	17:06 48	16:29 (T-32) 17:48		19:25		20:04 20:41
11	08:03	15:42 (T-32) 07:34		07:48		06:51 06:05
	17:07 48	16:30 (T-32) 17:49		19:26		20:05 20:42
12	08:03	15:42 (T-32) 07:33		07:46		06:49 06:03
	17:08 47	16:29 (T-32) 17:51		19:27		20:06 20:43
13	08:02	15:43 (T-32) 07:31		07:45		06:48 06:02
	17:10 47	16:30 (T-32) 17:52		19:29		20:08 20:44
14	08:02	15:44 (T-32) 07:30		07:43		06:46 06:01
	17:11 46	16:30 (T-32) 17:53		19:30		20:09 20:45
15	08:01	15:45 (T-32) 07:28		07:41		06:44 06:00
	17:12 45	16:30 (T-32) 17:55		19:31		20:10 20:47
16	08:01	15:45 (T-32) 07:27		07:39		06:42 05:59
	17:13 45	16:30 (T-32) 17:56		19:32		20:11 20:48
17	08:00	15:46 (T-32) 07:25		07:37		06:41 05:58
	17:15 43	16:29 (T-32) 17:58		19:34		20:13 20:49
18	07:59	15:47 (T-32) 07:24		07:35		06:39 05:57
	17:16 43	16:30 (T-32) 17:59		19:35		20:14 20:50
19	07:59	15:48 (T-32) 07:22		07:33		06:37 05:55
	17:17 42	16:30 (T-32) 18:00		19:36		20:15 20:51
20	07:58	15:48 (T-32) 07:21		07:32		06:36 05:54
	17:18 41	16:29 (T-32) 18:00		19:37		20:16 20:52
21	07:57	15:49 (T-32) 07:19		07:30		06:34 05:54
	17:20 40	16:29 (T-32) 18:02		19:39		20:17 20:53
22	07:57	15:50 (T-32) 07:18		07:28		06:32 05:53
	17:21 38	16:28 (T-32) 18:03		19:40		20:19 20:54
23	07:56	15:51 (T-32) 07:16		07:26		06:31 05:52
	17:22 37	16:28 (T-32) 18:04		19:41		20:20 20:55
24	07:55	15:52 (T-32) 07:14		07:24		06:29 05:51
	17:24 36	16:57 (T-82) 18:06		19:43		20:21 20:56
25	07:54	15:55 (T-32) 07:13		07:22		06:27 05:50
	17:25 34	16:59 (T-82) 18:07		19:44		20:22 20:57
26	07:53	15:56 (T-32) 07:11	17:46 (T-93)	07:20		06:26 05:49
	17:27 33	17:00 (T-82) 18:09	1 17:47 (T-93)	19:45		20:24 20:58
27	07:52	15:58 (T-32) 07:09	17:45 (T-93)	07:19		06:24 05:48
	17:28 32	17:02 (T-82) 18:10	3 17:48 (T-93)	19:46		20:25 20:59
28	07:51	15:59 (T-32) 07:08	17:44 (T-93)	07:17		06:23 05:48
	17:29 29	17:03 (T-82) 18:11	5 17:49 (T-93)	19:48		20:26 21:00
29	07:50	16:02 (T-32)		07:15		06:21 05:47
	17:31 25	17:04 (T-82)		19:49		20:27 21:01
30	07:49	16:06 (T-32)		07:13		06:20 05:46
	17:32 19	17:06 (T-82)		19:50		20:29 21:02
31	07:48	16:59 (T-82)		07:11		05:46
	17:34 8	17:07 (T-82)		19:51		21:03
Potential sun hours	287	292	369		403	465
Total, worst case	1264		62			
Sun reduction	0.58	0.58	0.59			
Oper. time red.	0.90	0.90	0.90			
Wind dir. red.	0.61	0.58	0.58			
Total reduction	0.32	0.31	0.31			
Total, real	404	7	19			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-155 - R-155
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:12 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:48
2	05:46 21:16	06:14 20:54	06:50 20:05	07:25 19:09	07:05 17:15	48 16:48
3	05:46 21:16	06:15 20:52	06:51 20:03	07:27 19:07	07:07 17:14	48 16:48
4	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	49 16:47
5	05:47 21:16	06:17 20:50	06:53 20:00	07:29 19:03	07:09 17:11	48 16:47
6	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:02	07:11 17:10	48 16:47
7	05:49 21:15	06:19 20:47	06:56 19:56	07:31 19:00	8 18:24 (T-93) 18:32 (T-93)	49 16:47
8	05:49 21:15	06:20 20:46	06:57 19:54	07:33 18:56	12 18:33 (T-93)	48 16:47
9	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54	11 18:30 (T-93)	6 16:39 (T-82)
10	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:53	10 18:28 (T-93)	8 16:40 (T-82)
11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51	9 18:27 (T-93)	8 16:38 (T-82)
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	8 18:25 (T-93)	20 16:38 (T-82)
13	05:53 21:12	06:26 20:38	07:03 19:45	07:39 18:47	6 18:23 (T-93)	25 16:36 (T-82)
14	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	5 18:22 (T-93)	29 16:35 (T-82)
15	05:55 21:11	06:29 20:35	07:05 19:41	07:42 18:44	3 18:20 (T-93)	32 16:34 (T-82)
16	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	17 16:59	33 16:33 (T-82)
17	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40	16 16:58	34 16:32 (T-82)
18	05:58 21:09	06:32 20:31	07:09 19:35	07:45 18:39	15 16:57	36 16:31 (T-82)
19	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	14 16:56	37 16:03 (T-32)
20	06:00 21:07	06:34 20:27	07:11 19:32	07:48 18:35	13 16:55	38 16:03 (T-32)
21	06:01 21:06	06:36 20:26	07:12 19:30	07:49 18:34	12 16:54	40 16:05 (T-32)
22	06:02 21:05	06:37 20:24	07:13 19:28	07:51 18:32	11 16:54	41 16:05 (T-32)
23	06:03 21:05	06:38 20:23	07:14 19:26	07:52 18:30	10 16:53	42 16:06 (T-32)
24	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	9 16:52	43 16:07 (T-32)
25	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	8 16:51	44 16:08 (T-32)
26	06:06 21:02	06:42 20:17	07:18 19:20	07:56 18:26	7 16:51	45 16:08 (T-32)
27	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	6 16:50	45 16:09 (T-32)
28	06:08 20:59	06:44 20:14	07:20 19:16	07:59 18:23	5 16:50	46 16:10 (T-32)
29	06:09 20:58	06:45 20:12	07:22 19:15	08:00 18:21	4 16:49	47 16:10 (T-32)
30	06:10 20:57	06:46 20:10	07:23 19:13	08:01 18:20	3 16:49	47 16:10 (T-32)
31	06:11 20:56	06:47 20:09	08:03 18:18			48 16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case				72	746	1511
Sun reduction				0.56	0.48	0.52
Oper. time red.				0.90	0.90	0.90
Wind dir. red.				0.58	0.61	0.61
Total reduction				0.29	0.26	0.29
Total, real				21	197	433

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-156 - R-156

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	
1	08:04	07:47	08:09 (T-42)	07:06	07:09	06:18	05:45
	16:57	17:35	7 08:16 (T-42)	18:13	19:52	20:30	21:04
2	08:04	07:46	08:08 (T-42)	07:04	07:07	06:17	05:44
	16:58	17:36	9 08:17 (T-42)	18:14	19:54	20:31	21:05
3	08:04	07:45	08:06 (T-42)	07:02	07:06	06:15	05:44
	16:59	17:38	11 08:17 (T-42)	18:15	19:55	20:32	21:06
4	08:04	07:43	08:05 (T-42)	07:01	07:04	06:14	05:44
	17:00	17:39	12 08:17 (T-42)	18:17	19:56	20:33	21:07
							2 06:09 (T-18)
5	08:04	07:42	08:04 (T-42)	06:59	07:02	06:12	05:43
	17:01	17:41	14 08:18 (T-42)	18:18	19:57	20:35	21:07
							3 06:10 (T-18)
6	08:04	07:41	08:03 (T-42)	06:57	07:00	06:11	05:43
	17:02	17:42	15 08:18 (T-42)	18:19	19:59	20:36	21:08
							4 06:10 (T-18)
7	08:04	07:40	08:01 (T-42)	06:55	06:58	06:10	05:42
	17:03	17:43	16 08:17 (T-42)	18:21	20:00	20:37	21:09
							5 06:11 (T-18)
8	08:04	07:38	08:00 (T-42)	07:53	06:56	06:08	05:42
	17:04	17:45	17 08:17 (T-42)	18:22	20:01	20:38	21:09
							6 06:12 (T-18)
9	08:04	07:37	07:58 (T-42)	07:52	06:55	06:07	05:42
	17:05	17:46	18 08:16 (T-42)	19:23	20:02	20:40	21:10
							7 06:13 (T-18)
10	08:03	07:36	07:57 (T-42)	07:50	19:02 (T-30)	06:53	06:06
	17:06	17:48	19 08:16 (T-42)	19:25	1 19:03 (T-30)	20:04	20:41
							8 06:13 (T-18)
11	08:03	07:34	07:58 (T-42)	07:48	19:00 (T-30)	06:51	06:04
	17:07	17:49	17 08:15 (T-42)	19:26	4 19:04 (T-30)	20:05	20:42
							8 06:13 (T-18)
12	08:03	07:33	07:59 (T-42)	07:46	19:00 (T-30)	06:49	06:03
	17:08	17:50	14 08:13 (T-42)	19:27	6 19:06 (T-30)	20:06	20:43
							9 06:14 (T-18)
13	08:02	07:31	08:02 (T-42)	07:44	19:00 (T-30)	06:48	06:02
	17:09	17:52	9 08:11 (T-42)	19:28	7 19:07 (T-30)	20:07	20:44
							10 06:15 (T-18)
14	08:02	07:30	07:43	07:43	19:00 (T-30)	06:46	06:01
	17:11	17:53	19:30	8 19:08 (T-30)	20:09	20:45	21:13
							10 06:15 (T-18)
15	08:01	07:28	07:41	07:41	19:00 (T-30)	06:44	06:00
	17:12	17:55	19:31	10 19:10 (T-30)	20:10	20:47	21:14
							10 06:15 (T-18)
16	08:01	07:27	07:39	07:39	19:00 (T-30)	06:42	05:59
	17:13	17:56	19:32	11 19:11 (T-30)	20:11	20:48	21:14
							11 06:16 (T-18)
17	08:00	07:25	07:37	07:37	19:01 (T-30)	06:41	05:57
	17:14	17:57	19:34	11 19:12 (T-30)	20:12	20:49	21:14
							11 06:16 (T-18)
18	07:59	07:24	07:35	07:35	19:04 (T-30)	06:39	05:56
	17:16	17:59	19:35	5 19:09 (T-30)	20:14	20:50	21:15
							11 06:16 (T-18)
19	07:59	07:22	07:33	07:33	06:37	05:55	05:41
	17:17	18:00	19:36	20:15	20:51	21:15	11 06:16 (T-18)
20	07:58	07:21	07:31	07:31	06:35	05:54	05:41
	17:18	18:00	19:37	20:16	20:52	21:15	12 06:17 (T-18)
21	07:57	07:19	07:30	07:30	06:34	05:53	05:41
	17:20	18:02	19:39	20:17	20:53	21:16	12 06:18 (T-18)
22	07:57	07:18	07:28	07:28	06:32	05:52	05:41
	17:21	18:03	19:40	20:19	20:54	21:16	12 06:18 (T-18)
23	07:56	07:16	07:26	07:26	06:31	05:52	05:42
	17:22	18:04	19:41	20:20	20:55	21:16	11 06:17 (T-18)
24	07:55	07:14	07:24	07:24	06:29	05:51	05:42
	17:24	18:06	19:42	20:21	20:56	21:16	11 06:17 (T-18)
25	07:54	07:13	07:22	07:22	06:27	05:50	05:42
	17:25	18:07	19:44	20:22	20:57	21:16	11 06:18 (T-18)
26	07:53	07:11	07:20	07:20	06:26	05:49	05:43
	17:26	18:08	19:45	20:24	20:58	21:17	11 06:18 (T-18)
27	07:52	07:09	07:18	07:18	06:24	05:48	05:43
	17:28	18:10	19:46	20:25	20:59	21:17	11 06:19 (T-18)
28	07:51	07:08	07:17	07:17	06:23	05:48	05:43
	17:29	18:11	19:47	20:26	21:00	21:17	10 06:18 (T-18)
29	07:50	08:12 (T-42)	07:15	07:15	06:21	05:47	05:44
	17:31	1 08:13 (T-42)	19:49	20:27	21:01	21:17	10 06:18 (T-18)
30	07:49	08:11 (T-42)	07:13	07:13	06:20	05:46	05:44
	17:32	3 08:14 (T-42)	19:50	20:29	21:02	21:17	9 06:18 (T-18)
31	07:48	08:10 (T-42)	07:11	07:11	06:19	05:45	
	17:33	6 08:16 (T-42)	19:51			21:03	
Potential sun hours	287	292	369	403	459	465	246
Total, worst case	10	178	63				0.73
Sun reduction	0.58	0.58	0.59				0.90
Oper. time red.	0.90	0.90	0.90				0.59
Wind dir. red.	0.64	0.64	0.58				0.39
Total reduction	0.34	0.34	0.31				95
Total, real	3	60	19				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

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Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-156 - R-156

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December			
1	05:45 21:16	06:09 (T-18) 06:18 (T-18)	06:12 20:55	06:49 20:07	07:24 19:11	18:39 (T-30) 18:45 (T-30)	07:04 17:17	07:27 (T-42) 07:46 (T-42)	07:43 16:48
2	05:45 21:16	06:10 (T-18) 06:18 (T-18)	06:13 20:54	06:50 20:05	07:25 19:09	18:39 (T-30) 18:43 (T-30)	07:05 17:15	07:28 (T-42) 07:46 (T-42)	07:44 16:48
3	05:46 21:16	06:10 (T-18) 06:17 (T-18)	06:15 20:52	06:51 20:03	07:26 19:07	18:40 (T-30) 18:42 (T-30)	07:07 17:14	07:30 (T-42) 07:47 (T-42)	07:45 16:48
4	05:47 21:16	06:11 (T-18) 06:18 (T-18)	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	07:08 16	07:31 (T-42) 07:47 (T-42)	07:47 16:47
5	05:47 21:16	06:12 (T-18) 06:18 (T-18)	06:17 20:50	06:53 20:00	07:29 19:03	07:09 17:11	15	07:33 (T-42) 07:48 (T-42)	07:48 16:47
6	05:48 21:15	06:12 (T-18) 06:17 (T-18)	06:18 20:48	06:54 19:58	07:30 19:01	07:11 17:10	14	07:34 (T-42) 07:48 (T-42)	07:49 16:47
7	05:49 21:15	06:13 (T-18) 06:17 (T-18)	06:19 20:47	06:56 19:56	07:31 19:00	07:12 17:09	12	07:35 (T-42) 07:47 (T-42)	07:50 16:47
8	05:49 21:15	06:14 (T-18) 06:16 (T-18)	06:20 20:46	06:57 19:54	07:33 18:56	07:13 17:07	11	07:37 (T-42) 07:48 (T-42)	07:51 16:47
9	05:50 21:14	06:14 (T-18) 06:15 (T-18)	06:21 20:44	06:58 19:52	07:34 18:54	07:15 17:06	9	07:38 (T-42) 07:47 (T-42)	07:52 16:46
10	05:51 21:14	06:15 (T-18) 06:23	06:22 20:43	06:59 19:50	07:35 18:52	07:16 17:05	7	07:40 (T-42) 07:47 (T-42)	07:53 16:46
11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51	07:18 17:04	07:18 5	07:41 (T-42) 07:46 (T-42)	07:53 16:46	
12	05:52 21:13	06:25 20:40	07:01 19:47	07:38 18:49	07:19 17:03	07:19 3	07:43 (T-42) 07:46 (T-42)	07:54 16:46	
13	05:53 21:12	06:26 20:38	07:03 19:45	07:39 18:47	07:20 17:02	07:20 1	07:44 (T-42) 07:45 (T-42)	07:55 16:47	
14	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	07:22 17:01	07:22 17:01	07:46 (T-42)	07:56 16:47	
15	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:44	07:23 17:00	07:23 17:00	07:47 (T-42)	07:57 16:47	
16	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59	07:24 16:59	07:48 (T-42)	07:58 16:47	
17	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40	07:26 16:58	07:26 16:58	07:49 (T-42)	07:58 16:47	
18	05:58 21:09	06:32 20:31	07:08 19:35	07:45 18:39	07:27 16:57	07:27 16:57	07:50 (T-42)	07:59 16:48	
19	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	07:28 16:56	07:28 16:56	07:51 (T-42)	08:00 16:48	
20	06:00 21:07	06:34 20:27	07:11 19:31	07:48 18:35	07:30 16:55	07:30 16:55	07:52 (T-42)	08:00 16:49	
21	06:01 21:06	06:36 20:26	07:12 19:30	07:49 18:34	07:31 16:54	07:31 16:54	07:53 (T-42)	08:01 16:49	
22	06:02 21:05	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:53	07:32 16:53	07:54 (T-42)	08:01 16:49	
23	06:03 21:05	06:38 20:22	07:14 19:26	07:52 18:30	07:33 16:53	07:33 16:53	07:55 (T-42)	08:02 16:50	
24	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	07:35 16:52	07:56 (T-42)	08:02 16:51	
25	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	07:36 16:51	07:36 16:51	07:57 (T-42)	08:03 16:51	
26	06:06 21:02	06:41 20:17	07:18 19:20	18:44 (T-30) 18:54 (T-30)	07:56 18:26	07:37 16:51	07:58 (T-42)	08:03 16:52	
27	06:07 21:00	06:43 20:16	07:19 19:18	18:42 (T-30) 18:53 (T-30)	07:57 18:24	07:38 16:50	07:59 (T-42)	08:03 16:53	
28	06:08 20:59	06:44 20:14	07:20 19:16	18:41 (T-30) 18:51 (T-30)	07:59 18:23	07:40 16:50	08:00 (T-42)	08:04 16:53	
29	06:09 20:58	06:45 20:12	07:22 19:14	18:40 (T-30) 18:50 (T-30)	08:00 18:21	08:30 (T-42) 08:41 (T-42)	07:41 16:49	08:04 16:54	
30	06:10 20:57	06:46 20:10	07:23 19:13	18:40 (T-30) 18:48 (T-30)	08:01 18:20	08:28 (T-42) 08:43 (T-42)	07:42 16:49	08:04 16:55	
31	06:11 20:56	06:47 20:09	07:24 19:12	18:47 (T-30) 18:03	08:02 18:18	08:44 (T-42)	07:43 16:48	08:04 16:56	
Potential sun hours	471	436	377	341	289	275			
Total, worst case	49			56	147				
Sun reduction	0.75		0.67	0.56	0.48				
Oper. time red.	0.90		0.90	0.90	0.90				
Wind dir. red.	0.59		0.58	0.63	0.64				
Total reduction	0.40		0.35	0.32	0.28				
Total, real	20		17	18	41				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Last time (hh:mm) with flicker	(WTG causing flicker last time)
	Minutes with flicker		



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-157 - R-157

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June				
1	08:04	07:47	16:44 (T-30)	07:06	07:09	19:15 (T-29)	06:18	06:39 (T-17)	05:45	19:59 (T-13)
	16:57	17:35	25 17:09 (T-30)	18:13	19:53	19:31 (T-29)	20:30	12 20:06 (T-13)	21:04	16 20:15 (T-13)
2	08:04	07:46	16:44 (T-30)	07:04	07:07	19:15 (T-29)	06:17	06:38 (T-17)	05:45	20:00 (T-13)
	16:58	17:36	27 17:11 (T-30)	18:14	19:54	19:33 (T-29)	20:31	17 20:08 (T-13)	21:05	14 20:14 (T-13)
3	08:04	07:45	16:42 (T-30)	07:02	07:06	19:15 (T-29)	06:15	06:36 (T-17)	05:44	20:02 (T-13)
	16:59	17:38	30 17:12 (T-30)	18:15	19:55	19:34 (T-29)	20:32	21 20:08 (T-13)	21:06	11 20:13 (T-13)
4	08:04	07:43	16:42 (T-30)	07:01	07:04	19:15 (T-29)	06:14	06:35 (T-17)	05:44	20:03 (T-13)
	17:00	17:39	31 17:13 (T-30)	18:17	19:56	19:35 (T-29)	20:34	26 20:10 (T-13)	21:07	8 20:11 (T-13)
5	08:04	07:42	16:42 (T-30)	06:59	07:02	19:15 (T-29)	06:12	06:34 (T-17)	05:43	
	17:01	17:41	33 17:15 (T-30)	18:18	19:58	19:36 (T-29)	20:35	29 20:11 (T-13)	21:07	
6	08:04	07:41	16:41 (T-30)	06:57	07:00	19:15 (T-29)	06:11	06:32 (T-17)	05:43	
	17:02	17:42	36 17:17 (T-30)	18:19	19:59	19:37 (T-29)	20:36	34 20:12 (T-13)	21:08	
7	08:04	07:40	16:40 (T-30)	06:55	06:58	19:15 (T-29)	06:10	06:31 (T-17)	05:42	
	17:03	17:43	38 17:18 (T-30)	18:21	20:00	19:36 (T-29)	20:37	36 20:13 (T-13)	21:09	
8	08:04	07:38	16:40 (T-30)	07:54	06:57	19:17 (T-29)	06:08	06:30 (T-17)	05:42	
	17:04	17:45	40 17:20 (T-30)	18:22	20:01	19:35 (T-29)	20:38	38 20:14 (T-13)	21:10	
9	08:04	07:37	16:41 (T-30)	07:52	06:55	19:18 (T-29)	06:07	06:29 (T-17)	05:42	
	17:05	17:46	41 17:22 (T-30)	19:23	20:03	19:33 (T-29)	20:40	41 20:16 (T-13)	21:10	
10	08:03	07:36	16:40 (T-30)	07:50	06:53	19:20 (T-29)	06:06	06:27 (T-17)	05:42	
	17:06	17:48	43 17:23 (T-30)	19:25	20:04	19:30 (T-29)	20:41	44 20:16 (T-13)	21:11	
11	08:03	07:34	16:40 (T-30)	07:48	06:51		06:04	44 20:16 (T-13)	21:11	
	17:07	17:49	45 17:25 (T-30)	19:26	20:05		20:42	46 20:17 (T-13)	21:12	
12	08:03	07:33	16:40 (T-30)	07:46	06:49		06:03	46 20:17 (T-13)	21:12	
	17:08	17:51	46 17:26 (T-30)	19:27	20:06		20:43	49 20:19 (T-13)	21:12	
13	08:02	07:31	16:40 (T-30)	07:44	06:48		06:02	49 20:19 (T-13)	21:12	
	17:10	17:52	47 17:27 (T-30)	19:28	20:08		20:44	51 20:20 (T-13)	21:13	
14	08:02	07:30	16:40 (T-30)	07:43	06:46		06:01	51 20:20 (T-13)	21:13	
	17:11	17:53	47 17:27 (T-30)	19:30	20:09		20:45	52 20:21 (T-13)	21:13	
15	08:01	07:28	16:40 (T-30)	07:41	06:44		06:00	52 20:21 (T-13)	21:13	
	17:12	17:55	47 17:27 (T-30)	19:31	20:10		20:47	53 20:22 (T-13)	21:14	
16	08:01	07:27	16:40 (T-30)	07:39	06:42		05:59	53 20:22 (T-13)	21:14	
	17:13	17:56	47 17:27 (T-30)	19:32	20:11		20:48	53 20:22 (T-13)	21:14	
17	08:00	07:25	16:41 (T-30)	07:37	06:41		05:58	53 20:22 (T-13)	21:14	
	17:15	17:58	46 17:27 (T-30)	19:34	20:13		20:49	51 20:22 (T-13)	21:15	
18	07:59	07:24	16:41 (T-30)	07:35	06:39		05:56	51 20:22 (T-13)	21:15	
	17:16	17:59	45 17:26 (T-30)	19:35	20:14		20:50	49 20:22 (T-13)	21:15	
19	07:59	07:22	16:41 (T-30)	07:33	06:37		05:55	49 20:22 (T-13)	21:15	
	17:17	18:00	44 17:25 (T-30)	19:36	20:15		20:51	45 20:22 (T-13)	21:15	
20	07:58	07:21	16:42 (T-30)	07:32	06:36		05:54	45 20:22 (T-13)	21:15	
	17:18	18:00	43 17:25 (T-30)	19:37	20:16		20:52	39 20:21 (T-13)	21:16	
21	07:57	07:19	16:43 (T-30)	07:30	06:34		05:53	39 20:21 (T-13)	21:16	
	17:20	18:02	41 17:24 (T-30)	19:39	20:18		20:53	31 20:21 (T-13)	21:16	
22	07:57	07:18	16:44 (T-30)	07:28	06:32		05:53	31 20:21 (T-13)	21:16	
	17:21	18:03	39 17:23 (T-30)	19:40	20:19		20:54	30 20:20 (T-13)	21:16	
23	07:56	07:16	16:45 (T-30)	07:26	06:31		05:52	30 20:20 (T-13)	21:16	
	17:22	18:04	37 17:22 (T-30)	19:41	20:20		20:55	29 20:20 (T-13)	21:16	
24	07:55	07:14	16:46 (T-30)	07:24	06:29		05:51	29 20:20 (T-13)	21:16	
	17:24	18:06	34 17:20 (T-30)	19:43	20:21		20:56	28 20:20 (T-13)	21:16	
25	07:54	16:55 (T-30)	07:13	07:22	06:27		05:50	28 20:20 (T-13)	21:16	
	17:25	16:59 (T-30)	18:07	19:44	20:22		20:57	27 20:20 (T-13)	21:17	
26	07:53	16:52 (T-30)	07:11	07:20	06:26		05:49	27 20:20 (T-13)	21:17	
	17:27	17:00 (T-30)	18:09	19:45	20:24		20:58	26 20:19 (T-13)	21:17	
27	07:52	16:50 (T-30)	07:09	07:19	06:24	19:22 (T-29)	05:48	26 20:19 (T-13)	21:17	
	17:28	17:02 (T-30)	18:10	19:46	20:25	3 19:25 (T-29)	20:59	25 20:18 (T-13)	21:17	
28	07:51	16:48 (T-30)	07:08	07:17	06:23	19:20 (T-29)	05:48	25 20:18 (T-13)	21:17	
	17:29	17:02 (T-30)	18:11	19:48	20:26	6 19:26 (T-29)	21:00	23 20:18 (T-13)	21:17	
29	07:50	16:47 (T-30)		07:15	06:21	19:18 (T-29)	05:47	23 20:18 (T-13)	21:17	
	17:31	17:04 (T-30)		19:49	20:27	9 19:27 (T-29)	21:01	22 20:17 (T-13)	21:17	
30	07:49	16:46 (T-30)		07:13	06:20	19:17 (T-29)	05:46	22 20:17 (T-13)	21:17	
	17:32	17:06 (T-30)		19:50	20:29	11 19:28 (T-29)	21:02	20 20:17 (T-13)	21:17	
31	07:48	16:45 (T-30)		07:11	06:19	19:16 (T-29)	05:46	20 20:17 (T-13)	21:17	
	17:33	17:07 (T-30)		19:51	20:29	14 19:30 (T-29)	21:03	18 20:16 (T-13)	21:17	
Potential sun hours	287	292	369	403	459			465		
Total, worst case	97	1047	43	187	1065			49		
Sun reduction	0.58	0.58	0.59	0.63	0.66			0.73		
Oper. time red.	0.90	0.90	0.90	0.90	0.90			0.90		
Wind dir. red.	0.59	0.59	0.60	0.60	0.62			0.62		
Total reduction	0.31	0.31	0.32	0.34	0.36			0.41		
Total, real	30	322	14	63	389			20		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-157 - R-157

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December	
1	05:45	06:12	06:36 (T-17)	06:49	07:24	07:04	
	21:17	20:55	48 20:29 (T-13)	20:07	19:11	17:17 42 16:52 (T-30)	
2	05:46	06:14	06:37 (T-17)	06:50	07:25	07:05	
	21:16	20:54	46 20:28 (T-13)	20:05 10	19:29 (T-29)	19:09 17:15 41 16:50 (T-30)	
3	05:46	06:15	06:38 (T-17)	06:51	07:27	07:07	
	21:16	20:52	43 20:26 (T-13)	20:03 15	19:31 (T-29)	19:07 17:14 39 16:49 (T-30)	
4	05:47	06:16	06:39 (T-17)	06:52	07:28	07:08	
	21:16	20:51	41 20:25 (T-13)	20:01 18	19:32 (T-29)	19:05 17:13 38 16:48 (T-30)	
5	05:47	06:17	06:40 (T-17)	06:53	07:29	07:09	
	21:16	20:50	39 20:24 (T-13)	20:00 21	19:33 (T-29)	19:03 17:11 36 16:47 (T-30)	
6	05:48	06:18	06:41 (T-17)	06:54	07:30	07:11	
	21:15	20:48	35 20:22 (T-13)	19:58 22	19:33 (T-29)	19:02 17:10 34 16:45 (T-30)	
7	05:49	06:19	06:42 (T-17)	06:56	07:31	07:12	
	21:15	20:47	32 20:21 (T-13)	19:56 21	19:31 (T-29)	19:00 17:09 31 16:44 (T-30)	
8	05:49	20:12 (T-13)	06:20	06:57	07:33	07:14	
	21:15	5 20:17 (T-13)	20:46 28	20:20 (T-13)	19:54 20	19:29 (T-29)	18:56 17:08 29 16:42 (T-30)
9	05:50	20:10 (T-13)	06:22	06:58	07:34	07:15	
	21:14	10 20:20 (T-13)	20:44 24	20:19 (T-13)	19:52 19	19:27 (T-29)	18:54 17:06 27 16:41 (T-30)
10	05:51	20:08 (T-13)	06:23	06:59	07:35	07:16	
	21:14	12 20:20 (T-13)	20:43 19	20:17 (T-13)	19:50 17	19:26 (T-29)	18:53 17:05 25 16:40 (T-30)
11	05:52	20:07 (T-13)	06:24	07:00	07:36	07:18	
	21:13	15 20:22 (T-13)	20:41 16	20:16 (T-13)	19:48 16	19:24 (T-29)	18:51 17:04 22 16:38 (T-30)
12	05:53	20:06 (T-13)	06:25	07:01	07:38	07:19	
	21:13	17 20:23 (T-13)	20:40 10	20:14 (T-13)	19:47 14	19:22 (T-29)	18:49 17:03 20 16:38 (T-30)
13	05:53	20:06 (T-13)	06:26	07:03	07:39	07:20	
	21:12	19 20:25 (T-13)	20:38 4	20:13 (T-13)	19:45 12	19:20 (T-29)	18:47 8 17:31 (T-30) 17:02 17 16:36 (T-30)
14	05:54	20:04 (T-13)	06:27	07:04	07:40	07:22	
	21:12	21 20:25 (T-13)	20:37 10	19:43 10	19:18 (T-29)	18:45 18	17:45 (T-30) 17:01 14 16:35 (T-30)
15	05:55	20:04 (T-13)	06:29	07:05	07:42	07:23	
	21:11	22 20:26 (T-13)	20:35 7	19:41 7	19:16 (T-29)	18:44 24	17:47 (T-30) 17:00 12 16:34 (T-30)
16	05:56	20:03 (T-13)	06:30	07:06	07:43	07:24	
	21:10	24 20:27 (T-13)	20:34 4	19:39 4	19:14 (T-29)	18:42 29	17:49 (T-30) 16:59 8 16:33 (T-30)
17	05:57	20:03 (T-13)	06:31	07:07	07:44	07:26	
	21:10	25 20:28 (T-13)	20:32 10	19:37 10	19:08 (T-29)	18:40 32	17:51 (T-30) 16:58 4 16:32 (T-30)
18	05:58	20:02 (T-13)	06:32	07:09	07:45	07:27	
	21:09	27 20:29 (T-13)	20:31 10	19:35 10	19:09 (T-29)	18:42 35	17:52 (T-30) 16:57 16:48
19	05:59	20:02 (T-13)	06:33	07:10	07:47	07:28	
	21:08	27 20:29 (T-13)	20:29 10	19:33 10	18:37 37	17:52 (T-30) 16:56 16:48	
20	06:00	20:01 (T-13)	06:34	07:11	07:48	07:30	
	21:07	29 20:30 (T-13)	20:27 10	19:32 10	18:35 39	17:54 (T-30) 16:55 16:49	
21	06:01	20:01 (T-13)	06:36	07:12	07:49	07:31	
	21:06	30 20:31 (T-13)	20:26 10	19:30 10	18:34 41	17:54 (T-30) 16:54 16:49	
22	06:02	20:01 (T-13)	06:37	07:13	07:51	07:32	
	21:06	30 20:31 (T-13)	20:24 10	19:28 10	18:32 42	17:55 (T-30) 16:54 16:50	
23	06:03	06:39 (T-17)	06:38	07:14	07:52	07:34	
	21:05	37 20:32 (T-13)	20:23 10	19:26 10	18:30 44	17:56 (T-30) 16:53 16:50	
24	06:04	06:36 (T-17)	06:39	07:16	07:53	07:35	
	21:04	43 20:32 (T-13)	20:21 10	19:24 10	18:29 45	17:56 (T-30) 16:52 16:51	
25	06:05	06:35 (T-17)	06:40	07:17	07:55	07:36	
	21:03	46 20:32 (T-13)	20:19 10	19:22 10	18:27 45	17:56 (T-30) 16:51 16:51	
26	06:06	06:34 (T-17)	06:42	07:18	07:56	07:37	
	21:02	49 20:33 (T-13)	20:17 10	19:20 10	18:26 46	17:56 (T-30) 16:51 16:52	
27	06:07	06:32 (T-17)	06:43	07:19	07:57	07:39	
	21:01	53 20:33 (T-13)	20:16 10	19:18 10	18:24 47	17:57 (T-30) 16:50 16:53	
28	06:08	06:32 (T-17)	06:44	07:20	07:59	07:40	
	20:59	54 20:33 (T-13)	20:14 10	19:16 10	18:23 48	17:57 (T-30) 16:50 16:53	
29	06:09	06:33 (T-17)	06:45	07:22	08:00	07:41	
	20:58	52 20:32 (T-13)	20:12 10	19:15 10	18:21 47	17:56 (T-30) 16:49 16:54	
30	06:10	06:34 (T-17)	06:46	07:23	08:01	07:42	
	20:57	51 20:31 (T-13)	20:10 10	19:13 10	18:20 46	17:55 (T-30) 16:49 16:55	
31	06:11	06:35 (T-17)	06:47	07:24	08:03	07:43	
	20:56	49 20:30 (T-13)	20:09 10	19:12 10	18:18 44	17:53 (T-30) 16:48 16:56	
Potential sun hours	471	436	377	341	288	275	
Total, worst case	747	385	226	717	439		
Sun reduction	0.75	0.72	0.67	0.56	0.48		
Oper. time red.	0.90	0.90	0.90	0.90	0.90		
Wind dir. red.	0.62	0.61	0.60	0.59	0.59		
Total reduction	0.42	0.40	0.36	0.30	0.25		
Total, real	311	152	81	213	112		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-158 - R-158
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:12	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:15	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:49	06:20	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:12	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:32	20:11	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:55	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:54	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:18	18:00	19:38	20:16	20:52	21:16	21:07	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:22	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:51	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39	08:04
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:57	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46	05:45	06:11	06:48	08:03	08:03	08:03	08:04
	17:34		19:51	21:03	21:03	21:17	20:56	20:09	18:18	18:18	16:56	16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-160 - R-160
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June			
1	08:04	08:29 (T-17)	07:47	07:06	07:09	07:29 (T-16)	06:18	05:45	
	16:57	1	08:30 (T-17)	17:35	18:13	3	07:32 (T-16)	20:30	21:04
2	08:04	08:29 (T-17)	07:46	07:04	07:07	07:28 (T-16)	06:17	05:45	
	16:58	1	08:30 (T-17)	17:36	18:14	4	07:32 (T-16)	20:31	21:05
3	08:05	08:29 (T-17)	07:45	07:02	07:06	07:26 (T-16)	06:15	05:44	
	16:59	2	08:31 (T-17)	17:38	18:15	6	07:32 (T-16)	20:32	21:06
4	08:04	08:29 (T-17)	07:44	07:01	07:04	07:24 (T-16)	06:14	05:44	
	17:00	2	08:31 (T-17)	17:39	18:17	7	07:31 (T-16)	20:34	21:07
5	08:04	08:29 (T-17)	07:42	06:59	07:02	07:22 (T-16)	06:12	05:43	
	17:01	3	08:32 (T-17)	17:41	18:18	7	07:29 (T-16)	20:35	21:07
6	08:04	08:28 (T-17)	07:41	06:57	07:00	07:20 (T-16)	06:11	05:43	
	17:02	4	08:32 (T-17)	17:42	18:19	7	07:27 (T-16)	20:36	21:08
7	08:04	08:28 (T-17)	07:40	06:55	06:58	07:18 (T-16)	06:10	05:42	
	17:03	4	08:32 (T-17)	17:43	18:21	6	07:24 (T-16)	20:37	21:09
8	08:04	08:28 (T-17)	07:38	07:54	06:57	06:08	05:42		
	17:04	5	08:33 (T-17)	17:45	18:22	20:01	20:38	21:10	
9	08:04	08:28 (T-17)	07:37	07:52	06:55	06:07	05:42		
	17:05	5	08:33 (T-17)	17:46	19:23	20:03	20:40	21:10	
10	08:03	08:27 (T-17)	07:36	07:50	06:53	06:06	05:42		
	17:06	6	08:33 (T-17)	17:48	19:25	20:04	20:41	21:11	
11	08:03	08:27 (T-17)	07:34	07:48	06:51	06:04	05:41		
	17:07	7	08:34 (T-17)	17:49	19:26	20:05	20:42	21:12	
12	08:03	08:26 (T-17)	07:33	07:46	06:49	06:03	05:41		
	17:08	7	08:33 (T-17)	17:51	19:27	20:06	20:43	21:12	
13	08:02	08:26 (T-17)	07:31	07:45	06:48	06:02	05:41		
	17:10	8	08:34 (T-17)	17:52	19:29	20:08	20:44	21:13	
14	08:02	08:25 (T-17)	07:30	07:43	08:03 (T-15)	06:46	06:01	05:41	
	17:11	8	08:33 (T-17)	17:53	19:30	2	08:05 (T-15)	20:09	21:13
15	08:01	08:25 (T-17)	07:29	07:41	08:01 (T-15)	06:44	06:00	05:41	
	17:12	8	08:33 (T-17)	17:55	19:31	5	08:06 (T-15)	20:10	21:14
16	08:01	08:24 (T-17)	07:27	07:39	07:59 (T-15)	06:42	05:59	05:41	
	17:13	8	08:32 (T-17)	17:56	19:32	6	08:05 (T-15)	20:11	21:14
17	08:00	08:23 (T-17)	07:26	07:37	07:57 (T-15)	06:41	05:58	05:41	
	17:14	8	08:31 (T-17)	17:58	19:34	8	08:05 (T-15)	20:13	21:15
18	08:00	07:24	07:35	07:56 (T-15)	06:39	05:56	05:41		
	17:16	17:59	19:35	9	08:05 (T-15)	20:14	20:50	21:15	
19	07:59	07:22	07:33	07:54 (T-15)	06:37	05:55	05:41		
	17:17	18:00	19:36	11	08:05 (T-15)	20:15	20:51	21:15	
20	07:58	07:21	07:32	07:52 (T-15)	06:36	05:54	05:41		
	17:18	18:00	19:37	11	08:03 (T-15)	20:16	20:52	21:16	
21	07:57	07:19	07:30	07:50 (T-15)	06:34	05:53	05:41		
	17:20	18:02	19:39	12	08:02 (T-15)	20:18	20:53	21:16	
22	07:57	07:18	07:28	07:48 (T-15)	06:32	05:53	05:42		
	17:21	18:03	19:40	12	08:00 (T-15)	20:19	20:54	21:16	
23	07:56	07:16	07:26	07:50 (T-15)	06:31	05:52	05:42		
	17:22	18:04	19:41	6	07:56 (T-15)	20:20	20:55	21:16	
24	07:55	07:14	07:24	06:29	05:51	05:42			
	17:24	18:06	19:43	20:21	20:57	21:17			
25	07:54	07:13	07:22	06:27	05:50	05:42			
	17:25	18:07	19:44	20:23	20:58	21:17			
26	07:53	07:11	07:20	06:26	05:49	05:43			
	17:26	18:09	19:45	20:24	20:59	21:17			
27	07:52	07:09	07:19	06:24	05:48	05:43			
	17:28	18:10	19:46	20:25	21:00	21:17			
28	07:51	07:08	07:17	06:23	05:48	05:44			
	17:29	18:11	19:48	20:26	21:01	21:17			
29	07:50	07:15	07:15	06:21	05:47	05:44			
	17:31	19:49	20:27	21:01	21:17				
30	07:49	07:13	07:13	06:20	05:46	05:44			
	17:32	19:50	20:29	21:02	21:17				
31	07:48	07:11	07:31 (T-16)	05:46	05:46				
	17:33	19:51	1	07:32 (T-16)	21:03	21:17			
Potential sun hours	287	292	369	404	459	465			
Total, worst case	87		83	40					
Sun reduction	0.58		0.59	0.63					
Oper. time red.	0.90		0.90	0.90					
Wind dir. red.	0.65		0.60	0.58					
Total reduction	0.34		0.32	0.33					
Total, real	30		26	13					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-160 - R-160

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:17	06:12 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:48
2	05:46 21:16	06:14 20:54	06:50 20:05	07:25 19:09	07:05 17:15	7 08:16 (T-17) 07:45 16:48
3	05:46 21:16	06:15 20:52	06:51 20:03	07:27 19:07	07:07 17:14	6 08:16 (T-17) 07:46 16:48
4	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	6 08:17 (T-17) 07:47 16:47
5	05:47 21:16	06:17 20:50	06:53 20:00	07:15 (T-16) 07:21 (T-16)	07:29 19:03	5 08:17 (T-17) 07:48 16:47
6	05:48 21:16	06:18 20:49	06:54 19:58	07:16 (T-16) 07:23 (T-16)	07:30 19:02	4 08:18 (T-17) 07:49 16:47
7	05:49 21:15	06:19 20:47	06:56 19:56	07:17 (T-16) 07:24 (T-16)	07:32 19:00	4 08:18 (T-17) 07:50 16:47
8	05:49 21:15	06:20 20:46	06:57 19:54	07:18 (T-16) 07:25 (T-16)	07:33 18:56	3 08:18 (T-17) 07:51 16:47
9	05:50 21:14	06:22 20:44	06:58 19:52	07:20 (T-16) 07:26 (T-16)	07:34 18:54	2 08:18 (T-17) 07:52 16:46
10	05:51 21:14	06:23 20:43	06:59 19:50	07:21 (T-16) 07:25 (T-16)	07:35 18:53	2 08:19 (T-17) 07:53 16:46
11	05:52 21:13	06:24 20:42	07:00 19:49	07:22 (T-16) 07:25 (T-16)	07:37 18:51	1 08:19 (T-17) 07:54 16:46
12	05:52 21:13	06:25 20:40	07:02 19:47	07:23 (T-16) 07:24 (T-16)	07:38 18:49	1 08:20 (T-17) 07:55 16:47
13	05:53 21:12	06:26 20:39	07:03 19:45	07:39 18:47	07:20 17:02	07:55 16:47
14	05:54 21:12	06:27 20:37	07:04 19:43	07:40 18:45	07:22 17:01	07:56 16:47
15	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	07:57 16:47
16	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59	07:58 16:47
17	05:57 21:10	06:31 20:32	07:07 19:37	07:44 18:40	07:26 16:58	07:58 16:47
18	05:58 21:09	06:32 20:31	07:09 19:35	07:45 18:39	07:27 16:57	07:59 16:48
19	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	07:28 16:56	08:00 16:48
20	06:00 21:07	06:34 20:28	07:11 19:32	07:48 18:35	07:30 16:55	08:00 16:49
21	06:01 21:06	06:36 20:26	07:12 19:30	07:34 (T-15) 07:44 (T-15)	07:49 18:34	08:01 16:54
22	06:02 21:06	06:37 20:24	07:13 19:28	07:34 (T-15) 07:46 (T-15)	07:51 18:32	08:01 16:50
23	06:03 21:05	06:38 20:23	07:14 19:26	07:36 (T-15) 07:48 (T-15)	07:52 18:30	08:02 16:50
24	06:04 21:04	06:39 20:21	07:16 19:24	07:37 (T-15) 07:48 (T-15)	07:53 18:29	08:02 16:51
25	06:05 21:03	06:40 20:19	07:17 19:22	07:38 (T-15) 07:48 (T-15)	07:55 18:27	08:03 16:51
26	06:06 21:02	06:42 20:17	07:18 19:20	07:39 (T-15) 07:48 (T-15)	07:56 18:26	7 08:09 (T-17) 08:02 (T-17)
27	06:07 21:01	06:43 20:16	07:19 19:18	07:40 (T-15) 07:47 (T-15)	07:57 18:24	8 08:10 (T-17) 08:04 (T-17)
28	06:08 21:00	06:44 20:14	07:20 19:16	07:42 (T-15) 07:47 (T-15)	07:59 18:23	8 08:12 (T-17) 08:05 (T-17)
29	06:09 20:58	06:45 20:12	07:22 19:15	07:43 (T-15) 07:46 (T-15)	08:00 18:21	8 08:13 (T-17) 08:06 (T-17)
30	06:10 20:57	06:46 20:10	07:23 19:13	07:44 (T-15) 07:45 (T-15)	08:01 18:20	8 08:14 (T-17) 08:08 (T-17)
31	06:11 20:56	06:47 20:09		08:03 18:18		7 08:15 (T-17) 08:04 16:56
Potential sun hours	471	436	377	341	288	275
Total, worst case			121		46	41
Sun reduction			0.67		0.48	0.52
Oper. time red.			0.90		0.90	0.90
Wind dir. red.			0.59		0.65	0.65
Total reduction			0.36		0.28	0.30
Total, real			43		13	13

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-161 - R-161

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04 16:57	07:47 17:35	07:06 18:13	07:09 19:53	19:19 (T-11) 12 19:31 (T-11)	06:18 20:30	05:45 21:04	05:45 21:17	06:12 20:55	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:48	
2	08:05 16:58	07:46 17:36	07:04 18:14	07:08 19:54	19:20 (T-11) 13 19:33 (T-11)	06:17 20:31	05:45 21:05	05:46 21:17	06:14 20:54	06:50 20:05	07:25 19:09	07:05 17:15	07:45 16:48	
3	08:05 16:59	07:45 17:38	07:03 18:15	07:06 19:55	19:19 (T-11) 15 19:34 (T-11)	06:15 20:32	05:44 21:06	05:46 21:16	06:15 20:53	06:51 20:03	19:23 (T-11) 7 19:30 (T-11)	07:27 19:07	07:07 17:14	07:46 16:48
4	08:05 17:00	07:44 17:39	07:01 18:17	07:04 19:56	19:19 (T-11) 16 19:35 (T-11)	06:14 20:34	05:44 21:07	05:47 21:16	06:16 20:51	06:52 20:02	19:20 (T-11) 13 19:33 (T-11)	07:28 19:05	07:08 17:13	07:47 16:47
5	08:04 17:01	07:42 17:41	06:59 18:18	07:02 19:58	19:19 (T-11) 17 19:36 (T-11)	06:12 20:35	05:43 21:08	05:47 21:16	06:17 20:50	06:53 20:00	19:18 (T-11) 16 19:34 (T-11)	07:29 19:03	07:10 17:11	07:48 16:47
6	08:04 17:02	07:41 17:42	06:57 18:19	07:00 19:59	19:20 (T-11) 17 19:37 (T-11)	06:11 20:36	05:43 21:08	05:48 21:16	06:18 20:49	06:55 19:58	19:16 (T-11) 17 19:33 (T-11)	07:30 19:02	07:11 17:10	07:49 16:47
7	08:04 17:03	07:40 17:43	06:55 18:21	06:58 20:00	19:22 (T-11) 16 19:38 (T-11)	06:10 20:37	05:42 21:09	05:49 21:15	06:19 20:47	06:56 19:56	19:15 (T-11) 16 19:31 (T-11)	07:32 19:00	07:12 17:09	07:50 16:47
8	08:04 17:04	07:38 17:45	07:54 18:22	06:57 20:01	19:23 (T-11) 13 19:36 (T-11)	06:08 20:39	05:42 21:10	05:49 21:15	06:20 20:46	06:57 19:54	19:13 (T-11) 16 19:29 (T-11)	07:33 18:56	07:14 17:08	07:51 16:47
9	08:04 17:05	07:37 17:46	07:52 19:23	06:55 20:03	19:25 (T-11) 7 19:32 (T-11)	06:07 20:40	05:42 21:10	05:50 21:14	06:22 20:44	06:58 19:52	19:14 (T-11) 14 19:28 (T-11)	07:34 18:54	07:15 17:06	07:52 16:47
10	08:03 17:06	07:36 17:48	07:50 19:25	06:53 20:04	19:20 (T-11) 20:41	06:06 21:11	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:50	19:13 (T-11) 13 19:26 (T-11)	07:35 18:53	07:16 17:05	07:53 16:47
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	19:20 (T-11) 20:42	06:05 21:12	05:41 21:12	05:52 21:13	06:24 20:42	07:00 19:49	19:12 (T-11) 12 19:24 (T-11)	07:37 18:51	07:18 17:04	07:54 16:47
12	08:03 17:08	07:33 17:51	07:46 19:27	06:49 20:06	19:23 (T-11) 20:43	06:03 21:12	05:41 21:13	05:53 21:13	06:25 20:40	07:02 19:47	19:12 (T-11) 10 19:22 (T-11)	07:38 18:49	07:19 17:03	07:55 16:47
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	19:20 (T-11) 20:44	06:02 21:13	05:41 21:12	05:53 21:12	06:26 20:39	07:03 19:45	19:12 (T-11) 8 19:20 (T-11)	07:39 18:47	07:20 17:02	07:55 16:47
14	08:02 17:11	07:30 17:53	07:43 19:30	06:46 20:09	19:23 (T-11) 20:46	06:01 21:13	05:41 21:12	05:54 21:12	06:27 20:37	07:04 19:43	19:12 (T-11) 6 19:18 (T-11)	07:40 18:46	07:22 17:01	07:56 16:47
15	08:01 17:12	07:29 17:55	07:41 19:31	06:44 20:10	19:24 (T-11) 20:47	06:00 21:14	05:41 21:11	05:55 21:11	06:29 20:36	07:05 19:41	19:13 (T-11) 3 19:16 (T-11)	07:42 18:44	07:23 17:00	07:57 16:47
16	08:01 17:13	07:27 17:56	07:39 19:32	06:42 20:11	19:25 (T-11) 20:48	05:59 21:14	05:41 21:10	05:56 21:10	06:30 20:34	07:06 19:39	18:44 18:42	07:43 18:42	07:24 16:59	07:58 16:47
17	08:00 17:15	07:26 17:58	07:37 19:34	06:41 20:13	19:26 (T-11) 20:49	05:58 21:15	05:41 21:10	05:57 21:10	06:31 20:32	07:07 19:37	18:44 18:40	07:44 16:58	07:26 16:48	07:58 16:48
18	08:00 17:16	07:24 17:59	07:35 19:35	06:39 20:14	19:27 (T-11) 20:50	05:57 21:15	05:41 21:09	05:58 21:09	06:32 20:31	07:09 19:35	18:40 18:39	07:45 16:57	07:27 16:48	07:59 16:48
19	07:59 17:17	07:22 18:00	07:34 19:36	06:37 20:15	19:28 (T-11) 20:51	05:55 21:15	05:41 21:08	05:59 21:08	06:33 20:29	07:10 19:34	18:37 18:37	07:47 16:56	07:28 16:48	08:00 16:48
20	07:58 17:18	07:21 18:00	07:32 19:38	06:36 20:16	19:29 (T-11) 20:52	05:54 21:16	05:41 21:07	06:00 21:07	06:34 20:28	07:11 19:32	18:35 18:35	07:48 16:55	07:30 16:49	08:00 16:49
21	07:58 17:20	07:19 18:02	07:30 19:39	06:34 20:18	19:30 (T-11) 20:53	05:54 21:16	05:41 21:07	06:01 21:07	06:36 20:26	07:12 19:30	18:34 18:34	07:49 16:54	07:31 16:49	08:01 16:49
22	07:57 17:21	07:18 18:03	07:28 19:40	06:32 20:19	19:31 (T-11) 20:54	05:53 21:16	05:42 21:06	06:02 21:06	06:37 20:24	07:13 19:28	18:32 18:32	07:51 16:54	07:32 16:50	08:01 16:50
23	07:56 17:22	07:16 18:05	07:26 19:41	06:31 20:20	19:32 (T-11) 20:55	05:52 21:16	05:42 21:05	06:03 21:05	06:38 20:23	07:15 19:26	18:32 18:30	07:52 16:53	07:34 16:50	08:02 16:50
24	07:55 17:24	07:14 18:06	07:24 19:43	06:29 20:21	19:33 (T-11) 20:56	05:51 21:16	05:42 21:05	06:04 21:05	06:39 20:23	07:16 19:26	18:30 18:30	07:53 16:53	07:35 16:50	08:02 16:51
25	07:54 17:25	07:13 18:07	07:22 19:44	06:27 20:23	19:34 (T-11) 20:57	05:50 21:17	05:42 21:04	06:05 21:04	06:40 20:21	07:17 19:24	18:29 18:29	07:55 16:52	07:36 16:51	08:03 16:51
26	07:53 17:27	07:11 18:09	07:20 19:45	06:26 20:24	19:35 (T-11) 20:59	05:49 21:17	05:43 21:02	06:06 21:02	06:42 20:17	07:18 19:20	18:27 18:26	07:56 16:51	07:37 16:51	08:03 16:52
27	07:52 17:28	07:09 18:10	07:19 19:46	06:24 20:25	19:36 (T-11) 21:00	05:48 21:17	05:43 21:07	06:07 21:01	06:43 20:16	07:19 19:18	18:24 18:24	07:57 16:50	07:39 16:50	08:03 16:53
28	07:51 17:29	07:08 18:11	07:17 19:48	06:23 20:26	19:37 (T-11) 21:01	05:48 21:17	05:44 21:07	06:08 21:00	06:44 20:14	07:21 19:17	18:23 18:23	07:59 16:50	07:40 16:50	08:04 16:53
29	07:50 17:31	07:15 19:49	07:15 19:49	06:21 20:28	19:38 (T-11) 21:02	05:47 21:17	05:44 21:09	06:09 20:59	06:45 20:12	07:22 19:15	18:21 18:21	08:00 16:49	07:41 16:49	08:04 16:54
30	07:49 17:32	07:13 19:50	07:13 19:49	06:20 20:29	19:39 (T-11) 21:02	05:46 21:17	05:45 21:07	06:10 20:57	06:46 20:11	07:23 19:13	18:20 18:20	08:01 16:49	07:42 16:49	08:04 16:55
31	07:48 17:34	07:11 19:51	07:11 19:30 (T-11)	05:46 21:03	19:40 (T-11) 21:03	05:46 21:03	06:11 20:56	06:47 20:09	07:23 19:13	19:13	18:18 18:18	08:03 16:48	07:43 16:48	08:04 16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275		
Total, worst case			24	126					151					
Sun reduction			0.59	0.63					0.67					
Oper. time red.			0.90	0.90					0.90					
Wind dir. red.			0.60	0.60					0.60					
Total reduction			0.32	0.34					0.36					
Total, real			8	43					54					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-162 - R-162

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	16:18 (T-29) 07:47	16:12 (T-13) 07:06	07:09	06:18	05:45
	16:57 10	16:28 (T-29) 17:35 52	17:04 (T-13) 18:13	19:53	20:30	21:04
2	08:04	16:18 (T-29) 07:46	16:12 (T-13) 07:04	07:07	06:17	05:45
	16:58 11	16:29 (T-29) 17:36 52	17:04 (T-13) 18:14	19:54	20:31	21:05
3	08:04	16:18 (T-29) 07:45	16:13 (T-13) 07:02	07:06	06:15	05:44
	16:59 12	16:30 (T-29) 17:38 51	17:04 (T-13) 18:15	19:55	20:32	21:06
4	08:04	16:18 (T-29) 07:43	16:12 (T-13) 07:01	07:04	06:14	05:44
	17:00 14	16:32 (T-29) 17:39 52	17:04 (T-13) 18:17	19:56	20:34	21:07
5	08:04	16:19 (T-29) 07:42	16:13 (T-13) 06:59	07:02	06:12	05:43
	17:01 14	16:33 (T-29) 17:41 51	17:04 (T-13) 18:18	19:58	20:35	21:07
6	08:04	16:18 (T-29) 07:41	16:14 (T-13) 06:57	07:18 (T-17) 07:00	06:11	05:43
	17:02 15	16:33 (T-29) 17:42 50	17:04 (T-13) 18:19	07:19 (T-17) 19:59	20:36	21:08
7	08:04	16:19 (T-29) 07:40	16:13 (T-13) 06:55	07:16 (T-17) 06:58	06:10	05:42
	17:03 15	16:34 (T-29) 17:43 51	17:04 (T-13) 18:21	07:19 (T-17) 20:00	20:37	21:09
8	08:04	16:19 (T-29) 07:38	16:14 (T-13) 07:54	08:14 (T-17) 06:57	06:08	05:42
	17:04 17	16:36 (T-29) 17:45 50	17:04 (T-13) 18:22	08:19 (T-17) 20:01	20:38	21:10
9	08:04	16:19 (T-29) 07:37	16:15 (T-13) 07:52	08:12 (T-17) 06:55	06:07	05:42
	17:05 18	16:37 (T-29) 17:46 49	17:04 (T-13) 19:23	08:19 (T-17) 20:03	20:40	21:10
10	08:03	16:18 (T-13) 07:36	16:15 (T-13) 07:50	08:10 (T-17) 06:53	06:06	05:42
	17:06 20	16:38 (T-29) 17:48 48	17:03 (T-13) 19:25	08:18 (T-17) 20:04	20:41	21:11
11	08:03	16:18 (T-13) 07:34	16:16 (T-13) 07:48	08:09 (T-17) 06:51	06:04	05:41
	17:07 22	16:40 (T-29) 17:49 47	17:03 (T-13) 19:26	08:18 (T-17) 20:05	20:42	21:12
12	08:03	16:17 (T-13) 07:33	16:17 (T-13) 07:46	08:07 (T-17) 06:49	06:03	05:41
	17:08 23	16:40 (T-29) 17:51 44	17:01 (T-13) 19:27	08:17 (T-17) 20:06	20:43	21:12
13	08:02	16:17 (T-13) 07:31	16:18 (T-13) 07:45	08:05 (T-17) 06:48	06:02	05:41
	17:10 25	16:42 (T-29) 17:52 43	17:01 (T-13) 19:29	08:16 (T-17) 20:08	20:44	21:13
14	08:02	16:16 (T-13) 07:30	16:18 (T-13) 07:43	08:03 (T-17) 06:46	06:01	05:41
	17:11 27	16:43 (T-29) 17:53 42	17:00 (T-13) 19:30	08:13 (T-17) 20:09	20:46	21:13
15	08:01	16:16 (T-13) 07:29	16:20 (T-13) 07:41	08:05 (T-17) 06:44	06:00	05:41
	17:12 29	16:45 (T-29) 17:55 39	16:59 (T-13) 19:31	08:10 (T-17) 20:10	20:47	21:14
16	08:01	16:15 (T-13) 07:27	16:21 (T-13) 07:39	06:42	05:59	05:41
	17:13 31	16:46 (T-29) 17:56 36	16:57 (T-13) 19:32	20:11	20:48	21:14
17	08:00	16:14 (T-13) 07:26	16:23 (T-13) 07:37	06:41	05:58	05:41
	17:15 33	16:47 (T-29) 17:58 33	16:56 (T-13) 19:34	20:13	20:49	21:15
18	08:00	16:15 (T-13) 07:24	16:25 (T-13) 07:35	06:39	05:56	05:41
	17:16 34	16:49 (T-29) 17:59 29	16:54 (T-13) 19:35	20:14	20:50	21:15
19	07:59	16:14 (T-13) 07:22	16:27 (T-13) 07:33	06:37	05:55	05:41
	17:17 36	16:50 (T-29) 18:00 25	16:52 (T-13) 19:36	20:15	20:51	21:15
20	07:58	16:14 (T-13) 07:21	16:30 (T-13) 07:32	06:36	05:54	05:41
	17:18 37	16:51 (T-29) 18:00 19	16:49 (T-13) 19:37	20:16	20:52	21:16
21	07:57	16:13 (T-13) 07:19	16:35 (T-13) 07:30	06:34	05:53	05:41
	17:20 39	16:52 (T-29) 18:02 9	16:44 (T-13) 19:39	20:18	20:53	21:16
22	07:57	16:13 (T-13) 07:18	07:28	06:32	05:53	05:42
	17:21 41	16:54 (T-13) 18:03	19:40	20:19	20:54	21:16
23	07:56	16:12 (T-13) 07:16	07:26	06:31	05:52	05:42
	17:22 43	16:55 (T-13) 18:04	19:41	20:20	20:55	21:16
24	07:55	16:13 (T-13) 07:14	07:24	06:29	05:51	05:42
	17:24 44	16:57 (T-13) 18:06	19:43	20:21	20:57	21:16
25	07:54	16:13 (T-13) 07:13	07:22	06:27	05:50	05:42
	17:25 46	16:59 (T-13) 18:07	19:44	20:23	20:58	21:17
26	07:53	16:13 (T-13) 07:11	07:20	06:26	05:49	05:43
	17:27 47	17:00 (T-13) 18:09	19:45	20:24	20:59	21:17
27	07:52	16:13 (T-13) 07:09	07:19	06:24	05:48	05:43
	17:28 49	17:02 (T-13) 18:10	19:46	20:25	21:00	21:17
28	07:51	16:13 (T-13) 07:08	07:17	06:23	05:48	05:44
	17:29 50	17:03 (T-13) 18:11	19:48	20:26	21:00	21:17
29	07:50	16:12 (T-13)	07:15	06:21	05:47	05:44
	17:31 50	17:02 (T-13)	19:49	20:27	21:01	21:17
30	07:49	16:12 (T-13)	07:13	06:20	05:46	05:44
	17:32 51	17:03 (T-13)	19:50	20:29	21:02	21:17
31	07:48	16:12 (T-13)	07:11	06:19	05:45	05:44
	17:34 51	17:03 (T-13)	19:51	21:03	21:03	21:17
Potential sun hours	287	292	369	403	459	465
Total, worst case	954	872	69		99	6
Sun reduction	0.58	0.58	0.59		0.66	0.73
Oper. time red.	0.90	0.90	0.90		0.90	0.90
Wind dir. red.	0.59	0.59	0.60		0.59	0.59
Total reduction	0.31	0.31	0.32		0.35	0.39
Total, real	295	269	22		35	2

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-163 - R-163
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June				
1	08:04	07:47	16:34 (T-29)	07:06	16:30 (T-13)	07:09	06:18	05:45	06:09 (T-15)	
	16:57	17:35	35 17:09 (T-13)	18:13	49 17:19 (T-13)	19:53	20:30	21:04	6 06:15 (T-15)	
2	08:04	07:46	16:33 (T-13)	07:04	16:31 (T-13)	07:07	06:17	05:45	06:08 (T-15)	
	16:58	17:36	38 17:11 (T-13)	18:14	47 17:18 (T-13)	19:54	20:31	21:05	6 06:14 (T-15)	
3	08:04	07:45	16:33 (T-13)	07:02	16:32 (T-13)	07:06	06:15	05:44	06:08 (T-15)	
	16:59	17:38	40 17:13 (T-13)	18:15	44 17:16 (T-13)	19:55	20:32	21:06	6 06:14 (T-15)	
4	08:04	07:43	16:31 (T-13)	07:01	16:33 (T-13)	07:04	06:14	05:44	06:07 (T-15)	
	17:00	17:39	42 17:13 (T-13)	18:17	41 17:14 (T-13)	19:56	20:34	21:07	7 06:14 (T-15)	
5	08:04	07:42	16:30 (T-13)	06:59	16:35 (T-13)	07:02	06:12	05:43	06:07 (T-15)	
	17:01	17:41	45 17:15 (T-13)	18:18	38 17:13 (T-13)	19:58	20:35	21:07	7 06:14 (T-15)	
6	08:04	07:41	16:30 (T-13)	06:57	16:37 (T-13)	07:00	06:11	05:43	06:06 (T-15)	
	17:02	17:42	47 17:17 (T-13)	18:19	34 17:11 (T-13)	19:59	20:36	21:08	7 06:13 (T-15)	
7	08:04	07:40	16:28 (T-13)	06:55	16:39 (T-13)	06:58	06:10	05:42	06:06 (T-15)	
	17:03	17:43	50 17:18 (T-13)	18:21	30 17:09 (T-13)	20:00	20:37	21:09	7 06:13 (T-15)	
8	08:04	07:38	16:28 (T-13)	07:54	17:41 (T-13)	06:57	06:08	05:42	06:06 (T-15)	
	17:04	17:45	52 17:20 (T-13)	18:22	24 18:05 (T-13)	20:01	20:38	21:10	7 06:13 (T-15)	
9	08:04	07:37	16:28 (T-13)	07:52	17:45 (T-13)	06:55	06:07	05:42	06:06 (T-15)	
	17:05	17:46	54 17:22 (T-13)	19:23	16 18:01 (T-13)	20:03	20:40	21:10	7 06:13 (T-15)	
10	08:03	16:35 (T-29)	07:36	16:27 (T-13)	07:50	06:53	06:06	05:42	06:05 (T-15)	
	17:06	3 16:38 (T-29)	17:48	56 17:23 (T-13)	19:25	20:04	20:41	21:11	7 06:12 (T-15)	
11	08:03	16:35 (T-29)	07:34	16:27 (T-13)	07:48	06:51	06:05	05:41	06:05 (T-15)	
	17:07	5 16:40 (T-29)	17:49	57 17:24 (T-13)	19:26	20:05	20:42	21:12	7 06:12 (T-15)	
12	08:03	16:34 (T-29)	07:33	16:26 (T-13)	07:46	06:49	06:03	05:41	06:05 (T-15)	
	17:08	6 16:40 (T-29)	17:51	57 17:23 (T-13)	19:27	20:06	20:43	21:12	7 06:12 (T-15)	
13	08:02	16:34 (T-29)	07:31	16:26 (T-13)	07:45	06:48	06:02	05:41	06:05 (T-15)	
	17:10	8 16:42 (T-29)	17:52	58 17:24 (T-13)	19:29	20:08	20:44	21:13	7 06:12 (T-15)	
14	08:02	16:33 (T-29)	07:30	16:25 (T-13)	07:43	08:03 (T-17)	06:46	06:01	05:41	06:05 (T-15)
	17:11	10 16:43 (T-29)	17:53	59 17:24 (T-13)	19:30	2 08:05 (T-17)	20:09	20:46	21:13	7 06:12 (T-15)
15	08:01	16:33 (T-29)	07:29	16:26 (T-13)	07:41	08:01 (T-17)	06:44	06:00	05:41	06:05 (T-15)
	17:12	12 16:45 (T-29)	17:55	59 17:25 (T-13)	19:31	4 08:05 (T-17)	20:10	20:47	21:14	6 06:11 (T-15)
16	08:01	16:32 (T-29)	07:27	16:25 (T-13)	07:39	07:59 (T-17)	06:42	05:59	05:41	06:05 (T-15)
	17:13	14 16:46 (T-29)	17:56	60 17:25 (T-13)	19:32	6 08:05 (T-17)	20:11	20:48	21:14	6 06:11 (T-15)
17	08:00	16:32 (T-29)	07:26	16:26 (T-13)	07:37	07:57 (T-17)	06:41	05:58	05:41	06:06 (T-15)
	17:15	15 16:47 (T-29)	17:58	59 17:25 (T-13)	19:34	7 08:04 (T-17)	20:13	20:49	21:15	5 06:11 (T-15)
18	08:00	16:32 (T-29)	07:24	16:25 (T-13)	07:35	07:56 (T-17)	06:39	05:56	05:41	06:06 (T-15)
	17:16	17 16:49 (T-29)	17:59	60 17:25 (T-13)	19:35	8 08:04 (T-17)	20:14	20:50	21:15	4 06:10 (T-15)
19	07:59	16:32 (T-29)	07:22	16:25 (T-13)	07:33	07:54 (T-17)	06:37	05:55	05:41	06:07 (T-15)
	17:17	18 16:50 (T-29)	18:00	59 17:24 (T-13)	19:36	9 08:03 (T-17)	20:15	20:51	21:15	3 06:10 (T-15)
20	07:58	16:31 (T-29)	07:21	16:25 (T-13)	07:32	07:52 (T-17)	06:36	05:54	05:41	06:08 (T-15)
	17:18	20 16:51 (T-29)	18:00	60 17:25 (T-13)	19:37	10 08:02 (T-17)	20:16	20:52	21:16	3 06:11 (T-15)
21	07:57	16:31 (T-29)	07:19	16:25 (T-13)	07:30	07:50 (T-17)	06:34	05:53	05:41	06:08 (T-15)
	17:20	21 16:52 (T-29)	18:02	59 17:24 (T-13)	19:39	9 07:59 (T-17)	20:18	20:53	21:16	3 06:11 (T-15)
22	07:57	16:31 (T-29)	07:18	16:26 (T-13)	07:28	07:52 (T-17)	06:32	05:53	05:42	06:08 (T-15)
	17:21	23 16:54 (T-29)	18:03	59 17:25 (T-13)	19:40	3 07:55 (T-17)	20:19	20:54	21:16	3 06:11 (T-15)
23	07:56	16:31 (T-29)	07:16	16:26 (T-13)	07:26	06:31	05:52	05:42	06:08 (T-15)	
	17:22	24 16:55 (T-29)	18:04	58 17:24 (T-13)	19:41	20:20	20:55	21:16	3 06:11 (T-15)	
24	07:55	16:32 (T-29)	07:14	16:26 (T-13)	07:24	06:29	05:51	05:42	06:08 (T-15)	
	17:24	25 16:57 (T-29)	18:06	57 17:23 (T-13)	19:43	20:21	20:57	21:16	4 06:12 (T-15)	
25	07:54	16:32 (T-29)	07:13	16:27 (T-13)	07:22	06:27	05:50	05:42	06:08 (T-15)	
	17:25	27 16:59 (T-29)	18:07	56 17:23 (T-13)	19:44	20:23	20:58	1 06:14 (T-15)	21:17	5 06:13 (T-15)
26	07:53	16:32 (T-29)	07:11	16:27 (T-13)	07:20	06:26	05:49	06:12 (T-15)	05:43	06:07 (T-15)
	17:27	28 17:00 (T-29)	18:09	55 17:22 (T-13)	19:45	20:24	20:59	2 06:14 (T-15)	21:17	6 06:13 (T-15)
27	07:52	16:32 (T-29)	07:09	16:28 (T-13)	07:19	06:24	05:48	06:11 (T-15)	05:43	06:08 (T-15)
	17:28	30 17:02 (T-29)	18:10	53 17:21 (T-13)	19:46	20:25	21:00	3 06:14 (T-15)	21:17	6 06:14 (T-15)
28	07:51	16:33 (T-29)	07:08	16:28 (T-13)	07:17	06:23	05:48	06:11 (T-15)	05:44	06:08 (T-15)
	17:29	30 17:03 (T-29)	18:11	52 17:20 (T-13)	19:48	20:26	21:00	3 06:14 (T-15)	21:17	6 06:14 (T-15)
29	07:50	16:32 (T-29)	07:07	16:25 (T-13)	07:15	06:21	05:47	06:10 (T-15)	05:44	06:08 (T-15)
	17:31	32 17:04 (T-29)	18:12	51 17:21 (T-13)	19:49	20:27	21:01	4 06:14 (T-15)	21:17	7 06:15 (T-15)
30	07:49	16:32 (T-29)	07:06	16:26 (T-13)	07:13	06:20	05:46	06:10 (T-15)	05:44	06:09 (T-15)
	17:32	34 17:06 (T-29)	18:13	50 17:22 (T-13)	19:50	20:29	21:02	5 06:15 (T-15)	21:17	7 06:16 (T-15)
31	07:48	16:33 (T-29)	07:05	16:27 (T-13)	07:11	06:19	05:46	06:09 (T-15)	05:44	06:09 (T-15)
	17:34	34 17:07 (T-13)	18:14	49 17:23 (T-13)	19:51	21:03	5 06:14 (T-15)	21:17	7 06:16 (T-15)	
Potential sun hours	287	292	369	403	459	465	172			
Total, worst case	436	1496	381	23	0.58	0.73				
Sun reduction	0.58	0.58	0.59	0.66	0.90	0.90				
Oper. time red.	0.90	0.90	0.90	0.90	0.59	0.59				
Wind dir. red.	0.59	0.59	0.59	0.59	0.35	0.39				
Total reduction	0.31	0.31	0.31	0.35	0.39	0.39				
Total, real	134	461	120	8	67	67				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-163 - R-163
Assumptions for shadow calculations Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45	06:09 (T-15)	06:12	06:49	07:24	07:04
	21:17	7 06:16 (T-15)	20:55	20:07	19:11	15:57 (T-13)
2	05:46	06:10 (T-15)	06:14	06:50	07:25	55 16:52 (T-13)
	21:16	7 06:17 (T-15)	20:54	20:05	17:17	16:48
3	05:46	06:11 (T-15)	06:15	06:51	07:27	15:57 (T-13)
	21:16	7 06:18 (T-15)	20:52	20:03	17:15	16:48
4	05:47	06:11 (T-15)	06:16	06:52	07:28	53 16:50 (T-13)
	21:16	7 06:18 (T-15)	20:51	20:01	17:14 (T-13)	16:48
5	05:47	06:12 (T-15)	06:17	06:53	07:29	15:58 (T-13)
	21:16	7 06:19 (T-15)	20:50	20:00	17:13	16:47
6	05:48	06:12 (T-15)	06:18	06:54	07:30	50 16:48 (T-13)
	21:15	7 06:19 (T-15)	20:49	19:58	17:12 (T-13)	16:47
7	05:49	06:13 (T-15)	06:19	06:56	07:32	47 16:47 (T-13)
	21:15	7 06:20 (T-15)	20:47	19:56	17:11 (T-13)	16:47
8	05:49	06:14 (T-15)	06:20	06:57	07:33	45 16:45 (T-13)
	21:15	7 06:21 (T-15)	20:46	19:54	17:10 (T-13)	16:47
9	05:50	06:15 (T-15)	06:22	06:58	07:34	42 16:44 (T-13)
	21:14	7 06:22 (T-15)	20:44	19:52	17:09 (T-13)	16:47
10	05:51	06:15 (T-15)	06:23	06:59	07:35	39 16:42 (T-13)
	21:14	6 06:21 (T-15)	20:43	19:50	17:08 (T-13)	16:47
11	05:52	06:16 (T-15)	06:24	07:00	07:37	38 16:42 (T-13)
	21:13	6 06:22 (T-15)	20:42	19:49	17:07 (T-13)	16:47
12	05:53	06:17 (T-15)	06:25	07:02	07:38	35 16:40 (T-13)
	21:13	5 06:22 (T-15)	20:40	19:47	17:06 (T-13)	16:47
13	05:53	06:18 (T-15)	06:26	07:03	07:39	34 16:38 (T-13)
	21:12	5 06:23 (T-15)	20:39	19:45	17:05 (T-13)	16:47
14	05:54	06:18 (T-15)	06:27	07:04	07:40	32 16:36 (T-13)
	21:12	4 06:22 (T-15)	20:37	19:43	17:04 (T-13)	16:47
15	05:55	06:19 (T-15)	06:29	07:05	07:42	31 16:35 (T-13)
	21:11	4 06:23 (T-15)	20:35	19:41	17:03 (T-13)	16:47
16	05:56	06:20 (T-15)	06:30	07:06	07:43	30 16:34 (T-13)
	21:10	3 06:23 (T-15)	20:34	19:39	17:02 (T-13)	16:47
17	05:57	06:21 (T-15)	06:31	07:07	07:44	28 16:33 (T-13)
	21:10	2 06:23 (T-15)	20:32	19:37	17:01 (T-13)	16:47
18	05:58	06:22 (T-15)	06:32	07:09	07:45	27 16:32 (T-13)
	21:09	2 06:24 (T-15)	20:31	19:35	17:00 (T-13)	16:48
19	05:59	06:23 (T-15)	06:33	07:10	07:47	25 16:31 (T-13)
	21:08	1 06:24 (T-15)	20:29	19:33	17:00 (T-13)	16:48
20	06:00		06:34	07:11	07:48	24 16:30 (T-13)
	21:07		20:28	19:32	17:00 (T-13)	16:48
21	06:01		06:36	07:12	07:49	23 16:29 (T-13)
	21:06		20:26	19:30	17:00 (T-13)	16:49
22	06:02		06:37	07:13	07:51	21 16:28 (T-13)
	21:06		20:24	19:28	17:00 (T-13)	16:49
23	06:03		06:38	07:15	07:52	20 16:27 (T-13)
	21:05		20:23	19:26	17:00 (T-13)	16:50
24	06:04		06:39	07:16	07:53	18 16:26 (T-13)
	21:04		20:21	19:24	17:00 (T-13)	16:50
25	06:05		06:40	07:17	07:55	17 16:26 (T-13)
	21:03		20:19	19:22	17:00 (T-13)	16:51
26	06:06		06:42	07:18	07:56	15 16:25 (T-13)
	21:02		20:17	19:20	17:00 (T-13)	16:51
27	06:07		06:43	07:19	07:57	14 16:24 (T-13)
	21:01		20:16	19:18	17:00 (T-13)	16:52
28	06:08		06:44	07:20	07:59	12 16:24 (T-13)
	21:00		20:14	19:16	17:00 (T-13)	16:53
29	06:09		06:45	07:22	08:00	10 16:23 (T-13)
	20:58		20:12	19:15	17:00 (T-13)	16:53
30	06:10		06:46	07:23	08:01	8 16:22 (T-13)
	20:57		20:10	19:13	17:00 (T-13)	16:54
31	06:11		06:47		08:03	6 16:22 (T-13)
	20:56		20:09		17:00 (T-13)	16:55
Potential sun hours	471	436	377	341	288	275
Total, worst case				1389	884	8
Sun reduction	101		60	0.56	0.48	0.52
Oper. time red.	0.75		0.67	0.90	0.90	0.90
Wind dir. red.	0.90		0.90	0.59	0.59	0.59
Total reduction	0.59		0.60	0.30	0.25	0.27
Total, real	0.40		0.36	413	225	2

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
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Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-164 - R-164
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June			
1	08:04	07:47	07:06	07:27 (T-30)	07:09	07:30 (T-29)	06:18	06:39 (T-13)	05:45
	16:57	17:35	18:13	10 07:37 (T-30)	19:53	31 08:01 (T-29)	20:30	26 07:05 (T-13)	21:04
2	08:05	07:46	07:04	07:25 (T-30)	07:08	07:28 (T-29)	06:17	06:39 (T-13)	05:45
	16:58	17:36	18:14	12 07:37 (T-30)	19:54	33 08:01 (T-29)	20:31	26 07:05 (T-13)	21:05
3	08:05	07:45	07:03	07:23 (T-30)	07:06	07:26 (T-29)	06:15	06:40 (T-13)	05:44
	16:59	17:38	18:15	13 07:36 (T-30)	19:55	35 08:01 (T-29)	20:32	25 07:05 (T-13)	21:06
4	08:05	07:44	07:01	07:21 (T-30)	07:04	07:24 (T-29)	06:14	06:40 (T-13)	05:44
	17:00	17:39	18:17	14 07:35 (T-30)	19:56	37 08:01 (T-29)	20:34	23 07:03 (T-13)	21:07
5	08:04	07:42	06:59	07:20 (T-30)	07:02	07:22 (T-29)	06:13	06:41 (T-13)	05:43
	17:01	17:41	18:18	15 07:35 (T-30)	19:58	38 08:00 (T-29)	20:35	21 07:02 (T-13)	21:08
6	08:04	07:41	06:57	07:18 (T-30)	07:00	07:20 (T-29)	06:11	06:43 (T-13)	05:43
	17:02	17:42	18:19	16 07:34 (T-30)	19:59	40 08:00 (T-29)	20:36	19 07:02 (T-13)	21:08
7	08:04	07:40	06:55	07:18 (T-30)	06:58	07:20 (T-29)	06:10	06:44 (T-13)	05:43
	17:03	17:44	18:21	14 07:32 (T-30)	20:00	40 08:00 (T-29)	20:37	15 06:59 (T-13)	21:09
8	08:04	07:38	07:54	08:20 (T-30)	06:57	07:20 (T-29)	06:08	06:46 (T-13)	05:42
	17:04	17:45	18:22	9 08:29 (T-30)	20:01	39 07:59 (T-29)	20:39	11 06:57 (T-13)	21:10
9	08:04	07:37	07:52		06:55	07:19 (T-29)	06:07	06:49 (T-13)	05:42
	17:05	17:46	19:23		20:03	39 07:58 (T-29)	20:40	5 06:54 (T-13)	21:10
10	08:03	07:36	07:50		06:53	07:19 (T-29)	06:06		05:42
	17:06	17:48	19:25		20:04	38 07:57 (T-29)	20:41		21:11
11	08:03	07:34	07:48		06:51	07:20 (T-29)	06:05		05:41
	17:07	17:49	19:26		20:05	36 07:56 (T-29)	20:42		21:12
12	08:03	07:33	07:46		06:49	07:21 (T-29)	06:03		05:41
	17:08	17:51	19:27		20:06	35 07:56 (T-29)	20:43		21:12
13	08:02	07:32	07:45		06:48	07:21 (T-29)	06:02		05:41
	17:10	17:52	19:29		20:08	33 07:54 (T-29)	20:44		21:13
14	08:02	07:30	07:43		06:46	07:22 (T-29)	06:01		05:41
	17:11	17:53	19:30		20:09	31 07:53 (T-29)	20:46		21:13
15	08:01	16:44 (T-28)	07:29		07:41	06:44	07:24 (T-29)	06:00	05:41
	17:12	1 16:45 (T-28)	17:55		19:31	20:10	28 07:52 (T-29)	20:47	21:14
16	08:01	16:43 (T-28)	07:27		07:39	06:42	07:25 (T-29)	05:59	05:41
	17:13	3 16:46 (T-28)	17:56		19:32	20:11	24 07:49 (T-29)	20:48	21:14
17	08:00	16:43 (T-28)	07:26		07:37	06:41	07:26 (T-29)	05:58	05:41
	17:15	4 16:47 (T-28)	17:58		19:34	20:13	21 07:47 (T-29)	20:49	21:15
18	08:00	16:44 (T-28)	07:24		07:35	06:39	07:28 (T-29)	05:57	05:41
	17:16	5 16:49 (T-28)	17:59		19:35	20:14	15 07:43 (T-29)	20:50	21:15
19	07:59	16:44 (T-28)	07:22		07:34	06:37	06:58 (T-13)	05:56	05:41
	17:17	6 16:50 (T-28)	18:00		19:36	20:15	6 07:37 (T-29)	20:51	21:15
20	07:58	16:44 (T-28)	07:21		07:32	06:36	06:56 (T-13)	05:55	05:41
	17:19	7 16:51 (T-28)	18:00		19:38	20:16	8 07:04 (T-13)	20:52	21:16
21	07:58	16:44 (T-28)	07:19		07:30	06:34	06:55 (T-13)	05:54	05:41
	17:20	8 16:52 (T-28)	18:02		19:39	20:18	10 07:05 (T-13)	20:53	21:16
22	07:57	16:44 (T-28)	07:18		07:28	06:32	06:53 (T-13)	05:53	05:42
	17:21	10 16:54 (T-28)	18:03		19:40	20:19	13 07:06 (T-13)	20:54	21:16
23	07:56	16:46 (T-28)	07:16		07:26	06:31	06:51 (T-13)	05:52	05:42
	17:23	10 16:56 (T-28)	18:05		19:41	20:20	15 07:06 (T-13)	20:56	21:16
24	07:55	16:46 (T-28)	07:14		07:24	06:29	06:50 (T-13)	05:51	05:42
	17:24	11 16:57 (T-28)	18:06		19:43	7 07:51 (T-29)	20:21	17 07:07 (T-13)	20:57
25	07:54	16:47 (T-28)	07:13	07:34 (T-30)	07:22	07:43 (T-29)	06:28	06:48 (T-13)	05:50
	17:25	12 16:59 (T-28)	18:07	1 07:35 (T-30)	19:44	12 07:55 (T-29)	20:23	19 07:07 (T-13)	20:58
26	07:53	16:48 (T-28)	07:11	07:32 (T-30)	07:21	07:41 (T-29)	06:26	06:47 (T-13)	05:49
	17:27	12 17:00 (T-28)	18:09	4 07:36 (T-30)	19:45	16 07:57 (T-29)	20:24	20 07:07 (T-13)	20:59
27	07:52	16:49 (T-28)	07:09	07:30 (T-30)	07:19	07:39 (T-29)	06:24	06:45 (T-13)	05:49
	17:28	12 17:01 (T-28)	18:10	6 07:36 (T-30)	19:46	19 07:58 (T-29)	20:25	22 07:07 (T-13)	21:00
28	07:51	16:51 (T-28)	07:08	07:28 (T-30)	07:17	07:37 (T-29)	06:23	06:44 (T-13)	05:48
	17:29	9 17:00 (T-28)	18:11	8 07:36 (T-30)	19:48	22 07:59 (T-29)	20:26	23 07:07 (T-13)	21:01
29	07:50	16:55 (T-28)		07:15	07:15	07:35 (T-29)	06:21	06:42 (T-13)	05:47
	17:31	1 16:56 (T-28)		19:49	25 08:00 (T-29)	20:28	24 07:06 (T-13)	21:01	21:17
30	07:49			07:13	07:33 (T-29)	06:20	06:41 (T-13)	05:46	05:45
	17:32			19:50	27 08:00 (T-29)	20:29	25 07:06 (T-13)	21:02	21:17
31	07:48			07:11	07:31 (T-29)			05:46	
	17:34			19:51	29 08:00 (T-29)			21:03	
Potential sun hours	287	292	369	403	459	465			
Total, worst case	111	19	260	795	171				
Sun reduction	0.58	0.58	0.59	0.63	0.66				
Oper. time red.	0.90	0.90	0.90	0.90	0.90				
Wind dir. red.	0.59	0.60	0.59	0.59	0.58				
Total reduction	0.31	0.31	0.31	0.33	0.35				
Total, real	34	6	82	264	59				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
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US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-164 - R-164
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:20 (T-29) 19:11	07:24 17:17	07:43 16:48
2	05:46 21:17	06:14 20:54	06:50 20:05	07:18 (T-29) 19:09	07:25 17:16	07:45 16:48
3	05:47 21:16	06:15 20:53	06:51 20:03	07:18 (T-29) 19:07	07:27 17:14	07:46 16:48
4	05:47 21:16	06:16 20:51	06:52 (T-13) 20:02	07:17 (T-29) 19:05	07:28 17:13	07:47 16:47
5	05:47 21:16	06:17 20:50	06:54 (T-13) 20:00	07:16 (T-29) 19:04	07:29 17:11	07:48 16:47
6	05:48 21:16	06:18 20:49	06:53 (T-13) 19:58	07:16 (T-29) 19:02	07:30 17:10	07:49 16:47
7	05:49 21:15	06:19 20:47	06:52 (T-13) 19:56	07:17 (T-29) 19:00	07:32 17:09	07:50 16:47
8	05:50 21:15	06:21 20:46	06:51 (T-13) 19:54	07:18 (T-29) 18:56	07:33 17:08	07:51 16:47
9	05:50 21:14	06:22 20:44	06:50 (T-13) 19:52	07:20 (T-29) 18:54	07:34 17:06	07:52 16:47
10	05:51 21:14	06:23 20:43	06:49 (T-13) 19:50	07:21 (T-29) 18:53	07:35 17:05	07:53 16:47
11	05:52 21:13	06:24 20:42	06:48 (T-13) 19:49	07:22 (T-29) 18:51	07:37 17:04	07:54 16:47
12	05:53 21:13	06:25 20:40	06:48 (T-13) 19:47	07:23 (T-29) 18:49	07:38 17:03	07:55 16:47
13	05:53 21:12	06:26 20:39	06:49 (T-13) 19:45	07:24 (T-29) 18:47	07:39 17:02	07:55 16:47
14	05:54 21:12	06:28 20:37	06:50 (T-13) 19:43	07:25 (T-29) 18:46	07:40 17:01	07:56 16:47
15	05:55 21:11	06:29 20:36	06:51 (T-13) 19:41	07:26 (T-29) 18:44	07:42 17:00	07:57 16:47
16	05:56 21:10	06:30 20:34	06:53 (T-13) 19:39	07:28 (T-29) 18:42	07:43 16:59	07:58 16:47
17	05:57 21:10	06:31 20:32	06:54 (T-13) 19:37	07:29 (T-29) 18:40	07:44 16:58	07:58 16:48
18	05:58 21:09	06:32 20:31	06:55 (T-13) 19:35	07:30 (T-29) 18:39	07:46 16:57	07:59 16:48
19	05:59 21:08	06:33 20:29	06:56 (T-13) 19:34	07:31 (T-29) 18:37	07:47 16:56	08:00 16:48
20	06:00 21:07	06:35 20:28	06:57 (T-13) 19:32	07:32 (T-29) 18:35	07:48 16:55	08:00 16:49
21	06:01 21:07	06:36 20:26	06:58 (T-13) 19:30	07:34 (T-29) 18:34	07:49 16:54	08:01 16:49
22	06:02 21:06	06:37 20:24	06:59 (T-13) 19:28	07:35 (T-29) 18:32	07:51 16:53	08:01 16:50
23	06:03 21:05	06:38 20:23	07:00 (T-13) 19:26	07:36 (T-29) 18:31	07:52 16:52	08:02 16:50
24	06:04 21:04	06:39 20:21	07:02 (T-13) 19:24	07:37 (T-29) 18:29	07:53 16:51	08:02 16:51
25	06:05 21:03	06:40 20:19	07:32 (T-29) 19:22	07:38 (T-29) 18:27	07:55 16:50	08:03 16:51
26	06:06 21:02	06:42 20:18	07:29 (T-29) 19:20	07:39 (T-29) 18:26	07:56 16:49	08:03 16:52
27	06:07 21:01	06:43 20:16	07:26 (T-29) 19:18	07:40 (T-29) 18:24	07:57 16:48	08:03 16:53
28	06:08 21:00	06:44 20:14	07:24 (T-29) 19:17	07:41 (T-29) 18:23	07:59 16:47	08:04 16:53
29	06:09 20:59	06:45 20:12	07:23 (T-29) 19:15	07:42 (T-29) 18:21	08:00 16:46	08:04 16:54
30	06:10 20:57	06:46 20:11	07:21 (T-29) 19:13	07:43 (T-29) 18:20	08:01 16:45	08:04 16:55
31	06:11 20:56	06:48 20:09	07:20 (T-29) 19:11	08:02 18:18	08:03 16:44	08:04 16:56
Potential sun hours	471	436	377	341	288	275
Total, worst case		571	569	127	112	
Sun reduction		0.72	0.67	0.56	0.48	
Oper. time red.		0.90	0.90	0.90	0.90	
Wind dir. red.		0.58	0.59	0.60	0.59	
Total reduction		0.38	0.35	0.30	0.25	
Total, real		216	201	38	28	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-165 - R-165
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June			
1	08:04	07:47	07:06	17:45 (T-38)	07:09	19:17 (T-82)	06:18	19:15 (T-31)	05:45
	16:57	17:35	18:13	6 17:51 (T-38)	19:53	13 19:30 (T-82)	20:30	41 19:56 (T-31)	21:04
2	08:04	07:46	07:04	17:45 (T-38)	07:07	19:19 (T-82)	06:17	19:16 (T-31)	05:45
	16:58	17:36	18:14	8 17:53 (T-38)	19:54	10 19:29 (T-82)	20:31	40 19:56 (T-31)	21:05
3	08:04	07:45	07:02	17:45 (T-38)	07:06		06:15	19:16 (T-31)	05:44
	16:59	17:38	18:15	9 17:54 (T-38)	19:55		20:32	39 19:55 (T-31)	21:06
4	08:04	07:43	07:01	17:45 (T-38)	07:04		06:14	19:16 (T-31)	05:44
	17:00	17:39	18:17	10 17:55 (T-38)	19:56		20:34	38 19:54 (T-31)	21:07
5	08:04	07:42	06:59	17:46 (T-38)	07:02		06:12	19:18 (T-31)	05:43
	17:01	17:41	18:18	10 17:56 (T-38)	19:58		20:35	36 19:54 (T-31)	21:07
6	08:04	07:41	06:57	17:49 (T-38)	07:00		06:11	19:18 (T-31)	05:43
	17:02	17:42	18:19	8 17:57 (T-38)	19:59		20:36	35 20:12 (T-93)	21:08
7	08:04	07:40	06:55		06:58		06:10	19:19 (T-31)	05:42
	17:03	17:43	18:21		20:00		20:37	34 20:13 (T-93)	21:09
8	08:04	07:38	07:54		06:57		06:08	19:20 (T-31)	05:42
	17:04	17:45	18:22		20:01		20:38	34 20:14 (T-93)	21:10
9	08:04	07:37	07:52		06:55		06:07	19:22 (T-31)	05:42
	17:05	17:46	19:23		20:03		20:40	33 20:16 (T-93)	21:10
10	08:03	07:36	07:50		06:53		06:06	19:22 (T-31)	05:42
	17:06	17:48	19:25		20:04	9 19:42 (T-31)	20:41	32 20:16 (T-93)	21:11
11	08:03	07:34	07:48		06:51		06:05	19:24 (T-31)	05:41
	17:07	17:49	19:26		20:05	14 19:43 (T-31)	20:42	29 20:17 (T-93)	21:11
12	08:03	07:33	07:46		06:49		06:03	19:27 (T-31)	05:41
	17:08	17:51	19:27		20:06	18 19:45 (T-31)	20:43	26 20:19 (T-93)	21:12
13	08:02	07:31	07:45		06:48		06:02	19:30 (T-31)	05:41
	17:10	17:52	19:29		20:08	20 19:45 (T-31)	20:44	21 20:20 (T-93)	21:13
14	08:02	07:30	07:43		06:46		06:01	19:23 (T-31)	05:41
	17:11	17:53	19:30		20:09	23 19:46 (T-31)	20:45	12 20:21 (T-93)	21:13
15	08:01	07:28	07:41		06:44		06:00	19:21 (T-31)	05:41
	17:12	17:55	19:31		20:10	26 19:47 (T-31)	20:47	12 20:22 (T-93)	21:14
16	08:01	07:27	07:39		06:42		05:59	19:20 (T-31)	05:41
	17:13	17:56	19:32		20:11	29 19:49 (T-31)	20:48	13 20:23 (T-93)	21:14
17	08:00	07:25	07:37		06:41		05:58	19:19 (T-31)	05:41
	17:15	17:58	19:34		20:13	31 19:50 (T-31)	20:49	13 20:24 (T-93)	21:14
18	07:59	07:24	07:35		06:39		05:57	19:17 (T-31)	05:41
	17:16	17:59	19:35		20:14	34 19:51 (T-31)	20:50	14 20:25 (T-93)	21:15
19	07:59	07:22	07:33		06:37		05:56	19:17 (T-31)	05:41
	17:17	18:00	19:36		20:15	36 19:53 (T-31)	20:51	14 20:26 (T-93)	21:15
20	07:58	07:21	07:32		06:36		05:55	19:16 (T-31)	05:41
	17:18	18:00	19:37		20:16	37 19:53 (T-31)	20:52	13 20:26 (T-93)	21:15
21	07:57	07:19	07:30		06:34		05:54	19:15 (T-31)	05:41
	17:20	18:02	19:39		20:17	39 19:54 (T-31)	20:53	11 20:25 (T-93)	21:16
22	07:57	07:18	07:28		06:32		05:53	19:15 (T-31)	05:42
	17:21	18:03	19:40		20:19	41 19:56 (T-31)	20:54	7 20:23 (T-93)	21:16
23	07:56	07:16	07:26		06:31		05:52	19:15 (T-31)	05:42
	17:22	18:05	19:41	1 19:19 (T-82)	20:20	42 19:57 (T-31)	20:55		21:16
24	07:55	07:14	07:24		06:29		05:51	19:15 (T-31)	05:42
	17:24	18:06	19:43	4 19:21 (T-82)	20:21	44 19:59 (T-31)	20:56		21:16
25	07:54	07:13	07:22		06:27		05:50	19:14 (T-31)	05:42
	17:25	18:07	19:44	6 19:22 (T-82)	20:22	45 19:59 (T-31)	20:57		21:17
26	07:53	07:11	07:20		06:26		05:49	19:15 (T-31)	05:43
	17:27	18:09	19:45	8 19:24 (T-82)	20:24	44 19:59 (T-31)	20:58		21:17
27	07:52	07:09	07:19		06:24		05:48	19:14 (T-31)	05:43
	17:28	18:10	2 17:46 (T-38)	9 19:16 (T-82)	20:25	44 19:58 (T-31)	20:59		21:17
28	07:51	07:08	07:17		06:23		05:48	19:15 (T-31)	05:44
	17:29	18:11	4 17:49 (T-38)	11 19:26 (T-82)	20:26	43 19:58 (T-31)	21:00		21:17
29	07:50		07:15		06:21		05:47	19:14 (T-31)	05:44
	17:31		19:49	12 19:27 (T-82)	20:27	44 19:58 (T-31)	21:01		21:17
30	07:49		07:13		06:20		05:46	19:15 (T-31)	05:45
	17:32		19:50	13 19:28 (T-82)	20:29	42 19:57 (T-31)	21:02		21:17
31	07:48		07:11		06:19		05:46		
	17:34		19:51	13 19:29 (T-82)			21:03		
Potential sun hours	287	292	369	403	459	465			
Total, worst case									
Sun reduction		6	128	728	547				
Oper. time red.		0.58	0.59	0.63	0.66				
Wind dir. red.		0.90	0.90	0.90	0.90				
Total reduction		0.58	0.59	0.60	0.61				
Total, real		0.30	0.31	0.34	0.36				
		2	40	246	197				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-165 - R-165

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:13 20:55	19:36 (T-31) 20:29 (T-93)	06:49 20:07	19:29 (T-31) 19:11	07:04 17:17
2	05:46 21:16	06:14 20:54	19:34 (T-31) 20:27 (T-93)	06:50 20:05	19:32 (T-31) 19:09	07:05 17:15
3	05:46 21:16	06:15 20:52	19:32 (T-31) 20:26 (T-93)	06:51 20:03	19:27 19:07	07:07 17:14
4	05:47 21:16	06:16 20:51	19:31 (T-31) 20:25 (T-93)	06:52 20:01	19:28 19:05	07:08 17:13
5	05:47 21:16	06:17 20:50	19:29 (T-31) 20:24 (T-93)	06:53 20:00	19:29 19:03	07:09 17:11
6	05:48 21:15	06:18 20:48	19:28 (T-31) 20:22 (T-93)	06:55 19:58	19:28 19:02	07:11 17:10
7	05:49 21:15	06:19 20:47	19:28 (T-31) 20:03 (T-31)	06:56 19:56	19:28 19:00	07:12 17:09
8	05:50 21:15	06:20 20:46	19:27 (T-31) 20:04 (T-31)	06:57 19:54	19:27 18:56	07:14 17:08
9	05:50 21:14	06:22 20:44	19:26 (T-31) 20:04 (T-31)	06:58 19:52	19:26 18:54	07:15 17:06
10	05:51 21:14	06:23 20:43	19:25 (T-31) 20:05 (T-31)	06:59 19:50	19:25 (T-82) 18:53	07:16 17:05
11	05:52 21:13	06:24 20:41	19:24 (T-31) 20:05 (T-31)	07:00 19:48	19:24 (T-82) 18:51	07:18 17:04
12	05:53 21:13	06:25 20:40	19:23 (T-31) 20:05 (T-31)	07:02 19:47	19:23 (T-82) 18:49	07:19 17:03
13	05:53 21:12	06:26 20:38	19:23 (T-31) 20:05 (T-31)	07:03 19:45	19:23 (T-82) 18:47	07:20 17:02
14	05:54 21:12	06:27 20:37	19:22 (T-31) 20:05 (T-31)	07:04 19:43	19:22 (T-82) 18:46	07:22 17:01
15	05:55 21:11	06:29 20:35	19:21 (T-31) 20:05 (T-31)	07:05 19:41	19:21 (T-82) 18:44	07:23 17:00
16	05:56 21:10	06:30 20:34	19:22 (T-31) 20:06 (T-31)	07:06 19:39	19:22 (T-82) 18:42	07:24 16:59
17	05:57 21:10	06:31 20:32	19:21 (T-31) 20:06 (T-31)	07:07 19:37	19:21 (T-82) 18:40	07:26 16:58
18	05:58 21:09	06:32 20:31	19:21 (T-31) 20:06 (T-31)	07:09 19:35	19:21 (T-82) 18:39	07:27 16:57
19	05:59 21:08	06:33 20:29	19:21 (T-31) 20:04 (T-31)	07:10 19:33	19:21 (T-82) 18:37	07:28 16:56
20	06:00 21:07	06:35 20:27	19:20 (T-31) 20:02 (T-31)	07:11 19:32	19:20 (T-82) 18:35	07:30 16:55
21	06:01 21:06	20:28 (T-93) 20:32 (T-93)	06:36 20:26	19:20 (T-31) 20:01 (T-31)	07:12 19:30	07:31 16:54
22	06:02 21:05	20:25 (T-93) 20:34 (T-93)	06:37 20:24	19:20 (T-31) 19:59 (T-31)	07:13 19:28	07:32 16:54
23	06:03 21:05	20:24 (T-93) 20:36 (T-93)	06:38 20:22	19:20 (T-31) 19:57 (T-31)	07:15 19:26	07:34 16:53
24	06:04 21:04	20:23 (T-93) 20:37 (T-93)	06:39 20:21	19:21 (T-31) 19:56 (T-31)	07:16 19:24	07:35 16:52
25	06:05 21:03	20:22 (T-93) 20:36 (T-93)	06:40 20:19	19:21 (T-31) 19:55 (T-31)	07:17 19:22	07:36 16:52
26	06:06 21:02	20:22 (T-93) 20:35 (T-93)	06:42 20:17	19:22 (T-31) 19:53 (T-31)	07:18 19:20	07:37 16:51
27	06:07 21:01	20:21 (T-93) 20:34 (T-93)	06:43 20:16	19:22 (T-31) 19:51 (T-31)	07:19 19:18	07:39 16:50
28	06:08 20:59	20:20 (T-93) 20:33 (T-93)	06:44 20:14	19:23 (T-31) 19:49 (T-31)	07:20 19:16	07:59 16:50
29	06:09 20:58	20:20 (T-93) 20:32 (T-93)	06:45 20:12	19:24 (T-31) 19:47 (T-31)	07:22 19:15	08:00 16:49
30	06:10 20:57	20:20 (T-93) 20:31 (T-93)	06:46 20:10	19:25 (T-31) 19:45 (T-31)	07:23 19:13	08:01 16:48
31	06:11 20:56	19:39 (T-31) 20:30 (T-93)	06:47 20:09	19:26 (T-31) 19:43 (T-31)	08:03 18:18	08:04 16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case	138	1109	126	57		
Sun reduction	0.75	0.72	0.67	0.56		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.63	0.60	0.59	0.58		
Total reduction	0.42	0.39	0.36	0.29		
Total, real	58	429	45	17		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-166 - R-166

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:47	07:06	07:09	06:18	19:34 (T-37) 05:45 20:26 (T-38)
	16:57	17:35	18:13	19:53	20:30	19 19:53 (T-37) 21:04 20:38 (T-38)
2	08:04	07:46	07:04	07:08	06:17	19:36 (T-37) 05:45 20:25 (T-38)
	16:58	17:36	18:14	19:54	20:31	15 19:51 (T-37) 21:05 20:38 (T-38)
3	08:04	07:45	07:02	07:06	06:15	19:39 (T-37) 05:44 20:24 (T-38)
	16:59	17:38	18:15	19:55	20:32	9 19:48 (T-37) 21:06 20:40 (T-38)
4	08:04	07:43	07:01	07:04	06:14	05:44 20:23 (T-38)
	17:00	17:39	18:17	19:56	20:34	21:07 17 20:40 (T-38)
5	08:04	07:42	06:59	07:02	06:13	05:43 20:23 (T-38)
	17:01	17:41	18:18	19:58	20:35	21:07 18 20:41 (T-38)
6	08:04	07:41	06:57	07:00	06:11	05:43 20:23 (T-38)
	17:02	17:42	18:19	19:59	20:36	21:08 19 20:42 (T-38)
7	08:04	07:40	06:55	06:58	06:10	05:43 20:22 (T-38)
	17:03	17:44	18:21	20:00	20:37	21:09 20 20:42 (T-38)
8	08:04	07:38	07:54	06:57	06:09	05:42 20:22 (T-38)
	17:04	17:45	18:22	20:01	20:38	21:10 21 20:43 (T-38)
9	08:04	07:37	07:52	06:55	06:07	05:42 20:22 (T-38)
	17:05	17:46	19:23	20:03	20:40	21:10 22 20:44 (T-38)
10	08:03	07:36	07:50	06:53	06:06	05:42 20:22 (T-38)
	17:06	17:48	19:25	20:04	20:41	21:11 22 20:44 (T-38)
11	08:03	07:34	07:48	06:51	19:40 (T-37) 06:05	05:42 20:22 (T-38)
	17:07	17:49	19:26	20:05	3 19:43 (T-37) 20:42	21:12 23 20:45 (T-38)
12	08:03	07:33	07:46	06:49	19:38 (T-37) 06:03	05:41 20:21 (T-38)
	17:09	17:51	19:27	20:06	7 19:45 (T-37) 20:43	21:12 24 20:45 (T-38)
13	08:02	07:31	07:45	06:48	19:36 (T-37) 06:02	05:41 20:21 (T-38)
	17:10	17:52	19:29	20:08	9 19:45 (T-37) 20:44	21:13 24 20:45 (T-38)
14	08:02	07:30	07:43	06:46	19:34 (T-37) 06:01	05:41 20:21 (T-38)
	17:11	17:53	19:30	20:09	12 19:46 (T-37) 20:46	21:13 25 20:46 (T-38)
15	08:01	07:29	07:41	06:44	19:33 (T-37) 06:00	05:41 20:21 (T-38)
	17:12	17:55	19:31	20:10	15 19:48 (T-37) 20:47	21:14 25 20:46 (T-38)
16	08:01	07:27	07:39	06:43	19:32 (T-37) 05:59	05:41 20:21 (T-38)
	17:13	17:56	19:32	20:11	17 19:49 (T-37) 20:48	21:14 26 20:47 (T-38)
17	08:00	07:26	07:37	06:41	19:31 (T-37) 05:58	05:41 20:21 (T-38)
	17:15	17:58	19:34	20:13	19 19:50 (T-37) 20:49	21:15 26 20:47 (T-38)
18	07:59	07:24	07:35	06:39	19:30 (T-37) 05:57	05:41 20:21 (T-38)
	17:16	17:59	19:35	20:14	21 19:51 (T-37) 20:50	21:15 26 20:47 (T-38)
19	07:59	07:22	07:34	06:37	19:30 (T-37) 05:56	05:41 20:22 (T-38)
	17:17	18:00	19:36	20:15	23 19:53 (T-37) 20:51	21:15 26 20:48 (T-38)
20	07:58	07:21	07:32	06:36	19:29 (T-37) 05:55	05:41 20:22 (T-38)
	17:19	18:00	19:38	20:16	24 19:53 (T-37) 20:52	21:16 27 20:49 (T-38)
21	07:57	07:19	07:30	06:34	19:30 (T-37) 05:54	05:42 20:22 (T-38)
	17:20	18:02	19:39	20:18	25 19:55 (T-37) 20:53	21:16 27 20:49 (T-38)
22	07:57	07:18	07:28	06:32	19:29 (T-37) 05:53	05:42 20:22 (T-38)
	17:21	18:03	19:40	20:19	27 19:56 (T-37) 20:54	21:16 27 20:49 (T-38)
23	07:56	07:16	07:26	06:31	19:29 (T-37) 05:52	05:42 20:22 (T-38)
	17:23	18:05	19:41	20:20	28 19:57 (T-37) 20:55	21:16 26 20:48 (T-38)
24	07:55	07:14	07:24	06:29	19:29 (T-37) 05:51	05:42 20:23 (T-38)
	17:24	18:06	19:43	20:21	30 19:59 (T-37) 20:56	21:16 26 20:49 (T-38)
25	07:54	07:13	07:22	06:28	19:29 (T-37) 05:50	05:43 20:23 (T-38)
	17:25	18:07	19:44	20:23	30 19:59 (T-37) 20:57	21:17 26 20:49 (T-38)
26	07:53	07:11	07:21	06:26	19:30 (T-37) 05:49	05:43 20:23 (T-38)
	17:27	18:09	19:45	20:24	29 19:59 (T-37) 20:58	21:17 26 20:49 (T-38)
27	07:52	07:09	07:19	06:24	19:30 (T-37) 05:49	05:43 20:24 (T-38)
	17:28	18:10	19:46	20:25	28 19:58 (T-37) 20:59	21:17 25 20:49 (T-38)
28	07:51	07:08	07:17	06:23	19:31 (T-37) 05:48	20:33 (T-38) 05:44 20:24 (T-38)
	17:29	18:11	19:48	20:26	26 19:57 (T-37) 21:00	2 20:35 (T-38) 21:17 25 20:49 (T-38)
29	07:50		07:15	06:21	19:31 (T-37) 05:47	20:30 (T-38) 05:44 20:25 (T-38)
	17:31		19:49	20:27	25 19:56 (T-37) 21:01	5 20:35 (T-38) 21:17 25 20:50 (T-38)
30	07:49		07:13	06:20	19:33 (T-37) 05:47	20:28 (T-38) 05:45 20:25 (T-38)
	17:32		19:50	20:29	22 19:55 (T-37) 21:02	9 20:37 (T-38) 21:17 24 20:49 (T-38)
31	07:48		07:11		05:46	20:27 (T-38)
	17:34		19:51		21:03	10 20:37 (T-38)
Potential sun hours	287	292	369	403	458	465
Total, worst case				420		689
Sun reduction				0.63		0.73
Oper. time red.				0.90		0.90
Wind dir. red.				0.60		0.65
Total reduction				0.34		0.42
Total, real				142		293

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-166 - R-166

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December		
1	05:45	20:26 (T-38)	06:13	06:49	19:40 (T-37)	07:24	07:04	07:43
	21:17	23 20:49 (T-38)	20:55	20:07	2 19:42 (T-37)	19:11	17:17	16:49
2	05:46	20:26 (T-38)	06:14	06:50		07:25	07:05	07:44
	21:16	23 20:49 (T-38)	20:54	20:05		19:09	17:16	16:48
3	05:46	20:27 (T-38)	06:15	06:51		07:27	07:07	07:46
	21:16	22 20:49 (T-38)	20:52	20:03		19:07	17:14	16:48
4	05:47	20:27 (T-38)	06:16	06:52		07:28	07:08	07:47
	21:16	21 20:48 (T-38)	20:51	20:01		19:05	17:13	16:48
5	05:48	20:28 (T-38)	06:17	06:53		07:29	07:09	07:48
	21:16	20 20:48 (T-38)	20:50	20:00		19:04	17:12	16:47
6	05:48	20:29 (T-38)	06:18	06:55		07:30	07:11	07:49
	21:15	19 20:48 (T-38)	20:49	19:58		19:02	17:10	16:47
7	05:49	20:29 (T-38)	06:19	06:56		07:32	07:12	07:50
	21:15	18 20:47 (T-38)	20:47	19:56		19:00	17:09	16:47
8	05:50	20:30 (T-38)	06:21	06:57		07:33	07:14	07:51
	21:15	17 20:47 (T-38)	20:46	19:54		18:56	17:08	16:47
9	05:50	20:31 (T-38)	06:22	06:58		07:34	07:15	07:52
	21:14	16 20:47 (T-38)	20:44	19:52		18:54	17:07	16:47
10	05:51	20:31 (T-38)	06:23	19:47 (T-37)	06:59	07:35	07:16	07:53
	21:14	15 20:46 (T-38)	20:43	11 19:58 (T-37)	19:50	18:53	17:05	16:47
11	05:52	20:33 (T-38)	06:24	19:44 (T-37)	07:00	07:37	07:18	07:54
	21:13	13 20:46 (T-38)	20:41	16 20:00 (T-37)	19:49	18:51	17:04	16:47
12	05:53	20:34 (T-38)	06:25	19:42 (T-37)	07:02	07:38	07:19	07:54
	21:13	12 20:46 (T-38)	20:40	20 20:02 (T-37)	19:47	18:49	17:03	16:47
13	05:54	20:36 (T-38)	06:26	19:40 (T-37)	07:03	07:39	07:20	07:55
	21:12	9 20:45 (T-38)	20:39	23 20:03 (T-37)	19:45	18:47	17:02	16:47
14	05:54	20:38 (T-38)	06:28	19:39 (T-37)	07:04	07:40	07:22	07:56
	21:12	7 20:45 (T-38)	20:37	25 20:04 (T-37)	19:43	18:46	17:01	16:47
15	05:55	20:40 (T-38)	06:29	19:39 (T-37)	07:05	07:42	07:23	07:57
	21:11	3 20:43 (T-38)	20:35	26 20:05 (T-37)	19:41	18:44	17:00	16:47
16	05:56		06:30	19:37 (T-37)	07:06	07:43	07:24	07:58
	21:10		20:34	29 20:06 (T-37)	19:39	18:42	16:59	16:47
17	05:57		06:31	19:36 (T-37)	07:07	07:44	07:26	07:58
	21:10		20:32	30 20:06 (T-37)	19:37	18:40	16:58	16:48
18	05:58		06:32	19:36 (T-37)	07:09	07:45	07:27	07:59
	21:09		20:31	30 20:06 (T-37)	19:35	18:39	16:57	16:48
19	05:59		06:33	19:35 (T-37)	07:10	07:47	07:28	08:00
	21:08		20:29	29 20:04 (T-37)	19:34	18:37	16:56	16:48
20	06:00		06:35	19:34 (T-37)	07:11	07:48	07:30	08:00
	21:07		20:28	28 20:02 (T-37)	19:32	18:35	16:55	16:49
21	06:01		06:36	19:34 (T-37)	07:12	07:49	07:31	08:01
	21:06		20:26	27 20:01 (T-37)	19:30	18:34	16:54	16:49
22	06:02		06:37	19:33 (T-37)	07:13	07:51	07:32	08:01
	21:06		20:24	26 19:59 (T-37)	19:28	18:32	16:54	16:50
23	06:03		06:38	19:33 (T-37)	07:15	07:52	07:34	08:02
	21:05		20:23	24 19:57 (T-37)	19:26	18:31	16:53	16:50
24	06:04		06:39	19:34 (T-37)	07:16	07:53	07:35	08:02
	21:04		20:21	22 19:56 (T-37)	19:24	18:29	16:52	16:51
25	06:05		06:40	19:34 (T-37)	07:17	07:55	07:36	08:03
	21:03		20:19	20 19:54 (T-37)	19:22	18:27	16:52	16:51
26	06:06		06:42	19:34 (T-37)	07:18	07:56	07:37	08:03
	21:02		20:17	19 19:53 (T-37)	19:20	18:26	16:51	16:52
27	06:07		06:43	19:34 (T-37)	07:19	07:57	07:39	08:03
	21:01		20:16	17 19:51 (T-37)	19:18	18:24	16:50	16:53
28	06:08		06:44	19:34 (T-37)	07:21	07:59	07:40	08:04
	21:00		20:14	15 19:49 (T-37)	19:17	18:23	16:50	16:54
29	06:09		06:45	19:35 (T-37)	07:22	08:00	07:41	08:04
	20:58		20:12	12 19:47 (T-37)	19:15	18:21	16:49	16:54
30	06:10		06:46	19:36 (T-37)	07:23	08:01	07:42	08:04
	20:57		20:10	9 19:45 (T-37)	19:13	18:20	16:49	16:55
31	06:12		06:48	19:37 (T-37)		08:03		08:04
	20:56		20:09	6 19:43 (T-37)		18:18		16:56
Potential sun hours	471	436	377			341	289	275
Total, worst case		238	464		2			
Sun reduction		0.75	0.72		0.67			
Oper. time red.		0.90	0.90		0.90			
Wind dir. red.		0.65	0.60		0.60			
Total reduction		0.44	0.39		0.36			
Total, real		104	179		1			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-167 - R-167

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:37	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:01	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:07	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:31	07:45	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:08	20:44	21:13	21:12	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:54	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:35	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:58
	17:13	17:56	19:32	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:58
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	08:00
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:19	18:00	19:38	20:16	20:52	21:16	21:07	20:28	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:18	20:53	21:16	21:06	20:26	19:30	18:34	16:55	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:55	21:16	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:56	21:16	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:41	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:57	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:17	21:02	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:39	08:03
	17:28	18:10	19:46	20:25	20:59	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:00	21:17	21:00	20:14	19:17	18:23	16:50	16:54
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:17	20:58	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:47	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:29	21:02	21:17	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:12	06:48		08:03		08:04
	17:34		19:51		21:03		20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-169 - R-169
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04 16:57	07:47 17:35	07:06 18:13	07:09 19:53	07:29 (T-89) 20:30	05:45 21:04
2	08:04 16:58	07:46 17:36	07:04 18:14	07:07 19:54	07:28 (T-89) 20:31	05:45 21:05
3	08:04 16:59	07:45 17:38	07:02 18:15	07:06 19:55	07:26 (T-89) 20:32	05:44 21:06
4	08:04 17:00	07:43 17:39	07:01 18:17	07:04 19:56	07:24 (T-89) 20:33	05:44 21:06
5	08:04 17:01	07:42 17:41	06:59 18:18	07:02 19:58	07:22 (T-89) 20:35	05:43 21:07
6	08:04 17:02	07:41 17:42	06:57 18:19	07:00 19:59	07:20 (T-89) 20:36	05:43 21:08
7	08:04 17:03	07:40 17:44	08:01 (T-H) 08:03 (T-H)	06:55 18:21	07:19 (T-89) 20:37	05:43 21:09
8	08:04 17:04	07:38 17:45	08:00 (T-H) 08:03 (T-H)	07:54 18:22	07:17 (T-89) 20:38	05:42 21:09
9	08:03 17:05	07:37 17:46	07:58 (T-H) 08:03 (T-H)	07:52 19:23	07:15 (T-89) 20:39	05:42 21:10
10	08:03 17:06	07:36 17:48	07:57 (T-H) 08:03 (T-H)	07:50 19:25	07:13 (T-89) 20:41	05:42 21:11
11	08:03 17:07	07:34 17:49	07:56 (T-H) 08:03 (T-H)	07:48 19:26	08:09 (T-54) 20:05	06:51 20:42
12	08:02 17:09	07:33 17:51	07:54 (T-H) 08:02 (T-H)	07:46 19:27	08:07 (T-54) 20:06	06:49 20:43
13	08:02 17:10	07:31 17:52	07:53 (T-H) 08:01 (T-H)	07:44 19:29	08:05 (T-54) 20:07	06:48 20:44
14	08:02 17:11	07:30 17:53	07:51 (T-H) 07:58 (T-H)	07:43 19:30	08:03 (T-54) 20:09	06:46 20:45
15	08:01 17:12	07:28 17:55	07:41 19:31	07:41 19:31	08:01 (T-54) 20:10	06:44 20:46
16	08:01 17:13	07:27 17:56	07:39 19:32	07:39 19:32	07:59 (T-54) 20:11	06:42 20:48
17	08:00 17:15	07:25 17:58	07:37 19:34	07:37 19:34	08:03 (T-54) 20:12	06:41 20:49
18	07:59 17:16	07:24 17:59	07:35 19:35	07:35 19:35	07:13 (T-89) 20:14	05:57 20:50
19	07:59 17:17	07:22 18:00	07:33 19:36	07:33 19:36	08:15 (T-89) 20:15	05:56 20:51
20	07:58 17:19	07:21 18:00	07:32 19:37	07:32 19:37	07:52 (T-89) 20:16	05:55 20:52
21	07:57 17:20	07:19 18:02	07:30 19:39	07:30 19:39	08:05 (T-89) 20:17	05:54 20:53
22	07:56 17:21	07:18 18:03	07:28 19:40	07:28 19:40	07:50 (T-89) 20:19	05:54 20:54
23	07:56 17:23	07:16 18:05	07:26 19:41	07:26 19:41	08:08 (T-89) 20:20	05:52 20:55
24	07:55 17:24	07:14 18:06	07:24 19:43	07:24 19:43	07:44 (T-89) 20:21	05:51 20:56
25	07:54 17:25	07:13 18:07	07:22 19:44	07:22 19:44	08:14 (T-89) 20:22	05:50 20:57
26	07:53 17:27	07:11 18:09	07:20 19:45	07:20 19:45	07:42 (T-89) 20:24	05:49 20:58
27	07:52 17:28	07:09 18:10	07:19 19:46	07:19 19:46	08:15 (T-89) 20:25	05:49 20:59
28	07:51 17:29	07:08 18:11	07:17 19:48	07:17 19:48	07:39 (T-89) 20:26	05:48 21:00
29	07:50 17:31		07:15 19:49	07:15 19:49	08:18 (T-89) 20:27	05:47 21:01
30	07:49 17:32		07:13 19:50	07:13 19:50	07:37 (T-89) 20:29	05:47 21:02
31	07:48 17:34		07:11 19:51	07:11 19:51	08:19 (T-89) 20:30	05:46 21:03
Potential sun hours	287	292	369	403	458	465
Total, worst case			425	1736		95
Sun reduction		0.58	0.59	0.63		0.66
Oper. time red.		0.90	0.90	0.90		0.90
Wind dir. red.		0.63	0.59	0.59		0.59
Total reduction		0.33	0.31	0.33		0.35
Total, real		15	133	578		33

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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L086 71 V163-4.5 WTGs on 98m HH
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-169 - R-169
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:13 20:55	06:49 20:07	07:12 (T-89) 20:07	07:24 19:11	07:45 (T-54) 17:17
2	05:46 21:16	06:14 20:54	06:50 20:05	07:12 (T-89) 20:05	07:25 19:09	07:46 (T-54) 17:16
3	05:46 21:16	06:15 20:52	06:51 20:03	07:13 (T-89) 20:03	07:27 19:07	07:47 (T-54) 17:14
4	05:47 21:16	06:16 20:51	06:52 20:01	07:14 (T-89) 20:01	07:28 19:05	07:48 (T-54) 17:13
5	05:48 21:16	06:17 20:50	06:53 20:00	07:15 (T-89) 20:00	07:29 19:03	07:49 (T-54) 17:11
6	05:48 21:15	06:18 20:48	06:55 19:58	07:16 (T-89) 19:58	07:30 19:02	07:50 (T-54) 17:10
7	05:49 21:15	06:19 20:47	06:56 19:56	07:17 (T-89) 19:56	07:31 19:00	07:51 (T-54) 17:09
8	05:50 21:15	06:21 20:46	06:57 19:54	07:18 (T-89) 19:54	07:33 18:56	07:52 (T-54) 17:08
9	05:50 21:14	06:22 20:44	07:42 (T-89) 07:59 (T-89)	06:58 19:52	07:20 (T-89) 18:54	07:34 17:06
10	05:51 21:14	06:23 20:43	07:38 (T-89) 08:02 (T-89)	06:59 19:50	07:21 (T-89) 18:53	07:35 17:05
11	05:52 21:13	06:24 20:41	07:35 (T-89) 08:04 (T-89)	07:00 19:48	07:22 (T-89) 18:51	07:36 17:04
12	05:53 21:13	06:25 20:40	07:33 (T-89) 08:06 (T-89)	07:02 19:47	07:23 (T-89) 18:49	07:37 17:03
13	05:54 21:12	06:26 20:38	07:31 (T-89) 08:08 (T-89)	07:03 19:45	07:24 (T-89) 18:47	07:38 17:02
14	05:54 21:11	06:28 20:37	07:29 (T-89) 08:10 (T-89)	07:04 19:43	07:25 (T-89) 18:46	07:39 17:01
15	05:55 21:11	06:29 20:35	07:27 (T-89) 08:11 (T-89)	07:05 19:41	07:26 (T-89) 18:44	07:40 17:00
16	05:56 21:10	06:30 20:34	07:26 (T-89) 08:13 (T-89)	07:06 19:39	07:27 (T-89) 18:42	07:41 16:59
17	05:57 21:09	06:31 20:32	07:25 (T-89) 08:14 (T-89)	07:07 19:37	07:28 (T-89) 18:40	07:42 16:58
18	05:58 21:09	06:32 20:31	07:23 (T-89) 08:15 (T-89)	07:09 19:35	07:30 (T-89) 18:39	07:43 16:57
19	05:59 21:08	06:33 20:29	07:22 (T-89) 08:15 (T-89)	07:10 19:33	07:31 (T-89) 18:37	07:44 16:56
20	06:00 21:07	06:35 20:27	07:21 (T-89) 08:16 (T-89)	07:11 19:32	07:32 (T-89) 18:35	07:45 16:55
21	06:01 21:06	06:36 20:26	07:20 (T-89) 08:17 (T-89)	07:12 19:30	07:33 (T-89) 18:34	07:46 16:54
22	06:02 21:05	06:37 20:24	07:18 (T-89) 08:17 (T-89)	07:13 19:28	07:34 (T-89) 18:32	07:47 16:53
23	06:03 21:04	06:38 20:22	07:17 (T-89) 08:18 (T-89)	07:14 19:26	07:35 (T-89) 18:30	07:48 16:53
24	06:04 21:03	06:39 20:21	07:17 (T-89) 08:19 (T-89)	07:16 19:24	07:37 (T-89) 18:29	07:49 16:52
25	06:05 21:02	06:40 20:19	07:16 (T-89) 08:19 (T-89)	07:17 19:22	07:38 (T-89) 18:27	07:50 16:51
26	06:06 21:01	06:42 20:17	07:16 (T-89) 08:19 (T-89)	07:18 19:20	07:39 (T-89) 18:26	07:51 16:50
27	06:07 21:00	06:43 20:16	07:15 (T-89) 08:19 (T-89)	07:19 19:18	07:40 (T-54) 18:24	07:52 16:50
28	06:08 20:59	06:44 20:14	07:14 (T-89) 08:19 (T-89)	07:20 19:16	07:42 (T-54) 18:23	07:53 (T-H) 16:50
29	06:09 20:58	06:45 20:12	07:13 (T-89) 08:19 (T-89)	07:22 19:15	07:43 (T-54) 18:21	07:54 (T-H) 16:49
30	06:10 20:57	06:46 20:10	07:13 (T-89) 08:19 (T-89)	07:23 19:13	07:44 (T-54) 18:20	07:55 (T-H) 16:48
31	06:11 20:56	06:47 20:09	07:12 (T-89) 08:19 (T-89)	07:23 19:13	07:45 (T-54) 18:18	07:56 (T-H) 16:47
Potential sun hours	471	436	377	341	289	275
Total, worst case		1174	1104	35	16	
Sun reduction		0.72	0.67	0.56	0.48	
Oper. time red.		0.90	0.90	0.90	0.90	
Wind dir. red.		0.59	0.59	0.63	0.63	
Total reduction		0.38	0.35	0.32	0.27	
Total, real		447	391	11	4	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-171 - R-171
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December						
1	08:04	07:47	07:06	07:10	06:19	05:46	20:08 (T-39)	05:45	20:15 (T-39)	06:13	06:49	07:24	07:04	07:43				
16:57	17:35	18:13	19:53	20:30	21:04	21:04	30	20:38 (T-39)	21:17	34	20:49 (T-39)	20:55	20:07	19:11	17:17	16:49		
2	08:05	07:46	07:04	07:08	06:17	05:45	20:08 (T-39)	05:46	20:14 (T-39)	06:14	06:50	07:26	07:06	07:45				
16:58	17:37	18:14	19:54	20:31	21:05	21:05	30	20:38 (T-39)	21:16	35	20:49 (T-39)	20:54	20:05	19:09	17:16	16:48		
3	08:05	07:45	07:03	07:06	06:16	05:44	20:09 (T-39)	05:47	20:15 (T-39)	06:15	06:51	07:27	07:07	07:46				
16:59	17:38	18:16	19:55	20:33	21:06	21:06	31	20:40 (T-39)	21:16	34	20:49 (T-39)	20:53	20:03	19:07	17:14	16:48		
4	08:04	07:44	07:01	07:04	06:14	05:44	20:09 (T-39)	05:47	20:16 (T-39)	06:16	06:52	07:28	07:08	07:47				
17:00	17:40	18:17	19:57	20:34	21:07	21:07	32	20:41 (T-39)	21:16	33	20:49 (T-39)	20:51	20:02	19:06	17:13	16:48		
5	08:04	07:42	06:59	07:02	06:13	05:44	20:09 (T-39)	05:48	20:15 (T-39)	06:17	06:54	07:29	07:10	07:48				
17:01	17:41	18:18	19:58	20:35	21:07	21:07	32	20:41 (T-39)	21:16	33	20:48 (T-39)	20:50	20:00	19:04	17:12	16:47		
6	08:04	07:41	06:57	07:00	06:11	05:43	20:09 (T-39)	05:48	20:16 (T-39)	06:19	06:55	07:30	07:11	07:49				
17:02	17:42	18:20	19:59	20:36	21:08	21:08	33	20:42 (T-39)	21:16	32	20:48 (T-39)	20:49	19:58	19:02	17:10	16:47		
7	08:04	07:40	06:56	06:59	06:10	05:43	20:10 (T-39)	05:49	20:16 (T-39)	06:20	06:56	07:32	07:12	07:50				
17:03	17:44	18:21	20:00	20:37	21:09	21:09	33	20:43 (T-39)	21:15	32	20:48 (T-39)	20:47	19:56	19:00	17:09	16:47		
8	08:04	07:39	07:54	06:57	06:09	05:43	20:09 (T-39)	05:50	20:15 (T-39)	06:21	06:57	07:33	07:14	07:51				
17:04	17:45	18:22	20:02	20:39	21:10	21:10	34	20:43 (T-39)	21:15	32	20:47 (T-39)	20:46	19:54	18:56	17:08	16:47		
9	08:04	07:37	07:52	06:55	06:07	05:42	20:10 (T-39)	05:51	20:16 (T-39)	06:22	06:58	07:34	07:15	07:52				
17:05	17:47	19:24	20:03	20:40	21:10	21:10	34	20:44 (T-39)	21:14	31	20:47 (T-39)	20:44	19:52	18:55	17:07	16:47		
10	08:03	07:36	07:50	06:53	06:06	05:42	20:10 (T-39)	05:51	20:16 (T-39)	06:23	06:59	07:35	07:16	07:53				
17:06	17:48	19:25	20:04	20:41	21:11	21:11	34	20:44 (T-39)	21:14	31	20:47 (T-39)	20:43	19:51	18:53	17:06	16:47		
11	08:03	07:34	07:48	06:51	06:05	05:42	20:11 (T-39)	05:52	20:16 (T-39)	06:24	07:01	07:37	07:18	07:54				
17:08	17:49	19:26	20:05	20:42	21:12	21:12	34	20:45 (T-39)	21:13	30	20:46 (T-39)	20:42	19:49	18:51	17:04	16:47		
12	08:03	07:33	07:47	06:50	06:04	05:42	20:11 (T-39)	05:53	20:16 (T-39)	06:25	07:02	07:38	07:19	07:55				
17:09	17:51	19:27	20:07	20:43	21:12	21:12	35	20:46 (T-39)	21:13	29	20:45 (T-39)	20:40	19:47	18:49	17:03	16:47		
13	08:02	07:32	07:45	06:48	06:02	20:17 (T-39)	05:41	05:41	20:17 (T-39)	06:27	07:03	07:39	07:20	07:55				
17:10	17:52	19:29	20:08	20:44	3	20:20 (T-39)	21:13	21:13	35	20:46 (T-39)	21:12	28	20:45 (T-39)	20:39	19:45	18:48	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	20:15 (T-39)	05:41	05:41	20:11 (T-39)	05:55	06:28	07:04	07:40	07:22	07:56			
17:11	17:54	19:30	20:09	20:46	6	20:21 (T-39)	21:13	21:13	35	20:46 (T-39)	21:12	28	20:45 (T-39)	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	20:14 (T-39)	05:41	05:41	20:11 (T-39)	05:56	06:29	07:05	07:42	07:23	07:57			
17:12	17:55	19:31	20:10	20:47	8	20:22 (T-39)	21:14	21:14	35	20:46 (T-39)	21:11	27	20:44 (T-39)	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	20:13 (T-39)	05:41	05:41	20:12 (T-39)	05:56	06:30	07:06	07:43	07:25	07:58			
17:14	17:56	19:33	20:11	20:48	10	20:23 (T-39)	21:14	21:14	36	20:48 (T-39)	21:10	26	20:44 (T-39)	20:34	19:39	18:42	16:59	16:48
17	08:00	07:26	07:37	06:41	05:58	20:12 (T-39)	05:41	05:41	20:12 (T-39)	05:57	06:31	07:08	07:44	07:26	07:58			
17:15	17:58	19:34	20:13	20:49	12	20:24 (T-39)	21:15	21:15	36	20:48 (T-39)	21:10	25	20:42 (T-39)	20:32	19:37	18:41	16:58	16:48
18	08:00	07:24	07:36	06:39	05:57	20:11 (T-39)	05:41	05:41	20:13 (T-39)	05:58	06:32	07:09	07:46	07:27	07:59			
17:16	17:59	19:35	20:14	20:50	14	20:25 (T-39)	21:15	21:15	35	20:48 (T-39)	21:09	24	20:42 (T-39)	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:38	05:56	20:10 (T-39)	05:42	05:42	20:13 (T-39)	05:59	06:34	07:10	07:47	07:28	08:00			
17:17	18:01	19:36	20:15	20:51	16	20:26 (T-39)	21:15	21:15	35	20:48 (T-39)	21:08	23	20:41 (T-39)	20:29	19:34	18:37	16:56	16:49
20	07:58	07:21	07:32	06:36	05:55	20:10 (T-39)	05:42	05:42	20:13 (T-39)	06:00	06:35	07:11	07:48	07:30	08:00			
17:19	18:01	19:38	20:16	20:52	17	20:27 (T-39)	21:16	21:16	35	20:48 (T-39)	21:07	22	20:40 (T-39)	20:28	19:32	18:36	16:56	16:49
21	07:58	07:19	07:30	06:34	05:54	20:09 (T-39)	05:42	05:42	20:19 (T-39)	06:01	06:36	07:12	07:50	07:31	08:01			
17:20	18:02	19:39	20:18	20:53	19	20:28 (T-39)	21:16	21:16	35	20:48 (T-39)	21:07	21	20:40 (T-39)	20:26	19:30	18:34	16:55	16:49
22	07:57	07:18	07:28	06:33	05:53	20:10 (T-39)	05:42	05:42	20:13 (T-39)	06:02	06:37	07:14	07:51	07:32	08:01			
17:21	18:03	19:40	20:19	20:54	20	20:30 (T-39)	21:16	21:16	35	20:48 (T-39)	21:06	20	20:39 (T-39)	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	20:09 (T-39)	05:42	05:42	20:12 (T-39)	06:03	06:38	07:15	07:52	07:34	08:02			
17:23	18:05	19:42	20:20	20:56	21	20:30 (T-39)	21:16	21:16	35	20:49 (T-39)	21:05	18	20:38 (T-39)	20:23	19:26	18:31	16:53	16:51
24	07:55	07:15	07:24	06:29	05:51	20:09 (T-39)	05:43	05:43	20:14 (T-39)	06:04	06:40	07:16	07:53	07:35	08:02			
17:24	18:06	19:43	20:21	20:57	22	20:31 (T-39)	21:17	21:17	35	20:49 (T-39)	21:04	16	20:37 (T-39)	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:23	06:28	05:50	20:08 (T-39)	05:43	05:43	20:13 (T-39)	06:05	06:41	07:17	07:55	07:36	08:03			
17:26	18:08	19:44	20:23	20:58	24	20:32 (T-39)	21:17	21:17	36	20:49 (T-39)	21:03	15	20:36 (T-39)	20:19	19:22	18:28	16:52	16:52
26	07:53	07:11	07:21	06:26	05:50	20:09 (T-39)	05:43	05:43	20:14 (T-39)	06:06	06:42	07:18	07:56	07:37	08:03			
17:27	18:09	19:45	20:24	20:59	24	20:33 (T-39)	21:17	21:17	36	20:50 (T-39)	21:02	13	20:35 (T-39)	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:25	05:49	20:08 (T-39)	05:44	05:44	20:14 (T-39)	06:07	06:43	07:20	07:57	07:39	08:03			
17:28	18:10	19:47	20:25	21:00	26	20:34 (T-39)	21:17	21:17	35	20:49 (T-39)	21:01	11	20:34 (T-39)	20:16	19:19	18:24	16:51	16:53
28	07:51	07:08	07:17	06:23	05:48	20:08 (T-39)	05:44	05:44	20:14 (T-39)	06:08	06:44	07:21	07:59	07:40	08:04			
17:30	18:12	19:48	20:26	21:01	27	20:35 (T-39)	21:17	21:17	35	20:49 (T-39)	21:00	9	20:33 (T-39)	20:14	19:17	18:23	16:50	16:54
29	07:50	07:15	07:25	06:22	05:47	20:09 (T-39)	05:44	05:44	20:15 (T-39)	06:10	06:45	07:22	08:00	07:41	08:04			
17:31	18:09	19:44	20:28	21:01	27	20:36 (T-39)	21:17	21:17	34	20:49 (T-39)	20:59	7	20:32 (T-39)	20:12	19:15	18:21	16:50	16:55
30	07:49	07:13	07:23	06:20	05:47	20:08 (T-39)	05:45	05:45	20:14 (T-39)	06:11	06:47	07:23	08:01	07:42	08:04			
17:32	18:10	19:45	20:29	21:02	28	20:36 (T-39)	21:17	21:17	35	20:49 (T-39)	20:57	4	20:31 (T-39)	20:11	19:13	18:20	16:49	16:55
31	07:48	07:11	07:21	06:24	05:46	20:08 (T-39)	05:45	05:45	20:16 (T-39)	06:12	06:48	07:25	08:03	07:44	08:04			
17:34	18:12	19:47	20:31	21:04	29	20:37 (T-39)	21:18	21:18	35	20:50 (T-39)	21:04	2	20:30 (T-39)	20:09	18:19	17:25	16:56	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275						
Total, worst case						353												

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-172 - R-172
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:10	06:18	05:45	05:45	06:13	06:49	19:33 (T-39)	07:24	07:04	07:43	
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	9	19:42 (T-39)	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	19:33 (T-39)	07:26	07:06	07:45	
	16:58	17:37	18:14	19:54	20:31	21:05	21:16	20:54	20:05	8	19:41 (T-39)	19:09	17:16	16:48
3	08:04	07:45	07:03	07:06	06:16	05:44	05:47	06:15	06:51	19:33 (T-39)	07:27	07:07	07:46	
	16:59	17:38	18:16	19:55	20:32	21:06	21:16	20:53	20:03	6	19:39 (T-39)	19:07	17:14	16:48
4	08:04	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	19:33 (T-39)	07:28	07:08	07:47	
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	4	19:37 (T-39)	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:44	05:48	06:17	06:54	19:34 (T-39)	07:29	07:10	07:48	
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	1	19:35 (T-39)	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55		07:30	07:11	07:49	
	17:02	17:42	18:20	19:59	20:36	21:08	21:15	20:49	19:58		19:02	17:10	16:47	
7	08:04	07:40	06:56	06:59	19:38 (T-39)	06:10	05:43	05:49	06:56		07:32	07:12	07:50	
	17:03	17:44	18:21	20:00	1	19:39 (T-39)	20:37	21:09	21:15		19:00	17:09	16:47	
8	08:04	07:38	07:54	06:57	19:36 (T-39)	06:09	05:42	05:50	06:21		06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	4	19:40 (T-39)	20:39	21:10	21:15		19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	19:35 (T-39)	06:07	05:42	05:51	06:22		06:58	07:34	07:15	07:52
	17:05	17:47	19:24	20:03	6	19:41 (T-39)	20:40	21:10	21:14		19:52	18:55	17:07	16:47
10	08:03	07:36	07:50	06:53	19:34 (T-39)	06:06	05:42	05:51	06:23		06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	8	19:42 (T-39)	20:41	21:11	21:14		19:51	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	19:34 (T-39)	06:05	05:42	05:52	06:24		07:01	07:37	07:18	07:54
	17:08	17:49	19:26	20:05	10	19:44 (T-39)	20:42	21:12	21:13		19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	19:34 (T-39)	06:04	05:42	05:53	06:25		07:02	07:38	07:19	07:55
	17:09	17:51	19:27	20:06	10	19:44 (T-39)	20:43	21:12	21:13		19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	19:34 (T-39)	06:02	05:41	05:54	06:27		07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:08	11	19:45 (T-39)	20:44	21:13	21:12		19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	19:34 (T-39)	06:01	05:41	05:55	06:28		07:04	07:40	07:22	07:56
	17:11	17:54	19:30	20:09	12	19:46 (T-39)	20:46	21:13	21:12		19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	19:35 (T-39)	06:00	05:41	05:55	06:29		07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	13	19:48 (T-39)	20:47	21:14	21:11		19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	19:35 (T-39)	05:59	05:41	05:56	06:30		07:06	07:43	07:24	07:58
	17:14	17:56	19:33	20:11	14	19:49 (T-39)	20:48	21:14	21:10		19:39	18:42	16:59	16:48
17	08:00	07:26	07:37	06:41	19:36 (T-39)	05:58	05:41	05:57	06:31		07:08	07:44	07:26	07:58
	17:15	17:58	19:34	20:13	13	19:49 (T-39)	20:49	21:15	21:10		19:37	18:41	16:58	16:48
18	08:00	07:24	07:36	06:39	19:39 (T-39)	05:57	05:41	05:58	06:32		07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	8	19:47 (T-39)	20:50	21:15	21:09		19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:38	05:56	05:41	05:59	06:34	07:10		07:10	07:47	07:28	08:00
	17:17	18:01	19:36	20:15	20:51	21:15	21:08	20:29	19:34		07:11	18:37	16:56	16:49
20	07:58	07:21	07:32	06:36	05:55	05:42	06:00	06:35	07:11		07:11	07:48	07:30	08:00
	17:19	18:01	19:38	20:16	20:52	21:16	21:07	20:28	19:32		07:12	18:36	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12		07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:18	20:53	21:16	21:06	20:26	19:30		07:13	18:34	16:55	16:49
22	07:57	07:18	07:28	06:33	05:53	05:42	06:02	06:37	07:14		07:14	07:51	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:06	20:24	19:28		07:15	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15		07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:16	21:05	20:23	19:26		07:16	18:31	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16		07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:57	21:16	21:04	20:21	19:24		07:17	18:29	16:52	16:51
25	07:54	07:13	07:23	06:28	05:50	05:43	06:05	06:41	07:17		07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	8	19:50 (T-39)	19:22	18:28	16:52	16:52
26	07:53	07:11	07:21	06:26	05:50	05:43	06:06	06:42	07:18		07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	13	19:52 (T-39)	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:25	05:49	05:44	06:07	06:43	07:19		07:19	07:57	07:39	08:03
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	14	19:51 (T-39)	19:19	18:24	16:51	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21		07:21	07:59	07:40	08:04
	17:30	18:12	19:48	20:26	21:00	21:17	21:00	20:14	13	19:49 (T-39)	19:17	18:23	16:50	16:54
29	07:50	07:15	07:21	06:21	05:47	05:44	06:09	06:45	07:22		07:22	08:00	07:41	08:04
	17:31	18:09	19:49	20:28	21:01	21:17	20:58	20:12	13	19:47 (T-39)	19:15	18:21	16:50	16:54
30	07:49	07:13	07:20	06:20	05:47	05:45	06:11	06:47	07:23		07:23	08:01	07:42	08:04
	17:32	18:09	19:50	20:29	21:02	21:17	20:57	20:11	11	19:45 (T-39)	19:13	18:20	16:49	16:55
31	07:48	07:11	07:18	06:19	05:46	05:44	06:12	06:48	07:24		07:24	08:03	07:43	08:04
	17:34	18:09	19:52	20:31	21:03	21:18	20:56	20:09	10	19:44 (T-39)	19:12	18:19	16:48	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377		341	289	275	
Total, worst case				110					82		28			
Sun reduction				0.63					0.72		0.67			
Oper. time red.				0.90					0.90		0.90			
Wind dir. red.				0.60					0.60		0.60			
Total reduction				0.34					0.39		0.36			
Total, real				37					32		10			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-173 - R-173
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June		
1	08:04	07:47	07:06	17:34 (T-39)	07:10	19:06 (T-40)	06:18	05:45
	16:57	17:35	18:13	11 17:45 (T-39)	19:53	26 19:32 (T-40)	20:30	21:04
2	08:05	07:46	07:04		07:08	19:05 (T-40)	06:17	05:45
	16:58	17:37	18:14		19:54	28 19:33 (T-40)	20:31	21:05
3	08:05	07:45	07:03		07:06	19:04 (T-40)	06:16	05:44
	16:59	17:38	18:16		19:55	30 19:34 (T-40)	20:32	21:06
4	08:04	07:44	07:01		07:04	19:03 (T-40)	06:14	05:44
	17:00	17:39	18:17		19:57	32 19:35 (T-40)	20:34	21:07
5	08:04	07:42	06:59		07:02	19:03 (T-40)	06:13	05:44
	17:01	17:41	18:18		19:58	33 19:36 (T-40)	20:35	21:07
6	08:04	07:41	06:57		07:00	19:03 (T-40)	06:11	05:43
	17:02	17:42	18:20		19:59	35 19:38 (T-40)	20:36	21:08
7	08:04	07:40	06:56		06:59	19:03 (T-40)	06:10	05:43
	17:03	17:44	18:21		20:00	36 19:39 (T-40)	20:37	21:09
8	08:04	07:39	07:54		06:57	19:03 (T-40)	06:09	05:42
	17:04	17:45	18:22		20:02	37 19:40 (T-40)	20:39	21:10
9	08:04	07:37	07:52		06:55	19:03 (T-40)	06:07	05:42
	17:05	17:47	19:24		20:03	38 19:41 (T-40)	20:40	21:10
10	08:03	07:36	07:50		06:53	19:03 (T-40)	06:06	05:42
	17:06	17:48	19:25		20:04	37 19:40 (T-40)	20:41	21:11
11	08:03	07:34	07:48		06:51	19:04 (T-40)	06:05	05:42
	17:08	17:49	19:26		20:05	35 19:39 (T-40)	20:42	21:12
12	08:03	07:33	07:47		06:50	19:04 (T-40)	06:04	05:42
	17:09	17:51	19:27		20:06	34 19:38 (T-40)	20:43	21:12
13	08:02	07:32	07:45		06:48	19:04 (T-40)	06:02	05:41
	17:10	17:52	19:29		20:08	33 19:37 (T-40)	20:44	21:13
14	08:02	07:30	07:43		06:46	19:05 (T-40)	06:01	05:41
	17:11	17:54	19:30		20:09	30 19:35 (T-40)	20:46	21:13
15	08:01	07:29	07:41		06:44	19:07 (T-40)	06:00	05:41
	17:12	17:55	19:31		20:10	27 19:34 (T-40)	20:47	21:14
16	08:01	07:27	07:39		06:43	19:08 (T-40)	05:59	05:41
	17:14	17:56	19:33		20:11	24 19:32 (T-40)	20:48	21:14
17	08:00	07:26	17:31 (T-39)	07:37	06:41	19:09 (T-40)	05:58	05:41
	17:15	17:58	3 17:34 (T-39)	19:34	20:13	20 19:29 (T-40)	20:49	21:15
18	08:00	07:24	17:30 (T-39)	07:36	06:39	19:13 (T-40)	05:57	05:41
	17:16	17:59	5 17:35 (T-39)	19:35	20:14	14 19:27 (T-40)	20:50	21:15
19	07:59	07:23	17:30 (T-39)	07:34	06:38		05:56	05:41
	17:17	18:01	7 17:37 (T-39)	19:36	20:15		20:51	21:15
20	07:58	07:21	17:29 (T-39)	07:32	06:36		05:55	05:42
	17:19	18:01	9 17:38 (T-39)	19:38	20:16		20:52	21:16
21	07:58	07:19	17:28 (T-39)	07:30	06:34		05:54	05:42
	17:20	18:02	11 17:39 (T-39)	19:39	20:18		20:53	21:16
22	07:57	07:18	17:28 (T-39)	07:28	06:33		05:53	05:42
	17:21	18:03	13 17:41 (T-39)	19:40	20:19		20:54	21:16
23	07:56	07:16	17:28 (T-39)	07:26	06:31		05:52	05:42
	17:23	18:05	15 17:43 (T-39)	19:41	20:20		20:56	21:16
24	07:55	07:15	17:28 (T-39)	07:24	06:29		05:51	05:42
	17:24	18:06	16 17:44 (T-39)	19:43	20:21		20:57	21:17
25	07:54	07:13	17:29 (T-39)	07:23	19:18 (T-40)	06:28	05:50	05:43
	17:25	18:07	17 17:46 (T-39)	19:44	5 19:23 (T-40)	20:23	20:58	21:17
26	07:53	07:11	17:29 (T-39)	07:21	9 19:15 (T-40)	06:26	05:50	05:43
	17:27	18:09	18 17:47 (T-39)	19:45	9 19:24 (T-40)	20:24	20:59	21:17
27	07:52	07:09	17:30 (T-39)	07:19	12 19:13 (T-40)	06:25	05:49	05:44
	17:28	18:10	18 17:48 (T-39)	19:47	12 19:25 (T-40)	20:25	21:00	21:17
28	07:51	07:08	17:31 (T-39)	07:17	15 19:11 (T-40)	06:23	05:48	05:44
	17:30	18:12	15 17:46 (T-39)	19:48	15 19:26 (T-40)	20:26	21:01	21:17
29	07:50		07:15	19:09 (T-40)	06:21		05:47	05:44
	17:31		19:49	18 19:27 (T-40)	20:28		21:01	21:17
30	07:49		07:13	19:07 (T-40)	06:20		05:47	05:45
	17:32		19:50	21 19:28 (T-40)	20:29		21:02	21:17
31	07:48		07:11	19:07 (T-40)			05:46	
	17:34		19:52	23 19:30 (T-40)			21:03	
Potential sun hours	287	292	369	403	458	465		
Total, worst case				549				
Sun reduction		0.58	0.59	0.63				
Oper. time red.		0.90	0.90	0.90				
Wind dir. red.		0.59	0.59	0.60				
Total reduction		0.31	0.32	0.34				
Total, real		45	36	185				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-173 - R-173
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	19:03 (T-40) 07:24		07:04 07:43
2	05:46 21:16	06:14 20:54	06:50 20:05	19:02 (T-40) 07:26		17:17 16:49
3	05:46 21:16	06:15 20:53	06:51 20:03	19:01 (T-40) 07:27		07:06 07:45
4	05:47 21:16	06:16 20:51	06:52 20:02	19:00 (T-40) 07:28		17:16 16:48
5	05:48 21:16	06:17 20:50	06:54 20:00	18:59 (T-40) 07:29		07:07 07:46
6	05:48 21:16	06:18 20:49	06:55 19:58	18:58 (T-40) 07:30		17:14 16:48
7	05:49 21:15	06:20 20:47	06:56 19:56	18:58 (T-40) 07:32		07:08 07:47
8	05:50 21:15	06:21 20:46	06:57 19:54	18:58 (T-40) 07:33		17:13 16:48
9	05:51 21:14	06:22 20:44	06:58 19:52	18:58 (T-40) 07:34		07:10 07:48
10	05:51 21:14	06:23 20:43	06:59 19:51	18:58 (T-40) 07:35		17:12 16:47
11	05:52 21:13	06:24 20:42	07:01 19:49	18:58 (T-40) 07:37		07:11 07:49
12	05:53 21:13	06:25 20:40	07:02 19:47	18:58 (T-40) 07:38	18:08 (T-39)	07:12 07:50
13	05:54 21:12	06:27 20:39	07:03 19:45	18:58 (T-40) 07:39	18:15 (T-39)	17:09 16:47
14	05:55 21:12	06:28 20:37	07:04 19:43	18:59 (T-40) 07:40	18:06 (T-39)	07:13 07:55
15	05:55 21:11	06:29 20:36	07:05 19:41	19:01 (T-40) 07:42	18:19 (T-39)	17:07 16:47
16	05:56 21:10	06:30 20:34	07:06 19:39	19:01 (T-40) 07:43	18:20 (T-39)	07:14 07:51
17	05:57 21:10	06:31 20:32	07:08 19:37	19:02 (T-40) 07:44	18:01 (T-39)	17:08 16:47
18	05:58 21:09	06:32 20:31	07:09 19:36	19:03 (T-40) 07:44	18:00 (T-39)	07:15 07:52
19	05:59 21:08	06:34 20:29	07:10 19:34	19:05 (T-40) 07:46	18:15 (T-39)	17:07 16:47
20	06:00 21:07	06:35 20:28	07:11 19:32	19:08 (T-40) 07:47	18:20 (T-39)	17:08 16:47
21	06:01 21:07	06:36 20:26	07:12 19:30	19:09 (T-40) 07:48	18:01 (T-39)	07:19 07:55
22	06:02 21:06	06:37 20:24	07:14 19:28	18:36 12	18:02 (T-39)	17:03 16:47
23	06:03 21:05	06:38 20:23	07:15 19:26	18:47 13	18:06 (T-39)	07:19 07:55
24	06:04 21:04	06:39 20:21	19:21 (T-40) 07:16	18:59 (T-40) 07:40	18:11 (T-39)	17:02 16:47
25	06:05 21:03	06:41 20:19	19:15 (T-40) 07:17	19:18 (T-40) 07:42	18:04 (T-39)	07:22 07:56
26	06:06 21:02	06:42 20:18	19:30 (T-40) 07:22	19:19 (T-40) 07:43	18:20 (T-39)	17:01 16:47
27	06:07 21:01	06:43 20:16	19:12 (T-40) 07:18	19:01 (T-40) 07:42	18:02 (T-39)	07:23 07:57
28	06:08 21:01	06:44 20:14	19:32 (T-40) 07:20	19:17 (T-40) 07:45	18:20 (T-39)	17:00 16:47
29	06:09 20:59	06:45 20:12	19:08 (T-40) 07:21	19:02 (T-40) 07:43	18:20 (T-39)	17:00 16:47
30	06:11 20:57	06:47 20:11	19:35 (T-40) 07:17	19:11 (T-40) 07:39	18:01 (T-39)	07:25 07:58
31	06:12 20:56	06:48 20:09	19:06 (T-40) 07:22	19:11 (T-40) 07:39	18:15 (T-39)	17:02 16:47
Potential sun hours	471	436	377	341	289	275
Total, worst case		187	478	164		
Sun reduction		0.72	0.67	0.56		
Oper. time red.		0.90	0.90	0.90		
Wind dir. red.		0.60	0.60	0.59		
Total reduction		0.39	0.36	0.29		
Total, real		72	172	48		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 V163-4.5 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Assumptions for shadow calculations

Shadow receptor: R-174 - R-174

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Calendar grid showing months January through December with columns for time (hh:mm) and shadow reduction values.

Table layout: For each day in each month the following matrix apply

Matrix with columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-175 - R-175
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04 16:57	07:47 17:35	07:06 18:13	07:09 19:53	19:28 (T-40) 20:30	06:18 20:00 (T-83)
2	08:04 16:58	07:46 17:37	07:04 18:14	07:08 19:54	4 19:32 (T-40) 6 19:33 (T-40)	6 20:06 (T-83) 8 20:08 (T-83)
3	08:04 16:59	07:45 17:38	07:03 18:16	07:06 19:55	7 19:34 (T-40) 8 19:35 (T-40)	9 20:09 (T-83) 11 20:10 (T-83)
4	08:04 17:00	07:44 17:39	07:01 18:17	07:04 19:56	8 19:27 (T-40) 8 19:28 (T-40)	11 19:59 (T-83) 12 20:11 (T-83)
5	08:04 17:01	07:42 17:41	06:59 18:18	07:02 19:58	8 19:36 (T-40) 8 19:29 (T-40)	12 20:11 (T-83) 13 20:12 (T-83)
6	08:04 17:02	07:41 17:42	06:57 18:20	07:00 19:59	8 19:37 (T-40) 8 19:37 (T-40)	13 20:12 (T-83) 14 20:13 (T-83)
7	08:04 17:03	07:40 17:44	06:55 18:21	06:59 20:00	14 20:13 (T-83) 14 20:13 (T-83)	14 20:13 (T-83) 15 20:14 (T-83)
8	08:04 17:04	07:38 17:45	07:54 18:22	06:57 20:01	15 20:14 (T-83) 15 20:14 (T-83)	15 20:14 (T-83) 16 20:16 (T-83)
9	08:04 17:05	07:37 17:47	07:52 19:23	06:55 20:03	16 20:16 (T-83) 16 20:16 (T-83)	16 20:16 (T-83) 17 20:17 (T-83)
10	08:03 17:06	07:36 17:48	07:50 19:25	06:53 20:04	16 20:17 (T-83) 16 20:17 (T-83)	16 20:17 (T-83) 17 20:18 (T-83)
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	15 20:16 (T-83) 15 20:16 (T-83)	15 20:16 (T-83) 16 20:18 (T-83)
12	08:03 17:09	07:33 17:51	07:46 19:27	06:50 20:06	12 20:15 (T-83) 12 20:15 (T-83)	12 20:15 (T-83) 13 20:16 (T-83)
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	9 20:13 (T-83) 9 20:13 (T-83)	9 20:13 (T-83) 10 20:14 (T-83)
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	10 20:14 (T-83) 10 20:14 (T-83)	10 20:14 (T-83) 11 20:15 (T-83)
15	08:01 17:12	07:29 17:55	07:41 19:31	06:44 20:10	11 20:15 (T-83) 11 20:15 (T-83)	11 20:15 (T-83) 12 20:16 (T-83)
16	08:01 17:14	07:27 17:56	07:39 19:33	06:43 20:11	12 20:16 (T-83) 12 20:16 (T-83)	12 20:16 (T-83) 13 20:17 (T-83)
17	08:00 17:15	07:26 17:58	07:37 19:34	06:41 20:13	13 20:17 (T-83) 13 20:17 (T-83)	13 20:17 (T-83) 14 20:18 (T-83)
18	08:00 17:16	07:24 17:59	07:35 19:35	06:39 20:14	14 20:18 (T-83) 14 20:18 (T-83)	14 20:18 (T-83) 15 20:19 (T-83)
19	07:59 17:17	07:22 18:01	07:34 19:36	06:37 20:15	15 20:19 (T-83) 15 20:19 (T-83)	15 20:19 (T-83) 16 20:20 (T-83)
20	07:58 17:19	07:21 18:01	07:32 19:38	06:36 20:16	16 20:20 (T-83) 16 20:20 (T-83)	16 20:20 (T-83) 17 20:21 (T-83)
21	07:57 17:20	07:19 18:02	07:30 19:39	06:34 20:18	17 20:21 (T-83) 17 20:21 (T-83)	17 20:21 (T-83) 18 20:22 (T-83)
22	07:57 17:21	07:18 18:03	07:28 19:40	06:32 20:19	18 20:22 (T-83) 18 20:22 (T-83)	18 20:22 (T-83) 19 20:23 (T-83)
23	07:56 17:23	07:16 18:05	07:26 19:41	06:31 20:20	19 20:23 (T-83) 19 20:23 (T-83)	19 20:23 (T-83) 20 20:24 (T-83)
24	07:55 17:24	07:14 18:06	07:24 19:43	06:29 20:21	20 20:24 (T-83) 20 20:24 (T-83)	20 20:24 (T-83) 21 20:25 (T-83)
25	07:54 17:25	07:13 18:07	07:22 19:44	06:28 20:23	21 20:25 (T-83) 21 20:25 (T-83)	21 20:25 (T-83) 22 20:26 (T-83)
26	07:53 17:27	07:11 18:09	07:21 19:45	06:26 20:24	22 20:26 (T-83) 22 20:26 (T-83)	22 20:26 (T-83) 23 20:27 (T-83)
27	07:52 17:28	07:09 18:10	07:19 19:46	06:24 20:25	23 20:27 (T-83) 23 20:27 (T-83)	23 20:27 (T-83) 24 20:28 (T-83)
28	07:51 17:30	07:08 18:11	07:17 19:48	06:23 20:26	24 20:28 (T-83) 24 20:28 (T-83)	24 20:28 (T-83) 25 20:29 (T-83)
29	07:50 17:31		07:15 19:49	06:21 20:28	25 20:29 (T-83) 25 20:29 (T-83)	25 20:29 (T-83) 26 20:30 (T-83)
30	07:49 17:32		07:13 19:50	06:20 20:29	26 20:30 (T-83) 26 20:30 (T-83)	26 20:30 (T-83) 27 20:31 (T-83)
31	07:48 17:34		07:11 19:51	19:28 (T-40) 19:29 (T-40)	27 20:31 (T-83) 27 20:31 (T-83)	27 20:31 (T-83) 28 20:32 (T-83)
Potential sun hours	287	292	369	403	458	465
Total, worst case			1	47	156	
Sun reduction			0.59	0.63	0.66	
Oper. time red.			0.90	0.90	0.90	
Wind dir. red.			0.60	0.60	0.62	
Total reduction			0.32	0.34	0.37	
Total, real			0	16	58	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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South Deuel Wind Project

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Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-175 - R-175

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45	06:13	20:13 (T-83) 06:49	07:24	07:04	07:43
	21:17	20:55 13	20:26 (T-83) 20:07	19:11	17:17	16:49
2	05:46	06:14	20:11 (T-83) 06:50	07:25	07:05	07:44
	21:16	20:54 16	20:27 (T-83) 20:05	19:09	17:16	16:48
3	05:46	06:15	20:10 (T-83) 06:51	07:27	07:07	07:46
	21:16	20:52 16	20:26 (T-83) 20:03	19:07	17:14	16:48
4	05:47	06:16	20:10 (T-83) 06:52	07:28	07:08	07:47
	21:16	20:51 15	20:25 (T-83) 20:02	19:05	17:13	16:48
5	05:48	06:17	20:10 (T-83) 06:53	07:29	07:10	07:48
	21:16	20:50 14	20:24 (T-83) 20:00	19:04	17:12	16:47
6	05:48	06:18	20:09 (T-83) 06:55	19:25 (T-40) 07:30	07:11	07:49
	21:15	20:49 14	20:23 (T-83) 19:58	19:33 (T-40) 19:02	17:10	16:47
7	05:49	06:20	20:09 (T-83) 06:56	19:23 (T-40) 07:32	07:12	07:50
	21:15	20:47 13	20:22 (T-83) 19:56	19:31 (T-40) 19:00	17:09	16:47
8	05:50	06:21	20:09 (T-83) 06:57	19:22 (T-40) 07:33	07:14	07:51
	21:15	20:46 11	20:20 (T-83) 19:54	19:30 (T-40) 18:56	17:08	16:47
9	05:50	06:22	20:08 (T-83) 06:58	19:21 (T-40) 07:34	07:15	07:52
	21:14	20:44 11	20:19 (T-83) 19:52	19:28 (T-40) 18:55	17:07	16:47
10	05:51	06:23	20:08 (T-83) 06:59	19:20 (T-40) 07:35	07:16	07:53
	21:14	20:43 9	20:17 (T-83) 19:50	19:26 (T-40) 18:53	17:05	16:47
11	05:52	06:24	20:08 (T-83) 07:01	19:20 (T-40) 07:37	07:18	07:54
	21:13	20:42 8	20:16 (T-83) 19:49	19:24 (T-40) 18:51	17:04	16:47
12	05:53	06:25	20:09 (T-83) 07:02	19:20 (T-40) 07:38	07:19	07:54
	21:13	20:40 5	20:14 (T-83) 19:47	19:22 (T-40) 18:49	17:03	16:47
13	05:54	06:26	20:09 (T-83) 07:03	07:39	07:20	07:55
	21:12	20:39 4	20:13 (T-83) 19:45	18:47	17:02	16:47
14	05:55	06:28	20:10 (T-83) 07:04	07:40	07:22	07:56
	21:12	20:37 1	20:11 (T-83) 19:43	18:46	17:01	16:47
15	05:55	06:29	07:05	07:42	07:23	07:57
	21:11	20:36	19:41	18:44	17:00	16:47
16	05:56	06:30	07:06	07:43	07:24	07:58
	21:10	20:34	19:39	18:42	16:59	16:48
17	05:57	06:31	07:08	07:44	07:26	07:58
	21:10	20:32	19:37	18:41	16:58	16:48
18	05:58	06:32	07:09	07:46	07:27	07:59
	21:09	20:31	19:35	18:39	16:57	16:48
19	05:59	06:34	07:10	07:47	07:28	08:00
	21:08	20:29	19:34	18:37	16:56	16:49
20	06:00	06:35	07:11	07:48	07:30	08:00
	21:07	20:28	19:32	18:35	16:55	16:49
21	06:01	06:36	07:12	07:49	07:31	08:01
	21:06	20:26	19:30	18:34	16:55	16:49
22	06:02	06:37	07:13	07:51	07:32	08:01
	21:06	20:24	19:28	18:32	16:54	16:50
23	06:03	06:38	07:15	07:52	07:34	08:02
	21:05	20:23	19:26	18:31	16:53	16:50
24	06:04	06:39	07:16	07:53	07:35	08:02
	21:04	20:21	19:24	18:29	16:52	16:51
25	06:05	06:41	07:17	07:55	07:36	08:03
	21:03	20:19	19:22	18:27	16:52	16:52
26	06:06	06:42	07:18	07:56	07:37	08:03
	21:02	20:17	19:20	18:26	16:51	16:52
27	06:07	06:43	07:19	07:57	07:39	08:03
	21:01	20:16	19:18	18:24	16:51	16:53
28	06:08	06:44	07:21	07:59	07:40	08:04
	21:00	20:14	19:17	18:23	16:50	16:54
29	06:09	06:45	07:22	08:00	07:41	08:04
	20:58	20:12	19:15	18:21	16:49	16:54
30	06:10	20:17 (T-83) 06:46	07:23	08:01	07:42	08:04
	20:57	5 20:22 (T-83) 20:11	19:13	18:20	16:49	16:55
31	06:12	20:14 (T-83) 06:48		08:03		08:04
	20:56	11 20:25 (T-83) 20:09		18:18		16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case	16	150	43			
Sun reduction	0.75	0.72	0.67			
Oper. time red.	0.90	0.90	0.90			
Wind dir. red.	0.62	0.62	0.60			
Total reduction	0.42	0.40	0.36			
Total, real	7	60	15			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)		Last time (hh:mm) with flicker	(WTG causing flicker last time)



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SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-176 - R-176
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:49
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:37	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48
3	08:04	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:48
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:15	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:20	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:01	20:38	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:10	21:14	20:44	19:52	18:54	17:07	16:47
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:13	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:50	06:04	05:41	05:53	06:25	07:02	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:29	20:08	20:44	21:13	21:12	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	19:07 (T-83)	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22
	17:11	17:54	19:30	2	19:09 (T-83)	20:09	20:46	21:13	21:12	20:37	19:43	18:46
15	08:01	07:29	07:41	19:05 (T-83)	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23
	17:12	17:55	19:31	5	19:10 (T-83)	20:10	20:47	21:14	21:11	20:36	19:41	18:44
16	08:01	07:27	07:39	19:04 (T-83)	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:24
	17:13	17:56	19:33	7	19:11 (T-83)	20:11	20:48	21:14	21:10	20:34	19:39	18:42
17	08:00	07:26	07:37	19:04 (T-83)	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26
	17:15	17:58	19:34	9	19:13 (T-83)	20:13	20:49	21:15	21:10	20:32	19:37	18:40
18	08:00	07:24	07:35	19:04 (T-83)	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27
	17:16	17:59	19:35	10	19:14 (T-83)	20:14	20:50	21:15	21:09	20:31	19:35	18:39
19	07:59	07:22	07:34	19:04 (T-83)	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28
	17:17	18:01	19:36	11	19:15 (T-83)	20:15	20:51	21:15	21:08	20:29	19:34	18:37
20	07:58	07:21	07:32	19:04 (T-83)	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30
	17:19	18:01	19:38	12	19:16 (T-83)	20:16	20:52	21:16	21:07	20:28	19:32	10
21	07:57	07:19	07:30	19:04 (T-83)	06:34	05:54	05:42	06:01	06:36	07:12	18:51 (T-83)	18:35
	17:20	18:02	19:39	14	19:18 (T-83)	20:18	20:53	21:16	21:06	20:26	19:30	13
22	07:57	07:18	07:28	19:05 (T-83)	06:32	05:53	05:42	06:02	06:37	07:13	18:50 (T-83)	18:34
	17:21	18:03	19:40	14	19:19 (T-83)	20:19	20:54	21:16	21:06	20:24	19:28	13
23	07:56	07:16	07:26	19:06 (T-83)	06:31	05:52	05:42	06:03	06:38	07:15	18:48 (T-83)	18:32
	17:23	18:05	19:41	11	19:17 (T-83)	20:20	20:55	21:16	21:05	20:23	19:26	13
24	07:55	07:14	07:24	19:10 (T-83)	06:29	05:51	05:42	06:04	06:39	07:16	18:47 (T-83)	18:31
	17:24	18:06	19:43	3	19:13 (T-83)	20:21	20:57	21:16	21:04	20:21	19:24	12
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:41	07:17	07:17	18:47 (T-83)	18:29
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	10	18:57 (T-83)	18:27
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:18	18:46 (T-83)	18:26
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	9	18:55 (T-83)	18:26
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:19	18:46 (T-83)	18:26
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	7	18:53 (T-83)	18:24
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:21	18:47 (T-83)	18:24
	17:30	18:11	19:48	20:26	21:00	21:17	21:00	20:14	19:17	5	18:52 (T-83)	18:23
29	07:50	07:15	07:25	06:21	05:47	05:44	06:09	06:45	07:22	07:22	18:47 (T-83)	18:23
	17:31	18:13	19:49	20:28	21:01	21:17	20:58	20:12	19:15	3	18:50 (T-83)	18:21
30	07:49	07:13	07:23	06:20	05:47	05:45	06:10	06:46	07:23	07:23	18:47 (T-83)	18:21
	17:32	18:15	19:50	20:29	21:02	21:17	20:57	20:11	19:13	1	18:48 (T-83)	18:20
31	07:48	07:11	07:21	05:46	05:46	06:12	06:48	06:48	07:24	07:24	18:48 (T-83)	18:20
	17:34	18:17	19:51	21:03	20:56	20:56	20:09	20:09	18:18	18:18	18:18	18:18
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case			98						96			
Sun reduction			0.59						0.67			
Oper. time red.			0.90						0.90			
Wind dir. red.			0.58						0.58			
Total reduction			0.31						0.35			
Total, real			30						34			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-177 - R-177
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:05 16:57	07:47 17:35	07:06 18:13	07:10 19:53	19:11 (T-34) 21 19:32 (T-34)	06:18 20:30
2	08:05 16:58	07:46 17:37	07:04 18:14	07:08 19:54	19:11 (T-34) 22 19:33 (T-34)	06:17 20:31
3	08:05 16:59	07:45 17:38	07:03 18:16	07:06 19:55	19:11 (T-34) 23 19:34 (T-34)	06:16 20:33
4	08:05 17:00	07:44 17:39	07:01 18:17	07:04 19:57	19:11 (T-34) 24 19:35 (T-34)	06:14 20:34
5	08:04 17:01	07:42 17:41	06:59 18:18	07:02 19:58	19:11 (T-34) 24 19:35 (T-34)	06:13 20:35
6	08:04 17:02	07:41 17:42	06:57 18:20	07:00 19:59	19:13 (T-34) 22 19:35 (T-34)	06:11 20:36
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	19:14 (T-34) 19 19:33 (T-34)	06:10 20:37
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	19:15 (T-34) 16 19:31 (T-34)	06:09 20:39
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 20:03	19:17 (T-34) 10 19:27 (T-34)	06:07 20:40
10	08:03 17:06	07:36 17:48	07:50 19:25	06:53 20:04	20:01 (T-24) 16 20:17 (T-24)	05:42 21:11
11	08:03 17:08	07:34 17:49	07:48 19:26	06:51 20:05	20:01 (T-24) 17 20:18 (T-24)	05:42 21:12
12	08:03 17:09	07:33 17:51	07:47 19:27	06:50 20:07	19:59 (T-24) 19 20:18 (T-24)	05:42 21:12
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	19:59 (T-24) 21 20:20 (T-24)	05:41 21:13
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	19:58 (T-24) 23 20:21 (T-24)	05:41 21:13
15	08:01 17:12	07:29 17:55	07:41 19:31	06:44 20:10	19:58 (T-24) 24 20:22 (T-24)	05:41 21:14
16	08:01 17:14	07:27 17:56	07:39 19:33	06:43 08:00 (T-37)	19:57 (T-24) 26 20:23 (T-24)	05:41 21:14
17	08:00 17:15	07:26 17:58	07:37 19:34	06:41 08:01 (T-37)	19:57 (T-24) 27 20:24 (T-24)	05:41 21:15
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 08:01 (T-37)	19:57 (T-24) 28 20:25 (T-24)	05:41 21:15
19	07:59 17:17	07:23 18:01	07:34 19:36	06:38 19:15 (T-33)	19:57 (T-24) 29 20:26 (T-24)	05:41 21:15
20	07:58 17:19	07:21 18:01	07:32 19:38	06:36 19:16 (T-33)	19:57 (T-24) 30 20:27 (T-24)	05:42 21:16
21	07:58 17:20	07:19 18:02	07:30 19:39	06:34 19:18 (T-33)	19:56 (T-24) 32 20:28 (T-24)	05:42 21:16
22	07:57 17:21	07:18 18:03	07:28 19:40	06:33 19:19 (T-33)	19:57 (T-24) 33 20:30 (T-24)	05:42 21:16
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 19:20 (T-33)	19:57 (T-24) 34 20:31 (T-24)	05:42 21:16
24	07:55 17:24	07:15 18:06	07:24 19:43	06:29 19:12 (T-33)	19:57 (T-24) 34 20:31 (T-24)	05:42 21:17
25	07:54 17:25	07:13 18:08	07:23 19:44	06:28 19:13 (T-33)	19:57 (T-24) 35 20:32 (T-24)	05:43 21:17
26	07:53 17:27	07:11 18:09	07:21 19:45	06:26 19:13 (T-33)	19:57 (T-24) 36 20:33 (T-24)	05:43 21:17
27	07:52 17:28	07:10 18:10	07:19 19:47	06:25 19:14 (T-34)	19:57 (T-24) 37 20:34 (T-24)	05:43 21:17
28	07:51 17:30	07:08 18:12	07:17 19:48	06:23 19:13 (T-34)	19:57 (T-24) 38 20:35 (T-24)	05:44 21:17
29	07:50 17:31		07:15 19:49	06:21 19:12 (T-34)	19:57 (T-24) 38 20:35 (T-24)	05:44 21:17
30	07:49 17:32		07:13 19:50	06:20 19:11 (T-34)	19:58 (T-24) 39 20:37 (T-24)	05:45 21:17
31	07:48 17:34		07:11 19:52	06:20 19:12 (T-34)	19:58 (T-24) 39 20:37 (T-24)	05:45 21:17
Potential sun hours	287	292	369	403	458	465
Total, worst case			180	181	698	1129
Sun reduction			0.59	0.63	0.66	0.73
Oper. time red.			0.90	0.90	0.90	0.90
Wind dir. red.			0.59	0.59	0.63	0.63
Total reduction			0.31	0.34	0.38	0.42
Total, real			57	61	263	470

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-177 - R-177

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December		
1	05:45	20:07 (T-24)	06:13	20:10 (T-24)	06:49	07:24	07:04	07:43
	21:17	37 20:44 (T-24)	20:55	19 20:29 (T-24)	20:07	19:11	17:17	16:49
2	05:46	20:06 (T-24)	06:14	20:11 (T-24)	06:50	07:26	07:06	07:45
	21:17	38 20:44 (T-24)	20:54	16 20:27 (T-24)	20:05	19:09	17:16	16:48
3	05:46	20:07 (T-24)	06:15	20:11 (T-24)	06:51	19:15 (T-34)	07:27	07:07
	21:16	38 20:45 (T-24)	20:53	15 20:26 (T-24)	20:03	10 19:25 (T-34)	19:07	17:14
4	05:47	20:06 (T-24)	06:16	20:12 (T-24)	06:52	19:12 (T-34)	07:28	07:08
	21:16	39 20:45 (T-24)	20:51	13 20:25 (T-24)	20:02	16 19:28 (T-34)	19:06	17:13
5	05:48	20:06 (T-24)	06:17	20:14 (T-24)	06:54	19:10 (T-34)	07:29	07:10
	21:16	40 20:46 (T-24)	20:50	10 20:24 (T-24)	20:00	19 19:29 (T-34)	19:04	17:12
6	05:48	20:07 (T-24)	06:18	20:15 (T-24)	06:55	19:08 (T-34)	07:30	07:11
	21:16	39 20:46 (T-24)	20:49	8 20:23 (T-24)	19:58	22 19:30 (T-34)	19:02	17:10
7	05:49	20:06 (T-24)	06:20	20:17 (T-24)	06:56	19:07 (T-34)	07:32	07:12
	21:15	40 20:46 (T-24)	20:47	5 20:22 (T-24)	19:56	24 19:31 (T-34)	19:00	17:09
8	05:50	20:06 (T-24)	06:21	20:19 (T-24)	06:57	19:06 (T-34)	07:33	07:14
	21:15	41 20:47 (T-24)	20:46	1 20:20 (T-24)	19:54	24 19:30 (T-34)	18:56	17:08
9	05:51	20:07 (T-24)	06:22	06:58	19:05 (T-34)	07:34	07:15	07:52
	21:14	40 20:47 (T-24)	20:45	19:52	23 19:28 (T-34)	18:55	17:07	16:47
10	05:51	20:07 (T-24)	06:23	06:59	19:04 (T-34)	07:35	07:16	07:53
	21:14	40 20:47 (T-24)	20:43	19:51	22 19:26 (T-34)	18:53	17:05	16:47
11	05:52	20:06 (T-24)	06:24	07:01	19:03 (T-34)	07:37	07:18	07:54
	21:14	40 20:46 (T-24)	20:42	19:49	21 19:24 (T-34)	18:51	17:04	16:47
12	05:53	20:06 (T-24)	06:25	07:02	19:03 (T-34)	07:38	07:19	07:55
	21:13	40 20:46 (T-24)	20:40	19:47	19 19:22 (T-34)	18:49	17:03	16:47
13	05:54	20:06 (T-24)	06:27	07:03	19:02 (T-34)	07:39	07:21	07:55
	21:12	39 20:45 (T-24)	20:39	19:45	18 19:20 (T-34)	18:47	17:02	16:47
14	05:55	20:07 (T-24)	06:28	07:04	19:02 (T-34)	07:41	07:22	07:56
	21:12	38 20:45 (T-24)	20:37	19:43	16 19:18 (T-34)	18:46	17:01	16:47
15	05:55	20:07 (T-24)	06:29	07:05	19:03 (T-34)	07:42	07:23	07:57
	21:11	37 20:44 (T-24)	20:36	19:41	14 19:17 (T-34)	18:44	17:00	16:47
16	05:56	20:07 (T-24)	06:30	07:06	19:03 (T-34)	07:43	07:25	07:58
	21:11	37 20:44 (T-24)	20:34	19:39	12 19:15 (T-34)	18:42	16:59	16:48
17	05:57	20:06 (T-24)	06:31	07:08	19:02 (T-33)	07:44	07:26	07:58
	21:10	36 20:42 (T-24)	20:33	19:37	11 19:13 (T-33)	18:41	16:58	16:48
18	05:58	20:06 (T-24)	06:32	07:09	19:00 (T-33)	07:46	07:27	07:59
	21:09	36 20:42 (T-24)	20:31	19:36	11 19:11 (T-33)	18:39	16:57	16:48
19	05:59	20:06 (T-24)	06:34	07:10	18:59 (T-33)	07:47	07:29	08:00
	21:08	35 20:41 (T-24)	20:29	19:34	10 19:09 (T-33)	18:37	16:56	16:49
20	06:00	20:06 (T-24)	06:35	07:11	07:33 (T-37)	07:48	07:30	08:00
	21:07	34 20:40 (T-24)	20:28	19:32	15 19:07 (T-33)	18:36	16:55	16:49
21	06:01	20:07 (T-24)	06:36	07:12	07:34 (T-37)	07:50	07:31	08:01
	21:07	33 20:40 (T-24)	20:26	19:30	16 19:05 (T-33)	18:34	16:55	16:49
22	06:02	20:07 (T-24)	06:37	07:14	07:35 (T-37)	07:51	07:32	08:01
	21:06	32 20:39 (T-24)	20:24	19:28	14 19:03 (T-33)	18:32	16:54	16:50
23	06:03	20:07 (T-24)	06:38	07:15	07:36 (T-37)	07:52	07:34	08:02
	21:05	31 20:38 (T-24)	20:23	19:26	12 19:01 (T-33)	18:31	16:53	16:50
24	06:04	20:07 (T-24)	06:39	07:16	07:37 (T-37)	07:53	07:35	08:02
	21:04	30 20:37 (T-24)	20:21	19:24	9 18:59 (T-33)	18:29	16:52	16:51
25	06:05	20:07 (T-24)	06:41	07:17	07:38 (T-37)	07:55	07:36	08:03
	21:03	29 20:36 (T-24)	20:19	19:22	6 07:44 (T-37)	18:28	16:52	16:52
26	06:06	20:08 (T-24)	06:42	07:18	07:39 (T-37)	07:56	07:38	08:03
	21:02	27 20:35 (T-24)	20:18	19:20	4 07:43 (T-37)	18:26	16:51	16:52
27	06:07	20:08 (T-24)	06:43	07:20	07:41 (T-37)	07:57	07:39	08:03
	21:01	26 20:34 (T-24)	20:16	19:19	2 07:43 (T-37)	18:24	16:51	16:53
28	06:08	20:08 (T-24)	06:44	07:21	07:59	07:59	07:40	08:04
	21:00	25 20:33 (T-24)	20:14	19:17	18:23	16:50	16:54	16:54
29	06:09	20:09 (T-24)	06:45	07:22	08:00	07:41	08:04	08:04
	20:59	23 20:32 (T-24)	20:12	19:15	18:21	16:50	16:54	16:54
30	06:11	20:09 (T-24)	06:47	07:23	08:02	07:42	08:04	08:04
	20:57	22 20:31 (T-24)	20:11	19:13	18:20	16:49	16:55	16:55
31	06:12	20:09 (T-24)	06:48	08:03	08:03	08:03	08:04	08:04
	20:56	21 20:30 (T-24)	20:09	18:19	16:56	16:56	16:56	16:56
Potential sun hours	471	436	377	341	289	275		
Total, worst case	1063	87	370					
Sun reduction	0.75	0.72	0.67					
Oper. time red.	0.90	0.90	0.90					
Wind dir. red.	0.63	0.63	0.59					
Total reduction	0.43	0.41	0.36					
Total, real	455	36	132					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-178 - R-178

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June		
1	08:04	07:47	07:06	17:41 (T-83)	07:09	06:18	05:45	20:32 (T-25)
	16:57	17:35	18:13	10 17:51 (T-83)	19:53	20:30	21:04	6 20:38 (T-25)
2	08:04	07:46	07:04	17:41 (T-83)	07:08	06:17	05:45	20:33 (T-25)
	16:58	17:37	18:14	12 17:53 (T-83)	19:54	20:31	21:05	5 20:38 (T-25)
3	08:04	07:45	07:03	17:40 (T-83)	07:06	06:15	05:44	20:34 (T-25)
	16:59	17:38	18:16	14 17:54 (T-83)	19:55	20:32	21:06	6 20:40 (T-25)
4	08:04	07:44	07:01	17:40 (T-83)	07:04	06:14	05:44	20:34 (T-25)
	17:00	17:39	18:17	15 17:55 (T-83)	19:56	20:34	21:07	6 20:40 (T-25)
5	08:04	07:42	06:59	17:40 (T-83)	07:02	06:13	05:43	20:35 (T-25)
	17:01	17:41	18:18	17 17:57 (T-83)	19:58	20:35	21:07	6 20:41 (T-25)
6	08:04	07:41	06:57	17:40 (T-83)	07:00	06:11	05:43	20:36 (T-25)
	17:02	17:42	18:20	18 17:58 (T-83)	19:59	20:36	21:08	6 20:42 (T-25)
7	08:04	07:40	06:56	17:41 (T-83)	06:59	06:10	05:43	20:36 (T-25)
	17:03	17:44	18:21	18 17:59 (T-83)	20:00	20:37	21:09	6 20:42 (T-25)
8	08:04	07:38	07:54	18:41 (T-83)	06:57	06:09	05:42	20:38 (T-25)
	17:04	17:45	18:22	20 19:01 (T-83)	20:01	20:39	21:10	4 20:42 (T-25)
9	08:04	07:37	07:52	18:42 (T-83)	06:55	06:07	05:42	
	17:05	17:47	19:23	17 18:59 (T-83)	20:03	20:40	21:10	
10	08:03	07:36	07:50	18:44 (T-83)	06:53	06:06	05:42	
	17:06	17:48	19:25	14 18:58 (T-83)	20:04	20:41	21:11	
11	08:03	07:34	07:48	18:47 (T-83)	06:51	06:05	05:42	
	17:07	17:49	19:26	7 18:54 (T-83)	20:05	20:42	21:12	
12	08:03	07:33	07:46		06:50	06:04	05:41	
	17:09	17:51	19:27		20:06	20:43	21:12	
13	08:02	07:32	07:45		06:48	06:02	05:41	
	17:10	17:52	19:29		20:08	20:44	21:13	
14	08:02	07:30	17:28 (T-40)	07:43	06:46	06:01	05:41	
	17:11	17:54	1 17:29 (T-40)	19:30	20:09	20:46	21:13	
15	08:01	07:29	17:28 (T-40)	07:41	06:44	06:00	05:41	
	17:12	17:55	3 17:31 (T-40)	19:31	20:10	20:47	21:14	
16	08:01	07:27	17:28 (T-40)	07:39	06:43	05:59	05:41	
	17:14	17:56	4 17:32 (T-40)	19:33	20:11	20:48	21:14	
17	08:00	07:26	17:28 (T-40)	07:37	06:41	05:58	05:41	
	17:15	17:58	6 17:34 (T-40)	19:34	20:13	20:49	21:15	
18	08:00	07:24	17:28 (T-40)	07:35	06:39	05:57	05:41	
	17:16	17:59	7 17:35 (T-40)	19:35	20:14	20:50	21:15	
19	07:59	07:23	17:29 (T-40)	07:34	06:37	05:56	05:41	
	17:17	18:01	8 17:37 (T-40)	19:36	20:15	20:51	21:15	
20	07:58	07:21	17:30 (T-40)	07:32	06:36	05:55	05:41	
	17:19	18:01	8 17:38 (T-40)	19:38	20:16	20:52	21:16	
21	07:57	07:19	17:31 (T-40)	07:30	06:34	05:54	05:42	
	17:20	18:02	8 17:39 (T-40)	19:39	20:18	20:53	21:16	
22	07:57	07:18		07:28	06:32	05:53	05:42	
	17:21	18:03		19:40	20:19	20:54	21:16	
23	07:56	07:16		07:26	06:31	05:52	05:42	
	17:23	18:05		19:41	20:20	20:55	21:16	
24	07:55	07:14		07:24	06:29	05:51	05:42	
	17:24	18:06		19:43	20:21	20:57	21:16	
25	07:54	07:13		07:22	06:28	05:50	05:43	
	17:25	18:07		19:44	20:23	20:58	21:17	
26	07:53	07:11	17:45 (T-83)	07:21	06:26	05:49	05:43	
	17:27	18:09	2 17:47 (T-83)	19:45	20:24	20:59	21:17	
27	07:52	07:09	17:43 (T-83)	07:19	06:24	05:49	05:43	
	17:28	18:10	5 17:48 (T-83)	19:46	20:25	21:00	21:17	
28	07:51	07:08	17:42 (T-83)	07:17	06:23	05:48	05:44	
	17:30	18:11	7 17:49 (T-83)	19:48	20:26	21:00	21:17	
29	07:50			07:15	06:21	05:47	05:44	
	17:31			19:49	20:28	21:01	21:17	
30	07:49			07:13	06:20	05:47	05:45	
	17:32			19:50	20:29	21:02	21:17	
31	07:48			07:11		05:46	05:45	
	17:34			19:51		21:03	21:17	
Potential sun hours	287	292	369	403	458	465		
Total, worst case			162				45	
Sun reduction		0.59	0.58				0.73	
Oper. time red.		0.90	0.90				0.90	
Wind dir. red.		0.59	0.58				0.64	
Total reduction		0.30	0.30			0.38	0.42	
Total, real		18	49			11	19	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-178 - R-178
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:13	06:49	07:24	07:04	07:43
	21:17	20:55	20:07	19:11	17:17	16:49
2	05:46	06:14	06:50	07:25	07:05	07:45
	21:16	20:54	20:05	19:09	17:16	16:48
3	05:46	06:15	06:51	07:27	18:23 (T-83)	07:07
	21:16	20:52	20:03	19:07	11 18:34 (T-83)	17:14
4	05:47	20:44 (T-25)	06:16	06:52	07:28	18:20 (T-83)
	21:16	3 20:47 (T-25)	20:51	20:02	19:05	16 18:36 (T-83)
5	05:48	20:43 (T-25)	06:17	06:53	07:29	18:18 (T-83)
	21:16	5 20:48 (T-25)	20:50	20:00	19:04	19 18:37 (T-83)
6	05:48	20:43 (T-25)	06:18	06:55	07:30	18:18 (T-83)
	21:15	5 20:48 (T-25)	20:49	19:58	19:02	19 18:37 (T-83)
7	05:49	20:41 (T-25)	06:20	06:56	07:32	18:16 (T-83)
	21:15	6 20:47 (T-25)	20:47	19:56	19:00	19 18:35 (T-83)
8	05:50	20:41 (T-25)	06:21	06:57	07:33	18:15 (T-83)
	21:15	6 20:47 (T-25)	20:46	19:54	18:56	18 18:33 (T-83)
9	05:50	20:41 (T-25)	06:22	06:58	07:34	18:14 (T-83)
	21:14	6 20:47 (T-25)	20:44	19:52	18:55	17 18:31 (T-83)
10	05:51	20:41 (T-25)	06:23	06:59	07:35	18:15 (T-83)
	21:14	6 20:47 (T-25)	20:43	19:51	18:53	14 18:29 (T-83)
11	05:52	20:40 (T-25)	06:24	07:01	07:37	18:14 (T-83)
	21:13	6 20:46 (T-25)	20:42	19:49	18:51	13 18:27 (T-83)
12	05:53	20:40 (T-25)	06:25	07:02	07:38	18:14 (T-83)
	21:13	6 20:46 (T-25)	20:40	19:47	18:49	11 18:25 (T-83)
13	05:54	20:40 (T-25)	06:26	07:03	07:39	18:15 (T-83)
	21:12	5 20:45 (T-25)	20:39	19:45	18:47	9 18:24 (T-83)
14	05:55	20:40 (T-25)	06:28	07:04	07:40	18:15 (T-83)
	21:12	5 20:45 (T-25)	20:37	19:43	18:46	7 18:22 (T-83)
15	05:55	20:40 (T-25)	06:29	07:05	07:42	18:16 (T-83)
	21:11	4 20:44 (T-25)	20:36	19:41	18:44	4 18:20 (T-83)
16	05:56	20:39 (T-25)	06:30	07:06	07:43	18:18 (T-83)
	21:10	4 20:43 (T-25)	20:34	19:39	18:42	1 18:19 (T-83)
17	05:57	20:39 (T-25)	06:31	07:08	07:44	07:26
	21:10	3 20:42 (T-25)	20:32	19:37	18:41	16:58
18	05:58	20:39 (T-25)	06:32	07:09	07:46	07:27
	21:09	3 20:42 (T-25)	20:31	19:35	18:39	16:57
19	05:59	20:40 (T-25)	06:34	07:10	07:47	07:28
	21:08	1 20:41 (T-25)	20:29	19:34	18:37	16:56
20	06:00	06:35	07:11	07:48	18:04 (T-40)	07:30
	21:07	20:28	19:32	18:35	5 18:09 (T-40)	16:55
21	06:01	06:36	07:12	07:49	18:01 (T-40)	07:31
	21:06	20:26	19:30	18:34	8 18:09 (T-40)	16:55
22	06:02	06:37	07:13	07:51	18:00 (T-40)	07:32
	21:06	20:24	19:28	18:32	8 18:08 (T-40)	16:54
23	06:03	06:38	07:15	07:52	17:59 (T-40)	07:34
	21:05	20:23	19:26	18:31	7 18:06 (T-40)	16:53
24	06:04	06:39	07:16	07:53	17:58 (T-40)	07:35
	21:04	20:21	19:24	18:29	6 18:04 (T-40)	16:52
25	06:05	06:41	07:17	07:55	17:58 (T-40)	07:36
	21:03	20:19	19:22	18:27	5 18:03 (T-40)	16:52
26	06:06	06:42	07:18	07:56	17:57 (T-40)	07:37
	21:02	20:18	19:20	18:26	4 18:01 (T-40)	16:51
27	06:07	06:43	07:19	07:57	17:58 (T-40)	07:39
	21:01	20:16	19:18	18:24	2 18:00 (T-40)	16:50
28	06:08	06:44	07:21	07:59	07:40	08:04
	21:00	20:14	19:17	18:23	16:50	16:54
29	06:09	06:45	07:22	08:00	07:41	08:04
	20:58	20:12	19:15	18:21	16:49	16:54
30	06:10	06:46	07:23	08:01	07:42	08:04
	20:57	20:11	19:13	18:20	16:49	16:55
31	06:12	06:48	08:03	08:03	08:04	08:04
	20:56	20:09	18:18	18:18	16:56	16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case	74			223		
Sun reduction	0.75			0.56		
Oper. time red.	0.90			0.90		
Wind dir. red.	0.64			0.58		
Total reduction	0.43			0.29		
Total, real	32			65		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-179 - R-179
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June										
1	08:04	07:47	17:08 (T-40)	07:06	07:09	06:18	05:45	06:09 (T-37)								
	16:57	17:35	1	17:09 (T-40)	18:13	19:53	20:30	21:04	37	20:38 (T-25)						
2	08:05	07:46	17:08 (T-40)	07:04	07:08	06:17	05:45	06:08 (T-37)								
	16:58	17:37	3	17:11 (T-40)	18:14	19:54	20:31	21:05	38	20:38 (T-25)						
3	08:05	07:45	17:08 (T-40)	07:03	07:06	06:16	05:44	06:08 (T-37)								
	16:59	17:38	5	17:13 (T-40)	18:16	19:55	20:32	21:06	41	20:40 (T-25)						
4	08:04	07:44	17:07 (T-40)	07:01	07:04	06:14	05:44	06:07 (T-37)								
	17:00	17:39	7	17:14 (T-40)	18:17	19:56	20:34	21:07	41	20:40 (T-25)						
5	08:04	07:42	17:08 (T-40)	06:59	07:02	06:13	20:10 (T-24)	05:43	06:07 (T-37)							
	17:01	17:41	7	17:15 (T-40)	18:18	19:58	20:35	1	20:11 (T-24)	21:07	43	20:41 (T-25)				
6	08:04	07:41	17:08 (T-40)	06:57	07:00	06:11	20:10 (T-24)	05:43	06:07 (T-37)							
	17:02	17:42	9	17:17 (T-40)	18:20	19:59	20:36	3	20:13 (T-24)	21:08	44	20:42 (T-25)				
7	08:04	07:40	17:08 (T-40)	06:56	06:59	06:10	06:31 (T-38)	05:43	06:06 (T-37)							
	17:03	17:44	10	17:18 (T-40)	18:21	20:00	20:37	4	20:13 (T-24)	21:09	45	20:42 (T-25)				
8	08:04	07:38	17:09 (T-40)	07:54	06:57	06:09	06:30 (T-38)	05:42	06:06 (T-37)							
	17:04	17:45	11	17:20 (T-40)	18:22	20:01	20:39	8	20:14 (T-24)	21:10	46	20:43 (T-25)				
9	08:04	07:37	17:10 (T-40)	07:52	06:55	06:07	06:29 (T-38)	05:42	06:06 (T-37)							
	17:05	17:47	12	17:22 (T-40)	19:23	20:03	20:40	11	20:16 (T-24)	21:10	48	20:44 (T-25)				
10	08:03	07:36	17:11 (T-40)	07:50	06:53	06:06	06:28 (T-38)	05:42	06:06 (T-37)							
	17:06	17:48	12	17:23 (T-40)	19:25	20:04	20:41	12	20:17 (T-24)	21:11	47	20:44 (T-25)				
11	08:03	07:34	17:13 (T-40)	07:48	06:51	06:05	06:27 (T-38)	05:42	06:06 (T-37)							
	17:07	17:49	12	17:25 (T-83)	19:26	20:05	20:42	13	20:18 (T-24)	21:12	48	20:45 (T-25)				
12	08:03	07:33	17:16 (T-40)	07:47	06:50	06:04	06:25 (T-38)	05:41	06:05 (T-37)							
	17:09	17:51	10	17:26 (T-83)	19:27	20:06	20:43	11	06:36 (T-38)	21:12	50	20:45 (T-25)				
13	08:02	07:32	17:17 (T-83)	07:45	06:48	06:02	06:24 (T-38)	05:41	06:05 (T-37)							
	17:10	17:52	11	17:28 (T-83)	19:29	20:08	20:44	13	06:37 (T-38)	21:13	49	20:45 (T-25)				
14	08:02	07:30	17:15 (T-83)	07:43	06:46	06:01	06:23 (T-38)	05:41	06:05 (T-37)							
	17:11	17:54	14	17:29 (T-83)	19:30	20:09	20:46	14	06:37 (T-38)	21:13	50	20:46 (T-25)				
15	08:01	07:29	17:15 (T-83)	07:41	06:44	06:00	06:22 (T-38)	05:41	06:05 (T-37)							
	17:12	17:55	16	17:31 (T-83)	19:31	20:10	20:47	16	06:38 (T-38)	21:14	51	20:46 (T-25)				
16	08:01	07:27	17:14 (T-83)	07:39	06:43	05:59	06:21 (T-38)	05:41	06:05 (T-37)							
	17:14	17:56	18	17:32 (T-83)	19:33	20:11	20:48	17	06:38 (T-38)	21:14	51	20:47 (T-25)				
17	08:00	07:26	17:15 (T-83)	07:37	06:41	05:58	06:20 (T-38)	05:41	06:05 (T-37)							
	17:15	17:58	19	17:34 (T-83)	19:34	20:13	20:49	18	06:38 (T-38)	21:15	51	20:47 (T-25)				
18	08:00	07:24	17:14 (T-83)	07:35	06:39	05:57	06:19 (T-38)	05:41	06:06 (T-37)							
	17:16	17:59	21	17:35 (T-83)	19:35	20:14	20:50	19	06:38 (T-38)	21:15	51	20:48 (T-25)				
19	07:59	07:23	17:14 (T-83)	07:34	06:37	05:56	06:18 (T-38)	05:41	06:06 (T-37)							
	17:17	18:01	23	17:37 (T-83)	19:36	20:15	20:51	20	06:38 (T-38)	21:15	51	20:48 (T-25)				
20	07:58	07:21	17:14 (T-83)	07:32	06:36	05:55	06:17 (T-38)	05:41	06:06 (T-37)							
	17:19	18:01	24	17:38 (T-83)	19:38	20:16	20:52	21	06:38 (T-38)	21:16	52	20:49 (T-25)				
21	07:57	07:19	17:14 (T-83)	07:30	06:34	05:54	06:16 (T-38)	05:42	06:06 (T-37)							
	17:20	18:02	25	17:39 (T-83)	19:39	20:18	20:53	22	06:38 (T-38)	21:16	52	20:49 (T-25)				
22	07:57	07:18	17:15 (T-83)	07:28	06:32	05:53	06:15 (T-38)	05:42	06:06 (T-37)							
	17:21	18:03	26	17:41 (T-83)	19:40	20:19	20:54	23	06:38 (T-37)	21:16	52	20:49 (T-25)				
23	07:56	07:16	17:15 (T-83)	07:26	06:31	05:52	06:15 (T-38)	05:42	06:06 (T-37)							
	17:23	18:05	28	17:43 (T-83)	19:41	20:20	20:56	24	06:39 (T-37)	21:16	51	20:48 (T-25)				
24	07:55	07:14	17:15 (T-83)	07:24	06:29	05:51	06:14 (T-38)	05:42	06:07 (T-37)							
	17:24	18:06	27	17:42 (T-83)	19:43	20:21	20:57	26	06:40 (T-37)	21:17	51	20:49 (T-25)				
25	07:54	07:13	17:17 (T-83)	07:22	06:28	05:50	06:13 (T-38)	05:43	06:07 (T-37)							
	17:25	18:07	24	17:41 (T-83)	19:44	20:23	20:58	27	06:40 (T-37)	21:17	51	20:49 (T-25)				
26	07:53	07:11	17:18 (T-83)	07:21	06:26	05:49	06:12 (T-38)	05:43	06:07 (T-37)							
	17:27	18:09	21	17:39 (T-83)	19:45	20:24	20:59	29	06:41 (T-37)	21:17	51	20:49 (T-25)				
27	07:52	07:09	17:19 (T-83)	07:19	06:24	05:49	06:12 (T-38)	05:43	06:08 (T-37)							
	17:28	18:10	18	17:37 (T-83)	19:46	20:25	21:00	30	06:42 (T-37)	21:17	51	20:49 (T-25)				
28	07:51	07:08	17:21 (T-83)	07:17	06:23	05:48	06:11 (T-38)	05:44	06:08 (T-37)							
	17:30	18:12	13	17:34 (T-83)	19:48	20:26	21:01	31	06:42 (T-37)	21:17	51	20:49 (T-25)				
29	07:50			07:15	06:21	05:47	06:10 (T-38)	05:44	06:09 (T-37)							
	17:31			19:49	20:28	21:01	06:42 (T-37)	21:17	50	20:50 (T-25)						
30	07:49			07:13	06:20	05:47	06:10 (T-37)	05:45	06:09 (T-37)							
	17:32			19:50	20:29	21:02	20:37 (T-25)	21:17	50	20:49 (T-25)						
31	07:48			07:11	05:46	05:46	06:09 (T-37)									
	17:34			19:51	21:03	21:03	20:37 (T-25)									
Potential sun hours	287	292	369	403	458	465										
Total, worst case			427				514		1444							
Sun reduction			0.58				0.66		0.73							
Oper. time red.			0.90				0.90		0.90							
Wind dir. red.			0.59				0.59		0.60							
Total reduction			0.31				0.35		0.39							
Total, real			131				181		566							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-179 - R-179
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:10 (T-37) 20:49 (T-25)	06:13 20:55	06:36 (T-38) 20:29 (T-24)	06:49 20:07	07:24 19:11
2	05:46 21:16	06:10 (T-37) 20:49 (T-25)	06:14 20:54	06:37 (T-38) 20:27 (T-24)	06:50 20:05	07:26 19:09
3	05:46 21:16	06:11 (T-37) 20:49 (T-25)	06:15 20:53	06:38 (T-38) 20:26 (T-24)	06:51 20:03	07:27 19:07
4	05:47 21:16	06:11 (T-37) 20:48 (T-25)	06:16 20:51	06:39 (T-38) 20:25 (T-24)	06:52 20:02	07:28 19:05
5	05:48 21:16	06:12 (T-37) 20:48 (T-25)	06:17 20:50	06:41 (T-38) 20:24 (T-24)	06:54 20:00	07:29 19:04
6	05:48 21:16	06:13 (T-37) 20:48 (T-25)	06:18 20:49	20:20 (T-24) 20:23 (T-24)	06:55 19:58	07:30 19:02
7	05:49 21:15	06:13 (T-37) 20:47 (T-25)	06:20 20:47	20:20 (T-24) 20:22 (T-24)	06:56 19:56	07:32 19:00
8	05:50 21:15	06:14 (T-37) 20:47 (T-25)	06:21 20:46	20:19 (T-24) 20:20 (T-24)	06:57 19:54	07:33 18:56
9	05:50 21:14	06:15 (T-37) 20:47 (T-25)	06:22 20:44	06:58 19:52	07:34 18:55	07:34 17:07
10	05:51 21:14	06:16 (T-37) 20:47 (T-25)	06:23 20:43	06:59 19:51	07:35 18:53	07:35 17:05
11	05:52 21:13	06:16 (T-37) 20:46 (T-25)	06:24 20:42	07:01 19:49	07:37 18:51	07:37 17:04
12	05:53 21:13	06:17 (T-37) 20:46 (T-25)	06:25 20:40	07:02 19:47	07:38 18:49	07:38 17:03
13	05:54 21:12	06:18 (T-37) 20:46 (T-25)	06:26 20:39	07:03 19:45	07:39 18:47	07:39 17:02
14	05:55 21:12	06:19 (T-37) 20:46 (T-25)	06:28 20:37	07:04 19:43	07:40 18:46	07:40 17:01
15	05:55 21:11	06:20 (T-38) 20:46 (T-25)	06:29 20:36	07:05 19:41	07:42 18:44	07:42 17:00
16	05:56 21:10	06:20 (T-38) 20:46 (T-25)	06:30 20:34	07:06 19:39	07:43 18:42	07:43 17:59
17	05:57 21:10	06:21 (T-38) 20:46 (T-25)	06:31 20:32	07:08 19:37	07:44 18:41	07:44 17:58
18	05:58 21:09	06:22 (T-38) 20:46 (T-25)	06:32 20:31	07:09 19:35	07:46 18:39	07:46 17:57
19	05:59 21:08	06:23 (T-38) 20:46 (T-25)	06:34 20:29	07:10 19:34	07:47 18:37	07:47 17:56
20	06:00 21:07	06:24 (T-38) 20:46 (T-25)	06:35 20:28	07:11 19:32	07:48 18:35	07:48 17:55
21	06:01 21:06	06:25 (T-38) 20:46 (T-25)	06:36 20:26	07:12 19:30	07:49 18:34	07:49 17:54
22	06:02 21:06	06:26 (T-38) 20:46 (T-25)	06:37 20:24	07:13 19:28	07:51 18:32	07:51 17:53
23	06:03 21:05	06:27 (T-38) 20:46 (T-25)	06:38 20:23	07:15 19:26	07:52 18:31	07:52 17:52
24	06:04 21:04	06:28 (T-38) 20:46 (T-25)	06:39 20:21	07:16 19:24	07:53 18:29	07:53 17:51
25	06:05 21:03	06:29 (T-38) 20:46 (T-25)	06:41 20:19	07:17 19:22	07:55 18:27	07:55 17:50
26	06:06 21:02	06:30 (T-38) 20:46 (T-25)	06:42 20:18	07:18 19:20	07:56 18:26	07:56 17:49
27	06:07 21:01	06:31 (T-38) 20:46 (T-25)	06:43 20:16	07:19 19:19	07:57 18:24	07:57 17:48
28	06:08 21:00	06:32 (T-38) 20:46 (T-25)	06:44 20:14	07:21 19:17	07:59 18:23	07:59 17:47
29	06:09 20:58	06:33 (T-38) 20:46 (T-25)	06:45 20:12	07:22 19:15	08:00 18:21	08:00 17:46
30	06:10 20:57	06:34 (T-38) 20:46 (T-25)	06:46 20:11	07:23 19:13	08:01 18:20	08:01 17:45
31	06:12 20:56	06:35 (T-38) 20:46 (T-25)	06:48 20:09	08:03 19:11	08:03 18:18	08:04 17:44
Potential sun hours	471	436	377	341	289	275
Total, worst case	959	59	354	75		
Sun reduction	0.75	0.72	0.56	0.48		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.59	0.60	0.59	0.59		
Total reduction	0.40	0.39	0.30	0.25		
Total, real	383	23	105	19		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
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Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-180 - R-180
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June			
1	08:05	07:47	07:06	07:33 (T-37)	07:10	19:08 (T-24)	06:18	19:19 (T-25)	05:45
	16:57	17:35	18:13	5 07:38 (T-37)	19:53	23 19:31 (T-24)	20:30	44 20:03 (T-25)	21:04
2	08:05	07:46	07:04	17:50 (T-34)	07:08	19:09 (T-24)	06:17	19:19 (T-25)	05:45
	16:58	17:37	18:14	3 17:53 (T-34)	19:54	20 19:29 (T-24)	20:31	42 20:01 (T-25)	21:05
3	08:05	07:45	07:03	17:48 (T-34)	07:06	19:10 (T-24)	06:16	19:20 (T-25)	05:44
	16:59	17:38	18:16	6 17:54 (T-34)	19:55	17 19:27 (T-24)	20:33	41 20:01 (T-25)	21:06
4	08:05	07:44	07:01	17:48 (T-34)	07:04	19:12 (T-24)	06:14	19:20 (T-25)	05:44
	17:00	17:39	18:17	7 17:55 (T-33)	19:57	12 19:24 (T-24)	20:34	40 20:00 (T-25)	21:07
5	08:04	07:42	06:59	17:48 (T-34)	07:02		06:13	19:21 (T-25)	05:43
	17:01	17:41	18:18	9 17:57 (T-33)	19:58		20:35	38 19:59 (T-25)	21:08
6	08:04	07:41	06:57	17:48 (T-34)	07:00		06:11	19:22 (T-25)	05:43
	17:02	17:42	18:20	10 17:58 (T-33)	19:59		20:36	37 19:59 (T-25)	21:08
7	08:04	07:40	06:56	07:16 (T-38)	06:59		06:10	19:22 (T-25)	05:43
	17:03	17:44	18:21	14 17:59 (T-33)	20:00		20:37	35 19:57 (T-25)	21:09
8	08:04	07:39	07:54	08:14 (T-38)	06:57		06:09	19:23 (T-25)	05:42
	17:04	17:45	18:22	18 19:01 (T-33)	20:02		20:39	33 19:56 (T-25)	21:10
9	08:04	07:37	07:52	08:12 (T-38)	06:55	19:37 (T-25)	06:07	19:25 (T-25)	05:42
	17:05	17:47	19:24	19 19:02 (T-33)	20:03	4 19:41 (T-25)	20:40	30 19:55 (T-25)	21:10
10	08:03	07:36	07:50	08:11 (T-38)	06:53	19:33 (T-25)	06:06	19:26 (T-25)	05:42
	17:06	17:48	19:25	20 19:04 (T-34)	20:04	9 19:42 (T-25)	20:41	28 19:54 (T-25)	21:11
11	08:03	07:34	07:48	08:09 (T-38)	06:51	19:31 (T-25)	06:05	19:28 (T-25)	05:42
	17:07	17:49	19:26	18 19:03 (T-34)	20:05	13 19:44 (T-25)	20:42	24 19:52 (T-25)	21:12
12	08:03	07:33	07:47	08:07 (T-38)	06:50	19:29 (T-25)	06:04	19:29 (T-25)	05:41
	17:09	17:51	19:27	11 18:59 (T-34)	20:07	16 19:45 (T-25)	20:43	20 19:49 (T-25)	21:12
13	08:02	07:32	07:45		06:48	19:27 (T-25)	06:02	19:32 (T-25)	05:41
	17:10	17:52	19:29		20:08	18 19:45 (T-25)	20:45	15 19:47 (T-25)	21:13
14	08:02	07:30	07:43		06:46	19:25 (T-25)	06:01	19:36 (T-25)	05:41
	17:11	17:54	19:30		20:09	21 19:46 (T-25)	20:46	7 19:43 (T-25)	21:13
15	08:01	07:29	07:41		06:44	19:24 (T-25)	06:00		05:41
	17:12	17:55	19:31		20:10	24 19:48 (T-25)	20:47		21:14
16	08:01	07:27	07:39		06:43	19:23 (T-25)	05:59		05:41
	17:14	17:56	19:33		20:11	26 19:49 (T-25)	20:48		21:14
17	08:00	07:26	07:37		06:41	19:22 (T-25)	05:58		05:41
	17:15	17:58	19:34		20:13	28 19:50 (T-25)	20:49		21:15
18	08:00	07:24	07:36		06:39	19:21 (T-25)	05:57		05:41
	17:16	17:59	19:35		20:14	31 19:52 (T-25)	20:50		21:15
19	07:59	07:23	07:44 (T-37)	07:34	19:13 (T-24)	06:38	19:20 (T-25)	05:56	05:41
	17:17	18:01	2 07:46 (T-37)	19:36	2 19:15 (T-24)	20:15	33 19:53 (T-25)	20:51	21:15
20	07:58	07:21	07:42 (T-37)	07:32	19:11 (T-24)	06:36	19:19 (T-25)	05:55	05:42
	17:19	18:01	5 07:47 (T-37)	19:38	5 19:16 (T-24)	20:16	34 19:53 (T-25)	20:52	21:16
21	07:58	07:19	07:40 (T-37)	07:30	19:10 (T-24)	06:34	19:19 (T-25)	05:54	05:42
	17:20	18:02	7 07:47 (T-37)	19:39	8 19:18 (T-24)	20:18	36 19:55 (T-25)	20:53	21:16
22	07:57	07:18	07:39 (T-37)	07:28	19:08 (T-24)	06:33	19:18 (T-25)	05:53	05:42
	17:21	18:03	8 07:47 (T-37)	19:40	11 19:19 (T-24)	20:19	38 19:56 (T-25)	20:55	21:16
23	07:56	07:16	07:37 (T-37)	07:26	19:07 (T-24)	06:31	19:19 (T-25)	05:52	05:42
	17:23	18:05	10 07:47 (T-37)	19:42	13 19:20 (T-24)	20:20	39 19:58 (T-25)	20:56	21:16
24	07:55	07:15	07:35 (T-37)	07:24	19:07 (T-24)	06:29	19:18 (T-25)	05:51	05:42
	17:24	18:06	11 07:46 (T-37)	19:43	15 19:22 (T-24)	20:21	41 19:59 (T-25)	20:57	21:17
25	07:54	07:13	07:34 (T-37)	07:23	19:07 (T-24)	06:28	19:17 (T-25)	05:50	05:43
	17:25	18:07	12 07:46 (T-37)	19:44	16 19:23 (T-24)	20:23	42 19:59 (T-25)	20:58	21:17
26	07:53	07:11	07:32 (T-37)	07:21	19:06 (T-24)	06:26	19:18 (T-25)	05:49	05:43
	17:27	18:09	13 07:45 (T-37)	19:45	18 19:24 (T-24)	20:24	43 20:01 (T-25)	20:59	21:17
27	07:52	07:10	07:30 (T-37)	07:19	19:06 (T-24)	06:25	19:17 (T-25)	05:49	05:43
	17:28	18:10	13 07:43 (T-37)	19:47	19 19:25 (T-24)	20:25	45 20:02 (T-25)	21:00	21:17
28	07:51	07:08	07:30 (T-37)	07:17	19:06 (T-24)	06:23	19:18 (T-25)	05:48	05:44
	17:30	18:12	12 07:42 (T-37)	19:48	20 19:26 (T-24)	20:26	45 20:03 (T-25)	21:01	21:17
29	07:50		07:15	07:15	19:06 (T-24)	06:21	19:18 (T-25)	05:47	05:44
	17:31		19:49	21 19:27 (T-24)	20:28	45 20:03 (T-25)	21:02		21:17
30	07:49		07:13	19:06 (T-24)	06:20	19:18 (T-25)	05:47		05:45
	17:32		19:50	22 19:28 (T-24)	20:29	45 20:03 (T-25)	21:02		21:17
31	07:48		07:11	19:07 (T-24)			05:46		
	17:34		19:52	23 19:30 (T-24)			21:03		
Potential sun hours	287	292	369	403	459	465			
Total, worst case									
Sun reduction		93	333	748	434				
Oper. time red.		0.58	0.59	0.63	0.66				
Wind dir. red.		0.90	0.90	0.90	0.90				
Total reduction		0.61	0.59	0.60	0.60				
Total, real		0.32	0.31	0.34	0.35				
		30	104	253	154				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
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Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-180 - R-180

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December			
1	05:45	06:13	19:39 (T-25)	06:49	19:30 (T-25)	07:24	07:45 (T-38)	07:04	07:43
	21:17	20:55	22 20:01 (T-25)	20:07	13 19:43 (T-25)	19:11	5 07:50 (T-38)	17:17	16:49
2	05:46	06:14	19:37 (T-25)	06:50	19:32 (T-25)	07:26	07:47 (T-38)	07:06	07:45
	21:17	20:54	25 20:02 (T-25)	20:05	9 19:41 (T-25)	19:09	16 18:41 (T-34)	17:16	16:48
3	05:46	06:15	19:35 (T-25)	06:51	19:35 (T-25)	07:27	07:48 (T-38)	07:07	07:46
	21:16	20:53	29 20:04 (T-25)	20:03	4 19:39 (T-25)	19:07	20 18:42 (T-34)	17:14	16:48
4	05:47	06:16	19:34 (T-25)	06:52		07:28	07:49 (T-38)	07:08	07:47
	21:16	20:51	31 20:05 (T-25)	20:02		19:06	19 18:40 (T-33)	17:13	16:48
5	05:48	06:17	19:34 (T-25)	06:54		07:29	07:50 (T-38)	07:10	07:48
	21:16	20:50	33 20:07 (T-25)	20:00		19:04	17 18:38 (T-33)	17:12	16:47
6	05:48	06:18	19:32 (T-25)	06:55		07:30	07:52 (T-38)	07:11	07:49
	21:16	20:49	36 20:08 (T-25)	19:58		19:02	16 18:37 (T-33)	17:10	16:47
7	05:49	06:20	19:31 (T-25)	06:56		07:32	07:53 (T-38)	07:12	07:50
	21:15	20:47	37 20:08 (T-25)	19:56		19:00	13 18:35 (T-33)	17:09	16:47
8	05:50	06:21	19:30 (T-25)	06:57	19:08 (T-24)	07:33	18:23 (T-34)	07:14	07:51
	21:15	20:46	39 20:09 (T-25)	19:54	10 19:18 (T-24)	18:56	10 18:33 (T-33)	17:08	16:47
9	05:50	06:22	19:29 (T-25)	06:58	19:04 (T-24)	07:34	18:22 (T-34)	07:15	07:52
	21:14	20:45	41 20:10 (T-25)	19:52	17 19:21 (T-24)	18:55	8 18:30 (T-33)	17:07	16:47
10	05:51	06:23	19:28 (T-25)	06:59	19:02 (T-24)	07:35	18:23 (T-34)	07:16	07:53
	21:14	20:43	42 20:10 (T-25)	19:51	20 19:22 (T-24)	18:53	6 18:29 (T-34)	17:05	16:47
11	05:52	06:24	19:27 (T-25)	07:01	19:00 (T-24)	07:37	18:23 (T-34)	07:18	07:54
	21:14	20:42	43 20:10 (T-25)	19:49	23 19:23 (T-24)	18:51	4 18:27 (T-34)	17:04	16:47
12	05:53	06:25	19:27 (T-25)	07:02	18:58 (T-24)	07:38	18:23 (T-34)	07:19	07:55
	21:13	20:40	43 20:10 (T-25)	19:47	24 19:22 (T-24)	18:49	2 18:25 (T-34)	17:03	16:47
13	05:54	06:27	19:26 (T-25)	07:03	18:57 (T-24)	07:39	08:05 (T-37)	07:21	07:55
	21:12	20:39	45 20:11 (T-25)	19:45	23 19:20 (T-24)	18:47	8 08:13 (T-37)	17:02	16:47
14	05:55	06:28	19:26 (T-25)	07:04	18:56 (T-24)	07:40	08:02 (T-37)	07:22	07:56
	21:12	20:37	46 20:12 (T-25)	19:43	22 19:18 (T-24)	18:46	13 08:15 (T-37)	17:01	16:47
15	05:55	06:29	19:26 (T-25)	07:05	18:56 (T-24)	07:42	08:03 (T-37)	07:23	07:57
	21:11	20:36	45 20:11 (T-25)	19:41	21 19:17 (T-24)	18:44	13 08:16 (T-37)	17:00	16:47
16	05:56	06:30	19:25 (T-25)	07:06	18:55 (T-24)	07:43	08:05 (T-37)	07:25	07:58
	21:11	20:34	44 20:09 (T-25)	19:39	20 19:15 (T-24)	18:42	12 08:17 (T-37)	16:59	16:48
17	05:57	06:31	19:24 (T-25)	07:08	18:54 (T-24)	07:44	08:06 (T-37)	07:26	07:58
	21:10	20:33	43 20:07 (T-25)	19:37	19 19:13 (T-24)	18:41	12 08:18 (T-37)	16:58	16:48
18	05:58	06:32	19:24 (T-25)	07:09	18:54 (T-24)	07:46	08:07 (T-37)	07:27	07:59
	21:09	20:31	42 20:06 (T-25)	19:36	17 19:11 (T-24)	18:39	11 08:18 (T-37)	16:57	16:48
19	05:59	06:34	19:24 (T-25)	07:10	18:54 (T-24)	07:47	08:09 (T-37)	07:29	08:00
	21:08	20:29	40 20:04 (T-25)	19:34	15 19:09 (T-24)	18:37	9 08:18 (T-37)	16:56	16:49
20	06:00	06:35	19:23 (T-25)	07:11	18:54 (T-24)	07:48	08:10 (T-37)	07:30	08:00
	21:07	20:28	39 20:02 (T-25)	19:32	13 19:07 (T-24)	18:36	8 08:18 (T-37)	16:55	16:49
21	06:01	06:36	19:23 (T-25)	07:12	18:54 (T-24)	07:50	08:11 (T-37)	07:31	08:01
	21:07	20:26	38 20:01 (T-25)	19:30	10 19:04 (T-24)	18:34	6 08:17 (T-37)	16:55	16:49
22	06:02	06:37	19:23 (T-25)	07:14	18:55 (T-24)	07:51	08:13 (T-37)	07:32	08:01
	21:06	20:24	36 19:59 (T-25)	19:28	8 19:03 (T-24)	18:32	4 08:17 (T-37)	16:54	16:50
23	06:03	06:38	19:24 (T-25)	07:15	18:55 (T-24)	07:52	08:14 (T-37)	07:34	08:02
	21:05	20:23	34 19:58 (T-25)	19:26	6 19:01 (T-24)	18:31	2 08:16 (T-37)	16:53	16:50
24	06:04	06:39	19:24 (T-25)	07:16	18:56 (T-24)	07:53		07:35	08:02
	21:04	20:21	32 19:56 (T-25)	19:24	3 18:59 (T-24)	18:29		16:52	16:51
25	06:05	06:41	19:24 (T-25)	07:17		07:55		07:36	08:03
	21:03	20:19	31 19:55 (T-25)	19:22		18:28		16:52	16:52
26	06:06	06:42	19:24 (T-25)	07:18		07:56		07:37	08:03
	21:02	20:18	29 19:53 (T-25)	19:20		18:26		16:51	16:52
27	06:07	06:43	19:25 (T-25)	07:20		07:57		07:39	08:03
	21:01	20:16	26 19:51 (T-25)	19:19		18:24		16:51	16:53
28	06:08	06:44	19:25 (T-25)	07:21		07:59		07:40	08:04
	21:00	20:14	24 19:49 (T-25)	19:17		18:23		16:50	16:54
29	06:09	06:45	19:26 (T-25)	07:22		08:00		07:41	08:04
	20:59	20:12	21 19:47 (T-25)	19:15		18:21		16:49	16:54
30	06:11	19:44 (T-25)	06:47	19:27 (T-25)	07:23	08:02		07:42	08:04
	20:57	12 19:56 (T-25)	20:11	18 19:45 (T-25)	19:13	18:20		16:49	16:55
31	06:12	19:41 (T-25)	06:48	19:29 (T-25)		08:03		08:04	08:04
	20:56	18 19:59 (T-25)	20:09	15 19:44 (T-25)		18:19		16:56	16:56
Potential sun hours	471	436		377		341		289	275
Total, worst case	30	1069		297		234			
Sun reduction	0.75	0.72		0.67		0.56			
Oper. time red.	0.90	0.90		0.90		0.90			
Wind dir. red.	0.60	0.60		0.59		0.59			
Total reduction	0.40	0.39		0.36		0.30			
Total, real	12	413		106		70			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-181 - R-181
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-37)	07:47		07:09	06:18
	16:57 35	09:04 (T-37)	17:35		19:53	20:30
2	08:05	08:30 (T-37)	07:46		07:08	06:17
	16:58 35	09:05 (T-37)	17:37		19:54	20:31
3	08:05	08:30 (T-37)	07:45		07:06	06:15
	16:59 35	09:05 (T-37)	17:38		19:55	20:33
4	08:05	08:31 (T-37)	07:44		07:04	06:14
	17:00 34	09:05 (T-37)	17:39		19:56	20:34
5	08:04	08:32 (T-37)	07:42	08:04 (T-38)	06:59	
	17:01 34	09:06 (T-37)	17:41	1 08:05 (T-38)	18:18	
6	08:04	08:32 (T-37)	07:41	08:03 (T-38)	06:57	
	17:02 33	09:05 (T-37)	17:42	3 08:06 (T-38)	18:20	
7	08:04	08:33 (T-37)	07:40	08:01 (T-38)	06:56	
	17:03 33	09:06 (T-37)	17:44	6 08:07 (T-38)	18:21	
8	08:04	08:34 (T-37)	07:39	08:00 (T-38)	07:54	
	17:04 32	09:06 (T-37)	17:45	8 08:08 (T-38)	18:22	
9	08:04	08:35 (T-37)	07:37	07:59 (T-38)	07:52	
	17:05 31	09:06 (T-37)	17:47	10 08:09 (T-38)	19:23	
10	08:03	08:35 (T-37)	07:36	07:57 (T-38)	07:50	
	17:06 31	09:06 (T-37)	17:48	12 08:09 (T-38)	19:25	
11	08:03	08:36 (T-37)	07:34	07:56 (T-38)	07:48	
	17:07 30	09:06 (T-37)	17:49	13 08:09 (T-38)	19:26	
12	08:03	08:36 (T-37)	07:33	07:54 (T-38)	07:47	
	17:09 30	09:06 (T-37)	17:51	15 08:09 (T-38)	19:27	
13	08:02	08:38 (T-37)	07:32	07:53 (T-38)	07:45	19:05 (T-24)
	17:10 28	09:06 (T-37)	17:52	16 08:09 (T-38)	19:29	2 19:07 (T-24)
14	08:02	08:38 (T-37)	07:30	07:51 (T-38)	07:43	19:04 (T-24)
	17:11 27	09:05 (T-37)	17:54	18 08:09 (T-38)	19:30	4 19:08 (T-24)
15	08:01	08:40 (T-37)	07:29	07:50 (T-38)	07:41	19:04 (T-24)
	17:12 25	09:05 (T-37)	17:55	19 08:09 (T-38)	19:31	6 19:10 (T-24)
16	08:01	08:41 (T-37)	07:27	07:48 (T-38)	07:39	19:04 (T-24)
	17:13 23	09:04 (T-37)	17:56	20 08:08 (T-38)	19:33	7 19:11 (T-24)
17	08:00	08:42 (T-37)	07:26	07:47 (T-38)	07:37	19:05 (T-24)
	17:15 21	09:03 (T-37)	17:58	21 08:08 (T-38)	19:34	8 19:13 (T-24)
18	08:00	08:44 (T-37)	07:24	07:46 (T-38)	07:35	19:06 (T-24)
	17:16 19	09:03 (T-37)	17:59	20 08:06 (T-38)	19:35	8 19:14 (T-24)
19	07:59	08:46 (T-37)	07:23	07:47 (T-38)	07:34	19:08 (T-24)
	17:17 16	09:02 (T-37)	18:01	18 08:05 (T-38)	19:36	7 19:15 (T-24)
20	07:58	08:48 (T-37)	07:21	07:49 (T-38)	07:32	07:52 (T-82)
	17:19 11	08:59 (T-37)	18:01	14 08:03 (T-38)	19:38	5 19:16 (T-25)
21	07:58		07:19	07:51 (T-38)	07:30	07:50 (T-82)
	17:20		18:02	9 08:00 (T-38)	19:39	12 19:18 (T-25)
22	07:57		07:18	07:28	07:28	07:48 (T-82)
	17:21		18:03		19:40	16 19:19 (T-25)
23	07:56		07:16	07:26	07:26	07:46 (T-82)
	17:23		18:05	19:41	20 19:20 (T-25)	20:20
24	07:55		07:14	07:24	07:45 (T-82)	06:29
	17:24		18:06	19:43	22 19:22 (T-25)	20:21
25	07:54		07:13	07:22	07:43 (T-82)	06:28
	17:25		18:07	19:44	24 19:23 (T-25)	20:23
26	07:53		07:11	07:21	07:41 (T-82)	06:26
	17:27		18:09	19:45	28 19:24 (T-25)	20:24
27	07:52		07:09	07:19	07:39 (T-82)	06:24
	17:28		18:10	19:46	28 19:25 (T-25)	20:25
28	07:51		07:08	07:17	07:37 (T-82)	06:23
	17:30		18:12	19:48	30 19:26 (T-25)	20:26
29	07:50			07:15	07:35 (T-82)	06:21
	17:31			19:49	30 19:27 (T-25)	20:28
30	07:49			07:13	07:37 (T-82)	06:20
	17:32			19:50	22 19:25 (T-25)	20:29
31	07:48			07:11	19:15 (T-25)	05:46
	17:34			19:51	6 19:21 (T-25)	21:03
Potential sun hours	287	292	369		403	459
Total, worst case	563	223	285			98
Sun reduction	0.58	0.58	0.59			0.66
Oper. time red.	0.90	0.90	0.90			0.90
Wind dir. red.	0.67	0.63	0.59			0.59
Total reduction	0.35	0.33	0.31			0.35
Total, real	197	74	90			34

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-181 - R-181
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December				
1	05:45	06:13	06:36 (T-93)	06:49	07:24	18:44 (T-24)	07:04	07:27 (T-38)	07:43	08:18 (T-37)
	21:17	20:55	11 06:47 (T-93)	20:07	19:11	1 18:45 (T-24)	17:17	07:38 (T-38)	16:49	30 08:48 (T-37)
2	05:46	06:14	06:37 (T-93)	06:50	07:26		07:06	07:28 (T-38)	07:45	08:18 (T-37)
	21:17	20:54	10 06:47 (T-93)	20:05	19:09		17:16	10 07:38 (T-38)	16:48	31 08:49 (T-37)
3	05:46	06:15	06:38 (T-93)	06:51	07:27		07:07	07:30 (T-38)	07:46	08:18 (T-37)
	21:16	20:53	10 06:48 (T-93)	20:03	19:07		17:14	8 07:38 (T-38)	16:48	32 08:50 (T-37)
4	05:47	06:16	06:39 (T-93)	06:52	07:28		07:08	07:31 (T-38)	07:47	08:18 (T-37)
	21:16	20:51	9 06:48 (T-93)	20:02	19:05		17:13	5 07:36 (T-38)	16:48	32 08:50 (T-37)
5	05:48	06:17	06:41 (T-93)	06:54	07:29		07:10	07:33 (T-38)	07:48	08:18 (T-37)
	21:16	20:50	8 06:49 (T-93)	20:00	19:04		17:12	3 07:36 (T-38)	16:47	33 08:51 (T-37)
6	05:48	06:18	06:42 (T-93)	06:55	07:30		07:11		07:49	08:18 (T-37)
	21:16	20:49	7 06:49 (T-93)	19:58	19:02		17:10		16:47	33 08:51 (T-37)
7	05:49	06:20	06:43 (T-93)	06:56	07:32		07:12		07:50	08:18 (T-37)
	21:15	20:47	6 06:49 (T-93)	19:56	19:00		17:09		16:47	34 08:52 (T-37)
8	05:50	06:21	06:44 (T-93)	06:57	07:33		07:14		07:51	08:18 (T-37)
	21:15	20:46	5 06:49 (T-93)	19:54	18:56		17:08		16:47	34 08:52 (T-37)
9	05:50	06:22	06:45 (T-93)	06:58	07:34		07:15		07:52	08:18 (T-37)
	21:14	20:44	3 06:48 (T-93)	19:52	18:55		17:07		16:47	35 08:53 (T-37)
10	05:51	06:23	06:46 (T-93)	06:59	07:35		07:16		07:53	08:19 (T-37)
	21:14	20:43	2 06:48 (T-93)	19:51	18:53		17:05		16:47	35 08:54 (T-37)
11	05:52	06:24		07:01	07:37		07:18		07:54	08:19 (T-37)
	21:13	20:42		19:49	18:51		17:04		16:47	35 08:54 (T-37)
12	05:53	06:25		07:02	19:08 (T-25)		07:19		08:20 (T-37)	08:19 (T-37)
	21:13	20:40		19:47	5 19:13 (T-25)		17:03		16:47	35 08:55 (T-37)
13	05:54	06:26		07:03	07:28 (T-82)		07:20		08:21 (T-37)	08:19 (T-37)
	21:12	20:39		19:45	21 19:16 (T-25)		17:02		16:47	35 08:56 (T-37)
14	05:54	06:28		07:04	07:25 (T-82)		07:22		07:56	08:22 (T-37)
	21:12	20:37		19:43	30 19:17 (T-25)		17:01		16:47	34 08:56 (T-37)
15	05:55	06:29		07:05	07:27 (T-82)		07:23		07:57	08:23 (T-37)
	21:11	20:36		19:41	31 19:17 (T-25)		17:00		16:47	34 08:57 (T-37)
16	05:56	06:30		07:06	07:28 (T-82)		07:25		07:58	08:23 (T-37)
	21:10	20:34		19:39	29 19:15 (T-25)		16:59		16:48	34 08:57 (T-37)
17	05:57	06:31		07:08	07:29 (T-82)		07:26		07:58	08:24 (T-37)
	21:10	20:32		19:37	28 19:13 (T-25)		16:58		16:48	34 08:58 (T-37)
18	05:58	06:32		07:09	07:30 (T-82)		07:27		07:59	08:25 (T-37)
	21:09	20:31		19:36	26 19:11 (T-25)		16:57		16:48	34 08:59 (T-37)
19	05:59	06:34		07:10	07:31 (T-82)		07:28		08:00	08:25 (T-37)
	21:08	20:29		19:34	23 19:09 (T-25)		16:56		16:48	33 08:58 (T-37)
20	06:00	06:35		07:11	07:32 (T-82)		07:30		08:00	08:26 (T-37)
	21:07	20:28		19:32	20 19:07 (T-25)		16:55		16:49	33 08:59 (T-37)
21	06:01	06:36		07:12	07:33 (T-82)		07:31		08:01	08:26 (T-37)
	21:07	20:26		19:30	15 19:04 (T-25)		16:55		16:49	33 08:59 (T-37)
22	06:02	06:37		07:13	07:35 (T-82)		07:32		08:24 (T-37)	08:01
	21:06	20:24		19:28	11 19:03 (T-25)		16:54	11 08:35 (T-37)	16:50	33 09:00 (T-37)
23	06:03	06:38		07:15	07:36 (T-82)		07:34		08:23 (T-37)	08:02
	21:05	20:23		19:26	7 19:01 (T-25)		16:53	16 08:39 (T-37)	16:50	33 09:00 (T-37)
24	06:04	06:39		07:16	07:37 (T-82)		07:35		08:21 (T-37)	08:02
	21:04	20:21		19:24	8 18:59 (T-25)		16:52	19 08:40 (T-37)	16:51	33 09:01 (T-37)
25	06:05	06:41		07:17	18:49 (T-24)		07:36		08:20 (T-37)	08:03
	21:03	20:19		19:22	8 18:57 (T-24)		16:52	21 08:38 (T-38)	16:52	33 09:01 (T-37)
26	06:06	06:42		07:18	18:47 (T-24)		07:37		08:20 (T-37)	08:03
	21:02	20:18		19:20	8 18:55 (T-24)		16:51	23 08:43 (T-37)	16:52	34 09:02 (T-37)
27	06:07	06:43		07:19	18:47 (T-24)		07:39		08:19 (T-37)	08:03
	21:01	20:16		19:19	7 18:54 (T-24)		16:50	25 08:44 (T-37)	16:53	34 09:02 (T-37)
28	06:08	06:44		07:21	18:46 (T-24)		07:40		08:18 (T-37)	08:04
	21:00	20:14		19:17	6 18:52 (T-24)		16:50	27 08:45 (T-37)	16:54	34 09:03 (T-37)
29	06:09	06:45	7 06:35 (T-93)	07:22	18:45 (T-24)		08:00		08:18 (T-37)	08:04
	20:59	20:12	06:42 (T-93)	19:15	5 18:50 (T-24)		16:49	28 08:46 (T-37)	16:54	34 09:03 (T-37)
30	06:10	06:46	06:34 (T-93)	07:23	18:44 (T-24)		08:01		08:18 (T-37)	08:04
	20:57	20:11	10 06:44 (T-93)	19:13	4 18:48 (T-24)		16:49	30 08:48 (T-37)	16:55	35 09:04 (T-37)
31	06:12	06:48	06:35 (T-93)				08:03		08:26 (T-38)	08:04
	20:56	20:09	11 06:46 (T-93)				18:18	13 08:39 (T-38)	16:56	35 09:04 (T-37)
Potential sun hours	471	436		377		341		289		275
Total, worst case	28	71		292		187		237		1041
Sun reduction	0.75	0.72		0.67		0.56		0.48		0.52
Oper. time red.	0.90	0.90		0.90		0.90		0.90		0.90
Wind dir. red.	0.59	0.59		0.59		0.63		0.66		0.67
Total reduction	0.40	0.38		0.36		0.32		0.29		0.31
Total, real	11	27		104		60		68		326

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-182 - R-182

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05	08:29 (T-37)	07:47	17:05 (T-25)	07:06	07:10
	16:57	9 08:38 (T-37)	17:35	4 17:09 (T-25)	18:13	19:53
2	08:05	08:29 (T-37)	07:46	08:08 (T-38)	07:04	19:53
	16:58	9 08:38 (T-37)	17:37	8 17:11 (T-25)	18:14	20:30
3	08:05	08:29 (T-37)	07:45	08:07 (T-38)	07:03	19:54
	16:59	10 08:39 (T-37)	17:38	12 17:13 (T-25)	18:16	20:31
4	08:05	08:29 (T-37)	07:44	08:05 (T-38)	07:01	19:55
	17:00	10 08:39 (T-37)	17:39	15 17:13 (T-25)	18:17	20:33
5	08:04	08:29 (T-37)	07:42	08:04 (T-38)	06:59	19:57
	17:01	10 08:39 (T-37)	17:41	19 17:15 (T-25)	18:18	20:34
6	08:04	08:29 (T-37)	07:41	08:03 (T-38)	06:57	19:57
	17:02	11 08:40 (T-37)	17:42	22 17:17 (T-25)	18:20	20:35
7	08:04	08:28 (T-37)	07:40	08:01 (T-38)	06:56	19:58
	17:03	11 08:39 (T-37)	17:44	24 17:18 (T-25)	18:21	20:36
8	08:04	08:28 (T-37)	07:39	08:00 (T-38)	07:54	19:59
	17:04	12 08:40 (T-37)	17:45	27 17:20 (T-25)	18:22	20:37
9	08:04	08:28 (T-37)	07:37	07:59 (T-38)	07:52	19:59
	17:05	12 08:40 (T-37)	17:47	28 17:22 (T-25)	19:24	20:39
10	08:03	08:27 (T-37)	07:36	16:59 (T-25)	07:50	19:59
	17:06	13 08:40 (T-37)	17:48	24 17:23 (T-25)	19:25	20:40
11	08:03	08:27 (T-37)	07:34	17:00 (T-25)	07:48	19:59
	17:07	13 08:40 (T-37)	17:49	25 17:25 (T-25)	19:26	20:41
12	08:03	08:26 (T-37)	07:33	16:59 (T-25)	07:47	19:59
	17:09	13 08:39 (T-37)	17:51	27 17:26 (T-25)	19:27	20:42
13	08:02	08:26 (T-37)	07:32	17:00 (T-25)	07:45	19:59
	17:10	13 08:39 (T-37)	17:52	28 17:28 (T-25)	19:29	20:43
14	08:02	08:26 (T-37)	07:30	16:59 (T-25)	07:43	19:59
	17:11	12 08:38 (T-37)	17:54	30 17:29 (T-25)	19:30	20:44
15	08:01	08:29 (T-37)	07:29	17:00 (T-25)	07:41	19:59
	17:12	9 08:38 (T-37)	17:55	31 17:31 (T-25)	19:31	20:45
16	08:01	08:31 (T-37)	07:27	17:00 (T-25)	07:39	19:59
	17:14	4 08:35 (T-37)	17:56	32 17:32 (T-25)	19:33	20:46
17	08:00		07:26	17:01 (T-25)	07:37	19:59
	17:15		17:58	33 17:34 (T-25)	19:34	20:47
18	08:00		07:24	17:01 (T-25)	07:36	19:59
	17:16		17:59	32 17:33 (T-25)	19:35	20:48
19	07:59		07:23	17:03 (T-25)	07:34	19:59
	17:17		18:01	29 17:32 (T-25)	19:36	20:49
20	07:58		07:21	17:03 (T-25)	07:32	19:59
	17:19		18:01	28 17:31 (T-25)	19:38	20:50
21	07:58		07:19	17:04 (T-25)	07:30	19:59
	17:20		18:02	25 17:29 (T-25)	19:39	20:51
22	07:57		07:18	17:07 (T-25)	07:28	19:59
	17:21		18:03	21 17:28 (T-25)	19:40	20:52
23	07:56		07:16	17:09 (T-25)	07:26	19:59
	17:23		18:05	16 17:25 (T-25)	19:41	20:53
24	07:55		07:15	17:12 (T-25)	07:24	19:59
	17:24		18:06	9 17:21 (T-25)	19:43	20:54
25	07:54		07:13		07:23	19:59
	17:25		18:07		19:44	20:55
26	07:53		07:11		07:21	19:59
	17:27		18:09		19:45	20:56
27	07:52		07:10		07:19	19:59
	17:28		18:10		19:47	20:57
28	07:51		07:08		07:17	19:59
	17:30		18:12		19:48	20:58
29	07:50				07:15	19:59
	17:31				19:49	20:59
30	07:49				07:13	19:59
	17:32				19:50	21:00
31	07:48	17:06 (T-34)			07:11	19:59
	17:34	1 17:07 (T-34)			19:52	21:01
Potential sun hours	287	292	369	403	459	465
Total, worst case	172	549	14	8		
Sun reduction	0.58	0.58	0.59	0.63		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.65	0.59	0.60	0.58		
Total reduction	0.34	0.31	0.32	0.33		
Total, real	59	170	4	3		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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South Deuel Wind Project

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Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-182 - R-182
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:13	06:49	07:24	07:04	07:43
	21:17	20:55	20:07	19:11	17:17	16:29 (T-25)
2	05:46	06:14	06:50	07:26	07:06	07:45
	21:17	20:54	20:05	19:09	17:16	16:50 (T-25)
3	05:46	06:15	06:51	07:27	07:07	07:46
	21:16	20:53	20:03	19:07	17:14	16:49 (T-25)
4	05:47	06:16	06:52	07:28	07:08	07:47
	21:16	20:51	20:02	19:05	17:13	16:48 (T-25)
5	05:48	06:17	06:54	07:29	07:10	07:48
	21:16	20:50	20:00	19:04	17:12	16:47 (T-25)
6	05:48	06:18	06:55	07:30	07:11	07:49
	21:16	20:49	19:58	19:02	17:10	16:45 (T-25)
7	05:49	06:20	06:56	07:32	07:12	07:50
	21:15	20:47	19:56	19:00	17:09	16:44 (T-25)
8	05:50	06:21	06:57	07:33	07:14	07:51
	21:15	20:46	19:54	18:56	17:08	16:42 (T-25)
9	05:50	06:22	06:58	07:34	07:15	07:52
	21:14	20:45	19:52	18:55	17:07	16:42 (T-25)
10	05:51	06:23	06:59	07:35	07:16	07:53
	21:14	20:43	19:51	18:53	17:05	16:40 (T-25)
11	05:52	06:24	07:01	07:37	07:18	07:54
	21:14	20:42	19:49	18:51	17:04	16:39 (T-34)
12	05:53	06:25	07:02	07:38	07:19	07:55
	21:13	20:40	19:47	18:49	17:03	16:47
13	05:54	06:27	07:03	07:39	07:21	07:55
	21:12	20:39	19:45	18:47	17:02	16:47
14	05:55	06:28	07:04	07:40	07:22	07:56
	21:12	20:37	19:43	18:46	17:01	16:47
15	05:55	06:29	07:05	07:42	07:23	07:57
	21:11	20:36	19:41	18:44	17:00	16:47
16	05:56	06:30	07:06	07:43	07:25	07:58
	21:11	20:34	19:39	18:42	16:59	16:48
17	05:57	06:31	07:08	07:44	07:26	07:58
	21:10	20:33	19:37	18:41	16:58	16:48
18	05:58	06:32	07:09	07:46	07:27	07:59
	21:09	20:31	19:36	18:39	16:57	16:48
19	05:59	06:34	07:10	07:47	07:29	08:00
	21:08	20:29	19:34	18:37	16:56	16:48
20	06:00	06:35	07:11	07:48	07:30	08:00
	21:07	20:28	19:32	18:36	16:55	16:49
21	06:01	06:36	07:12	07:50	07:31	08:01
	21:07	20:26	19:30	18:34	16:55	16:49
22	06:02	06:37	07:14	07:51	07:32	08:01
	21:06	20:24	19:28	18:32	16:54	16:50
23	06:03	06:38	07:15	07:52	07:34	08:02
	21:05	20:23	19:26	18:31	16:53	16:50
24	06:04	06:39	07:16	07:53	07:35	08:02
	21:04	20:21	19:24	18:29	16:52	16:51
25	06:05	06:41	07:17	07:55	07:36	08:03
	21:03	20:19	19:22	18:27	16:52	16:52
26	06:06	06:42	07:18	07:56	07:38	08:03
	21:02	20:18	19:20	18:26	16:51	16:52
27	06:07	06:43	07:19	07:57	07:39	08:04
	21:01	20:16	19:19	18:24	16:51	16:53
28	06:08	06:44	07:21	07:59	07:40	08:04
	21:00	20:14	19:17	18:23	16:50	16:54
29	06:09	06:45	07:22	08:00	07:41	08:04
	20:59	20:12	19:15	18:21	16:49	16:54
30	06:11	06:46	07:23	08:02	07:42	08:04
	20:57	20:11	19:13	18:20	16:49	16:55
31	06:12	06:48	07:24	08:03	07:43	08:04
	20:56	20:09	19:14	18:18	16:48	16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case				381	229	263
Sun reduction			0.67	0.56	0.48	0.52
Oper. time red.			0.90	0.90	0.90	0.90
Wind dir. red.			0.58	0.59	0.61	0.65
Total reduction			0.35	0.30	0.26	0.31
Total, real			3	114	60	81

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



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Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-183 - R-183

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05	08:29 (T-93)	07:47	16:44 (T-27)	07:06	07:09
	16:57	14 08:43 (T-93)	17:35	16 17:00 (T-27)	18:13	19:53
2	08:05	08:29 (T-93)	07:46	16:46 (T-27)	07:04	07:08
	16:58	14 08:43 (T-93)	17:37	13 16:59 (T-27)	18:14	19:54
3	08:05	08:29 (T-93)	07:45	16:49 (T-27)	07:03	07:06
	16:59	14 08:43 (T-93)	17:38	7 16:56 (T-27)	18:16	19:55
4	08:05	08:30 (T-93)	07:44		07:01	07:04
	17:00	13 08:43 (T-93)	17:39		18:17	19:56
5	08:04	08:31 (T-93)	07:42		06:59	07:02
	17:01	12 08:43 (T-93)	17:41		18:18	19:58
6	08:04	08:32 (T-93)	07:41		06:57	07:00
	17:02	11 08:43 (T-93)	17:42		18:20	19:59
7	08:04	08:33 (T-93)	07:40		06:56	06:58
	17:03	8 08:41 (T-93)	17:44		18:21	20:00
8	08:04	08:36 (T-93)	07:39		07:54	06:57
	17:04	4 08:40 (T-93)	17:45		18:22	20:01
9	08:04		07:37		07:52	06:55
	17:05		17:46		19:23	20:03
10	08:03		07:36		07:50	06:53
	17:06		17:48		19:25	20:04
11	08:03	16:38 (T-27)	07:34		07:48	06:51
	17:07	2 16:40 (T-27)	17:49		19:26	20:05
12	08:03	16:37 (T-27)	07:33		07:47	06:50
	17:09	3 16:40 (T-27)	17:51		19:27	20:06
13	08:02	16:38 (T-27)	07:32		07:45	06:48
	17:10	4 16:42 (T-27)	17:52		19:29	20:08
14	08:02	16:37 (T-27)	07:30		07:43	06:46
	17:11	6 16:43 (T-27)	17:54		19:30	20:09
15	08:01	16:37 (T-27)	07:29		07:41	06:44
	17:12	8 16:45 (T-27)	17:55		19:31	20:10
16	08:01	16:37 (T-27)	07:27		07:39	06:43
	17:13	9 16:46 (T-27)	17:56		19:33	20:11
17	08:00	16:36 (T-27)	07:26		07:37	06:41
	17:15	11 16:47 (T-27)	17:58		19:34	20:13
18	08:00	16:37 (T-27)	07:24		07:35	06:39
	17:16	12 16:49 (T-27)	17:59		19:35	20:14
19	07:59	16:37 (T-27)	07:23		07:34	06:37
	17:17	13 16:50 (T-27)	18:01		19:36	20:15
20	07:58	16:37 (T-27)	07:21		07:32	06:36
	17:19	14 16:51 (T-27)	18:01		19:38	20:16
21	07:58	16:37 (T-27)	07:19		07:30	06:34
	17:20	15 16:52 (T-27)	18:02		19:39	20:18
22	07:57	16:38 (T-27)	07:18		07:28	06:32
	17:21	17 16:55 (T-27)	18:03		19:40	20:19
23	07:56	16:38 (T-27)	07:16		07:26	06:31
	17:23	18 16:56 (T-27)	18:05		19:41	20:20
24	07:55	16:38 (T-27)	07:14		07:24	06:29
	17:24	19 16:57 (T-27)	18:06		19:43	20:21
25	07:54	16:38 (T-27)	07:13		07:22	06:28
	17:25	21 16:59 (T-27)	18:07		19:44	20:23
26	07:53	16:39 (T-27)	07:11		07:21	06:26
	17:27	21 17:00 (T-27)	18:09		19:45	20:24
27	07:52	16:39 (T-27)	07:09		07:19	06:24
	17:28	23 17:02 (T-27)	18:10		19:46	20:25
28	07:51	16:40 (T-27)	07:08		07:17	06:23
	17:29	23 17:03 (T-27)	18:11		19:48	20:26
29	07:50	16:41 (T-27)			07:15	06:21
	17:31	22 17:03 (T-27)			19:49	20:28
30	07:49	16:41 (T-27)			07:13	06:20
	17:32	21 17:02 (T-27)			19:50	20:29
31	07:48	16:42 (T-27)			07:11	06:19
	17:34	19 17:01 (T-27)			19:51	20:30
Potential sun hours	287	292	369	403	459	465
Total, worst case	391	36		37		
Sun reduction	0.58	0.58		0.63		
Oper. time red.	0.90	0.90		0.90		
Wind dir. red.	0.60	0.59		0.57		
Total reduction	0.32	0.31		0.33		
Total, real	123	11		12		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-183 - R-183
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-29) 19:11	07:24 17:17	07:43 16:49
2	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-29) 19:09	07:26 17:16	07:45 16:48
3	05:46 21:16	06:15 20:53	06:51 20:03	07:13 (T-29) 19:07	07:27 17:14	07:46 16:48
4	05:47 21:16	06:16 20:51	06:52 20:02	07:14 (T-29) 19:05	07:28 17:13	07:47 16:48
5	05:48 21:16	06:17 20:50	06:53 20:00	07:15 (T-29) 19:04	07:29 17:12	07:48 16:47
6	05:48 21:16	06:18 20:49	06:55 19:58	07:30 19:02	07:11 17:10	07:49 16:47
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	07:12 17:09	07:50 16:47
8	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	07:14 17:08	07:51 16:47
9	05:50 21:14	06:22 20:45	06:58 19:52	07:34 18:54	07:15 17:07	07:52 16:47
10	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:16 17:05	07:53 16:47
11	05:52 21:14	06:24 20:42	07:01 19:49	07:37 18:51	07:18 17:04	07:54 16:47
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:55 16:47
13	05:54 21:12	06:26 20:39	07:03 19:45	07:39 18:47	07:21 17:02	07:55 16:47
14	05:54 21:12	06:28 20:37	07:04 19:43	07:40 18:46	07:22 17:01	07:56 16:47
15	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	07:57 16:47
16	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42	07:25 16:59	07:58 16:47
17	05:57 21:10	06:31 20:32	07:08 19:37	07:44 18:40	07:26 16:58	07:58 16:48
18	05:58 21:09	06:32 20:31	07:09 19:35	07:46 18:39	07:27 16:57	07:59 16:48
19	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37	07:29 16:56	08:00 16:48
20	06:00 21:07	06:35 20:28	07:11 19:32	07:48 18:35	07:30 16:55	08:00 16:49
21	06:01 21:07	06:36 20:26	07:12 19:30	07:49 18:34	07:31 16:54	08:01 16:49
22	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:54	08:01 16:50
23	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53	08:02 16:50
24	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	08:02 16:51
25	06:05 21:03	06:41 20:19	07:17 19:22	07:55 18:27	07:36 16:52	08:03 16:51
26	06:06 21:02	06:42 20:18	07:18 19:20	07:56 18:26	07:37 16:51	08:03 16:52
27	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	07:39 16:50	08:03 16:53
28	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50	08:04 16:54
29	06:09 20:59	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	08:04 16:54
30	06:10 20:57	06:46 20:11	07:23 (T-29) 19:13	08:01 18:20	07:42 16:49	08:04 16:55
31	06:12 20:56	06:48 20:09	07:10 (T-29) 07:17 (T-29)	08:03 18:18	07:44 16:49	08:04 16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case						354
Sun reduction		0.72	0.67		0.48	0.52
Oper. time red.		0.90	0.90		0.90	0.90
Wind dir. red.		0.57	0.57		0.59	0.66
Total reduction		0.37	0.35		0.25	0.31
Total, real		5	8		85	110

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-184 - R-184

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum		
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-82) 07:47	08:21 (T-82) 07:06	07:27 (T-31) 07:09	07:30 (T-32) 06:18	06:46 (T-93) 05:45
2	16:57 16	08:45 (T-82) 17:35 34	08:55 (T-82) 18:13	4 07:31 (T-31) 19:53	6 07:36 (T-32) 20:30	50 20:06 (T-28) 21:04
3	08:05	08:29 (T-82) 07:46	08:22 (T-82) 07:04	07:25 (T-31) 07:08	07:28 (T-32) 06:17	06:47 (T-93) 05:45
4	16:58 17	08:46 (T-82) 17:37 33	08:55 (T-82) 18:14	6 07:31 (T-31) 19:54	6 07:34 (T-32) 20:31	49 20:08 (T-28) 21:05
5	08:05	08:29 (T-82) 07:45	08:23 (T-82) 07:03	07:23 (T-31) 07:06	07:26 (T-32) 06:15	06:48 (T-93) 05:44
6	16:59 18	08:47 (T-82) 17:38 31	08:54 (T-82) 18:15	8 07:31 (T-31) 19:55	5 07:31 (T-32) 20:32	48 20:09 (T-28) 21:06
7	08:04	08:29 (T-82) 07:44	08:24 (T-82) 07:01	07:21 (T-31) 07:04	06:14	06:48 (T-93) 05:44
8	17:00 19	08:48 (T-82) 17:39 28	08:52 (T-82) 18:17	10 07:31 (T-31) 19:56	20:34	48 20:10 (T-28) 21:07
9	08:04	08:29 (T-82) 07:42	08:26 (T-82) 06:59	07:20 (T-31) 07:02	06:13	06:50 (T-93) 05:43
10	17:01 20	08:49 (T-82) 17:41 25	08:51 (T-82) 18:18	11 07:31 (T-31) 19:58	20:35	46 20:11 (T-28) 21:07
11	08:04	08:28 (T-82) 07:41	08:28 (T-82) 06:57	07:18 (T-31) 07:00	06:11	06:51 (T-93) 05:43
12	17:02 21	08:49 (T-82) 17:42 21	08:49 (T-82) 18:19	12 07:30 (T-31) 19:59	20:36	46 20:13 (T-28) 21:08
13	08:04	08:28 (T-82) 07:40	08:30 (T-82) 06:55	07:16 (T-31) 06:58	06:10	06:52 (T-93) 05:43
14	17:03 22	08:50 (T-82) 17:44 16	08:46 (T-82) 18:21	13 07:29 (T-31) 20:00	20:37	44 20:13 (T-28) 21:09
15	08:04	08:28 (T-82) 07:38	08:36 (T-82) 07:54	08:14 (T-31) 06:57	06:09	06:54 (T-93) 05:42
16	17:04 23	08:51 (T-82) 17:45 6	08:42 (T-82) 18:22	14 08:28 (T-31) 20:01	20:39	41 20:14 (T-28) 21:10
17	08:04	08:28 (T-82) 07:37	07:52	08:13 (T-31) 06:55	06:07	06:57 (T-93) 05:42
18	17:05 24	08:52 (T-82) 17:46	19:23	12 08:25 (T-31) 20:03	5 07:20 (T-93) 20:40	37 20:16 (T-28) 21:10
19	08:03	08:27 (T-82) 07:36	07:50	08:17 (T-31) 06:53	07:13 (T-93) 06:06	19:52 (T-28) 05:42
20	17:06 25	08:52 (T-82) 17:48	19:25	6 08:23 (T-31) 20:04	9 07:22 (T-93) 20:41	25 20:17 (T-28) 21:11
21	08:03	08:27 (T-82) 07:34	07:48	06:51	07:12 (T-93) 06:05	19:52 (T-28) 05:42
22	17:07 26	08:53 (T-82) 17:49	19:26	20:05	12 07:24 (T-93) 20:42	25 20:17 (T-28) 21:12
23	08:03	08:26 (T-82) 07:33	07:46	06:50	07:10 (T-93) 06:03	19:52 (T-28) 05:41
24	17:09 27	08:53 (T-82) 17:51	19:27	20:06	15 07:25 (T-93) 20:43	27 20:19 (T-28) 21:12
25	08:02	08:26 (T-82) 07:32	07:45	06:48	07:08 (T-93) 06:02	19:53 (T-28) 05:41
26	17:10 28	08:54 (T-82) 17:52	19:29	20:08	18 07:26 (T-93) 20:44	27 20:20 (T-28) 21:13
27	08:02	08:25 (T-82) 07:30	07:43	06:46	07:06 (T-93) 06:01	19:53 (T-28) 05:41
28	17:11 29	08:54 (T-82) 17:54	19:30	20:09	20 07:26 (T-93) 20:46	27 20:20 (T-28) 21:13
29	08:01	08:25 (T-82) 07:29	07:41	06:44	07:05 (T-93) 06:00	19:54 (T-28) 05:41
30	17:12 30	08:55 (T-82) 17:55	19:31	20:10	23 07:28 (T-93) 20:47	26 20:20 (T-28) 21:14
31	08:01	08:24 (T-82) 07:27	07:39	06:43	07:03 (T-93) 05:59	19:55 (T-28) 05:41
32	17:13 31	08:55 (T-82) 17:56	19:33	20:11	25 07:28 (T-93) 20:48	24 20:19 (T-28) 21:14
33	08:00	08:23 (T-82) 07:26	07:37	06:41	07:01 (T-93) 05:58	19:55 (T-28) 05:41
34	17:15 32	08:55 (T-82) 17:58	19:34	20:13	27 07:28 (T-93) 20:49	23 20:18 (T-28) 21:15
35	08:00	08:23 (T-82) 07:24	07:35	06:39	07:00 (T-93) 05:57	19:56 (T-28) 05:41
36	17:16 34	08:57 (T-82) 17:59	19:35	20:14	29 07:29 (T-93) 20:50	22 20:18 (T-28) 21:15
37	07:59	08:22 (T-82) 07:23	07:34	06:37	06:58 (T-93) 05:56	19:57 (T-28) 05:41
38	17:17 35	08:57 (T-82) 18:01	19:36	20:15	30 07:28 (T-93) 20:51	20 20:17 (T-28) 21:15
39	07:58	08:21 (T-82) 07:21	07:32	06:36	06:56 (T-93) 05:55	19:58 (T-28) 05:41
40	17:19 36	08:57 (T-82) 18:01	19:38	20:16	32 07:28 (T-93) 20:52	17 20:15 (T-28) 21:16
41	07:57	08:20 (T-82) 07:19	07:30	06:34	06:55 (T-93) 05:54	20:00 (T-28) 05:42
42	17:20 37	08:57 (T-82) 18:02	19:39	20:18	35 19:55 (T-27) 20:53	14 20:14 (T-28) 21:16
43	07:57	08:19 (T-82) 07:18	07:28	06:32	06:53 (T-93) 05:53	20:01 (T-28) 05:42
44	17:21 38	08:57 (T-82) 18:03	19:40	20:19	38 19:56 (T-27) 20:54	11 20:12 (T-28) 21:16
45	07:56	08:19 (T-82) 07:16	07:26	06:31	06:51 (T-93) 05:52	20:05 (T-28) 05:42
46	17:23 39	08:58 (T-82) 18:05	19:41	20:20	42 19:57 (T-27) 20:56	5 20:10 (T-28) 21:16
47	07:55	08:18 (T-82) 07:14	07:24	06:29	06:50 (T-93) 05:51	05:42
48	17:24 40	08:58 (T-82) 18:06	19:43	20:21	46 19:59 (T-27) 20:57	21:17
49	07:54	08:17 (T-82) 07:13	07:22	06:28	06:48 (T-93) 05:50	05:43
50	17:25 41	08:58 (T-82) 18:07	19:44	20:23	48 19:59 (T-27) 20:58	21:17
51	07:53	08:16 (T-82) 07:11	07:21	06:26	06:47 (T-93) 05:49	05:43
52	17:27 42	08:58 (T-82) 18:09	19:45	20:24	50 20:01 (T-27) 20:59	21:17
53	07:52	08:17 (T-82) 07:09	07:19	06:24	06:45 (T-93) 05:49	05:43
54	17:28 41	08:58 (T-82) 18:10	19:46	20:25	53 20:02 (T-27) 21:00	21:17
55	07:51	08:18 (T-82) 07:08	07:17	06:23	06:45 (T-93) 05:48	05:44
56	17:29 40	08:58 (T-82) 18:11	2 07:30 (T-31) 19:48	2 07:39 (T-32) 20:26	53 20:03 (T-28) 21:01	21:17
57	07:50	08:17 (T-82) 07:15	07:15	06:21	06:45 (T-93) 05:47	05:44
58	17:31 40	08:57 (T-82) 18:11	19:49	3 07:38 (T-32) 20:28	52 20:04 (T-28) 21:01	21:17
59	07:49	08:18 (T-82) 07:13	07:13	06:20	06:46 (T-93) 05:47	05:45
60	17:32 38	08:56 (T-82) 18:10	19:50	5 07:38 (T-32) 20:29	52 20:06 (T-28) 21:02	21:17
61	07:48	08:19 (T-82) 07:11	07:11	06:19	06:46 (T-93) 05:46	05:45
62	17:34 37	08:56 (T-82) 18:10	19:51	6 07:37 (T-32) 20:29	52 20:06 (T-28) 21:02	21:17
Potential sun hours	287	292	369	403	459	465
Total, worst case	946	196	112	731	702	
Sun reduction	0.58	0.58	0.59	0.63	0.66	
Oper. time red.	0.90	0.90	0.90	0.90	0.90	
Wind dir. red.	0.65	0.65	0.59	0.58	0.61	
Total reduction	0.34	0.34	0.32	0.33	0.36	
Total, real	322	67	36	242	254	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-184 - R-184
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	06:13	20:03 (T-28) 06:49	07:11 (T-93) 07:24	07:04	07:43
	21:17	20:55	26 20:29 (T-28) 20:07	12 07:23 (T-93) 19:11	17:17	16:49
2	05:46	06:14	20:02 (T-28) 06:50	07:12 (T-93) 07:25	07:05	07:45
	21:16	20:54	25 20:27 (T-28) 20:05	9 07:21 (T-93) 19:09	17:16	16:48
3	05:46	06:15	07:10 (T-93) 06:51	07:13 (T-93) 07:27	07:07	07:46
	21:16	20:53	31 20:26 (T-28) 20:03	5 07:18 (T-93) 19:07	17:14	16:48
4	05:47	06:16	07:06 (T-93) 06:52	07:28	07:08	07:47
	21:16	20:51	38 20:25 (T-28) 20:02	10 08:02 (T-31) 17:13	16 08:16 (T-82) 16:48	23 08:35 (T-82)
5	05:48	06:17	07:03 (T-93) 06:53	07:29	07:10	07:48
	21:16	20:50	42 20:24 (T-28) 20:00	14 08:04 (T-31) 17:12	21 08:19 (T-82) 16:47	22 08:35 (T-82)
6	05:48	06:18	07:02 (T-93) 06:55	07:30	07:11	07:49
	21:16	20:49	45 20:23 (T-28) 19:58	13 08:05 (T-31) 17:10	25 08:21 (T-82) 16:47	21 08:35 (T-82)
7	05:49	06:19	07:00 (T-93) 06:56	07:32	07:12	07:50
	21:15	20:47	47 20:22 (T-28) 19:56	13 08:06 (T-31) 17:09	28 08:23 (T-82) 16:47	20 08:35 (T-82)
8	05:50	06:21	06:59 (T-93) 06:57	07:33	07:14	07:51
	21:15	20:46	47 20:20 (T-28) 19:54	12 08:06 (T-31) 17:08	31 08:24 (T-82) 16:47	19 08:35 (T-82)
9	05:50	06:22	06:57 (T-93) 06:58	07:34	07:15	07:52
	21:14	20:44	48 20:19 (T-28) 19:52	4 07:25 (T-32) 18:54	11 08:06 (T-31) 17:07	18 08:35 (T-82)
10	05:51	06:23	06:56 (T-93) 06:59	07:35	07:16	07:53
	21:14	20:43	48 20:17 (T-28) 19:50	6 07:27 (T-32) 18:53	9 08:06 (T-31) 17:05	17 08:35 (T-82)
11	05:52	06:24	06:55 (T-93) 07:00	07:37	07:18	07:54
	21:13	20:42	49 20:16 (T-28) 19:49	6 07:28 (T-32) 18:51	7 08:05 (T-31) 17:04	16 08:35 (T-82)
12	05:53	06:25	06:54 (T-93) 07:02	07:38	07:19	07:55
	21:13	20:40	50 20:14 (T-28) 19:47	6 07:29 (T-32) 18:49	6 08:05 (T-31) 17:03	16 08:36 (T-82)
13	05:54	06:26	06:53 (T-93) 07:03	07:39	07:20	07:55
	21:12	20:39	52 20:13 (T-28) 19:45	5 07:29 (T-32) 18:47	3 08:04 (T-31) 17:02	15 08:36 (T-82)
14	05:54	06:28	06:52 (T-93) 07:04	07:40	07:22	07:56
	21:12	20:37	53 20:11 (T-28) 19:43	4 07:29 (T-32) 18:46	1 08:03 (T-31) 17:01	15 08:37 (T-82)
15	05:55	06:29	06:52 (T-93) 07:05	07:42	07:23	07:57
	21:11	20:36	53 20:11 (T-28) 19:41	2 07:28 (T-32) 18:44	17:00	16:47
16	05:56	06:30	06:53 (T-93) 07:06	07:43	07:24	07:58
	21:10	20:34	51 20:09 (T-27) 19:39	18:42	16:59	16:47
17	05:57	06:31	06:54 (T-93) 07:08	07:44	07:26	07:58
	21:10	20:32	49 20:07 (T-27) 19:37	18:40	16:58	16:48
18	05:58	06:32	06:55 (T-93) 07:09	07:46	07:27	07:59
	21:09	20:31	47 20:06 (T-27) 19:35	18:39	16:57	16:48
19	05:59	06:33	06:56 (T-93) 07:10	07:47	07:28	08:00
	21:08	20:29	44 20:04 (T-27) 19:34	18:37	16:56	16:48
20	06:00	06:35	06:57 (T-93) 07:11	07:48	07:30	08:00
	21:07	20:28	41 20:02 (T-27) 19:32	18:35	16:55	16:49
21	06:01	20:13 (T-28)	06:36	06:58 (T-93) 07:12	07:31	07:56 (T-82) 08:01
	21:07	8 20:21 (T-28)	20:26	39 20:01 (T-27) 19:30	18:34	16:54
22	06:02	20:11 (T-28)	06:37	06:59 (T-93) 07:13	07:32	07:57 (T-82) 08:01
	21:06	13 20:24 (T-28)	20:24	34 19:59 (T-27) 19:28	18:32	16:54
23	06:03	20:09 (T-28)	06:38	07:01 (T-93) 07:15	07:34	07:59 (T-82) 08:02
	21:05	16 20:25 (T-28)	20:23	32 07:33 (T-93) 19:26	18:31	16:53
24	06:04	20:08 (T-28)	06:39	07:02 (T-93) 07:16	07:35	08:00 (T-82) 08:02
	21:04	19 20:27 (T-28)	20:21	30 07:32 (T-93) 19:24	18:29	16:52
25	06:05	20:07 (T-28)	06:41	07:03 (T-93) 07:17	07:36	08:01 (T-82) 08:03
	21:03	21 20:28 (T-28)	20:19	28 07:31 (T-93) 19:22	18:27	16:52
26	06:06	20:06 (T-28)	06:42	07:04 (T-93) 07:18	07:37	08:03 (T-82) 08:03
	21:02	22 20:28 (T-28)	20:18	26 07:30 (T-93) 19:20	18:26	16:51
27	06:07	20:06 (T-28)	06:43	07:05 (T-93) 07:19	07:39	08:04 (T-82) 08:03
	21:01	23 20:29 (T-28)	20:16	24 07:29 (T-93) 19:18	18:24	16:50
28	06:08	20:05 (T-28)	06:44	07:06 (T-93) 07:21	07:39	08:05 (T-82) 08:04
	21:00	25 20:30 (T-28)	20:14	22 07:28 (T-93) 19:17	18:23	16:50
29	06:09	20:04 (T-28)	06:45	07:07 (T-93) 07:22	07:41	08:06 (T-82) 08:04
	20:58	26 20:30 (T-28)	20:12	20 07:27 (T-93) 19:15	18:21	16:49
30	06:10	20:04 (T-28)	06:46	07:08 (T-93) 07:23	07:42	08:08 (T-82) 08:04
	20:57	27 20:31 (T-28)	20:11	18 07:26 (T-93) 19:13	18:20	16:49
31	06:12	20:03 (T-28)	06:48	07:10 (T-93) 07:24	08:03	08:04
	20:56	27 20:30 (T-28)	20:09	15 07:25 (T-93) 19:11	18:18	16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case	227	1174	59	99	912	505
Sun reduction	0.75	0.72	0.67	0.56	0.48	0.52
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90
Wind dir. red.	0.62	0.59	0.58	0.60	0.65	0.65
Total reduction	0.42	0.38	0.35	0.30	0.28	0.31
Total, real	96	449	21	30	257	154

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-185 - R-185
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January		February		March		April		May		June					
1	08:05	08:35 (T-82)	07:47	17:04 (T-25)	07:06	07:27 (T-93)	07:09	18:30 (T-28)	06:18		05:45	06:09 (T-29)				
	16:57	16	08:51 (T-82)	17:35	5	17:09 (T-25)	18:13	19	07:46 (T-93)	19:53	59	19:30 (T-27)	20:30	21:04	5	06:14 (T-29)
2	08:05	08:36 (T-82)	07:46	17:05 (T-25)	07:04	07:25 (T-93)	07:08	07:25 (T-93)	07:08	18:31 (T-28)	06:17		05:45	06:08 (T-29)		
	16:58	15	08:51 (T-82)	17:37	6	17:11 (T-25)	18:14	20	07:45 (T-93)	19:54	54	19:29 (T-27)	20:31	21:05	5	06:13 (T-29)
3	08:05	08:37 (T-82)	07:45	17:05 (T-25)	07:03	07:23 (T-93)	07:06	07:23 (T-93)	07:06	18:33 (T-28)	06:15		05:44	06:08 (T-29)		
	16:59	14	08:51 (T-82)	17:38	8	17:13 (T-25)	18:16	22	07:45 (T-93)	19:55	47	19:27 (T-27)	20:33	21:06	6	06:14 (T-29)
4	08:05	08:38 (T-82)	07:44	17:05 (T-25)	07:01	07:21 (T-93)	07:04	07:21 (T-93)	07:04	18:35 (T-28)	06:14		05:44	06:07 (T-29)		
	17:00	13	08:51 (T-82)	17:39	8	17:13 (T-25)	18:17	22	07:43 (T-93)	19:56	39	19:25 (T-27)	20:34	21:07	6	06:13 (T-29)
5	08:04	08:39 (T-82)	07:42	17:06 (T-25)	06:59	07:21 (T-93)	07:02	07:21 (T-93)	07:02	18:38 (T-28)	06:13		05:43	06:07 (T-29)		
	17:01	11	08:50 (T-82)	17:41	9	17:15 (T-25)	18:18	22	07:43 (T-93)	19:58	27	19:22 (T-27)	20:35	21:08	6	06:13 (T-29)
6	08:04	08:40 (T-82)	07:41	17:08 (T-25)	06:57	07:22 (T-93)	07:00	07:22 (T-93)	07:00		06:11		05:43	06:07 (T-29)		
	17:02	9	08:49 (T-82)	17:42	9	17:17 (T-25)	18:20	28	17:58 (T-28)	19:59		20:36	21:08	7	06:14 (T-29)	
7	08:04	08:43 (T-82)	07:40	17:09 (T-25)	06:56	07:23 (T-93)	06:58	07:23 (T-93)	06:58		06:10		05:43	06:06 (T-29)		
	17:03	5	08:48 (T-82)	17:44	9	17:18 (T-25)	18:21	31	17:59 (T-28)	20:00		20:37	21:09	7	06:13 (T-29)	
8	08:04		07:39	17:13 (T-25)	07:54	08:26 (T-93)	06:57		08:26 (T-93)	06:57		06:09	05:42			06:06 (T-29)
	17:04		17:45	17:14 (T-25)	18:22	29	19:00 (T-28)	20:01		20:39		20:39	21:10	7	06:13 (T-29)	
9	08:04		07:37		07:52	18:38 (T-28)	06:55		18:38 (T-28)	06:55		06:07	05:42			06:06 (T-29)
	17:05		17:46		19:23	24	19:02 (T-28)	20:03		20:40		20:40	21:10	7	06:13 (T-29)	
10	08:03		07:36	07:57 (T-31)	07:50	18:37 (T-28)	06:53		18:37 (T-28)	06:53		06:06	05:42			06:06 (T-29)
	17:06		17:48	2	07:59 (T-31)	19:25	27	19:04 (T-28)	20:04		20:41		21:11	7	06:13 (T-29)	
11	08:03		07:34	07:56 (T-31)	07:48	18:35 (T-28)	06:51		18:35 (T-28)	06:51		06:05	05:42			06:06 (T-29)
	17:07		17:49	3	07:59 (T-31)	19:26	30	19:05 (T-28)	20:05		20:42		21:12	7	06:13 (T-29)	
12	08:03		07:33	07:54 (T-31)	07:46	18:33 (T-28)	06:50		18:33 (T-28)	06:50		06:03	05:41			06:05 (T-29)
	17:09		17:51	5	07:59 (T-31)	19:27	33	19:06 (T-28)	20:06		20:43		21:12	7	06:12 (T-29)	
13	08:02		07:32	07:53 (T-31)	07:45	18:32 (T-28)	06:48		18:32 (T-28)	06:48		06:02	05:41			06:05 (T-29)
	17:10		17:52	6	07:59 (T-31)	19:29	35	19:07 (T-28)	20:08		20:44		21:13	7	06:12 (T-29)	
14	08:02		07:30	07:51 (T-31)	07:43	18:30 (T-28)	06:46		18:30 (T-28)	06:46		06:01	05:41			06:05 (T-29)
	17:11		17:54	7	07:58 (T-31)	19:30	38	19:08 (T-28)	20:09		20:46		21:13	7	06:12 (T-29)	
15	08:01		07:29	07:50 (T-31)	07:41	18:29 (T-28)	06:44		18:29 (T-28)	06:44		06:00	05:41			06:05 (T-29)
	17:12		17:55	7	07:57 (T-31)	19:31	41	19:10 (T-28)	20:10		20:47		21:14	7	06:12 (T-29)	
16	08:01		07:27	07:48 (T-31)	07:39	18:28 (T-28)	06:43		18:28 (T-28)	06:43		05:59	05:41			06:05 (T-29)
	17:13		17:56	7	07:55 (T-31)	19:33	43	19:11 (T-28)	20:11		20:48		21:14	7	06:12 (T-29)	
17	08:00		07:26		07:37	18:28 (T-28)	06:41		18:28 (T-28)	06:41		05:58	05:41			06:05 (T-29)
	17:15		17:58		19:34	45	19:13 (T-28)	20:13		20:49		20:49	21:15	7	06:12 (T-29)	
18	08:00		07:24		07:35	18:28 (T-28)	06:39		18:28 (T-28)	06:39		05:57	05:41			06:05 (T-29)
	17:16		17:59		19:35	46	19:14 (T-28)	20:14		20:50		20:50	21:15	7	06:12 (T-29)	
19	07:59		07:23		07:34	18:27 (T-28)	06:37		18:27 (T-28)	06:37		05:56	05:41			06:06 (T-29)
	17:17		18:01		19:36	48	19:15 (T-28)	20:15		20:51		20:51	21:15	7	06:13 (T-29)	
20	07:58		07:21		07:32	18:26 (T-28)	06:36		18:26 (T-28)	06:36		05:55	05:41			06:06 (T-29)
	17:19		18:01		19:38	49	19:15 (T-28)	20:16		20:52		20:52	21:16	7	06:13 (T-29)	
21	07:58		07:19	07:40 (T-93)	07:30	18:26 (T-28)	06:34		18:26 (T-28)	06:34		05:54	05:42			06:06 (T-29)
	17:20		18:02	2	07:42 (T-93)	19:39	51	19:17 (T-27)	20:18		20:53		21:16	7	06:13 (T-29)	
22	07:57		07:18	07:39 (T-93)	07:28	18:25 (T-28)	06:32		18:25 (T-28)	06:32		05:53	05:42			06:06 (T-29)
	17:21		18:03	5	07:44 (T-93)	19:40	54	19:19 (T-27)	20:19		20:55		21:16	7	06:13 (T-29)	
23	07:56		07:16	07:37 (T-93)	07:26	18:25 (T-28)	06:31		18:25 (T-28)	06:31		05:52	05:42			06:06 (T-29)
	17:23		18:05	8	07:45 (T-93)	19:41	55	19:20 (T-27)	20:20		20:56		21:16	7	06:13 (T-29)	
24	07:55		07:14	07:35 (T-93)	07:24	18:25 (T-28)	06:29		18:25 (T-28)	06:29		05:51	05:42			06:07 (T-29)
	17:24		18:06	10	07:45 (T-93)	19:43	56	19:21 (T-27)	20:21		20:57		21:17	7	06:14 (T-29)	
25	07:54		07:13	07:34 (T-93)	07:22	18:26 (T-28)	06:28		18:26 (T-28)	06:28		05:50	05:43			06:07 (T-29)
	17:25		18:07	12	07:46 (T-93)	19:44	57	19:23 (T-27)	20:23		20:58		21:17	7	06:14 (T-29)	
26	07:53		07:11	07:32 (T-93)	07:21	18:26 (T-28)	06:26		18:26 (T-28)	06:26		05:49	05:43			06:07 (T-29)
	17:27		18:09	14	07:46 (T-93)	19:45	58	19:24 (T-27)	20:24		20:59		21:17	7	06:14 (T-29)	
27	07:52		07:09	07:30 (T-93)	07:19	18:26 (T-28)	06:24		18:26 (T-28)	06:24		05:49	05:43			06:08 (T-29)
	17:28		18:10	16	07:46 (T-93)	19:46	59	19:25 (T-27)	20:25		21:00	1	06:12 (T-29)	21:17	7	06:15 (T-29)
28	07:51		07:08	07:28 (T-93)	07:17	18:27 (T-28)	06:23		18:27 (T-28)	06:23		05:48	06:11 (T-29)	05:44		06:08 (T-29)
	17:29		18:11	18	07:46 (T-93)	19:48	59	19:26 (T-27)	20:26		21:01	2	06:13 (T-29)	21:17	7	06:15 (T-29)
29	07:50				07:15	18:27 (T-28)	06:21		18:27 (T-28)	06:21		05:47	06:10 (T-29)	05:44		06:09 (T-29)
	17:31				19:49	60	19:27 (T-27)	20:28		21:02	3	06:13 (T-29)	21:17	7	06:16 (T-29)	
30	07:49		17:04 (T-25)		07:13	18:28 (T-28)	06:20		18:28 (T-28)	06:20		05:47	06:10 (T-29)	05:45		06:09 (T-29)
	17:32	2	17:06 (T-25)		19:50	60	19:28 (T-27)	20:29		21:02	4	06:14 (T-29)	21:17	7	06:16 (T-29)	
31	07:48		17:04 (T-25)		07:11	18:28 (T-28)			18:28 (T-28)			05:46	06:09 (T-29)			
	17:34	3	17:07 (T-25)		19:51	61	19:29 (T-27)		19:29 (T-27)			21:03	4	06:13 (T-29)		
Potential sun hours	287		292		369		403		459		465					
Total, worst case	88		177		1282		226		14		203					
Sun reduction	0.58		0.58		0.59		0.63		0.66		0.73					
Oper. time red.	0.90		0.90		0.90		0.90		0.90		0.90					
Wind dir. red.	0.66		0.61		0.58		0.58		0.59		0.59					
Total reduction	0.35		0.32		0.31		0.33		0.35		0.39					
Total, real	30		56		396		75		5		79					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-185 - R-185
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time													N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
													561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

		July	August	September	October	November	December				
1	05:45	06:10 (T-29)	06:13	06:49	07:24	18:11 (T-28)	07:04	07:27 (T-31)	07:43		
	21:17	7 06:17 (T-29)	20:55	20:07	19:11	34 18:45 (T-28)	17:17	1 07:28 (T-31)	16:49		
2	05:46	06:10 (T-29)	06:14	06:50	07:26	18:13 (T-28)	07:06		07:45		
	21:17	7 06:17 (T-29)	20:54	20:05	19:09	31 18:44 (T-28)	17:16		16:48		
3	05:48	06:11 (T-29)	06:15	06:51	07:27	18:14 (T-28)	07:07		07:46		
	21:16	7 06:18 (T-29)	20:53	20:03	19:07	28 18:42 (T-28)	17:14	4 16:45 (T-25)	16:48		
4	05:47	06:11 (T-29)	06:16	06:52	07:28	18:15 (T-28)	07:08		07:47		
	21:16	7 06:18 (T-29)	20:51	20:02	19:05	25 18:40 (T-28)	17:13	10 16:48 (T-25)	16:48		
5	05:48	06:12 (T-29)	06:17	06:53	07:29	08:05 (T-93)	07:10		07:48		
	21:16	7 06:19 (T-29)	20:50	20:00	19:04	27 18:38 (T-28)	17:12	10 16:47 (T-25)	16:47	4 08:28 (T-82)	
6	05:48	06:13 (T-29)	06:18	06:55	07:30	08:01 (T-93)	07:11		07:49	08:26 (T-82)	
	21:16	7 06:20 (T-29)	20:49	19:58	19:02	32 18:37 (T-28)	17:10	9 16:45 (T-25)	16:47	9 08:35 (T-82)	
7	05:49	06:13 (T-29)	06:19	06:56		18:33 (T-28)	07:32		07:50	08:26 (T-82)	
	21:15	7 06:20 (T-29)	20:47	19:56	27 19:17 (T-27)	19:00	30 18:35 (T-28)	17:09	8 16:44 (T-25)	16:47	10 08:36 (T-82)
8	05:50	06:14 (T-29)	06:21	06:57		18:30 (T-28)	07:33		07:51	08:25 (T-82)	
	21:15	6 06:20 (T-29)	20:46	19:54	39 19:20 (T-27)	18:56	21 08:17 (T-93)	17:08	7 16:42 (T-25)	16:47	13 08:38 (T-82)
9	05:50	06:15 (T-29)	06:22	06:58		18:27 (T-28)	07:34		07:52	08:25 (T-82)	
	21:14	6 06:21 (T-29)	20:44	19:52	47 19:21 (T-27)	18:54	23 08:18 (T-93)	17:07	6 16:42 (T-25)	16:47	14 08:39 (T-82)
10	05:51	06:15 (T-29)	06:23	06:59		18:25 (T-28)	07:35		07:53	08:25 (T-82)	
	21:14	5 06:20 (T-29)	20:43	19:51	53 19:22 (T-27)	18:53	22 08:19 (T-93)	17:05	5 16:40 (T-25)	16:47	15 08:40 (T-82)
11	05:52	06:16 (T-29)	06:24	07:01		18:23 (T-28)	07:37		07:54	08:25 (T-82)	
	21:13	5 06:21 (T-29)	20:42	19:49	57 19:22 (T-27)	18:51	21 08:19 (T-93)	17:04	3 16:39 (T-25)	16:47	16 08:41 (T-82)
12	05:53	06:17 (T-29)	06:25	07:02		18:21 (T-28)	07:38		07:55	08:25 (T-82)	
	21:13	4 06:21 (T-29)	20:40	19:47	61 19:22 (T-27)	18:49	20 08:19 (T-93)	17:03	2 16:38 (T-25)	16:47	17 08:42 (T-82)
13	05:54	06:18 (T-29)	06:26	07:03		18:19 (T-28)	07:39		07:55	08:25 (T-82)	
	21:12	4 06:22 (T-29)	20:39	19:45	61 19:20 (T-27)	18:47	19 08:20 (T-93)	17:02		16:47	18 08:43 (T-82)
14	05:54	06:19 (T-29)	06:28	07:04		18:17 (T-28)	07:40		07:56	08:26 (T-82)	
	21:12	3 06:22 (T-29)	20:37	19:43	61 19:18 (T-27)	18:46	17 08:19 (T-93)	17:01		16:47	18 08:44 (T-82)
15	05:55	06:20 (T-29)	06:29	07:05		18:16 (T-28)	07:42		07:57	08:26 (T-82)	
	21:11	2 06:22 (T-29)	20:36	19:41	60 19:16 (T-27)	18:44	15 08:18 (T-93)	17:00		16:47	19 08:45 (T-82)
16	05:56	06:20 (T-29)	06:30	07:06		18:16 (T-28)	07:43		07:58	08:26 (T-82)	
	21:10	2 06:22 (T-29)	20:34	19:39	59 19:15 (T-27)	18:42	14 08:19 (T-93)	16:59		16:47	19 08:45 (T-82)
17	05:57	06:21 (T-29)	06:31	07:08		18:15 (T-28)	07:44		07:58	08:26 (T-82)	
	21:10	1 06:22 (T-29)	20:32	19:37	58 19:13 (T-27)	18:40	12 08:18 (T-93)	16:58		16:48	19 08:45 (T-82)
18	05:58		06:32	07:09		18:13 (T-28)	07:46		07:59	08:27 (T-82)	
	21:09		20:31	19:35	58 19:11 (T-27)	18:39	9 08:16 (T-93)	16:57		16:48	19 08:46 (T-82)
19	05:59		06:33	07:10		18:13 (T-28)	07:47		08:00	08:27 (T-82)	
	21:08		20:29	19:34	56 19:09 (T-27)	18:37	7 08:16 (T-93)	16:56		16:48	19 08:46 (T-82)
20	06:00		06:35	07:11		18:12 (T-28)	07:48		08:00	08:28 (T-82)	
	21:07		20:28	19:32	55 19:07 (T-27)	18:35	4 08:14 (T-93)	16:55		16:49	19 08:47 (T-82)
21	06:01		06:36	07:12		18:11 (T-28)	07:49		08:01	08:27 (T-82)	
	21:07		20:26	19:30	53 19:04 (T-27)	18:34	1 08:12 (T-93)	16:54		16:49	20 08:47 (T-82)
22	06:02		06:37	07:13		18:11 (T-28)	07:51		08:01	08:28 (T-82)	
	21:06		20:24	19:28	52 19:03 (T-27)	18:32		16:54		16:50	20 08:48 (T-82)
23	06:03		06:38	07:15		18:11 (T-28)	07:52		08:02	08:28 (T-82)	
	21:05		20:23	19:26	49 19:00 (T-28)	18:31		16:53		16:50	20 08:48 (T-82)
24	06:04		06:39	07:16		18:10 (T-28)	07:53		08:02	08:30 (T-82)	
	21:04		20:21	19:24	49 18:59 (T-28)	18:29		16:52		16:51	19 08:49 (T-82)
25	06:05		06:41	07:17		18:10 (T-28)	07:55		08:03	08:30 (T-82)	
	21:03		20:19	19:22	47 18:57 (T-28)	18:27	3 08:22 (T-31)	16:52		16:51	19 08:49 (T-82)
26	06:06		06:42	07:18		18:10 (T-28)	07:56		08:03	08:30 (T-82)	
	21:02		20:18	19:20	45 18:55 (T-28)	18:26	7 08:25 (T-31)	16:51		16:52	19 08:49 (T-82)
27	06:07		06:43	07:19		18:11 (T-28)	07:57		08:03	08:31 (T-82)	
	21:01		20:16	19:18	43 18:54 (T-28)	18:24	7 08:27 (T-31)	16:50		16:53	20 08:51 (T-82)
28	06:08		06:44	07:21		18:11 (T-28)	07:59		08:04	08:32 (T-82)	
	21:00		20:14	19:17	41 18:52 (T-28)	18:23	6 08:27 (T-31)	16:50		16:54	19 08:51 (T-82)
29	06:09		06:45	07:22		18:11 (T-28)	08:00		08:04	08:32 (T-82)	
	20:59		20:12	19:15	39 18:50 (T-28)	18:21	5 08:28 (T-31)	16:49		16:54	19 08:51 (T-82)
30	06:10		06:46	07:23		18:11 (T-28)	08:01		08:04	08:33 (T-82)	
	20:57		20:11	19:13	37 18:48 (T-28)	18:20	4 08:28 (T-31)	16:49		16:55	18 08:51 (T-82)
31	06:12		06:48			08:03			08:04	08:34 (T-82)	
	20:56		20:09			18:18	3 08:29 (T-31)		16:56	17 08:51 (T-82)	
Potential sun hours	471		436	377	341		289		275		458
Total, worst case		87			1207		447		65		0.52
Sun reduction		0.75			0.67		0.56		0.48		0.90
Oper. time red.		0.90			0.90		0.90		0.90		0.67
Wind dir. red.		0.59			0.58		0.60		0.59		0.31
Total reduction		0.40			0.35		0.30		0.26		0.143
Total, real		35			422		135		17		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-186 - R-186

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05	15:55 (T-28) 07:47	17:02 (T-27) 07:06	07:09	06:18	05:45
	16:57	17 16:12 (T-28) 17:35	7 17:09 (T-27) 18:13	19:53	20:30	21:04
2	08:05	15:56 (T-28) 07:46	17:02 (T-27) 07:04	07:08	06:17	05:45
	16:58	16 16:12 (T-28) 17:36	9 17:11 (T-27) 18:14	19:54	20:31	21:05
3	08:05	15:57 (T-28) 07:45	17:02 (T-27) 07:03	07:06	06:15	05:44
	16:59	15 16:12 (T-28) 17:38	11 17:13 (T-27) 18:15	19:55	20:33	21:06
4	08:05	15:58 (T-28) 07:44	17:02 (T-27) 07:01	07:04	06:14	05:44
	17:00	14 16:12 (T-28) 17:39	11 17:13 (T-27) 18:17	19:56	20:34	21:07
5	08:04	16:00 (T-28) 07:42	17:02 (T-27) 06:59	07:02	06:13	05:43
	17:01	12 16:12 (T-28) 17:41	13 17:15 (T-27) 18:18	19:58	20:35	21:08
6	08:04	16:02 (T-28) 07:41	17:03 (T-27) 06:57	07:00	06:11	05:43
	17:02	9 16:11 (T-28) 17:42	14 17:17 (T-27) 18:19	19:59	20:36	21:08
7	08:04	16:04 (T-28) 07:40	17:03 (T-27) 06:56	06:58	07:19 (T-29) 06:10	05:43
	17:03	4 16:08 (T-28) 17:44	15 17:18 (T-27) 18:21	20:00	1 07:20 (T-29) 20:37	21:09
8	08:04	07:39	17:04 (T-27) 07:54	06:57	07:17 (T-29) 06:09	05:42
	17:04	17:45	16 17:20 (T-27) 18:22	20:01	3 07:20 (T-29) 20:39	21:10
9	08:04	07:37	17:05 (T-27) 07:52	06:55	07:15 (T-29) 06:07	05:42
	17:05	17:46	16 17:21 (T-27) 19:23	20:03	5 07:20 (T-29) 20:40	21:10
10	08:03	07:36	17:06 (T-27) 07:50	06:53	07:13 (T-29) 06:06	05:42
	17:06	17:48	13 17:19 (T-27) 19:25	20:04	7 07:20 (T-29) 20:41	21:11
11	08:03	07:34	17:08 (T-27) 07:48	06:51	07:12 (T-29) 06:05	05:42
	17:07	17:49	10 17:18 (T-27) 19:26	20:05	9 07:21 (T-29) 20:42	21:12
12	08:03	07:33	07:46	06:50	07:10 (T-29) 06:03	05:41
	17:09	17:51	19:27	20:06	10 07:20 (T-29) 20:43	21:12
13	08:02	07:32	07:45	06:48	07:08 (T-29) 06:02	05:41
	17:10	17:52	19:29	20:08	11 07:19 (T-29) 20:44	21:13
14	08:02	07:30	07:43	06:46	07:06 (T-29) 06:01	05:41
	17:11	17:54	19:30	20:09	12 07:18 (T-29) 20:46	21:13
15	08:01	07:29	07:41	06:44	07:05 (T-29) 06:00	05:41
	17:12	17:55	19:31	20:10	13 07:18 (T-29) 20:47	21:14
16	08:01	07:27	07:39	06:43	07:03 (T-29) 05:59	05:41
	17:13	17:56	19:33	20:11	13 07:16 (T-29) 20:48	21:14
17	08:00	07:26	07:37	06:41	07:03 (T-29) 05:58	05:41
	17:15	17:58	19:34	20:13	11 07:14 (T-29) 20:49	21:15
18	08:00	07:24	07:35	06:39	07:07 (T-29) 05:57	05:41
	17:16	17:59	19:35	20:14	4 07:11 (T-29) 20:50	21:15
19	07:59	07:23	07:34	06:37	05:56	05:41
	17:17	18:00	19:36	20:15	20:51	21:15
20	07:58	07:21	07:32	06:36	05:55	05:41
	17:19	18:00	19:38	20:16	20:52	21:16
21	07:58	07:19	07:30	06:34	06:55 (T-13) 05:54	05:42
	17:20	18:02	19:39	20:18	1 06:56 (T-13) 20:53	21:16
22	07:57	07:18	07:28	06:32	06:53 (T-13) 05:53	05:42
	17:21	18:03	19:40	20:19	3 06:56 (T-13) 20:55	21:16
23	07:56	07:16	07:26	06:31	06:51 (T-13) 05:52	05:42
	17:23	18:05	19:41	20:20	5 06:56 (T-13) 20:56	21:16
24	07:55	07:14	07:24	06:29	06:50 (T-13) 05:51	05:42
	17:24	18:06	19:43	20:21	6 06:56 (T-13) 20:57	21:17
25	07:54	07:13	07:22	06:28	06:48 (T-13) 05:50	05:43
	17:25	18:07	19:44	20:23	7 06:55 (T-13) 20:58	21:17
26	07:53	07:11	07:21	06:26	06:47 (T-13) 05:49	05:43
	17:27	18:09	19:45	20:24	8 06:55 (T-13) 20:59	21:17
27	07:52	07:09	07:19	06:24	06:45 (T-13) 05:49	05:43
	17:28	18:10	19:46	20:25	8 06:53 (T-13) 21:00	21:17
28	07:51	07:08	07:17	06:23	06:44 (T-13) 05:48	05:44
	17:29	18:11	19:48	20:26	8 06:52 (T-13) 21:01	21:17
29	07:50		07:15	06:21	06:43 (T-13) 05:47	05:44
	17:31		19:49	20:28	6 06:49 (T-13) 21:02	21:17
30	07:49	17:03 (T-27)	07:13	06:20	05:46	05:45
	17:32	3 17:06 (T-27)	19:50	20:29	21:02	21:17
31	07:48	17:03 (T-27)	07:11		05:46	
	17:34	4 17:07 (T-27)	19:51		21:03	
Potential sun hours	287	292	369	403	459	465
Total, worst case	94	135		151		
Sun reduction	0.58	0.58		0.63		
Oper. time red.	0.90	0.90		0.90		
Wind dir. red.	0.61	0.59		0.57		
Total reduction	0.32	0.31		0.33		
Total, real	30	42		49		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
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Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-186 - R-186
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-29) 19:11	07:24 17:17	07:43 16:48
2	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-29) 19:09	07:25 17:16	07:45 16:48
3	05:46 21:16	06:15 20:53	06:51 20:03	07:13 (T-29) 19:07	07:27 17:14	07:46 16:48
4	05:47 21:16	06:16 20:51	06:52 20:02	07:14 (T-29) 19:05	07:28 17:13	07:47 16:47
5	05:48 21:16	06:17 20:50	06:53 20:00	07:15 (T-29) 19:04	07:29 17:12	07:48 16:47
6	05:48 21:16	06:18 20:49	06:55 19:58	07:30 19:02	07:11 17:10	07:49 16:47
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	07:12 17:09	07:50 16:47
8	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	07:14 17:08	07:51 16:47
9	05:50 21:14	06:22 20:45	06:58 19:52	07:34 18:54	07:15 17:07	07:52 16:47
10	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:16 17:05	07:53 16:47
11	05:52 21:14	06:24 20:42	07:00 19:49	07:37 18:51	07:18 17:04	07:54 16:47
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:55 16:47
13	05:54 21:12	06:26 20:39	07:03 19:45	07:39 18:47	07:20 17:02	07:55 16:47
14	05:54 21:12	06:28 20:37	06:50 (T-13) 19:43	07:04 18:46	07:22 17:01	07:56 16:47
15	05:55 21:11	06:29 20:36	06:52 (T-13) 19:41	07:05 18:44	07:23 17:00	07:57 16:47
16	05:56 21:10	06:30 20:34	06:53 (T-13) 19:39	07:06 18:42	07:25 16:59	07:58 16:47
17	05:57 21:10	06:31 20:32	06:54 (T-13) 19:37	07:08 18:40	07:26 16:58	07:58 16:48
18	05:58 21:09	06:32 20:31	06:55 (T-13) 19:35	07:09 18:39	07:27 16:57	07:59 16:48
19	05:59 21:08	06:33 20:29	06:56 (T-13) 19:34	07:10 18:37	07:29 16:56	08:00 16:48
20	06:00 21:07	06:35 20:28	06:57 (T-13) 19:32	07:11 18:35	07:30 16:55	08:00 16:49
21	06:01 21:07	06:36 20:26	06:58 (T-13) 19:30	07:12 18:34	07:31 16:54	08:01 16:49
22	06:02 21:06	06:37 20:24	06:59 (T-13) 19:28	07:13 18:32	07:32 16:54	08:01 16:50
23	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53	08:02 16:50
24	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	08:02 16:51
25	06:05 21:03	06:41 20:19	07:09 (T-29) 19:22	07:17 18:27	07:36 16:51	08:03 16:52
26	06:06 21:02	06:42 20:18	07:05 (T-29) 19:20	07:18 18:26	07:37 16:51	08:03 16:52
27	06:07 21:01	06:43 20:16	07:05 (T-29) 19:18	07:19 18:24	07:39 16:50	08:03 16:53
28	06:08 21:00	06:44 20:14	07:06 (T-29) 19:17	07:21 18:23	07:40 16:50	08:04 16:53
29	06:09 20:59	06:45 20:12	07:07 (T-29) 19:15	07:22 18:21	07:41 16:49	08:04 16:54
30	06:10 20:57	06:46 20:11	07:08 (T-29) 19:13	07:23 18:20	07:42 17:48 (T-27)	08:04 16:55
31	06:11 20:56	06:48 20:09	07:10 (T-29) 19:11	08:03 18:18	07:43 17:48 (T-27)	08:04 16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case						494
Sun reduction		0.72	0.67	0.56	0.48	0.52
Oper. time red.		0.90	0.90	0.90	0.90	0.90
Wind dir. red.		0.58	0.57	0.59	0.59	0.61
Total reduction		0.37	0.35	0.30	0.26	0.29
Total, real		48	9	4	34	142

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-187 - R-187
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:05	07:47	07:06	07:10	06:18	20:00 (T-06)	05:45	05:45	06:13	06:49	07:24	07:04	07:44	
	16:57	17:35	18:13	19:53	20:30	6 20:06 (T-06)	21:04	21:17	20:55	20:07	19:11	17:17	16:49	
2	08:05	07:46	07:04	07:08	06:17	20:00 (T-06)	05:45	05:46	06:14	06:50	07:26	07:06	07:45	
	16:58	17:37	18:14	19:54	20:31	8 20:08 (T-06)	21:05	21:17	20:54	20:05	19:09	17:16	16:48	
3	08:05	07:45	07:03	07:06	06:15	20:00 (T-06)	05:44	05:46	06:15	06:51	07:27	07:07	07:46	
	16:59	17:38	18:16	19:55	20:33	9 20:09 (T-06)	21:06	21:16	20:53	20:03	19:07	17:14	16:48	
4	08:05	07:44	07:01	07:04	06:14	20:00 (T-06)	05:44	05:47	06:16	06:52	07:28	07:08	07:47	
	17:00	17:39	18:17	19:57	20:34	10 20:10 (T-06)	21:07	21:16	20:51	7 20:22 (T-06)	20:02	19:05	17:13	16:48
5	08:05	07:42	06:59	07:02	06:13	20:01 (T-06)	05:43	05:48	06:17	20:14 (T-06)	06:54	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	10 20:11 (T-06)	21:08	21:16	20:50	11 20:25 (T-06)	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	20:02 (T-06)	05:43	05:48	06:18	20:12 (T-06)	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	11 20:13 (T-06)	21:08	21:16	20:49	11 20:23 (T-06)	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:59	06:10	20:02 (T-06)	05:43	05:49	06:19	20:11 (T-06)	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	11 20:13 (T-06)	21:09	21:15	20:47	11 20:22 (T-06)	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:09	20:04 (T-06)	05:42	05:50	06:21	20:10 (T-06)	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	10 20:14 (T-06)	21:10	21:15	20:46	10 20:20 (T-06)	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	20:06 (T-06)	05:42	05:50	06:22	20:09 (T-06)	06:58	07:34	07:15	07:52
	17:05	17:47	18:24	20:03	20:40	5 20:11 (T-06)	21:10	21:15	20:45	10 20:19 (T-06)	19:52	18:55	17:07	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	20:09 (T-06)	06:59	07:35	07:16	07:53	
	17:06	17:48	18:25	20:04	20:41	21:11	21:14	20:43	8 20:17 (T-06)	19:51	18:53	17:05	16:47	
11	08:03	07:35	07:48	06:51	06:05	05:42	05:52	06:24	20:08 (T-06)	07:01	07:37	07:18	07:54	
	17:07	17:49	18:26	20:05	20:42	21:12	21:14	20:42	8 20:16 (T-06)	19:49	18:51	17:04	16:47	
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	20:08 (T-06)	07:02	07:38	07:19	07:55	
	17:09	17:51	18:27	20:07	20:43	21:12	21:13	20:40	6 20:14 (T-06)	19:47	18:49	17:03	16:47	
13	08:02	07:32	07:45	06:48	06:02	05:41	05:54	06:26	20:08 (T-06)	07:03	07:39	07:21	07:56	
	17:10	17:52	18:29	20:08	20:45	21:13	21:12	20:39	5 20:13 (T-06)	19:45	18:47	17:02	16:47	
14	08:02	07:30	07:43	19:07 (T-23)	06:46	06:01	05:41	05:54	06:28	20:08 (T-06)	07:04	07:41	07:22	07:56
	17:11	17:54	18:30	1 19:08 (T-23)	20:09	20:46	21:13	21:12	20:37	3 20:11 (T-06)	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	19:06 (T-23)	06:44	06:00	05:41	05:55	06:29	20:10 (T-06)	07:05	07:42	07:23	07:57
	17:12	17:55	18:31	4 19:10 (T-23)	20:10	20:47	21:14	21:11	20:36	1 20:11 (T-06)	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	19:08 (T-23)	06:43	06:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58	
	17:13	17:56	18:33	4 19:12 (T-23)	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47	
17	08:00	07:26	07:37	19:08 (T-23)	06:41	06:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59	
	17:15	17:58	18:34	5 19:13 (T-23)	20:13	20:49	21:15	21:10	20:33	19:37	18:41	16:58	16:48	
18	08:00	07:24	07:36	19:10 (T-23)	06:39	06:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59	
	17:16	17:59	18:35	4 19:14 (T-23)	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48	
19	07:59	07:23	07:34	06:37	06:56	06:51	05:41	05:59	06:34	07:10	07:47	07:29	08:00	
	17:17	18:01	18:36	20:15	20:51	21:15	21:15	21:08	20:29	19:30	18:37	16:56	16:48	
20	07:58	07:21	07:32	06:36	06:55	06:51	06:00	06:35	07:11	07:48	07:30	08:00		
	17:19	18:01	18:38	20:16	20:52	21:16	21:07	20:28	19:32	18:36	16:55	16:49		
21	07:58	07:19	07:30	06:34	06:54	06:52	06:01	06:36	07:12	07:50	07:31	08:01		
	17:20	18:02	18:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:55	16:49		
22	07:57	07:18	07:28	06:32	06:53	06:52	06:02	06:37	07:14	07:51	07:32	08:02		
	17:21	18:03	18:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50		
23	07:56	07:16	07:26	06:31	06:52	06:52	06:03	06:38	07:15	07:52	07:34	08:02		
	17:23	18:05	18:41	20:20	20:56	21:16	21:05	20:23	19:26	18:31	16:53	16:50		
24	07:55	07:15	07:24	06:29	06:51	06:52	06:04	06:39	07:16	07:53	07:35	08:02		
	17:24	18:06	18:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51		
25	07:54	07:13	07:23	06:28	06:50	06:53	06:05	06:41	07:17	18:54 (T-23)	07:55	07:36	08:03	
	17:25	18:07	18:44	20:23	20:58	21:17	21:03	20:19	19:22	3 18:57 (T-23)	18:27	16:52	16:51	
26	07:53	07:11	07:21	06:26	06:49	06:53	06:06	06:42	07:18	18:50 (T-23)	07:56	07:38	08:03	
	17:27	18:09	18:45	20:24	20:59	21:17	21:02	20:18	19:20	5 18:55 (T-23)	18:26	16:51	16:52	
27	07:52	07:10	07:19	06:24	06:49	06:53	06:07	06:43	07:19	18:50 (T-23)	07:57	07:39	08:04	
	17:28	18:10	18:47	20:25	21:00	21:17	21:01	20:16	19:19	4 18:54 (T-23)	18:24	16:50	16:53	
28	07:51	07:08	07:17	06:23	20:02 (T-06)	05:48	05:44	06:08	06:44	07:21	18:48 (T-23)	07:59	07:40	08:04
	17:30	18:12	18:48	20:26	1 20:03 (T-06)	21:01	21:17	21:00	20:14	19:17	4 18:52 (T-23)	18:23	16:50	16:54
29	07:50	07:15	07:25	06:21	20:01 (T-06)	05:47	05:44	06:09	06:45	07:22	18:47 (T-23)	08:00	07:41	08:04
	17:31	18:13	18:49	20:28	3 20:04 (T-06)	21:02	21:17	20:59	20:12	19:15	3 18:50 (T-23)	18:21	16:49	16:54
30	07:49	07:13	07:23	06:20	20:00 (T-06)	05:47	05:45	06:10	06:46	07:23	18:47 (T-23)	08:02	07:42	08:04
	17:32	18:14	18:50	20:29	6 20:06 (T-06)	21:03	21:17	20:57	20:11	19:13	1 18:48 (T-23)	18:20	16:49	16:55
31	07:48	07:11	07:21	06:19	06:46	06:54	06:12	06:48	07:24	18:58 (T-23)	08:03	07:45	08:04	
	17:34	18:16	18:52	20:31	21:03	21:18	21:06	20:09	19:21	18:18	16:56	16:56		
Potential sun hours	287	292	369	403	459	465	471	436	377	20	341	289	275	
Total, worst case			18	10	80			91		20				
Sun reduction			0.59	0.63	0.66			0.72		0.67				
Oper. time red.			0.90	0.90	0.90			0.90		0.90				
Wind dir. red.			0.58	0.62	0.62			0.68		0.58				
Total reduction			0.31	0.35	0.37			0.40		0.35				
Total, real			6	4	29			36		7				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-188 - R-188
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June		
1	08:05	07:47	07:06	17:41 (T-23)	07:10	06:18	19:57 (T-06)	05:45
	16:57	17:35	18:13	10 17:51 (T-23)	19:53	20:30	9 20:06 (T-06)	21:04
2	08:05	07:46	07:04	17:41 (T-23)	07:08	06:17	19:56 (T-06)	05:45
	16:58	17:37	18:14	11 17:52 (T-23)	19:54	20:31	12 20:08 (T-06)	21:05
3	08:05	07:45	07:03	17:41 (T-23)	07:06	06:16	19:56 (T-06)	05:44
	16:59	17:38	18:16	13 17:54 (T-23)	19:55	20:33	13 20:09 (T-06)	21:06
4	08:05	07:44	07:01	17:43 (T-23)	07:04	06:14	19:55 (T-06)	05:44
	17:00	17:39	18:17	13 17:56 (T-23)	19:57	20:34	15 20:10 (T-06)	21:07
5	08:05	07:42	06:59	17:45 (T-23)	07:02	06:13	19:55 (T-06)	05:43
	17:01	17:41	18:18	10 17:55 (T-23)	19:58	20:35	16 20:11 (T-06)	21:08
6	08:04	07:41	06:57	07:00	06:11	19:55 (T-06)	05:43	
	17:02	17:42	18:20	19:59	20:36	18 20:13 (T-06)	21:08	
7	08:04	07:40	06:56	06:59	06:10	19:54 (T-06)	05:43	
	17:03	17:44	18:21	20:00	20:37	19 20:13 (T-06)	21:09	
8	08:04	07:39	07:54	06:57	06:09	19:54 (T-06)	05:42	
	17:04	17:45	18:22	20:02	20:39	20 20:14 (T-06)	21:10	
9	08:04	07:37	07:52	06:55	06:07	19:54 (T-06)	05:42	
	17:05	17:47	19:24	20:03	20:40	22 20:16 (T-06)	21:11	
10	08:04	07:36	07:50	06:53	06:06	19:54 (T-06)	05:42	
	17:06	17:48	19:25	20:04	20:41	23 20:17 (T-06)	21:11	
11	08:03	07:35	07:48	06:51	06:05	19:55 (T-06)	05:42	
	17:07	17:49	19:26	20:05	20:42	23 20:18 (T-06)	21:12	
12	08:03	07:33	07:47	06:50	06:04	19:54 (T-06)	05:41	
	17:09	17:51	19:27	20:07	20:43	25 20:19 (T-06)	21:12	
13	08:02	07:32	07:45	06:48	06:02	19:54 (T-06)	05:41	
	17:10	17:52	19:29	20:08	20:45	26 20:20 (T-06)	21:13	
14	08:02	07:30	07:43	06:46	06:01	19:55 (T-06)	05:41	
	17:11	17:54	19:30	20:09	20:46	26 20:21 (T-06)	21:13	
15	08:01	07:29	07:41	06:44	06:00	19:56 (T-06)	05:41	
	17:12	17:55	19:31	20:10	20:47	24 20:20 (T-06)	21:14	
16	08:01	07:27	07:39	06:43	05:59	19:56 (T-06)	05:41	
	17:14	17:56	19:33	20:12	20:48	24 20:20 (T-06)	21:14	
17	08:00	07:26	07:37	06:41	05:58	19:57 (T-06)	05:41	
	17:15	17:58	19:34	20:13	20:49	22 20:19 (T-06)	21:15	
18	08:00	07:24	07:36	06:39	05:57	19:58 (T-06)	05:41	
	17:16	17:59	19:35	20:14	20:50	20 20:18 (T-06)	21:15	
19	07:59	07:23	07:34	06:38	05:56	19:59 (T-06)	05:41	
	17:17	18:01	19:36	20:15	20:51	18 20:17 (T-06)	21:16	
20	07:58	07:21	07:32	06:36	05:55	20:00 (T-06)	05:41	
	17:19	18:01	19:38	20:17	20:52	16 20:16 (T-06)	21:16	
21	07:58	07:19	07:30	06:34	05:54	20:02 (T-06)	05:42	
	17:20	18:02	19:39	20:18	20:54	12 20:14 (T-06)	21:16	
22	07:57	07:18	07:28	06:33	05:53	20:04 (T-06)	05:42	
	17:21	18:03	19:40	20:19	20:55	8 20:12 (T-06)	21:16	
23	07:56	07:16	07:26	06:31	05:52	05:52	05:42	
	17:23	18:05	19:42	20:20	20:56	20:56	21:17	
24	07:55	07:15	17:42 (T-23)	07:24	06:29	05:51	05:42	
	17:24	18:06	2 17:44 (T-23)	19:43	20:21	20:57	21:17	
25	07:54	07:13	17:41 (T-23)	07:23	06:28	05:50	05:43	
	17:25	18:07	5 17:46 (T-23)	19:44	20:23	20:58	21:17	
26	07:53	07:11	17:41 (T-23)	07:21	06:26	05:49	05:43	
	17:27	18:09	6 17:47 (T-23)	19:45	20:24	20:59	21:17	
27	07:52	07:10	17:40 (T-23)	07:19	06:25	05:49	05:43	
	17:28	18:10	8 17:48 (T-23)	19:47	20:25	21:00	21:17	
28	07:51	07:08	17:41 (T-23)	07:17	06:23	20:02 (T-06)	05:48	
	17:30	18:12	9 17:50 (T-23)	19:48	20:26	1 20:03 (T-06)	21:01	
29	07:50		07:15	06:21	20:00 (T-06)	05:47	05:44	
	17:31		19:49	20:28	4 20:04 (T-06)	21:02	21:17	
30	07:49		07:13	06:20	19:59 (T-06)	05:47	05:45	
	17:32		19:50	20:29	7 20:06 (T-06)	21:03	21:17	
31	07:48		07:11	05:46				
	17:34		19:52	21:03				
Potential sun hours	287	292	369	403	459		465	
Total, worst case								
Sun reduction		30	57	12	411			
Oper. time red.		0.58	0.59	0.63	0.66			
Wind dir. red.		0.90	0.90	0.90	0.90			
Total reduction		0.58	0.58	0.62	0.62			
Total, real		0.30	0.31	0.35	0.37			
		9	18	4	152			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-188 - R-188

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	20:04 (T-06) 20:29 (T-06)	06:49 20:07	07:24 19:11	07:04 17:17
2	05:46 21:17	06:14 20:54	20:04 (T-06) 20:28 (T-06)	06:50 20:05	07:26 19:09	07:06 17:16
3	05:46 21:16	06:15 20:53	20:04 (T-06) 20:26 (T-06)	06:51 20:04	07:27 19:07	07:07 17:14
4	05:47 21:16	06:16 20:51	20:04 (T-06) 20:25 (T-06)	06:52 20:02	07:28 19:06	07:08 17:13
5	05:48 21:16	06:17 20:50	20:04 (T-06) 20:25 (T-06)	06:54 20:00	07:29 19:04	07:10 17:12
6	05:48 21:16	06:18 20:49	20:04 (T-06) 20:23 (T-06)	06:55 19:58	07:31 19:02	07:11 17:10
7	05:49 21:15	06:20 20:47	20:04 (T-06) 20:22 (T-06)	06:56 19:56	07:32 19:00	07:12 17:09
8	05:50 21:15	06:21 20:46	20:04 (T-06) 20:20 (T-06)	06:57 19:54	07:33 18:56	18:21 (T-23) 18:29 (T-23)
9	05:50 21:15	06:22 20:45	20:05 (T-06) 20:19 (T-06)	06:58 19:52	07:34 18:55	18:18 (T-23) 18:30 (T-23)
10	05:51 21:14	06:23 20:43	20:05 (T-06) 20:17 (T-06)	06:59 19:51	07:35 18:53	18:17 (T-23) 18:29 (T-23)
11	05:52 21:14	06:24 20:42	20:05 (T-06) 20:16 (T-06)	07:01 19:49	07:37 18:51	18:15 (T-23) 18:27 (T-23)
12	05:53 21:13	06:25 20:40	20:06 (T-06) 20:14 (T-06)	07:02 19:47	07:38 18:49	18:14 (T-23) 18:25 (T-23)
13	05:54 21:13	06:26 20:39	20:07 (T-06) 20:13 (T-06)	07:03 19:45	07:39 18:47	18:14 (T-23) 18:24 (T-23)
14	05:54 21:12	06:28 20:37	20:09 (T-06) 20:12 (T-06)	07:04 19:43	07:41 18:46	18:13 (T-23) 18:22 (T-23)
15	05:55 21:11	06:29 20:36	20:09 (T-06)	07:05 19:41	07:42 18:44	18:12 (T-23) 18:20 (T-23)
16	05:56 21:11	06:30 20:34		07:06 19:39	07:43 18:42	18:13 (T-23) 18:19 (T-23)
17	05:57 21:10	06:31 20:33		07:08 19:37	07:44 18:41	18:13 (T-23) 18:17 (T-23)
18	05:58 21:09	06:32 20:31		07:09 19:36	07:46 18:39	18:13 (T-23) 18:14 (T-23)
19	05:59 21:08	06:34 20:29		07:10 19:34	07:47 18:37	07:29 16:56
20	06:00 21:08	06:35 20:28		07:11 19:32	07:48 18:36	07:30 16:55
21	06:01 21:07	20:16 (T-06) 20:21 (T-06)	06:36 20:26	07:12 19:30	07:50 18:34	07:31 16:55
22	06:02 21:06	20:13 (T-06) 20:24 (T-06)	06:37 20:24	07:14 19:28	07:51 18:32	07:33 16:54
23	06:03 21:05	20:11 (T-06) 20:26 (T-06)	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53
24	06:04 21:04	20:10 (T-06) 20:27 (T-06)	06:39 20:21	07:16 19:24	07:54 18:29	07:35 16:52
25	06:05 21:03	20:09 (T-06) 20:28 (T-06)	06:41 20:19	07:17 19:22	07:55 18:27	07:36 16:52
26	06:06 21:02	20:08 (T-06) 20:29 (T-06)	06:42 20:18	07:18 19:20	07:56 18:26	07:38 16:51
27	06:07 21:01	20:07 (T-06) 20:30 (T-06)	06:43 20:16	07:20 19:19	07:58 18:24	07:39 16:50
28	06:08 21:00	20:07 (T-06) 20:31 (T-06)	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50
29	06:09 20:59	20:06 (T-06) 20:31 (T-06)	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49
30	06:10 20:58	20:05 (T-06) 20:31 (T-06)	06:46 20:11	07:23 19:13	08:02 18:20	07:42 16:49
31	06:12 20:56	20:05 (T-06) 20:30 (T-06)	06:48 20:09	08:03 18:18	08:03 18:18	08:04 16:56
Potential sun hours	471	436	377	341	288	275
Total, worst case	211	220		93		
Sun reduction	0.75	0.72		0.56		
Oper. time red.	0.90	0.90		0.90		
Wind dir. red.	0.62	0.62		0.58		
Total reduction	0.42	0.40		0.29		
Total, real	89	89		27		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-189 - R-189
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:05	07:47	07:06	07:10	06:18	05:45
	16:57	17:35	18:13	19:53	20:30	21:04
2	08:05	07:46	07:04	07:08	06:17	05:45
	16:58	17:37	18:14	19:54	20:31	21:05
3	08:05	07:45	17:12 (T-06) 07:03	07:06	06:15	05:44
	16:59	17:38	1 17:13 (T-06) 18:16	19:55	20:33	21:06
4	08:05	07:44	17:10 (T-06) 07:01	07:04	06:14	05:44
	17:00	17:39	3 17:13 (T-06) 18:17	19:57	20:34	21:07
5	08:05	07:42	17:10 (T-06) 06:59	07:02	06:13	05:43
	17:01	17:41	5 17:15 (T-06) 18:18	19:58	20:35	21:08
6	08:04	07:41	17:10 (T-06) 06:57	07:00	06:11	05:43
	17:02	17:42	7 17:17 (T-06) 18:20	19:59	20:36	21:08
7	08:04	07:40	17:11 (T-06) 06:56	06:59	06:10	05:43
	17:03	17:44	8 17:19 (T-06) 18:21	20:00	20:37	21:09
8	08:04	07:39	17:10 (T-06) 07:54	06:57	06:09	05:42
	17:04	17:45	10 17:20 (T-06) 18:22	20:02	20:39	21:10
9	08:04	07:37	17:11 (T-06) 07:52	18:57 (T-07) 06:55	06:07	05:42
	17:05	17:46	11 17:22 (T-06) 19:24	5 19:02 (T-07) 20:03	20:40	21:11
10	08:04	07:36	17:11 (T-06) 07:50	18:56 (T-07) 06:53	07:13 (T-11) 06:06	05:42
	17:06	17:48	12 17:23 (T-06) 19:25	8 19:04 (T-07) 20:04	3 19:42 (T-35) 20:41	21:11
11	08:03	07:35	17:12 (T-06) 07:48	18:55 (T-07) 06:51	07:12 (T-11) 06:05	05:42
	17:07	17:49	13 17:25 (T-06) 19:26	10 19:05 (T-07) 20:05	7 19:44 (T-35) 20:42	21:12
12	08:03	07:33	17:12 (T-06) 07:47	18:54 (T-07) 06:50	07:10 (T-11) 06:03	05:41
	17:09	17:51	14 17:26 (T-06) 19:27	12 19:06 (T-07) 20:07	11 19:45 (T-35) 20:43	21:12
13	08:02	07:32	17:14 (T-06) 07:45	18:53 (T-07) 06:48	07:08 (T-11) 06:02	05:41
	17:10	17:52	13 17:27 (T-06) 19:29	14 19:07 (T-07) 20:08	14 19:46 (T-35) 20:45	21:13
14	08:02	07:30	17:15 (T-06) 07:43	18:52 (T-07) 06:46	07:06 (T-11) 06:01	05:41
	17:11	17:54	10 17:25 (T-06) 19:30	16 19:08 (T-07) 20:09	15 19:46 (T-35) 20:46	21:13
15	08:01	07:29	07:41	18:51 (T-07) 06:44	07:05 (T-11) 06:00	05:41
	17:12	17:55	19 19:10 (T-07) 20:10	17 19:48 (T-35) 20:47	21:14	
16	08:01	07:27	07:39	18:52 (T-07) 06:43	07:03 (T-11) 05:59	05:41
	17:13	17:56	19 19:12 (T-07) 20:12	18 19:49 (T-35) 20:48	21:14	
17	08:00	07:26	07:37	18:52 (T-07) 06:41	07:01 (T-11) 05:58	05:41
	17:15	17:58	19 19:13 (T-07) 20:13	13 07:14 (T-11) 20:49	21:15	
18	08:00	07:24	07:36	18:52 (T-07) 06:39	07:00 (T-11) 05:57	05:41
	17:16	17:59	19 19:14 (T-07) 20:14	14 07:14 (T-11) 20:50	21:15	
19	07:59	07:23	07:34	18:52 (T-07) 06:37	06:58 (T-11) 05:56	05:41
	17:17	18:01	19 19:15 (T-07) 20:15	14 07:12 (T-11) 20:51	21:16	
20	07:58	07:21	07:32	18:52 (T-07) 06:36	06:56 (T-11) 05:55	05:41
	17:19	18:01	19 19:14 (T-07) 20:17	15 07:11 (T-11) 20:53	21:16	
21	07:58	07:19	07:30	18:53 (T-07) 06:34	06:56 (T-11) 05:54	05:42
	17:20	18:02	19 19:13 (T-07) 20:18	14 07:10 (T-11) 20:54	21:16	
22	07:57	07:18	07:28	18:54 (T-07) 06:32	06:57 (T-11) 05:53	05:42
	17:21	18:03	16 19:10 (T-07) 20:19	10 07:07 (T-11) 20:55	21:16	
23	07:56	07:16	07:26	18:56 (T-07) 06:31	05:52	05:42
	17:23	18:05	19 19:12 (T-07) 20:20	20:20	20:56	21:17
24	07:55	07:15	07:24	06:29	05:51	05:42
	17:24	18:06	19 19:13	20:21	20:57	21:17
25	07:54	07:13	07:23	06:28	05:50	05:43
	17:25	18:07	19 19:14	20:23	20:58	21:17
26	07:53	07:11	07:21	06:26	05:49	05:43
	17:27	18:09	19 19:15	20:24	20:59	21:17
27	07:52	07:10	07:19	06:24	05:49	05:43
	17:28	18:10	19 19:17	20:25	21:00	21:17
28	07:51	07:08	07:17	06:23	05:48	05:44
	17:29	18:12	19 19:18	20:26	21:01	21:17
29	07:50		07:15	06:21	05:47	05:44
	17:31		19 19:19	20:28	21:02	21:17
30	07:49		07:13	06:20	05:47	05:45
	17:32		19 19:50	20:29	21:03	21:17
31	07:48		07:11		05:46	
	17:34		19 19:52		21:03	
Potential sun hours	287	292	369	404	459	465
Total, worst case						
Sun reduction		107	239	165		
Oper. time red.		0.58	0.59	0.63		
Wind dir. red.		0.90	0.90	0.90		
Total reduction		0.59	0.58	0.58		
Total, real		0.31	0.31	0.33		
		33	73	54		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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South Deuel Wind Project

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Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-189 - R-189
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-11) 20:07	07:24 18:32 (T-07)	07:44 16:40 (T-06)
2	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-11) 19:41 (T-35)	07:26 19:09	13 11
3	05:46 21:16	06:15 20:53	06:51 20:03	07:27 19:07	18:34 (T-07) 18:42 (T-07)	07:07 17:14
4	05:47 21:16	06:16 20:51	06:52 20:02	07:28 19:05	18:34 (T-07) 18:40 (T-07)	07:08 17:13
5	05:48 21:16	06:17 20:50	06:54 20:00	07:29 19:04	18:36 (T-07) 18:38 (T-07)	07:10 17:12
6	05:48 21:16	06:18 20:49	06:55 19:58	07:30 19:02	07:11 17:10	5 16:45 (T-06)
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	07:12 17:09	3 16:44 (T-06)
8	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	07:14 17:08	07:51 16:47
9	05:50 21:15	06:22 20:45	06:58 19:52	07:34 18:55	07:15 17:07	07:52 16:47
10	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:17 17:05	07:53 16:47
11	05:52 21:14	06:24 20:42	07:01 19:49	07:37 18:51	07:18 17:04	07:54 16:47
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:55 16:47
13	05:54 21:13	06:26 20:39	07:03 19:45	07:39 18:47	07:21 17:02	07:56 16:47
14	05:54 21:12	06:28 20:37	07:04 19:43	07:41 18:46	07:22 17:01	07:56 16:47
15	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	07:57 16:47
16	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42	07:25 16:59	07:58 16:47
17	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:41	07:26 16:58	07:59 16:48
18	05:58 21:09	06:32 20:31	07:09 19:36	07:46 18:39	07:27 16:57	07:59 16:48
19	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37	07:29 16:56	08:00 16:48
20	06:00 21:08	06:35 20:28	07:11 19:32	18:44 (T-07) 18:53 (T-07)	07:48 18:35	07:30 16:55
21	06:01 21:07	06:36 20:26	07:12 (T-11) 19:30	07:12 18:40 (T-07)	07:50 18:34	07:31 16:54
22	06:02 21:06	06:37 20:24	06:59 (T-11) 07:14 (T-11)	07:14 19:28	15 19	16:54 16:50
23	06:03 21:05	06:38 20:23	07:01 (T-11) 07:16 (T-11)	07:15 19:26	18:37 (T-07) 18:58 (T-07)	07:34 16:53
24	06:04 21:04	06:39 20:21	07:02 (T-11) 07:16 (T-11)	07:16 19:24	07:52 18:35 (T-07)	07:34 16:53
25	06:05 21:03	06:41 20:19	07:03 (T-11) 07:17 (T-11)	07:17 19:22	18:29 18:57 (T-07)	07:35 16:52
26	06:06 21:02	06:42 20:18	07:04 (T-11) 07:17 (T-11)	07:18 19:20	22 18:33 (T-07)	07:38 16:51
27	06:07 21:01	06:43 20:16	07:05 (T-11) 19:51 (T-35)	07:20 19:19	18:33 (T-07) 18:54 (T-07)	07:39 16:50
28	06:08 21:00	06:44 20:14	07:06 (T-11) 19:49 (T-35)	07:21 19:17	4 19	17:52 (T-06) 17:44 (T-06)
29	06:09 20:59	06:45 20:12	07:07 (T-11) 19:47 (T-35)	07:22 19:15	11 18	17:55 (T-06) 17:43 (T-06)
30	06:10 20:58	06:46 20:11	07:08 (T-11) 19:45 (T-35)	07:23 19:13	14 16	17:57 (T-06) 17:42 (T-06)
31	06:12 20:56	06:48 20:09	07:10 (T-11) 19:44 (T-35)	07:23 19:13	13 13	17:42 (T-06) 17:55 (T-06)
Potential sun hours	471	436	377	341	288	275
Total, worst case						
Sun reduction		154	217	95	54	
Oper. time red.		0.72	0.67	0.56	0.48	
Wind dir. red.		0.90	0.90	0.90	0.90	
Total reduction		0.58	0.58	0.58	0.59	
Total, real		0.37	0.35	0.29	0.26	
		58	76	28	14	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-190 - R-190
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January			February			March			April			May		June	
1	08:05	16:19 (T-06)	07:47				07:06	17:25 (T-07)	07:10				06:18	05:45		
	16:57	9	16:28 (T-06)	17:35			18:13	26	17:51 (T-07)	19:53			20:30	21:04		
2	08:05	16:19 (T-06)	07:46				07:04	17:23 (T-07)	07:08				06:17	05:45		
	16:58	10	16:29 (T-06)	17:37			18:14	29	17:52 (T-07)	19:54			20:31	21:05		
3	08:05	16:20 (T-06)	07:45				07:03	17:22 (T-07)	07:06				06:15	05:44		
	16:59	10	16:30 (T-06)	17:38			18:16	32	17:54 (T-07)	19:55			20:33	21:06		
4	08:05	16:20 (T-06)	07:44				07:01	17:22 (T-07)	07:04				06:14	05:44		
	17:00	12	16:32 (T-06)	17:39			18:17	34	17:56 (T-07)	19:57			20:34	21:07		
5	08:05	16:21 (T-06)	07:43				06:59	17:21 (T-07)	07:02				06:13	05:43		
	17:01	12	16:33 (T-06)	17:41			18:18	36	17:57 (T-07)	19:58			20:35	21:08		
6	08:05	16:21 (T-06)	07:41				06:57	17:20 (T-07)	07:00				06:11	05:43		
	17:02	13	16:34 (T-06)	17:42			18:20	38	17:58 (T-07)	19:59	1	07:21 (T-11)	20:36	21:08		
7	08:04	16:20 (T-06)	07:40				06:56	17:19 (T-07)	06:59				07:19 (T-11)	06:10	05:43	
	17:03	14	16:34 (T-06)	17:44			18:21	40	17:59 (T-07)	20:00	3	07:22 (T-11)	20:38	21:09		
8	08:04	16:21 (T-06)	07:39				07:54	18:18 (T-07)	06:57				07:17 (T-11)	06:09	05:42	
	17:04	15	16:36 (T-06)	17:45			18:22	42	19:00 (T-07)	20:02	4	07:21 (T-11)	20:39	21:10		
9	08:04	16:22 (T-06)	07:37				07:52	18:19 (T-07)	06:55				07:15 (T-11)	06:07	05:42	
	17:05	15	16:37 (T-06)	17:47			19:24	44	19:03 (T-07)	20:03	5	07:20 (T-11)	20:40	21:11		
10	08:04	16:21 (T-06)	07:36				07:50	18:19 (T-07)	06:53				07:13 (T-11)	06:06	05:42	
	17:06	17	16:38 (T-06)	17:48			19:25	45	19:04 (T-07)	20:04	6	07:19 (T-11)	20:41	21:11		
11	08:03	16:22 (T-06)	07:35				07:48	18:18 (T-07)	06:51				07:12 (T-11)	06:05	05:42	
	17:07	17	16:39 (T-06)	17:49			19:26	45	19:03 (T-07)	20:05	8	19:44 (T-05)	20:42	21:12		
12	08:03	16:23 (T-06)	07:33				07:47	18:18 (T-07)	06:50				07:10 (T-11)	06:04	05:41	
	17:09	18	16:41 (T-06)	17:51			19:27	45	19:03 (T-07)	20:07	9	19:45 (T-05)	20:43	21:12		
13	08:02	16:23 (T-06)	07:32				07:45	18:18 (T-07)	06:48				19:40 (T-05)	06:02	05:41	
	17:10	19	16:42 (T-06)	17:52			19:29	44	19:02 (T-07)	20:08	6	19:46 (T-05)	20:45	21:13		
14	08:02	16:23 (T-06)	07:30				07:43	18:18 (T-07)	06:46				19:40 (T-05)	06:01	05:41	
	17:11	20	16:43 (T-06)	17:54			19:30	43	19:01 (T-07)	20:09	6	19:46 (T-35)	20:46	21:13		
15	08:02	16:24 (T-06)	07:29				07:41	18:18 (T-07)	06:44				19:41 (T-05)	06:00	05:41	
	17:12	21	16:45 (T-06)	17:55			19:31	42	19:00 (T-07)	20:10	7	19:48 (T-35)	20:47	21:14		
16	08:01	16:24 (T-06)	07:27				07:39	18:20 (T-07)	06:43				19:42 (T-35)	05:59	05:41	
	17:13	22	16:46 (T-06)	17:56			19:33	40	19:00 (T-07)	20:12	7	19:49 (T-35)	20:48	21:14		
17	08:00	16:25 (T-06)	07:26				07:37	18:20 (T-07)	06:41				19:41 (T-35)	05:58	05:41	
	17:15	23	16:48 (T-06)	17:58			19:34	39	18:59 (T-07)	20:13	9	19:50 (T-35)	20:49	21:15		
18	08:00	16:25 (T-06)	07:24				07:36	18:21 (T-07)	06:39				19:42 (T-35)	05:57	05:41	
	17:16	24	16:49 (T-06)	17:59			19:35	36	18:57 (T-07)	20:14	10	19:52 (T-35)	20:50	21:15		
19	07:59	16:25 (T-06)	07:23				07:34	18:22 (T-07)	06:37				19:41 (T-35)	05:56	05:41	
	17:17	25	16:50 (T-06)	18:01			19:36	33	18:55 (T-07)	20:15	12	19:53 (T-35)	20:51	21:16		
20	07:58	16:26 (T-06)	07:21				07:32	18:23 (T-07)	06:36				19:41 (T-35)	05:55	05:41	
	17:19	25	16:51 (T-06)	18:01			19:38	31	18:54 (T-07)	20:17	13	19:54 (T-35)	20:53	21:16		
21	07:58	16:26 (T-06)	07:19				07:30	18:24 (T-07)	06:34				19:42 (T-35)	05:54	05:42	
	17:20	26	16:52 (T-06)	18:02			19:39	27	18:51 (T-07)	20:18	13	19:55 (T-35)	20:54	21:16		
22	07:57	16:28 (T-06)	07:18				07:28	18:26 (T-07)	06:32				19:42 (T-35)	05:53	05:42	
	17:21	24	16:52 (T-06)	18:03			19:40	23	18:49 (T-07)	20:19	14	19:56 (T-35)	20:55	21:16		
23	07:56	16:29 (T-06)	07:16				07:26	18:29 (T-07)	06:31				19:42 (T-35)	05:52	05:42	
	17:23	23	16:52 (T-06)	18:05			19:42	16	18:45 (T-07)	20:20	15	19:57 (T-35)	20:56	21:17		
24	07:55	16:30 (T-06)	07:15			17:35 (T-07)	07:24		06:29				19:44 (T-35)	05:51	05:42	
	17:24	21	16:51 (T-06)	18:06	9	17:44 (T-07)	19:43		20:22	14	19:58 (T-35)	20:57	21:17			
25	07:54	16:31 (T-06)	07:13			17:32 (T-07)	07:23		06:28				19:45 (T-35)	05:50	05:43	
	17:25	19	16:50 (T-06)	18:07	14	17:46 (T-07)	19:44		20:23	10	19:55 (T-35)	20:58	21:17			
26	07:53	16:33 (T-06)	07:11			17:30 (T-07)	07:21		06:26				05:49	05:43		
	17:27	16	16:49 (T-06)	18:09	17	17:47 (T-07)	19:45		20:24				20:59	21:17		
27	07:53	16:35 (T-06)	07:10			17:27 (T-07)	07:19		06:24				05:49	05:43		
	17:28	13	16:48 (T-06)	18:10	21	17:48 (T-07)	19:47		20:25				21:00	21:17		
28	07:52	16:38 (T-06)	07:08			17:26 (T-07)	07:17		06:23				05:48	05:44		
	17:30	7	16:45 (T-06)	18:12	24	17:50 (T-07)	19:48		20:26				21:01	21:17		
29	07:51						07:15		06:21				05:47	05:44		
	17:31						19:49		20:28				21:02	21:17		
30	07:49						07:13		06:20				05:47	05:45		
	17:32						19:50		20:29				21:03	21:17		
31	07:48						07:11						05:46			
	17:34						19:52						21:04			
Potential sun hours	287		292			369			404			459		465		
Total, worst case	490			85		830			172							
Sun reduction	0.58			0.58		0.59			0.63							
Oper. time red.	0.90			0.90		0.90			0.90							
Wind dir. red.	0.60			0.58		0.58			0.59							
Total reduction	0.31			0.30		0.31			0.34							
Total, real	153		26			254			58							

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-190 - R-190
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December		
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-11) 19:43 (T-05)	07:24 19:11	17:57 (T-07) 18:41 (T-07)	07:04 16:49	16:04 (T-06) 18 16:22 (T-06)
2	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-11) 07:18 (T-11)	07:26 19:09	17:57 (T-07) 18:42 (T-07)	07:06 17:16	16:04 (T-06) 16:48 17 16:21 (T-06)
3	05:46 21:17	06:15 20:53	06:51 20:04	07:13 (T-11) 07:18 (T-11)	07:27 19:07	17:56 (T-07) 18:41 (T-07)	07:07 17:14	16:05 (T-06) 16:48 15 16:20 (T-06)
4	05:47 21:16	06:16 20:51	06:52 20:02	07:14 (T-11) 07:18 (T-11)	07:28 19:06	17:56 (T-07) 18:40 (T-07)	07:08 17:13	16:05 (T-06) 16:48 15 16:20 (T-06)
5	05:48 21:16	06:17 20:50	06:54 20:00	07:15 (T-11) 07:18 (T-11)	07:29 19:04	17:55 (T-07) 18:38 (T-07)	07:10 17:12	16:07 (T-06) 16:47 13 16:20 (T-06)
6	05:48 21:16	06:18 20:49	06:55 19:58	07:16 (T-11) 07:17 (T-11)	07:31 19:02	17:56 (T-07) 18:37 (T-07)	07:11 17:10	16:07 (T-06) 16:47 13 16:20 (T-06)
7	05:49 21:15	06:20 20:47	06:56 19:56	07:17 (T-11) 19:00	07:32 19:00	17:55 (T-07) 18:35 (T-07)	07:12 17:09	16:08 (T-06) 16:47 12 16:20 (T-06)
8	05:50 21:15	06:21 20:46	06:57 19:54	07:18 (T-11) 19:00	07:33 19:00	17:55 (T-07) 18:33 (T-07)	07:14 17:08	16:08 (T-06) 16:47 12 16:20 (T-06)
9	05:50 21:15	06:22 20:45	06:58 19:52	07:19 (T-11) 19:00	07:34 18:55	17:55 (T-07) 18:30 (T-07)	07:15 17:07	16:09 (T-06) 16:47 11 16:20 (T-06)
10	05:51 21:14	06:23 20:43	06:59 19:51	07:20 (T-11) 19:00	07:35 18:53	17:56 (T-07) 18:29 (T-07)	07:17 17:05	16:09 (T-06) 16:47 10 16:19 (T-06)
11	05:52 21:14	06:24 20:42	07:01 19:49	07:21 (T-11) 19:00	07:36 18:51	17:57 (T-07) 18:27 (T-07)	07:18 17:04	16:10 (T-06) 16:47 10 16:20 (T-06)
12	05:53 21:13	06:25 20:40	07:02 19:47	07:22 (T-11) 19:00	07:37 18:49	17:57 (T-07) 18:25 (T-07)	07:19 17:03	16:10 (T-06) 16:47 9 16:19 (T-06)
13	05:54 21:13	06:26 20:39	07:03 19:45	07:23 (T-11) 19:00	07:38 18:47	17:59 (T-07) 18:24 (T-07)	07:21 17:02	16:11 (T-06) 16:47 8 16:19 (T-06)
14	05:54 21:12	06:28 20:37	07:04 19:43	07:24 (T-11) 19:00	07:39 18:46	17:59 (T-07) 18:22 (T-07)	07:22 17:01	16:12 (T-06) 7 16:17 (T-06)
15	05:55 21:11	06:29 20:36	07:05 19:41	07:25 (T-11) 19:00	07:40 18:44	18:00 (T-07) 18:20 (T-07)	07:23 17:00	16:12 (T-06) 13 16:21 (T-06)
16	05:56 21:11	06:30 20:34	07:06 19:39	07:26 (T-11) 19:00	07:41 18:42	18:03 (T-07) 18:19 (T-07)	07:25 16:59	16:13 (T-06) 16 16:22 (T-06)
17	05:57 21:10	06:31 20:33	07:08 19:37	07:27 (T-11) 19:00	07:42 18:41	18:04 (T-07) 18:17 (T-07)	07:26 16:58	16:13 (T-06) 19 16:23 (T-06)
18	05:58 21:09	06:32 20:31	07:09 19:36	07:28 (T-11) 19:00	07:43 18:39	18:05 (T-07) 18:08 (T-07)	07:27 16:57	16:14 (T-06) 21 16:25 (T-06)
19	05:59 21:08	06:34 20:29	07:10 19:34	07:29 (T-11) 19:00	07:44 18:37	18:09 (T-07) 18:14 (T-07)	07:28 16:56	16:14 (T-06) 23 16:26 (T-06)
20	06:00 21:08	06:35 20:28	07:11 19:32	07:30 (T-11) 19:00	07:45 18:36	18:15 (T-07) 18:13 (T-07)	07:29 16:55	16:15 (T-06) 24 16:27 (T-06)
21	06:01 21:07	06:36 20:26	07:12 19:30	07:31 (T-11) 19:00	07:46 18:34	18:16 (T-07) 18:10 (T-07)	07:30 16:54	16:16 (T-06) 26 16:28 (T-06)
22	06:02 21:06	06:37 20:24	07:14 19:28	07:32 (T-11) 19:00	07:47 18:32	18:17 (T-07) 18:08 (T-07)	07:31 16:53	16:16 (T-06) 25 16:27 (T-06)
23	06:03 21:05	06:38 20:23	07:15 19:26	07:33 (T-11) 19:00	07:48 18:31	18:09 (T-07) 18:07 (T-07)	07:32 16:52	16:16 (T-06) 25 16:27 (T-06)
24	06:04 21:04	06:39 20:21	07:16 19:24	07:34 (T-11) 19:00	07:49 18:29	18:08 (T-07) 18:39 (T-07)	07:33 16:52	16:17 (T-06) 24 16:26 (T-06)
25	06:05 21:03	06:41 20:19	07:17 19:22	07:35 (T-11) 19:00	07:50 18:27	18:09 (T-07) 18:39 (T-07)	07:34 16:52	16:17 (T-06) 23 16:25 (T-06)
26	06:06 21:02	06:42 20:18	07:18 19:20	07:36 (T-11) 19:00	07:51 18:26	18:10 (T-07) 18:40 (T-07)	07:35 16:51	16:18 (T-06) 22 16:25 (T-06)
27	06:07 21:01	06:43 20:16	07:19 19:19	07:37 (T-11) 19:00	07:52 18:24	18:11 (T-07) 18:41 (T-07)	07:36 16:50	16:18 (T-06) 21 16:24 (T-06)
28	06:08 21:00	06:44 20:14	07:21 19:17	07:38 (T-11) 19:00	07:53 18:23	18:12 (T-07) 18:42 (T-07)	07:37 16:50	16:18 (T-06) 20 16:23 (T-06)
29	06:09 20:59	06:45 20:12	07:22 19:15	07:39 (T-11) 19:00	07:54 18:21	18:13 (T-07) 17:59 (T-07)	07:38 16:49	16:19 (T-06) 19 16:23 (T-06)
30	06:10 20:58	06:46 20:11	07:23 19:13	07:40 (T-11) 19:00	07:55 18:20	18:14 (T-07) 18:41 (T-07)	07:39 16:49	16:19 (T-06) 18 16:22 (T-06)
31	06:12 20:56	06:48 20:09	07:24 19:11	07:41 (T-11) 19:00	07:56 18:18	18:15 (T-07) 18:42 (T-07)	07:40 16:48	16:19 (T-06) 8 16:27 (T-06)
Potential sun hours	471	436	377	341	288	275	281	
Total, worst case		145	390	568	346	281	52	
Sun reduction		0.72	0.67	0.56	0.48	0.52	0.90	
Oper. time red.		0.90	0.90	0.90	0.90	0.90	0.60	
Wind dir. red.		0.60	0.58	0.58	0.60	0.60	0.28	
Total reduction		0.39	0.35	0.29	0.26	0.28	79	
Total, real		56	136	165	89	79		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-191 - R-191

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05	07:47	16:46 (T-06)	07:06	17:36 (T-07)	07:10
	16:57	17:35	8 16:54 (T-06)	18:13	15 17:51 (T-07)	19:53
2	08:05	07:46		07:04	17:33 (T-07)	07:08
	16:58	17:37		18:14	19 17:52 (T-07)	19:54
3	08:05	07:45		07:03	17:32 (T-07)	07:06
	16:59	17:38		18:16	22 17:54 (T-07)	19:55
4	08:05	07:44		07:01	17:31 (T-07)	07:04
	17:00	17:39		18:17	25 17:56 (T-07)	19:57
5	08:05	07:43		06:59	17:30 (T-07)	07:02
	17:01	17:41		18:18	27 17:57 (T-07)	19:58
6	08:05	07:41		06:57	17:29 (T-07)	07:00
	17:02	17:42		18:20	29 17:58 (T-07)	19:59
7	08:04	16:33 (T-06)	07:40	06:56	17:28 (T-07)	06:59
	17:03	1 16:34 (T-06)	17:44	18:21	31 17:59 (T-07)	20:00
8	08:04	16:33 (T-06)	07:39	07:54	18:27 (T-07)	06:57
	17:04	3 16:36 (T-06)	17:45	18:22	33 19:00 (T-07)	20:02
9	08:04	16:34 (T-06)	07:37	07:52	18:27 (T-07)	06:55
	17:05	3 16:37 (T-06)	17:47	19:24	36 19:03 (T-07)	20:03
10	08:04	16:33 (T-06)	07:36	07:50	18:27 (T-07)	06:53
	17:06	5 16:38 (T-06)	17:48	19:25	37 19:04 (T-07)	20:04
11	08:03	16:33 (T-06)	07:35	07:48	18:26 (T-07)	06:51
	17:07	6 16:39 (T-06)	17:49	19:26	39 19:05 (T-07)	20:05
12	08:03	16:34 (T-06)	07:33	07:47	18:26 (T-07)	06:50
	17:09	7 16:41 (T-06)	17:51	19:27	40 19:06 (T-07)	20:07
13	08:02	16:33 (T-06)	07:32	07:45	18:26 (T-07)	06:48
	17:10	9 16:42 (T-06)	17:52	19:29	39 19:05 (T-07)	20:08
14	08:02	16:33 (T-06)	07:30	07:43	18:26 (T-07)	06:46
	17:11	10 16:43 (T-06)	17:54	19:30	38 19:04 (T-07)	20:09
15	08:02	16:33 (T-06)	07:29	07:41	18:26 (T-07)	06:44
	17:12	12 16:45 (T-06)	17:55	19:31	38 19:04 (T-07)	20:10
16	08:01	16:33 (T-06)	07:27	07:39	18:27 (T-07)	06:43
	17:13	13 16:46 (T-06)	17:56	19:33	37 19:04 (T-07)	20:12
17	08:00	16:34 (T-06)	07:26	07:37	18:28 (T-07)	06:41
	17:15	14 16:48 (T-06)	17:58	19:34	34 19:02 (T-07)	20:13
18	08:00	16:34 (T-06)	07:24	07:36	18:28 (T-07)	06:39
	17:16	15 16:49 (T-06)	17:59	19:35	33 19:01 (T-07)	20:14
19	07:59	16:34 (T-06)	07:23	07:34	18:29 (T-07)	06:37
	17:17	16 16:50 (T-06)	18:01	19:36	30 18:59 (T-07)	20:15
20	07:58	16:34 (T-06)	07:21	07:32	18:30 (T-07)	06:36
	17:19	17 16:51 (T-06)	18:01	19:38	27 18:57 (T-07)	20:17
21	07:58	16:34 (T-06)	07:19	07:30	18:32 (T-07)	06:34
	17:20	18 16:52 (T-06)	18:02	19:39	23 18:55 (T-07)	20:18
22	07:57	16:35 (T-06)	07:18	07:28	18:34 (T-07)	06:32
	17:21	20 16:55 (T-06)	18:03	19:40	18 18:52 (T-07)	20:19
23	07:56	16:35 (T-06)	07:16	07:26	18:37 (T-07)	06:31
	17:23	21 16:56 (T-06)	18:05	19:42	11 18:48 (T-07)	20:20
24	07:55	16:36 (T-06)	07:15	07:24		06:29
	17:24	21 16:57 (T-06)	18:06	19:43		20:22
25	07:54	16:37 (T-06)	07:13	07:23		06:28
	17:25	22 16:59 (T-06)	18:07	19:44		20:23
26	07:53	16:37 (T-06)	07:11	17:46 (T-07)	07:21	06:26
	17:27	23 17:00 (T-06)	18:09	1 17:47 (T-07)	19:45	20:24
27	07:53	16:38 (T-06)	07:10	17:40 (T-07)	07:19	06:24
	17:28	22 17:00 (T-06)	18:10	8 17:48 (T-07)	19:47	20:25
28	07:52	16:39 (T-06)	07:08	17:38 (T-07)	07:17	06:23
	17:30	21 17:00 (T-06)	18:12	12 17:50 (T-07)	19:48	20:26
29	07:51	16:40 (T-06)		07:15		06:21
	17:31	19 16:59 (T-06)		19:49		20:28
30	07:49	16:42 (T-06)		07:13		06:20
	17:32	16 16:58 (T-06)		19:50		20:29
31	07:48	16:43 (T-06)		07:11		
	17:34	13 16:56 (T-06)		19:52		
Potential sun hours	287	292	369		404	459
Total, worst case				681		465
Sun reduction	0.58	0.58		0.59		
Oper. time red.	0.90	0.90		0.90		
Wind dir. red.	0.59	0.58		0.57		
Total reduction	0.31	0.30		0.30		
Total, real	107	9		208	53	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-191 - R-191
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-11) 19:43 (T-05)	07:24 19:11	18:05 (T-07) 17:17
2	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-11) 19:41 (T-05)	07:26 19:09	18:05 (T-07) 17:16
3	05:46 21:17	06:15 20:53	06:51 20:04	07:13 (T-11) 19:41 (T-05)	07:27 19:07	18:04 (T-07) 17:14
4	05:47 21:16	06:16 20:51	06:52 20:02	07:14 (T-11) 19:41 (T-05)	07:28 19:06	18:04 (T-07) 17:13
5	05:48 21:16	06:17 20:50	06:54 20:00	07:15 (T-11) 19:41 (T-05)	07:29 19:04	18:04 (T-07) 17:12
6	05:48 21:16	06:18 20:49	06:55 19:58	07:16 (T-11) 19:41 (T-05)	07:31 19:02	18:04 (T-07) 17:10
7	05:49 21:15	06:19 20:47	06:56 19:56	07:17 (T-11) 19:41 (T-05)	07:32 19:00	18:04 (T-07) 17:09
8	05:50 21:15	06:21 20:46	06:57 19:54	07:18 (T-11) 19:41 (T-05)	07:33 18:56	18:04 (T-07) 17:08
9	05:50 21:15	06:22 20:45	06:58 19:52	07:19 (T-11) 19:41 (T-05)	07:34 18:55	18:05 (T-07) 17:07
10	05:51 21:14	06:23 20:43	06:59 19:51	07:20 (T-11) 19:41 (T-05)	07:35 18:53	18:06 (T-07) 17:05
11	05:52 21:14	06:24 20:42	07:01 19:49	07:21 (T-11) 19:41 (T-05)	07:36 18:51	18:07 (T-07) 17:04
12	05:53 21:13	06:25 20:40	07:02 19:47	07:22 (T-11) 19:41 (T-05)	07:37 18:49	18:07 (T-07) 17:03
13	05:54 21:13	06:26 20:39	07:03 19:45	07:23 (T-11) 19:41 (T-05)	07:38 18:47	18:08 (T-07) 17:02
14	05:54 21:12	06:28 20:37	07:04 19:43	07:24 (T-11) 19:41 (T-05)	07:39 18:46	18:09 (T-07) 17:01
15	05:55 21:11	06:29 20:36	07:05 19:41	07:25 (T-11) 19:41 (T-05)	07:40 18:44	18:10 (T-07) 17:00
16	05:56 21:11	06:30 20:34	07:06 19:39	07:26 (T-11) 19:41 (T-05)	07:41 18:42	18:11 (T-07) 16:59
17	05:57 21:10	06:31 20:33	07:07 19:37	07:27 (T-11) 19:41 (T-05)	07:42 18:41	18:12 (T-07) 16:58
18	05:58 21:09	06:32 20:31	07:09 19:36	07:28 (T-11) 19:41 (T-05)	07:43 18:39	18:13 (T-07) 16:57
19	05:59 21:08	06:34 20:29	07:10 19:34	07:29 (T-11) 19:41 (T-05)	07:44 18:37	18:14 (T-07) 16:56
20	06:00 21:08	06:35 20:28	19:50 (T-35) 19:32	07:11 18:33 (T-07)	07:45 18:36	18:15 (T-07) 16:55
21	06:01 21:07	06:36 20:26	19:51 (T-35) 20:00 (T-35)	07:12 19:30	18:34 (T-07) 18:34	18:16 (T-07) 16:55
22	06:02 21:06	06:37 20:24	19:52 (T-35) 19:59 (T-35)	07:13 19:28	18:35 (T-07) 18:32	18:17 (T-07) 16:54
23	06:03 21:05	06:38 20:23	19:53 (T-35) 19:58 (T-35)	07:14 19:26	18:36 (T-07) 18:31	18:18 (T-07) 16:53
24	06:04 21:04	06:39 20:21	19:54 (T-35) 19:56 (T-35)	07:15 19:24	18:37 (T-07) 18:29	18:19 (T-07) 16:52
25	06:05 21:03	06:41 20:19	19:55 (T-35) 19:57 (T-35)	07:16 19:22	18:38 (T-07) 18:27	18:20 (T-07) 16:51
26	06:06 21:02	06:42 20:18	19:58 (T-35) 19:59 (T-35)	07:17 19:20	18:39 (T-07) 18:26	18:21 (T-07) 16:50
27	06:07 21:01	06:43 20:16	19:59 (T-35) 19:59 (T-35)	07:18 19:19	18:40 (T-07) 18:24	18:22 (T-07) 16:49
28	06:08 21:00	06:44 20:14	19:59 (T-35) 19:59 (T-35)	07:19 19:17	18:41 (T-07) 18:23	18:23 (T-07) 16:48
29	06:09 20:59	06:45 20:12	19:59 (T-35) 19:59 (T-35)	07:20 19:15	18:42 (T-07) 18:21	18:24 (T-07) 16:47
30	06:10 20:58	06:46 20:11	19:59 (T-35) 19:59 (T-35)	07:21 19:13	18:43 (T-07) 18:20	18:25 (T-07) 16:46
31	06:12 20:56	06:48 20:09	19:59 (T-35) 19:59 (T-35)	07:22 19:11	18:44 (T-07) 18:18	18:26 (T-07) 16:45
Potential sun hours	471	436	377	341	288	275
Total, worst case						
Sun reduction		123	352	396	337	19
Oper. time red.		0.72	0.67	0.56	0.48	0.52
Wind dir. red.		0.90	0.90	0.90	0.90	0.90
Total reduction		0.59	0.57	0.57	0.59	0.59
Total, real		0.39	0.35	0.29	0.25	0.28
		47	122	115	86	5

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-192 - R-192
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June		
1	08:05	15:58 (T-07)	07:47	07:06	07:27 (T-11)	07:10	06:18	05:45
	16:57	24 16:22 (T-07)	17:35	18:13	7 07:34 (T-11)	19:53	20:30	21:04
2	08:05	15:59 (T-07)	07:46	07:04	07:25 (T-11)	07:08	06:17	05:45
	16:58	24 16:23 (T-07)	17:37	18:14	8 07:33 (T-11)	19:54	20:31	21:05
3	08:05	15:59 (T-07)	07:45	07:03	07:23 (T-11)	07:06	06:15	05:44
	16:59	24 16:23 (T-07)	17:38	18:16	11 17:54 (T-35)	19:55	20:33	21:06
4	08:05	16:00 (T-07)	07:44	07:01	07:22 (T-11)	07:04	06:14	05:44
	17:00	23 16:23 (T-07)	17:39	18:17	13 17:56 (T-35)	19:57	20:34	21:07
5	08:05	16:01 (T-07)	07:43	06:59	07:20 (T-11)	07:02	06:13	05:43
	17:01	22 16:23 (T-07)	17:41	18:18	15 17:57 (T-35)	19:58	20:35	21:08
6	08:05	16:02 (T-07)	07:41	06:57	07:22 (T-11)	07:00	06:11	05:43
	17:02	21 16:23 (T-07)	17:42	18:20	11 17:58 (T-35)	19:59	20:36	21:08
7	08:04	16:03 (T-07)	07:40	06:56	17:50 (T-35)	06:59	06:10	05:43
	17:03	20 16:23 (T-07)	17:44	18:21	9 17:59 (T-35)	20:00	20:38	21:09
8	08:04	16:04 (T-07)	07:39	07:54	18:50 (T-35)	06:57	06:09	05:42
	17:04	19 16:23 (T-07)	17:45	18:22	10 19:00 (T-35)	20:02	20:39	21:10
9	08:04	16:05 (T-07)	07:37	07:52	18:52 (T-35)	06:55	06:07	05:42
	17:05	18 16:23 (T-07)	17:46	19:24	11 19:03 (T-35)	20:03	20:40	21:11
10	08:04	16:06 (T-07)	07:36	07:50	18:53 (T-35)	06:53	06:06	05:42
	17:06	16 16:22 (T-07)	17:48	19:25	11 19:04 (T-35)	20:04	20:41	21:11
11	08:03	16:08 (T-07)	07:35	07:48	18:54 (T-35)	06:51	06:05	05:42
	17:07	13 16:21 (T-07)	17:49	19:26	9 19:03 (T-35)	20:05	20:42	21:12
12	08:03	16:11 (T-07)	07:33	07:47		06:50	06:03	05:41
	17:09	10 16:21 (T-07)	17:51	19:27		20:07	20:43	21:12
13	08:02	16:13 (T-07)	07:32	07:45		06:48	06:02	05:41
	17:10	5 16:18 (T-07)	17:52	19:29		20:08	20:45	21:13
14	08:02		07:30	07:43		06:46	06:01	05:41
	17:11		17:54	19:30		20:09	20:46	21:13
15	08:02		07:29	07:41		06:44	06:00	05:41
	17:12		17:55	19:31		20:10	20:47	21:14
16	08:01		07:27	07:39		06:43	05:59	05:41
	17:13		17:56	19:33		20:12	20:48	21:14
17	08:00		07:26	07:37		06:41	05:58	05:41
	17:15		17:58	19:34		20:13	20:49	21:15
18	08:00		07:24	07:36		06:39	05:57	05:41
	17:16		17:59	19:35		20:14	20:50	21:15
19	07:59		07:23	07:34		06:37	05:56	05:41
	17:17		18:01	19:36		20:15	20:51	21:16
20	07:58		07:21	07:32		06:36	05:55	05:41
	17:19		18:01	19:38		20:17	20:53	21:16
21	07:58		07:19	07:30		06:34	05:54	05:42
	17:20		18:02	19:39		20:18	20:54	21:16
22	07:57		07:18	07:28		06:32	05:53	05:42
	17:21		18:03	19:40		20:19	20:55	21:16
23	07:56		07:16	07:26		06:31	05:52	05:42
	17:23		18:05	19:42		20:20	20:56	21:17
24	07:55		07:15	07:24		06:29	05:51	05:42
	17:24		18:06	19:43		20:22	20:57	21:17
25	07:54		07:13	07:23		06:28	05:50	05:43
	17:25		18:07	19:44		20:23	20:58	21:17
26	07:53		07:11	07:32 (T-11)	07:21	06:26	05:49	05:43
	17:27		18:09	2 07:34 (T-11)	19:45	20:24	20:59	21:17
27	07:53		07:10	07:30 (T-11)	07:19	06:24	05:49	05:43
	17:28		18:10	4 07:34 (T-11)	19:47	20:25	21:00	21:17
28	07:52		07:08	07:29 (T-11)	07:17	06:23	05:48	05:44
	17:29		18:12	5 07:34 (T-11)	19:48	20:26	21:01	21:17
29	07:51			07:15		06:21	05:47	05:44
	17:31			19:49		20:28	21:02	21:17
30	07:49			07:13		06:20	05:47	05:45
	17:32			19:50		20:29	21:03	21:17
31	07:48			07:11			05:46	
	17:34			19:52			21:04	
Potential sun hours	287	292	369		404	459	465	
Total, worst case	239	11	115					
Sun reduction	0.58	0.58	0.59					
Oper. time red.	0.90	0.90	0.90					
Wind dir. red.	0.61	0.60	0.58					
Total reduction	0.32	0.31	0.31					
Total, real	76	3	36					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-192 - R-192
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:24 19:11		07:04 17:17
2	05:46 21:17	06:14 20:54	06:50 20:05	07:26 19:09	18:35 (T-35) 5 18:40 (T-35)	07:06 17:16
3	05:46 21:17	06:15 20:53	06:51 20:04	07:27 19:07	18:31 (T-35) 11 18:42 (T-35)	07:07 17:14
4	05:47 21:16	06:16 20:51	06:52 20:02	07:28 19:06	18:29 (T-35) 11 18:40 (T-35)	07:08 17:13
5	05:48 21:16	06:17 20:50	06:54 20:00	07:29 19:04	18:27 (T-35) 11 18:38 (T-35)	07:10 17:12
6	05:48 21:16	06:18 20:49	06:55 19:58	07:31 19:02	18:27 (T-35) 10 18:37 (T-35)	07:11 17:10
7	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	18:26 (T-35) 9 18:35 (T-35)	07:12 17:09
8	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	07:55 (T-11) 15 18:33 (T-35)	07:14 17:08
9	05:50 21:15	06:22 20:45	06:58 19:52	07:34 18:55	07:55 (T-11) 15 18:30 (T-35)	07:15 17:07
10	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:57 (T-11) 12 18:29 (T-35)	07:17 17:05
11	05:52 21:14	06:24 20:42	07:01 19:49	07:37 18:51	07:58 (T-11) 9 08:07 (T-11)	07:18 17:04
12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:59 (T-11) 8 08:07 (T-11)	07:19 17:03
13	05:54 21:13	06:26 20:39	07:03 19:45	07:39 18:47	08:01 (T-11) 6 08:07 (T-11)	07:21 17:02
14	05:54 21:12	06:28 20:37	07:04 19:43	07:41 18:46	08:02 (T-11) 5 08:07 (T-11)	07:22 17:01
15	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	08:03 (T-11) 3 08:06 (T-11)	07:23 17:00
16	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42	08:05 (T-11) 1 08:06 (T-11)	07:25 16:59
17	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:41		07:26 16:58
18	05:58 21:09	06:32 20:31	07:09 19:36	07:46 18:39		07:27 16:57
19	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37		07:29 16:56
20	06:00 21:08	06:35 20:28	07:11 19:32	07:48 18:36		07:30 16:55
21	06:01 21:07	06:36 20:26	07:12 19:30	07:50 18:34		07:31 16:54
22	06:02 21:06	06:37 20:24	07:14 19:28	07:51 18:32		07:33 16:54
23	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:31		07:34 16:53
24	06:04 21:04	06:39 20:21	07:16 19:24	07:54 18:29		07:35 16:52
25	06:05 21:03	06:41 20:19	07:17 19:22	07:55 18:27		07:36 16:52
26	06:06 21:02	06:42 20:18	07:18 19:20	07:56 18:26		07:38 16:51
27	06:07 21:01	06:43 20:16	07:20 19:19	07:58 18:24		07:39 16:50
28	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23		07:40 16:50
29	06:09 20:59	06:45 20:12	07:22 19:15	08:00 18:21		07:41 16:49
30	06:10 20:58	06:46 20:11	07:23 19:13	08:02 18:20	15:54 (T-07) 5 15:59 (T-07)	08:04 16:54
31	06:12 20:56	06:48 20:09	07:23 19:13	08:03 18:20	15:52 (T-07) 10 16:02 (T-07)	08:04 16:55
Potential sun hours	471	436	377	341	288	275
Total, worst case				131	15	735
Sun reduction				0.56	0.48	0.52
Oper. time red.				0.90	0.90	0.90
Wind dir. red.				0.58	0.61	0.61
Total reduction				0.29	0.26	0.29
Total, real				39	4	210

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-193 - R-193
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:05 16:57 49	09:25 (T-11) 10:14 (T-11) 17:35	07:47 18:13	07:06 19:53	07:09 20:30	06:18 21:04	05:45 21:17	05:45 20:55	06:13 20:07	06:49 19:11	07:24 17:17	07:04 16:48	09:18 (T-11) 35 09:53 (T-11)
2	08:05 16:58 48	09:26 (T-11) 10:14 (T-11) 17:36	07:46 18:14	07:04 19:54	07:08 20:31	06:17 21:05	05:45 21:17	05:46 20:54	06:14 20:05	06:50 19:09	07:26 17:16	07:06 16:48	09:17 (T-11) 37 09:54 (T-11)
3	08:05 16:59 47	09:27 (T-11) 10:14 (T-11) 17:38	07:45 18:15	07:03 19:55	07:06 20:33	06:15 21:06	05:44 21:16	05:46 20:53	06:15 20:03	06:51 19:07	07:27 17:14	07:07 16:48	09:17 (T-11) 39 09:56 (T-11)
4	08:05 17:00 46	09:28 (T-11) 10:14 (T-11) 17:39	07:44 18:17	07:01 19:57	07:04 20:34	06:14 21:07	05:44 21:16	05:47 20:51	06:16 20:02	06:52 19:05	07:28 17:13	07:08 16:47	09:16 (T-11) 41 09:57 (T-11)
5	08:05 17:01 45	09:29 (T-11) 10:14 (T-11) 17:41	07:42 18:18	06:59 19:58	07:02 20:35	06:13 21:08	05:43 21:16	05:47 20:50	06:17 20:00	06:53 19:04	07:29 17:11	07:10 16:47	09:16 (T-11) 42 09:58 (T-11)
6	08:04 17:02 44	09:30 (T-11) 10:14 (T-11) 17:42	07:41 18:19	06:57 19:59	07:00 20:36	06:11 21:08	05:43 21:16	05:48 20:49	06:18 19:58	06:55 19:02	07:30 17:10	07:11 16:47	09:17 (T-11) 43 10:00 (T-11)
7	08:04 17:03 42	09:31 (T-11) 10:13 (T-11) 17:44	07:40 18:21	06:56 20:00	06:58 20:37	06:10 21:09	05:42 21:15	05:49 20:47	06:19 19:56	06:56 19:00	07:32 17:09	07:12 16:47	09:16 (T-11) 45 10:01 (T-11)
8	08:04 17:04 41	09:32 (T-11) 10:13 (T-11) 17:45	07:39 18:22	06:54 20:02	06:57 20:39	06:08 21:10	05:42 21:15	05:50 20:46	06:21 19:54	06:57 18:56	07:33 17:08	07:14 16:47	09:16 (T-11) 46 10:02 (T-11)
9	08:04 17:05 39	09:34 (T-11) 10:13 (T-11) 17:46	07:37 19:23	06:52 20:03	06:55 20:40	06:07 21:11	05:42 21:15	06:22 20:45	06:58 19:52	07:34 18:54	07:15 17:06	07:15 16:47	09:16 (T-11) 47 10:03 (T-11)
10	08:04 17:06 37	09:34 (T-11) 10:11 (T-11) 17:48	07:36 19:25	06:50 20:04	06:53 20:41	06:06 21:11	05:42 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:16 17:05	07:16 16:47	09:16 (T-11) 48 10:04 (T-11)
11	08:03 17:07 35	09:36 (T-11) 10:11 (T-11) 17:49	07:34 19:26	06:51 20:05	06:05 20:42	05:41 21:12	05:42 21:14	06:24 20:42	07:00 19:49	07:37 18:51	07:18 17:04	07:18 16:47	09:15 (T-11) 49 10:04 (T-11)
12	08:03 17:08 33	09:37 (T-11) 10:10 (T-11) 17:51	07:33 19:27	06:50 20:07	06:03 20:43	05:41 21:12	05:43 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:19 16:47	09:16 (T-11) 49 10:05 (T-11)
13	08:02 17:10 30	09:39 (T-11) 10:09 (T-11) 17:52	07:32 19:29	06:45 20:08	06:48 20:45	05:41 21:13	05:43 21:13	06:26 20:39	07:03 19:45	07:39 18:47	07:21 17:02	07:21 16:47	09:16 (T-11) 50 10:06 (T-11)
14	08:02 17:11 26	09:41 (T-11) 10:07 (T-11) 17:53	07:30 19:30	06:43 20:09	06:46 20:46	05:41 21:13	05:44 21:12	06:28 20:37	07:04 19:43	07:40 18:46	07:22 17:01	07:22 16:47	09:16 (T-11) 50 10:06 (T-11)
15	08:01 17:12 22	09:44 (T-11) 10:06 (T-11) 17:55	07:29 19:31	06:41 20:10	06:44 20:47	05:41 21:14	05:45 21:11	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	07:23 16:47	09:17 (T-11) 50 10:07 (T-11)
16	08:01 17:13 18	09:46 (T-11) 10:04 (T-11) 17:56	07:27 19:33	06:39 20:11	06:43 20:48	05:41 21:14	05:46 21:11	06:30 20:34	07:06 19:39	07:43 18:42	07:25 16:59	07:25 16:47	09:16 (T-11) 51 10:07 (T-11)
17	08:00 17:15 9	09:50 (T-11) 09:59 (T-11) 17:58	07:26 19:34	06:37 20:13	06:41 20:49	05:41 21:15	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:40	07:26 16:58	07:26 16:48	09:17 (T-11) 51 10:08 (T-11)
18	08:00 17:16	07:24 17:59	07:35 19:35	06:39 20:14	06:39 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:35	07:46 18:39	07:27 16:57	07:27 16:48	09:18 (T-11) 51 10:09 (T-11)
19	07:59 17:17	07:23 18:00	07:34 19:36	06:37 20:15	06:37 20:51	05:41 21:16	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37	07:29 16:56	07:29 16:48	09:18 (T-11) 51 10:09 (T-11)
20	07:58 17:19	07:21 18:00	07:32 19:38	06:36 20:16	06:36 20:52	05:41 21:16	06:00 21:08	06:35 20:28	07:11 19:32	07:48 18:35	07:30 16:55	07:30 16:49	09:18 (T-11) 52 10:10 (T-11)
21	07:58 17:20	07:19 18:02	07:30 19:39	06:34 20:18	06:34 20:54	05:41 21:16	06:01 21:07	06:36 20:26	07:12 19:30	07:50 18:34	07:31 16:54	07:31 16:49	09:18 (T-11) 52 10:10 (T-11)
22	07:57 17:21	07:18 18:03	07:28 19:40	06:32 20:19	06:32 20:55	05:42 21:16	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:54	07:32 16:50	09:19 (T-11) 52 10:11 (T-11)
23	07:56 17:23	07:16 18:05	07:26 19:41	06:31 20:20	06:31 20:56	05:42 21:17	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53	07:34 16:50	09:19 (T-11) 52 10:11 (T-11)
24	07:55 17:24	07:15 18:06	07:24 19:43	06:29 20:21	06:29 20:57	05:42 21:17	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	07:35 16:51	09:20 (T-11) 52 10:12 (T-11)
25	07:54 17:25	07:13 18:07	07:22 19:44	06:28 20:23	06:28 20:58	05:42 21:17	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	07:36 16:52	07:36 16:52	09:21 (T-11) 51 10:12 (T-11)
26	07:53 17:27	07:11 18:09	07:21 19:45	06:26 20:24	06:26 20:59	05:43 21:17	06:06 21:02	06:42 20:18	07:18 19:20	07:56 18:26	07:38 16:51	07:38 16:51	09:21 (T-11) 51 10:12 (T-11)
27	07:52 17:28	07:09 18:10	07:19 19:46	06:24 20:25	06:24 21:00	05:43 21:17	06:07 21:01	06:43 20:16	07:19 19:18	07:57 18:24	07:39 16:50	07:39 16:50	09:22 (T-11) 51 10:13 (T-11)
28	07:51 17:29	07:08 18:11	07:17 19:48	06:23 20:26	06:23 21:01	05:44 21:17	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50	07:40 16:50	09:21 (T-11) 50 10:13 (T-11)
29	07:50 17:31	07:05 18:19	07:15 19:49	06:21 20:28	06:21 21:02	05:44 21:17	06:09 20:59	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	07:41 16:49	09:23 (T-11) 50 10:13 (T-11)
30	07:49 17:32	07:03 18:20	07:13 19:50	06:20 20:29	06:20 21:03	05:45 21:17	06:10 20:57	06:46 20:11	07:23 19:13	08:02 18:20	07:42 16:49	07:42 16:49	09:24 (T-11) 50 10:14 (T-11)
31	07:48 17:34	07:01 18:21	07:11 19:52	06:19 21:03	06:19 21:03	05:46 21:17	06:11 20:56	06:48 20:09	08:03 18:18	08:04 16:56	08:04 16:56	08:04 16:56	09:24 (T-11) 50 10:14 (T-11)
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275	
Total, worst case	611										136		1488
Sun reduction	0.58										0.48		0.52
Oper. time red.	0.90										0.90		0.90
Wind dir. red.	0.68										0.68		0.68
Total reduction	0.36										0.29		0.32
Total, real	217										40		474

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-194 - R-194
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:05 16:57 39	09:01 (T-11) 09:01 (T-11)	07:47 17:35	07:06 18:13	07:09 19:53	06:18 20:30	05:45 21:04	05:45 21:17	06:13 20:55	06:49 20:07	07:24 19:11	07:04 17:17	08:53 (T-11) 16:48 28
2	08:05 16:58 39	09:01 (T-11) 09:02 (T-11)	07:46 17:36	07:04 18:14	07:08 19:54	06:17 20:31	05:45 21:05	05:46 21:17	06:14 20:54	06:50 20:05	07:26 19:09	07:06 17:16	08:52 (T-11) 16:48 30
3	08:05 16:59 39	09:02 (T-11) 09:41 (T-11)	07:45 17:38	07:03 18:15	07:06 19:55	06:15 20:33	05:44 21:06	05:46 21:16	06:15 20:53	06:51 20:03	07:27 19:07	07:07 17:14	08:51 (T-11) 16:48 32
4	08:05 17:00 38	09:03 (T-11) 09:41 (T-11)	07:44 17:39	07:01 18:17	07:04 19:57	06:14 20:34	05:44 21:07	05:47 21:16	06:16 20:51	06:52 20:02	07:28 19:05	07:08 17:13	08:51 (T-11) 16:47 33
5	08:05 17:01 37	09:04 (T-11) 09:04 (T-11)	07:42 17:41	06:59 18:18	07:02 19:58	06:13 20:35	05:43 21:08	05:47 21:16	06:17 20:50	06:53 20:00	07:29 19:04	07:10 17:12	08:52 (T-11) 16:47 34
6	08:04 17:02 36	09:05 (T-11) 09:41 (T-11)	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:16	06:18 20:49	06:55 19:58	07:30 19:02	07:11 17:10	08:51 (T-11) 16:47 36
7	08:04 17:03 35	09:05 (T-11) 09:40 (T-11)	07:40 17:44	06:56 18:21	06:58 20:00	06:10 20:37	05:43 21:09	05:49 21:15	06:19 20:47	06:56 19:56	07:32 19:00	07:12 17:09	08:51 (T-11) 16:47 37
8	08:04 17:04 33	09:07 (T-11) 09:40 (T-11)	07:39 17:45	07:54 18:22	06:57 20:02	06:08 20:39	05:42 21:10	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	07:14 17:08	08:51 (T-11) 16:47 38
9	08:04 17:05 32	09:08 (T-11) 09:40 (T-11)	07:37 17:46	07:52 19:23	06:55 20:03	06:07 20:40	05:42 21:11	05:50 21:15	06:22 20:45	06:58 19:52	07:34 18:54	07:15 17:06	08:51 (T-11) 16:47 39
10	08:04 17:06 30	09:09 (T-11) 09:39 (T-11)	07:36 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:51	07:35 18:53	07:17 17:05	08:51 (T-11) 16:47 39
11	08:03 17:07 29	09:10 (T-11) 09:39 (T-11)	07:35 17:49	07:48 19:26	06:51 20:05	06:05 20:42	05:41 21:12	05:52 21:14	06:24 20:42	07:01 19:49	07:37 18:51	07:18 17:04	08:51 (T-11) 16:47 39
12	08:03 17:08 27	09:11 (T-11) 09:38 (T-11)	07:33 17:51	07:47 19:27	06:50 20:07	06:03 20:43	05:41 21:12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	08:51 (T-11) 16:47 40
13	08:02 17:10 24	09:13 (T-11) 09:37 (T-11)	07:32 17:52	07:45 19:29	06:48 20:08	06:02 20:45	05:41 21:13	05:53 21:13	06:26 20:39	07:03 19:45	07:39 18:47	07:21 17:02	08:51 (T-11) 16:47 41
14	08:02 17:11 21	09:15 (T-11) 09:36 (T-11)	07:30 17:53	07:43 19:30	06:46 20:09	06:01 20:46	05:41 21:13	05:54 21:12	06:28 20:37	07:04 19:43	07:40 18:46	07:22 17:01	08:52 (T-11) 16:47 41
15	08:01 17:12 17	09:18 (T-11) 09:35 (T-11)	07:29 17:55	07:41 19:31	06:44 20:10	06:00 20:47	05:41 21:14	05:55 21:11	06:29 20:36	07:05 19:41	07:42 18:44	07:23 17:00	08:52 (T-11) 16:47 42
16	08:01 17:13 12	09:20 (T-11) 09:32 (T-11)	07:27 17:56	07:39 19:33	06:43 20:12	05:59 20:48	05:41 21:14	05:56 21:11	06:30 20:34	07:06 19:39	07:43 18:42	07:25 16:59	08:52 (T-11) 16:47 42
17	08:00 17:15 15	09:21 (T-11) 17:58	07:26 17:58	07:37 19:34	06:41 20:13	05:58 20:49	05:41 21:15	05:57 21:10	06:31 20:33	07:08 19:37	07:44 18:40	07:26 16:58	08:53 (T-11) 16:48 42
18	08:00 17:16 14	09:22 (T-11) 17:59	07:25 17:59	07:35 19:35	06:39 20:14	05:57 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:36	07:46 18:39	07:27 16:57	08:53 (T-11) 16:48 42
19	07:59 17:17 13	09:23 (T-11) 18:00	07:23 18:00	07:34 19:36	06:37 20:15	05:56 20:51	05:41 21:16	05:59 21:08	06:33 20:29	07:10 19:34	07:47 18:37	07:29 16:56	08:53 (T-11) 16:48 42
20	07:58 17:19 12	09:24 (T-11) 18:01	07:22 18:01	07:32 19:37	06:36 20:16	05:55 20:52	05:41 21:16	06:00 21:08	06:35 20:28	07:11 19:32	07:48 18:35	07:30 16:55	08:54 (T-11) 16:49 42
21	07:58 17:20 11	09:25 (T-11) 18:02	07:21 18:02	07:30 19:38	06:34 20:18	05:54 20:54	05:41 21:16	06:01 21:07	06:36 20:26	07:12 19:30	07:50 18:34	07:31 16:54	08:54 (T-11) 16:49 42
22	07:57 17:21 10	09:26 (T-11) 18:03	07:20 18:03	07:28 19:40	06:32 20:19	05:53 20:55	05:42 21:16	06:02 21:06	06:37 20:24	07:13 19:28	07:51 18:32	07:33 16:54	08:55 (T-11) 16:50 42
23	07:56 17:23 9	09:27 (T-11) 18:04	07:19 18:04	07:26 19:41	06:31 20:20	05:52 20:56	05:42 21:17	06:03 21:05	06:38 20:23	07:15 19:26	07:52 18:31	07:34 16:53	08:55 (T-11) 16:50 42
24	07:55 17:24 8	09:28 (T-11) 18:05	07:18 18:05	07:24 19:42	06:29 20:21	05:51 20:57	05:42 21:17	06:04 21:04	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	08:56 (T-11) 16:51 42
25	07:54 17:25 7	09:29 (T-11) 18:06	07:17 18:06	07:22 19:43	06:28 20:22	05:50 20:57	05:43 21:17	06:05 21:04	06:40 20:21	07:17 19:24	07:55 18:29	07:36 16:52	08:56 (T-11) 16:51 42
26	07:53 17:27 6	09:30 (T-11) 18:07	07:16 18:07	07:21 19:44	06:26 20:23	05:49 20:58	05:43 21:17	06:06 21:03	06:42 20:19	07:18 19:22	07:56 18:27	07:38 16:52	08:57 (T-11) 16:51 42
27	07:52 17:28 5	09:31 (T-11) 18:08	07:15 18:08	07:20 19:45	06:25 20:24	05:48 20:59	05:43 21:17	06:06 21:02	06:43 20:18	07:19 19:20	07:57 18:26	07:39 16:51	08:58 (T-11) 16:52 42
28	07:51 17:29 4	09:32 (T-11) 18:09	07:14 18:09	07:19 19:46	06:24 20:25	05:49 21:00	05:43 21:17	06:07 21:01	06:44 20:16	07:19 19:18	07:57 18:24	07:40 16:50	08:58 (T-11) 16:53 42
29	07:50 17:31 3	09:33 (T-11) 18:10	07:13 18:10	07:18 19:47	06:23 20:26	05:48 21:01	05:44 21:17	06:08 21:00	06:44 20:14	07:21 19:17	07:59 18:23	07:40 16:50	08:58 (T-11) 16:53 42
30	07:49 17:32 2	09:34 (T-11) 18:11	07:12 18:11	07:17 19:48	06:22 20:27	05:47 21:02	05:45 21:17	06:09 20:59	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	08:59 (T-11) 16:54 41
31	07:48 17:34 1	09:35 (T-11) 18:12	07:11 18:12	07:16 19:49	06:21 20:28	05:46 21:03	05:45 21:17	06:10 20:57	06:46 20:11	07:23 19:13	08:02 18:20	07:42 16:49	08:59 (T-11) 16:55 41
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275	
Total, worst case	488												1217
Sun reduction	0.58										100		0.52
Oper. time red.	0.90										0.48		0.90
Wind dir. red.	0.68										0.90		0.68
Total reduction	0.35										0.68		0.32
Total, real	173										29		387

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-195 - R-195

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:16	20:52	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
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	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:03
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28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
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	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:03			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-196 - R-196

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:15	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:56	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
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	17:04	17:45	18:22	20:01	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
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10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
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14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:22	07:56
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15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
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	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
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	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00
	17:18	18:00	19:38	20:16	20:52	21:16	21:07	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:49	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
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24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
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	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:57	07:39	08:04
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:57	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46	05:45	06:11	06:48	08:03	08:03	08:03	08:04
	17:34		19:51	21:03	21:03	21:17	20:56	20:09	18:18	18:18	16:56	16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-197 - R-197

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
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	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
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10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:01	07:37	07:18	07:54
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14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:41	07:22	07:56
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15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
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19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
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	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:41	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46	05:45	06:11	06:48	08:03	08:03	08:03	08:04
	17:34		19:52	21:04	21:04	21:17	20:56	20:09	18:18	18:18	16:56	16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-198 - R-198
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:12	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:20	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:41	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:04			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-200 - R-200
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December			
1	08:05 16:57	07:47 17:35	07:06 18:13	17:12 (T-35) 19:53	07:10 20:30	06:18 21:04	05:45 21:17	05:45 20:55	06:13 20:07	06:49 20:07	07:24 19:11	17:53 (T-35) 18:46 (T-04)	07:04 17:17	07:44 16:49	
2	08:05 16:58	07:46 17:37	07:04 18:14	17:12 (T-35) 19:54	07:08 20:31	06:17 21:05	05:45 21:17	05:46 20:54	06:14 20:05	06:50 20:05	07:26 19:09	17:52 (T-35) 18:44 (T-04)	07:06 17:16	07:45 16:48	
3	08:05 16:59	07:45 17:38	07:03 18:16	17:11 (T-35) 19:55	07:06 20:33	06:16 21:06	05:44 21:17	05:46 20:53	06:15 20:04	06:51 20:04	07:27 19:07	17:50 (T-35) 18:42 (T-04)	07:07 17:14	07:46 16:48	
4	08:05 17:00	07:44 17:39	07:01 18:17	17:12 (T-35) 19:57	07:04 20:34	06:14 21:07	05:44 21:16	05:47 20:51	06:16 20:02	06:52 20:02	07:28 19:06	17:49 (T-35) 18:40 (T-04)	07:08 17:13	07:47 16:48	
5	08:05 17:01	07:43 17:41	06:59 18:18	17:11 (T-35) 19:58	07:02 20:35	06:13 21:08	05:43 21:16	05:48 20:50	06:17 20:00	06:54 20:00	07:29 19:04	17:48 (T-35) 18:38 (T-04)	07:10 17:12	07:48 16:47	
6	08:05 17:03	07:41 17:42	06:57 18:20	17:11 (T-35) 19:59	07:00 20:36	06:11 21:09	05:43 21:16	05:48 20:49	06:18 20:00	06:55 20:00	07:31 19:02	17:48 (T-35) 18:37 (T-04)	07:11 17:10	07:49 16:47	
7	08:04 17:03	07:40 17:44	06:56 18:21	17:11 (T-35) 20:00	06:10 20:38	06:10 21:09	05:43 21:15	05:49 20:47	06:20 20:00	06:56 20:00	07:32 19:00	17:47 (T-35) 18:35 (T-04)	07:13 17:09	07:50 16:47	
8	08:04 17:04	07:39 17:45	07:54 18:22	18:11 (T-35) 20:02	06:09 20:39	06:09 21:10	05:42 21:15	05:50 20:46	06:21 20:00	06:57 20:00	07:33 18:56	17:46 (T-35) 18:33 (T-35)	07:14 17:08	07:51 16:47	
9	08:04 17:05	07:37 17:47	07:52 19:24	18:12 (T-35) 20:03	06:07 20:40	06:07 21:11	05:42 21:15	05:50 20:45	06:22 20:00	06:58 20:00	07:34 18:55	17:47 (T-35) 18:31 (T-35)	07:15 17:07	07:52 16:47	
10	08:04 17:06	07:36 17:48	07:50 19:25	18:12 (T-35) 20:04	06:06 20:41	06:06 21:11	05:42 21:14	05:51 20:43	06:23 20:00	06:59 20:00	07:35 18:53	17:46 (T-35) 18:29 (T-35)	07:17 17:05	07:53 16:47	
11	08:03 17:07	07:35 17:49	07:48 19:26	18:13 (T-35) 20:05	06:05 20:42	06:05 21:12	05:42 21:14	05:52 20:42	06:24 20:00	07:01 20:00	07:37 18:51	17:46 (T-35) 18:27 (T-35)	07:18 17:04	07:54 16:47	
12	08:03 17:09	07:33 17:51	07:47 19:28	18:13 (T-35) 20:07	06:04 20:44	06:04 21:12	05:41 21:13	05:53 20:40	06:25 20:00	07:02 20:00	07:38 18:49	17:45 (T-35) 18:25 (T-35)	07:19 17:03	07:55 16:47	
13	08:03 17:10	07:32 17:52	07:45 19:29	18:14 (T-35) 20:08	06:48 20:45	06:48 21:13	05:41 21:13	05:54 20:39	06:27 20:00	07:03 20:00	07:39 18:48	17:46 (T-35) 18:24 (T-35)	07:21 17:02	07:56 16:47	
14	08:02 17:11	07:30 17:54	07:43 19:30	18:15 (T-35) 20:09	06:46 20:46	06:46 21:14	05:41 21:12	05:54 20:37	06:28 20:00	07:04 20:00	07:41 18:46	17:46 (T-35) 18:22 (T-35)	07:22 17:01	07:56 16:47	
15	08:02 17:12	07:29 17:55	07:41 19:31	18:16 (T-35) 20:10	06:44 20:47	06:44 21:14	05:41 21:11	05:55 20:36	06:29 20:00	07:05 20:00	07:42 18:44	17:46 (T-35) 18:20 (T-35)	07:23 17:00	07:57 16:47	
16	08:01 17:14	07:27 17:56	07:39 19:33	18:18 (T-35) 20:12	06:43 20:48	06:43 21:14	05:41 21:11	05:56 20:34	06:30 20:00	07:07 20:00	07:43 18:42	17:47 (T-35) 18:19 (T-35)	07:25 16:59	07:58 16:48	
17	08:00 17:15	07:26 17:58	17:31 (T-35) 19:34	18:20 (T-35) 20:13	06:41 20:49	06:41 21:15	05:41 21:10	05:57 20:33	06:31 20:00	07:08 20:00	07:44 18:41	17:47 (T-35) 18:17 (T-35)	07:26 16:58	07:59 16:48	
18	08:00 17:16	07:24 17:59	17:27 (T-35) 19:35	18:22 (T-35) 20:14	06:39 20:50	06:39 21:15	05:41 21:09	05:58 20:31	06:32 20:00	07:09 20:00	07:46 18:39	17:47 (T-35) 18:14 (T-35)	07:27 16:57	07:59 16:48	
19	07:59 17:17	07:23 18:01	17:24 (T-35) 19:37	18:27 (T-35) 20:15	06:38 20:52	06:38 21:16	05:41 21:08	05:59 20:29	06:34 20:00	07:10 20:00	07:47 18:37	17:49 (T-35) 18:13 (T-35)	07:29 16:56	08:00 16:48	
20	07:58 17:19	07:21 18:01	17:22 (T-35) 19:38	18:51 (T-05) 20:17	06:36 20:53	06:36 21:16	06:00 21:08	06:35 20:28	07:11 20:00	07:11 20:00	07:48 18:36	17:50 (T-35) 18:11 (T-35)	07:30 16:55	08:01 16:49	
21	07:58 17:20	07:20 18:02	17:21 (T-35) 19:39	18:53 (T-05) 20:18	06:34 20:54	06:34 21:16	06:01 21:07	06:36 20:26	07:12 20:00	07:12 20:00	07:50 18:34	17:52 (T-35) 18:10 (T-35)	07:31 16:55	08:01 16:49	
22	07:57 17:21	07:18 18:03	17:19 (T-35) 19:40	19:04 (T-05) 20:19	06:33 20:55	06:33 21:16	06:02 21:06	06:37 20:25	07:14 20:00	07:14 20:00	07:51 19:28	17:53 (T-35) 18:49 (T-05)	07:33 18:32	08:02 16:50	
23	07:56 17:23	07:16 18:05	17:17 (T-35) 19:42	06:31 20:20	05:52 20:56	05:52 21:17	06:03 21:05	06:38 20:23	07:15 20:00	07:15 20:00	18:49 (T-05) 18:34 (T-05)	18:32 18:31	17:55 (T-35) 18:06 (T-35)	07:34 16:53	08:02 16:50
24	07:55 17:24	07:15 18:06	17:17 (T-35) 19:43	06:29 20:22	05:51 20:57	05:51 21:17	06:04 21:04	06:39 20:21	07:16 20:00	07:16 20:00	18:51 (T-05) 18:53 (T-05)	18:31 18:29	18:06 (T-35) 18:05 (T-35)	07:35 16:52	08:03 16:51
25	07:54 17:25	07:13 18:08	17:15 (T-35) 19:44	06:28 20:23	05:50 20:58	05:50 21:17	06:05 21:03	06:41 20:19	07:17 20:00	07:17 20:00	18:06 (T-35) 18:54 (T-05)	18:28 18:28	17:58 (T-35) 18:02 (T-35)	07:36 16:52	08:03 16:52
26	07:54 17:27	07:11 18:09	17:14 (T-35) 19:45	06:26 20:24	05:49 20:59	05:49 21:17	06:06 21:02	06:42 20:18	07:18 20:00	07:18 20:00	18:02 (T-35) 18:54 (T-05)	18:26 18:26	17:56 (T-35) 18:00 (T-35)	07:38 16:51	08:03 16:52
27	07:53 17:28	07:10 18:10	17:13 (T-35) 19:47	06:25 20:25	05:49 21:00	05:49 21:17	06:07 21:01	06:43 20:16	07:20 20:00	07:20 20:00	19:21 19:19	18:00 (T-35) 18:54 (T-05)	17:58 (T-35) 18:24 (T-35)	07:39 16:50	08:04 16:53
28	07:52 17:30	07:08 18:12	17:13 (T-35) 19:48	06:23 20:27	05:48 21:01	05:48 21:17	06:08 21:00	06:44 20:14	07:21 20:00	07:21 20:00	18:00 (T-35) 18:52 (T-05)	17:58 (T-35) 18:29 (T-35)	17:58 (T-35) 18:00 (T-35)	07:40 16:50	08:04 16:54
29	07:51 17:31	07:07 19:49	17:11 (T-35) 19:49	06:21 20:28	05:47 21:02	05:47 21:17	06:09 20:59	06:45 20:13	07:22 20:00	07:22 20:00	19:15 18:50 (T-05)	18:21 18:21	17:56 (T-35) 18:50 (T-05)	07:41 16:49	08:04 16:54
30	07:50 17:32	07:06 19:50	17:10 (T-35) 19:50	06:20 20:29	05:47 21:03	05:47 21:17	06:10 20:58	06:47 20:11	07:23 20:00	07:23 20:00	19:13 18:48 (T-05)	18:20 18:20	17:54 (T-35) 18:48 (T-05)	07:43 16:49	08:04 16:55
31	07:48 17:34	07:04 19:52	17:09 (T-35) 19:52	06:19 21:04	05:46 21:04	05:46 21:10	06:12 20:56	06:48 20:09	07:24 20:00	07:24 20:00	18:03 18:19	18:20 18:19	17:52 (T-35) 18:19 (T-05)	07:44 16:56	08:05 16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275			
Total, worst case		270	925						343		863				
Sun reduction		0.58	0.59						0.67		0.56				
Oper. time red.		0.90	0.90						0.90		0.90				
Wind dir. red.		0.58	0.58						0.58		0.58				
Total reduction		0.30	0.31						0.35		0.29				
Total, real		82	284						119		253				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-201 - R-201
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:05 16:57	07:47 17:35	07:06 18:13	07:36 (T-06) 08:00 (T-06)	07:10 19:53	06:19 20:30
2	08:05 16:58	07:46 17:37	07:05 18:14	07:38 (T-06) 07:58 (T-06)	07:08 19:54	06:17 20:32
3	08:05 16:59	07:45 17:38	07:03 18:16	07:39 (T-06) 07:56 (T-06)	07:06 19:55	06:16 20:33
4	08:05 17:00	07:44 17:40	07:01 18:17	07:43 (T-06) 07:53 (T-06)	07:04 19:57	06:14 20:34
5	08:05 17:01	07:43 17:41	06:59 18:18	07:02 19:58	06:13 20:35	05:44 21:08
6	08:05 17:02	07:41 17:42	06:58 18:20	07:01 19:59	06:11 20:36	05:43 21:09
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	06:10 20:38	05:43 21:09
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	07:17 (T-07) 07:21 (T-07)	06:09 20:39
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 20:03	07:15 (T-07) 07:22 (T-07)	06:07 20:40
10	08:04 17:06	07:36 17:48	07:50 19:25	06:53 20:04	07:13 (T-07) 07:22 (T-07)	06:06 20:41
11	08:03 17:08	07:35 17:49	07:49 19:26	06:52 20:05	07:12 (T-07) 07:24 (T-07)	06:05 20:42
12	08:03 17:09	07:33 17:51	07:55 (T-06) 07:58 (T-06)	07:47 19:28	06:50 20:07	06:04 20:44
13	08:03 17:10	07:32 17:52	07:53 (T-06) 07:59 (T-06)	07:45 19:29	06:48 20:08	06:02 20:45
14	08:02 17:11	07:30 17:54	07:52 (T-06) 08:01 (T-06)	07:43 19:30	06:46 20:09	06:01 20:46
15	08:02 17:12	07:29 17:55	07:50 (T-06) 08:02 (T-06)	07:41 19:31	06:44 20:10	06:00 20:47
16	08:01 17:14	07:27 17:57	07:49 (T-06) 08:04 (T-06)	07:39 19:33	06:43 20:12	05:59 20:48
17	08:01 17:15	07:26 17:58	07:47 (T-06) 08:04 (T-06)	07:38 19:34	06:41 20:13	05:58 20:49
18	08:00 17:16	07:24 17:59	07:45 (T-06) 08:04 (T-06)	07:36 19:35	06:39 20:14	05:57 20:50
19	07:59 17:17	07:23 18:01	07:44 (T-06) 08:05 (T-06)	07:34 19:37	06:38 20:15	05:56 20:52
20	07:59 17:19	07:21 18:01	07:42 (T-06) 08:05 (T-06)	07:32 19:38	06:36 20:17	05:55 20:53
21	07:58 17:20	07:20 18:02	07:41 (T-06) 08:06 (T-06)	07:30 19:39	06:34 20:18	05:54 20:54
22	07:57 17:21	07:18 18:03	07:39 (T-06) 08:05 (T-06)	07:28 19:40	06:33 20:19	05:53 20:55
23	07:56 17:23	07:16 18:05	07:37 (T-06) 08:05 (T-06)	07:26 19:42	06:31 20:20	05:52 20:56
24	07:55 17:24	07:15 18:06	07:36 (T-06) 08:05 (T-06)	07:25 19:43	06:29 20:22	05:51 20:57
25	07:54 17:26	07:13 18:08	07:34 (T-06) 08:04 (T-06)	07:23 19:44	06:28 20:23	05:50 20:58
26	07:54 17:27	07:11 18:09	07:34 (T-06) 08:03 (T-06)	07:21 19:45	06:26 20:24	05:50 20:59
27	07:53 17:28	07:10 18:10	07:34 (T-06) 08:02 (T-06)	07:19 19:47	06:25 20:25	05:49 21:00
28	07:52 17:30	07:08 18:12	07:36 (T-06) 08:02 (T-06)	07:17 19:48	06:23 20:27	05:48 21:01
29	07:51 17:31		07:15 19:49	06:22 20:28	05:47 21:02	05:44 21:17
30	07:50 17:32		07:13 19:50	06:20 20:29	05:47 21:03	05:45 21:17
31	07:48 17:34		07:12 19:52		05:46 21:04	
Potential sun hours	287	292	346	369	404	465
Total, worst case			71		243	
Sun reduction			0.58	0.59	0.63	
Oper. time red.			0.90	0.90	0.90	
Wind dir. red.			0.62	0.62	0.57	
Total reduction			0.33	0.33	0.32	
Total, real		113		23		79

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-201 - R-201
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:17	06:13 20:55	06:49 20:07	07:11 (T-07) 20:07	07:24 19:11	07:04 17:17
2	05:46 21:17	06:14 20:54	06:50 20:05	07:12 (T-07) 07:21 (T-07)	07:26 19:09	07:06 17:16
3	05:46 21:17	06:15 20:53	06:51 20:04	07:13 (T-07) 07:20 (T-07)	07:27 19:07	07:07 17:14
4	05:47 21:16	06:16 20:52	06:52 20:02	07:14 (T-07) 07:18 (T-07)	07:28 19:06	07:09 17:13
5	05:48 21:16	06:17 20:50	06:54 20:00		07:29 19:04	07:10 17:12
6	05:48 21:16	06:18 20:49	06:55 19:58		07:31 19:02	07:11 17:10
7	05:49 21:16	06:20 20:48	06:56 19:56		07:32 19:00	07:13 17:09
8	05:50 21:15	06:21 20:46	06:57 19:54		07:33 18:56	07:14 17:08
9	05:51 21:15	06:22 20:45	06:58 19:53		07:34 18:55	07:15 17:07
10	05:51 21:14	06:23 20:43	07:00 19:51		07:36 18:53	07:17 17:06
11	05:52 21:14	06:24 20:42	07:01 19:49		07:37 18:51	07:18 17:04
12	05:53 21:13	06:25 20:40	07:02 19:47		07:38 18:49	07:19 17:03
13	05:54 21:13	06:27 20:39	07:03 19:45		07:39 18:48	07:21 17:02
14	05:55 21:12	06:28 20:37	07:04 19:43		07:41 18:46	07:22 17:01
15	05:55 21:11	06:29 20:36	07:05 19:41		07:42 18:44	07:23 17:00
16	05:56 21:11	06:30 20:34	07:07 19:39		07:43 18:42	07:25 16:59
17	05:57 21:10	06:31 20:33	07:08 19:38		07:45 18:41	07:26 16:58
18	05:58 21:09	06:32 20:31	07:09 19:36		07:46 18:39	07:27 16:57
19	05:59 21:08	06:34 20:30	07:10 19:34		07:47 18:37	07:29 16:56
20	06:00 21:08	06:35 20:28	07:11 19:32		07:48 18:36	07:30 16:55
21	06:01 21:07	06:36 20:26	07:12 19:30		07:50 18:34	07:31 16:55
22	06:02 21:06	06:37 20:25	07:14 19:28		07:51 18:32	07:33 16:54
23	06:03 21:05	06:38 20:23	07:15 19:26		07:52 18:31	07:34 16:53
24	06:04 21:04	06:40 20:21	07:16 19:24		07:54 18:29	07:35 16:52
25	06:05 21:03	06:41 20:20	07:17 19:22		07:55 18:28	07:36 16:52
26	06:06 21:02	06:42 20:18	07:18 19:21		07:56 18:26	07:38 16:51
27	06:07 21:01	06:43 20:16	07:20 19:19		07:58 18:25	07:39 16:51
28	06:08 21:00	06:44 20:14	07:21 19:17		07:59 18:23	07:40 16:50
29	06:09 20:59	06:45 20:13	07:22 19:15		08:00 18:22	07:41 16:50
30	06:11 20:58	06:47 20:11	07:23 19:13		08:02 18:20	07:43 16:50
31	06:12 20:56	06:48 20:09	07:24 (T-07) 19:11		08:03 18:19	07:44 16:50
Potential sun hours	471	436	377	341	288	275
Total, worst case						
Sun reduction		0.72	0.67	0.56		
Oper. time red.		0.90	0.90	0.90		
Wind dir. red.		0.57	0.57	0.62		
Total reduction		0.37	0.34	0.31		
Total, real		79	11	132		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-203 - R-203

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June			
1	08:05	07:47	07:06	07:37 (T-83)	07:10	06:19	05:46	20:03 (T-33)	
	16:57	17:35	18:13	15 07:52 (T-83)	19:53	20:30	21:04	33 20:36 (T-33)	
2	08:05	07:46	07:04	07:40 (T-83)	07:08	06:17	05:45	20:02 (T-33)	
	16:58	17:37	18:14	9 07:49 (T-83)	19:54	20:31	21:05	33 20:35 (T-33)	
3	08:05	07:45	07:03		07:06	06:16	05:44	20:03 (T-33)	
	16:59	17:38	18:16		19:55	20:33	21:06	33 20:36 (T-33)	
4	08:05	07:44	07:01		07:04	06:14	05:44	20:04 (T-33)	
	17:00	17:40	18:17		19:57	20:34	21:07	32 20:36 (T-33)	
5	08:05	07:42	06:59		07:02	06:13	20:10 (T-33)	05:44	20:04 (T-33)
	17:01	17:41	18:18		19:58	20:35	1 20:11 (T-33)	21:08	31 20:35 (T-33)
6	08:04	07:41	06:57		07:00	06:11	20:08 (T-33)	05:43	20:05 (T-33)
	17:02	17:42	18:20		19:59	20:36	5 20:13 (T-33)	21:08	30 20:35 (T-33)
7	08:04	07:40	06:56		06:59	06:10	20:07 (T-33)	05:43	20:06 (T-33)
	17:03	17:44	18:21		20:00	20:37	7 20:14 (T-33)	21:09	29 20:35 (T-33)
8	08:04	07:39	07:54		06:57	06:09	20:05 (T-33)	05:42	20:05 (T-33)
	17:04	17:45	18:22		20:02	20:39	9 20:14 (T-33)	21:10	30 20:35 (T-33)
9	08:04	07:37	07:52		06:55	06:07	20:04 (T-33)	05:42	20:06 (T-33)
	17:05	17:47	19:24		20:03	20:40	12 20:16 (T-33)	21:10	29 20:35 (T-33)
10	08:04	07:36	07:50		06:53	06:06	20:03 (T-33)	05:42	20:07 (T-33)
	17:06	17:48	19:25		20:04	20:41	14 20:17 (T-33)	21:11	28 20:35 (T-33)
11	08:03	07:35	07:48		06:51	06:05	20:03 (T-33)	05:42	20:07 (T-33)
	17:08	17:49	19:26		20:05	20:42	15 20:18 (T-33)	21:12	28 20:35 (T-33)
12	08:03	07:33	07:47		06:50	06:04	20:01 (T-33)	05:42	20:08 (T-33)
	17:09	17:51	19:28		20:07	20:43	17 20:18 (T-33)	21:12	27 20:35 (T-33)
13	08:02	07:32	07:53 (T-83)	07:45	06:48	06:02	20:01 (T-33)	05:41	20:09 (T-33)
	17:10	17:52	1 07:54 (T-83)	19:29	20:08	20:45	19 20:20 (T-33)	21:13	26 20:35 (T-33)
14	08:02	07:30	07:51 (T-83)	07:43	06:46	06:01	20:00 (T-33)	05:41	20:08 (T-33)
	17:11	17:54	4 07:55 (T-83)	19:30	20:09	20:46	21 20:21 (T-33)	21:13	26 20:34 (T-33)
15	08:01	07:29	07:50 (T-83)	07:41	06:44	06:00	20:00 (T-33)	05:41	20:09 (T-33)
	17:12	17:55	7 07:57 (T-83)	19:31	20:10	20:47	22 20:22 (T-33)	21:14	25 20:34 (T-33)
16	08:01	07:27	07:48 (T-83)	07:39	06:43	05:59	20:00 (T-33)	05:41	20:09 (T-33)
	17:14	17:57	10 07:58 (T-83)	19:33	20:12	20:48	23 20:23 (T-33)	21:14	25 20:34 (T-33)
17	08:00	07:26	07:47 (T-83)	07:37	06:41	05:58	19:59 (T-33)	05:41	20:10 (T-33)
	17:15	17:58	12 07:59 (T-83)	19:34	20:13	20:49	25 20:24 (T-33)	21:15	25 20:35 (T-33)
18	08:00	07:24	07:45 (T-83)	07:36	06:39	05:57	19:59 (T-33)	05:41	20:10 (T-33)
	17:16	17:59	14 07:59 (T-83)	19:35	20:14	20:50	26 20:25 (T-33)	21:15	25 20:35 (T-33)
19	07:59	07:23	07:44 (T-83)	07:34	06:38	05:56	19:59 (T-33)	05:41	20:11 (T-33)
	17:17	18:01	16 08:00 (T-83)	19:37	20:15	20:51	27 20:26 (T-33)	21:15	24 20:35 (T-33)
20	07:58	07:21	07:42 (T-83)	07:32	06:36	05:55	19:59 (T-33)	05:42	20:11 (T-33)
	17:19	18:01	18 08:00 (T-83)	19:38	20:17	20:52	28 20:27 (T-33)	21:16	24 20:35 (T-33)
21	07:58	07:19	07:40 (T-83)	07:30	06:34	05:54	19:59 (T-33)	05:42	20:11 (T-33)
	17:20	18:02	19 07:59 (T-83)	19:39	20:18	20:54	29 20:28 (T-33)	21:16	24 20:35 (T-33)
22	07:57	07:18	07:39 (T-83)	07:28	06:33	05:53	20:00 (T-33)	05:42	20:11 (T-33)
	17:21	18:03	21 08:00 (T-83)	19:40	20:19	20:55	30 20:30 (T-33)	21:16	24 20:35 (T-33)
23	07:56	07:16	07:37 (T-83)	07:26	06:31	05:52	20:00 (T-33)	05:42	20:12 (T-33)
	17:23	18:05	22 07:59 (T-83)	19:42	20:20	20:56	30 20:30 (T-33)	21:16	24 20:36 (T-33)
24	07:55	07:15	07:35 (T-83)	07:24	06:29	05:51	20:00 (T-33)	05:43	20:12 (T-33)
	17:24	18:06	23 07:58 (T-83)	19:43	20:21	20:57	31 20:31 (T-33)	21:17	24 20:36 (T-33)
25	07:54	07:13	07:34 (T-83)	07:23	06:28	05:50	20:00 (T-33)	05:43	20:11 (T-33)
	17:26	18:08	24 07:58 (T-83)	19:44	20:23	20:58	32 20:32 (T-33)	21:17	25 20:36 (T-33)
26	07:53	07:11	07:33 (T-83)	07:21	06:26	05:50	20:01 (T-33)	05:43	20:12 (T-33)
	17:27	18:09	24 07:57 (T-83)	19:45	20:24	20:59	33 20:34 (T-33)	21:17	25 20:37 (T-33)
27	07:52	07:10	07:34 (T-83)	07:19	06:25	05:49	20:01 (T-33)	05:44	20:12 (T-33)
	17:28	18:10	22 07:56 (T-83)	19:47	20:25	21:00	33 20:34 (T-33)	21:17	25 20:37 (T-33)
28	07:51	07:08	07:36 (T-83)	07:17	06:23	05:48	20:01 (T-33)	05:44	20:11 (T-33)
	17:30	18:12	19 07:55 (T-83)	19:48	20:26	21:01	34 20:35 (T-33)	21:17	26 20:37 (T-33)
29	07:50			07:15	06:22	05:47	20:02 (T-33)	05:44	20:12 (T-33)
	17:31			19:49	20:28	21:02	34 20:36 (T-33)	21:17	26 20:38 (T-33)
30	07:49			07:13	06:20	05:47	20:02 (T-33)	05:45	20:11 (T-33)
	17:32			19:50	20:29	21:03	34 20:36 (T-33)	21:17	27 20:38 (T-33)
31	07:48			07:11		05:46	20:02 (T-33)		
	17:34			19:52		21:03	33 20:35 (T-33)		
Potential sun hours	287	292	369		403	458		465	
Total, worst case				24			624		813
Sun reduction				0.58			0.66		0.73
Oper. time red.				0.90			0.90		0.90
Wind dir. red.				0.62			0.63		0.63
Total reduction				0.32			0.38		0.42
Total, real				83			235		338

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-203 - R-203
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45	20:12 (T-33)	06:13	20:12 (T-33)	06:49	07:24
	21:17	27 20:39 (T-33)	20:55	17 20:29 (T-33)	20:07	19:11
2	05:46	20:11 (T-33)	06:14	20:12 (T-33)	06:50	07:26
	21:17	28 20:39 (T-33)	20:54	15 20:27 (T-33)	20:05	19:09
3	05:47	20:11 (T-33)	06:15	20:13 (T-33)	06:51	07:27
	21:16	29 20:40 (T-33)	20:53	13 20:26 (T-33)	20:04	19:07
4	05:47	20:12 (T-33)	06:16	20:15 (T-33)	06:52	07:28
	21:16	29 20:41 (T-33)	20:51	11 20:26 (T-33)	20:02	19:06
5	05:48	20:11 (T-33)	06:17	20:16 (T-33)	06:54	07:29
	21:16	29 20:40 (T-33)	20:50	8 20:24 (T-33)	20:00	19:04
6	05:48	20:11 (T-33)	06:19	20:17 (T-33)	06:55	07:31
	21:16	30 20:41 (T-33)	20:49	6 20:23 (T-33)	19:58	19:02
7	05:49	20:11 (T-33)	06:20	20:19 (T-33)	06:56	07:32
	21:15	31 20:42 (T-33)	20:47	3 20:22 (T-33)	19:56	19:00
8	05:50	20:11 (T-33)	06:21		06:57	07:33
	21:15	31 20:42 (T-33)	20:46		19:54	18:56
9	05:51	20:11 (T-33)	06:22		06:58	07:34
	21:15	32 20:43 (T-33)	20:45		19:53	18:55
10	05:51	20:11 (T-33)	06:23		06:59	07:36
	21:14	32 20:43 (T-33)	20:43		19:51	18:53
11	05:52	20:10 (T-33)	06:24		07:01	07:37
	21:14	33 20:43 (T-33)	20:42		19:49	18:51
12	05:53	20:10 (T-33)	06:25		07:02	07:38
	21:13	34 20:44 (T-33)	20:40		19:47	18:49
13	05:54	20:10 (T-33)	06:27		07:03	07:39
	21:12	34 20:44 (T-33)	20:39		19:45	18:48
14	05:55	20:10 (T-33)	06:28		07:04	07:41
	21:12	35 20:45 (T-33)	20:37		19:43	18:46
15	05:56	20:10 (T-33)	06:29		07:05	07:42
	21:11	34 20:44 (T-33)	20:36		19:41	18:44
16	05:56	20:10 (T-33)	06:30		07:07	07:43
	21:11	34 20:44 (T-33)	20:34		19:39	18:42
17	05:57	20:09 (T-33)	06:31		07:08	07:44
	21:10	33 20:42 (T-33)	20:33		19:38	18:41
18	05:58	20:09 (T-33)	06:32		07:09	07:46
	21:09	33 20:42 (T-33)	20:31		19:36	18:39
19	05:59	20:09 (T-33)	06:34		07:10	07:47
	21:08	32 20:41 (T-33)	20:29		19:34	18:37
20	06:00	20:09 (T-33)	06:35		07:11	07:48
	21:07	31 20:40 (T-33)	20:28		19:32	18:36
21	06:01	20:09 (T-33)	06:36		07:12	07:50
	21:07	31 20:40 (T-33)	20:26		19:30	18:34
22	06:02	20:09 (T-33)	06:37		07:14	07:51
	21:06	30 20:39 (T-33)	20:24		19:28	18:32
23	06:03	20:10 (T-33)	06:38		07:15	07:52
	21:05	28 20:38 (T-33)	20:23		19:26	18:31
24	06:04	20:10 (T-33)	06:40		07:16	07:54
	21:04	27 20:37 (T-33)	20:21		19:24	18:29
25	06:05	20:10 (T-33)	06:41		07:17	07:55
	21:03	26 20:36 (T-33)	20:19		19:22	18:28
26	06:06	20:10 (T-33)	06:42		07:18	07:56
	21:02	25 20:35 (T-33)	20:18		19:21	18:26
27	06:07	20:10 (T-33)	06:43		07:20	07:58
	21:01	24 20:34 (T-33)	20:16		19:19	18:25
28	06:08	20:10 (T-33)	06:44		07:21	07:59
	21:00	23 20:33 (T-33)	20:14		19:17	18:23
29	06:10	20:11 (T-33)	06:45		07:22	08:00
	20:59	21 20:32 (T-33)	20:12		19:15	18:22
30	06:11	20:11 (T-33)	06:47		07:23	08:02
	20:57	20 20:31 (T-33)	20:11		19:13	18:20
31	06:12	20:11 (T-33)	06:48			08:03
	20:56	19 20:30 (T-33)	20:09			18:19
Potential sun hours	471	436	377	341	289	275
Total, worst case	905	73	280			
Sun reduction	0.75	0.72	0.56			
Oper. time red.	0.90	0.90	0.90			
Wind dir. red.	0.63	0.63	0.62			
Total reduction	0.43	0.41	0.31			
Total, real	387	30	87			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-209 - R-209

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05 07:47		07:06 07:10	07:10 06:19		05:46	06:11 (T-34) 05:46	06:13 06:49	07:25 07:04		07:04	07:44
	16:57 17:35		18:13 19:53	20:30		21:04	10 06:21 (T-34) 21:17	20:55 20:07	19:11 17:17		17:17	16:49
2	08:05 07:46		08:08 (T-39) 07:05	07:08 06:17		05:45	06:13 (T-34) 05:46	06:14 06:50	07:26 07:06		07:06	07:45
	16:58 17:37	2	08:10 (T-39) 18:14	19:54 20:31		21:05	7 06:20 (T-34) 21:17	20:54 20:05	19:09 17:16	8	07:29 (T-39) 07:45	16:48
3	08:05 07:45		08:07 (T-39) 07:03	07:06 06:16		05:45	06:14 (T-34) 05:47	06:15 06:51	07:27 07:07		07:07	07:46
	16:59 17:38	3	08:10 (T-39) 18:16	19:55 20:33		21:06	4 06:18 (T-34) 21:17	20:53 20:04	19:08 17:15	8	07:38 (T-39) 07:46	16:48
4	08:05 07:44		08:06 (T-39) 07:01	07:04 06:14		05:44		06:16 06:53	07:28 07:08		07:08	07:47
	17:00 17:40	5	08:11 (T-39) 18:17	19:57 20:34		21:07		20:51 20:02	19:06 17:13	8	07:40 (T-39) 07:48	16:48
5	08:05 07:43		08:04 (T-39) 06:59	07:02 06:13		05:44		06:17 06:54	07:29 07:10		07:10	07:48
	17:01 17:41	6	08:10 (T-39) 18:18	19:58 20:35		21:08		20:50 20:00	19:04 17:12	7	07:40 (T-39) 07:48	16:48
6	08:05 07:41		08:03 (T-39) 06:58	07:01 06:12		05:43		06:19 06:55	07:31 07:11		07:11	07:49
	17:02 17:43	7	08:10 (T-39) 18:20	19:59 20:36		21:08		20:49 19:58	19:02 17:11	6	07:40 (T-39) 07:48	16:47
7	08:04 07:40		08:02 (T-39) 06:56	06:59 06:10		05:43		06:20 06:56	07:32 07:13		07:13	07:50
	17:03 17:44	8	08:10 (T-39) 18:21	20:00 20:38		21:09		20:47 19:56	19:00 17:09	5	07:41 (T-39) 07:49	16:47
8	08:04 07:39		08:00 (T-39) 07:54	06:57 06:09		05:43		06:21 06:57	07:33 07:14		07:14	07:51
	17:04 17:45	8	08:08 (T-39) 18:22	20:02 20:39		21:10		20:46 19:54	18:57 17:08	3	07:40 (T-39) 07:48	16:47
9	08:04 07:37		07:59 (T-39) 07:52	06:55 06:08		05:42		05:51 06:22	06:58 07:34		07:34	07:52
	17:05 17:47	8	08:07 (T-39) 19:24	20:03 20:40		21:11		20:45 19:53	18:55 17:07	2	07:41 (T-39) 07:49	16:47
10	08:04 07:36		07:50 06:53	06:06		05:42		05:51 06:23	07:00 07:36		07:36	07:53
	17:07 17:48		19:25 20:04	20:41		21:11		06:27 (T-34) 20:43	19:51 18:53		17:06	16:47
11	08:03 07:35		07:49 06:52	06:05		05:42		05:52 06:20 (T-34) 20:24	07:01 07:37		07:37	07:54
	17:08 17:50		19:26 20:05	20:42		21:12		21:14 9 06:29 (T-34) 20:42	19:49 18:51		17:05	16:47
12	08:03 07:33		07:47 06:50	06:04		05:42		05:53 06:18 (T-34) 20:26	07:02 07:38		07:38	07:55
	17:09 17:51		19:28 20:07	20:44		21:12		21:13 11 06:29 (T-34) 20:40	19:47 18:49		17:03	16:47
13	08:02 07:32		07:45 06:48	06:03		05:42		05:54 06:18 (T-34) 20:27	07:03 07:39		07:39	07:56
	17:10 17:52		19:29 20:08	20:45		21:13		21:13 12 06:30 (T-34) 20:39	19:45 18:48		17:02	16:47
14	08:02 07:30		07:43 06:46	06:01		05:41		05:55 06:19 (T-34) 20:28	07:04 07:41		07:41	07:56
	17:11 17:54		19:30 20:09	20:46		21:13		21:12 12 06:31 (T-34) 20:37	19:43 18:46		17:01	16:47
15	08:02 07:29		07:41 06:45	06:00		05:41		05:56 06:20 (T-34) 20:29	07:05 07:42		07:42	07:57
	17:13 17:55		19:32 20:10	20:47	1	06:23 (T-34) 21:14		21:11 12 06:32 (T-34) 20:36	19:41 18:44		17:00	16:48
16	08:01 07:27		07:39 06:43	05:59		05:41		05:57 06:21 (T-34) 20:30	07:07 07:43		07:43	07:58
	17:14 17:57		19:33 20:12	20:48	2	06:23 (T-34) 21:14		21:11 12 06:33 (T-34) 20:34	19:40 18:42		16:59	16:48
17	08:00 07:26		07:38 06:41	05:58		05:41		06:06 (T-33) 05:57	06:22 (T-34) 06:31		07:08	07:45
	17:15 17:58		19:34 20:13	20:49	4	06:24 (T-34) 21:15	1	06:07 (T-33) 21:10	12 06:34 (T-34) 20:33		19:38	18:41
18	08:00 07:24		07:36 06:39	05:57		05:42		06:06 (T-33) 05:58	06:22 (T-34) 06:33		07:09	07:46
	17:16 17:59		19:35 20:14	20:50	5	06:24 (T-34) 21:15	1	06:07 (T-33) 21:09	11 06:33 (T-34) 20:31		19:36	18:39
19	07:59 07:23		07:34 06:38	05:56		05:42		06:06 (T-33) 05:59	11 06:23 (T-34) 20:34		07:10	07:47
	17:18 18:01		19:37 20:15	20:51	6	06:24 (T-34) 21:16	1	06:07 (T-33) 21:08	11 06:34 (T-34) 20:29		19:34	18:37
20	07:58 07:21		07:32 06:36	05:55		05:42		06:06 (T-33) 06:00	10 06:24 (T-34) 20:35		07:11	07:48
	17:19 18:01		19:38 20:17	20:53	7	06:24 (T-34) 21:16	1	06:07 (T-33) 21:08	10 06:34 (T-34) 20:28		19:32	18:36
21	07:58 07:20		07:30 06:34	05:54		05:42		06:06 (T-33) 06:01	9 06:25 (T-34) 20:36		07:13	07:50
	17:20 18:02		19:39 20:18	20:54	8	06:25 (T-34) 21:16	1	06:07 (T-33) 21:07	9 06:34 (T-34) 20:26		19:30	18:34
22	07:57 07:18		07:28 06:33	05:53		05:42		06:06 (T-33) 06:02	9 06:26 (T-34) 20:37		07:14	07:51
	17:22 18:04		19:40 20:19	20:55	9	06:25 (T-34) 21:16	1	06:07 (T-33) 21:06	9 06:35 (T-34) 20:25		19:28	18:32
23	07:56 07:16		07:26 06:31	05:52		05:42		06:07 (T-33) 06:03	9 06:27 (T-34) 20:38		07:15	07:52
	17:23 18:05		19:42 20:20	20:56	10	06:25 (T-34) 21:17	1	06:08 (T-33) 21:05	8 06:35 (T-34) 20:23		19:26	18:31
24	07:55 07:15		07:25 06:29	05:51		05:43		06:07 (T-33) 06:04	8 06:28 (T-34) 20:40		07:16	07:54
	17:24 18:06		19:43 20:22	20:57	10	06:24 (T-34) 21:17	1	06:08 (T-33) 21:04	7 06:35 (T-34) 20:21		19:24	18:29
25	07:54 07:13		07:23 06:28	05:50		05:43		06:07 (T-33) 06:05	7 06:29 (T-34) 20:41		07:17	07:55
	17:26 18:08		19:44 20:23	20:58	11	06:24 (T-34) 21:17	1	06:08 (T-33) 21:03	6 06:35 (T-34) 20:19		19:23	18:28
26	07:53 07:11		07:21 06:26	05:50		05:43		06:08 (T-33) 06:06	6 06:30 (T-34) 20:42		07:18	07:56
	17:27 18:09		19:45 20:24	20:59	11	06:24 (T-34) 21:17	1	06:09 (T-33) 21:02	4 06:34 (T-34) 20:18		19:21	18:26
27	07:53 07:10		07:19 06:25	05:49		05:44		06:07	4 06:31 (T-34) 20:43		07:20	07:58
	17:28 18:10		19:47 20:25	21:00	12	06:24 (T-34) 21:17		21:01	3 06:34 (T-34) 20:16		19:19	18:25
28	07:52 07:08		07:17 06:23	05:48		05:44		06:09	2 06:32 (T-34) 20:44		07:21	07:59
	17:30 18:12		19:48 20:27	21:01	12	06:23 (T-34) 21:17		21:00	2 06:34 (T-34) 20:14		19:17	18:23
29	07:51 17:31		07:15 06:22	05:48		05:45		06:10			07:22	08:00
	17:31 17:49		19:49 20:28	21:02	12	06:23 (T-34) 21:17		20:59			19:15	18:22
30	07:49 17:33		07:13 06:20	05:47		05:45		06:11			07:23	08:02
	17:33 17:48		19:50 20:29	21:03	12	06:22 (T-34) 21:17		20:58			20:11	19:13
31	07:48 17:34		07:12 06:19	05:46		05:44		06:12			19:13	18:20
			19:52 21:04	21:06	11	06:22 (T-34) 21:17		20:56			18:19	17:26
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275
Total, worst case		47			143			166			47	
Sun reduction		0.58			0.66			0.73			0.48	
Oper. time red.		0.90			0.90			0.90			0.90	
Wind dir. red.		0.64			0.59			0.59			0.64	
Total reduction		0.33			0.35			0.40			0.28	
Total, real		16			50			66			13	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-212 - R-212
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:05	07:47	07:06	07:10	06:19	05:46	05:46	06:13	06:49	07:25	07:46 (T-33)	07:04	07:44	
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	13 07:59 (T-33)	17:17	16:49	
2	08:05	07:46	07:05	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:47 (T-33)	07:06	07:45	
	16:58	17:37	18:14	19:54	20:32	21:05	21:17	20:54	20:05	19:09	11 07:58 (T-33)	17:16	16:48	
3	08:05	07:45	07:03	07:06	06:16	05:45	05:47	06:15	06:51	07:27	07:48 (T-33)	07:07	07:46	
	16:59	17:38	18:16	19:55	20:33	21:06	21:17	20:53	20:04	19:08	9 07:57 (T-33)	17:15	16:48	
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:53	07:28	07:49 (T-33)	07:08	07:47	
	17:00	17:40	18:17	19:57	20:34	21:07	21:16	20:52	20:02	19:06	8 07:57 (T-33)	17:13	16:48	
5	08:05	07:43	06:59	07:02	06:13	05:44	05:48	06:17	06:54	07:29	07:49 (T-33)	07:10	07:48	
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	5 07:56 (T-33)	17:12	16:48	
6	08:05	07:41	06:58	07:01	06:12	05:43	05:49	06:19	06:55	07:31	07:52 (T-33)	07:11	07:49	
	17:02	17:43	18:20	19:59	20:36	21:09	21:16	20:49	19:58	19:02	3 07:55 (T-33)	17:11	16:47	
7	08:04	07:40	06:56	07:16 (T-33)	06:59	06:10	05:43	05:49	06:20	06:56	07:32	07:13	07:50	
	17:03	17:44	18:21	2 07:18 (T-33)	20:00	20:38	21:09	21:15	20:48	19:56	19:00	17:09	16:47	
8	08:04	07:39	07:54	08:14 (T-33)	06:57	06:09	05:43	05:50	06:21	06:57	07:33	07:14	07:51	
	17:04	17:45	18:22	4 08:18 (T-33)	20:02	20:39	21:10	21:15	20:46	19:54	18:57	17:08	16:47	
9	08:04	07:37	07:52	08:13 (T-33)	06:55	06:08	05:42	05:51	06:22	06:58	07:34	07:15	07:52	
	17:05	17:47	19:24	7 08:20 (T-33)	20:03	20:40	21:11	21:15	20:45	19:53	18:55	17:07	16:47	
10	08:04	07:36	07:50	08:11 (T-33)	06:53	06:06	05:42	05:51	06:23	07:00	07:36	07:17	07:53	
	17:07	17:48	19:25	9 08:20 (T-33)	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:06	16:47	
11	08:03	07:35	07:49	08:09 (T-33)	06:52	06:05	05:42	05:52	06:24	07:01	07:37	07:18	07:54	
	17:08	17:50	19:26	10 08:19 (T-33)	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:05	16:47	
12	08:03	07:33	07:47	08:07 (T-33)	06:50	06:04	05:42	05:53	06:26	07:02	07:38	07:19	07:55	
	17:09	17:51	19:28	12 08:19 (T-33)	20:07	20:44	21:12	21:13	20:40	19:47	18:49	17:03	16:47	
13	08:03	07:32	07:45	08:05 (T-33)	06:48	06:03	05:42	05:54	06:27	07:03	07:39	07:21	07:56	
	17:10	17:52	19:29	13 08:18 (T-33)	20:08	20:45	21:13	21:13	20:39	19:45	18:48	17:02	16:47	
14	08:02	07:30	07:43	08:03 (T-33)	06:46	06:01	05:41	05:55	06:28	07:04	07:41	07:22	07:56	
	17:11	17:54	19:30	15 08:18 (T-33)	20:09	20:46	21:14	21:12	20:37	19:43	18:46	17:01	16:47	
15	08:02	07:29	07:41	08:02 (T-33)	06:45	06:00	05:41	05:56	06:29	07:05	07:42	07:23	07:57	
	17:13	17:55	19:32	15 08:17 (T-33)	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:48	
16	08:01	07:27	07:39	08:00 (T-33)	06:43	05:59	05:41	05:57	06:30	07:07	07:43	07:25	07:58	
	17:14	17:57	19:33	16 08:16 (T-33)	20:12	20:48	21:14	21:11	20:34	19:40	18:42	16:59	16:48	
17	08:00	07:26	07:38	07:59 (T-33)	06:41	05:58	05:41	05:57	06:31	07:08	07:45	07:26	07:59	
	17:15	17:58	19:34	15 08:14 (T-33)	20:13	20:49	21:15	21:10	20:33	19:38	18:41	16:58	16:48	
18	08:00	07:24	07:36	07:56 (T-34)	06:39	05:57	05:41	05:58	06:33	07:09	07:46	07:27	07:59	
	17:16	17:59	19:35	12 08:11 (T-33)	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48	
19	07:59	07:23	07:34	07:54 (T-34)	06:38	05:56	05:42	05:59	06:34	07:10	07:47	07:29	08:00	
	17:18	18:01	19:37	4 07:58 (T-34)	20:15	20:52	21:16	21:08	20:30	19:34	2 07:36 (T-34)	18:37	16:56	16:49
20	07:58	07:21	07:32	07:52 (T-34)	06:36	05:55	05:42	06:00	06:35	07:11	07:33 (T-34)	07:48	07:30	08:01
	17:19	18:01	19:38	5 07:57 (T-34)	20:17	20:53	21:16	21:08	20:28	19:32	7 07:40 (T-34)	18:36	16:56	16:49
21	07:58	07:20	07:30	07:50 (T-34)	06:34	05:54	05:42	06:01	06:36	07:13	07:34 (T-34)	07:50	07:31	08:01
	17:20	18:02	19:39	6 07:56 (T-34)	20:18	20:54	21:16	21:07	20:26	19:30	7 07:41 (T-34)	18:34	16:55	16:50
22	07:57	07:18	07:28	07:49 (T-34)	06:33	05:53	05:42	06:02	06:37	07:14	07:35 (T-34)	07:51	07:33	08:02
	17:22	18:04	19:40	7 07:56 (T-34)	20:19	20:55	21:16	21:06	20:25	19:28	6 07:41 (T-34)	18:32	16:54	16:50
23	07:56	07:16	07:26	07:47 (T-34)	06:31	05:52	05:42	06:03	06:38	07:15	07:36 (T-34)	07:52	07:34	08:02
	17:23	18:05	19:42	7 07:54 (T-34)	20:20	20:56	21:17	21:05	20:23	19:26	5 07:41 (T-34)	18:31	16:53	16:51
24	07:55	07:15	07:25	07:46 (T-34)	06:29	05:51	05:43	06:04	06:40	07:16	07:37 (T-34)	07:54	07:35	08:03
	17:24	18:06	19:43	5 07:51 (T-34)	20:22	20:57	21:17	21:04	20:21	19:24	4 07:41 (T-34)	18:29	16:53	16:51
25	07:54	07:13	07:23	06:28	05:50	05:43	06:05	06:41	07:17	07:38 (T-34)	07:55	07:36	08:03	
	17:26	18:08	19:44	20:23	20:58	21:17	21:03	20:20	19:23	10 07:53 (T-33)	18:28	16:52	16:52	
26	07:54	07:11	07:21	06:26	05:50	05:43	06:06	06:42	07:19	07:42 (T-33)	07:56	07:38	08:03	
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:21	14 07:56 (T-33)	18:26	16:51	16:52	
27	07:53	07:10	07:19	06:25	05:49	05:44	06:07	06:43	07:20	07:41 (T-33)	07:58	07:39	08:04	
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	16 07:57 (T-33)	18:25	16:51	16:53	
28	07:52	07:08	07:17	06:23	05:48	05:44	06:09	06:44	07:21	07:42 (T-33)	07:59	07:40	08:04	
	17:30	18:12	19:48	20:27	21:01	21:17	21:00	20:14	19:17	16 07:58 (T-33)	18:23	16:50	16:54	
29	07:51	07:15	07:25	06:22	05:47	05:45	06:10	06:46	07:22	07:43 (T-33)	08:00	07:41	08:04	
	17:31	19:49		20:28	21:02	21:17	20:59	20:13	19:15	15 07:58 (T-33)	18:22	16:50	16:55	
30	07:50	07:13	07:23	06:20	05:47	05:45	06:11	06:47	07:23	07:44 (T-33)	08:02	07:43	08:04	
	17:33	19:50		20:29	21:03	21:17	20:58	20:11	19:13	14 07:58 (T-33)	18:20	16:49	16:55	
31	07:48	07:12	07:22	06:18	05:46		06:12	06:48		08:03		08:05		
	17:34	19:52		21:04			20:56	20:09		18:19		16:56		
Potential sun hours	287	292	369	403	458	465	471	436	377	341		289	275	
Total, worst case			164					116		49				
Sun reduction			0.59					0.67		0.56				
Oper. time red.			0.90					0.90		0.90				
Wind dir. red.			0.60					0.60		0.60				
Total reduction			0.32					0.36		0.30				
Total, real			52					42		15				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-215 - R-215
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05 16:57	07:47 17:35	07:06 18:13	07:27 (T-23) 18:13	07:10 20:30	06:19 21:05	05:46 21:17	06:13 20:55	06:49 20:07	07:25 19:11	07:04 17:17	07:44 16:49
2	08:05 16:58	07:46 17:37	07:05 18:14	07:25 (T-23) 18:14	07:08 19:54	06:17 20:32	05:45 21:05	06:14 21:17	06:50 20:54	07:26 20:06	07:06 17:16	07:45 16:48
3	08:05 16:59	07:45 17:38	07:03 18:16	07:24 (T-23) 18:16	07:06 19:56	06:16 20:33	05:45 21:06	06:15 21:17	06:51 20:53	07:27 19:08	07:07 17:14	07:46 16:48
4	08:05 17:00	07:44 17:40	07:01 18:17	07:22 (T-23) 18:17	07:04 19:57	06:14 20:34	05:44 21:07	06:16 21:16	06:53 20:52	07:28 19:06	07:09 17:13	07:47 16:48
5	08:05 17:01	07:43 17:41	06:59 18:18	07:22 (T-23) 18:18	07:02 19:58	06:13 20:35	05:44 21:08	06:17 21:16	06:54 20:50	07:29 19:04	07:10 17:12	07:48 16:48
6	08:05 17:02	07:41 17:42	06:58 18:20	07:23 (T-23) 18:20	07:01 19:59	06:11 20:36	05:43 21:09	06:19 21:16	06:55 20:49	07:31 19:58	07:11 17:11	07:49 16:47
7	08:05 17:03	07:40 17:44	06:56 18:21	07:25 (T-23) 18:21	06:59 20:01	06:10 20:38	05:43 21:09	06:20 21:16	06:56 20:48	07:32 19:00	08:00 (T-23) 17:09	07:50 16:47
8	08:04 17:04	07:39 17:45	07:54 18:22	07:31 (T-23) 18:22	06:57 20:02	06:09 20:39	05:43 21:10	06:21 21:15	06:57 20:46	07:33 18:57	08:08 (T-23) 17:08	07:51 16:47
9	08:04 17:05	07:37 17:47	07:52 19:24	07:32 (T-23) 19:24	06:55 20:03	06:07 20:40	05:42 21:11	06:22 21:15	06:58 20:45	07:34 19:53	08:11 (T-23) 17:07	07:52 16:47
10	08:04 17:06	07:36 17:48	07:50 19:25	07:33 (T-23) 19:25	06:53 20:04	06:06 20:41	05:42 21:11	06:23 21:14	07:00 19:51	07:36 18:53	08:12 (T-23) 17:06	07:53 16:47
11	08:03 17:08	07:35 17:50	07:49 19:26	07:34 (T-23) 19:26	06:52 20:06	06:05 20:42	05:42 21:12	06:24 21:14	07:01 19:49	07:37 18:51	08:11 (T-23) 17:04	07:54 16:47
12	08:03 17:09	07:33 17:51	07:47 19:28	07:35 (T-23) 19:28	06:50 20:07	06:04 20:44	05:42 21:13	06:26 21:13	07:02 19:47	07:38 18:49	08:00 (T-23) 17:03	07:55 16:47
13	08:03 17:10	07:32 17:52	07:45 19:29	07:36 (T-23) 19:29	06:48 20:08	06:03 20:45	05:41 21:13	06:27 21:13	07:03 19:45	07:39 18:48	08:01 (T-23) 17:02	07:56 16:47
14	08:02 17:11	07:30 17:54	07:43 19:30	07:37 (T-23) 19:30	06:46 20:09	06:01 20:46	05:41 21:14	06:28 21:12	07:04 19:43	07:41 18:46	08:02 (T-23) 17:01	07:57 16:47
15	08:02 17:12	07:29 17:55	07:41 19:32	07:38 (T-23) 19:32	06:45 20:11	06:00 20:47	05:41 21:14	06:29 21:11	07:05 19:41	07:42 18:44	08:04 (T-23) 17:00	07:57 16:47
16	08:01 17:14	07:27 17:57	07:39 19:33	07:39 (T-23) 19:33	06:43 20:12	05:59 20:48	05:41 21:15	06:30 21:11	07:07 19:40	07:43 18:42	08:05 (T-23) 17:25	07:58 16:48
17	08:01 17:15	07:26 17:58	07:38 19:34	07:40 (T-23) 19:34	06:41 20:13	05:58 20:49	05:41 21:15	06:31 21:10	07:08 19:38	07:45 18:41	08:08 (T-23) 17:26	07:59 16:48
18	08:00 17:16	07:24 17:59	07:36 19:35	07:41 (T-23) 19:35	06:39 20:14	05:57 20:51	05:41 21:15	06:33 21:09	07:09 19:36	07:46 18:39	08:11 (T-23) 17:29	07:59 16:48
19	07:59 17:18	07:23 18:01	07:34 19:37	07:42 (T-23) 19:37	06:38 20:15	05:56 20:52	05:42 21:16	06:34 21:09	07:10 19:34	07:47 18:37	08:12 (T-23) 17:31	08:00 16:56
20	07:59 17:19	07:21 18:01	07:32 19:38	07:43 (T-23) 19:38	06:36 20:17	05:55 20:53	05:42 21:16	06:00 21:08	07:11 19:32	07:48 18:36	08:13 (T-23) 17:32	08:01 16:50
21	07:58 17:20	07:20 18:02	07:30 19:39	07:44 (T-23) 19:39	06:34 20:18	05:54 20:54	05:42 21:16	06:01 21:07	07:13 19:30	07:50 18:34	08:14 (T-23) 17:33	08:01 16:50
22	07:57 17:22	07:18 18:04	07:28 19:40	07:45 (T-23) 19:40	06:33 20:19	05:53 20:55	05:42 21:17	06:02 21:06	07:14 19:28	07:51 18:32	08:15 (T-23) 17:34	08:02 16:50
23	07:56 17:23	07:16 18:05	07:26 19:42	07:46 (T-23) 19:42	06:31 20:20	05:52 20:56	05:42 21:17	06:03 21:05	07:15 19:26	07:52 18:31	08:16 (T-23) 17:35	08:02 16:51
24	07:55 17:24	07:15 18:06	07:25 19:43	07:47 (T-23) 19:43	06:29 20:22	05:51 20:57	05:43 21:17	06:04 21:04	07:16 19:24	07:54 18:29	08:17 (T-23) 17:36	08:03 16:51
25	07:55 17:26	07:13 18:08	07:23 19:44	07:48 (T-23) 19:44	06:28 20:23	05:50 20:58	05:43 21:17	06:05 21:03	07:17 19:23	07:55 18:28	08:18 (T-23) 17:37	08:03 16:52
26	07:54 17:27	07:11 18:09	07:21 19:46	07:49 (T-23) 19:46	06:26 20:24	05:50 20:59	05:43 21:17	06:06 21:02	07:19 19:21	07:56 18:26	08:19 (T-23) 17:38	08:03 16:52
27	07:53 17:28	07:10 18:10	07:19 19:47	07:50 (T-23) 19:47	06:25 20:25	05:49 21:00	05:44 21:17	06:07 21:01	07:20 19:19	07:58 18:25	08:20 (T-23) 17:39	08:04 16:53
28	07:52 17:30	07:08 18:12	07:17 19:48	07:51 (T-23) 19:48	06:23 20:27	05:48 21:01	05:44 21:17	06:08 21:00	07:21 19:17	07:59 18:23	08:21 (T-23) 17:40	08:04 16:54
29	07:51 17:31		07:15 19:49	07:52 (T-23) 19:49	06:22 20:28	05:47 21:02	05:44 21:17	06:10 20:59	07:22 19:15	08:00 18:22	08:22 (T-23) 17:41	08:04 16:55
30	07:50 17:33		07:13 19:51	07:53 (T-23) 19:51	06:20 20:29	05:47 21:03	05:45 21:17	06:11 20:58	07:23 19:13	08:02 18:20	08:23 (T-23) 17:42	08:05 16:55
31	07:49 17:34		07:12 19:52	07:54 (T-23) 19:52	06:19 21:04	05:46 20:57	05:46 21:09	06:12 20:57	07:24 19:19	08:03 18:19	08:24 (T-23) 17:43	08:05 16:56
Potential sun hours	287	292	369	403	459	465	471	436	377	341	288	275
Total, worst case		21	84							103		
Sun reduction		0.58	0.59							0.56		
Oper. time red.		0.90	0.90							0.90		
Wind dir. red.		0.60	0.60							0.60		
Total reduction		0.31	0.32							0.30		
Total, real		7	27							31		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenery Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-216 - R-216
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:05 16:57	07:47 17:35	07:06 18:13	07:10 19:53	07:30 (T-35) 08:11 (T-04)	06:19 20:30	05:46 21:05	05:45 21:17	06:13 20:55	06:49 20:07	07:31 (T-05) 07:37 (T-05)	07:25 19:11	07:05 17:17	07:44 16:49
2	08:05 16:58	07:46 17:37	07:05 18:14	07:08 19:54	07:28 (T-05) 08:10 (T-04)	06:17 20:32	05:45 21:05	05:46 21:17	06:14 20:54	06:50 20:06	07:27 (T-05) 07:40 (T-05)	07:26 19:09	07:06 17:16	07:45 16:48
3	08:05 16:59	07:45 17:38	07:03 18:16	07:06 19:56	07:26 (T-05) 08:09 (T-04)	06:16 20:33	05:44 21:06	05:47 21:17	06:15 20:53	06:51 20:04	07:25 (T-05) 07:41 (T-05)	07:27 19:08	07:07 17:14	07:46 16:48
4	08:05 17:00	07:44 17:40	07:01 18:17	07:04 19:57	07:25 (T-05) 08:08 (T-04)	06:14 20:34	05:44 21:07	05:47 21:17	06:16 20:52	06:53 20:02	07:23 (T-05) 07:57 (T-04)	07:28 19:06	07:09 17:13	07:47 16:48
5	08:05 17:01	07:43 17:41	06:59 18:18	07:02 19:58	07:26 (T-05) 08:07 (T-04)	06:13 20:35	05:44 21:08	05:48 21:16	06:17 20:50	06:54 20:00	07:22 (T-05) 07:59 (T-04)	07:29 19:04	07:10 17:12	07:48 16:47
6	08:05 17:02	07:41 17:42	06:58 18:20	07:01 19:59	07:26 (T-05) 08:05 (T-04)	06:11 20:37	05:43 21:09	05:48 21:16	06:19 20:49	06:55 19:58	07:22 (T-05) 08:01 (T-04)	07:31 19:02	07:11 17:11	07:49 16:47
7	08:05 17:03	07:40 17:44	06:56 18:21	06:59 20:01	07:26 (T-05) 08:03 (T-04)	06:10 20:38	05:43 21:09	05:49 21:16	06:20 20:48	06:56 19:56	07:21 (T-05) 08:02 (T-04)	07:32 19:00	07:13 17:09	07:50 16:47
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	07:26 (T-05) 08:00 (T-04)	06:09 20:39	05:42 21:10	05:50 21:15	06:21 20:46	06:57 19:55	07:20 (T-05) 08:03 (T-04)	07:33 18:57	07:14 17:08	07:51 16:47
9	08:04 17:05	07:38 17:47	07:52 19:24	06:55 20:03	07:27 (T-05) 07:43 (T-05)	06:07 20:40	05:42 21:11	05:51 21:15	06:22 20:45	06:58 19:53	07:20 (T-05) 08:03 (T-04)	07:34 18:55	07:15 17:07	07:52 16:47
10	08:04 17:06	07:36 17:48	07:50 19:25	06:53 20:04	07:30 (T-05) 07:42 (T-05)	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	07:00 19:51	07:21 (T-05) 08:04 (T-04)	07:36 18:53	07:17 17:06	07:53 16:47
11	08:03 17:08	07:35 17:50	07:49 19:26	06:52 20:06	07:32 (T-05) 07:38 (T-05)	06:05 20:43	05:42 21:12	05:52 21:14	06:24 20:42	07:01 19:49	07:22 (T-35) 08:04 (T-04)	07:37 18:51	07:18 17:04	07:54 16:47
12	08:03 17:09	07:33 17:51	07:47 19:28	06:50 20:07	06:01 20:44	06:04 20:44	05:42 21:13	05:53 21:13	06:26 20:40	07:02 19:47	07:23 (T-35) 08:03 (T-04)	07:38 18:49	07:19 17:03	07:55 16:47
13	08:03 17:10	07:32 17:52	07:45 19:29	06:48 20:08	06:02 20:45	06:02 20:45	05:41 21:13	05:54 21:13	06:27 20:39	07:03 19:45	07:24 (T-35) 08:03 (T-04)	07:39 18:48	07:21 17:02	07:56 16:47
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	06:01 20:46	06:01 21:14	05:41 21:12	05:55 21:12	06:28 20:37	07:04 19:43	07:26 (T-35) 08:04 (T-04)	07:41 18:46	07:22 17:01	07:57 16:47
15	08:02 17:12	07:29 17:55	07:41 19:32	06:45 20:11	06:00 20:47	06:00 21:14	05:41 21:12	05:56 21:12	06:29 20:36	07:05 19:41	07:27 (T-35) 08:03 (T-04)	07:42 18:44	07:24 17:00	07:57 16:47
16	08:01 17:14	07:27 17:57	07:39 19:33	06:43 20:12	06:00 20:48	06:00 21:15	05:41 21:11	05:56 21:11	06:30 20:34	07:07 19:40	07:28 (T-35) 08:02 (T-04)	07:43 18:42	07:25 16:59	07:58 16:48
17	08:01 17:15	07:26 17:58	07:38 19:34	06:41 20:13	06:00 20:49	06:00 21:15	05:41 21:10	05:57 21:10	06:31 20:33	07:08 19:38	07:29 (T-35) 08:02 (T-04)	07:45 18:41	07:26 16:58	07:59 16:48
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 20:14	06:00 20:51	06:00 21:15	05:41 21:09	05:58 21:09	06:33 20:31	07:09 19:36	07:30 (T-35) 08:00 (T-04)	07:46 18:39	07:28 16:57	08:00 16:48
19	07:59 17:18	07:23 18:01	07:34 19:37	06:38 20:16	06:00 20:52	06:00 21:16	05:41 21:09	05:59 21:09	06:34 20:30	07:10 19:34	07:31 (T-04) 07:59 (T-04)	07:47 18:37	07:29 16:56	08:00 16:49
20	07:59 17:19	07:21 18:01	07:32 19:38	06:36 20:17	06:00 20:53	06:00 21:16	05:41 21:08	06:00 21:08	06:35 20:28	07:11 19:32	07:33 (T-04) 07:59 (T-04)	07:48 18:36	07:30 16:56	08:01 16:49
21	07:58 17:20	07:20 18:02	07:30 19:39	06:34 20:18	06:00 20:54	06:00 21:16	05:41 21:07	06:01 21:07	06:36 20:26	07:13 19:30	07:34 (T-04) 07:57 (T-04)	07:50 18:34	07:31 16:55	08:01 16:49
22	07:57 17:21	07:18 18:04	07:28 19:40	06:33 20:19	06:00 20:55	06:00 21:17	05:41 21:06	06:02 21:06	06:37 20:25	07:14 19:28	07:35 (T-04) 07:55 (T-04)	07:51 18:32	07:33 16:54	08:02 16:50
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 20:20	06:00 20:56	06:00 21:17	05:41 21:05	06:03 21:05	06:38 20:23	07:15 19:26	07:36 (T-04) 07:52 (T-04)	07:52 18:31	07:34 16:53	08:02 16:50
24	07:55 17:24	07:15 18:06	07:25 19:43	06:29 20:22	06:00 20:57	06:00 21:17	05:41 21:04	06:04 21:04	06:40 20:21	07:16 19:24	07:39 (T-04) 07:47 (T-04)	07:54 18:29	07:35 16:53	08:03 16:51
25	07:55 17:26	07:13 18:08	07:23 19:44	06:28 20:23	06:00 20:58	06:00 21:17	05:41 21:03	06:05 21:03	06:41 20:20	07:17 19:23	07:40 (T-04) 07:55 (T-04)	07:55 18:28	07:37 16:52	08:03 16:52
26	07:54 17:27	07:11 18:09	07:21 19:46	06:26 20:24	06:00 20:59	06:00 21:17	05:41 21:02	06:06 21:02	06:42 20:18	07:19 19:21	07:41 (T-35) 07:56 (T-04)	07:56 18:26	07:38 16:51	08:04 16:52
27	07:53 17:28	07:10 18:10	07:19 19:47	06:25 20:25	06:00 21:00	06:00 21:17	05:41 21:01	06:07 21:01	06:43 20:16	07:20 19:19	07:42 (T-04) 07:57 (T-04)	07:57 18:25	07:39 16:51	08:04 16:53
28	07:52 17:30	07:08 18:12	07:17 19:48	06:23 20:27	06:00 21:01	06:00 21:17	05:41 21:00	06:08 21:00	06:44 20:14	07:21 19:17	07:43 (T-04) 07:58 (T-04)	07:58 18:23	07:40 16:50	08:04 16:54
29	07:51 17:31	07:15 19:49	07:15 19:49	06:22 20:28	06:00 21:02	06:00 21:17	05:41 21:09	06:10 20:59	06:46 20:13	07:22 19:15	07:59 (T-04) 08:00 (T-04)	07:59 18:22	07:41 16:50	08:04 16:54
30	07:50 17:33	07:13 19:51	07:13 19:51	06:20 20:29	06:00 21:03	06:00 21:17	05:41 21:08	06:11 20:58	06:47 20:11	07:23 19:13	08:01 (T-04) 08:02 (T-04)	07:59 18:20	07:43 16:49	08:05 16:55
31	07:49 17:34	07:12 19:52	07:12 19:52	06:18 20:29	06:00 21:04	06:00 21:17	05:41 21:07	06:12 20:57	06:48 20:09	07:24 19:13	08:03 (T-04) 08:03 (T-04)	07:59 18:19	07:45 16:55	08:05 16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	726	341	288	275	
Total, worst case			360	352						726				
Sun reduction			0.59	0.63						0.67				
Oper. time red.			0.90	0.90						0.90				
Wind dir. red.			0.59	0.59						0.59				
Total reduction			0.31	0.33						0.36				
Total, real			113	118						259				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-228 - R-228
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43		
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:49		
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44		
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	20:05	19:09	17:16	16:48		
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:45		
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	20:03	19:07	17:14	16:48		
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46		
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:48		
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:48		
	17:01	17:41	18:18	19:58	20:35	21:07	21:16	20:50	20:00	19:03	17:12	16:47		
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49		
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47		
7	08:04	07:40	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:50		
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47		
8	08:04	07:38	07:54	06:57	06:09	05:42	05:50	06:21	06:57	07:33	07:13	07:51		
	17:04	17:45	18:22	20:01	20:38	21:09	21:15	20:46	19:54	18:56	17:08	16:47		
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52		
	17:05	17:46	19:23	20:03	20:39	21:10	21:14	20:44	19:52	18:54	17:07	16:47		
10	08:03	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52		
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47		
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:36	07:17	07:53		
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47		
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:54		
	17:09	17:51	19:27	20:06	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47		
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55		
	17:10	17:52	19:29	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47		
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56		
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:46	17:01	16:47		
15	08:01	07:28	07:41	08:01 (T-H)	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:53		
	17:12	17:55	19:31	1 08:02 (T-H)	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47	
16	08:01	07:27	07:39	07:59 (T-H)	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57	
	17:13	17:56	19:32	3 08:02 (T-H)	20:11	20:48	21:14	21:10	20:34	19:39	18:42	16:59	16:47	
17	08:00	07:25	07:37	07:57 (T-H)	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:26	07:58	
	17:15	17:58	19:34	5 08:02 (T-H)	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48	
18	07:59	07:24	07:35	07:56 (T-H)	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59	
	17:16	17:59	19:35	6 08:02 (T-H)	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48	
19	07:59	07:22	07:33	07:54 (T-H)	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59	
	17:17	18:00	19:36	7 08:01 (T-H)	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48	
20	07:58	07:21	07:32	07:52 (T-H)	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:00	
	17:19	18:00	19:37	8 08:00 (T-H)	20:16	20:52	21:15	21:07	20:27	19:32	18:35	16:55	16:49	
21	07:57	07:19	07:30	07:50 (T-H)	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:01	
	17:20	18:02	19:39	8 07:58 (T-H)	20:17	20:53	21:16	21:06	20:26	19:30	18:34	16:54	16:49	
22	07:56	07:18	07:28	07:51 (T-H)	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:32	08:01	
	17:21	18:03	19:40	2 07:53 (T-H)	20:19	20:54	21:16	21:05	20:24	19:28	7 07:41 (T-H)	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:36 (T-H)	07:52	07:33	08:02
	17:23	18:05	19:41	20:20	20:55	21:16	21:04	20:22	19:26	8 07:44 (T-H)	18:31	16:53	16:50	
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:37 (T-H)	07:53	07:35	08:02
	17:24	18:06	19:43	20:21	20:56	21:16	21:03	20:21	19:24	7 07:44 (T-H)	18:29	16:52	16:51	
25	07:54	07:13	07:22	06:28	05:50	05:43	06:05	06:40	07:17	07:55	07:38 (T-H)	07:55	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	7 07:45 (T-H)	18:27	16:52	16:51	
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:39 (T-H)	07:56	07:37	08:03
	17:27	18:09	19:45	20:24	20:58	21:16	21:01	20:17	19:20	5 07:44 (T-H)	18:26	16:51	16:52	
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:40 (T-H)	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:16	19:18	4 07:44 (T-H)	18:24	16:50	16:53	
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:59	07:42 (T-H)	07:59	07:40	08:03
	17:29	18:11	19:48	20:26	21:00	21:16	20:59	20:14	19:16	2 07:44 (T-H)	18:23	16:50	16:54	
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04		
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:15	18:21	16:49	16:54		
30	07:49		07:13	06:20	05:47	05:45	06:10	06:46	07:23	08:01	07:42	08:04		
	17:32		19:50	20:29	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55		
31	07:48		07:11		05:46		06:12	06:48		08:03		08:04		
	17:34		19:51		21:03		20:56	20:09		18:18		16:56		
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275		
Total, worst case			40											
Sun reduction			0.59							0.67				
Oper. time red.			0.90							0.90				
Wind dir. red.			0.60							0.60				
Total reduction			0.32							0.36				
Total, real			13							14				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-229 - R-229

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:47
	17:01	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:49
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:03	07:38	07:53	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	20:04	20:41	21:11	21:13	20:43	19:50	18:52	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:01	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:08	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:30	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:31	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:29	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:00
	17:20	18:02	19:39	20:17	20:53	21:15	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56	07:17	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:01
	17:23	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:18	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:03
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:02		08:04
	17:34		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-231 - R-231
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43		
	16:57	17:35	18:13	19:52	20:29	21:04	21:16	20:54	20:07	19:11	17:17	16:48		
2	08:04	07:45	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44		
	16:58	17:36	18:14	19:54	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48		
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45		
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:48		
4	08:04	07:43	07:00	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46		
	17:00	17:39	18:17	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:13	16:47		
5	08:04	07:42	06:59	07:02	06:12	05:43	05:48	06:17	06:53	07:29	07:09	07:47		
	17:01	17:41	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47		
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48		
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:57	19:01	17:10	16:47		
7	08:04	07:39	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:49		
	17:03	17:43	18:21	20:00	20:37	21:08	21:15	20:47	19:56	19:00	17:09	16:47		
8	08:03	07:38	07:53	06:56	06:08	05:42	05:50	06:20	06:57	07:32	07:13	07:50		
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:08	16:47		
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:14	07:51		
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47		
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52		
	17:06	17:48	19:24	20:04	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:47		
11	08:02	07:34	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:36	07:17	07:53		
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47		
12	08:02	07:32	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:37	07:19	07:54		
	17:08	17:50	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:47		
13	08:02	07:31	07:44	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:20	07:55		
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	16:47		
14	08:01	07:30	07:42	06:46	06:04	05:41	05:54	06:27	07:04	07:40	07:21	07:56		
	17:11	17:53	19:30	20:08	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47		
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:56		
	17:12	17:55	19:31	20:10	20:46	21:13	21:10	20:35	19:41	18:44	17:00	16:47		
16	08:00	07:27	07:39	06:42	07:03 (T-65)	05:59	05:41	05:56	06:30	06:58 (T-65)	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	3 07:06 (T-65)	20:47	21:14	21:10	20:34	6 07:04 (T-65)	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	07:01 (T-65)	05:58	05:41	05:57	06:31	06:56 (T-65)	07:07	07:44	07:25	07:58
	17:15	17:57	19:33	20:12	5 07:06 (T-65)	20:48	21:14	21:09	20:32	11 07:07 (T-65)	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	06:59 (T-65)	05:57	05:41	05:58	06:32	06:55 (T-65)	07:08	07:45	07:27	07:58
	17:16	17:59	19:35	20:13	7 07:06 (T-65)	20:50	21:14	21:08	20:30	14 07:09 (T-65)	19:35	18:39	16:57	16:48
19	07:58	07:22	07:33	06:37	06:58 (T-65)	05:56	05:41	05:59	06:33	06:56 (T-65)	07:10	07:46	07:28	07:59
	17:17	18:00	19:36	20:15	8 07:06 (T-65)	20:51	21:15	21:08	20:29	13 07:09 (T-65)	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:36	06:56 (T-65)	05:55	05:41	06:00	06:34	06:57 (T-65)	07:11	07:48	07:29	08:00
	17:18	18:00	19:37	20:16	10 07:06 (T-65)	20:52	21:15	21:07	20:27	13 07:10 (T-65)	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	06:54 (T-65)	05:54	05:42	06:01	06:36	06:58 (T-65)	07:12	07:49	07:31	08:00
	17:20	18:02	19:39	20:17	11 07:05 (T-65)	20:53	21:15	21:06	20:25	12 07:10 (T-65)	19:29	18:34	16:54	16:49
22	07:56	07:17	07:28	06:32	06:53 (T-65)	05:53	05:42	06:02	06:37	06:59 (T-65)	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	12 07:05 (T-65)	20:54	21:16	21:05	20:24	11 07:10 (T-65)	19:28	18:32	16:54	16:50
23	07:55	07:16	07:26	06:31	06:51 (T-65)	05:52	05:42	06:03	06:38	07:00 (T-65)	07:14	07:52	07:33	08:01
	17:22	18:04	19:41	20:20	13 07:04 (T-65)	20:55	21:16	21:04	20:22	10 07:10 (T-65)	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	06:50 (T-65)	05:51	05:42	06:04	06:39	07:01 (T-65)	07:15	07:53	07:34	08:02
	17:24	18:06	19:42	20:21	13 07:03 (T-65)	20:56	21:16	21:03	20:20	8 07:09 (T-65)	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	06:48 (T-65)	05:50	05:43	06:05	06:40	07:03 (T-65)	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	14 07:02 (T-65)	20:57	21:16	21:02	20:19	7 07:10 (T-65)	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	06:49 (T-65)	05:49	05:43	06:06	06:41	07:04 (T-65)	07:18	07:56	07:37	08:02
	17:27	18:08	19:45	20:23	11 07:00 (T-65)	20:58	21:16	21:01	20:17	5 07:09 (T-65)	19:20	18:26	16:51	16:52
27	07:52	07:09	07:18	06:24	06:52 (T-65)	05:49	05:43	06:07	06:43	07:05 (T-65)	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	4 06:56 (T-65)	20:59	21:16	21:00	20:15	3 07:08 (T-65)	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	05:48	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:53	16:53	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:21	08:00	07:40	08:03	08:03	08:03
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54	16:54	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04	08:04	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55	16:55	16:55
31	07:48		07:11		05:46		06:11	06:47		08:02		08:04	08:04	08:04
	17:34		19:51		21:03		20:56	20:08		18:18		16:56	16:56	16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276		
Total, worst case				111				113						
Sun reduction				0.63				0.72						
Oper. time red.				0.90				0.90						
Wind dir. red.				0.58				0.58						
Total reduction				0.33				0.37						
Total, real				36				42						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-241 - R-241

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:03	07:43
	16:57	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:17	05:45	05:46	06:13	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:30	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:15	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:00	07:03	06:14	05:44	05:47	06:16	06:52	07:27	07:07	07:46
	17:00	17:39	18:16	19:56	20:33	21:06	21:15	20:50	20:01	19:05	17:13	16:47
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:01	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
6	08:03	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48
	17:02	17:42	18:19	19:58	20:35	21:07	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:10	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:08	21:14	20:46	19:55	18:58	17:09	16:47
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:32	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:47
9	08:03	07:36	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:09	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:47
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:41	21:11	21:13	20:41	19:48	18:50	17:04	16:47
12	08:02	07:32	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:42	21:11	21:12	20:39	19:46	18:49	17:03	16:47
13	08:01	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:54
	17:10	17:52	19:28	20:07	20:44	21:12	21:11	20:38	19:44	18:47	17:02	16:47
14	08:01	07:29	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:55
	17:11	17:53	19:29	20:08	20:45	21:12	21:11	20:36	19:42	18:45	17:01	16:47
15	08:00	07:28	07:40	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:22	07:56
	17:12	17:55	19:31	20:09	20:46	21:13	21:10	20:35	19:41	18:43	17:00	16:47
16	08:00	07:26	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:13	21:10	20:33	19:39	18:42	16:59	16:47
17	07:59	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:26	07:58
	17:16	17:59	19:35	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:14	20:50	21:14	21:07	20:29	19:33	18:37	16:56	16:48
20	07:57	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:47	07:29	07:59
	17:18	18:00	19:37	20:16	20:51	21:15	21:06	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
	17:20	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:15	21:05	20:24	19:27	18:32	16:53	16:50
23	07:55	07:15	07:26	06:30	05:52	05:42	06:03	06:38	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:19	20:55	21:15	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:01
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52	16:51
25	07:53	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:35	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:52	07:10	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:16	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:13	19:16	18:22	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03
	17:31		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:48		07:13	06:20	05:46	05:45	06:10	06:46	07:22	08:01	07:41	08:03
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:20	16:49	16:55
31	07:47		07:11	06:19	05:46		06:11	06:47		08:02		08:03
	17:33		19:51	21:02	21:02		20:55	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	435	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project: South Deuel Wind Project

Description: Invenery Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 V163-4.5 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-242 - R-242

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Calendar grid showing sun rise and set times for each day from January to December. Includes summary rows for 'Potential sun hours', 'Total, worst case', 'Sun reduction', 'Oper. time red.', 'Wind dir. red.', 'Total reduction', and 'Total, real'.

Table layout: For each day in each month the following matrix apply

Matrix defining columns: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker, First time (hh:mm) with flicker, Last time (hh:mm) with flicker, (WTG causing flicker first time), (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-243 - R-243

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:46	07:05	17:10 (T-72)	07:09	06:18
	16:57	17:35	18:12	28 17:38 (T-72)	19:52	18 06:39 (T-75)
2	08:04	07:45	07:04	17:11 (T-72)	07:07	20:29 06:57 (T-75)
	16:58	17:36	18:14	25 17:36 (T-72)	19:53	20:31 06:38 (T-75)
3	08:04	07:44	07:02	17:13 (T-72)	07:05	19 06:57 (T-75)
	16:59	17:38	18:15	22 17:35 (T-72)	19:55	20:31 06:36 (T-75)
4	08:04	07:43	07:00	17:15 (T-72)	07:03	21 06:57 (T-75)
	17:00	17:39	18:16	17 17:32 (T-72)	19:56	20:32 06:35 (T-75)
5	08:04	07:42	06:58	17:19 (T-72)	07:02	22 06:57 (T-75)
	17:01	17:40	18:18	9 17:28 (T-72)	19:57	20:33 06:34 (T-75)
6	08:03	07:40	06:57	07:00	06:11	23 06:57 (T-75)
	17:02	17:42	18:19	19:58	20:35	24 06:32 (T-75)
7	08:03	07:39	06:55	06:58	06:10	25 06:56 (T-75)
	17:03	17:43	18:20	20:00	20:37	26 06:31 (T-75)
8	08:03	07:38	07:53	06:56	06:08	27 06:56 (T-75)
	17:04	17:45	18:22	20:01	20:38	28 06:30 (T-75)
9	08:03	07:36	17:19 (T-72)	07:51	06:54	29 06:56 (T-75)
	17:05	17:46	2 17:21 (T-72)	19:23	20:02	30 06:28 (T-75)
10	08:03	07:35	17:16 (T-72)	07:50	06:53	31 06:56 (T-75)
	17:06	17:48	6 17:22 (T-72)	19:24	20:03	06:06 06:29 (T-75)
11	08:02	07:34	17:14 (T-72)	07:48	06:51	20:40 25 06:54 (T-75)
	17:07	17:49	10 17:24 (T-72)	19:26	20:05	20:41 26 06:30 (T-75)
12	08:02	07:32	17:13 (T-72)	07:46	06:49	23 06:53 (T-75)
	17:08	17:50	13 17:26 (T-72)	19:27	20:06	20:41 24 06:30 (T-75)
13	08:01	07:31	17:11 (T-72)	07:44	06:47	21 06:31 (T-75)
	17:09	17:52	16 17:27 (T-72)	19:28	20:07	20:43 21 06:32 (T-75)
14	08:01	07:29	17:10 (T-72)	07:42	06:46	19 06:51 (T-75)
	17:11	17:53	19 17:29 (T-72)	19:29	20:08	20:44 19 06:51 (T-75)
15	08:01	07:28	17:09 (T-72)	07:40	06:44	17 06:50 (T-75)
	17:12	17:55	21 17:30 (T-72)	19:31	20:10	20:45 17 06:35 (T-75)
16	08:00	07:26	17:09 (T-72)	07:39	06:42	14 06:49 (T-75)
	17:13	17:56	23 17:32 (T-72)	19:32	20:11	15 06:37 (T-75)
17	07:59	07:25	17:08 (T-72)	07:37	06:40	9 06:46 (T-75)
	17:14	17:57	25 17:33 (T-72)	19:33	20:12	20:47 9 06:46 (T-75)
18	07:59	07:23	17:07 (T-72)	07:35	06:39	05:57 05:41
	17:16	17:59	27 17:34 (T-72)	19:35	20:13	20:48 11 21:14
19	07:58	07:22	17:07 (T-72)	07:33	06:37	05:55 05:41
	17:17	18:00	29 17:36 (T-72)	19:36	20:14	20:49 11 21:15
20	07:57	07:20	17:06 (T-72)	07:31	06:35	20:50 11 21:15
	17:18	18:00	31 17:37 (T-72)	19:37	20:16	20:51 11 21:16
21	07:57	07:19	17:07 (T-72)	07:29	06:34	05:53 05:41
	17:20	18:01	33 17:40 (T-72)	19:38	20:17	20:52 11 21:16
22	07:56	07:17	17:07 (T-72)	07:27	06:32	05:52 05:41
	17:21	18:03	34 17:41 (T-72)	19:40	20:18	20:53 11 21:17
23	07:55	07:15	17:06 (T-72)	07:26	06:30	05:52 05:41
	17:22	18:04	36 17:42 (T-72)	19:41	20:19	20:54 11 21:18
24	07:54	07:14	17:07 (T-72)	07:24	06:29	05:51 05:41
	17:24	18:06	36 17:43 (T-72)	19:42	20:21	20:52 11 21:19
25	07:53	07:12	17:07 (T-72)	07:22	06:27	2 06:51 (T-75)
	17:25	18:07	35 17:42 (T-72)	19:43	20:22	5 06:48 (T-75)
26	07:53	07:11	17:07 (T-72)	07:20	06:26	5 06:53 (T-75)
	17:26	18:08	34 17:41 (T-72)	19:45	20:23	8 06:46 (T-75)
27	07:52	07:09	17:09 (T-72)	07:18	06:24	8 06:54 (T-75)
	17:28	18:10	32 17:41 (T-72)	19:46	20:24	10 06:45 (T-75)
28	07:51	07:07	17:09 (T-72)	07:16	06:23	10 06:55 (T-75)
	17:29	18:11	31 17:40 (T-72)	19:47	20:26	12 06:43 (T-75)
29	07:50			07:15	06:21	12 06:55 (T-75)
	17:31			19:48	20:27	14 06:42 (T-75)
30	07:49			07:13	06:19	14 06:56 (T-75)
	17:32			19:50	20:28	16 06:40 (T-75)
31	07:47			07:11		16 06:56 (T-75)
	17:33			19:51		21:02 20:36 (T-65)
Potential sun hours	287	292	369	403	458	465
Total, worst case						260
Sun reduction		493	101	67	333	0.73
Oper. time red.		0.58	0.59	0.63	0.66	0.90
Wind dir. red.		0.90	0.90	0.90	0.90	0.65
Total reduction		0.59	0.59	0.59	0.59	0.42
Total, real		0.31	0.31	0.33	0.35	110
		151	32	22	116	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-243 - R-243
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	20:39 (T-65) 20:48 (T-65)	06:12 20:54	06:41 (T-75) 22 07:03 (T-75)	06:48 20:06	07:24 19:10
2	05:46 21:16	20:40 (T-65) 20:48 (T-65)	06:13 20:53	06:40 (T-75) 24 07:04 (T-75)	06:50 20:05	07:25 19:09
3	05:46 21:15	20:39 (T-65) 20:48 (T-65)	06:15 20:52	06:39 (T-75) 26 07:05 (T-75)	06:51 20:03	07:26 19:07
4	05:47 21:15	20:40 (T-65) 20:48 (T-65)	06:16 20:50	06:39 (T-75) 26 07:05 (T-75)	06:52 20:01	07:27 19:05
5	05:47 21:15	20:41 (T-65) 20:48 (T-65)	06:17 20:49	06:40 (T-75) 25 07:05 (T-75)	06:53 19:59	07:29 19:03
6	05:48 21:15	20:40 (T-65) 20:47 (T-65)	06:18 20:48	06:41 (T-75) 25 07:06 (T-75)	06:54 19:57	07:30 19:01
7	05:49 21:14	20:41 (T-65) 20:47 (T-65)	06:19 20:47	06:42 (T-75) 24 07:06 (T-75)	06:55 19:55	07:31 18:58
8	05:49 21:14	20:42 (T-65) 20:47 (T-65)	06:20 20:45	06:43 (T-75) 23 07:06 (T-75)	06:57 19:54	07:32 18:56
9	05:50 21:14	20:42 (T-65) 20:46 (T-65)	06:21 20:44	06:44 (T-75) 21 07:05 (T-75)	06:58 19:52	07:34 18:54
10	05:51 21:13	20:42 (T-65) 20:46 (T-65)	06:23 20:42	06:46 (T-75) 20 07:06 (T-75)	06:59 18:52	07:35 20 18:08 (T-72)
11	05:52 21:13	20:43 (T-65) 20:45 (T-65)	06:24 20:41	06:47 (T-75) 19 07:06 (T-75)	07:00 19:48	07:36 23 18:09 (T-72)
12	05:53 21:12	20:44 (T-65) 20:45 (T-65)	06:25 20:39	06:48 (T-75) 17 07:05 (T-75)	07:01 19:46	07:37 27 18:11 (T-72)
13	05:53 21:12	06:26 20:38	06:49 (T-75) 16 07:05 (T-75)	07:02 19:44	07:39 18:47	07:20 29 18:12 (T-72)
14	05:54 21:11	06:27 20:36	06:50 (T-75) 14 07:04 (T-75)	07:04 19:42	07:40 18:45	07:21 31 18:12 (T-72)
15	05:55 21:10	06:28 20:35	06:51 (T-75) 12 07:03 (T-75)	07:05 19:41	07:41 18:43	07:22 33 18:14 (T-72)
16	05:56 21:10	06:30 20:33	06:52 (T-75) 10 07:02 (T-75)	07:06 19:39	07:42 18:42	07:24 35 18:14 (T-72)
17	05:57 21:09	06:31 20:32	06:53 (T-75) 8 07:01 (T-75)	07:07 19:37	07:44 18:40	07:25 36 18:14 (T-72)
18	05:58 21:08	06:32 20:30	06:54 (T-75) 5 06:59 (T-75)	07:08 19:35	07:45 18:38	07:26 36 18:14 (T-72)
19	05:59 21:07	06:33 20:29	06:56 (T-75) 2 06:58 (T-75)	07:09 19:33	07:46 18:37	07:28 35 18:13 (T-72)
20	06:00 21:07	06:34 20:27	07:11 19:31	07:48 18:35	07:29 34 18:11 (T-72)	08:00 16:55
21	06:01 21:06	06:35 20:25	07:12 19:29	07:49 18:33	07:30 33 18:10 (T-72)	08:00 16:54
22	06:02 21:05	06:37 20:24	07:13 19:27	07:50 18:32	07:32 31 18:08 (T-72)	08:01 16:53
23	06:03 21:04	06:38 20:22	07:14 19:25	07:51 18:30	07:33 28 18:05 (T-72)	08:01 16:53
24	06:04 21:03	06:39 20:20	07:15 19:24	07:53 18:29	07:34 26 18:04 (T-72)	08:02 16:52
25	06:05 21:02	06:40 20:19	07:16 19:22	07:54 18:27	07:35 24 18:02 (T-72)	08:02 16:51
26	06:06 21:01	06:41 20:17	07:18 19:20	07:55 18:25	07:37 22 18:01 (T-72)	08:02 16:52
27	06:07 21:00	06:50 (T-75) 06:55 (T-75)	06:42 20:15	07:19 19:18	07:57 18:24	07:38 20 17:59 (T-72)
28	06:08 20:59	06:46 (T-75) 06:58 (T-75)	06:44 20:13	07:20 19:16	07:58 18:22	07:39 18 17:57 (T-72)
29	06:09 20:58	06:45 (T-75) 07:00 (T-75)	06:45 20:12	07:21 19:14	07:59 18:21	07:40 15 17:56 (T-72)
30	06:10 20:57	06:43 (T-75) 07:01 (T-75)	06:46 20:10	07:22 19:12	08:01 18:19	07:41 13 17:42 (T-72)
31	06:11 20:55	06:42 (T-75) 07:02 (T-75)	06:47 20:08	07:23 18:18	08:02 10 17:54 (T-72)	07:42 16:56
Potential sun hours	471	436	377	341	289	276
Total, worst case	140	339	592	7		
Sun reduction	0.75	0.72	0.56	0.48		
Oper. time red.	0.90	0.90	0.90	0.90		
Wind dir. red.	0.62	0.59	0.59	0.59		
Total reduction	0.41	0.38	0.30	0.25		
Total, real	58	128	175	2		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-244 - R-244
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
0.58	0.58	0.59	0.63	0.66	0.73	0.75	0.72	0.67	0.56	0.48	0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June		
1	08:04	07:46	07:05	07:26 (T-74)	07:09	06:18	05:45	
	16:57	17:35	18:12	39 08:05 (T-74)	19:52	20:29	21:03	
2	08:04	07:45	07:04	07:24 (T-75)	07:07	19:29 (T-65)	06:17	05:45
	16:58	17:36	18:14	40 08:04 (T-74)	19:53	3 19:32 (T-65)	20:31	21:04
3	08:04	07:44	07:02	07:23 (T-75)	07:05	19:26 (T-65)	06:15	05:44
	16:59	17:38	18:15	41 08:04 (T-74)	19:55	7 19:33 (T-65)	20:32	21:05
4	08:04	07:43	07:00	07:21 (T-75)	07:03	19:25 (T-65)	06:14	05:44
	17:00	17:39	18:16	42 08:03 (T-74)	19:56	10 19:35 (T-65)	20:33	21:06
5	08:04	07:42	06:58	07:19 (T-75)	07:02	19:23 (T-65)	06:12	05:43
	17:01	17:40	18:18	42 08:01 (T-74)	19:57	13 19:36 (T-65)	20:34	21:07
6	08:04	07:40	06:57	07:17 (T-75)	07:00	19:22 (T-65)	06:11	05:43
	17:02	17:42	18:19	43 08:00 (T-74)	19:58	15 19:37 (T-65)	20:35	21:07
7	08:03	07:39	06:55	07:18 (T-75)	06:58	19:21 (T-65)	06:10	05:42
	17:03	17:43	18:20	40 07:58 (T-74)	20:00	17 19:38 (T-65)	20:37	21:08
8	08:03	07:38	07:53	08:21 (T-75)	06:56	19:20 (T-65)	06:08	05:42
	17:04	17:45	18:22	35 08:57 (T-74)	20:01	19 19:39 (T-65)	20:38	21:09
9	08:03	07:36	07:51	08:34 (T-74)	06:54	19:20 (T-65)	06:07	05:42
	17:05	17:46	19:23	20 08:54 (T-74)	20:02	21 19:41 (T-65)	20:39	21:10
10	08:03	07:35	07:50	08:37 (T-74)	06:53	19:19 (T-65)	06:06	05:42
	17:06	17:48	19:24	13 08:50 (T-74)	20:03	23 19:42 (T-65)	20:40	21:10
11	08:02	07:34	07:48		06:51	19:19 (T-65)	06:04	05:41
	17:07	17:49	19:26		20:05	23 19:42 (T-65)	20:41	21:11
12	08:02	07:32	07:46		06:49	19:19 (T-65)	06:03	05:41
	17:08	17:50	19:27		20:06	24 19:43 (T-65)	20:43	21:11
13	08:02	07:31	07:44		06:47	19:19 (T-65)	06:02	05:41
	17:09	17:52	19:28		20:07	26 19:45 (T-65)	20:44	21:12
14	08:01	07:29	07:51 (T-74)	07:42	06:46	19:19 (T-65)	06:01	05:41
	17:11	17:53	5 07:56 (T-74)	19:29	20:08	27 19:46 (T-65)	20:45	21:12
15	08:01	07:28	07:49 (T-74)	07:40	06:44	19:20 (T-65)	06:00	05:41
	17:12	17:55	9 07:58 (T-74)	19:31	20:10	27 19:47 (T-64)	20:46	21:13
16	08:00	07:26	07:48 (T-74)	07:39	06:42	19:20 (T-65)	05:59	05:41
	17:13	17:56	13 08:01 (T-74)	19:32	20:11	27 19:48 (T-64)	20:47	21:13
17	07:59	07:25	07:46 (T-74)	07:37	06:40	19:22 (T-65)	05:57	05:41
	17:14	17:57	16 08:02 (T-74)	19:33	20:12	27 19:50 (T-64)	20:48	21:14
18	07:59	07:23	07:44 (T-74)	07:35	06:39	19:23 (T-65)	05:56	05:41
	17:16	17:59	18 08:02 (T-74)	19:35	20:13	25 19:51 (T-64)	20:49	21:14
19	07:58	07:22	07:43 (T-74)	07:33	06:37	19:24 (T-65)	05:55	05:41
	17:17	18:00	21 08:04 (T-74)	19:36	20:15	22 19:51 (T-64)	20:51	21:15
20	07:58	07:20	07:41 (T-74)	07:31	06:35	19:28 (T-65)	05:54	05:41
	17:18	18:00	23 08:04 (T-74)	19:37	20:16	15 19:53 (T-64)	20:52	21:15
21	07:57	07:19	07:40 (T-74)	07:29	06:34	19:44 (T-64)	05:53	05:41
	17:20	18:01	25 08:05 (T-74)	19:38	20:17	10 19:54 (T-64)	20:53	21:15
22	07:56	07:17	07:38 (T-74)	07:28	06:32	19:46 (T-64)	05:52	05:42
	17:21	18:03	27 08:05 (T-74)	19:40	20:18	10 19:56 (T-64)	20:54	21:15
23	07:55	07:15	07:36 (T-74)	07:26	06:30	19:47 (T-64)	05:52	05:42
	17:22	18:04	29 08:05 (T-74)	19:41	20:19	9 19:56 (T-64)	20:55	21:16
24	07:54	07:14	07:35 (T-74)	07:24	06:29		05:51	05:42
	17:24	18:06	31 08:06 (T-74)	19:42	20:21		20:56	21:16
25	07:53	07:12	07:33 (T-74)	07:22	06:27		05:50	05:42
	17:25	18:07	33 08:06 (T-74)	19:43	20:22		20:57	21:16
26	07:53	07:11	07:31 (T-74)	07:20	06:26		05:49	05:43
	17:26	18:08	35 08:06 (T-74)	19:45	20:23		20:58	21:16
27	07:52	07:09	07:30 (T-74)	07:18	06:24		05:48	05:43
	17:28	18:10	36 08:06 (T-74)	19:46	20:24		20:59	21:16
28	07:51	07:07	07:28 (T-74)	07:16	06:23		05:48	05:44
	17:29	18:11	37 08:05 (T-74)	19:47	20:26		21:00	21:16
29	07:50		07:15		06:21		05:47	05:44
	17:31		19:48		20:27		21:01	21:16
30	07:49		07:13		06:19		05:46	05:44
	17:32		19:50		20:28		21:02	21:16
31	07:47		07:11				05:46	
	17:33		19:51				21:03	
Potential sun hours	287	292	369	403	458	465		
Total, worst case			358	355	400			
Sun reduction			0.58	0.59	0.63			
Oper. time red.			0.90	0.90	0.90			
Wind dir. red.			0.61	0.61	0.60			
Total reduction			0.32	0.32	0.34			
Total, real			115	115	136			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-244 - R-244
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December		
1	05:45	06:12	06:48	19:18 (T-65) 07:24		07:03	07:43	
	21:16	20:54	20:06	23 19:41 (T-65) 19:10		17:17	16:48	
2	05:46	06:13	06:50	19:17 (T-65) 07:25		07:05	07:44	
	21:16	20:53	20:05	22 19:39 (T-65) 19:09		17:15	16:48	
3	05:46	06:15	06:51	19:17 (T-65) 07:26	08:17 (T-74)	07:06	07:45	
	21:16	20:52	20:03	21 19:38 (T-65) 19:07	9 08:26 (T-74)	17:14	16:48	
4	05:47	06:16	06:52	19:18 (T-65) 07:27	08:12 (T-74)	07:08	07:46	
	21:15	20:51	20:01	19 19:37 (T-65) 19:05	17 08:29 (T-74)	17:13	16:47	
5	05:47	06:17	06:53	19:18 (T-65) 07:29	07:59 (T-75)	07:09	07:47	
	21:15	20:49	19:59	17 19:35 (T-65) 19:03	29 08:32 (T-74)	17:11	16:47	
6	05:48	06:18	06:54	19:18 (T-65) 07:30	07:56 (T-75)	07:10	07:48	
	21:15	20:48	19:57	15 19:33 (T-65) 19:01	38 08:34 (T-74)	17:10	16:47	
7	05:49	06:19	06:55	19:18 (T-65) 07:31	07:53 (T-75)	07:12	07:49	
	21:14	20:47	19:55	13 19:31 (T-65) 18:58	42 08:35 (T-74)	17:09	16:47	
8	05:49	06:20	06:57	19:19 (T-65) 07:32	07:53 (T-75)	07:13	07:50	
	21:14	20:45	19:54	10 19:29 (T-65) 18:56	42 08:35 (T-74)	17:07	16:47	
9	05:50	06:21	06:58	19:20 (T-65) 07:34	07:55 (T-75)	07:14	07:51	
	21:14	20:44	19:52	7 19:27 (T-65) 18:54	42 08:37 (T-74)	17:06	16:46	
10	05:51	06:23	06:59	19:22 (T-65) 07:35	07:56 (T-75)	07:16	07:52	
	21:13	20:42	19:50	3 19:25 (T-65)	18:52	41 08:37 (T-74)	17:05	16:46
11	05:52	06:24	07:00		07:36	40 08:37 (T-74)	17:04	16:46
	21:13	20:41	19:48		18:50	40 08:37 (T-74)	17:04	16:46
12	05:53	06:25	07:01		07:37	39 08:38 (T-74)	17:03	16:47
	21:12	20:39	19:46		18:49	39 08:38 (T-74)	17:03	16:47
13	05:53	06:26	07:02		07:39	38 08:38 (T-74)	17:02	16:47
	21:12	20:38	19:44		18:47	38 08:38 (T-74)	17:02	16:47
14	05:54	06:27	07:04		07:40	37 08:38 (T-74)	17:01	16:47
	21:11	20:36	19:42		18:45	37 08:38 (T-74)	17:01	16:47
15	05:55	06:28	07:05		07:41	36 08:39 (T-74)	17:00	16:47
	21:10	20:35	19:41		18:43	36 08:39 (T-74)	17:00	16:47
16	05:56	06:30	07:06		07:42	34 08:38 (T-74)	16:59	16:47
	21:10	20:33	19:39		18:42	34 08:38 (T-74)	16:59	16:47
17	05:57	06:31	07:07		07:44	32 08:37 (T-74)	16:58	16:47
	21:09	20:32	19:37		18:40	32 08:37 (T-74)	16:58	16:47
18	05:58	06:32	07:08		07:45	31 08:38 (T-74)	16:57	16:48
	21:08	20:30	19:35		18:38	31 08:38 (T-74)	16:57	16:48
19	05:59	06:33	19:56 (T-64) 07:09		07:46	29 08:37 (T-74)	16:56	16:48
	21:07	20:29	3 19:59 (T-64) 19:33		18:37	29 08:37 (T-74)	16:56	16:48
20	06:00	06:34	19:52 (T-64) 07:11		07:48	27 08:36 (T-74)	16:55	16:49
	21:07	20:27	10 20:02 (T-64) 19:31		18:35	27 08:36 (T-74)	16:55	16:49
21	06:01	06:35	19:50 (T-64) 07:12		07:49	25 08:36 (T-74)	16:54	16:49
	21:06	20:25	10 20:00 (T-64) 19:29		18:33	25 08:36 (T-74)	16:54	16:49
22	06:02	06:37	19:49 (T-64) 07:13		07:50	22 08:34 (T-74)	16:53	16:50
	21:05	20:24	10 19:59 (T-64) 19:27		18:32	22 08:34 (T-74)	16:53	16:50
23	06:03	06:38	19:31 (T-65) 07:14		07:51	20 08:33 (T-74)	16:53	16:50
	21:04	20:22	17 19:57 (T-64) 19:25		18:30	20 08:33 (T-74)	16:53	16:50
24	06:04	06:39	19:28 (T-65) 07:15		07:53	18 08:33 (T-74)	16:52	16:51
	21:03	20:20	22 19:55 (T-64) 19:24		18:29	18 08:33 (T-74)	16:52	16:51
25	06:05	06:40	19:25 (T-65) 07:17		07:54	15 08:31 (T-74)	16:51	16:51
	21:02	20:19	25 19:53 (T-64) 19:22		18:27	15 08:31 (T-74)	16:51	16:51
26	06:06	06:41	19:23 (T-65) 07:18		07:55	12 08:30 (T-74)	16:51	16:52
	21:01	20:17	28 19:52 (T-64) 19:20		18:25	12 08:30 (T-74)	16:51	16:52
27	06:07	06:42	19:23 (T-65) 07:19		07:57	8 08:27 (T-74)	16:50	16:53
	21:00	20:15	27 19:51 (T-64) 19:18		18:24	8 08:27 (T-74)	16:50	16:53
28	06:08	06:44	19:21 (T-65) 07:20		07:58	4 08:24 (T-74)	16:50	16:53
	20:59	20:13	28 19:49 (T-64) 19:16		18:22	4 08:24 (T-74)	16:50	16:53
29	06:09	06:45	19:20 (T-65) 07:21		07:59		07:40	08:03
	20:58	20:12	27 19:47 (T-65) 19:14		18:21		16:49	16:54
30	06:10	06:46	19:19 (T-65) 07:23		08:01		07:41	08:03
	20:57	20:10	26 19:45 (T-65) 19:12		18:19		16:49	16:55
31	06:11	06:47	19:19 (T-65)		08:02			08:04
	20:55	20:08	24 19:43 (T-65)		18:18			16:56
Potential sun hours	471	436	377	341	289	276		
Total, worst case			257	150	727			
Sun reduction			0.72	0.67	0.56			
Oper. time red.			0.90	0.90	0.90			
Wind dir. red.			0.60	0.60	0.61			
Total reduction			0.39	0.36	0.31			
Total, real		100	54	225				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-245 - R-245
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June
1	08:04	15:17 (T-74)	07:46	07:05	07:09	06:18
	16:57	58 16:15 (T-74)	17:35	18:12	19:52	10 19:47 (T-67)
2	08:04	15:17 (T-74)	07:45	07:04	07:07	21:03
	16:58	58 16:15 (T-74)	17:36	18:14	19:53	20 06:28 (T-71)
3	08:04	15:18 (T-74)	07:44	07:02	07:05	05:44
	16:59	58 16:16 (T-74)	17:38	18:15	19:55	20 06:28 (T-71)
4	08:04	15:19 (T-74)	07:43	07:00	07:03	05:43
	17:00	57 16:16 (T-74)	17:39	18:16	19:56	18 06:27 (T-71)
5	08:04	15:19 (T-74)	07:42	06:58	07:02	05:43
	17:01	58 16:17 (T-74)	17:40	18:18	19:57	17 06:27 (T-71)
6	08:03	15:20 (T-74)	07:40	06:57	07:00	05:43
	17:02	57 16:17 (T-74)	17:42	18:19	19:58	16 06:26 (T-71)
7	08:03	15:20 (T-74)	07:39	06:55	06:58	05:42
	17:03	57 16:17 (T-74)	17:43	18:20	20:00	15 06:26 (T-71)
8	08:03	15:21 (T-74)	07:38	07:53	06:56	05:42
	17:04	56 16:17 (T-74)	17:45	18:22	20:01	14 06:26 (T-71)
9	08:03	15:22 (T-74)	07:36	07:51	06:54	05:42
	17:05	57 16:37 (T-72)	17:46	19:23	20:02	13 06:26 (T-71)
10	08:03	15:22 (T-74)	07:35	07:49	06:53	05:41
	17:06	57 16:38 (T-72)	17:47	19:24	20:03	12 06:25 (T-71)
11	08:02	15:23 (T-74)	07:34	07:48	06:51	05:41
	17:07	57 16:39 (T-72)	17:49	19:26	20:05	11 06:25 (T-71)
12	08:02	15:24 (T-74)	07:32	07:46	06:49	05:41
	17:08	56 16:40 (T-72)	17:50	19:27	20:06	9 06:24 (T-71)
13	08:01	15:25 (T-74)	07:31	07:44	06:47	06:02
	17:09	57 16:42 (T-72)	17:52	19:28	20:07	2 06:24 (T-71)
14	08:01	15:25 (T-74)	07:29	07:42	06:46	06:01
	17:11	57 16:43 (T-72)	17:53	19:29	20:08	1 19:45 (T-66)
15	08:01	15:27 (T-74)	07:28	07:40	06:44	06:00
	17:12	56 16:44 (T-72)	17:54	19:31	20:09	3 19:47 (T-66)
16	08:00	15:27 (T-74)	07:26	07:39	06:42	05:58
	17:13	56 16:45 (T-72)	17:56	19:32	20:11	4 19:43 (T-66)
17	07:59	15:28 (T-74)	07:25	07:37	06:40	05:57
	17:14	55 16:46 (T-72)	17:57	19:33	20:12	7 19:50 (T-66)
18	07:59	15:30 (T-74)	07:23	07:35	06:39	05:56
	17:16	54 16:48 (T-72)	17:59	19:35	20:13	8 19:51 (T-66)
19	07:58	15:30 (T-74)	07:22	07:33	06:37	05:55
	17:17	54 16:50 (T-72)	18:00	19:36	20:14	9 19:52 (T-66)
20	07:57	15:31 (T-74)	07:20	07:31	06:35	05:54
	17:18	53 16:51 (T-72)	18:00	19:37	20:16	11 19:53 (T-66)
21	07:57	15:32 (T-74)	07:19	07:29	06:34	05:53
	17:20	49 16:51 (T-72)	18:01	19:38	20:17	13 19:54 (T-66)
22	07:56	15:35 (T-74)	07:17	07:27	06:32	05:52
	17:21	40 16:15 (T-74)	18:03	19:40	20:18	14 19:56 (T-66)
23	07:55	15:36 (T-74)	07:15	07:26	06:30	05:52
	17:22	38 16:14 (T-74)	18:04	19:41	20:19	16 19:57 (T-67)
24	07:54	15:37 (T-74)	07:14	07:24	06:29	05:51
	17:24	36 16:13 (T-74)	18:06	19:42	20:21	16 19:57 (T-67)
25	07:53	15:39 (T-74)	07:12	07:22	06:27	05:50
	17:25	33 16:12 (T-74)	18:07	19:43	20:22	18 19:59 (T-67)
26	07:52	15:41 (T-74)	07:10	07:20	06:26	05:49
	17:26	30 16:11 (T-74)	18:08	19:45	20:23	19 20:00 (T-67)
27	07:52	15:44 (T-74)	07:09	07:18	06:24	05:48
	17:28	25 16:09 (T-74)	18:10	19:46	20:24	19 20:01 (T-67)
28	07:51	15:46 (T-74)	07:07	07:16	06:22	05:48
	17:29	21 16:07 (T-74)	18:11	19:47	20:26	20 20:02 (T-67)
29	07:50	15:51 (T-74)		07:14	06:21	05:47
	17:30	12 16:03 (T-74)		19:48	20:27	17 20:01 (T-67)
30	07:49			07:13	06:19	05:46
	17:32			19:50	20:28	14 19:59 (T-67)
31	07:47			07:11		05:46
	17:33			19:51		21:02
Potential sun hours	287	292	369	403	458	465
Total, worst case	1412			210	256	241
Sun reduction	0.58			0.63	0.66	0.73
Oper. time red.	0.90			0.90	0.90	0.90
Wind dir. red.	0.62			0.60	0.59	0.59
Total reduction	0.32			0.34	0.35	0.39
Total, real	455			71	90	94

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Inverney Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-245 - R-245
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July			August			September			October			November			December		
1	05:45	06:18 (T-71)	06:12		06:48	07:24	07:03		07:43		15:05 (T-74)							
	21:16	11 06:29 (T-71)	20:54		20:06	19:10	17:17		16:48	57	16:21 (T-72)							
2	05:45	06:18 (T-71)	06:13		06:49	07:25	07:05		07:44		15:05 (T-74)							
	21:16	12 06:30 (T-71)	20:53		20:05	19:09	17:15		16:48	57	16:21 (T-72)							
3	05:46	06:17 (T-71)	06:15		06:51	07:26	07:06		07:45		15:05 (T-74)							
	21:15	13 06:30 (T-71)	20:52		20:03	19:07	17:14		16:47	57	16:20 (T-72)							
4	05:47	06:17 (T-71)	06:16		06:52	07:27	07:07		07:46		15:05 (T-74)							
	21:15	14 06:31 (T-71)	20:50		20:01	19:05	17:12		16:47	56	16:01 (T-74)							
5	05:47	06:17 (T-71)	06:17		06:53	07:29	07:09		07:47		15:05 (T-74)							
	21:15	15 06:32 (T-71)	20:49		19:59	19:03	17:11		16:47	57	16:02 (T-74)							
6	05:48	06:16 (T-71)	06:18		06:54	07:30	07:10		07:48		15:06 (T-74)							
	21:15	16 06:32 (T-71)	20:48		19:57	19:01	17:10		16:47	57	16:03 (T-74)							
7	05:49	06:16 (T-71)	06:19		06:55	07:31	07:12		07:49		15:07 (T-74)							
	21:14	17 06:33 (T-71)	20:46		19:55	18:58	17:09		16:47	57	16:04 (T-74)							
8	05:49	06:16 (T-71)	06:20		06:56	07:32	07:13		07:50		15:07 (T-74)							
	21:14	18 06:34 (T-71)	20:45		19:54	18:56	17:07		16:46	57	16:04 (T-74)							
9	05:50	06:15 (T-71)	06:21		06:58	07:33	07:14		07:51		15:07 (T-74)							
	21:14	19 06:34 (T-71)	20:44		19:52	18:54	17:06		16:46	58	16:05 (T-74)							
10	05:51	06:15 (T-71)	06:23		06:59	07:35	07:16		07:52		15:06 (T-74)							
	21:13	20 06:35 (T-71)	20:42		19:50	18:52	17:05		16:46	58	16:04 (T-74)							
11	05:52	06:16 (T-71)	06:24		19:59 (T-67)	07:00	07:36		07:53		15:07 (T-74)							
	21:13	20 06:36 (T-71)	20:41	4	20:03 (T-67)	19:48	18:50		16:46	58	16:05 (T-74)							
12	05:52	06:17 (T-71)	06:25		19:55 (T-67)	07:01	07:37		07:54		15:07 (T-74)							
	21:12	20 06:37 (T-71)	20:39	12	20:07 (T-67)	19:46	18:49		16:46	59	16:06 (T-74)							
13	05:53	06:17 (T-71)	06:26		19:53 (T-67)	07:02	07:38		07:55		15:08 (T-74)							
	21:12	19 06:36 (T-71)	20:38	15	20:08 (T-67)	19:44	18:47		16:47	58	16:06 (T-74)							
14	05:54	06:18 (T-71)	06:27		19:51 (T-67)	07:03	07:40		07:55		15:08 (T-74)							
	21:11	19 06:37 (T-71)	20:36	18	20:09 (T-67)	19:42	18:45		16:47	59	16:07 (T-74)							
15	05:55	06:19 (T-71)	06:28		19:50 (T-67)	07:05	07:41		07:56		15:09 (T-74)							
	21:10	19 06:38 (T-71)	20:35	19	20:09 (T-67)	19:41	18:43		16:47	59	16:08 (T-74)							
16	05:56	06:20 (T-71)	06:30		19:49 (T-67)	07:06	07:42		07:57		15:09 (T-74)							
	21:10	18 06:38 (T-71)	20:33	19	20:08 (T-67)	19:39	18:42		16:47	59	16:08 (T-74)							
17	05:57	06:21 (T-71)	06:31		19:48 (T-67)	07:07	07:44		07:58		15:09 (T-74)							
	21:09	18 06:39 (T-71)	20:32	18	20:06 (T-67)	19:37	18:40		16:47	59	16:08 (T-74)							
18	05:58	06:22 (T-71)	06:32		19:47 (T-67)	07:08	07:45		07:58		15:10 (T-74)							
	21:08	17 06:39 (T-71)	20:30	18	20:05 (T-67)	19:35	18:38		16:48	59	16:09 (T-74)							
19	05:59	06:23 (T-71)	06:33		19:47 (T-67)	07:09	07:46		07:59		15:10 (T-74)							
	21:07	16 06:39 (T-71)	20:29	17	20:04 (T-67)	19:33	18:37		16:48	59	16:09 (T-74)							
20	06:00	06:24 (T-71)	06:34		19:47 (T-67)	07:11	07:47		07:59		15:11 (T-74)							
	21:07	16 06:40 (T-71)	20:27	15	20:02 (T-67)	19:31	18:35		16:48	59	16:10 (T-74)							
21	06:01	06:25 (T-71)	06:35		19:46 (T-67)	07:12	07:49		08:00		15:11 (T-74)							
	21:06	15 06:40 (T-71)	20:25	14	20:00 (T-66)	19:29	18:33		16:49	59	16:10 (T-74)							
22	06:02	06:26 (T-71)	06:37		19:46 (T-67)	07:13	07:50		08:01		15:12 (T-74)							
	21:05	14 06:40 (T-71)	20:24	13	19:59 (T-66)	19:27	18:32		16:49	59	16:11 (T-74)							
23	06:03	06:26 (T-71)	06:38		19:46 (T-67)	07:14	07:51		08:01		15:12 (T-74)							
	21:04	13 06:39 (T-71)	20:22	11	19:57 (T-66)	19:25	18:30		16:50	59	16:11 (T-74)							
24	06:04	06:27 (T-71)	06:39		19:46 (T-66)	07:15	07:53		08:01		15:13 (T-74)							
	21:03	12 06:39 (T-71)	20:20	9	19:55 (T-66)	19:24	18:29		16:51	59	16:12 (T-74)							
25	06:05	06:28 (T-71)	06:40		19:46 (T-66)	07:16	07:54		08:02		15:13 (T-74)							
	21:02	11 06:39 (T-71)	20:19	7	19:53 (T-66)	19:22	18:27		16:51	59	16:12 (T-74)							
26	06:06	06:29 (T-71)	06:41		19:45 (T-66)	07:18	07:55		08:02		15:13 (T-74)							
	21:01	9 06:38 (T-71)	20:17	7	19:52 (T-66)	19:20	18:25		16:52	59	16:12 (T-74)							
27	06:07	06:30 (T-71)	06:42		19:46 (T-66)	07:19	07:57		08:03		15:15 (T-74)							
	21:00	8 06:38 (T-71)	20:15	5	19:51 (T-66)	19:18	18:24		16:52	59	16:14 (T-74)							
28	06:08	06:32 (T-71)	06:44		19:46 (T-66)	07:20	07:58		08:03		15:15 (T-74)							
	20:59	6 06:38 (T-71)	20:13	3	19:49 (T-66)	19:16	18:22		16:53	59	16:14 (T-74)							
29	06:09	06:33 (T-71)	06:45		19:46 (T-66)	07:21	07:59		08:03		15:15 (T-74)							
	20:58	5 06:38 (T-71)	20:12	1	19:47 (T-66)	19:14	18:21		16:54	59	16:14 (T-74)							
30	06:10	06:34 (T-71)	06:46			07:22	08:01		08:03		15:16 (T-74)							
	20:57	3 06:37 (T-71)	20:10			19:12	18:19		16:49	56	16:22 (T-72)							
31	06:11	06:35 (T-71)	06:47				08:02		08:03		15:16 (T-74)							
	20:55	1 06:36 (T-71)	20:08				18:18		16:56	59	16:15 (T-74)							
Potential sun hours	471		436		377	341	289		276		1807							
Total, worst case		434		225			787			1807								
Sun reduction		0.75		0.72			0.48			0.52								
Oper. time red.		0.90		0.90			0.90			0.90								
Wind dir. red.		0.59		0.60			0.62			0.62								
Total reduction		0.40		0.39			0.27			0.29								
Total, real		173		87			210			523								

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-246 - R-246
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June					
1	08:04	15:43 (T-67)	07:46	16:51 (T-66)	07:05	07:26 (T-71)	07:09	07:31 (T-70)	06:18	05:45	20:22 (T-85)
2	08:04	15:45 (T-67)	07:45	16:52 (T-66)	07:04	07:29 (T-71)	19:52	08:08 (T-70)	20:29	21:03	15 20:37 (T-85)
3	16:58	16:01 (T-67)	17:36	17:10 (T-66)	18:14	07:24 (T-71)	07:07	07:31 (T-70)	06:16	05:44	20:22 (T-85)
4	08:04	15:46 (T-67)	07:44	16:52 (T-66)	07:02	07:29 (T-71)	19:53	08:07 (T-70)	20:31	21:04	16 20:38 (T-85)
5	16:59	16:00 (T-67)	17:38	17:12 (T-66)	18:15	07:23 (T-71)	07:05	07:31 (T-70)	06:15	05:44	20:22 (T-85)
6	08:04	15:48 (T-67)	07:43	16:53 (T-66)	07:00	07:29 (T-71)	19:55	08:05 (T-70)	20:32	21:05	16 20:38 (T-85)
7	17:00	16:00 (T-67)	17:39	17:14 (T-66)	18:16	07:21 (T-71)	07:03	07:33 (T-70)	06:14	05:43	20:22 (T-85)
8	08:04	15:50 (T-67)	07:42	16:53 (T-66)	06:58	07:29 (T-71)	19:56	08:05 (T-70)	20:33	21:06	18 20:40 (T-85)
9	17:01	15:59 (T-67)	17:40	17:15 (T-66)	18:18	07:19 (T-71)	07:02	07:34 (T-70)	06:12	05:43	20:22 (T-85)
10	08:04	15:51 (T-67)	07:40	16:54 (T-66)	06:57	07:28 (T-71)	19:57	08:03 (T-70)	20:34	21:07	19 20:41 (T-85)
11	17:02	17:42	22 17:16 (T-66)	18:19	07:17 (T-71)	07:00	07:34 (T-70)	06:11	05:43	05:43	20:22 (T-85)
12	08:03	17:43	21 17:16 (T-66)	18:20	07:26 (T-71)	19:58	08:01 (T-70)	20:35	21:07	19 20:41 (T-85)	
13	17:03	07:39	16:55 (T-66)	06:55	07:15 (T-71)	06:58	07:36 (T-70)	06:09	05:42	20:22 (T-85)	
14	08:03	17:04	18 17:14 (T-66)	18:22	07:24 (T-71)	20:00	07:59 (T-70)	20:37	21:08	20 20:42 (T-85)	
15	17:04	07:38	16:56 (T-66)	07:53	08:19 (T-71)	06:56	07:37 (T-70)	06:08	05:42	20:23 (T-85)	
16	08:03	17:05	19 17:14 (T-66)	18:22	08:20 (T-71)	20:01	07:56 (T-70)	20:38	21:09	19 20:42 (T-85)	
17	17:05	07:36	16:58 (T-66)	07:51	06:54	07:41 (T-70)	06:07	05:42	20:23 (T-85)		
18	08:03	17:06	15 17:13 (T-66)	19:23	20:02	07:53 (T-70)	20:39	21:10	20 20:43 (T-85)		
19	17:06	07:35	17:01 (T-66)	07:50	06:53	06:06	05:41	20:22 (T-85)			
20	08:02	17:07	10 17:11 (T-66)	19:24	20:03	20:40	21:10	21 20:43 (T-85)			
21	17:07	07:34	07:48	07:48	06:51	06:04	05:41	20:23 (T-85)			
22	08:02	17:08	19:26	20:05	20:41	21:11	21 20:44 (T-85)				
23	17:08	07:32	07:46	06:49	06:03	05:41	20:23 (T-85)				
24	08:02	17:09	19:27	20:06	20:43	21:11	21 20:44 (T-85)				
25	17:09	07:31	07:44	06:47	06:02	05:41	20:23 (T-85)				
26	08:01	17:10	19:28	20:07	20:44	21:12	22 20:45 (T-85)				
27	17:11	07:29	07:42	06:46	06:01	05:41	20:24 (T-85)				
28	08:01	17:12	19:29	20:08	20:45	21:12	22 20:46 (T-85)				
29	17:12	07:28	07:40	06:44	06:00	05:41	20:24 (T-85)				
30	08:00	17:13	19:31	20:10	20:46	21:13	22 20:46 (T-85)				
31	17:13	07:26	07:39	06:42	05:58	05:41	20:24 (T-85)				
1	17:14	17:56	19:32	20:11	2 19:48 (T-84)	20:47	21:13	22 20:46 (T-85)			
2	07:59	07:25	07:37	06:40	19:46 (T-84)	05:57	05:41	20:24 (T-85)			
3	17:14	17:57	19:33	20:12	4 19:50 (T-84)	20:48	21:14	23 20:47 (T-85)			
4	07:59	07:23	07:35	06:39	19:46 (T-84)	05:56	05:41	20:24 (T-85)			
5	17:16	17:59	19:35	20:13	5 19:51 (T-84)	20:49	21:14	23 20:47 (T-85)			
6	07:58	16:49 (T-65)	07:22	07:33	7 19:45 (T-84)	05:55	05:41	20:24 (T-85)			
7	17:17	16:50 (T-65)	18:00	19:36	14 08:07 (T-70)	20:15	7 19:52 (T-84)	20:51	21:15	23 20:47 (T-85)	
8	07:58	16:49 (T-65)	07:20	07:31	07:51 (T-70)	06:35	19:46 (T-84)	05:54	05:41	20:24 (T-85)	
9	17:18	16:51 (T-65)	18:00	19:37	17 08:08 (T-70)	20:16	7 19:53 (T-84)	20:52	21:15	23 20:47 (T-85)	
10	07:57	16:50 (T-65)	07:19	07:29	07:50 (T-70)	06:34	19:46 (T-84)	05:53	05:41	20:25 (T-85)	
11	17:20	16:53 (T-65)	18:01	19:38	20 08:10 (T-70)	20:17	8 19:54 (T-84)	20:53	21:15	23 20:48 (T-85)	
12	07:56	16:50 (T-65)	07:17	07:27	07:48 (T-70)	06:32	19:47 (T-84)	05:52	05:41	20:25 (T-85)	
13	17:21	16:54 (T-65)	18:03	19:40	22 08:10 (T-70)	20:18	9 19:56 (T-84)	20:54	2 20:28 (T-85)	21:15	23 20:48 (T-85)
14	07:55	16:50 (T-65)	07:15	07:26	07:46 (T-70)	06:30	19:48 (T-84)	05:52	20:25 (T-85)	05:42	20:25 (T-85)
15	17:22	16:56 (T-66)	18:04	19:41	25 08:11 (T-70)	20:19	9 19:57 (T-84)	20:55	4 20:29 (T-85)	21:16	23 20:48 (T-85)
16	07:54	16:50 (T-65)	07:14	07:24	07:44 (T-70)	06:29	19:49 (T-84)	05:51	20:24 (T-85)	05:42	20:25 (T-85)
17	17:24	16:57 (T-66)	18:06	19:42	27 08:11 (T-70)	20:21	7 19:56 (T-84)	20:56	6 20:30 (T-85)	21:16	23 20:48 (T-85)
18	07:53	16:51 (T-65)	07:12	07:22	07:42 (T-70)	06:27	05:50	05:41	20:24 (T-85)	05:42	20:26 (T-85)
19	17:25	16:58 (T-66)	18:07	19:43	29 08:11 (T-70)	20:22	20:57	8 20:32 (T-85)	21:16	23 20:49 (T-85)	
20	07:53	16:51 (T-65)	07:11	07:20	07:40 (T-70)	06:26	05:49	05:41	20:24 (T-85)	05:43	20:26 (T-85)
21	17:26	17:00 (T-66)	18:08	19:45	31 08:11 (T-70)	20:23	20:58	8 20:32 (T-85)	21:16	22 20:48 (T-85)	
22	07:52	16:52 (T-66)	07:09	07:18	07:38 (T-70)	06:24	05:48	05:41	20:23 (T-85)	05:43	20:26 (T-85)
23	17:28	17:01 (T-66)	18:10	19:46	32 08:10 (T-70)	20:24	20:59	10 20:33 (T-85)	21:16	22 20:48 (T-85)	
24	07:51	16:51 (T-66)	07:07	07:16	07:36 (T-70)	06:22	05:48	05:41	20:23 (T-85)	05:43	20:27 (T-85)
25	17:29	17:03 (T-66)	18:11	1 07:28 (T-71)	07:16	07:36 (T-70)	06:22	21:00	11 20:34 (T-85)	21:16	22 20:49 (T-85)
26	07:50	16:51 (T-66)	07:06	07:14	07:35 (T-70)	06:21	05:47	05:41	20:22 (T-85)	05:44	20:26 (T-85)
27	17:30	17:05 (T-66)	18:07	19:48	35 08:10 (T-70)	20:27	21:01	13 20:35 (T-85)	21:16	22 20:48 (T-85)	
28	07:49	16:52 (T-66)	07:06	07:13	07:33 (T-70)	06:19	05:46	05:41	20:22 (T-85)	05:44	20:27 (T-85)
29	17:32	17:06 (T-66)	18:07	19:50	37 08:10 (T-70)	20:28	21:02	13 20:35 (T-85)	21:16	22 20:49 (T-85)	
30	07:47	16:51 (T-66)	07:06	07:11	07:31 (T-70)	06:19	05:46	05:41	20:22 (T-85)	05:44	20:27 (T-85)
31	17:33	17:07 (T-66)	18:08	19:51	38 08:09 (T-70)	20:29	21:03	15 20:37 (T-85)	21:16	22 20:49 (T-85)	
Potential sun hours	287	292	369	403	458	465					
Total, worst case	173	186	430	307	90	630					
Sun reduction	0.58	0.58	0.59	0.63	0.66	0.73					
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90					
Wind dir. red.	0.60	0.59	0.59	0.59	0.64	0.64					
Total reduction	0.31	0.31	0.31	0.34	0.38	0.42					
Total, real	54	57	135	103	34	266					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-246 - R-246
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December										
1	05:45	20:27 (T-85)	06:12	06:48	07:24	07:03	16:29 (T-66)	07:43								
	21:16	21	20:48 (T-85)	20:54	20:06	19:10	17:17	11	16:40 (T-66)	16:48						
2	05:45	20:28 (T-85)	06:13	06:49	07:25	07:05	16:28 (T-66)	07:44								
	21:16	20	20:48 (T-85)	20:53	20:05	19:09	17:15	15	16:43 (T-66)	16:48						
3	05:46	20:27 (T-85)	06:15	06:51	07:38 (T-70)	07:26	07:06	16:26 (T-66)	07:45							
	21:16	21	20:48 (T-85)	20:52	20:03	12	07:50 (T-70)	19:07	17:14	18	16:44 (T-66)	16:47				
4	05:47	20:28 (T-85)	06:16	06:52	07:36 (T-70)	07:27	07:08	16:25 (T-66)	07:46							
	21:15	20	20:48 (T-85)	20:51	20:01	18	07:54 (T-70)	19:05	17:12	21	16:46 (T-66)	16:47				
5	05:47	20:28 (T-85)	06:17	06:53	07:33 (T-70)	07:29	07:09	16:24 (T-66)	07:47							
	21:15	20	20:48 (T-85)	20:49	19:59	23	07:56 (T-70)	19:03	17:11	22	16:46 (T-66)	16:47				
6	05:48	20:28 (T-85)	06:18	06:54	07:31 (T-70)	07:30	07:10	16:24 (T-66)	07:48							
	21:15	19	20:47 (T-85)	20:48	19:57	26	07:57 (T-70)	19:01	7	07:52 (T-71)	17:10	21	16:45 (T-66)	16:47		
7	05:49	20:29 (T-85)	06:19	06:55	07:29 (T-70)	07:31	07:12	16:23 (T-66)	07:49	15:37 (T-67)						
	21:14	18	20:47 (T-85)	20:47	19:55	29	07:58 (T-70)	18:58	9	08:01 (T-71)	17:09	21	16:44 (T-66)	16:47	9	15:46 (T-67)
8	05:49	20:29 (T-85)	06:20	06:56	07:27 (T-70)	07:32	07:13	16:22 (T-66)	07:50	15:36 (T-67)						
	21:14	18	20:47 (T-85)	20:45	19:54	32	07:59 (T-70)	18:56	9	08:02 (T-71)	17:07	20	16:42 (T-66)	16:46	12	15:48 (T-67)
9	05:50	20:29 (T-85)	06:21	06:58	07:26 (T-70)	07:34	07:14	16:23 (T-66)	07:51	15:35 (T-67)						
	21:14	17	20:46 (T-85)	20:44	19:52	33	07:59 (T-70)	18:54	8	08:03 (T-71)	17:06	18	16:41 (T-66)	16:46	14	15:49 (T-67)
10	05:51	20:29 (T-85)	06:23	06:59	07:24 (T-70)	07:35	07:16	16:22 (T-66)	07:52	15:35 (T-67)						
	21:13	17	20:46 (T-85)	20:42	19:50	36	08:00 (T-70)	18:52	7	08:03 (T-71)	17:05	17	16:39 (T-66)	16:46	16	15:51 (T-67)
11	05:52	20:30 (T-85)	06:24	07:00	07:23 (T-70)	07:36	07:17	16:23 (T-66)	07:53	15:34 (T-67)						
	21:13	16	20:46 (T-85)	20:41	19:48	37	08:00 (T-70)	18:50	6	08:03 (T-71)	17:04	16	16:39 (T-66)	16:46	17	15:51 (T-67)
12	05:52	20:30 (T-85)	06:25	07:01	07:23 (T-70)	07:37	07:18	16:23 (T-66)	07:54	15:33 (T-67)						
	21:12	15	20:45 (T-85)	20:39	19:46	38	08:01 (T-70)	18:49	4	08:03 (T-71)	17:03	14	16:37 (T-66)	16:46	19	15:52 (T-67)
13	05:53	20:30 (T-85)	06:26	07:02	07:24 (T-70)	07:39	07:20	16:23 (T-66)	07:55	15:34 (T-67)						
	21:12	14	20:44 (T-85)	20:38	19:44	37	08:01 (T-70)	18:47	2	08:02 (T-71)	17:02	13	16:36 (T-66)	16:47	19	15:53 (T-67)
14	05:54	20:31 (T-85)	06:27	07:04	07:25 (T-70)	07:40	07:21	16:23 (T-66)	07:55	15:34 (T-67)						
	21:11	13	20:44 (T-85)	20:36	19:42	36	08:01 (T-70)	18:45	17:01	12	16:35 (T-66)	16:47	20	15:54 (T-67)		
15	05:55	20:31 (T-85)	06:28	07:05	07:26 (T-70)	07:41	07:22	16:25 (T-66)	07:56	15:34 (T-67)						
	21:10	12	20:43 (T-85)	20:35	19:41	34	08:00 (T-70)	18:43	17:00	9	16:34 (T-66)	16:47	21	15:55 (T-67)		
16	05:56	20:32 (T-85)	06:30	07:06	07:27 (T-70)	07:42	07:24	16:24 (T-65)	07:57	15:33 (T-67)						
	21:10	11	20:43 (T-85)	20:33	19:39	33	08:00 (T-70)	18:42	16:59	9	16:33 (T-66)	16:47	22	15:55 (T-67)		
17	05:57	20:33 (T-85)	06:31	07:07	07:28 (T-70)	07:44	07:25	16:24 (T-65)	07:58	15:34 (T-67)						
	21:09	9	20:42 (T-85)	20:32	19:37	31	07:59 (T-70)	18:40	16:58	7	16:31 (T-66)	16:47	22	15:56 (T-67)		
18	05:58	20:33 (T-85)	06:32	07:08	07:29 (T-70)	07:45	07:26	16:24 (T-65)	07:58	15:35 (T-67)						
	21:08	8	20:41 (T-85)	20:30	19:35	29	07:58 (T-70)	18:38	16:57	7	16:31 (T-66)	16:48	22	15:57 (T-67)		
19	05:59	20:34 (T-85)	06:33	19:55 (T-84)	07:09	07:31 (T-70)	07:46	07:28	16:24 (T-65)	07:59	15:34 (T-67)					
	21:07	7	20:41 (T-85)	20:29	8	20:03 (T-84)	19:33	27	07:58 (T-70)	18:37	16:56	6	16:30 (T-66)	16:48	23	15:57 (T-67)
20	06:00	20:35 (T-85)	06:34	19:53 (T-84)	07:11	07:32 (T-70)	07:48	07:29	16:25 (T-65)	08:00	15:35 (T-67)					
	21:07	5	20:40 (T-85)	20:27	9	20:02 (T-84)	19:31	25	07:57 (T-70)	18:35	16:55	4	16:29 (T-65)	16:48	23	15:58 (T-67)
21	06:01	20:36 (T-85)	06:35	19:51 (T-84)	07:12	07:33 (T-70)	07:49	07:30	16:25 (T-65)	08:00	15:35 (T-67)					
	21:06	3	20:39 (T-85)	20:25	9	20:00 (T-84)	19:29	23	07:56 (T-70)	18:33	16:54	3	16:28 (T-65)	16:49	23	15:58 (T-67)
22	06:02	20:38 (T-85)	06:37	19:50 (T-84)	07:13	07:34 (T-70)	07:50	07:32	16:25 (T-65)	08:01	15:36 (T-67)					
	21:05	1	20:39 (T-85)	20:24	9	19:59 (T-84)	19:27	21	07:55 (T-70)	18:32	16:53	2	16:27 (T-65)	16:49	23	15:59 (T-67)
23	06:03	20:41 (T-85)	06:38	19:49 (T-84)	07:14	07:35 (T-70)	07:51	07:33	16:26 (T-65)	08:01	15:36 (T-67)					
	21:04	20:22	8	19:57 (T-84)	19:25	18	07:53 (T-70)	18:30	16:53	1	16:27 (T-65)	16:50	23	15:59 (T-67)		
24	06:04	20:23	8	19:58 (T-84)	19:26	18	07:54 (T-70)	18:31	16:54	1	16:28 (T-65)	16:51	23	15:59 (T-67)		
	21:03	20:20	6	19:55 (T-84)	19:24	15	07:51 (T-70)	18:29	16:52	16:51	23	16:00 (T-67)				
25	06:05	20:21	6	19:56 (T-84)	19:25	16	07:52 (T-70)	18:30	16:53	16:52	23	16:00 (T-67)				
	21:02	20:19	5	19:53 (T-84)	19:22	12	07:50 (T-70)	18:27	16:51	16:51	22	16:00 (T-67)				
26	06:06	20:20	6	19:54 (T-84)	19:23	13	07:51 (T-70)	18:28	16:52	16:52	22	16:00 (T-67)				
	21:01	20:17	4	19:52 (T-84)	19:20	8	07:47 (T-70)	18:25	16:51	16:51	22	16:00 (T-67)				
27	06:07	20:18	5	19:53 (T-84)	19:21	9	07:48 (T-70)	18:26	16:52	16:52	22	16:00 (T-67)				
	21:00	20:15	2	19:51 (T-84)	19:18	3	07:43 (T-70)	18:24	16:50	16:50	22	16:01 (T-67)				
28	06:08	20:16	3	19:52 (T-84)	19:19	4	07:44 (T-70)	18:25	16:51	16:51	22	16:01 (T-67)				
	20:59	20:13	4	19:53 (T-84)	19:20	5	07:45 (T-70)	18:26	16:52	16:52	22	16:01 (T-67)				
29	06:09	20:14	5	19:54 (T-84)	19:21	6	07:46 (T-70)	18:27	16:53	16:53	22	16:01 (T-67)				
	20:58	20:12	6	19:55 (T-84)	19:22	7	07:47 (T-70)	18:28	16:54	16:54	22	16:01 (T-67)				
30	06:10	20:13	7	19:56 (T-84)	19:23	8	07:48 (T-70)	18:29	16:55	16:55	22	16:01 (T-67)				
	20:57	20:10	8	19:57 (T-84)	19:24	9	07:49 (T-70)	18:30	16:56	16:56	22	16:01 (T-67)				
31	06:11	20:11	9	19:58 (T-84)	19:25	10	07:50 (T-70)	18:31	16:57	16:57	22	16:01 (T-67)				
	20:55	20:08	10	19:59 (T-84)	19:26	11	07:51 (T-70)	18:32	16:58	16:58	22	16:01 (T-67)				
Potential sun hours	471	436	377	341	289	276										
Total, worst case	305	60	636	52	287	498										
Sun reduction	0.75	0.72	0.67	0.56	0.48	0.52										
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90										
Wind dir. red.	0.64	0.60	0.59	0.60	0.59	0.62										
Total reduction	0.43	0.38	0.36	0.30	0.25	0.29										
Total, real	132	23	227	16	73	143										

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-251 - R-251

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December								
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	18:36 (T-63)	07:03	16:31 (T-80)	07:43						
	16:57	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	19:10	18:46 (T-63)	17:16	21	16:52 (T-80)	16:48					
2	08:04	07:45	17:08 (T-80)	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	18:35 (T-62)	07:05	16:32 (T-80)	07:44					
	16:57	17:36	2	17:10 (T-80)	18:14	19:53	20:31	21:04	21:16	20:53	20:04	19:09	8	18:43 (T-62)	17:15	19	16:51 (T-80)	16:48		
3	08:04	07:44	17:06 (T-80)	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	18:33 (T-62)	07:06	16:32 (T-80)	07:45					
	16:58	17:37	6	17:12 (T-80)	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	8	18:41 (T-62)	17:14	17	16:49 (T-80)	16:47		
4	08:04	07:43	17:06 (T-80)	07:00	07:03	06:13	05:43	05:46	06:16	06:52	07:27	18:32 (T-62)	07:07	16:33 (T-80)	07:46					
	16:59	17:39	8	17:14 (T-80)	18:16	19:56	20:33	21:06	21:15	20:50	20:01	19:05	7	18:39 (T-62)	17:12	15	16:48 (T-80)	16:47		
5	08:04	07:42	17:04 (T-80)	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	18:32 (T-62)	07:09	16:34 (T-80)	07:47					
	17:00	17:40	11	17:15 (T-80)	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	6	18:38 (T-62)	17:11	12	16:46 (T-80)	16:47		
6	08:04	07:40	17:04 (T-80)	06:57	17:55 (T-62)	07:00	06:11	05:43	05:48	06:18	06:54	07:30	18:31 (T-62)	07:10	10	16:44 (T-80)	07:48			
	17:01	17:42	12	17:16 (T-80)	18:19	2	17:57 (T-62)	19:58	20:35	21:07	21:15	20:48	19:57	19:01	5	18:36 (T-62)	17:10	10	16:44 (T-80)	16:47
7	08:03	07:39	17:03 (T-80)	06:55	17:54 (T-62)	06:58	06:09	05:42	05:48	06:19	06:55	07:31	18:30 (T-62)	07:12	10	16:44 (T-80)	07:49			
	17:02	17:43	15	17:18 (T-80)	18:20	4	17:58 (T-62)	20:00	20:37	21:08	21:14	20:47	19:55	18:57	4	18:34 (T-62)	17:08	7	16:43 (T-80)	16:46
8	08:03	07:38	17:02 (T-80)	07:53	18:55 (T-62)	06:56	06:08	05:42	05:49	06:20	06:56	07:32	18:30 (T-62)	07:13	10	16:44 (T-80)	07:50			
	17:04	17:45	17	17:19 (T-80)	18:22	6	19:01 (T-62)	20:01	20:38	21:09	21:14	20:45	19:54	18:56						16:46
9	08:03	07:36	17:02 (T-80)	07:51	18:55 (T-62)	06:54	06:07	05:42	05:50	06:21	06:58	07:33	2	18:32 (T-62)	07:17	6	16:42 (T-80)	17:07	16:46	
	17:05	17:46	19	17:21 (T-80)	19:23	7	19:02 (T-62)	20:02	20:39	21:10	21:14	20:44	19:52	18:54						16:46
10	08:03	07:35	17:02 (T-80)	07:49	18:55 (T-62)	06:53	06:05	05:41	05:51	06:22	06:59	07:35								16:46
	17:06	17:47	20	17:22 (T-80)	19:24	8	19:03 (T-62)	20:03	20:40	21:10	21:13	20:42	19:50	18:52						16:46
11	08:02	07:34	17:02 (T-80)	07:48	18:56 (T-62)	06:51	06:04	05:41	05:51	06:24	07:00	07:36								16:46
	17:07	17:49	22	17:24 (T-80)	19:25	8	19:04 (T-62)	20:05	20:41	21:11	21:13	20:41	19:48	18:50						16:46
12	08:02	07:32	17:02 (T-80)	07:46	18:56 (T-63)	06:49	06:03	05:41	05:52	06:25	07:01	07:37								16:46
	17:08	17:50	24	17:26 (T-80)	19:27	9	19:05 (T-63)	20:06	20:43	21:11	21:12	20:39	19:46	18:49						16:46
13	08:02	07:31	17:02 (T-80)	07:44	18:56 (T-63)	06:47	06:02	05:41	05:53	06:26	07:02	07:38								16:46
	17:09	17:52	25	17:27 (T-80)	19:28	10	19:06 (T-63)	20:07	20:44	21:12	21:12	20:38	19:44	18:47						16:46
14	08:01	07:29	17:03 (T-80)	07:42	18:56 (T-63)	06:45	06:01	05:41	05:54	06:27	07:03	07:40								16:46
	17:10	17:53	26	17:29 (T-80)	19:29	12	19:08 (T-63)	20:08	20:45	21:12	21:11	20:36	19:42	18:45						16:47
15	08:01	07:28	17:03 (T-80)	07:40	18:57 (T-63)	06:44	05:59	05:41	05:55	06:28	07:05	07:41								16:47
	17:12	17:54	27	17:30 (T-80)	19:31	13	19:10 (T-63)	20:09	20:46	21:13	21:10	20:35	19:40	18:43						16:47
16	08:00	07:26	17:04 (T-80)	07:39	18:58 (T-63)	06:42	05:58	05:41	05:56	06:29	07:06	07:42								16:47
	17:13	17:56	27	17:31 (T-80)	19:32	13	19:11 (T-63)	20:11	20:47	21:13	21:10	20:33	19:39	18:42						16:47
17	07:59	07:25	17:04 (T-80)	07:37	18:59 (T-63)	06:40	05:57	05:41	05:57	06:31	07:07	07:44								16:47
	17:14	17:57	26	17:30 (T-80)	19:33	13	19:12 (T-63)	20:12	20:48	21:14	21:09	20:32	19:37	18:40						16:47
18	07:59	07:23	17:05 (T-80)	07:35	19:00 (T-63)	06:39	05:56	05:41	05:58	06:32	07:08	07:45								16:47
	17:16	17:59	24	17:29 (T-80)	19:34	9	19:09 (T-63)	20:13	20:49	21:14	21:08	20:30	19:35	18:38						16:48
19	07:58	07:22	17:06 (T-80)	07:33	19:02 (T-63)	06:37	05:55	05:41	05:59	06:33	07:09	07:46								16:48
	17:17	18:00	22	17:28 (T-80)	19:36	20:14	20:50	21:15	21:07	20:29	19:33	18:37								16:48
20	07:57	07:20	17:08 (T-80)	07:31	19:03 (T-63)	06:35	05:54	05:41	06:00	06:34	07:10	07:47								16:48
	17:18	18:00	18	17:28 (T-80)	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	9	17:43 (T-80)	07:29					16:48
21	07:57	07:19	17:10 (T-80)	07:29	19:04 (T-63)	06:34	05:53	05:41	06:00	06:35	07:12	07:49								16:48
	17:19	18:01	14	17:24 (T-80)	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16	17:56 (T-80)	07:30					16:49
22	07:56	07:17	17:14 (T-80)	07:27	19:05 (T-63)	06:32	05:52	05:41	06:01	06:36	07:13	07:50								16:49
	17:21	18:03	6	17:20 (T-80)	19:40	20:18	20:54	21:15	21:05	20:24	19:27	18:32	19	17:57 (T-80)	07:32					16:49
23	07:55	07:15	17:07 (T-80)	07:26	19:00 (T-63)	06:30	05:51	05:42	06:02	06:38	07:14	07:51								16:49
	17:22	18:04		19:41	20:19	20:55	21:16	21:04	20:22	19:25		18:30	22	17:58 (T-80)	07:32					16:50
24	07:54	07:14	17:09 (T-80)	07:24	19:06 (T-63)	06:29	05:51	05:42	06:04	06:39	07:15	07:53								16:50
	17:23	18:05		19:42	20:21	20:56	21:16	21:03	20:20	19:23		18:28	25	18:00 (T-80)	07:32					16:50
25	07:53	07:12	17:09 (T-80)	07:22	19:07 (T-63)	06:27	05:50	05:42	06:05	06:40	07:16	07:54								16:50
	17:25	18:07		19:43	20:22	20:57	21:16	21:02	20:19	19:22	7	18:51 (T-63)	18:27	26	18:00 (T-80)	07:31				16:51
26	07:53	07:10	17:07 (T-80)	07:20	19:08 (T-63)	06:25	05:49	05:43	06:06	06:41	07:18	07:55								16:51
	17:26	18:08		19:45	20:23	20:58	21:16	21:01	20:17	19:20	12	18:54 (T-63)	18:25	28	18:01 (T-80)	07:31				16:52
27	07:52	07:09	17:05 (T-80)	07:18	19:09 (T-63)	06:24	05:48	05:43	06:07	06:42	07:19	07:57								16:52
	17:28	18:10		19:46	20:24	20:59	21:16	21:00	20:15	19:18	13	18:53 (T-63)	18:24	27	17:59 (T-80)	07:30				16:52
28	07:51	07:07	17:04 (T-80)	07:16	19:04 (T-63)	06:22	05:47	05:43	06:08	06:43	07:20	07:58								16:52
	17:29	18:11		19:47	20:26	21:00	21:16	21:00	20:59	20:13	19:16	13	18:51 (T-63)	18:22	26	17:57 (T-80)	07:30			16:53
29	07:50	07:14	17:06 (T-80)	07:27	19:05 (T-63)	06:21	05:47	05:44	06:09	06:45	07:21	07:59								16:53
	17:30	18:12		19:48	20:27	21:01	21:16	21:00	20:58	20:12	19:14	12	18:49 (T-63)	18:21	24	17:56 (T-80)	07:40			16:54
30	07:49	07:13	17:03 (T-80)	07:23	19:06 (T-63)	06:19	05:46	05:44	06:10	06:46	07:22	07:59								16:54
	17:32	18:14		19:50	20:28	21:02	21:16	21:00	20:57	20:10	19:12	11	18:47 (T-63)	18:19	23	17:54 (T-80)	07:41			16:55
31	07:47	07:11	17:04 (T-80)	07:21	19:07 (T-63)	06:17	05:45	05:41	06:11	06:47	07:23	07:59								16:55
	17:33	18:15		19:51	20:29	21:03	21:17	21:01	20:55	20:08	19:10	18:18	21	17:53 (T-80)	07:41					16:55
Potential sun hours																				

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-252 - R-252
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	07:46 17:35	07:05 18:12	07:09 19:52	06:18 20:29	19:39 (T-80) 20:29	05:45 21:03	05:45 21:16	06:12 20:54	19:59 (T-80) 20:06	07:24 19:10	07:03 17:16	07:43 16:48
2	08:04 16:58	07:45 17:36	07:04 18:14	07:07 19:53	06:16 20:30	19:38 (T-80) 20:06 (T-80)	05:44 21:04	05:45 21:16	06:13 20:53	19:56 (T-80) 20:04	07:25 19:09	07:05 17:15	07:44 16:48
3	08:04 16:58	07:44 17:37	07:02 18:15	07:05 19:55	06:15 20:32	19:39 (T-80) 20:08 (T-80)	05:44 21:05	05:46 21:15	06:14 20:52	19:55 (T-80) 20:03	07:26 19:07	07:06 17:14	07:45 16:47
4	08:04 16:59	07:43 17:39	07:00 18:16	07:03 19:56	06:14 20:33	19:40 (T-80) 20:09 (T-80)	05:43 21:06	05:47 21:15	06:16 20:50	19:53 (T-80) 20:01	07:27 19:05	07:07 17:12	07:46 16:47
5	08:04 17:00	07:42 17:40	06:58 18:18	07:02 19:57	06:12 20:34	19:39 (T-80) 20:10 (T-63)	05:43 21:07	05:47 21:15	06:17 20:49	19:52 (T-80) 20:01 (T-63)	07:28 19:03	07:09 17:11	07:47 16:47
6	08:03 17:01	07:40 17:42	06:57 18:19	07:00 19:58	06:11 20:35	19:40 (T-80) 20:11 (T-63)	05:43 21:07	05:48 21:15	06:18 20:48	19:51 (T-80) 20:01 (T-63)	07:30 19:01	07:10 17:10	07:48 16:47
7	08:03 17:02	07:39 17:43	06:55 18:20	06:58 20:00	06:09 20:37	19:41 (T-80) 20:11 (T-63)	05:42 21:08	05:49 21:14	06:19 20:46	19:50 (T-80) 20:01 (T-63)	07:31 18:58	07:12 17:08	07:49 16:46
8	08:03 17:04	07:38 17:45	06:53 18:23	06:56 20:01	06:08 20:38	19:43 (T-80) 20:11 (T-63)	05:42 21:09	05:49 21:14	06:20 20:45	19:49 (T-80) 20:01 (T-63)	07:32 18:56	07:13 17:07	07:50 16:46
9	08:03 17:05	07:36 17:46	06:51 19:23	06:54 20:02	06:07 20:39	19:43 (T-80) 20:04 (T-80)	05:42 21:10	05:50 21:14	06:21 20:44	19:48 (T-80) 20:01 (T-80)	07:33 18:54	07:14 17:06	07:51 16:46
10	08:03 17:06	07:35 17:47	06:49 19:24	06:53 20:03	06:05 20:40	19:45 (T-80) 20:03 (T-80)	05:41 21:10	05:51 21:13	06:22 20:42	19:47 (T-80) 20:01 (T-80)	07:35 18:52	07:16 17:05	07:52 16:46
11	08:02 17:07	07:34 17:49	06:48 19:25	06:51 20:05	06:04 20:41	19:47 (T-80) 20:01 (T-80)	05:41 21:11	05:52 21:13	06:24 20:41	19:48 (T-80) 20:01 (T-80)	07:36 18:50	07:17 17:04	07:53 16:46
12	08:02 17:08	07:32 17:50	06:46 19:27	06:49 20:06	06:03 20:43	19:49 (T-80) 19:58 (T-80)	05:41 21:11	05:52 21:12	06:25 20:39	19:47 (T-80) 20:01 (T-80)	07:37 18:49	07:18 17:03	07:54 16:46
13	08:01 17:09	07:31 17:52	06:44 19:28	06:47 20:07	06:02 20:44	19:42 (T-62) 19:44 (T-62)	05:41 21:12	05:53 21:12	06:26 20:38	19:47 (T-80) 20:01 (T-80)	07:38 18:47	07:20 17:02	07:55 16:46
14	08:01 17:11	07:29 17:53	06:42 19:29	06:45 20:08	06:01 20:45	19:42 (T-62) 19:46 (T-62)	05:41 21:12	05:54 21:11	06:27 20:36	19:47 (T-80) 20:01 (T-80)	07:40 18:45	07:21 17:00	07:55 16:47
15	08:01 17:12	07:28 17:54	06:40 19:31	06:44 20:09	05:59 20:46	19:41 (T-62) 19:47 (T-62)	05:41 21:13	05:55 21:10	06:28 20:35	19:46 (T-80) 20:01 (T-80)	07:41 18:43	07:22 16:59	07:56 16:47
16	08:00 17:13	07:26 17:56	06:39 19:32	06:42 20:11	05:58 20:47	19:41 (T-62) 19:48 (T-62)	05:41 21:13	05:56 21:10	06:29 20:33	19:46 (T-80) 20:01 (T-80)	07:42 18:42	07:24 16:58	07:57 16:47
17	07:59 17:14	07:25 17:57	06:37 19:33	06:40 20:12	05:57 20:48	19:42 (T-62) 19:50 (T-62)	05:41 21:14	05:57 21:09	06:31 20:32	19:46 (T-80) 20:06 (T-80)	07:44 18:40	07:25 16:57	07:58 16:47
18	07:59 17:16	07:23 17:59	06:35 19:34	06:39 20:13	05:56 20:49	19:43 (T-62) 19:51 (T-62)	05:41 21:14	05:58 21:08	06:32 20:30	19:46 (T-80) 20:05 (T-80)	07:45 18:38	07:26 16:57	07:58 16:48
19	07:58 17:17	07:22 18:00	06:33 19:36	06:37 20:14	05:55 20:50	19:44 (T-62) 19:52 (T-62)	05:41 21:15	05:59 21:07	06:33 20:29	19:46 (T-80) 20:03 (T-80)	07:46 18:37	07:28 16:56	07:59 16:48
20	07:57 17:18	07:20 18:00	06:31 19:37	06:35 20:16	05:54 20:52	19:46 (T-80) 19:53 (T-80)	05:41 21:15	06:00 21:07	06:34 20:27	19:48 (T-80) 20:02 (T-80)	07:47 18:35	07:29 16:55	08:00 16:48
21	07:57 17:19	07:19 18:01	06:29 19:38	06:34 20:17	05:53 20:53	19:44 (T-80) 19:54 (T-80)	05:41 21:15	06:01 21:06	06:35 20:25	19:48 (T-80) 20:00 (T-80)	07:49 18:33	07:30 16:54	08:00 16:49
22	07:56 17:21	07:17 18:03	06:27 19:40	06:32 20:18	05:52 20:54	19:42 (T-80) 19:55 (T-80)	05:41 21:15	06:02 21:03	06:36 20:24	19:49 (T-80) 20:01 (T-80)	07:50 18:32	07:32 16:53	08:01 16:49
23	07:55 17:22	07:15 18:04	06:26 19:41	06:30 20:19	05:51 20:55	19:42 (T-80) 19:57 (T-80)	05:42 21:16	06:05 21:04	06:38 20:22	19:50 (T-80) 19:57 (T-80)	07:51 18:30	07:33 16:53	08:01 16:50
24	07:54 17:23	07:14 18:05	06:24 19:42	06:29 20:21	05:51 20:56	19:41 (T-80) 19:57 (T-80)	05:42 21:16	06:04 21:03	06:39 20:20	19:47 (T-62) 19:55 (T-62)	07:53 18:28	07:34 16:52	08:02 16:50
25	07:53 17:25	07:12 18:07	06:22 19:43	06:27 20:22	05:50 20:57	19:40 (T-80) 19:59 (T-80)	05:42 21:16	06:05 21:02	06:40 20:19	19:45 (T-62) 19:53 (T-62)	07:54 18:27	07:35 16:51	08:02 16:51
26	07:52 17:26	07:10 18:08	06:20 19:45	06:25 20:23	05:49 20:58	19:39 (T-80) 20:00 (T-80)	05:43 21:16	06:06 21:01	06:41 20:17	19:44 (T-62) 19:52 (T-62)	07:55 18:25	07:37 16:51	08:02 16:52
27	07:52 17:28	07:09 18:10	06:18 19:46	06:24 20:24	05:48 20:59	19:39 (T-80) 20:01 (T-80)	05:43 21:16	06:07 21:00	06:42 20:15	19:43 (T-62) 19:50 (T-62)	07:57 18:24	07:38 16:50	08:03 16:52
28	07:51 17:29	07:07 18:11	06:16 19:47	06:22 20:26	05:47 21:00	19:39 (T-80) 20:02 (T-80)	05:43 21:16	06:08 20:59	06:44 20:13	19:43 (T-62) 19:49 (T-62)	07:58 18:22	07:39 16:49	08:03 16:53
29	07:50 17:30	07:04 18:14	06:21 19:48	06:27 20:27	05:47 21:01	19:39 (T-80) 20:04 (T-80)	05:44 21:16	06:09 20:58	06:45 20:12	19:43 (T-62) 19:47 (T-62)	07:59 18:21	07:40 16:49	08:03 16:54
30	07:49 17:32	07:13 19:50	06:19 20:28	06:26 20:04	05:46 21:02	19:38 (T-80) 20:04 (T-80)	05:44 21:16	06:10 20:57	06:46 20:10	19:42 (T-62) 19:45 (T-62)	08:01 18:19	07:41 16:48	08:03 16:55
31	07:47 17:33	07:11 19:51	06:17 20:00	06:24 20:00	05:45 21:02	20:04 (T-80) 20:06 (T-80)	06:11 20:55	06:47 20:08	06:47 20:08	19:45 (T-62)	08:02 18:18	07:41 16:48	08:03 16:55
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	
Total, worst case				240	292								
Sun reduction				0.63	0.66								
Oper. time red.				0.90	0.90								
Wind dir. red.				0.61	0.61								
Total reduction				0.34	0.36								
Total, real				83	106		1	212					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-253 - R-253

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June		
1	08:04	15:53 (T-71)	07:46	07:05	07:09	06:18	05:45	
	16:57	35 16:28 (T-71)	17:35	18:12	19:52	20:29	21:03	
2	08:04	15:54 (T-71)	07:45	07:04	07:07	06:16	05:44	
	16:57	35 16:29 (T-71)	17:36	18:14	19:53	20:30	21:04	
3	08:04	15:54 (T-71)	07:44	07:02	07:05	06:15	05:44	
	16:58	36 16:30 (T-71)	17:37	18:15	19:54	20:32	21:05	
4	08:04	15:55 (T-71)	07:43	07:00	07:03	06:13	05:43	
	16:59	36 16:31 (T-71)	17:39	18:16	19:56	20:33	21:06	
5	08:04	15:56 (T-71)	07:42	06:58	07:01	06:12	05:43	
	17:00	36 16:32 (T-71)	17:40	18:18	19:57	20:34	21:07	
6	08:03	15:57 (T-71)	07:40	06:57	07:00	06:11	05:42	
	17:01	36 16:33 (T-71)	17:42	18:19	19:58	20:35	21:07	
7	08:03	15:56 (T-71)	07:39	06:55	06:58	06:09	05:42	
	17:02	36 16:32 (T-71)	17:43	18:20	19:59	20:36	21:08	
8	08:03	15:57 (T-71)	07:38	07:53	06:56	06:08	05:42	
	17:03	36 16:33 (T-71)	17:44	18:21	20:01	20:38	21:09	
9	08:03	15:58 (T-71)	07:36	07:51	19:00 (T-70)	06:54	06:07	05:42
	17:05	35 16:33 (T-71)	17:46	19:23	2 19:02 (T-70)	20:02	20:39	21:09
10	08:03	15:58 (T-71)	07:35	07:49	18:59 (T-70)	06:52	06:05	05:41
	17:06	35 16:33 (T-71)	17:47	19:24	4 19:03 (T-70)	20:03	20:40	21:10
11	08:02	16:00 (T-71)	07:34	07:48	18:58 (T-70)	06:51	06:04	05:41
	17:07	33 16:33 (T-71)	17:49	19:25	6 19:04 (T-70)	20:04	20:41	21:11
12	08:02	16:00 (T-71)	07:32	07:46	18:58 (T-70)	06:49	06:03	05:41
	17:08	33 16:33 (T-71)	17:50	19:27	7 19:05 (T-70)	20:06	20:42	21:11
13	08:01	16:01 (T-71)	07:31	07:44	18:58 (T-70)	06:47	06:02	05:41
	17:09	32 16:33 (T-71)	17:52	19:28	8 19:06 (T-70)	20:07	20:44	21:12
14	08:01	16:01 (T-71)	07:29	07:42	18:58 (T-70)	06:45	06:01	05:41
	17:10	32 16:33 (T-71)	17:53	19:29	10 19:08 (T-70)	20:08	20:45	21:12
15	08:00	16:03 (T-71)	07:28	07:40	18:59 (T-70)	06:44	05:59	05:41
	17:12	30 16:33 (T-71)	17:54	19:31	11 19:10 (T-70)	20:09	20:46	21:13
16	08:00	16:04 (T-71)	07:26	07:38	19:00 (T-70)	06:42	05:58	05:41
	17:13	28 16:32 (T-71)	17:56	19:32	11 19:11 (T-70)	20:11	20:47	21:13
17	07:59	16:04 (T-71)	07:25	07:37	19:02 (T-70)	06:40	05:57	05:41
	17:14	28 16:32 (T-71)	17:57	19:33	8 19:10 (T-70)	20:12	20:48	21:14
18	07:59	16:06 (T-71)	07:23	07:35	06:39	05:56	05:41	05:41
	17:15	26 16:32 (T-71)	17:59	19:34	20:13	20:49	21:14	21:14
19	07:58	16:07 (T-71)	07:22	07:33	06:37	05:55	05:41	05:41
	17:17	24 16:31 (T-71)	18:00	19:36	20:14	20:50	21:14	21:14
20	07:57	16:09 (T-71)	07:20	07:31	06:35	05:54	05:41	05:41
	17:18	21 16:30 (T-71)	18:00	19:37	20:16	20:51	21:15	21:15
21	07:57	16:10 (T-71)	07:19	07:29	06:33	05:53	05:41	05:41
	17:19	18 16:28 (T-71)	18:01	19:38	20:17	20:53	21:15	21:15
22	07:56	16:14 (T-71)	07:17	07:27	06:32	05:52	05:41	05:41
	17:21	14 16:28 (T-71)	18:03	19:39	20:18	20:54	21:15	21:15
23	07:55	16:17 (T-71)	07:15	07:25	06:30	05:51	05:42	05:42
	17:22	7 16:24 (T-71)	18:04	19:41	20:19	20:55	21:15	21:15
24	07:54		07:14	07:24	06:29	05:50	05:42	05:42
	17:23		18:05	19:42	20:21	20:56	21:16	21:16
25	07:53		07:12	07:22	06:27	05:50	05:42	05:42
	17:25		18:07	19:43	20:22	20:57	21:16	21:16
26	07:52		07:10	07:20	06:25	05:49	05:42	05:42
	17:26		18:08	19:44	20:23	20:58	21:16	21:16
27	07:51		07:09	07:18	06:24	05:48	05:43	05:43
	17:28		18:09	19:46	20:24	20:59	21:16	21:16
28	07:50		07:07	07:16	06:22	05:47	05:43	05:43
	17:29		18:11	19:47	20:25	21:00	21:16	21:16
29	07:49			07:14	06:21	05:47	05:44	05:44
	17:30			19:48	20:27	21:01	21:16	21:16
30	07:48			07:12	06:19	05:46	05:44	05:44
	17:32			19:49	20:28	21:02	21:16	21:16
31	07:47			07:11		05:45		
	17:33			19:51		21:02		
Potential sun hours	287	292	369	403	458	465		
Total, worst case	682		67					
Sun reduction	0.58		0.59					
Oper. time red.	0.90		0.90					
Wind dir. red.	0.61		0.57					
Total reduction	0.32		0.31					
Total, real	217		20					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-253 - R-253
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	18:38 (T-70) 17:16	07:43 16:48
2	05:45 21:16	06:13 20:53	06:49 20:04	07:25 19:08	18:37 (T-70) 17:15	07:44 16:48
3	05:46 21:15	06:14 20:52	06:50 20:03	07:26 19:07	18:37 (T-70) 17:14	07:45 16:47
4	05:46 21:15	06:15 20:50	06:52 20:01	07:27 19:05	18:37 (T-70) 17:12	07:46 16:47
5	05:47 21:15	06:17 20:49	06:53 19:59	07:28 19:03	07:09 17:11	07:47 16:47
6	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	07:10 17:10	07:48 16:47
7	05:48 21:14	06:19 20:46	06:55 19:55	07:31 18:57	07:11 17:08	07:49 16:46
8	05:49 21:14	06:20 20:45	06:56 19:53	07:32 18:56	07:13 17:07	07:50 16:46
9	05:50 21:13	06:21 20:44	06:58 19:52	07:33 18:54	07:14 17:06	07:51 16:46
10	05:51 21:13	06:22 20:42	06:59 19:50	07:35 18:52	07:16 17:05	07:52 16:46
11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:50	07:17 17:04	07:53 16:46
12	05:52 21:12	06:25 20:39	07:01 19:46	07:37 18:48	07:18 17:03	07:54 16:46
13	05:53 21:11	06:26 20:38	07:02 19:44	07:38 18:47	07:20 17:01	07:54 16:46
14	05:54 21:11	06:27 20:36	07:03 19:42	07:40 18:45	07:21 17:00	07:55 16:47
15	05:55 21:10	06:28 20:35	07:05 19:40	07:41 18:43	07:22 16:59	07:56 16:47
16	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	07:24 16:58	07:57 16:47
17	05:57 21:09	06:31 20:32	07:07 19:37	07:43 18:40	07:25 16:57	07:58 16:47
18	05:58 21:08	06:32 20:30	07:08 19:35	07:45 18:38	07:26 16:57	07:58 16:48
19	05:59 21:07	06:33 20:28	07:09 19:33	07:46 18:36	07:28 16:56	07:59 16:48
20	05:59 21:06	06:34 20:27	07:10 19:31	07:47 18:35	07:29 16:55	07:59 16:48
21	06:00 21:06	06:35 20:25	07:12 19:29	07:49 18:33	07:30 16:54	08:00 16:49
22	06:01 21:05	06:36 20:24	07:13 19:27	07:50 18:32	07:32 16:53	08:01 16:49
23	06:02 21:04	06:38 20:22	07:14 19:25	07:51 18:30	07:33 16:52	08:01 16:50
24	06:03 21:03	06:39 20:20	07:15 19:23	07:53 18:28	07:34 16:52	08:01 16:50
25	06:05 21:02	06:40 20:18	07:16 19:22	07:54 18:27	07:35 16:51	08:02 16:51
26	06:06 21:01	06:41 20:17	07:18 19:20	18:46 (T-70) 18:25	07:37 16:50	08:02 16:52
27	06:07 21:00	06:42 20:15	07:19 19:18	18:43 (T-70) 18:24	07:38 16:50	08:03 16:52
28	06:08 20:59	06:43 20:13	07:20 19:16	18:40 (T-70) 18:22	07:39 16:49	08:03 16:53
29	06:09 20:58	06:45 20:12	07:21 19:14	18:39 (T-70) 18:21	07:40 16:49	08:03 16:54
30	06:10 20:56	06:46 20:10	07:22 19:12	18:38 (T-70) 18:19	07:41 16:48	08:03 16:55
31	06:11 20:55	06:47 20:08		08:02 18:18		08:03 16:55
Potential sun hours	471	436	377	341	289	276
Total, worst case					291	1053
Sun reduction			0.67	0.56	0.48	0.52
Oper. time red.			0.90	0.90	0.90	0.90
Wind dir. red.			0.57	0.57	0.61	0.61
Total reduction			0.35	0.29	0.26	0.29
Total, real			16	6	77	300

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-255 - R-255
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	
1	08:04 16:57 08:04 16:57 08:04 16:58 08:04 16:59 08:04 17:00 08:03 17:01 08:03 17:02 08:03 17:04 08:03 17:05 08:02 17:06 08:02 17:07 08:02 17:08 08:01 17:09 08:01 17:10 08:00 17:12 08:00 17:13 07:59 17:14 07:59 17:15 07:58 17:17 07:57 17:18 07:57 17:19 07:56 17:21 07:55 17:22 07:54 17:23 07:53 17:25 07:52 17:26 07:51 17:28 07:50 17:29 07:49 17:30 07:48 17:32 07:47 17:33	16:41 (T-75) 16:42 (T-75) 16:41 (T-75) 16:42 (T-75) 16:42 (T-75) 16:44 (T-75) 16:42 (T-75) 16:45 (T-75) 16:42 (T-75) 16:46 (T-75) 16:43 (T-75) 16:48 (T-75) 16:43 (T-75) 16:50 (T-75) 16:44 (T-75) 16:51 (T-75) 16:44 (T-75) 16:52 (T-75) 16:46 (T-75) 16:54 (T-75) 16:47 (T-75) 16:56 (T-75) 16:49 (T-75) 16:57 (T-75) 16:52 (T-75) 16:55 (T-75) 07:10 18:08 07:09 18:09 07:07 18:11 07:14 19:48 07:12 19:49 07:11 19:51	07:05 18:12 07:04 18:14 07:02 18:15 07:00 18:16 06:58 18:18 06:57 18:19 06:55 18:20 07:53 18:21 07:51 19:23 07:49 19:24 07:48 19:25 07:46 19:27 07:44 19:28 07:42 19:29 07:40 19:31 07:38 19:32 07:37 19:33 07:35 19:34 07:33 19:34 07:33 19:34 07:22 07:33 19:36 18:00 07:20 19:37 07:29 19:38 07:27 19:39 07:15 18:04 07:14 18:05 07:12 19:43 07:20 19:44 07:18 19:46 07:16 19:47 07:14 19:48 07:12 19:49 07:11 19:51	07:09 19:52 07:07 19:53 07:05 19:54 07:03 19:56 07:01 19:57 07:00 19:58 06:58 19:59 06:56 20:01 06:54 20:02 06:52 20:03 06:51 20:04 06:49 20:06 06:47 20:07 06:45 20:08 06:44 20:09 06:42 20:11 06:40 20:12 06:39 20:13 06:37 20:14 06:35 20:16 06:34 20:17 06:32 20:18 06:30 20:19 06:29 20:21 06:27 20:22 06:25 20:23 06:24 20:24 06:22 20:25 06:21 20:27 06:19 20:28 06:18 19:29 (T-71)	18:44 (T-71) 19:31 (T-71) 18:43 (T-71) 19:32 (T-71) 18:43 (T-71) 19:31 (T-71) 18:43 (T-71) 19:30 (T-71) 18:44 (T-71) 19:30 (T-71) 18:44 (T-71) 19:29 (T-71) 18:44 (T-71) 19:28 (T-71) 18:44 (T-71) 19:27 (T-71) 18:45 (T-71) 19:26 (T-71) 18:46 (T-71) 19:25 (T-71) 18:47 (T-71) 19:24 (T-71) 18:48 (T-71) 19:22 (T-71) 18:49 (T-71) 19:20 (T-71) 18:51 (T-71) 19:18 (T-71) 18:53 (T-71) 19:47 (T-70) 18:56 (T-71) 19:48 (T-70) 19:44 (T-70) 19:50 (T-70) 19:43 (T-70) 19:51 (T-70) 19:43 (T-70) 19:52 (T-70) 19:44 (T-70) 19:53 (T-70) 19:43 (T-70) 19:54 (T-70) 19:43 (T-70) 19:55 (T-70) 19:45 (T-70) 19:57 (T-70) 19:46 (T-70) 19:57 (T-70) 19:49 (T-70) 19:55 (T-70) 05:49 20:58 05:48 20:59 05:47 21:00 05:47 21:01 05:46 21:01 05:45 21:02	06:18 20:29 06:16 20:30 06:15 20:32 06:13 20:33 06:12 20:34 06:11 20:35 06:09 20:36 06:08 20:38 06:07 20:39 06:05 20:40 06:04 20:41 06:03 20:42 06:02 20:44 06:01 20:45 05:59 20:46 05:58 20:47 05:57 20:48 05:56 20:49 05:55 20:50 05:54 20:51 05:53 20:53 05:52 20:54 05:51 20:55 05:51 20:56 05:50 20:57 05:49 20:58 05:48 20:59 05:47 21:00 05:47 21:01 05:46 21:01 05:45	05:45 21:03 05:44 21:04 05:44 21:05 05:43 21:06 05:43 21:07 05:43 21:07 05:42 21:08 05:42 21:09 05:42 21:09 05:41 21:10 05:41 21:11 05:41 21:11 05:41 21:12 05:41 21:12 05:41 21:13 05:41 21:13 05:41 21:14 05:41 21:14 05:41 21:14 05:41 21:15 05:41 21:15 05:42 21:16 05:42 21:16 05:43 21:16 05:43 21:16 05:44 21:16 05:44 21:16 05:45 21:02
Potential sun hours	287	292	369	403	458	465	
Total, worst case	66		438	706			
Sun reduction	0.58		0.59	0.63			
Oper. time red.	0.90		0.90	0.90			
Wind dir. red.	0.59		0.59	0.59			
Total reduction	0.31		0.31	0.33			
Total, real	20		137	236			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-255 - R-255

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:54	06:48 20:06	18:46 (T-71) 19:23 (T-71)	07:24 19:10	07:42 17:16
2	05:45 21:16	06:13 20:53	06:49 20:04	18:44 (T-71) 19:23 (T-71)	07:25 19:08	07:05 17:15
3	05:46 21:15	06:14 20:52	06:50 20:03	18:43 (T-71) 19:24 (T-71)	07:26 19:07	07:06 17:14
4	05:46 21:15	06:16 20:50	06:52 20:01	18:41 (T-71) 19:24 (T-71)	07:27 19:05	07:07 17:12
5	05:47 21:15	06:17 20:49	06:53 19:59	18:40 (T-71) 19:24 (T-71)	07:28 19:03	07:09 17:11
6	05:48 21:15	06:18 20:48	06:54 19:57	18:40 (T-71) 19:25 (T-71)	07:30 19:01	07:10 17:10
7	05:48 21:14	06:19 20:46	06:55 19:55	18:39 (T-71) 19:25 (T-71)	07:31 18:57	07:11 17:08
8	05:49 21:14	06:20 20:45	06:56 19:53	18:38 (T-71) 19:25 (T-71)	07:32 18:56	07:13 17:07
9	05:50 21:13	06:21 20:44	06:58 19:52	18:37 (T-71) 19:25 (T-71)	07:33 18:54	07:14 17:06
10	05:51 21:13	06:22 20:42	06:59 19:50	18:37 (T-71) 19:25 (T-71)	07:35 18:52	07:16 17:05
11	05:51 21:13	06:24 20:41	07:00 19:48	18:36 (T-71) 19:23 (T-71)	07:36 18:50	07:17 17:04
12	05:52 21:12	06:25 20:39	07:01 19:46	18:36 (T-71) 19:21 (T-71)	07:37 18:49	07:18 17:03
13	05:53 21:11	06:26 20:38	07:02 19:44	18:36 (T-71) 19:20 (T-71)	07:38 18:47	07:20 17:01
14	05:54 21:11	06:27 20:36	07:03 19:42	18:36 (T-71) 19:18 (T-71)	07:40 18:45	07:21 17:00
15	05:55 21:10	06:28 20:35	07:05 19:40	18:36 (T-71) 19:16 (T-71)	07:41 18:43	07:22 16:59
16	05:56 21:10	06:29 20:33	07:06 19:39	18:35 (T-71) 19:14 (T-71)	07:42 18:42	07:24 16:58
17	05:57 21:09	06:31 20:32	07:07 19:37	18:35 (T-71) 19:12 (T-71)	07:43 18:40	07:25 16:57
18	05:58 21:08	06:32 20:30	19:54 (T-70) 20:01 (T-70)	07:08 19:35	18:36 (T-71) 19:10 (T-71)	07:45 18:38
19	05:59 21:07	06:33 20:28	19:51 (T-70) 20:03 (T-70)	07:09 19:33	18:36 (T-71) 19:08 (T-71)	07:46 18:36
20	06:00 21:06	06:34 20:27	19:50 (T-70) 20:02 (T-70)	07:10 19:31	18:37 (T-71) 19:07 (T-71)	07:47 18:35
21	06:00 21:06	06:35 20:25	19:49 (T-70) 20:00 (T-70)	07:12 19:29	18:38 (T-71) 19:04 (T-71)	07:49 18:33
22	06:01 21:05	06:36 20:24	19:48 (T-70) 19:59 (T-70)	07:13 19:27	18:39 (T-71) 19:02 (T-71)	07:50 18:32
23	06:02 21:04	06:38 20:22	19:47 (T-70) 19:57 (T-70)	07:14 19:25	18:40 (T-71) 19:00 (T-71)	07:51 18:30
24	06:04 21:03	06:39 20:20	19:47 (T-70) 19:55 (T-70)	07:15 19:23	18:41 (T-71) 18:58 (T-71)	07:54 18:28
25	06:05 21:02	06:40 20:18	19:46 (T-70) 19:53 (T-70)	07:16 19:22	18:43 (T-71) 18:56 (T-71)	07:55 18:27
26	06:06 21:01	06:41 20:17	19:04 (T-71) 19:52 (T-70)	07:18 19:20	18:47 (T-71) 18:55 (T-71)	07:55 18:25
27	06:07 21:00	06:42 20:15	18:57 (T-71) 19:50 (T-70)	07:19 19:18	18:55 (T-71) 18:24	07:57 16:50
28	06:08 20:59	06:43 20:13	18:55 (T-71) 19:49 (T-70)	07:20 19:16	07:58 18:22	07:39 16:49
29	06:09 20:58	06:45 20:12	18:52 (T-71) 19:19 (T-71)	07:21 19:14	07:59 18:21	07:40 16:49
30	06:10 20:56	06:46 20:10	18:50 (T-71) 19:21 (T-71)	07:22 19:12	08:01 18:19	07:41 16:48
31	06:11 20:55	06:47 20:08	18:48 (T-71) 19:22 (T-71)	07:23 19:12	08:02 18:18	07:42 16:48
Potential sun hours	471	436	377	341	289	276
Total, worst case						
Sun reduction		0.72	0.67		0.68	
Oper. time red.		0.90	0.90		0.90	
Wind dir. red.		0.59	0.59		0.59	
Total reduction		0.38	0.36		0.25	
Total, real		86	333		17	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-257 - R-257
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June				
1	08:04	07:46	07:05	07:09	19:00 (T-75)	06:18	05:45			
	16:57	17:35	18:12	19:52	31	19:31 (T-74)	20:29	21:03		
2	08:04	07:45	07:04	07:07	18:59 (T-75)	06:16	05:44			
	16:58	17:36	18:14	19:53	33	19:32 (T-74)	20:30	21:04		
3	08:04	07:44	07:02	07:05	18:58 (T-75)	06:15	05:44			
	16:59	17:37	18:15	19:55	35	19:33 (T-74)	20:32	21:05		
4	08:04	07:43	07:00	07:03	18:57 (T-75)	06:14	05:43			
	16:59	17:39	18:16	19:56	37	19:34 (T-74)	20:33	21:06		
5	08:04	07:42	06:58	07:02	18:57 (T-75)	06:12	05:43			
	17:00	17:40	18:18	19:57	39	19:36 (T-74)	20:34	21:07		
6	08:03	07:40	06:57	07:00	18:56 (T-75)	06:11	05:43			
	17:01	17:42	18:19	19:58	41	19:37 (T-74)	20:35	21:07		
7	08:03	07:39	06:55	06:58	18:55 (T-75)	06:09	05:42			
	17:03	17:43	18:20	19:59	43	19:38 (T-74)	20:37	21:08		
8	08:03	07:38	07:53	06:56	18:55 (T-75)	06:08	05:42			
	17:04	17:45	18:22	20:01	44	19:39 (T-74)	20:38	21:09		
9	08:03	07:36	07:51	06:54	18:54 (T-75)	06:07	05:42			
	17:05	17:46	19:23	20:02	46	19:40 (T-74)	20:39	21:09		
10	08:03	07:35	17:21 (T-73)	07:49	06:53	18:55 (T-75)	06:06	05:41		
	17:06	17:47	1	17:22 (T-73)	19:24	20:03	47	19:42 (T-74)	20:40	21:10
11	08:02	07:34	17:21 (T-73)	07:48	06:51	18:54 (T-75)	06:04	05:41		
	17:07	17:49	3	17:24 (T-73)	19:25	20:04	48	19:42 (T-74)	20:41	21:11
12	08:02	07:32	17:21 (T-73)	07:46	06:49	18:54 (T-75)	06:03	05:41		
	17:08	17:50	5	17:26 (T-73)	19:27	20:06	48	19:42 (T-74)	20:42	21:11
13	08:01	07:31	17:21 (T-73)	07:44	06:47	18:54 (T-75)	06:02	05:41		
	17:09	17:52	6	17:27 (T-73)	19:28	20:07	46	19:40 (T-74)	20:44	21:12
14	08:01	07:29	17:22 (T-73)	07:42	06:45	18:55 (T-75)	06:01	05:41		
	17:11	17:53	7	17:29 (T-73)	19:29	20:08	45	19:40 (T-75)	20:45	21:12
15	08:00	07:28	17:23 (T-73)	07:40	06:44	18:55 (T-75)	06:00	05:41		
	17:12	17:54	7	17:30 (T-73)	19:31	20:09	44	19:39 (T-75)	20:46	21:13
16	08:00	07:26	17:24 (T-73)	07:38	06:42	18:55 (T-75)	05:58	05:41		
	17:13	17:56	7	17:31 (T-73)	19:32	20:11	43	19:38 (T-75)	20:47	21:13
17	07:59	07:25	07:37	06:40	18:56 (T-75)	05:57	05:41			
	17:14	17:57	19:33	20:12	41	19:37 (T-75)	20:48	21:14		
18	07:59	07:23	07:35	06:39	18:57 (T-75)	05:56	05:41			
	17:16	17:59	19:34	20:13	39	19:36 (T-75)	20:49	21:14		
19	07:58	07:22	07:33	06:37	18:57 (T-75)	05:55	05:41			
	17:17	18:00	19:36	20:14	37	19:34 (T-75)	20:50	21:14		
20	07:57	07:20	07:31	06:35	18:59 (T-75)	05:54	05:41			
	17:18	18:00	19:37	20:16	34	19:33 (T-75)	20:51	21:15		
21	07:57	07:19	07:29	06:34	19:00 (T-75)	05:53	05:41			
	17:20	18:01	19:38	20:17	31	19:31 (T-75)	20:53	21:15		
22	07:56	07:17	07:27	06:32	19:01 (T-75)	05:52	05:41			
	17:21	18:03	19:40	20:18	28	19:29 (T-75)	20:54	21:15		
23	07:55	07:15	07:26	06:30	19:03 (T-75)	05:51	05:42			
	17:22	18:04	19:41	20:19	24	19:27 (T-75)	20:55	21:15		
24	07:54	07:14	07:24	06:29	19:05 (T-75)	05:51	05:42			
	17:24	18:05	19:42	20:21	19	19:24 (T-75)	20:56	21:16		
25	07:53	07:12	07:22	19:16 (T-75)	06:27	19:10 (T-75)	05:50	05:42		
	17:25	18:07	19:43	6	19:22 (T-75)	20:22	11	19:21 (T-75)	20:57	21:16
26	07:52	07:10	07:20	19:12 (T-75)	06:26	19:12 (T-75)	05:49	05:43		
	17:26	18:08	19:45	11	19:23 (T-75)	20:23	20:58	21:16		
27	07:51	07:09	07:18	19:09 (T-75)	06:24	19:09 (T-75)	05:48	05:43		
	17:28	18:10	19:46	15	19:24 (T-75)	20:24	20:59	21:16		
28	07:51	07:07	07:16	19:06 (T-75)	06:22	19:06 (T-75)	05:48	05:43		
	17:29	18:11	19:47	19	19:25 (T-75)	20:26	21:00	21:16		
29	07:49		07:14	19:05 (T-75)	06:21	19:05 (T-75)	05:47	05:44		
	17:30		19:48	22	19:27 (T-75)	20:27	21:01	21:16		
30	07:48		07:13	19:03 (T-75)	06:19	19:03 (T-75)	05:46	05:44		
	17:32		19:50	25	19:28 (T-75)	20:28	21:01	21:16		
31	07:47		07:11	19:02 (T-75)			05:46			
	17:33		19:51	27	19:29 (T-74)		21:02			
Potential sun hours	287	292	369	403	458	465				
Total, worst case										
Sun reduction		36	125	934						
Oper. time red.		0.58	0.59	0.63						
Wind dir. red.		0.90	0.90	0.90						
Total reduction		0.59	0.60	0.60						
Total, real		0.31	0.32	0.34						
		11	40	315						

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-257 - R-257
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:54	06:48 20:06	18:53 (T-75) 19:41 (T-74)	07:24 19:10	07:03 16:50 (T-73)
2	05:45 21:16	06:13 20:53	06:49 20:04	18:53 (T-75) 19:39 (T-74)	07:25 19:09	07:05 17:15
3	05:46 21:15	06:14 20:52	06:51 20:03	18:52 (T-75) 19:38 (T-74)	07:26 19:07	07:06 17:14
4	05:47 21:15	06:16 20:50	06:52 20:01	18:52 (T-75) 19:36 (T-74)	07:27 19:05	07:07 17:12
5	05:47 21:15	06:17 20:49	06:53 19:59	18:52 (T-75) 19:35 (T-74)	07:28 19:03	07:09 17:11
6	05:48 21:15	06:18 20:48	06:54 19:57	18:52 (T-75) 19:33 (T-74)	07:30 19:01	07:10 17:10
7	05:49 21:14	06:19 20:46	06:55 19:55	18:52 (T-75) 19:31 (T-74)	07:31 18:58	07:11 17:09
8	05:49 21:14	06:20 20:45	06:56 19:54	18:52 (T-75) 19:29 (T-74)	07:32 18:56	07:13 17:07
9	05:50 21:13	06:21 20:44	06:58 19:52	18:52 (T-75) 19:27 (T-74)	07:33 18:54	07:14 17:06
10	05:51 21:13	06:22 20:42	06:59 19:50	18:52 (T-75) 19:25 (T-74)	07:35 18:52	07:16 17:05
11	05:52 21:13	06:24 20:41	07:00 19:48	18:52 (T-75) 19:23 (T-74)	07:36 18:50	07:17 17:04
12	05:52 21:12	06:25 20:39	07:01 19:46	18:53 (T-75) 19:21 (T-74)	07:37 18:49	07:18 17:03
13	05:53 21:11	06:26 20:38	07:02 19:44	18:54 (T-75) 19:20 (T-75)	07:38 18:47	07:20 17:02
14	05:54 21:11	06:27 20:36	07:03 19:42	18:55 (T-75) 19:18 (T-75)	07:40 18:45	07:21 17:01
15	05:55 21:10	06:28 20:35	07:05 19:40	18:56 (T-75) 19:16 (T-75)	07:41 18:43	07:22 16:59
16	05:56 21:10	06:29 20:33	07:06 19:39	18:57 (T-75) 19:14 (T-75)	07:42 18:42	07:24 16:58
17	05:57 21:09	06:31 20:32	07:07 19:37	18:59 (T-75) 19:12 (T-75)	07:44 18:40	07:25 16:58
18	05:58 21:08	06:32 20:30	19:14 (T-75) 19:27 (T-75)	07:08 19:35	07:45 18:38	07:26 16:57
19	05:59 21:07	06:33 20:28	19:12 (T-75) 19:31 (T-75)	07:09 19:33	07:46 18:37	07:28 16:56
20	06:00 21:06	06:34 20:27	19:09 (T-75) 19:34 (T-75)	07:10 19:31	07:47 18:35	07:29 16:55
21	06:01 21:06	06:35 20:25	19:06 (T-75) 19:35 (T-75)	07:12 19:29	07:49 18:33	07:30 16:54
22	06:02 21:05	06:36 20:24	19:04 (T-75) 19:36 (T-75)	07:13 19:27	07:50 18:32	07:32 16:53
23	06:03 21:04	06:38 20:22	19:03 (T-75) 19:37 (T-75)	07:14 19:25	07:51 18:30	07:33 16:53
24	06:04 21:03	06:39 20:20	19:01 (T-75) 19:38 (T-75)	07:15 19:23	07:53 18:28	07:34 16:52
25	06:05 21:02	06:40 20:18	19:00 (T-75) 19:39 (T-75)	07:16 19:22	07:54 18:27	07:35 17:58 (T-73)
26	06:06 21:01	06:41 20:17	18:58 (T-75) 19:39 (T-75)	07:18 19:20	07:55 18:25	1 17:59 (T-73)
27	06:07 21:00	06:42 20:15	18:57 (T-75) 19:39 (T-75)	07:19 19:18	07:57 18:24	7 18:01 (T-73)
28	06:08 20:59	06:44 20:13	18:57 (T-75) 19:41 (T-75)	07:20 19:16	07:58 18:22	7 17:59 (T-73)
29	06:09 20:58	06:45 20:12	18:56 (T-75) 19:41 (T-75)	07:21 19:14	07:59 18:21	6 17:51 (T-73)
30	06:10 20:57	06:46 20:10	18:55 (T-75) 19:41 (T-74)	07:22 19:12	08:01 18:19	5 17:56 (T-73)
31	06:11 20:55	06:47 20:08	18:54 (T-75) 19:42 (T-74)	07:23 19:12	08:02 18:18	5 17:50 (T-73)
Potential sun hours	471	436	377	341	289	276
Total, worst case		494	578	34	2	
Sun reduction		0.72	0.67	0.56	0.48	
Oper. time red.		0.90	0.90	0.90	0.90	
Wind dir. red.		0.60	0.60	0.59	0.59	
Total reduction		0.39	0.36	0.30	0.25	
Total, real		191	208	10	1	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-258 - R-258
Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:03	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	19:38 (T-75)	07:24	07:03	07:42	
	16:57	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	3 19:41 (T-75)	19:10	17:16	16:48	
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	19:38 (T-75)	07:25	07:05	07:44	
	16:58	17:36	18:14	19:53	20:30	21:04	21:15	20:53	20:04	1 19:39 (T-75)	19:08	17:15	16:48	
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51		07:26	07:06	07:45	
	16:58	17:37	18:15	19:54	20:32	21:05	21:15	20:52	20:03		19:07	17:14	16:47	
4	08:04	07:43	07:00	07:03	06:14	05:43	05:47	06:16	06:52		07:27	07:07	07:46	
	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:50	20:01		19:05	17:12	16:47	
5	08:03	07:41	06:58	07:01	06:12	05:43	05:47	06:17	06:53		07:28	07:09	07:47	
	17:00	17:40	18:18	19:57	20:34	21:06	21:15	20:49	19:59		19:03	17:11	16:47	
6	08:03	07:40	06:57	07:00	06:11	05:43	05:48	06:19	06:54		07:30	07:10	07:48	
	17:01	17:42	18:19	19:58	20:35	21:07	21:15	20:48	19:57		19:01	17:10	16:47	
7	08:03	07:39	06:55	06:58	06:09	05:42	05:49	06:19	06:55		07:31	07:11	07:49	
	17:02	17:43	18:20	19:59	20:36	21:08	21:14	20:46	19:55		18:57	17:08	16:46	
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56		07:32	07:13	07:50	
	17:04	17:45	18:21	20:01	20:38	21:09	21:14	20:45	19:53		18:56	17:07	16:46	
9	08:03	07:36	07:51	06:54	06:07	05:42	05:50	06:21	06:58		07:33	07:14	07:51	
	17:05	17:46	19:23	20:02	20:39	21:09	21:13	20:44	19:52		18:54	17:06	16:46	
10	08:02	07:35	07:49	06:52	19:40 (T-75)	06:05	05:41	05:51	06:22		06:59	07:35	07:15	07:52
	17:06	17:47	19:24	20:03	2 19:42 (T-75)	20:40	21:10	21:13	20:42		19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	19:39 (T-75)	06:04	05:41	05:52	06:24		07:00	07:36	07:17	07:53
	17:07	17:49	19:25	20:04	3 19:42 (T-75)	20:41	21:11	21:12	20:41		19:48	18:50	17:04	16:46
12	08:02	07:32	07:46	06:49	19:38 (T-75)	06:03	05:41	05:52	06:25		07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	5 19:43 (T-75)	20:42	21:11	21:12	20:39		19:46	18:49	17:03	16:46
13	08:01	07:31	07:44	06:47	19:37 (T-75)	06:02	05:41	05:53	06:26		07:02	07:38	07:20	07:54
	17:09	17:52	19:28	20:07	7 19:44 (T-75)	20:44	21:12	21:11	20:38		19:44	18:47	17:01	16:46
14	08:01	07:29	07:42	06:45	19:38 (T-75)	06:01	05:41	05:54	06:27		07:03	07:40	07:21	07:55
	17:11	17:53	19:29	20:08	8 19:46 (T-75)	20:45	21:12	21:11	20:36		19:42	18:45	17:00	16:47
15	08:00	07:28	07:40	06:44	19:38 (T-75)	05:59	05:41	05:55	06:28		07:05	07:41	07:22	07:56
	17:12	17:54	19:31	20:09	9 19:47 (T-75)	20:46	21:13	21:10	20:35		19:40	18:43	16:59	16:47
16	08:00	07:26	07:38	06:42	19:38 (T-75)	05:58	05:41	05:56	06:29		07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	10 19:48 (T-75)	20:47	21:13	21:09	20:33		19:39	18:42	16:58	16:47
17	07:59	07:25	07:37	06:40	19:40 (T-75)	05:57	05:41	05:57	06:31		07:07	07:43	07:25	07:57
	17:14	17:57	19:33	20:12	10 19:50 (T-75)	20:48	21:14	21:09	20:32		19:37	18:40	16:57	16:47
18	07:59	07:23	07:35	06:39	19:41 (T-75)	05:56	05:41	05:58	06:32		07:08	07:45	07:26	07:58
	17:16	17:59	19:34	20:13	9 19:50 (T-75)	20:49	21:14	21:08	20:30		19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37		05:55	05:41	05:59	06:33		07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:14		20:50	21:14	21:07	20:28		19:33	18:37	16:56	16:48
20	07:57	07:20	07:31	06:35		05:54	05:41	06:00	06:34		07:10	07:47	07:29	07:59
	17:18	18:00	19:37	20:16		20:51	21:15	21:06	20:27		19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34		05:53	05:41	06:01	06:35		07:12	07:49	07:30	08:00
	17:19	18:01	19:38	20:17		20:52	21:15	21:06	20:25		19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32		05:52	05:41	06:02	06:36		07:13	07:50	07:31	08:00
	17:21	18:03	19:39	20:18		20:54	21:15	21:05	20:23		19:27	18:32	16:53	16:49
23	07:55	07:15	07:25	06:30		05:51	05:42	06:03	06:38		07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:19		20:55	21:15	21:04	20:22		19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29		05:51	05:42	06:04	06:39		07:15	07:53	07:34	08:01
	17:23	18:05	19:42	20:21		20:56	21:16	21:03	20:20		19:23	18:28	16:52	16:50
25	07:53	07:12	07:22	06:27		05:50	05:42	06:05	06:40		07:16	07:54	07:35	08:02
	17:25	18:07	19:43	20:22		20:57	21:16	21:02	20:18	9 19:53 (T-75)	19:22	18:27	16:51	16:51
26	07:52	07:10	07:20	06:25		05:49	05:43	06:06	06:41	10 19:52 (T-75)	07:18	07:55	07:36	08:02
	17:26	18:08	19:44	20:23		20:58	21:16	21:01	20:17	10 19:52 (T-75)	19:20	18:25	16:51	16:52
27	07:51	07:09	07:18	06:24		05:48	05:43	06:07	06:42	10 19:40 (T-75)	07:19	07:57	07:38	08:02
	17:28	18:09	19:46	20:24		20:59	21:16	21:00	20:15	10 19:50 (T-75)	19:18	18:24	16:50	16:52
28	07:50	07:07	07:16	06:22		05:47	05:43	06:08	06:43	9 19:40 (T-75)	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:25		21:00	21:16	20:59	20:13	9 19:49 (T-75)	19:16	18:22	16:49	16:53
29	07:49		07:14	06:21		05:47	05:44	06:09	06:45	8 19:39 (T-75)	07:21	07:59	07:40	08:03
	17:30		19:48	20:27		21:01	21:16	20:58	20:11	8 19:47 (T-75)	19:14	18:21	16:49	16:54
30	07:48		07:12	06:19		05:46	05:44	06:10	06:46	7 19:38 (T-75)	07:22	08:01	07:41	08:03
	17:32		19:49	20:28		21:01	21:16	20:56	20:10	7 19:45 (T-75)	19:12	18:19	16:48	16:55
31	07:47		07:11			05:45		06:11	06:47	5 19:38 (T-75)		08:02		08:03
	17:33		19:51			21:02		20:55	20:08	5 19:43 (T-75)		18:18		16:55
Potential sun hours	287	292	369	403	458	465	471	436	377		341	289	276	
Total, worst case				63					58		4			
Sun reduction				0.63					0.72		0.67			
Oper. time red.				0.90					0.90		0.90			
Wind dir. red.				0.60					0.60		0.60			
Total reduction				0.34					0.39		0.36			
Total, real				21				22			1			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-280 - R-280

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:17	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:01	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:02	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:17	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:54	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:47	20:25	21:00	21:17	21:01	20:16	19:19	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:03			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-281 - R-281
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:05	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:44
	16:57	17:35	18:13	19:53	20:30	21:04	21:17	20:55	20:07	19:11	17:17	16:48
2	08:05	07:46	07:04	07:08	06:17	05:45	05:46	06:14	06:50	07:26	07:06	07:45
	16:58	17:36	18:14	19:54	20:31	21:05	21:17	20:54	20:05	19:09	17:16	16:48
3	08:05	07:45	07:03	07:06	06:15	05:44	05:46	06:15	06:51	07:27	07:07	07:46
	16:59	17:38	18:15	19:55	20:33	21:06	21:16	20:53	20:03	19:07	17:14	16:48
4	08:05	07:44	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:47
	17:00	17:39	18:17	19:57	20:34	21:07	21:16	20:51	20:02	19:05	17:13	16:47
5	08:05	07:42	06:59	07:02	06:13	05:43	05:47	06:17	06:53	07:29	07:10	07:48
	17:01	17:41	18:18	19:58	20:35	21:08	21:16	20:50	20:00	19:04	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:55	07:30	07:11	07:49
	17:02	17:42	18:19	19:59	20:36	21:08	21:16	20:49	19:58	19:02	17:10	16:47
7	08:04	07:40	06:56	06:58	06:10	05:42	05:49	06:19	06:56	07:32	07:12	07:50
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:39	07:54	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:14	07:51
	17:04	17:45	18:22	20:02	20:39	21:10	21:15	20:46	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:52
	17:05	17:46	19:23	20:03	20:40	21:11	21:15	20:45	19:52	18:54	17:06	16:47
10	08:04	07:36	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:17	07:53
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:51	18:53	17:05	16:47
11	08:03	07:35	07:48	06:51	06:05	05:41	05:52	06:24	07:00	07:37	07:18	07:54
	17:07	17:49	19:26	20:05	20:42	21:12	21:14	20:42	19:49	18:51	17:04	16:47
12	08:03	07:33	07:47	06:50	06:03	05:41	05:53	06:25	07:02	07:38	07:19	07:55
	17:08	17:51	19:27	20:07	20:43	21:12	21:13	20:40	19:47	18:49	17:03	16:47
13	08:02	07:32	07:45	06:48	06:02	05:41	05:53	06:26	07:03	07:39	07:21	07:56
	17:10	17:52	19:29	20:08	20:45	21:13	21:13	20:39	19:45	18:47	17:02	16:47
14	08:02	07:30	07:43	06:46	06:01	05:41	05:54	06:28	07:04	07:40	07:22	07:56
	17:11	17:53	19:30	20:09	20:46	21:13	21:12	20:37	19:43	18:46	17:01	16:47
15	08:01	07:29	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:42	07:23	07:57
	17:12	17:55	19:31	20:10	20:47	21:14	21:11	20:36	19:41	18:44	17:00	16:47
16	08:01	07:27	07:39	06:43	05:59	05:41	05:56	06:30	07:06	07:43	07:25	07:58
	17:13	17:56	19:33	20:12	20:48	21:14	21:11	20:34	19:39	18:42	16:59	16:47
17	08:00	07:26	07:37	06:41	05:58	05:41	05:57	06:31	07:08	07:44	07:26	07:59
	17:15	17:58	19:34	20:13	20:49	21:15	21:10	20:33	19:37	18:40	16:58	16:48
18	08:00	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:46	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:36	18:39	16:57	16:48
19	07:59	07:23	07:34	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:29	08:00
	17:17	18:00	19:36	20:15	20:51	21:16	21:08	20:29	19:34	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:30	08:01
	17:19	18:00	19:38	20:16	20:53	21:16	21:08	20:28	19:32	18:35	16:55	16:49
21	07:58	07:19	07:30	06:34	05:54	05:41	06:01	06:36	07:12	07:50	07:31	08:01
	17:20	18:02	19:39	20:18	20:54	21:16	21:07	20:26	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:51	07:33	08:02
	17:21	18:03	19:40	20:19	20:55	21:16	21:06	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:15	07:52	07:34	08:02
	17:23	18:05	19:41	20:20	20:56	21:17	21:05	20:23	19:26	18:31	16:53	16:50
24	07:55	07:15	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:03
	17:24	18:06	19:43	20:21	20:57	21:17	21:04	20:21	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:28	05:50	05:42	06:05	06:40	07:17	07:55	07:36	08:03
	17:25	18:07	19:44	20:23	20:58	21:17	21:03	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:21	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:38	08:03
	17:27	18:09	19:45	20:24	20:59	21:17	21:02	20:18	19:20	18:26	16:51	16:52
27	07:52	07:10	07:19	06:24	05:48	05:43	06:07	06:43	07:19	07:58	07:39	08:04
	17:28	18:10	19:46	20:25	21:00	21:17	21:01	20:16	19:18	18:24	16:50	16:53
28	07:51	07:08	07:17	06:23	05:48	05:44	06:08	06:44	07:21	07:59	07:40	08:04
	17:29	18:11	19:48	20:26	21:01	21:17	21:00	20:14	19:17	18:23	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:28	21:02	21:17	20:59	20:12	19:15	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:02	07:42	08:04
	17:32		19:50	20:29	21:03	21:17	20:58	20:11	19:13	18:20	16:49	16:55
31	07:48		07:11	06:18	05:46		06:11	06:48		08:03		08:04
	17:34		19:52	21:03			20:56	20:09		18:18		16:56
Potential sun hours	287	292	369	404	459	465	471	436	377	341	288	275
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-282 - R-282
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04 16:56	07:47 17:35	07:05 18:12	07:09 19:52	06:18 20:29	05:45 21:04	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	18:33 (T-48)	07:04 16:48
2	08:04 16:57	07:45 17:36	07:04 18:14	07:07 19:53	06:16 20:31	05:44 21:05	05:45 21:16	06:13 20:53	06:49 20:05	07:25 19:09	18:30 (T-48)	07:05 16:48
3	08:04 16:58	07:44 17:37	07:02 18:15	07:05 19:55	06:15 20:32	05:44 21:05	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	18:28 (T-48)	07:06 17:14
4	08:04 16:59	07:43 17:39	07:00 18:16	07:03 19:56	06:13 20:33	05:43 21:06	05:46 21:16	06:15 20:51	06:52 20:01	07:27 19:05	18:26 (T-48)	07:08 17:12
5	08:04 17:00	07:42 17:40	06:59 18:18	07:02 19:57	06:12 20:34	05:43 21:07	05:47 21:15	06:17 20:49	06:53 19:59	07:29 19:03	18:26 (T-48)	07:09 17:11
6	08:04 17:01	07:41 17:42	06:57 18:19	07:00 19:58	06:11 20:36	05:42 21:08	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	18:25 (T-48)	07:10 16:47
7	08:04 17:02	07:39 17:43	06:55 18:20	06:58 20:00	06:09 20:37	05:42 21:08	05:48 21:15	06:19 20:47	06:55 19:56	07:31 18:58	18:25 (T-48)	07:12 16:46
8	08:03 17:03	07:38 17:44	07:53 18:22	06:56 20:01	06:08 20:38	05:42 21:09	05:49 21:14	06:20 20:45	06:56 19:54	07:32 18:56	18:25 (T-48)	07:13 16:46
9	08:03 17:05	07:37 17:46	07:51 19:23	06:54 20:02	06:07 20:39	05:41 21:10	05:50 21:14	06:21 20:44	06:58 19:52	07:34 18:54	18:25 (T-48)	07:15 16:46
10	08:03 17:06	07:35 17:47	07:50 19:24	06:53 20:03	06:05 20:40	05:41 21:10	05:51 21:13	06:22 20:43	06:59 19:50	07:35 18:52	18:25 (T-48)	07:16 16:46
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:04 20:42	05:41 21:11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:50	18:25 (T-48)	07:17 16:46
12	08:02 17:08	07:32 17:50	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:52 21:12	06:25 20:40	07:01 19:46	07:37 18:49	18:25 (T-48)	07:19 16:46
13	08:02 17:09	07:31 17:52	07:44 19:28	06:47 20:07	06:02 20:44	05:41 21:12	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	18:25 (T-48)	07:20 16:46
14	08:01 17:10	07:30 17:53	07:42 19:29	06:45 20:08	06:01 20:45	05:41 21:13	05:54 21:11	06:27 20:37	07:03 19:42	07:40 18:45	18:25 (T-48)	07:21 16:46
15	08:01 17:12	07:28 17:54	07:40 19:31	06:44 20:10	05:59 20:46	05:41 21:13	05:55 21:11	06:28 20:35	07:05 19:41	07:41 18:43	18:25 (T-48)	07:23 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:58 20:47	05:41 21:14	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	18:25 (T-48)	07:24 16:47
17	08:00 17:14	07:25 17:57	07:37 19:33	06:40 20:12	05:57 20:49	05:41 21:14	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	18:25 (T-48)	07:25 16:47
18	07:59 17:15	07:24 17:59	07:35 19:35	06:39 20:13	05:56 20:50	05:41 21:14	05:58 21:08	06:32 20:30	07:08 19:35	07:45 18:38	18:25 (T-48)	07:27 16:47
19	07:58 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:55 20:51	05:41 21:15	05:58 21:08	06:33 20:29	07:09 19:33	07:46 18:37	18:25 (T-48)	07:28 16:48
20	07:58 17:18	07:20 18:00	07:31 19:37	06:35 20:16	05:54 20:52	05:41 21:15	05:59 21:07	06:34 20:27	07:11 19:31	07:48 18:35	18:25 (T-48)	07:29 16:48
21	07:57 17:19	07:19 18:01	07:29 19:38	06:34 20:17	05:53 20:53	05:41 21:15	06:00 21:06	06:35 20:25	07:12 19:29	07:49 18:33	18:25 (T-48)	07:31 16:49
22	07:56 17:21	07:17 18:03	07:27 19:40	06:32 20:18	05:52 20:54	05:41 21:16	06:01 21:05	06:36 20:24	07:13 19:27	07:50 18:32	18:25 (T-48)	07:32 16:53
23	07:55 17:22	07:16 18:04	07:26 19:41	06:30 20:20	05:51 20:55	05:41 21:16	06:02 21:04	06:38 20:22	07:14 19:25	07:52 18:30	18:25 (T-48)	07:33 16:52
24	07:55 17:23	07:14 18:05	07:24 19:42	06:29 20:21	05:50 20:56	05:42 21:16	06:03 21:03	06:39 20:20	07:15 19:24	07:53 18:28	18:25 (T-48)	07:34 16:52
25	07:54 17:25	07:12 18:07	07:22 19:43	06:27 20:22	05:50 20:57	05:42 21:16	06:04 21:02	06:40 20:19	07:16 19:22	07:54 18:27	18:25 (T-48)	07:36 16:51
26	07:53 17:26	07:11 18:08	07:20 19:45	06:25 20:23	05:49 20:58	05:42 21:16	06:06 21:01	06:41 20:17	07:18 19:20	07:56 18:25	18:25 (T-48)	07:37 16:52
27	07:52 17:28	07:09 18:10	07:18 19:46	06:24 20:25	05:48 20:59	05:43 21:16	06:07 21:00	06:42 20:15	07:19 19:18	07:57 18:24	18:25 (T-48)	07:38 16:52
28	07:51 17:29	07:07 18:11	07:16 19:47	06:22 20:26	05:47 21:00	05:43 21:16	06:08 20:59	06:44 20:14	07:20 19:16	07:58 18:22	18:25 (T-48)	07:39 16:49
29	07:50 17:30	07:06 19:48	07:14 19:48	06:21 20:27	05:47 21:01	05:44 21:16	06:09 20:58	06:45 20:12	07:21 19:14	08:00 18:21	18:25 (T-48)	07:41 16:49
30	07:49 17:32	07:05 19:50	07:13 19:50	06:19 20:28	05:46 21:02	05:44 21:16	06:10 20:57	06:46 20:10	07:23 19:12	08:01 18:19	18:25 (T-48)	07:42 16:48
31	07:48 17:33	07:04 19:51	07:11 19:51	06:18 21:03	05:45 21:03	05:45 21:03	06:11 20:56	06:47 20:08	08:02 18:18	08:02 18:18	18:25 (T-48)	07:43 16:55
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275
Total, worst case			96							98		
Sun reduction			0.59							0.56		
Oper. time red.			0.90							0.90		
Wind dir. red.			0.57							0.57		
Total reduction			0.30							0.29		
Total, real			29							28		

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-283 - R-283

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	15:25 (T-80) 07:46		07:05	17:41 (T-62) 07:09	06:18 05:45
	16:57	52 16:17 (T-80) 17:35		18:12	9 17:50 (T-62) 19:52	20:29 21:03
2	08:04	15:25 (T-80) 07:45		07:04	17:40 (T-62) 07:07	06:16 05:44
	16:58	52 16:17 (T-80) 17:36		18:14	12 17:52 (T-62) 19:53	20:31 21:04
3	08:04	15:26 (T-80) 07:44		07:02	17:41 (T-62) 07:05	06:15 05:44
	16:58	52 16:18 (T-80) 17:37		18:15	13 17:54 (T-62) 19:55	20:32 21:05
4	08:04	15:27 (T-80) 07:43		07:00	17:41 (T-62) 07:03	06:14 05:43
	16:59	51 16:18 (T-80) 17:39		18:16	14 17:55 (T-62) 19:56	20:33 21:06
5	08:04	15:27 (T-80) 07:42	17:14 (T-85)	06:58	17:40 (T-63) 07:02	06:12 05:43
	17:00	52 16:19 (T-80) 17:40	1 17:15 (T-85) 18:18	16 17:56 (T-62) 19:57	20:34 21:07	
6	08:04	15:28 (T-80) 07:40	17:14 (T-85)	06:57	17:39 (T-63) 07:00	06:11 05:43
	17:01	51 16:19 (T-80) 17:42	2 17:16 (T-85) 18:19	18 17:57 (T-62) 19:58	20:35 21:07	
7	08:03	15:28 (T-80) 07:39	17:14 (T-85)	06:55	17:38 (T-63) 06:58	06:09 05:42
	17:02	51 16:19 (T-80) 17:43	4 17:18 (T-85) 18:20	20 17:58 (T-63) 20:00	20:37 21:08	
8	08:03	15:29 (T-80) 07:38	17:14 (T-85)	07:53	18:39 (T-63) 06:56	06:08 05:42
	17:04	50 16:19 (T-80) 17:45	5 17:19 (T-85) 18:22	22 19:01 (T-63) 20:01	20:38 21:09	
9	08:03	15:30 (T-80) 07:36	17:15 (T-85)	07:51	18:39 (T-63) 06:54	06:07 05:42
	17:05	50 16:20 (T-80) 17:46	6 17:21 (T-85) 19:23	23 19:02 (T-63) 20:02	20:39 21:10	
10	08:03	15:30 (T-80) 07:35	17:16 (T-85)	07:49	18:39 (T-63) 06:53	06:05 05:41
	17:06	49 16:19 (T-80) 17:47	7 17:23 (T-85) 19:24	24 19:03 (T-63) 20:03	20:40 21:10	
11	08:02	15:31 (T-80) 07:34	17:16 (T-85)	07:48	18:39 (T-63) 06:51	06:04 05:41
	17:07	49 16:20 (T-80) 17:49	8 17:24 (T-85) 19:25	25 19:04 (T-63) 20:05	20:41 21:11	
12	08:02	15:32 (T-80) 07:32	17:19 (T-85)	07:46	18:39 (T-63) 06:49	06:03 05:41
	17:08	48 16:20 (T-80) 17:50	7 17:26 (T-85) 19:27	26 19:05 (T-63) 20:06	20:43 21:11	
13	08:02	15:33 (T-80) 07:31	07:44	18:40 (T-63) 06:47	06:02 05:41	
	17:09	47 16:20 (T-80) 17:52	19:28	24 19:04 (T-63) 20:07	20:44 21:12	
14	08:01	15:33 (T-80) 07:29	07:42	18:42 (T-63) 06:45	06:01 05:41	
	17:11	46 16:19 (T-80) 17:53	19:29	21 19:03 (T-63) 20:08	20:45 21:12	
15	08:01	15:35 (T-80) 07:28	07:40	18:43 (T-63) 06:44	05:59 05:41	
	17:12	45 16:20 (T-80) 17:54	19:31	18 19:01 (T-63) 20:10	20:46 21:13	
16	08:00	15:35 (T-80) 07:26	07:39	18:45 (T-63) 06:42	05:58 05:41	
	17:13	44 16:19 (T-80) 17:56	19:32	13 18:58 (T-63) 20:11	20:47 21:13	
17	07:59	15:37 (T-80) 07:25	07:37	06:40	05:57 05:41	
	17:14	42 16:19 (T-80) 17:57	19:33	20:12	20:48 21:14	
18	07:59	15:38 (T-80) 07:23	07:35	06:39	05:56 05:41	
	17:16	41 16:19 (T-80) 17:59	19:34	20:13	20:49 21:14	
19	07:58	15:39 (T-80) 07:22	07:33	06:37	05:55 05:41	
	17:17	39 16:18 (T-80) 18:00	19:36	20:14	20:51 21:15	
20	07:57	15:40 (T-80) 07:20	07:31	06:35	05:54 05:41	
	17:18	37 16:17 (T-80) 18:00	19:37	20:16	20:52 21:15	
21	07:57	15:42 (T-80) 07:19	07:29	06:34	05:53 05:41	
	17:19	36 16:18 (T-80) 18:01	19:38	20:17	20:53 21:15	
22	07:56	15:43 (T-80) 07:17	07:27	06:32	05:52 05:41	
	17:21	34 16:17 (T-80) 18:03	19:40	20:18	20:54 21:15	
23	07:55	15:45 (T-80) 07:15	07:26	06:30	05:51 05:42	
	17:22	30 16:15 (T-80) 18:04	19:41	20:19	20:55 21:16	
24	07:54	15:46 (T-80) 07:14	07:24	06:29	05:51 05:42	
	17:24	28 16:14 (T-80) 18:05	19:42	20:21	20:56 21:16	
25	07:53	15:49 (T-80) 07:12	07:22	06:27	05:50 05:42	
	17:25	24 16:13 (T-80) 18:07	19:43	20:22	20:57 21:16	
26	07:53	15:51 (T-80) 07:10	17:43 (T-62)	07:20	06:25	05:49 05:43
	17:26	19 16:10 (T-80) 18:08	3 17:46 (T-62)	19:45	20:23	20:58 21:16
27	07:52	15:55 (T-80) 07:09	17:42 (T-62)	07:18	06:24	05:48 05:43
	17:28	12 16:07 (T-80) 18:10	6 17:48 (T-62)	19:46	20:24	20:59 21:16
28	07:51	07:07	17:41 (T-62)	07:16	06:22	05:47 05:43
	17:29	18:11	8 17:49 (T-62)	19:47	20:26	21:00 21:16
29	07:50	07:14	07:14	06:21	05:47 05:44	
	17:30	19:48	20:27	21:01 21:16		
30	07:49	07:13	06:19	05:46 05:44		
	17:32	19:50	20:28	21:02 21:16		
31	07:47	07:11	05:45			
	17:33	19:51	21:03			
Potential sun hours	287	292	369	403	458	465
Total, worst case	1131	57	298			
Sun reduction	0.58	0.58	0.59			
Oper. time red.	0.90	0.90	0.90			
Wind dir. red.	0.62	0.59	0.57			
Total reduction	0.32	0.31	0.31			
Total, real	364	17	91			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-283 - R-283
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December		
1	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	18:19 (T-63) 25 18:44 (T-63)	07:03 8 16:44 (T-85)	07:43 16:48	15:13 (T-80) 49 16:02 (T-80)
2	05:45 21:16	06:13 20:53	06:49 20:05	07:25 19:09	18:18 (T-63) 25 18:43 (T-63)	07:05 7 16:51 (T-85)	07:44 16:48	15:13 (T-80) 49 16:02 (T-80)
3	05:46 21:16	06:14 20:52	06:51 20:03	07:26 19:07	18:17 (T-63) 24 18:41 (T-63)	07:06 5 16:49 (T-85)	07:45 16:47	15:13 (T-80) 50 16:03 (T-80)
4	05:47 21:15	06:16 20:51	06:52 20:01	07:27 19:05	18:16 (T-63) 23 18:39 (T-63)	07:08 4 16:48 (T-85)	07:46 16:47	15:13 (T-80) 50 16:03 (T-80)
5	05:47 21:15	06:17 20:49	06:53 19:59	07:29 19:03	18:16 (T-63) 22 18:38 (T-63)	07:09 2 16:46 (T-85)	07:47 16:47	15:14 (T-80) 51 16:05 (T-80)
6	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	18:15 (T-63) 21 18:36 (T-63)	07:10 1 16:44 (T-85)	07:48 16:47	15:14 (T-80) 51 16:05 (T-80)
7	05:49 21:14	06:19 20:47	06:55 19:55	07:31 18:58	18:15 (T-63) 19 18:34 (T-62)	07:12 17:08	07:49 16:46	15:14 (T-80) 52 16:06 (T-80)
8	05:49 21:14	06:20 20:45	06:56 19:54	07:32 18:56	18:14 (T-63) 18 18:32 (T-62)	07:13 17:07	07:50 16:46	15:15 (T-80) 51 16:06 (T-80)
9	05:50 21:14	06:21 20:44	06:58 19:52	07:33 18:54	18:14 (T-63) 16 18:31 (T-62)	07:14 17:06	07:51 16:46	15:15 (T-80) 52 16:07 (T-80)
10	05:51 21:13	06:22 20:42	06:59 19:50	07:35 18:52	18:15 (T-62) 13 18:28 (T-62)	07:16 17:05	07:52 16:46	15:15 (T-80) 53 16:08 (T-80)
11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:50	18:14 (T-62) 12 18:26 (T-62)	07:17 17:04	07:53 16:46	15:15 (T-80) 52 16:07 (T-80)
12	05:52 21:12	06:25 20:39	07:01 19:46	07:37 18:49	18:14 (T-62) 11 18:25 (T-62)	07:18 17:03	07:54 16:46	15:15 (T-80) 53 16:08 (T-80)
13	05:53 21:12	06:26 20:38	07:02 19:44	07:39 18:47	18:14 (T-62) 9 18:23 (T-62)	07:20 17:02	07:55 16:46	15:16 (T-80) 52 16:08 (T-80)
14	05:54 21:11	06:27 20:36	07:03 19:42	07:40 18:45	18:14 (T-62) 7 18:21 (T-62)	07:21 17:00	07:55 16:47	15:16 (T-80) 53 16:09 (T-80)
15	05:55 21:10	06:28 20:35	07:05 19:41	07:41 18:43	18:15 (T-62) 5 18:20 (T-62)	07:22 16:59	07:56 15:28 (T-80)	15:17 (T-80) 52 16:10 (T-80)
16	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	18:16 (T-62) 2 18:18 (T-62)	07:24 16:58	07:57 15:44 (T-80)	15:17 (T-80) 53 16:10 (T-80)
17	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	18:16 (T-62) 24 15:46 (T-80)	07:25 16:57	07:58 15:22 (T-80)	15:17 (T-80) 54 16:11 (T-80)
18	05:58 21:08	06:32 20:30	07:08 19:35	07:45 18:38	18:16 (T-62) 28 15:48 (T-80)	07:26 16:57	07:58 15:20 (T-80)	15:18 (T-80) 53 16:11 (T-80)
19	05:59 21:07	06:33 20:29	07:09 19:33	07:46 18:37	18:16 (T-62) 30 15:49 (T-80)	07:28 16:56	07:59 15:19 (T-80)	15:18 (T-80) 53 16:11 (T-80)
20	06:00 21:07	06:34 20:27	07:10 19:31	07:47 18:35	18:16 (T-62) 34 15:52 (T-80)	07:29 16:55	08:00 15:18 (T-80)	15:19 (T-80) 53 16:12 (T-80)
21	06:01 21:06	06:35 20:25	07:12 19:29	07:49 18:33	18:16 (T-62) 36 15:53 (T-80)	07:30 16:54	08:00 15:17 (T-80)	15:19 (T-80) 53 16:12 (T-80)
22	06:02 21:05	06:36 20:24	07:13 19:27	07:50 18:32	18:16 (T-62) 37 15:53 (T-80)	07:32 16:53	08:01 15:16 (T-80)	15:20 (T-80) 53 16:13 (T-80)
23	06:03 21:04	06:38 20:22	07:14 19:25	07:51 18:30	18:16 (T-62) 39 15:55 (T-80)	07:33 16:53	08:01 15:16 (T-80)	15:20 (T-80) 53 16:13 (T-80)
24	06:04 21:03	06:39 20:20	07:15 19:24	07:53 18:28	18:16 (T-62) 41 15:56 (T-80)	07:34 16:52	08:02 15:15 (T-80)	15:21 (T-80) 53 16:14 (T-80)
25	06:05 21:02	06:40 20:19	07:16 19:22	07:54 18:27	18:16 (T-62) 42 15:56 (T-80)	07:35 16:51	08:02 15:14 (T-80)	15:21 (T-80) 53 16:14 (T-80)
26	06:06 21:01	06:41 20:17	07:18 19:20	07:55 18:25	18:16 (T-62) 44 15:58 (T-80)	07:37 16:51	08:02 15:14 (T-80)	15:21 (T-80) 53 16:14 (T-80)
27	06:07 21:00	06:42 20:15	07:19 19:18	07:57 18:24	18:16 (T-62) 45 15:59 (T-80)	07:38 16:50	08:03 15:14 (T-80)	15:22 (T-80) 54 16:16 (T-80)
28	06:08 20:59	06:44 20:13	07:20 19:16	07:58 18:22	18:16 (T-62) 46 15:59 (T-80)	07:39 16:49	08:03 15:13 (T-80)	15:23 (T-80) 53 16:16 (T-80)
29	06:09 20:58	06:45 20:12	07:21 19:14	07:59 18:21	18:16 (T-62) 20 18:42 (T-63)	07:40 16:49	08:03 15:14 (T-80)	15:23 (T-80) 53 16:16 (T-80)
30	06:10 20:57	06:46 20:10	07:22 19:12	08:01 18:19	18:16 (T-62) 7 17:47 (T-85)	07:41 16:48	08:03 15:14 (T-80)	15:24 (T-80) 52 16:16 (T-80)
31	06:11 20:55	06:47 20:08	07:23 19:11	08:02 18:18	18:16 (T-62) 7 17:53 (T-85)	07:41 16:48	08:04 15:14 (T-80)	15:24 (T-80) 53 16:17 (T-80)
Potential sun hours	471	436	377	341	289	275		1620
Total, worst case				266		599		0.52
Sun reduction			0.67	0.56		0.48		0.90
Oper. time red.			0.90	0.90		0.90		0.62
Wind dir. red.			0.57	0.58		0.61		0.29
Total reduction			0.35	0.29		0.27		0.29
Total, real			24	77		159		467

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-284 - R-284

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:46	16:38 (T-71) 07:05	07:09	06:18	05:45
	16:57	17:35 26	17:04 (T-71) 18:12	19:52	20:29	21:03
2	08:04	07:45	16:39 (T-71) 07:04	07:07	06:16	05:44
	16:57	17:36 24	17:03 (T-71) 18:14	19:53	20:30	21:04
3	08:04	07:44	16:41 (T-71) 07:02	07:05	06:15	05:44
	16:58	17:37 21	17:02 (T-71) 18:15	19:54	20:32	21:05
4	08:04	07:43	16:41 (T-71) 07:00	07:03	06:13	05:43
	16:59	17:39 19	17:00 (T-71) 18:16	19:56	20:33	21:06
5	08:04	07:41	16:44 (T-71) 06:58	07:01	06:12	05:43
	17:00	17:40 14	16:58 (T-71) 18:18	19:57	20:34	21:07
6	08:03	07:40	16:48 (T-71) 06:57	07:00	06:11	05:42
	17:01	17:42 8	16:56 (T-71) 18:19	19:58	20:35	21:07
7	08:03	07:39	06:55	06:58	06:09	05:42
	17:02	17:43	18:20	19:59	20:36	21:08
8	08:03	16:34 (T-71) 07:38	07:53	06:56	06:08	05:42
	17:03	1 16:35 (T-71) 17:44	18:21	20:01	20:38	21:09
9	08:03	16:34 (T-71) 07:36	07:51	06:54	06:07	05:42
	17:05	3 16:37 (T-71) 17:46	19:23	20:02	20:39	21:09
10	08:02	16:33 (T-71) 07:35	07:49	06:52	06:05	05:41
	17:06	5 16:38 (T-71) 17:47	19:24	20:03	20:40	21:10
11	08:02	16:33 (T-71) 07:34	07:48	06:51	06:04	05:41
	17:07	6 16:39 (T-71) 17:49	19:25	20:04	20:41	21:11
12	08:02	16:32 (T-71) 07:32	07:46	06:49	06:03	05:41
	17:08	8 16:40 (T-71) 17:50	19:27	20:06	20:42	21:11
13	08:01	16:33 (T-71) 07:31	07:44	19:04 (T-70) 06:47	06:02	05:41
	17:09	9 16:42 (T-71) 17:52	19:28	2 19:06 (T-70) 20:07	20:44	21:12
14	08:01	16:32 (T-71) 07:29	07:42	19:04 (T-70) 06:45	06:01	05:41
	17:10	10 16:42 (T-71) 17:53	19:29	4 19:08 (T-70) 20:08	20:45	21:12
15	08:00	16:33 (T-71) 07:28	07:40	19:04 (T-70) 06:44	05:59	05:41
	17:12	11 16:44 (T-71) 17:54	19:31	6 19:10 (T-70) 20:09	20:46	21:13
16	08:00	16:32 (T-71) 07:26	07:38	19:04 (T-70) 06:42	05:58	05:41
	17:13	13 16:45 (T-71) 17:56	19:32	7 19:11 (T-70) 20:11	20:47	21:13
17	07:59	16:32 (T-71) 07:25	07:37	19:05 (T-70) 06:40	05:57	05:41
	17:14	14 16:46 (T-71) 17:57	19:33	7 19:12 (T-70) 20:12	20:48	21:14
18	07:59	16:32 (T-71) 07:23	07:35	19:05 (T-70) 06:39	05:56	05:41
	17:15	16 16:48 (T-71) 17:59	19:34	8 19:13 (T-70) 20:13	20:49	21:14
19	07:58	16:32 (T-71) 07:22	07:33	19:07 (T-70) 06:37	05:55	05:41
	17:17	18 16:50 (T-71) 18:00	19:36	7 19:14 (T-70) 20:14	20:50	21:14
20	07:57	16:32 (T-71) 07:20	07:31	06:35	05:54	05:41
	17:18	19 16:51 (T-71) 18:00	19:37	20:16	20:51	21:15
21	07:57	16:32 (T-71) 07:19	07:29	06:33	05:53	05:41
	17:19	20 16:52 (T-71) 18:01	19:38	20:17	20:53	21:15
22	07:56	16:33 (T-71) 07:17	07:27	06:32	05:52	05:41
	17:21	21 16:54 (T-71) 18:03	19:39	20:18	20:54	21:15
23	07:55	16:33 (T-71) 07:15	07:25	06:30	05:51	05:42
	17:22	23 16:56 (T-71) 18:04	19:41	20:19	20:55	21:15
24	07:54	16:33 (T-71) 07:14	07:24	06:29	05:50	05:42
	17:23	24 16:57 (T-71) 18:05	19:42	20:21	20:56	21:16
25	07:53	16:34 (T-71) 07:12	07:22	06:27	05:50	05:42
	17:25	24 16:58 (T-71) 18:07	19:43	20:22	20:57	21:16
26	07:52	16:34 (T-71) 07:10	07:20	06:25	05:49	05:42
	17:26	26 17:00 (T-71) 18:08	19:44	20:23	20:58	21:16
27	07:51	16:34 (T-71) 07:09	07:18	06:24	05:48	05:43
	17:28	27 17:01 (T-71) 18:09	19:46	20:24	20:59	21:16
28	07:50	16:35 (T-71) 07:07	07:16	06:22	05:47	05:43
	17:29	28 17:03 (T-71) 18:11	19:47	20:25	21:00	21:16
29	07:49	16:36 (T-71)	07:14	06:21	05:47	05:44
	17:30	29 17:05 (T-71)	19:48	20:27	21:01	21:16
30	07:48	16:36 (T-71)	07:12	06:19	05:46	05:44
	17:32	28 17:04 (T-71)	19:49	20:28	21:01	21:16
31	07:47	16:36 (T-71)	07:11		05:45	
	17:33	28 17:04 (T-71)	19:51		21:02	
Potential sun hours	287	292	369	403	458	465
Total, worst case	411	112	41			
Sun reduction	0.58	0.58	0.59			
Oper. time red.	0.90	0.90	0.90			
Wind dir. red.	0.59	0.59	0.58			
Total reduction	0.31	0.31	0.31			
Total, real	126	34	13			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)	
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker	(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-284 - R-284
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10	18:45 (T-70) 07:03	07:42 16:15 (T-71)
2	05:45 21:16	06:13 20:53	06:49 20:04	07:25 19:08	18:46 (T-70) 07:05	6 16:21 (T-71)
3	05:46 21:15	06:14 20:52	06:50 20:03	07:26 19:07	07:06 17:14	5 16:21 (T-71)
4	05:46 21:15	06:15 20:50	06:52 20:01	07:27 19:05	07:07 17:12	3 16:20 (T-71)
5	05:47 21:15	06:17 20:49	06:53 19:59	07:28 19:03	07:09 17:11	2 16:20 (T-71)
6	05:48 21:15	06:18 20:48	06:54 19:57	07:30 19:01	07:10 17:10	9 16:26 (T-71)
7	05:48 21:14	06:19 20:46	06:55 19:55	07:31 18:57	07:11 17:08	16 16:29 (T-71)
8	05:49 21:14	06:20 20:45	06:56 19:53	07:32 18:56	07:13 17:07	19 16:31 (T-71)
9	05:50 21:13	06:21 20:44	06:57 19:52	07:33 18:54	07:14 17:06	22 16:32 (T-71)
10	05:51 21:13	06:22 20:42	06:59 19:50	07:35 18:52	07:16 17:05	24 16:34 (T-71)
11	05:51 21:13	06:24 20:41	07:00 19:48	07:36 18:50	07:17 17:04	28 16:36 (T-71)
12	05:52 21:12	06:25 20:39	07:01 19:46	07:37 18:48	07:18 17:03	29 16:36 (T-71)
13	05:53 21:11	06:26 20:38	07:02 19:44	07:38 18:47	07:20 17:01	28 16:36 (T-71)
14	05:54 21:11	06:27 20:36	07:03 19:42	07:40 18:45	07:21 17:00	28 16:35 (T-71)
15	05:55 21:10	06:28 20:35	07:05 19:40	07:41 18:43	07:22 16:59	27 16:33 (T-71)
16	05:56 21:10	06:29 20:33	07:06 19:39	07:42 18:42	07:24 16:58	26 16:33 (T-71)
17	05:57 21:09	06:31 20:32	07:07 19:37	07:43 18:40	07:25 16:57	24 16:31 (T-71)
18	05:58 21:08	06:32 20:30	07:08 19:35	07:45 18:38	07:26 16:57	24 16:31 (T-71)
19	05:59 21:07	06:33 20:28	07:09 19:33	07:46 18:36	07:28 16:56	23 16:30 (T-71)
20	05:59 21:06	06:34 20:27	07:10 19:31	07:47 18:35	07:29 16:55	21 16:28 (T-71)
21	06:00 21:06	06:35 20:25	07:12 19:29	07:49 18:33	07:30 16:54	20 16:28 (T-71)
22	06:01 21:05	06:36 20:24	07:13 19:27	07:50 18:32	07:31 16:53	19 16:27 (T-71)
23	06:02 21:04	06:38 20:22	07:14 19:25	07:51 18:30	07:33 16:52	18 16:27 (T-71)
24	06:03 21:03	06:39 20:20	07:15 19:23	18:52 (T-70) 07:53	07:34 16:52	16 16:25 (T-71)
25	06:05 21:02	06:40 20:18	07:16 19:22	18:48 (T-70) 18:56 (T-70)	07:35 16:51	14 16:24 (T-71)
26	06:06 21:01	06:41 20:17	07:18 19:20	18:47 (T-70) 18:55 (T-70)	07:37 16:50	13 16:24 (T-71)
27	06:07 21:00	06:42 20:15	07:19 19:18	18:46 (T-70) 18:53 (T-70)	07:38 16:50	11 16:23 (T-71)
28	06:08 20:59	06:43 20:13	07:20 19:16	18:45 (T-70) 18:51 (T-70)	07:39 16:49	11 16:23 (T-71)
29	06:09 20:58	06:45 20:12	07:21 19:14	18:44 (T-70) 18:49 (T-70)	07:40 16:49	9 16:22 (T-71)
30	06:10 20:56	06:46 20:10	07:22 19:12	18:44 (T-70) 18:19	07:41 16:48	8 16:22 (T-71)
31	06:11 20:55	06:47 20:08		08:02 18:18		
Potential sun hours	471	436	377	341	289	276
Total, worst case					513	16
Sun reduction			0.67	0.56	0.48	0.52
Oper. time red.			0.90	0.90	0.90	0.90
Wind dir. red.			0.58	0.58	0.59	0.59
Total reduction			0.35	0.29	0.25	0.28
Total, real			15	0	130	4

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-285 - R-285

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June		
1	08:04	07:46	16:39 (T-71)	07:05	07:09	06:18	05:45	
	16:57	17:35	25 17:04 (T-71)	18:12	19:52	20:29	21:03	
2	08:04	07:45	16:41 (T-71)	07:04	07:07	06:16	05:44	
	16:57	17:36	23 17:04 (T-71)	18:14	19:53	20:30	21:04	
3	08:04	07:44	16:42 (T-71)	07:02	07:05	06:15	05:44	
	16:58	17:37	21 17:03 (T-71)	18:15	19:54	20:32	21:05	
4	08:04	07:43	16:43 (T-71)	07:00	07:03	06:13	05:43	
	16:59	17:39	18 17:01 (T-71)	18:16	19:56	20:33	21:06	
5	08:04	07:41	16:46 (T-71)	06:58	07:01	06:12	05:43	
	17:00	17:40	13 16:59 (T-71)	18:18	19:57	20:34	21:07	
6	08:03	07:40	16:50 (T-71)	06:57	07:00	06:11	05:42	
	17:01	17:42	6 16:56 (T-71)	18:19	19:58	20:35	21:07	
7	08:03	07:39	07:39	06:55	06:58	06:09	05:42	
	17:02	17:43	18:20	19:59	20:36	21:08		
8	08:03	07:38	07:38	07:53	06:56	06:08	05:42	
	17:03	17:44	18:21	20:01	20:38	21:09		
9	08:03	16:36 (T-71)	07:36	07:51	06:54	06:07	05:42	
	17:05	1 16:37 (T-71)	17:46	19:23	20:02	20:39	21:09	
10	08:02	16:35 (T-71)	07:35	07:49	06:52	06:05	05:41	
	17:06	3 16:38 (T-71)	17:47	19:24	20:03	20:40	21:10	
11	08:02	16:35 (T-71)	07:34	07:48	06:51	06:04	05:41	
	17:07	4 16:39 (T-71)	17:49	19:25	20:04	20:41	21:11	
12	08:02	16:34 (T-71)	07:32	07:46	19:04 (T-70)	06:49	06:03	05:41
	17:08	6 16:40 (T-71)	17:50	19:27	1 19:05 (T-70)	20:06	20:42	21:11
13	08:01	16:35 (T-71)	07:31	07:44	19:03 (T-70)	06:47	06:02	05:41
	17:09	7 16:42 (T-71)	17:52	19:28	3 19:06 (T-70)	20:07	20:44	21:12
14	08:01	16:34 (T-71)	07:29	07:42	19:03 (T-70)	06:45	06:01	05:41
	17:10	8 16:42 (T-71)	17:53	19:29	5 19:08 (T-70)	20:08	20:45	21:12
15	08:00	16:35 (T-71)	07:28	07:40	19:04 (T-70)	06:44	05:59	05:41
	17:12	9 16:44 (T-71)	17:54	19:31	6 19:10 (T-70)	20:09	20:46	21:13
16	08:00	16:34 (T-71)	07:26	07:38	19:04 (T-70)	06:42	05:58	05:41
	17:13	11 16:45 (T-71)	17:56	19:32	7 19:11 (T-70)	20:11	20:47	21:13
17	07:59	16:34 (T-71)	07:25	07:37	19:05 (T-70)	06:40	05:57	05:41
	17:14	12 16:46 (T-71)	17:57	19:33	7 19:12 (T-70)	20:12	20:48	21:14
18	07:59	16:34 (T-71)	07:23	07:35	19:06 (T-70)	06:39	05:56	05:41
	17:15	14 16:48 (T-71)	17:59	19:34	7 19:13 (T-70)	20:13	20:49	21:14
19	07:58	16:34 (T-71)	07:22	07:33	06:37	05:55	05:41	
	17:17	16 16:50 (T-71)	18:00	19:36	20:14	20:50	21:14	
20	07:57	16:34 (T-71)	07:20	07:31	06:35	05:54	05:41	
	17:18	17 16:51 (T-71)	18:00	19:37	20:16	20:51	21:15	
21	07:57	16:34 (T-71)	07:19	07:29	06:33	05:53	05:41	
	17:19	18 16:52 (T-71)	18:01	19:38	20:17	20:53	21:15	
22	07:56	16:35 (T-71)	07:17	07:27	06:32	05:52	05:41	
	17:21	19 16:54 (T-71)	18:03	19:39	20:18	20:54	21:15	
23	07:55	16:35 (T-71)	07:15	07:25	06:30	05:51	05:42	
	17:22	21 16:56 (T-71)	18:04	19:41	20:19	20:55	21:15	
24	07:54	16:35 (T-71)	07:14	07:24	06:29	05:50	05:42	
	17:23	22 16:57 (T-71)	18:05	19:42	20:21	20:56	21:16	
25	07:53	16:35 (T-71)	07:12	07:22	06:27	05:50	05:42	
	17:25	23 16:58 (T-71)	18:07	19:43	20:22	20:57	21:16	
26	07:52	16:36 (T-71)	07:10	07:20	06:25	05:49	05:42	
	17:26	24 17:00 (T-71)	18:08	19:44	20:23	20:58	21:16	
27	07:51	16:36 (T-71)	07:09	07:18	06:24	05:48	05:43	
	17:28	25 17:01 (T-71)	18:09	19:46	20:24	20:59	21:16	
28	07:50	16:37 (T-71)	07:07	07:16	06:22	05:47	05:43	
	17:29	26 17:03 (T-71)	18:11	19:47	20:25	21:00	21:16	
29	07:49	16:37 (T-71)	07:07	07:14	06:21	05:47	05:44	
	17:30	28 17:05 (T-71)	18:11	19:48	20:27	21:01	21:16	
30	07:48	16:37 (T-71)	07:06	07:12	06:19	05:46	05:44	
	17:32	28 17:05 (T-71)	18:11	19:49	20:28	21:01	21:16	
31	07:47	16:38 (T-71)	07:05	07:11	06:18	05:45	05:44	
	17:33	27 17:05 (T-71)	18:10	19:51	20:29	21:02	21:16	
Potential sun hours	287	292	369	403	458	465		
Total, worst case	369	106	36					
Sun reduction	0.58	0.58	0.59					
Oper. time red.	0.90	0.90	0.90					
Wind dir. red.	0.59	0.59	0.58					
Total reduction	0.31	0.31	0.31					
Total, real	113	32	11					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-285 - R-285
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December		
1	05:45	06:12	06:48	07:24	18:44 (T-70)	07:03	07:42	16:17 (T-71)
	21:16	20:54	20:06	19:10	2 18:46 (T-70)	17:16	16:48	4 16:21 (T-71)
2	05:45	06:13	06:49	07:25		07:05	07:44	16:18 (T-71)
	21:16	20:53	20:04	19:08		17:15	16:48	3 16:21 (T-71)
3	05:46	06:14	06:50	07:26		07:06	07:45	16:19 (T-71)
	21:15	20:52	20:03	19:07		17:14	16:47	1 16:20 (T-71)
4	05:46	06:15	06:52	07:27		07:07	07:46	
	21:15	20:50	20:01	19:05		17:12	16:47	
5	05:47	06:17	06:53	07:28		07:09	16:19 (T-71)	07:47
	21:15	20:49	19:59	19:03		17:11	16:26 (T-71)	16:47
6	05:48	06:18	06:54	07:30		07:10	16:15 (T-71)	07:48
	21:15	20:48	19:57	19:01		17:10	16:29 (T-71)	16:47
7	05:48	06:19	06:55	07:31		07:11	16:14 (T-71)	07:49
	21:14	20:46	19:55	18:57		17:08	16:32 (T-71)	16:46
8	05:49	06:20	06:56	07:32		07:13	16:12 (T-71)	07:50
	21:14	20:45	19:53	18:56		17:07	21 16:33 (T-71)	16:46
9	05:50	06:21	06:57	07:33		07:14	16:11 (T-71)	07:51
	21:13	20:44	19:52	18:54		17:06	24 16:35 (T-71)	16:46
10	05:51	06:22	06:59	07:35		07:16	16:10 (T-71)	07:52
	21:13	20:42	19:50	18:52		17:05	25 16:35 (T-71)	16:46
11	05:51	06:24	07:00	07:36		07:17	16:10 (T-71)	07:53
	21:13	20:41	19:48	18:50		17:04	27 16:37 (T-71)	16:46
12	05:52	06:25	07:01	07:37		07:18	16:09 (T-71)	07:54
	21:12	20:39	19:46	18:48		17:03	28 16:37 (T-71)	16:46
13	05:53	06:26	07:02	07:38		07:20	16:09 (T-71)	07:54
	21:11	20:38	19:44	18:47		17:01	27 16:36 (T-71)	16:46
14	05:54	06:27	07:03	07:40		07:21	16:09 (T-71)	07:55
	21:11	20:36	19:42	18:45		17:00	26 16:35 (T-71)	16:47
15	05:55	06:28	07:05	07:41		07:22	16:08 (T-71)	07:56
	21:10	20:35	19:40	18:43		16:59	25 16:33 (T-71)	16:47
16	05:56	06:29	07:06	07:42		07:24	16:09 (T-71)	07:57
	21:10	20:33	19:39	18:42		16:58	24 16:33 (T-71)	16:47
17	05:57	06:31	07:07	07:43		07:25	16:08 (T-71)	07:58
	21:09	20:32	19:37	18:40		16:57	23 16:31 (T-71)	16:47
18	05:58	06:32	07:08	07:45		07:26	16:09 (T-71)	07:58
	21:08	20:30	19:35	18:38		16:56	22 16:31 (T-71)	16:48
19	05:59	06:33	07:09	07:46		07:28	16:09 (T-71)	07:59
	21:07	20:28	19:33	18:36		16:56	21 16:30 (T-71)	16:48
20	05:59	06:34	07:10	07:47		07:29	16:09 (T-71)	07:59
	21:06	20:27	19:31	18:35		16:55	19 16:28 (T-71)	16:48
21	06:00	06:35	07:12	07:49		07:30	16:10 (T-71)	08:00
	21:06	20:25	19:29	18:33		16:54	18 16:28 (T-71)	16:49
22	06:01	06:36	07:13	07:50		07:31	16:10 (T-71)	08:00
	21:05	20:23	19:27	18:32		16:53	17 16:27 (T-71)	16:49
23	06:02	06:38	07:14	07:51		07:33	16:11 (T-71)	08:01
	21:04	20:22	19:25	18:30		16:52	16 16:27 (T-71)	16:50
24	06:03	06:39	07:15	07:53		07:34	16:11 (T-71)	08:01
	21:03	20:20	19:23	18:28		16:52	14 16:25 (T-71)	16:50
25	06:05	06:40	07:16	18:50 (T-70)	07:54	07:35	16:12 (T-71)	08:02
	21:02	20:18	19:22	6 18:56 (T-70)	18:27	16:51	12 16:24 (T-71)	16:51
26	06:06	06:41	07:18	7 18:48 (T-70)	07:55	07:37	16:13 (T-71)	08:02
	21:01	20:17	19:20	7 18:55 (T-70)	18:25	16:50	11 16:24 (T-71)	16:52
27	06:07	06:42	07:19	8 18:46 (T-70)	07:57	07:38	16:14 (T-71)	08:03
	21:00	20:15	19:18	7 18:53 (T-70)	18:24	16:50	9 16:23 (T-71)	16:52
28	06:08	06:43	07:20	9 18:45 (T-70)	07:58	07:39	16:14 (T-71)	08:03
	20:59	20:13	19:16	6 18:51 (T-70)	18:22	16:49	9 16:23 (T-71)	16:53
29	06:09	06:45	07:21	10 18:44 (T-70)	07:59	07:40	16:15 (T-71)	08:03
	20:58	20:12	19:14	5 18:49 (T-70)	18:21	16:49	7 16:22 (T-71)	16:54
30	06:10	06:46	07:22	11 18:43 (T-70)	08:01	07:41	16:16 (T-71)	08:03
	20:56	20:10	19:12	4 18:47 (T-70)	18:19	16:48	6 16:22 (T-71)	16:55
31	06:11	06:47			08:02			08:03
	20:55	20:08			18:18			16:55
Potential sun hours	471	436	377	341	289		276	
Total, worst case						470		8
Sun reduction			0.67		0.56	0.48		0.52
Oper. time red.			0.90		0.90	0.90		0.90
Wind dir. red.			0.58		0.58	0.59		0.59
Total reduction			0.35		0.29	0.25		0.27
Total, real			12		1	119		2

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-286 - R-286

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:03	07:43
	16:57	17:35	18:12	19:52	20:29	21:03	21:16	20:54	20:06	19:10	17:17	16:48
2	08:04	07:45	07:04	07:07	06:17	05:45	05:46	06:13	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:53	20:30	21:04	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:15	06:51	07:26	07:06	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:15	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:00	07:03	06:14	05:44	05:47	06:16	06:52	07:27	07:07	07:46
	17:00	17:39	18:16	19:56	20:33	21:06	21:15	20:50	20:01	19:05	17:13	16:47
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47
	17:01	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47
6	08:03	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48
	17:02	17:42	18:19	19:58	20:35	21:07	21:15	20:48	19:57	19:01	17:10	16:47
7	08:03	07:39	06:55	06:58	06:10	05:42	05:49	06:19	06:55	07:31	07:12	07:49
	17:03	17:43	18:20	20:00	20:37	21:08	21:14	20:46	19:55	18:58	17:09	16:47
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:57	07:32	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:47
9	08:03	07:36	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14	07:51
	17:05	17:46	19:23	20:02	20:39	21:09	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:41	21:11	21:13	20:41	19:48	18:50	17:04	16:47
12	08:02	07:32	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:37	07:18	07:54
	17:08	17:50	19:27	20:06	20:42	21:11	21:12	20:39	19:46	18:49	17:03	16:47
13	08:01	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:11	20:38	19:44	18:47	17:02	16:47
14	08:01	07:29	07:42	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:55
	17:11	17:53	19:29	20:08	20:45	21:12	21:11	20:36	19:42	18:45	17:01	16:47
15	08:00	07:28	07:40	06:44	06:00	05:41	05:55	06:28	07:05	07:41	07:22	07:56
	17:12	17:55	19:31	20:10	20:46	21:13	21:10	20:35	19:41	18:43	17:00	16:47
16	08:00	07:26	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:42	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:13	21:10	20:33	19:39	18:42	16:59	16:47
17	07:59	07:25	07:37	06:40	05:57	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:14	17:57	19:33	20:12	20:48	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:23	07:35	06:39	05:56	05:41	05:58	06:32	07:08	07:45	07:26	07:58
	17:16	17:59	19:35	20:13	20:49	21:14	21:08	20:30	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	05:55	05:41	05:59	06:33	07:09	07:46	07:28	07:59
	17:17	18:00	19:36	20:14	20:50	21:14	21:07	20:29	19:33	18:37	16:56	16:48
20	07:57	07:20	07:31	06:35	05:54	05:41	06:00	06:34	07:11	07:47	07:29	07:59
	17:18	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:29	06:34	05:53	05:41	06:01	06:35	07:12	07:49	07:30	08:00
	17:20	18:01	19:38	20:17	20:53	21:15	21:06	20:25	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:18	20:54	21:15	21:05	20:24	19:27	18:32	16:53	16:50
23	07:55	07:15	07:26	06:30	05:52	05:42	06:03	06:38	07:14	07:51	07:33	08:01
	17:22	18:04	19:41	20:19	20:55	21:15	21:04	20:22	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:15	07:53	07:34	08:01
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:20	19:24	18:29	16:52	16:51
25	07:53	07:12	07:22	06:27	05:50	05:42	06:05	06:40	07:16	07:54	07:35	08:02
	17:25	18:07	19:43	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:51	16:51
26	07:52	07:10	07:20	06:26	05:49	05:43	06:06	06:41	07:18	07:55	07:37	08:02
	17:26	18:08	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	05:48	05:43	06:07	06:42	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:16	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:13	19:16	18:22	16:50	16:53
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:21	07:59	07:40	08:03
	17:31		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:48		07:13	06:20	05:46	05:45	06:10	06:46	07:22	08:01	07:41	08:03
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:49	16:55
31	07:47		07:11	06:19	05:46		06:11	06:47		08:02		08:03
	17:33		19:51		21:02		20:55	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	435	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-289 - R-289

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:05	08:29 (T-13)	07:47	07:06	07:09	06:18
	16:57	20 08:49 (T-13)	17:35	18:13	19:53	20:30
2	08:05	08:29 (T-13)	07:46	07:04	07:08	06:17
	16:58	21 08:50 (T-13)	17:36	18:14	19:54	20:31
3	08:05	08:29 (T-13)	07:45	07:03	07:06	06:15
	16:59	21 08:50 (T-13)	17:38	18:15	19:55	20:32
4	08:05	08:29 (T-13)	07:44	07:01	07:04	06:14
	17:00	22 08:51 (T-13)	17:39	18:17	19:56	20:34
5	08:04	08:29 (T-13)	07:42	06:59	07:02	06:12
	17:01	23 08:52 (T-13)	17:41	18:18	19:58	20:35
6	08:04	08:29 (T-13)	07:41	06:57	07:00	06:11
	17:02	24 08:53 (T-13)	17:42	18:19	19:59	20:36
7	08:04	08:28 (T-13)	07:40	06:55	06:58	06:10
	17:03	24 08:52 (T-13)	17:44	18:21	20:00	20:37
8	08:04	08:28 (T-13)	07:38	07:54	06:57	06:08
	17:04	25 08:53 (T-13)	17:45	18:22	20:01	20:39
9	08:04	08:28 (T-13)	07:37	07:52	06:55	06:07
	17:05	26 08:54 (T-13)	17:46	19:23	20:03	20:40
10	08:03	08:27 (T-13)	07:36	07:50	06:53	06:06
	17:06	27 08:54 (T-13)	17:48	19:25	20:04	20:41
11	08:03	08:27 (T-13)	07:34	07:48	06:51	06:05
	17:07	27 08:54 (T-13)	17:49	19:26	20:05	20:42
12	08:03	08:26 (T-13)	07:33	07:46	06:49	06:03
	17:08	28 08:54 (T-13)	17:51	19:27	20:06	20:43
13	08:02	08:26 (T-13)	07:32	07:45	06:48	06:02
	17:10	29 08:55 (T-13)	17:52	19:29	20:08	20:44
14	08:02	08:25 (T-13)	07:30	07:43	06:46	06:01
	17:11	30 08:55 (T-13)	17:53	19:30	20:09	20:46
15	08:01	08:27 (T-13)	07:29	07:41	06:44	06:00
	17:12	28 08:55 (T-13)	17:55	19:31	20:10	20:47
16	08:01	08:27 (T-13)	07:27	07:39	06:42	05:59
	17:13	28 08:55 (T-13)	17:56	19:32	20:11	20:48
17	08:00	08:27 (T-13)	07:26	07:37	06:41	05:58
	17:15	28 08:55 (T-13)	17:58	19:34	20:13	20:49
18	08:00	08:29 (T-13)	07:24	07:35	06:39	05:57
	17:16	26 08:55 (T-13)	17:59	19:35	20:14	20:50
19	07:59	08:29 (T-13)	07:23	07:34	06:37	05:56
	17:17	26 08:55 (T-13)	18:00	19:36	20:15	20:51
20	07:58	08:30 (T-13)	07:21	07:32	06:36	05:55
	17:18	25 08:55 (T-13)	18:00	19:38	20:16	20:52
21	07:58	08:31 (T-13)	07:19	07:30	06:34	05:54
	17:20	23 08:54 (T-13)	18:02	19:39	20:18	20:53
22	07:57	08:32 (T-13)	07:18	07:28	06:32	05:53
	17:21	21 08:53 (T-13)	18:03	19:40	20:19	20:55
23	07:56	08:34 (T-13)	07:16	07:26	06:31	05:52
	17:22	19 08:53 (T-13)	18:05	19:41	20:20	20:56
24	07:55	08:35 (T-13)	07:14	07:24	06:29	05:51
	17:24	17 08:52 (T-13)	18:06	19:43	20:21	20:57
25	07:54	08:37 (T-13)	07:13	07:22	06:27	05:50
	17:25	14 08:51 (T-13)	18:07	19:44	20:23	20:58
26	07:53	08:40 (T-13)	07:11	07:21	06:26	05:49
	17:27	8 08:48 (T-13)	18:09	19:45	20:24	20:59
27	07:52		07:09	07:19	06:24	05:48
	17:28		18:10	19:46	20:25	21:00
28	07:51		07:08	07:17	06:23	05:48
	17:29		18:11	19:48	20:26	21:01
29	07:50			07:15	06:21	05:47
	17:31			19:49	20:28	21:02
30	07:49			07:13	06:20	05:46
	17:32			19:50	20:29	21:02
31	07:48			07:11	06:19	05:46
	17:34			19:51	21:03	21:03
Potential sun hours	287	292	369	404	459	465
Total, worst case	610				593	665
Sun reduction	0.58				0.66	0.73
Oper. time red.	0.90				0.90	0.90
Wind dir. red.	0.66				0.63	0.63
Total reduction	0.34				0.38	0.42
Total, real	210				224	277

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-289 - R-289
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July		August		September		October		November		December	
1	05:45	20:14 (T-11)	06:13	20:13 (T-11)	06:49	07:24	07:04	07:43	08:09 (T-13)			
	21:17	22 20:36 (T-11)	20:55	16 20:29 (T-11)	20:07	19:11	17:17	16:48	27 08:36 (T-13)			
2	05:46	20:13 (T-11)	06:14	20:13 (T-11)	06:50	07:25	07:06	07:45	08:10 (T-13)			
	21:17	23 20:36 (T-11)	20:54	15 20:28 (T-11)	20:05	19:09	17:15	16:48	27 08:37 (T-13)			
3	05:46	20:13 (T-11)	06:15	20:14 (T-11)	06:51	07:27	07:07	07:46	08:11 (T-13)			
	21:16	24 20:37 (T-11)	20:53	12 20:26 (T-11)	20:03	19:07	17:14	16:48	26 08:37 (T-13)			
4	05:47	20:13 (T-11)	06:16	20:15 (T-11)	06:52	07:28	07:08	07:47	08:12 (T-13)			
	21:16	24 20:37 (T-11)	20:51	10 20:25 (T-11)	20:02	19:05	17:13	16:47	25 08:37 (T-13)			
5	05:47	20:13 (T-11)	06:17	20:16 (T-11)	06:53	07:29	07:10	07:48	08:13 (T-13)			
	21:16	25 20:38 (T-11)	20:50	8 20:24 (T-11)	20:00	19:04	17:11	16:47	24 08:37 (T-13)			
6	05:48	20:12 (T-11)	06:18	20:17 (T-11)	06:55	07:30	07:11	07:49	08:14 (T-13)			
	21:16	26 20:38 (T-11)	20:49	5 20:22 (T-11)	19:58	19:02	17:10	16:47	24 08:38 (T-13)			
7	05:49	20:12 (T-11)	06:19	20:20 (T-11)	06:56	07:32	07:12	07:50	08:15 (T-13)			
	21:15	27 20:39 (T-11)	20:47	2 20:22 (T-11)	19:56	19:00	17:09	16:47	23 08:38 (T-13)			
8	05:49	20:12 (T-11)	06:20	20:20 (T-11)	06:57	07:33	07:14	07:51	08:17 (T-13)			
	21:15	27 20:39 (T-11)	20:46		19:54	18:56	17:08	16:47	22 08:39 (T-13)			
9	05:50	20:12 (T-11)	06:22	20:20 (T-11)	06:58	07:34	07:15	07:52	08:17 (T-13)			
	21:14	28 20:40 (T-11)	20:44		19:52	18:54	17:06	16:47	22 08:39 (T-13)			
10	05:51	20:11 (T-11)	06:23	20:20 (T-11)	06:59	07:35	07:16	07:53	08:18 (T-13)			
	21:14	29 20:40 (T-11)	20:43		19:50	18:53	17:05	16:47	21 08:39 (T-13)			
11	05:52	20:11 (T-11)	06:24	20:20 (T-11)	07:00	07:37	07:18	07:54	08:19 (T-13)			
	21:14	30 20:41 (T-11)	20:42		19:49	18:51	17:04	16:47	20 08:39 (T-13)			
12	05:53	20:11 (T-11)	06:25	20:20 (T-11)	07:02	07:38	07:19	07:55	08:20 (T-13)			
	21:13	30 20:41 (T-11)	20:40		19:47	18:49	17:03	16:47	20 08:40 (T-13)			
13	05:53	20:11 (T-11)	06:26	20:20 (T-11)	07:03	07:39	07:20	07:55	08:21 (T-13)			
	21:12	31 20:42 (T-11)	20:39		19:45	18:47	17:02	16:47	19 08:40 (T-13)			
14	05:54	20:11 (T-11)	06:27	20:20 (T-11)	07:04	07:40	07:22	07:56	08:22 (T-13)			
	21:12	32 20:43 (T-11)	20:37		19:43	18:46	17:01	16:47	19 08:41 (T-13)			
15	05:55	20:10 (T-11)	06:29	20:20 (T-11)	07:05	07:42	07:23	07:57	08:23 (T-13)			
	21:11	32 20:42 (T-11)	20:36		19:41	18:44	17:00	16:47	18 08:41 (T-13)			
16	05:56	20:10 (T-11)	06:30	20:20 (T-11)	07:06	07:43	07:25	07:58	08:23 (T-13)			
	21:10	33 20:43 (T-11)	20:34		19:39	18:42	16:59	8 08:21 (T-13)	16:47	18 08:41 (T-13)		
17	05:57	20:10 (T-11)	06:31	20:20 (T-11)	07:07	07:44	07:26	08:10 (T-13)	07:58	08:24 (T-13)		
	21:10	33 20:43 (T-11)	20:32		19:37	18:40	16:58	14 08:24 (T-13)	16:48	18 08:42 (T-13)		
18	05:58	20:10 (T-11)	06:32	20:20 (T-11)	07:09	07:46	07:27	08:09 (T-13)	07:59	08:25 (T-13)		
	21:09	32 20:42 (T-11)	20:31		19:35	18:39	16:57	17 08:26 (T-13)	16:48	18 08:43 (T-13)		
19	05:59	20:10 (T-11)	06:33	20:20 (T-11)	07:10	07:47	07:28	08:08 (T-13)	08:00	08:25 (T-13)		
	21:08	31 20:41 (T-11)	20:29		19:34	18:37	16:56	19 08:27 (T-13)	16:48	17 08:42 (T-13)		
20	06:00	20:10 (T-11)	06:35	20:20 (T-11)	07:11	07:48	07:30	08:07 (T-13)	08:00	08:26 (T-13)		
	21:07	31 20:41 (T-11)	20:28		19:32	18:35	16:55	21 08:28 (T-13)	16:49	17 08:43 (T-13)		
21	06:01	20:10 (T-11)	06:36	20:20 (T-11)	07:12	07:49	07:31	08:07 (T-13)	08:01	08:26 (T-13)		
	21:07	30 20:40 (T-11)	20:26		19:30	18:34	16:54	23 08:30 (T-13)	16:49	17 08:43 (T-13)		
22	06:02	20:10 (T-11)	06:37	20:20 (T-11)	07:13	07:51	07:32	08:06 (T-13)	08:01	08:27 (T-13)		
	21:06	29 20:39 (T-11)	20:24		19:28	18:32	16:54	25 08:31 (T-13)	16:50	17 08:44 (T-13)		
23	06:03	20:10 (T-11)	06:38	20:20 (T-11)	07:15	07:52	07:34	08:06 (T-13)	08:02	08:27 (T-13)		
	21:05	28 20:38 (T-11)	20:23		19:26	18:30	16:53	26 08:32 (T-13)	16:50	17 08:44 (T-13)		
24	06:04	20:11 (T-11)	06:39	20:20 (T-11)	07:16	07:53	07:35	08:06 (T-13)	08:02	08:28 (T-13)		
	21:04	26 20:37 (T-11)	20:21		19:24	18:29	16:52	26 08:32 (T-13)	16:51	17 08:45 (T-13)		
25	06:05	20:11 (T-11)	06:40	20:20 (T-11)	07:17	07:55	07:36	08:05 (T-13)	08:03	08:28 (T-13)		
	21:03	25 20:36 (T-11)	20:19		19:22	18:27	16:51	28 08:33 (T-13)	16:51	18 08:46 (T-13)		
26	06:06	20:11 (T-11)	06:42	20:20 (T-11)	07:18	07:56	07:37	08:06 (T-13)	08:03	08:28 (T-13)		
	21:02	24 20:35 (T-11)	20:18		19:20	18:26	16:51	28 08:34 (T-13)	16:52	18 08:46 (T-13)		
27	06:07	20:11 (T-11)	06:43	20:20 (T-11)	07:19	07:57	07:39	08:06 (T-13)	08:03	08:29 (T-13)		
	21:01	23 20:34 (T-11)	20:16		19:18	18:24	16:50	28 08:34 (T-13)	16:53	18 08:47 (T-13)		
28	06:08	20:11 (T-11)	06:44	20:20 (T-11)	07:21	07:59	07:40	08:05 (T-13)	08:04	08:29 (T-13)		
	21:00	22 20:33 (T-11)	20:14		19:17	18:23	16:50	30 08:35 (T-13)	16:53	18 08:47 (T-13)		
29	06:09	20:11 (T-11)	06:45	20:20 (T-11)	07:22	08:00	07:41	08:06 (T-13)	08:04	08:29 (T-13)		
	20:59	21 20:32 (T-11)	20:12		19:15	18:21	16:49	29 08:35 (T-13)	16:54	19 08:48 (T-13)		
30	06:10	20:12 (T-11)	06:46	20:20 (T-11)	07:23	08:01	07:42	08:08 (T-13)	08:04	08:29 (T-13)		
	20:57	19 20:31 (T-11)	20:11		19:13	18:20	16:49	28 08:36 (T-13)	16:55	19 08:48 (T-13)		
31	06:11	20:12 (T-11)	06:47	20:20 (T-11)		08:03		08:04		08:29 (T-13)		
	20:56	18 20:30 (T-11)	20:09			18:18		16:56	20 08:49 (T-13)			
Potential sun hours	471		436		377	341	288		275			
Total, worst case	835		68				350		623			
Sun reduction	0.75		0.72				0.48		0.52			
Oper. time red.	0.90		0.90				0.90		0.90			
Wind dir. red.	0.63		0.63				0.66		0.66			
Total reduction	0.43		0.41				0.28		0.31			
Total, real	358		28				100		192			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-290 - R-290

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-45)	07:47	07:06	07:09	06:18
	16:57	50 16:01 (T-42)	17:35	18:12	19:52	21:04
2	08:04	08:29 (T-45)	07:46	07:04	07:07	06:17
	16:58	49 16:01 (T-42)	17:36	18:14	19:54	21:05
3	08:04	08:29 (T-45)	07:44	07:02	07:05	06:15
	16:58	49 16:01 (T-42)	17:38	18:15	19:55	21:06
4	08:04	08:29 (T-45)	07:43	07:00	07:04	06:14
	16:59	48 16:01 (T-42)	17:39	18:16	19:56	21:06
5	08:04	08:28 (T-45)	07:42	06:59	07:02	06:12
	17:00	46 15:59 (T-42)	17:40	18:18	19:57	21:07
6	08:04	08:28 (T-45)	07:41	06:57	07:00	06:11
	17:01	46 15:59 (T-42)	17:42	18:19	19:59	21:08
7	08:04	08:28 (T-45)	07:39	06:55	06:58	06:09
	17:03	44 15:59 (T-42)	17:43	18:20	20:00	21:09
8	08:04	08:28 (T-45)	07:38	07:53	06:56	06:08
	17:04	42 15:58 (T-42)	17:45	18:22	20:01	21:09
9	08:03	08:27 (T-45)	07:37	07:52	06:55	06:07
	17:05	39 15:56 (T-42)	17:46	19:23	20:02	21:10
10	08:03	08:27 (T-45)	07:35	07:50	06:53	06:06
	17:06	30 08:57 (T-45)	17:48	19:24	20:04	21:11
11	08:03	08:26 (T-45)	07:34	07:48	06:51	06:04
	17:07	30 08:56 (T-45)	17:49	19:26	20:05	21:11
12	08:02	08:26 (T-45)	07:33	07:46	06:49	06:03
	17:08	31 08:57 (T-45)	17:50	19:27	20:06	21:12
13	08:02	08:25 (T-45)	07:31	07:44	06:47	06:02
	17:09	32 08:57 (T-45)	17:52	19:28	20:07	21:12
14	08:02	08:25 (T-45)	07:30	07:42	06:46	06:01
	17:11	33 08:58 (T-45)	17:53	19:30	20:09	21:13
15	08:01	08:25 (T-45)	07:28	07:41	06:44	06:00
	17:12	32 08:57 (T-45)	17:55	19:31	20:10	21:13
16	08:00	08:26 (T-45)	07:27	07:39	06:42	05:58
	17:13	32 08:58 (T-45)	17:56	19:32	20:11	21:14
17	08:00	08:27 (T-45)	07:25	07:37	06:40	05:57
	17:14	31 08:58 (T-45)	17:57	19:33	20:12	21:14
18	07:59	08:27 (T-45)	07:24	07:35	06:39	05:56
	17:16	31 08:58 (T-45)	17:59	19:35	20:14	21:15
19	07:59	08:28 (T-45)	07:22	07:33	06:37	05:55
	17:17	30 08:58 (T-45)	18:00	19:36	20:15	21:15
20	07:58	08:21 (T-48)	07:21	07:31	06:35	05:54
	17:18	30 08:58 (T-45)	18:00	19:37	20:16	21:15
21	07:57	08:20 (T-48)	07:19	07:30	06:34	19:53 (T-17)
	17:20	30 08:57 (T-45)	18:02	19:39	20:17	20:53
22	07:56	08:19 (T-48)	07:17	07:28	06:32	19:53 (T-17)
	17:21	30 08:57 (T-45)	18:03	19:40	20:19	20:54
23	07:56	08:18 (T-48)	07:16	07:26	06:30	19:52 (T-17)
	17:22	29 08:56 (T-45)	18:04	19:41	20:20	20:55
24	07:55	08:17 (T-48)	07:14	07:24	06:29	19:52 (T-17)
	17:24	28 08:55 (T-45)	18:06	19:42	20:21	20:56
25	07:54	08:16 (T-48)	07:12	07:22	06:27	19:52 (T-17)
	17:25	26 08:54 (T-45)	18:07	19:44	20:22	20:57
26	07:53	08:15 (T-48)	07:11	07:20	06:26	19:52 (T-17)
	17:26	24 08:52 (T-45)	18:08	19:45	20:24	20:58
27	07:52	08:14 (T-48)	07:09	07:18	06:24	19:53 (T-17)
	17:28	19 08:50 (T-45)	18:10	19:46	20:25	20:59
28	07:51	08:13 (T-48)	07:07	07:17	06:23	19:54 (T-17)
	17:29	8 08:21 (T-48)	18:11	19:47	20:26	21:00
29	07:50	08:12 (T-48)	07:05	07:15	06:21	19:56 (T-17)
	17:31	8 08:20 (T-48)	18:12	19:49	20:27	21:01
30	07:49		07:13	06:19	05:46	21:02
	17:32		19:50	20:28	21:02	23 20:36 (T-18)
31	07:48		07:11	06:17	05:46	21:03
	17:33		19:51	20:29	21:03	24 20:37 (T-18)
Potential sun hours	287	292	369	403	459	465
Total, worst case	957			54	150	782
Sun reduction	0.58			0.63	0.66	0.73
Oper. time red.	0.90			0.90	0.90	0.90
Wind dir. red.	0.65			0.61	0.62	0.63
Total reduction	0.34			0.34	0.37	0.42
Total, real	325			19	55	326

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-290 - R-290
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July	August	September	October	November	December
1	05:45 21:16	06:12 (T-21) 20:49 (T-18)	06:12 20:55	06:48 20:07	07:24 19:11	07:43 17:17
2	05:45 21:16	06:12 (T-21) 20:49 (T-18)	06:13 20:53	06:50 20:05	07:25 19:09	07:05 17:15
3	05:46 21:16	06:11 (T-21) 20:48 (T-18)	06:15 20:52	06:51 20:03	07:26 19:07	07:07 17:14
4	05:47 21:16	06:11 (T-21) 20:48 (T-18)	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:12
5	05:47 21:16	06:12 (T-21) 20:48 (T-18)	06:17 20:50	06:53 19:59	07:29 19:03	07:09 17:11
6	05:48 21:15	06:12 (T-21) 20:48 (T-18)	06:18 20:48	06:54 19:58	07:30 19:01	07:11 17:10
7	05:49 21:15	06:13 (T-21) 20:48 (T-18)	06:19 20:47	06:55 19:56	07:31 19:00	07:12 17:09
8	05:49 21:15	06:14 (T-21) 20:48 (T-18)	06:20 20:46	06:57 19:54	07:33 18:56	07:13 17:07
9	05:50 21:14	06:14 (T-21) 20:46 (T-18)	06:21 20:44	06:58 19:52	07:34 18:54	07:15 17:06
10	05:51 21:14	06:15 (T-21) 20:46 (T-18)	06:23 20:43	06:59 19:50	07:35 18:52	07:16 17:05
11	05:52 21:13	06:16 (T-21) 20:46 (T-18)	06:24 20:41	07:00 19:48	07:36 18:51	07:17 17:04
12	05:52 21:13	06:17 (T-21) 20:46 (T-18)	06:25 20:40	07:01 19:46	07:38 18:49	07:19 17:03
13	05:53 21:12	06:17 (T-21) 20:44 (T-18)	06:26 20:38	07:02 19:45	07:39 18:47	07:20 17:02
14	05:54 21:11	06:18 (T-21) 20:44 (T-18)	06:27 20:37	20:03 (T-17) 20:11 (T-17)	07:04 19:43	07:21 18:45
15	05:55 21:11	06:19 (T-21) 20:44 (T-18)	06:28 20:35	20:01 (T-17) 20:10 (T-17)	07:05 19:41	07:22 18:44
16	05:56 21:10	06:20 (T-21) 20:43 (T-18)	06:30 20:34	20:00 (T-17) 20:08 (T-17)	07:06 19:39	07:23 18:42
17	05:57 21:09	06:21 (T-21) 20:42 (T-18)	06:31 20:32	19:59 (T-17) 20:06 (T-17)	07:07 19:37	07:24 18:40
18	05:58 21:09	06:22 (T-21) 20:42 (T-18)	06:32 20:31	19:59 (T-17) 20:06 (T-17)	07:08 19:35	07:25 18:38
19	05:59 21:08	06:23 (T-21) 20:41 (T-18)	06:33 20:29	19:59 (T-17) 20:04 (T-17)	07:10 19:33	07:26 18:37
20	06:00 21:07	06:24 (T-21) 20:41 (T-18)	06:34 20:27	19:58 (T-17) 20:02 (T-17)	07:11 19:31	07:27 18:35
21	06:01 21:06	06:25 (T-21) 20:40 (T-18)	06:35 20:26	19:58 (T-17) 20:01 (T-17)	07:12 19:29	07:28 18:33
22	06:02 21:05	06:26 (T-21) 06:29 (T-21)	06:37 20:24	19:58 (T-17) 19:59 (T-17)	07:13 19:28	07:29 18:32
23	06:03 21:04	06:26 (T-21) 06:27 (T-21)	06:38 20:22	07:14 19:26	07:52 18:30	07:33 16:53
24	06:04 21:03	06:39 20:21	06:39 20:21	07:15 19:24	07:53 18:29	07:35 16:52
25	06:05 21:02	06:40 20:19	06:40 20:19	07:17 19:22	07:54 18:27	07:36 16:51
26	06:06 21:01	06:41 20:17	06:41 20:17	07:18 19:20	07:56 18:25	07:37 16:51
27	06:07 21:00	06:43 20:15	06:43 20:15	07:19 19:18	07:57 18:24	07:38 16:50
28	06:08 20:59	06:44 20:14	06:44 20:14	07:20 19:16	07:58 18:22	07:40 16:49
29	06:09 20:58	06:45 20:12	06:45 20:12	07:21 19:14	08:00 18:21	07:41 16:49
30	06:10 20:57	06:46 20:10	06:46 20:10	07:23 19:13	08:01 18:19	07:42 16:49
31	06:11 20:56	06:47 20:08	06:47 20:08	08:02 18:18	08:02 18:18	08:04 16:56
Potential sun hours	471	436	377	341	289	275
Total, worst case	490	52	484	484	484	1476
Sun reduction	0.75	0.72	0.48	0.48	0.48	0.52
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90
Wind dir. red.	0.62	0.61	0.66	0.66	0.66	0.64
Total reduction	0.42	0.39	0.28	0.28	0.28	0.30
Total, real	206	20	137	137	137	441

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 V163-4.5 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-291 - R-291

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Table with columns Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec and values 0.58, 0.58, 0.59, 0.63, 0.66, 0.73, 0.75, 0.72, 0.67, 0.56, 0.48, 0.52

Operational time

Table with directional wind speed categories (N, NNE, NE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW, NNW, Sum) and corresponding values (561, 438, 311, 293, 309, 330, 363, 461, 788, 773, 462, 449, 509, 600, 629, 608, 7,884)

Main calendar table with columns for months (January to December) and rows for each day of the month. Includes a summary table at the bottom for 'Potential sun hours' and 'Total, worst case'.

Table layout: For each day in each month the following matrix apply

Matrix defining day in month, sun rise/set times, and first/last times with flicker.



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment
Assumptions for shadow calculations

Shadow receptor: R-305 - R-305

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	06:49	07:24	07:04	07:43
	16:57	17:35	18:13	19:52	20:30	21:04	21:16	20:55	20:07	19:11	17:17	16:48
2	08:04	07:46	07:04	07:07	06:17	05:45	05:46	06:14	06:50	07:25	07:05	07:44
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:53	20:05	19:09	17:15	16:48
3	08:04	07:44	07:02	07:06	06:15	05:44	05:46	06:15	06:51	07:26	07:07	07:45
	16:59	17:38	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:48
4	08:04	07:43	07:01	07:04	06:14	05:44	05:47	06:16	06:52	07:28	07:08	07:46
	17:00	17:39	18:17	19:56	20:33	21:06	21:16	20:51	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	05:43	05:48	06:17	06:53	07:29	07:09	07:47
	17:01	17:41	18:18	19:57	20:35	21:07	21:15	20:50	19:59	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:11	07:48
	17:02	17:42	18:19	19:59	20:36	21:08	21:15	20:48	19:58	19:02	17:10	16:47
7	08:04	07:39	06:55	06:58	06:10	05:43	05:49	06:19	06:56	07:31	07:12	07:49
	17:03	17:44	18:21	20:00	20:37	21:09	21:15	20:47	19:56	19:00	17:09	16:47
8	08:04	07:38	07:53	06:57	06:08	05:42	05:50	06:21	06:57	07:33	07:13	07:50
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:08	16:47
9	08:03	07:37	07:52	06:55	06:07	05:42	05:50	06:22	06:58	07:34	07:15	07:51
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:47
10	08:03	07:35	07:50	06:53	06:06	05:42	05:51	06:23	06:59	07:35	07:16	07:52
	17:06	17:48	19:25	20:04	20:41	21:11	21:14	20:43	19:50	18:53	17:05	16:47
11	08:03	07:34	07:48	06:51	06:05	05:42	05:52	06:24	07:00	07:36	07:17	07:53
	17:07	17:49	19:26	20:05	20:42	21:11	21:13	20:41	19:48	18:51	17:04	16:47
12	08:02	07:33	07:46	06:49	06:03	05:41	05:53	06:25	07:01	07:38	07:19	07:54
	17:09	17:51	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:47
13	08:02	07:31	07:44	06:48	06:02	05:41	05:54	06:26	07:03	07:39	07:20	07:55
	17:10	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:45	18:47	17:02	16:47
14	08:01	07:30	07:43	06:46	06:01	05:41	05:54	06:27	07:04	07:40	07:21	07:56
	17:11	17:53	19:30	20:09	20:45	21:13	21:11	20:37	19:43	18:45	17:01	16:47
15	08:01	07:28	07:41	06:44	06:00	05:41	05:55	06:29	07:05	07:41	07:23	07:57
	17:12	17:55	19:31	20:10	20:46	21:13	21:11	20:35	19:41	18:44	17:00	16:47
16	08:00	07:27	07:39	06:42	05:59	05:41	05:56	06:30	07:06	07:43	07:24	07:57
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:34	19:39	18:42	16:59	16:47
17	08:00	07:25	07:37	06:41	05:58	05:41	05:57	06:31	07:07	07:44	07:25	07:58
	17:15	17:58	19:34	20:12	20:49	21:14	21:09	20:32	19:37	18:40	16:58	16:48
18	07:59	07:24	07:35	06:39	05:57	05:41	05:58	06:32	07:09	07:45	07:27	07:59
	17:16	17:59	19:35	20:14	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48
19	07:59	07:22	07:33	06:37	05:56	05:41	05:59	06:33	07:10	07:47	07:28	07:59
	17:17	18:00	19:36	20:15	20:51	21:15	21:08	20:29	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	05:55	05:41	06:00	06:35	07:11	07:48	07:29	08:00
	17:19	18:00	19:37	20:16	20:52	21:15	21:07	20:27	19:31	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	05:54	05:42	06:01	06:36	07:12	07:49	07:31	08:00
	17:20	18:02	19:39	20:17	20:53	21:15	21:06	20:26	19:30	18:34	16:54	16:49
22	07:56	07:17	07:28	06:32	05:53	05:42	06:02	06:37	07:13	07:50	07:32	08:01
	17:21	18:03	19:40	20:19	20:54	21:16	21:05	20:24	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	05:52	05:42	06:03	06:38	07:14	07:52	07:33	08:01
	17:23	18:04	19:41	20:20	20:55	21:16	21:04	20:22	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	05:51	05:42	06:04	06:39	07:16	07:53	07:35	08:02
	17:24	18:06	19:42	20:21	20:56	21:16	21:03	20:21	19:24	18:29	16:52	16:51
25	07:54	07:12	07:22	06:27	05:50	05:43	06:05	06:40	07:17	07:54	07:36	08:02
	17:25	18:07	19:44	20:22	20:57	21:16	21:02	20:19	19:22	18:27	16:52	16:51
26	07:53	07:11	07:20	06:26	05:49	05:43	06:06	06:42	07:18	07:56	07:37	08:03
	17:27	18:09	19:45	20:23	20:58	21:16	21:01	20:17	19:20	18:26	16:51	16:52
27	07:52	07:09	07:19	06:24	05:49	05:43	06:07	06:43	07:19	07:57	07:38	08:03
	17:28	18:10	19:46	20:25	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:53
28	07:51	07:07	07:17	06:23	05:48	05:44	06:08	06:44	07:20	07:58	07:39	08:03
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:14	19:16	18:23	16:50	16:54
29	07:50		07:15	06:21	05:47	05:44	06:09	06:45	07:22	08:00	07:41	08:04
	17:31		19:49	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54
30	07:49		07:13	06:20	05:46	05:45	06:10	06:46	07:23	08:01	07:42	08:04
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:13	18:20	16:49	16:55
31	07:48		07:11		05:46		06:11	06:47		08:02		08:04
	17:34		19:51		21:03		20:56	20:08		18:18		16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276
Total, worst case												
Sun reduction												
Oper. time red.												
Wind dir. red.												
Total reduction												
Total, real												

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-306 - R-306
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	07:47 17:35	07:06 18:13	07:09 19:52	06:18 20:30	05:45 21:04	05:45 21:16	06:13 20:55	06:36 (T-J) 06:44 (T-J)	06:49 20:07	07:24 19:11	07:04 17:17	07:43 16:48
2	08:04 16:58	07:46 17:36	07:04 18:14	07:07 19:54	06:17 20:31	05:45 21:05	05:46 21:16	06:14 20:53	06:37 (T-J) 06:44 (T-J)	06:50 20:05	07:25 19:09	07:05 17:16	07:44 16:48
3	08:04 16:59	07:44 17:38	07:02 18:15	07:06 19:55	06:15 20:32	05:44 21:05	05:46 21:16	06:15 20:52	06:38 (T-J) 06:43 (T-J)	06:51 20:03	07:26 19:07	07:07 17:14	07:45 16:48
4	08:04 17:00	07:43 17:39	07:01 18:17	07:04 19:56	06:14 20:33	05:44 21:06	05:47 21:16	06:16 20:51	06:39 (T-J) 06:42 (T-J)	06:52 20:01	07:28 19:05	07:08 17:13	07:46 16:48
5	08:04 17:01	07:42 17:41	06:59 18:18	07:02 19:57	06:13 20:35	05:43 21:07	05:48 21:15	06:17 20:50	06:40 (T-J) 06:42 (T-J)	06:53 19:59	07:29 19:03	07:09 17:11	07:47 16:47
6	08:04 17:02	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:54 19:58	07:30 19:02	07:11 19:02	07:11 17:10	07:48 16:47
7	08:04 17:03	07:39 17:44	06:55 18:21	06:58 20:00	06:10 20:37	05:43 21:09	05:49 21:15	06:19 20:47	06:56 19:56	07:31 19:00	07:12 17:09	07:12 16:47	07:49 16:47
8	08:04 17:04	07:38 17:45	07:53 18:22	06:57 20:01	06:08 20:38	05:42 21:09	05:50 21:14	06:21 20:46	06:57 19:54	07:33 18:56	07:13 17:08	07:13 16:47	07:50 16:47
9	08:03 17:05	07:37 17:46	07:52 19:23	06:55 20:02	06:07 20:39	05:42 21:10	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54	07:15 17:06	07:15 16:47	07:51 16:47
10	08:03 17:06	07:35 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:53	07:16 17:05	07:16 16:47	07:52 16:47
11	08:03 17:07	07:34 17:49	07:48 19:26	06:51 20:05	06:05 20:42	05:42 21:11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51	07:17 17:04	07:17 16:47	07:53 16:47
12	08:02 17:09	07:33 17:51	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	07:19 16:47	07:54 16:47
13	08:02 17:10	07:31 17:52	07:44 19:28	06:48 20:07	06:02 20:44	05:41 21:12	05:54 21:12	06:26 20:38	07:03 19:45	07:39 18:47	07:20 17:02	07:20 16:47	07:55 16:47
14	08:01 17:11	07:30 17:53	07:43 19:30	06:46 20:09	06:01 20:45	05:41 21:13	05:54 21:11	06:28 20:37	07:04 19:43	07:40 18:45	07:21 17:01	07:21 16:47	07:56 16:47
15	08:01 17:12	07:28 17:55	07:41 19:31	06:44 20:10	06:00 20:46	05:41 21:13	05:55 21:11	06:29 20:35	07:05 19:41	07:41 18:44	07:23 17:00	07:23 16:47	07:57 16:47
16	08:00 17:13	07:27 17:56	07:39 19:32	06:42 20:11	05:59 20:48	05:41 21:14	05:56 21:10	06:30 (T-J) 06:33 (T-J)	07:06 19:39	07:43 18:42	07:24 16:59	07:24 16:47	07:57 16:47
17	08:00 17:15	07:25 17:58	07:37 19:34	06:41 20:12	05:58 20:49	05:41 21:14	05:57 21:09	06:31 (T-J) 06:36 (T-J)	07:07 19:37	07:44 18:40	07:25 16:58	07:25 16:48	07:58 16:48
18	07:59 17:16	07:24 17:59	07:35 19:35	06:39 20:14	05:57 20:50	05:41 21:15	05:58 21:09	06:26 (T-J) 06:37 (T-J)	07:09 19:35	07:45 18:39	07:27 16:57	07:27 16:48	07:59 16:48
19	07:59 17:17	07:22 18:00	07:33 19:36	06:37 20:15	05:56 20:51	05:41 21:15	05:59 21:08	06:25 (T-J) 06:39 (T-J)	07:10 19:33	07:47 18:37	07:28 16:56	07:28 16:48	07:59 16:48
20	07:58 17:19	07:21 18:00	07:32 19:37	06:36 20:16	05:55 20:52	05:41 21:15	06:00 21:07	06:24 (T-J) 06:40 (T-J)	07:11 19:31	07:48 18:35	07:29 16:55	08:00 16:49	07:59 16:49
21	07:57 17:20	07:19 18:02	07:30 19:39	06:34 20:17	05:54 20:53	05:42 21:16	06:01 21:06	06:25 (T-J) 06:41 (T-J)	07:12 19:30	07:49 18:34	07:31 16:54	08:00 16:49	07:59 16:49
22	07:56 17:21	07:17 18:03	07:28 19:40	06:32 20:19	05:53 20:54	05:42 21:16	06:02 21:05	06:26 (T-J) 06:42 (T-J)	07:13 19:28	07:50 18:32	07:32 16:54	08:01 16:50	07:59 16:50
23	07:56 17:23	07:16 18:05	07:26 19:41	06:31 20:20	05:52 20:55	05:42 21:16	06:03 21:04	06:27 (T-J) 06:42 (T-J)	07:14 19:26	07:52 18:30	07:33 16:53	08:01 16:50	07:59 16:50
24	07:55 17:24	07:14 18:06	07:24 19:42	06:29 20:21	05:51 20:56	05:42 21:16	06:04 21:03	06:28 (T-J) 06:43 (T-J)	07:16 19:24	07:53 18:29	07:35 16:52	08:02 16:51	07:59 16:51
25	07:54 17:25	07:13 18:07	07:22 19:44	06:27 20:22	05:50 20:57	05:43 21:16	06:05 21:02	06:29 (T-J) 06:43 (T-J)	07:17 19:22	07:54 18:27	07:36 16:52	08:02 16:51	07:59 16:51
26	07:53 17:27	07:11 18:09	07:20 19:45	06:26 20:24	05:49 20:58	05:43 21:16	06:06 21:01	06:30 (T-J) 06:44 (T-J)	07:18 19:20	07:56 18:26	07:37 16:51	08:03 16:52	07:59 16:52
27	07:52 17:28	07:09 18:10	07:19 19:46	06:24 20:25	05:49 20:59	05:43 21:16	06:07 21:00	06:31 (T-J) 06:44 (T-J)	07:19 19:18	07:57 18:24	07:38 16:50	08:03 16:53	07:59 16:53
28	07:51 17:29	07:07 18:11	07:17 19:47	06:23 20:26	05:48 21:00	05:44 21:16	06:08 20:59	06:32 (T-J) 06:44 (T-J)	07:20 19:16	07:58 18:23	07:39 16:50	08:03 16:54	07:59 16:54
29	07:50 17:31	07:05 18:09	07:15 19:49	06:21 20:27	05:47 21:01	05:44 21:16	06:09 20:58	06:33 (T-J) 06:44 (T-J)	07:22 19:15	08:00 18:21	07:41 16:49	08:04 16:54	07:59 16:54
30	07:49 17:32	07:13 18:07	07:13 19:50	06:20 20:28	05:47 21:02	05:45 21:16	06:10 20:57	06:34 (T-J) 06:44 (T-J)	07:23 19:13	08:01 18:20	07:42 16:49	08:04 16:55	07:59 16:55
31	07:48 17:34	07:11 19:51	07:11 21:03	05:46 21:03	05:46 21:03	05:46 21:03	06:11 20:56	06:35 (T-J) 06:44 (T-J)	07:24 20:08	08:02 18:18	07:42 16:49	08:04 16:56	07:59 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	
Total, worst case					223					199			
Sun reduction					0.66					0.75			
Oper. time red.					0.90					0.90			
Wind dir. red.					0.59					0.59			
Total reduction					0.35					0.38			
Total, real					78					79			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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L086 71 V163-4.5 WTGs on 98m HH
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920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-314 - R-314
Assumptions for shadow calculations Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04		07:47	07:06	07:09	06:18
	16:57		17:35	18:12	19:52	20:30
2	08:04		07:46	07:04	07:07	06:16
	16:58		17:36	18:14	19:54	20:31
3	08:04		07:44	07:02	07:05	06:15
	16:58		17:38	18:15	19:55	20:32
4	08:04		07:43	07:00	07:04	06:14
	16:59		17:39	18:16	19:56	20:33
5	08:04	08:28 (T-51)	07:42	06:59	07:02	06:12
	17:00	1 08:29 (T-51)	17:40	18:18	19:57	20:35
6	08:04	08:28 (T-51)	07:41	06:57	07:00	06:11
	17:01	2 08:30 (T-51)	17:42	18:19	19:59	20:36
7	08:04	08:28 (T-51)	07:39	06:55	06:58	06:09
	17:03	3 08:31 (T-51)	17:43	18:20	20:00	20:37
8	08:04	08:28 (T-51)	07:38	07:53	06:56	06:08
	17:04	4 08:32 (T-51)	17:45	18:22	20:01	20:38
9	08:03	08:27 (T-51)	07:37	07:52	06:54	06:07
	17:05	4 08:31 (T-51)	17:46	19:23	20:02	20:39
10	08:03	08:27 (T-51)	07:35	07:50	06:53	06:06
	17:06	5 08:32 (T-51)	17:47	19:24	20:04	20:41
11	08:03	08:26 (T-51)	07:34	07:48	06:51	06:04
	17:07	6 08:32 (T-51)	17:49	19:26	20:05	20:42
12	08:02	08:26 (T-51)	07:33	07:46	06:49	06:03
	17:08	7 08:33 (T-51)	17:50	19:27	20:06	20:43
13	08:02	08:25 (T-51)	07:31	07:44	06:47	06:02
	17:09	7 08:32 (T-51)	17:52	19:28	20:07	20:44
14	08:01	08:25 (T-51)	07:30	07:42	06:46	06:01
	17:11	8 08:33 (T-51)	17:53	19:30	20:09	20:45
15	08:01	08:24 (T-51)	07:28	07:41	06:44	06:00
	17:12	9 08:33 (T-51)	17:55	19:31	20:10	20:46
16	08:00	08:24 (T-51)	07:27	07:39	06:42	05:58
	17:13	9 08:33 (T-51)	17:56	19:32	20:11	20:48
17	08:00	08:23 (T-51)	07:25	07:37	06:40	05:57
	17:14	9 08:32 (T-51)	17:57	19:33	20:12	20:49
18	07:59	08:22 (T-51)	07:24	07:35	06:39	05:56
	17:16	10 08:32 (T-51)	17:59	19:35	20:14	20:50
19	07:59	08:21 (T-51)	07:22	07:33	06:37	05:55
	17:17	10 08:31 (T-51)	18:00	19:36	20:15	20:51
20	07:58	08:24 (T-51)	07:21	07:31	06:35	05:54
	17:18	6 08:30 (T-51)	18:00	19:37	20:16	20:52
21	07:57		07:19	07:29	06:34	05:53
	17:20		18:01	19:38	20:17	20:53
22	07:56		07:17	07:28	06:32	05:52
	17:21		18:03	19:40	20:18	20:54
23	07:56		07:16	07:26	06:30	05:51
	17:22		18:04	19:41	20:20	20:55
24	07:55		07:14	07:24	06:29	05:51
	17:24		18:06	19:42	20:21	20:56
25	07:54		07:12	07:22	06:27	05:50
	17:25		18:07	19:44	20:22	20:57
26	07:53		07:11	07:20	06:26	05:49
	17:26		18:08	19:45	20:23	20:58
27	07:52		07:09	07:18	06:24	05:48
	17:28		18:10	19:46	20:25	20:59
28	07:51		07:07	07:16	06:22	05:47
	17:29		18:11	19:47	20:26	21:00
29	07:50			07:15	06:21	05:47
	17:30			19:49	20:27	21:01
30	07:49			07:13	06:19	05:46
	17:32			19:50	20:28	21:02
31	07:48			07:11		05:46
	17:33			19:51		21:03
Potential sun hours	287	292	369	403	459	465
Total, worst case	100			72	635	747
Sun reduction	0.58			0.63	0.66	0.73
Oper. time red.	0.90			0.90	0.90	0.90
Wind dir. red.	0.65			0.59	0.59	0.64
Total reduction	0.34			0.33	0.35	0.42
Total, real	34			24	224	316

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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South Deuel Wind Project

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Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
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Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-314 - R-314
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	July			August			September			October			November			December		
1	05:45	20:23 (T-43)	06:12	06:37 (T-48)	06:48	07:24	07:04	07:43	08:08 (T-51)									
	21:16	25 20:48 (T-43)	20:55	32 07:09 (T-48)	20:07	19:11	17:17	16:48	6 08:14 (T-51)									
2	05:45	20:24 (T-43)	06:13	06:37 (T-48)	06:50	07:25	07:05	07:44	08:10 (T-51)									
	21:16	25 20:49 (T-43)	20:53	32 07:09 (T-48)	20:05	19:09	17:15	16:48	5 08:15 (T-51)									
3	05:46	20:24 (T-43)	06:15	06:38 (T-48)	06:51	07:26	07:06	07:45	08:11 (T-51)									
	21:16	24 20:48 (T-43)	20:52	31 07:09 (T-48)	20:03	19:07	17:14	16:47	4 08:15 (T-51)									
4	05:47	20:25 (T-43)	06:16	06:39 (T-48)	06:52	07:28	07:08	07:46	08:12 (T-51)									
	21:16	23 20:48 (T-43)	20:51	30 07:09 (T-48)	20:01	19:05	17:12	16:47	4 08:16 (T-51)									
5	05:47	20:25 (T-43)	06:17	06:40 (T-48)	06:53	07:29	07:09	07:47	08:13 (T-51)									
	21:15	23 20:48 (T-43)	20:50	29 07:09 (T-48)	19:59	19:03	17:11	16:47	3 08:16 (T-51)									
6	05:48	20:25 (T-43)	06:18	06:41 (T-48)	06:54	07:30	07:11	07:48	08:14 (T-51)									
	21:15	22 20:47 (T-43)	20:48	28 07:09 (T-48)	19:58	19:01	17:10	16:47	2 08:16 (T-51)									
7	05:49	20:26 (T-43)	06:19	06:42 (T-48)	06:55	07:31	07:12	07:49	08:15 (T-51)									
	21:15	21 20:47 (T-43)	20:47	27 07:09 (T-48)	19:56	19:00	17:09	16:47	1 08:16 (T-51)									
8	05:49	20:27 (T-43)	06:20	06:43 (T-48)	06:57	07:32	07:13	07:50	08:16 (T-51)									
	21:14	20 20:47 (T-43)	20:45	25 07:08 (T-48)	19:54	18:56	17:07	16:46	1 08:17 (T-51)									
9	05:50	20:27 (T-43)	06:21	06:44 (T-48)	06:58	07:34	07:15	07:51										
	21:14	19 20:46 (T-43)	20:44	24 07:08 (T-48)	19:52	18:54	17:06	16:46										
10	05:51	20:27 (T-43)	06:23	06:46 (T-48)	06:59	07:35	07:16	07:52										
	21:14	19 20:46 (T-43)	20:43	23 07:09 (T-48)	19:50	18:52	17:05	16:46										
11	05:52	20:28 (T-43)	06:24	06:47 (T-48)	07:00	07:36	07:17	07:53										
	21:13	18 20:46 (T-43)	20:41	21 07:08 (T-48)	19:48	18:51	17:04	16:46										
12	05:52	20:29 (T-43)	06:25	06:48 (T-48)	07:01	07:37	07:19	07:54										
	21:13	17 20:46 (T-43)	20:40	19 07:07 (T-48)	19:46	18:49	17:03	16:46										
13	05:53	20:29 (T-43)	06:26	06:49 (T-48)	07:02	07:39	07:20	07:55										
	21:12	15 20:44 (T-43)	20:38	17 07:06 (T-48)	19:44	18:47	17:02	16:46										
14	05:54	20:30 (T-43)	06:27	06:50 (T-48)	07:04	07:40	07:21	07:56										
	21:11	14 20:44 (T-43)	20:37	15 07:05 (T-48)	19:43	18:45	17:01	16:47										
15	05:55	20:31 (T-43)	06:28	06:51 (T-48)	07:05	07:41	07:23	07:57										
	21:11	12 20:43 (T-43)	20:35	13 07:04 (T-48)	19:41	18:44	17:00	16:47										
16	05:56	20:32 (T-43)	06:30	06:52 (T-48)	07:06	07:43	07:24	07:57										
	21:10	11 20:43 (T-43)	20:34	10 07:02 (T-48)	19:39	18:42	16:59	16:47										
17	05:57	20:33 (T-43)	06:31	06:53 (T-48)	07:07	07:44	07:25	07:58										
	21:09	9 20:42 (T-43)	20:32	8 07:01 (T-48)	19:37	18:40	16:58	16:47										
18	05:58	20:35 (T-43)	06:32	06:55 (T-48)	07:08	07:45	07:27	07:59										
	21:09	7 20:42 (T-43)	20:30	4 06:59 (T-48)	19:35	18:38	16:57	16:48										
19	05:59	20:36 (T-43)	06:33		07:10	07:46	07:28	07:59										
	21:08	5 20:41 (T-43)	20:29		19:33	18:37	16:56	16:48										
20	06:00	20:37 (T-42)	06:34		07:11	07:48	07:29	08:00										
	21:07	3 20:40 (T-43)	20:27		19:31	18:35	16:55	16:48										
21	06:01	06:49 (T-48)	06:35		07:12	07:49	07:31	08:00										
	21:06	10 20:40 (T-42)	20:26		19:29	18:33	16:54	16:49										
22	06:02	06:47 (T-48)	06:37		07:13	07:50	07:32	08:01										
	21:05	12 06:59 (T-48)	20:24		19:28	18:32	16:53	6 08:06 (T-51)	16:49									
23	06:03	06:44 (T-48)	06:38		07:14	07:52	07:33	07:58 (T-51)	08:02									
	21:04	16 07:00 (T-48)	20:22		19:26	18:30	16:53	10 08:08 (T-51)	16:50									
24	06:04	06:43 (T-48)	06:39		07:15	07:53	07:35	07:59 (T-51)	08:02									
	21:03	19 07:02 (T-48)	20:21		19:24	18:29	16:52	10 08:09 (T-51)	16:50									
25	06:05	06:42 (T-48)	06:40		07:17	07:54	07:36	08:01 (T-51)	08:02									
	21:02	21 07:03 (T-48)	20:19		19:22	18:27	16:51	9 08:10 (T-51)	16:51									
26	06:06	06:41 (T-48)	06:41		07:18	07:56	07:37	08:02 (T-51)	08:03									
	21:01	23 07:04 (T-48)	20:17		19:20	18:25	16:51	9 08:11 (T-51)	16:52									
27	06:07	06:41 (T-48)	06:42		07:19	07:57	07:38	08:03 (T-51)	08:03									
	21:00	25 07:06 (T-48)	20:15		19:18	18:24	16:50	9 08:12 (T-51)	16:52									
28	06:08	06:40 (T-48)	06:44		07:20	07:58	07:39	08:05 (T-51)	08:03									
	20:59	27 07:07 (T-48)	20:14		19:16	18:22	16:49	8 08:13 (T-51)	16:53									
29	06:09	06:39 (T-48)	06:45		07:21	08:00	07:41	08:06 (T-51)	08:04									
	20:58	28 07:07 (T-48)	20:12		19:14	18:21	16:49	7 08:13 (T-51)	16:54									
30	06:10	06:38 (T-48)	06:46		07:23	08:01	07:42	08:07 (T-51)	08:04									
	20:57	30 07:08 (T-48)	20:10		19:12	18:19	16:49	7 08:14 (T-51)	16:55									
31	06:11	06:38 (T-48)	06:47			08:02		08:04										
	20:56	30 07:08 (T-48)	20:08			18:18		16:56										
Potential sun hours	471		436		377	341	289	275										
Total, worst case		573		388			75		26									
Sun reduction		0.75		0.72			0.48		0.52									
Oper. time red.		0.90		0.90			0.90		0.90									
Wind dir. red.		0.62		0.59			0.65		0.65									
Total reduction		0.42		0.38			0.28		0.30									
Total, real		240		147			21		8									

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-320 - R-320
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:47	07:06	07:09	06:18	05:45	05:45	06:13	20:17 (T-38)	06:49	07:24	07:04	07:43			
	16:57	17:35	18:13	19:53	20:30	21:04	21:16	20:55	12	20:29 (T-38)	20:07	19:11	17:17	16:48		
2	08:04	07:46	07:04	07:08	06:17	05:45	05:46	06:14	20:17 (T-38)	06:50	07:25	07:05	07:44			
	16:58	17:36	18:14	19:54	20:31	21:05	21:16	20:54	10	20:27 (T-38)	20:05	19:09	17:16	16:48		
3	08:04	07:45	07:02	07:06	06:15	05:44	05:46	06:15	20:16 (T-38)	06:51	07:27	07:07	07:45			
	16:59	17:38	18:15	19:55	20:32	21:06	21:16	20:52	10	20:26 (T-38)	20:03	19:07	17:14	16:48		
4	08:04	07:43	07:01	07:04	06:14	20:07 (T-38)	05:44	05:47	06:16	20:16 (T-38)	06:52	07:28	07:08	07:47		
	17:00	17:39	18:17	19:56	20:34	3	20:10 (T-38)	21:07	21:16	20:51	9	20:25 (T-38)	20:01	19:05	17:13	16:47
5	08:04	07:42	06:59	07:02	06:13	20:07 (T-38)	05:43	05:48	06:17	20:16 (T-38)	06:53	07:29	07:09	07:48		
	17:01	17:41	18:18	19:58	20:35	4	20:11 (T-38)	21:07	21:16	20:50	7	20:23 (T-38)	20:00	19:03	17:11	16:47
6	08:04	07:41	06:57	07:00	06:11	20:07 (T-38)	05:43	05:48	06:18	20:15 (T-38)	06:55	07:30	07:11	07:49		
	17:02	17:42	18:19	19:59	20:36	6	20:13 (T-38)	21:08	21:15	20:48	7	20:22 (T-38)	19:58	19:02	17:10	16:47
7	08:04	07:40	06:55	06:58	06:10	20:06 (T-38)	05:43	05:49	06:19	20:16 (T-38)	06:56	07:31	07:12	07:50		
	17:03	17:44	18:21	20:00	20:37	7	20:13 (T-38)	21:09	21:15	20:47	6	20:22 (T-38)	19:56	19:00	17:09	16:47
8	08:04	07:38	07:54	06:57	06:08	20:06 (T-38)	05:42	05:50	06:21	20:17 (T-38)	06:57	07:33	07:14	07:51		
	17:04	17:45	18:22	20:01	20:38	8	20:14 (T-38)	21:09	21:15	20:46	3	20:20 (T-38)	19:54	18:56	17:08	16:47
9	08:04	07:37	07:52	06:55	06:07	20:06 (T-38)	05:42	05:50	06:22	20:17 (T-38)	06:58	07:34	07:15	07:52		
	17:05	17:46	19:23	20:03	20:40	10	20:16 (T-38)	21:10	21:14	20:44	2	20:19 (T-38)	19:52	18:54	17:06	16:47
10	08:03	07:36	07:50	06:53	06:06	20:07 (T-38)	05:42	05:51	06:23	20:18 (T-38)	06:59	07:35	07:16	07:53		
	17:06	17:48	19:25	20:04	20:41	10	20:17 (T-38)	21:11	21:14	20:43	06:59	19:50	18:53	17:05	16:47	
11	08:03	07:34	07:48	06:51	06:05	20:06 (T-38)	05:41	05:52	06:24	20:17 (T-38)	07:00	07:36	07:18	07:53		
	17:07	17:49	19:26	20:05	20:42	11	20:17 (T-38)	21:11	21:13	20:41	19:49	18:51	17:04	16:47		
12	08:03	07:33	07:46	06:49	06:03	20:07 (T-38)	05:41	05:53	06:25	20:18 (T-38)	07:02	07:38	07:19	07:54		
	17:08	17:51	19:27	20:06	20:43	11	20:18 (T-38)	21:12	21:13	20:40	19:47	18:49	17:03	16:47		
13	08:02	07:31	07:45	06:48	06:02	20:08 (T-38)	05:41	05:54	06:26	20:19 (T-38)	07:03	07:39	07:20	07:55		
	17:10	17:52	19:29	20:08	20:44	12	20:20 (T-38)	21:13	21:12	20:38	19:45	18:47	17:02	16:47		
14	08:02	07:30	07:43	06:46	06:01	20:09 (T-38)	05:41	05:54	06:28	20:18 (T-38)	07:04	07:40	07:22	07:56		
	17:11	17:53	19:30	20:09	20:45	12	20:21 (T-38)	21:13	21:12	20:37	19:43	18:46	17:01	16:47		
15	08:01	07:28	07:41	06:44	06:00	20:10 (T-38)	05:41	05:55	06:29	20:19 (T-38)	07:05	07:42	07:23	07:57		
	17:12	17:55	19:31	20:10	20:47	11	20:21 (T-38)	21:14	21:11	20:35	19:41	18:44	17:00	16:47		
16	08:01	07:27	07:39	06:42	06:59	20:11 (T-38)	05:41	05:56	06:30	20:18 (T-38)	07:06	07:43	07:24	07:58		
	17:13	17:56	19:32	20:11	20:48	9	20:20 (T-38)	21:14	21:10	20:34	19:39	18:42	16:59	16:47		
17	08:00	07:25	07:37	06:41	19:49 (T-37)	05:58	05:41	05:57	06:31	20:17 (T-38)	07:07	07:44	07:26	07:58		
	17:15	17:58	19:34	20:13	1	19:50 (T-37)	20:49	21:14	21:10	20:32	19:37	18:40	16:58	16:48		
18	07:59	07:24	07:35	06:39	19:49 (T-37)	05:57	05:41	05:58	06:32	20:16 (T-38)	07:09	07:45	07:27	07:59		
	17:16	17:59	19:35	20:14	2	19:51 (T-37)	20:50	21:15	21:09	20:31	19:35	18:39	16:57	16:48		
19	07:59	07:22	07:33	06:37	19:49 (T-37)	05:56	05:41	05:59	06:33	19:57 (T-37)	07:10	07:47	07:28	08:00		
	17:17	18:00	19:36	20:15	4	19:53 (T-37)	20:51	21:15	21:08	20:29	7	20:04 (T-37)	19:33	18:37	16:56	16:48
20	07:58	07:21	07:32	06:36	19:48 (T-37)	05:55	05:41	06:00	06:35	19:55 (T-37)	07:11	07:48	07:30	08:00		
	17:19	18:00	19:38	20:16	5	19:53 (T-37)	20:52	21:15	21:07	20:27	7	20:02 (T-37)	19:32	18:35	16:55	16:49
21	07:57	07:19	07:30	06:34	19:49 (T-37)	05:54	05:42	06:01	06:36	19:54 (T-37)	07:12	07:49	07:31	08:01		
	17:20	18:02	19:39	20:17	6	19:55 (T-37)	20:53	21:16	21:06	20:26	7	20:01 (T-37)	19:30	18:34	16:54	16:49
22	07:57	07:18	07:28	06:32	19:49 (T-37)	05:53	05:42	06:02	06:37	19:53 (T-37)	07:13	07:51	07:32	08:01		
	17:21	18:03	19:40	20:19	7	19:56 (T-37)	20:54	21:16	21:05	20:24	6	19:59 (T-37)	19:28	18:32	16:54	16:50
23	07:56	07:16	07:26	06:31	19:50 (T-37)	05:52	05:42	06:03	06:38	19:52 (T-37)	07:15	07:52	07:33	08:02		
	17:23	18:05	19:41	20:20	7	19:57 (T-37)	20:55	21:16	21:05	20:22	5	19:57 (T-37)	19:26	18:30	16:53	16:50
24	07:55	07:14	07:24	06:29	19:52 (T-37)	05:51	05:42	06:04	06:39	19:53 (T-37)	07:16	07:53	07:35	08:02		
	17:24	18:06	19:43	20:21	7	19:59 (T-37)	20:56	21:16	21:04	20:21	3	19:56 (T-37)	19:24	18:29	16:52	16:51
25	07:54	07:13	07:22	06:27	05:50	20:08 (T-38)	05:43	06:05	06:40	19:52 (T-37)	07:17	07:55	07:36	08:03		
	17:25	18:07	19:44	20:22	20:57	21:16	21:03	20:19	2	19:54 (T-37)	19:22	18:27	16:52	16:51		
26	07:53	07:11	07:20	06:26	05:49	20:09 (T-38)	05:43	06:06	06:42	19:52 (T-37)	07:18	07:56	07:37	08:03		
	17:27	18:09	19:45	20:24	20:58	21:17	21:02	20:17	1	19:53 (T-37)	19:20	18:26	16:51	16:52		
27	07:52	07:09	07:19	06:24	05:49	20:07 (T-38)	05:43	06:07	06:43	20:24 (T-38)	07:19	07:57	07:38	08:03		
	17:28	18:10	19:46	20:25	20:59	21:17	21:01	5	20:29 (T-38)	20:16	19:18	18:24	16:50	16:53		
28	07:51	07:08	07:17	06:23	05:48	20:08 (T-38)	05:44	06:08	06:44	20:21 (T-38)	07:21	07:59	07:40	08:04		
	17:29	18:11	19:48	20:26	21:00	21:17	20:59	10	20:31 (T-38)	20:14	19:16	18:23	16:50	16:53		
29	07:50	07:15	06:21	05:47	05:44	20:09 (T-38)	05:44	06:09	06:45	20:20 (T-38)	07:22	08:00	07:41	08:04		
	17:31	18:13	19:49	20:27	21:01	21:17	20:58	12	20:32 (T-38)	20:12	19:15	18:21	16:49	16:54		
30	07:49	07:13	06:20	05:46	05:45	20:10 (T-38)	05:45	06:10	06:46	20:19 (T-38)	07:23	08:01	07:42	08:04		
	17:32	18:15	19:50	20:29	21:02	21:17	20:57	12	20:31 (T-38)	20:10	19:13	18:20	16:49	16:55		
31	07:48	07:11	06:17	05:46	05:46	20:11 (T-38)	05:41	06:11	06:47	20:18 (T-38)	07:24	08:03	07:43	08:04		
	17:34	18:17	19:51	20:30	21:03	20:56	12	20:30 (T-38)	20:09	20:19	19:18	18:18	16:48	16:56		
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275				
Total, worst case				39	114											
Sun reduction				0.63	0.66											
Oper. time red.				0.90	0.90											
Wind dir. red.				0.60	0.63											
Total reduction				0.34	0.37											
Total, real				13	42											

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christianajansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-321 - R-321
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time
N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57 46	08:39 (T-89) 09:25 (T-89)	07:47 17:35	07:06 18:13	07:09 19:53	06:18 20:30	05:45 21:04	05:45 21:16	06:13 20:55	06:49 20:07	07:24 19:11	07:04 17:17	08:26 (T-89) 16:48 43
2	08:04 16:58 46	08:39 (T-89) 09:25 (T-89)	07:46 17:36	07:04 18:14	07:07 19:54	06:17 20:31	05:45 21:05	05:46 21:16	06:14 20:54	06:50 20:05	07:25 19:09	07:05 17:16	08:27 (T-89) 16:48 43
3	08:04 16:59 46	08:40 (T-89) 09:26 (T-89)	07:45 17:38	07:02 18:15	07:06 19:55	06:15 20:32	05:44 21:06	05:46 21:16	06:15 20:52	06:51 20:03	07:27 19:07	07:07 17:14	08:27 (T-89) 16:48 44
4	08:04 17:00 45	08:41 (T-89) 09:26 (T-89)	07:43 17:39	07:01 18:17	07:04 19:56	06:14 20:33	05:44 21:06	05:47 21:16	06:16 20:51	06:52 20:01	07:28 19:05	07:08 17:13	08:27 (T-89) 16:48 44
5	08:04 17:01 46	08:40 (T-89) 09:26 (T-89)	07:42 17:41	06:59 18:18	07:02 19:58	06:13 20:35	05:43 21:07	05:48 21:16	06:17 20:50	06:53 20:00	07:29 19:03	07:09 17:11	08:27 (T-89) 16:47 45
6	08:04 17:02 45	08:41 (T-89) 09:26 (T-89)	07:41 17:42	06:57 18:19	07:00 19:59	06:11 20:36	05:43 21:08	05:48 21:15	06:18 20:48	06:55 19:58	07:30 19:02	07:11 17:10	08:27 (T-89) 16:47 45
7	08:04 17:03 45	08:42 (T-89) 09:27 (T-89)	07:40 17:44	06:55 18:21	06:58 20:00	06:10 20:37	05:43 21:09	05:49 21:15	06:19 20:47	06:56 19:56	07:31 19:00	07:12 17:09	08:27 (T-89) 16:47 46
8	08:04 17:04 44	08:43 (T-89) 09:27 (T-89)	07:38 17:45	07:54 18:22	06:57 20:01	06:08 20:38	05:42 21:09	05:50 21:15	06:21 20:46	06:57 19:54	07:33 18:56	07:13 17:08	08:28 (T-89) 16:47 45
9	08:03 17:05 44	08:43 (T-89) 09:27 (T-89)	07:37 17:46	07:52 19:23	06:55 20:03	06:07 20:40	05:42 21:10	05:50 21:14	06:22 20:44	06:58 19:52	07:34 18:54	07:15 17:06	08:28 (T-89) 16:47 46
10	08:03 17:06 43	08:44 (T-89) 09:27 (T-89)	07:36 17:48	07:50 19:25	06:53 20:04	06:06 20:41	05:42 21:11	05:51 21:14	06:23 20:43	06:59 19:50	07:35 18:53	07:16 17:05	08:28 (T-89) 16:47 47
11	08:03 17:07 43	08:44 (T-89) 09:27 (T-89)	07:34 17:49	07:48 19:26	06:51 20:05	06:05 20:42	05:42 21:11	05:52 21:13	06:24 20:41	07:00 19:48	07:36 18:51	07:18 17:04	08:29 (T-89) 16:47 46
12	08:02 17:09 42	08:45 (T-89) 09:27 (T-89)	07:33 17:51	07:46 19:27	06:49 20:06	06:03 20:43	05:41 21:12	05:53 21:13	06:25 20:40	07:02 19:47	07:38 18:49	07:19 17:03	08:29 (T-89) 16:47 47
13	08:02 17:10 41	08:47 (T-89) 09:28 (T-89)	07:31 17:52	07:44 19:29	06:48 20:07	06:02 20:44	05:41 21:12	05:54 21:12	06:26 20:38	07:03 19:45	07:39 18:47	07:20 17:02	08:30 (T-89) 16:47 46
14	08:02 17:11 40	08:47 (T-89) 09:27 (T-89)	07:30 17:53	07:43 19:30	06:46 20:09	06:01 20:45	05:41 21:13	05:54 21:11	06:28 20:37	07:04 19:43	07:40 18:46	07:22 17:01	08:30 (T-89) 16:47 47
15	08:01 17:12 39	08:47 (T-89) 09:26 (T-89)	07:28 17:55	07:41 19:31	06:44 20:10	06:00 20:47	05:41 21:13	05:55 21:11	06:29 20:35	07:05 19:41	07:42 18:44	07:23 17:00	08:30 (T-89) 16:47 47
16	08:01 17:13 38	08:49 (T-89) 09:27 (T-89)	07:27 17:56	07:39 19:32	06:42 20:11	05:59 20:48	05:41 21:14	05:56 21:10	06:30 20:34	07:06 19:39	07:43 18:42	07:24 16:59	08:31 (T-89) 16:47 47
17	08:00 17:15 36	08:50 (T-89) 09:26 (T-89)	07:25 17:58	07:37 19:34	06:41 20:12	05:58 20:49	05:41 21:14	05:57 21:09	06:31 20:32	07:07 19:37	07:44 18:40	07:26 16:58	08:32 (T-89) 16:48 46
18	07:59 17:16 35	08:50 (T-89) 09:25 (T-89)	07:24 17:59	07:35 19:35	06:39 20:14	05:57 20:50	05:41 21:15	05:58 21:09	06:32 20:31	07:09 19:35	07:45 18:39	07:27 16:57	08:34 (T-89) 16:48 47
19	07:59 17:17 34	08:52 (T-89) 09:26 (T-89)	07:22 18:00	07:33 19:36	06:37 20:15	05:56 20:51	05:41 21:15	05:59 21:08	06:33 20:29	07:10 19:33	07:47 18:37	07:28 16:56	08:33 (T-89) 16:48 47
20	07:58 17:19 32	08:53 (T-89) 09:25 (T-89)	07:21 18:00	07:32 19:37	06:36 20:16	05:55 20:52	05:41 21:15	06:00 21:07	06:35 20:27	07:11 19:32	07:48 18:35	07:30 16:55	08:31 (T-89) 16:49 47
21	07:57 17:20 29	08:55 (T-89) 09:24 (T-89)	07:19 18:02	07:30 19:39	06:34 20:17	05:54 20:53	05:42 21:16	06:01 21:06	06:36 20:26	07:12 19:30	07:49 18:34	07:49 16:54	08:31 (T-89) 16:49 47
22	07:56 17:21 26	08:56 (T-89) 09:22 (T-89)	07:18 18:03	07:28 19:40	06:32 20:19	05:53 20:54	05:42 21:16	06:02 21:05	06:37 20:24	07:13 19:28	07:51 18:32	07:32 16:54	08:29 (T-89) 16:50 47
23	07:56 17:23 23	08:58 (T-89) 09:21 (T-89)	07:16 18:05	07:26 19:41	06:31 20:20	05:52 20:55	05:42 21:16	06:03 21:04	06:38 20:22	07:14 19:26	07:52 18:30	07:33 16:53	08:28 (T-89) 16:50 47
24	07:55 17:24 19	09:00 (T-89) 09:19 (T-89)	07:14 18:06	07:24 19:43	06:29 20:21	05:51 20:56	05:42 21:16	06:04 21:03	06:39 20:21	07:16 19:24	07:53 18:29	07:35 16:52	08:28 (T-89) 16:51 47
25	07:54 17:25 13	09:03 (T-89) 09:16 (T-89)	07:13 18:07	07:22 19:44	06:28 20:22	05:50 20:57	05:43 21:16	06:05 21:03	06:40 20:19	07:17 19:22	07:55 18:27	07:36 16:52	08:28 (T-89) 16:51 47
26	07:53 17:27	09:11 18:09	07:11 18:09	07:20 19:45	06:26 20:24	05:49 20:58	05:43 21:16	06:06 21:01	06:42 20:17	07:18 19:20	07:56 18:26	07:37 16:51	08:27 (T-89) 16:52 47
27	07:52 17:28	09:09 18:10	07:09 18:10	07:19 19:46	06:24 20:25	05:49 20:59	05:43 21:17	06:07 21:00	06:43 20:16	07:19 19:18	07:57 18:24	07:38 16:50	08:28 (T-89) 16:53 47
28	07:51 17:29	09:08 18:11	07:08 18:11	07:17 19:48	06:23 20:26	05:48 21:00	05:44 21:17	06:08 20:59	06:44 20:14	07:20 19:16	07:59 18:23	07:40 16:50	08:27 (T-89) 16:54 47
29	07:50 17:31	09:07 18:11	07:07 18:11	07:16 19:48	06:22 20:26	05:47 21:00	05:44 21:17	06:09 20:58	06:45 20:12	07:22 19:15	08:00 18:21	07:41 16:49	08:27 (T-89) 16:54 47
30	07:49 17:32	09:06 18:10	07:06 18:10	07:15 19:49	06:21 20:27	05:47 21:01	05:44 21:17	06:10 20:58	06:46 20:12	07:23 19:15	08:01 18:21	07:42 16:49	08:26 (T-89) 16:54 47
31	07:48 17:34	09:05 18:09	07:05 18:09	07:14 19:50	06:20 20:29	05:47 21:02	05:45 21:16	06:10 20:57	06:46 20:10	07:23 19:13	08:01 18:20	07:42 16:49	08:26 (T-89) 16:55 46
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275	1431
Total, worst case	940										446		1431
Sun reduction	0.58										0.48		0.52
Oper. time red.	0.90										0.90		0.90
Wind dir. red.	0.67										0.67		0.67
Total reduction	0.35										0.29		0.31
Total, real	330										130		450

Table layout: For each day in each month the following matrix apply

Day in month Sun rise (hh:mm) First time (hh:mm) with flicker (WTG causing flicker first time)
Sun set (hh:mm) Minutes with flicker Last time (hh:mm) with flicker (WTG causing flicker last time)

Project: South Deuel Wind Project

Description: Invernergy Deuel Harvest Wind in Deuel County, SD Greenhouse Shadow Flicker Study Project Turbines Only L086 71 V163-4.5 WTGs on 98m HH June 14, 2024

Licensed user: Stantec Consulting Services Inc. 1165 Scheuring Road US-DE PERE WI 54115 920 278 3215 Christiana Jansen / christiana.jansen@stantec.com Calculated: 6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-322 - R-322 Sunshine probability S/S0 (Sun hours/Possible sun hours) [] Assumptions for shadow calculations

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec 0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum 561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

Table with 12 columns (January to December) and multiple rows. Each row represents a day with start and end times in hh:mm format. Includes a summary section at the bottom for 'Potential sun hours' and 'Total, worst case'.

Table layout: For each day in each month the following matrix apply

Matrix with 2 rows: Day in month, Sun rise (hh:mm), Sun set (hh:mm), Minutes with flicker. 2 columns: First time (hh:mm) with flicker, Last time (hh:mm) with flicker. 2 columns: (WTG causing flicker first time), (WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-323 - R-323

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	07:46	07:05	07:09	06:18	05:45 20:08 (T-71)
	16:57	17:35	18:12	19:52	20:29	21:03 29 20:37 (T-71)
2	08:04	07:45	07:04	07:07	06:16	05:44 20:09 (T-71)
	16:57	17:36	18:14	19:53	20:30	21:04 28 20:37 (T-71)
3	08:04	07:44	07:02	07:05	06:15	05:44 20:09 (T-71)
	16:58	17:37	18:15	19:54	20:32	21:05 27 20:36 (T-71)
4	08:04	07:43	07:00	07:03	06:13	05:43 20:10 (T-71)
	16:59	17:39	18:16	19:56	20:33	21:06 27 20:37 (T-71)
5	08:03	07:41	06:58	07:01	06:12	05:43 20:11 (T-71)
	17:00	17:40	18:18	19:57	20:34	21:07 26 20:37 (T-71)
6	08:03	07:40	06:57	07:00	06:11	05:43 20:11 (T-71)
	17:01	17:42	18:19	19:58	20:35	21:07 25 20:36 (T-71)
7	08:03	07:39	06:55	06:58	06:09	05:42 20:12 (T-71)
	17:02	17:43	18:20	19:59	20:36	21:08 24 20:36 (T-71)
8	08:03	07:38	07:53	06:56	06:08	05:42 20:12 (T-71)
	17:04	17:44	18:21	20:01	20:38	21:09 24 20:36 (T-71)
9	08:03	07:36	07:51	06:54	06:07	05:42 20:12 (T-71)
	17:05	17:46	19:23	20:02	20:39	21:09 24 20:36 (T-71)
10	08:02	07:35	07:49	06:52	06:05	20:12 (T-71) 05:41 20:13 (T-71)
	17:06	17:47	19:24	20:03	20:40	4 20:16 (T-71) 21:10 23 20:36 (T-71)
11	08:02	07:34	07:48	06:51	06:04	20:11 (T-71) 05:41 20:13 (T-71)
	17:07	17:49	19:25	20:04	20:41	6 20:17 (T-71) 21:11 23 20:36 (T-71)
12	08:02	07:32	07:46	06:49	06:03	20:10 (T-71) 05:41 20:14 (T-71)
	17:08	17:50	19:27	20:06	20:42	8 20:18 (T-71) 21:11 22 20:36 (T-71)
13	08:01	07:31	07:44	06:47	06:02	20:09 (T-71) 05:41 20:15 (T-71)
	17:09	17:52	19:28	20:07	20:44	10 20:19 (T-71) 21:12 21 20:36 (T-71)
14	08:01	07:29	07:42	06:45	06:01	20:09 (T-71) 05:41 20:15 (T-71)
	17:10	17:53	19:29	20:08	20:45	12 20:21 (T-71) 21:12 21 20:36 (T-71)
15	08:00	07:28	07:40	06:44	05:59	20:07 (T-71) 05:41 20:16 (T-71)
	17:12	17:54	19:31	20:09	20:46	14 20:21 (T-71) 21:13 20 20:36 (T-71)
16	08:00	07:26	07:38	06:42	05:58	20:07 (T-71) 05:41 20:16 (T-71)
	17:13	17:56	19:32	20:11	20:47	15 20:22 (T-71) 21:13 20 20:36 (T-71)
17	07:59	07:25	07:37	06:40	05:57	20:06 (T-71) 05:41 20:16 (T-71)
	17:14	17:57	19:33	20:12	20:48	17 20:23 (T-71) 21:14 20 20:36 (T-71)
18	07:59	07:23	07:35	06:39	05:56	20:06 (T-71) 05:41 20:17 (T-71)
	17:15	17:59	19:34	20:13	20:49	18 20:24 (T-71) 21:14 19 20:36 (T-71)
19	07:58	07:22	07:33	06:37	05:55	20:07 (T-71) 05:41 20:17 (T-71)
	17:17	18:00	19:36	20:14	20:50	19 20:26 (T-71) 21:14 19 20:36 (T-71)
20	07:57	07:20	07:31	06:35	05:54	20:07 (T-71) 05:41 20:17 (T-71)
	17:18	18:00	19:37	20:16	20:51	20 20:27 (T-71) 21:15 19 20:36 (T-71)
21	07:57	07:19	17:37 (T-75)	07:29	06:33	05:53 20:06 (T-71) 05:41 20:17 (T-71)
	17:19	18:01	2 17:39 (T-75)	19:38	20:17	20:52 22 20:28 (T-71) 21:15 19 20:36 (T-71)
22	07:56	07:17	17:37 (T-75)	07:27	06:32	05:52 20:06 (T-71) 05:41 20:18 (T-71)
	17:21	18:03	4 17:41 (T-75)	19:39	20:18	20:54 22 20:28 (T-71) 21:15 19 20:37 (T-71)
23	07:55	07:15	17:37 (T-75)	07:25	06:30	05:51 20:06 (T-71) 05:42 20:18 (T-71)
	17:22	18:04	5 17:42 (T-75)	19:41	20:19	20:55 23 20:29 (T-71) 21:15 19 20:37 (T-71)
24	07:54	07:14	17:37 (T-75)	07:24	06:29	05:51 20:06 (T-71) 05:42 20:18 (T-71)
	17:23	18:05	6 17:43 (T-75)	19:42	20:21	20:56 24 20:30 (T-71) 21:16 19 20:37 (T-71)
25	07:53	07:12	17:39 (T-75)	07:22	06:27	05:50 20:07 (T-71) 05:42 20:18 (T-71)
	17:25	18:07	6 17:45 (T-75)	19:43	20:22	20:57 25 20:32 (T-71) 21:16 20 20:38 (T-71)
26	07:52	07:10	17:41 (T-75)	07:20	06:25	05:49 20:07 (T-71) 05:43 20:18 (T-71)
	17:26	18:08	5 17:46 (T-75)	19:44	20:23	20:58 25 20:32 (T-71) 21:16 20 20:38 (T-71)
27	07:51	07:09	07:18	06:24	05:48	20:07 (T-71) 05:43 20:18 (T-71)
	17:28	18:09	19:46	20:24	20:59	26 20:33 (T-71) 21:16 20 20:38 (T-71)
28	07:50	07:07	07:16	06:22	05:47	20:07 (T-71) 05:43 20:18 (T-71)
	17:29	18:11	19:47	20:25	21:00	26 20:33 (T-71) 21:16 21 20:39 (T-71)
29	07:49		07:14	06:21	05:47	20:08 (T-71) 05:44 20:18 (T-71)
	17:30		19:48	20:27	21:01	27 20:35 (T-71) 21:16 21 20:39 (T-71)
30	07:48		07:12	06:19	05:46	20:08 (T-71) 05:44 20:18 (T-71)
	17:32		19:49	20:28	21:01	27 20:35 (T-71) 21:16 22 20:40 (T-71)
31	07:47		07:11		05:45	20:09 (T-71)
	17:33		19:51		21:02	28 20:37 (T-71)
Potential sun hours	287	292	369	403	458	465
Total, worst case					418	661
Sun reduction		28			0.66	0.73
Oper. time red.		0.58			0.90	0.90
Wind dir. red.		0.90			0.64	0.64
Total reduction		0.58			0.38	0.42
Total, real		0.30			158	276
		9				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	Sun set (hh:mm)	Minutes with flicker	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
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Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-323 - R-323

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	July	August	September	October	November	December		
1	05:45	20:18 (T-71)	06:12	20:21 (T-71)	06:48	07:24	07:03	07:42
	21:16	22 20:40 (T-71)	20:54	7 20:28 (T-71)	20:06	19:10	17:16	16:48
2	05:45	20:18 (T-71)	06:13	20:22 (T-71)	06:49	07:25	07:05	07:44
	21:16	23 20:41 (T-71)	20:53	5 20:27 (T-71)	20:04	19:08	17:15	16:48
3	05:46	20:17 (T-71)	06:14	20:24 (T-71)	06:50	07:26	07:06	07:45
	21:15	24 20:41 (T-71)	20:52	2 20:26 (T-71)	20:03	19:07	17:14	16:47
4	05:46	20:18 (T-71)	06:16		06:52	07:27	07:07	07:46
	21:15	23 20:41 (T-71)	20:50		20:01	19:05	17:12	16:47
5	05:47	20:17 (T-71)	06:17		06:53	07:28	07:09	07:47
	21:15	24 20:41 (T-71)	20:49		19:59	19:03	17:11	16:47
6	05:48	20:17 (T-71)	06:18		06:54	07:30	07:10	07:48
	21:15	25 20:42 (T-71)	20:48		19:57	19:01	17:10	16:47
7	05:48	20:17 (T-71)	06:19		06:55	07:31	07:11	07:49
	21:14	26 20:43 (T-71)	20:46		19:55	18:57	17:08	16:46
8	05:49	20:18 (T-71)	06:20		06:56	07:32	07:13	07:50
	21:14	26 20:44 (T-71)	20:45		19:53	18:56	17:07	16:46
9	05:50	20:17 (T-71)	06:21		06:57	07:33	07:14	07:51
	21:13	27 20:44 (T-71)	20:44		19:52	18:54	17:06	16:46
10	05:51	20:17 (T-71)	06:22		06:59	07:35	07:16	07:52
	21:13	27 20:44 (T-71)	20:42		19:50	18:52	17:05	16:46
11	05:51	20:17 (T-71)	06:24		07:00	07:36	07:17	07:53
	21:12	28 20:45 (T-71)	20:41		19:48	18:50	17:04	16:46
12	05:52	20:17 (T-71)	06:25		07:01	07:37	07:18	07:54
	21:12	28 20:45 (T-71)	20:39		19:46	18:48	17:03	16:46
13	05:53	20:16 (T-71)	06:26		07:02	07:38	07:20	07:54
	21:11	28 20:44 (T-71)	20:38		19:44	18:47	17:01	16:46
14	05:54	20:16 (T-71)	06:27		07:03	07:40	07:21	07:55
	21:11	27 20:43 (T-71)	20:36		19:42	18:45	17:00	16:47
15	05:55	20:16 (T-71)	06:28		07:05	07:41	07:22	07:56
	21:10	27 20:43 (T-71)	20:35		19:40	18:43	16:59	16:47
16	05:56	20:16 (T-71)	06:29		07:06	07:42	18:12 (T-75)	07:24
	21:09	27 20:43 (T-71)	20:33		19:38	18:42	6 18:18 (T-75)	16:58
17	05:57	20:16 (T-71)	06:31		07:07	07:43	18:10 (T-75)	07:25
	21:09	26 20:42 (T-71)	20:32		19:37	18:40	6 18:16 (T-75)	16:57
18	05:58	20:16 (T-71)	06:32		07:08	07:45	18:08 (T-75)	07:26
	21:08	25 20:41 (T-71)	20:30		19:35	18:38	6 18:14 (T-75)	16:57
19	05:59	20:17 (T-71)	06:33		07:09	07:46	18:08 (T-75)	07:28
	21:07	24 20:41 (T-71)	20:28		19:33	18:36	5 18:13 (T-75)	16:56
20	05:59	20:16 (T-71)	06:34		07:10	07:47	18:08 (T-75)	07:29
	21:06	23 20:39 (T-71)	20:27		19:31	18:35	3 18:11 (T-75)	16:55
21	06:00	20:16 (T-71)	06:35		07:12	07:49	18:07 (T-75)	07:30
	21:06	22 20:38 (T-71)	20:25		19:29	18:33	2 18:09 (T-75)	16:54
22	06:01	20:16 (T-71)	06:36		07:13	07:50		07:31
	21:05	22 20:38 (T-71)	20:23		19:27	18:32		16:53
23	06:02	20:16 (T-71)	06:38		07:14	07:51		07:33
	21:04	21 20:37 (T-71)	20:22		19:25	18:30		16:52
24	06:04	20:16 (T-71)	06:39		07:15	07:53		07:34
	21:03	20 20:36 (T-71)	20:20		19:23	18:28		16:52
25	06:05	20:17 (T-71)	06:40		07:16	07:54		07:35
	21:02	18 20:35 (T-71)	20:18		19:22	18:27		16:51
26	06:06	20:17 (T-71)	06:41		07:18	07:55		07:36
	21:01	17 20:34 (T-71)	20:17		19:20	18:25		16:51
27	06:07	20:17 (T-71)	06:42		07:19	07:57		07:38
	21:00	16 20:33 (T-71)	20:15		19:18	18:24		16:50
28	06:08	20:18 (T-71)	06:43		07:20	07:58		07:39
	20:59	14 20:32 (T-71)	20:13		19:16	18:22		16:49
29	06:09	20:18 (T-71)	06:45		07:21	07:59		07:40
	20:58	13 20:31 (T-71)	20:11		19:14	18:21		16:49
30	06:10	20:19 (T-71)	06:46		07:22	08:01		07:41
	20:56	11 20:30 (T-71)	20:10		19:12	18:19		16:48
31	06:11	20:20 (T-71)	06:47			08:02		08:03
	20:55	10 20:30 (T-71)	20:08			18:18		16:55
Potential sun hours	471	436	377	341	289	276		
Total, worst case	694	14	28					
Sun reduction	0.75	0.72	0.56					
Oper. time red.	0.90	0.90	0.90					
Wind dir. red.	0.64	0.64	0.58					
Total reduction	0.43	0.41	0.29					
Total, real	298	6	8					

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-324 - R-324
Assumptions for shadow calculations Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June
1	08:04	08:29 (T-45)	07:47	07:06	07:09	06:18
	16:57	12 08:41 (T-45)	17:35	18:12	19:52	21:04
2	08:04	08:29 (T-45)	07:46	07:04	07:07	06:17
	16:58	13 08:42 (T-45)	17:36	18:14	19:54	21:05
3	08:04	08:29 (T-45)	07:44	07:02	07:05	06:15
	16:58	13 08:42 (T-45)	17:38	18:15	19:55	20:32
4	08:04	08:29 (T-45)	07:43	07:00	07:04	06:14
	16:59	14 08:43 (T-45)	17:39	18:16	19:56	20:33
5	08:04	08:28 (T-45)	07:42	06:59	07:02	06:12
	17:00	15 08:43 (T-45)	17:40	18:18	19:57	20:35
6	08:04	08:28 (T-45)	07:41	06:57	07:00	06:11
	17:01	15 08:43 (T-45)	17:42	18:19	19:59	20:36
7	08:04	08:28 (T-45)	07:39	06:55	06:58	06:09
	17:03	16 08:44 (T-45)	17:43	18:20	20:00	20:37
8	08:04	08:28 (T-45)	07:38	07:53	06:56	06:08
	17:04	17 08:45 (T-45)	17:45	18:22	20:01	20:38
9	08:03	08:27 (T-45)	07:37	07:52	06:55	06:07
	17:05	18 08:45 (T-45)	17:46	19:23	20:02	20:39
10	08:03	08:27 (T-45)	07:35	07:50	06:53	06:06
	17:06	19 08:46 (T-45)	17:48	19:24	20:04	20:41
11	08:03	08:26 (T-45)	07:34	07:48	06:51	06:04
	17:07	20 08:46 (T-45)	17:49	19:26	20:05	20:42
12	08:02	08:26 (T-45)	07:33	07:46	06:49	06:03
	17:08	20 08:46 (T-45)	17:50	19:27	20:06	20:43
13	08:02	08:26 (T-45)	07:31	07:44	06:47	06:02
	17:09	21 08:47 (T-45)	17:52	19:28	20:07	20:44
14	08:02	08:25 (T-45)	07:30	07:42	06:46	06:01
	17:11	22 08:47 (T-45)	17:53	19:30	20:09	20:45
15	08:01	08:24 (T-45)	07:28	07:41	06:44	06:00
	17:12	23 08:47 (T-45)	17:55	19:31	20:10	20:46
16	08:01	08:24 (T-45)	07:27	07:39	06:42	05:58
	17:13	24 08:48 (T-45)	17:56	19:32	20:11	20:48
17	08:00	08:23 (T-45)	07:25	07:37	06:40	05:57
	17:14	24 08:47 (T-45)	17:57	19:33	20:12	1 19:49 (T-17)
18	07:59	08:22 (T-45)	07:24	07:35	06:39	05:56
	17:16	25 08:47 (T-45)	17:59	19:35	20:14	3 19:51 (T-17)
19	07:59	08:23 (T-45)	07:22	07:33	06:37	05:55
	17:17	25 08:48 (T-45)	18:00	19:36	20:15	5 19:53 (T-17)
20	07:58	08:23 (T-45)	07:21	07:31	06:35	05:54
	17:18	24 08:47 (T-45)	18:00	19:37	20:16	7 19:54 (T-17)
21	07:57	08:24 (T-45)	07:19	07:30	06:34	05:53
	17:20	23 08:47 (T-45)	18:02	19:39	20:17	8 19:54 (T-17)
22	07:56	08:25 (T-45)	07:17	07:28	06:32	05:52
	17:21	21 08:46 (T-45)	18:03	19:40	20:19	9 19:56 (T-17)
23	07:56	08:26 (T-45)	07:16	07:26	06:30	05:51
	17:22	20 08:46 (T-45)	18:04	19:41	20:20	10 19:57 (T-17)
24	07:55	08:27 (T-45)	07:14	07:24	06:29	05:51
	17:24	18 08:45 (T-45)	18:06	19:42	20:21	11 19:58 (T-17)
25	07:54	08:29 (T-45)	07:12	07:22	06:27	05:50
	17:25	14 08:43 (T-45)	18:07	19:44	20:22	11 19:59 (T-17)
26	07:53	08:31 (T-45)	07:11	07:20	06:26	05:49
	17:26	11 08:42 (T-45)	18:08	19:45	20:24	11 20:00 (T-17)
27	07:52		07:09	07:18	06:24	05:48
	17:28		18:10	19:46	20:25	8 19:59 (T-17)
28	07:51		07:07	07:17	06:23	05:47
	17:29		18:11	19:47	20:26	12 20:33 (T-18)
29	07:50			07:15	06:21	05:47
	17:31			19:49	20:27	14 20:35 (T-18)
30	07:49			07:13	06:19	05:46
	17:32			19:50	20:28	16 21:02
31	07:48			07:11		05:46
	17:33			19:51		17 21:03
Potential sun hours	287	292	369	403	459	465
Total, worst case	487			84	177	770
Sun reduction	0.58			0.63	0.66	0.73
Oper. time red.	0.90			0.90	0.90	0.90
Wind dir. red.	0.65			0.60	0.62	0.64
Total reduction	0.34			0.34	0.37	0.42
Total, real	166			29	65	327

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-324 - R-324
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

July		August		September		October		November		December		
1	05:45	20:23 (T-18)	06:12	06:36 (T-21)	06:48	07:24	07:04	07:43	08:08 (T-45)			
	21:16	26	20:49 (T-18)	20:55	8	06:44 (T-21)	20:07	19:11	17:17	16:48	20	08:28 (T-45)
2	05:45	20:23 (T-18)	06:13	06:37 (T-21)	06:50	07:25	07:05	07:44	08:10 (T-45)			
	21:16	26	20:49 (T-18)	20:53	7	06:44 (T-21)	20:05	19:09	17:15	16:48	19	08:29 (T-45)
3	05:46	20:23 (T-18)	06:15	06:38 (T-21)	06:51	07:26	07:07	07:45	08:11 (T-45)			
	21:16	25	20:48 (T-18)	20:52	6	06:44 (T-21)	20:03	19:07	17:14	16:47	18	08:29 (T-45)
4	05:47	20:24 (T-18)	06:16	06:39 (T-21)	06:52	07:28	07:08	07:46	08:12 (T-45)			
	21:16	24	20:48 (T-18)	20:51	5	06:44 (T-21)	20:01	19:05	17:13	16:47	17	08:29 (T-45)
5	05:47	20:25 (T-18)	06:17	06:40 (T-21)	06:53	07:29	07:09	07:48	08:13 (T-45)			
	21:16	23	20:48 (T-18)	20:50	3	06:43 (T-21)	19:59	19:03	17:11	16:47	16	08:29 (T-45)
6	05:48	20:24 (T-18)	06:18	06:41 (T-21)	06:54	07:30	07:11	07:49	08:14 (T-45)			
	21:15	24	20:48 (T-18)	20:48	2	06:43 (T-21)	19:58	19:01	17:10	16:47	15	08:29 (T-45)
7	05:49	20:25 (T-18)	06:19		06:55	07:31	07:12	07:50	08:15 (T-45)			
	21:15	23	20:48 (T-18)	20:47		19:56	19:00	17:09	16:47	15	08:30 (T-45)	
8	05:49	20:26 (T-18)	06:20		06:57	07:33	07:13	07:51	08:16 (T-45)			
	21:15	22	20:48 (T-18)	20:46		19:54	18:56	17:07	16:46	14	08:30 (T-45)	
9	05:50	20:26 (T-18)	06:21		06:58	07:34	07:15	07:52	08:17 (T-45)			
	21:14	20	20:46 (T-18)	20:44		19:52	18:54	17:06	16:46	13	08:30 (T-45)	
10	05:51	20:26 (T-18)	06:23		06:59	07:35	07:16	07:52	08:18 (T-45)			
	21:14	20	20:46 (T-18)	20:43		19:50	18:52	17:05	16:46	13	08:31 (T-45)	
11	05:52	20:27 (T-18)	06:24		07:00	07:36	07:17	07:53	08:19 (T-45)			
	21:13	19	20:46 (T-18)	20:41		19:48	18:51	17:04	16:46	12	08:31 (T-45)	
12	05:52	20:28 (T-18)	06:25		07:01	07:38	07:19	07:54	08:20 (T-45)			
	21:13	18	20:46 (T-18)	20:40		19:46	18:49	17:03	16:46	11	08:31 (T-45)	
13	05:53	20:28 (T-18)	06:26		07:02	07:39	07:20	07:55	08:21 (T-45)			
	21:12	16	20:44 (T-18)	20:38		19:45	18:47	17:02	16:46	11	08:32 (T-45)	
14	05:54	20:29 (T-18)	06:27		07:04	07:40	07:22	07:56	08:22 (T-45)			
	21:11	15	20:44 (T-18)	20:37		19:43	18:45	17:01	16:47	10	08:32 (T-45)	
15	05:55	20:29 (T-18)	06:28		07:05	07:41	07:23	07:57	08:22 (T-45)			
	21:11	15	20:44 (T-18)	20:35		19:41	18:44	17:00	16:47	10	08:32 (T-45)	
16	05:56	20:30 (T-18)	06:30		19:57 (T-17)	07:06	07:43	07:24	07:57	10	08:23 (T-45)	
	21:10	13	20:43 (T-18)	20:34	9	20:06 (T-17)	19:39	18:42	16:59	11	08:15 (T-45)	
17	05:57	20:32 (T-18)	06:31		19:55 (T-17)	07:07	07:44	07:26	08:03 (T-45)	9	08:32 (T-45)	
	21:09	10	20:42 (T-18)	20:32	11	20:06 (T-17)	19:37	18:40	16:58	14	08:17 (T-45)	
18	05:58	20:33 (T-18)	06:32		19:54 (T-17)	07:08	07:45	07:27	08:01 (T-45)	9	08:33 (T-45)	
	21:09	9	20:42 (T-18)	20:31	12	20:06 (T-17)	19:35	18:38	16:57	18	08:19 (T-45)	
19	05:59	20:34 (T-18)	06:33		19:53 (T-17)	07:10	07:47	07:28	08:01 (T-45)	9	08:25 (T-45)	
	21:08	7	20:41 (T-18)	20:29	11	20:04 (T-17)	19:33	18:37	16:56	20	08:21 (T-45)	
20	06:00	20:36 (T-18)	06:34		19:52 (T-17)	07:11	07:48	07:29	08:00 (T-45)	9	08:34 (T-45)	
	21:07	5	20:41 (T-18)	20:27	10	20:02 (T-17)	19:31	18:35	16:55	21	08:21 (T-45)	
21	06:01	20:37 (T-18)	06:35		19:52 (T-17)	07:12	07:49	07:31	08:00 (T-45)	9	08:34 (T-45)	
	21:06	3	20:40 (T-18)	20:26	9	20:01 (T-17)	19:29	18:33	16:54	23	08:23 (T-45)	
22	06:02		06:37		19:51 (T-17)	07:13	07:50	07:32	07:59 (T-45)	8	08:34 (T-45)	
	21:05		20:24		8	19:59 (T-17)	19:28	18:32	16:53	24	08:23 (T-45)	
23	06:03		06:38			19:51 (T-17)	07:14	07:52	07:33	25	07:59 (T-45)	
	21:04		20:22		6	19:57 (T-17)	19:26	18:30	16:53	25	08:24 (T-45)	
24	06:04		06:39			19:51 (T-17)	07:15	07:53	07:35	25	08:00 (T-45)	
	21:03		20:21		4	19:55 (T-17)	19:24	18:29	16:52	25	08:25 (T-45)	
25	06:05		06:40			19:51 (T-17)	07:17	07:54	07:36	25	08:01 (T-45)	
	21:02		20:19		3	19:54 (T-17)	19:22	18:27	16:51	24	08:25 (T-45)	
26	06:06	06:35 (T-21)	06:41			19:52 (T-17)	07:18	07:56	07:37	24	08:02 (T-45)	
	21:01	2	06:37 (T-21)	20:17	1	19:53 (T-17)	19:20	18:25	16:51	24	08:26 (T-45)	
27	06:07	06:32 (T-21)	06:43				07:19	07:57	07:38	24	08:04 (T-45)	
	21:00	8	06:40 (T-21)	20:15			19:18	18:24	16:50	23	08:27 (T-45)	
28	06:08	06:32 (T-21)	06:44				07:20	07:58	07:40	23	08:05 (T-45)	
	20:59	9	06:41 (T-21)	20:14			19:16	18:22	16:50	22	08:27 (T-45)	
29	06:09	06:33 (T-21)	06:45				07:22	08:00	07:41	22	08:06 (T-45)	
	20:58	9	06:42 (T-21)	20:12			19:14	18:21	16:49	21	08:27 (T-45)	
30	06:10	06:34 (T-21)	06:46				07:23	08:01	07:42	21	08:07 (T-45)	
	20:57	9	06:43 (T-21)	20:10			19:13	18:19	16:49	20	08:27 (T-45)	
31	06:11	06:35 (T-21)	06:47					08:02				
	20:56	8	06:43 (T-21)	20:08				18:18				
Potential sun hours	471		436			377	341	288		275		361
Total, worst case	408		115					315		0.52		0.90
Sun reduction	0.75		0.72					0.48		0.65		0.31
Oper. time red.	0.90		0.90					0.90		0.28		0.90
Wind dir. red.	0.64		0.60					0.65		0.31		0.65
Total reduction	0.43		0.39					0.28		0.31		0.31
Total, real	176		45					89		110		110

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



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South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-325 - R-325
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:04 16:57	07:46 17:35	07:05 18:12	17:31 (T-75) 18:12	07:09 20:29	06:18 21:03	05:45 21:16	06:12 20:54	06:48 20:06	07:24 19:10		07:03 17:16	07:42 16:48
2	08:04 16:58	07:45 17:36	07:04 18:14	17:34 (T-75) 17:43 (T-75)	07:07 19:53	06:16 20:30	05:44 21:04	06:13 21:16	06:49 20:53	07:25 20:04	18:35 (T-74) 18:43 (T-74)	07:05 17:15	07:44 16:48
3	08:04 16:58	07:44 17:37	07:02 18:15	17:43 (T-75) 19:53	07:05 20:30	06:15 21:05	05:44 21:15	06:14 20:52	06:51 20:03	07:26 19:07	8 18:41 (T-74) 18:31 (T-74)	07:06 17:14	07:45 16:47
4	08:04 16:59	07:43 17:39	07:00 18:16	17:54 (T-74) 19:56	07:03 20:33	06:14 21:06	05:43 21:15	06:16 20:50	06:52 20:01	07:27 19:05	8 18:39 (T-74) 18:39 (T-74)	07:07 17:12	07:46 16:47
5	08:04 17:00	07:42 17:40	06:58 18:18	17:55 (T-74) 17:56 (T-74)	07:02 19:57	06:12 20:34	05:43 21:07	06:17 21:15	06:53 20:49	07:28 19:59	7 18:38 (T-74) 18:30 (T-74)	07:09 17:11	07:47 16:47
6	08:03 17:01	07:40 17:42	06:57 18:19	17:54 (T-74) 17:57 (T-74)	07:00 19:58	06:11 20:35	05:43 21:07	06:18 21:15	06:54 20:48	07:30 19:57	7 18:30 (T-74) 18:36 (T-74)	07:10 17:10	07:48 16:47
7	08:03 17:02	07:39 17:43	06:55 18:20	17:54 (T-74) 17:58 (T-74)	06:58 19:59	06:09 20:36	05:42 21:08	06:19 21:14	06:55 20:46	07:31 19:55	6 18:30 (T-74) 18:34 (T-74)	07:11 17:08	07:49 16:47
8	08:03 17:04	07:38 17:45	07:53 18:22	18:53 (T-74) 19:00 (T-74)	06:08 20:01	06:08 20:38	05:42 21:09	06:20 21:14	06:56 20:45	07:32 19:53	4 18:30 (T-74) 18:32 (T-74)	07:13 17:07	07:50 16:46
9	08:03 17:05	07:36 17:46	07:51 19:23	18:54 (T-74) 19:02 (T-74)	06:07 20:02	06:07 20:39	05:42 21:09	06:21 21:13	06:58 20:44	07:33 19:52	2 18:32 (T-74) 18:32 (T-74)	07:14 17:06	07:51 16:46
10	08:02 17:06	07:35 17:47	07:49 19:24	18:55 (T-74) 19:03 (T-74)	06:53 20:03	06:05 20:40	05:41 21:10	06:22 21:13	06:59 20:42	07:35 18:52		07:16 17:05	07:52 16:46
11	08:02 17:07	07:34 17:49	07:48 19:25	18:56 (T-74) 19:04 (T-74)	06:51 20:04	06:04 20:41	05:41 21:11	06:24 21:13	07:00 20:41	07:36 18:50	2 18:11 (T-75) 18:13 (T-75)	07:17 17:04	07:53 16:46
12	08:02 17:08	07:32 17:50	07:46 19:27	18:58 (T-74) 19:04 (T-74)	06:49 20:06	06:03 20:42	05:41 21:11	06:25 21:12	07:01 19:46	07:37 18:49	11 18:17 (T-75) 18:06 (T-75)	07:18 17:03	07:54 16:46
13	08:01 17:09	07:31 17:52	07:44 19:28	19:04 (T-74) 19:28	06:47 20:07	06:02 20:44	05:41 21:12	06:26 21:11	07:02 19:44	07:38 18:47	16 18:04 (T-75) 18:20 (T-75)	07:20 17:02	07:54 16:46
14	08:01 17:11	07:29 17:53	07:42 19:29	19:29 19:29	06:45 20:08	06:01 20:45	05:41 21:12	06:27 21:11	07:03 19:42	07:40 18:45	19 18:02 (T-75) 18:21 (T-75)	07:21 17:00	07:55 16:47
15	08:00 17:12	07:28 17:54	07:40 19:31	19:31 19:31	06:44 20:09	05:59 20:46	05:41 21:13	06:28 21:10	07:05 19:40	07:41 18:43	19 18:00 (T-75) 18:19 (T-75)	07:22 16:59	07:56 16:47
16	08:00 17:13	07:26 17:56	07:38 19:32	19:32 19:32	06:42 20:11	05:58 20:47	05:41 21:13	06:29 21:10	07:06 19:39	07:42 18:42	18 18:00 (T-75) 18:18 (T-75)	07:24 16:58	07:57 16:47
17	07:59 17:14	07:25 17:57	17:31 (T-75) 19:33	17:33 (T-75) 19:33	06:40 20:12	05:57 20:48	05:41 21:14	06:31 21:09	07:07 20:32	07:43 19:37	17 17:59 (T-75) 18:16 (T-75)	07:25 16:57	07:57 16:47
18	07:59 17:16	07:23 17:59	2 17:30 (T-75) 19:34	17:30 (T-75) 19:34	06:39 20:13	05:56 20:49	05:41 21:14	06:32 21:08	07:08 20:30	07:45 19:35	17 17:58 (T-75) 18:14 (T-75)	07:26 16:57	07:58 16:48
19	07:58 17:17	07:22 18:00	4 17:34 (T-75) 19:34	17:34 (T-75) 19:34	06:37 20:14	05:55 20:50	05:41 21:14	06:33 21:07	07:09 19:33	07:46 18:37	16 17:59 (T-75) 18:13 (T-75)	07:28 16:56	07:59 16:48
20	07:57 17:18	07:20 18:00	7 17:36 (T-75) 19:36	17:36 (T-75) 19:36	06:35 20:14	05:54 20:50	05:41 21:15	06:34 21:07	07:10 19:33	07:47 18:37	14 17:58 (T-75) 18:13 (T-75)	07:29 16:56	07:59 16:48
21	07:57 17:19	07:19 18:01	9 17:37 (T-75) 19:37	17:37 (T-75) 19:37	06:34 20:16	05:53 20:51	05:41 21:15	06:35 21:06	07:12 19:31	07:49 18:35	13 18:11 (T-75) 17:59 (T-75)	07:30 16:55	08:00 16:48
22	07:56 17:21	07:17 18:03	12 17:39 (T-75) 19:38	17:39 (T-75) 19:38	06:32 20:17	05:52 20:53	05:41 21:15	06:36 21:06	07:13 19:29	07:50 18:33	11 18:10 (T-75) 17:59 (T-75)	07:31 16:54	08:00 16:49
23	07:55 17:22	07:15 18:04	13 17:41 (T-75) 19:39	17:41 (T-75) 19:39	06:30 20:18	05:51 20:54	05:42 21:15	06:38 21:05	07:14 19:27	07:51 18:32	9 17:59 (T-75) 18:08 (T-75)	07:33 16:53	08:01 16:49
24	07:54 17:24	07:14 18:05	15 17:42 (T-75) 19:41	17:42 (T-75) 19:41	06:29 20:19	05:51 20:55	05:42 21:15	06:39 21:04	07:15 19:25	07:53 18:30	6 18:05 (T-75) 18:00 (T-75)	07:34 16:53	08:01 16:50
25	07:53 17:24	07:12 18:05	16 17:44 (T-75) 19:42	17:44 (T-75) 19:42	06:27 20:21	05:50 20:56	05:42 21:16	06:40 21:03	07:16 19:23	07:54 18:28	4 18:04 (T-75) 18:01 (T-75)	07:35 16:52	08:02 16:50
26	07:52 17:26	07:10 18:08	17 17:45 (T-75) 19:43	17:45 (T-75) 19:43	06:25 20:22	05:49 20:57	05:43 21:16	06:41 21:02	07:18 19:22	07:55 18:27	1 18:02 (T-75) 18:02 (T-75)	07:37 16:51	08:02 16:51
27	07:51 17:28	07:09 18:10	18 17:46 (T-75) 19:44	17:46 (T-75) 19:44	06:23 20:24	05:48 20:59	05:43 21:16	06:42 21:00	07:19 19:18	07:57 18:24	17 17:59 (T-75) 18:05 (T-75)	07:38 16:50	08:02 16:52
28	07:50 17:29	07:07 18:11	19 17:47 (T-75) 19:46	17:47 (T-75) 19:46	06:22 20:25	05:47 21:00	05:43 21:16	06:43 20:59	07:20 19:16	07:58 18:22	6 18:05 (T-75) 18:01 (T-75)	07:39 16:48	08:03 16:53
29	07:49 17:30	07:30 18:11	18 17:48 (T-75) 19:47	17:48 (T-75) 19:47	06:21 20:27	05:47 21:01	05:44 21:16	06:09 20:58	07:21 19:14	07:59 18:21	5 18:06 (T-75) 18:02 (T-75)	07:40 16:49	08:03 16:54
30	07:48 17:32	07:48 18:11	17 17:49 (T-75) 19:48	17:49 (T-75) 19:48	06:19 20:28	05:46 21:01	05:44 21:16	06:10 20:56	07:22 19:12	08:01 18:19	4 18:04 (T-75) 18:01 (T-75)	07:41 16:48	08:03 16:55
31	07:47 17:33	07:47 18:11	16 17:49 (T-75) 19:49	17:49 (T-75) 19:49	06:17 20:29	05:45 21:02	05:44 21:16	06:11 20:55	07:23 19:08	08:02 18:18	3 18:05 (T-75) 18:02 (T-75)	07:42 16:55	08:03 16:55
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	276	
Total, worst case		150	69							219			
Sun reduction		0.58	0.59							0.56			
Oper. time red.		0.90	0.90							0.90			
Wind dir. red.		0.59	0.58							0.58			
Total reduction		0.31	0.31							0.29			
Total, real		46	21							64			

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Inverenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-326 - R-326

Assumptions for shadow calculations

Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December		
1	08:04													
2	08:04													
3	08:04													
4	08:04													
5	08:04													
6	08:04													
7	08:04													
8	08:04													
9	08:03													
10	08:03													
11	08:03													
12	08:02													
13	08:02													
14	08:02													
15	08:01													
16	08:01													
17	08:00													
18	07:59													
19	07:59													
20	07:58													
21	07:57													
22	07:56													
23	07:56													
24	07:55													
25	07:54													
26	07:53													
27	07:52													
28	07:51													
29	07:50													
30	07:49													
31	07:48													
Potential sun hours	287	292	369	403	459	465	471	436	377	341	289	275		
Total, worst case	886	886	886	886	886	886	886	886	886	886	886	886	404	
Sun reduction	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.52	
Oper. time red.	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	
Wind dir. red.	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	
Total reduction	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.30	
Total, real	300	300	300	300	300	300	300	300	300	300	300	300	123	

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	Last time (hh:mm) with flicker	(WTG causing flicker first time)	(WTG causing flicker last time)
	Sun set (hh:mm)	Minutes with flicker			



Exhibit 1-58

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-327 - R-327
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	July	August	September	October	November	December	
1	08:05 16:57	07:47 17:35	07:06 18:13	07:10 19:53	07:30 (T-33) 20:30	06:19 21:04	05:46 21:17	06:13 20:55	06:49 20:07	07:11 (T-33) 37	07:25 19:11	07:04 17:17	07:44 16:49
2	08:05 16:58	07:46 17:37	07:05 18:14	07:08 19:54	07:28 (T-33) 20:31	06:17 21:05	05:45 21:17	06:14 20:54	06:50 20:05	07:12 (T-33) 36	07:26 19:09	07:06 17:16	07:45 16:48
3	08:05 16:59	07:45 17:38	07:03 18:16	07:06 19:55	07:26 (T-33) 20:33	06:16 21:06	05:45 21:17	06:15 20:53	06:51 20:04	07:13 (T-33) 34	07:27 19:08	07:07 17:14	07:46 16:48
4	08:05 17:00	07:44 17:40	07:01 18:17	07:04 19:57	07:24 (T-33) 20:34	06:14 21:07	05:44 21:16	06:16 20:51	06:53 20:02	07:14 (T-33) 33	07:28 19:06	07:08 17:13	07:47 16:48
5	08:05 17:01	07:43 17:41	06:59 18:18	07:02 19:58	07:23 (T-33) 20:35	06:13 21:08	05:44 21:16	06:17 20:50	06:54 20:00	07:15 (T-33) 31	07:29 19:04	07:10 17:12	07:48 16:48
6	08:05 17:02	07:41 17:42	06:58 18:20	07:01 19:59	07:21 (T-33) 20:36	06:12 21:08	05:43 21:16	06:19 20:49	06:55 19:58	07:17 (T-33) 29	07:31 19:02	07:11 17:11	07:49 16:47
7	08:04 17:03	07:40 17:44	06:56 18:21	06:59 20:00	07:19 (T-33) 20:38	06:10 21:09	05:43 21:15	06:20 20:47	06:56 19:54	07:18 (T-33) 28	07:32 19:00	07:13 17:09	07:50 16:47
8	08:04 17:04	07:39 17:45	07:54 18:22	06:57 20:02	07:17 (T-33) 20:39	06:09 21:10	05:43 21:15	06:21 20:46	06:57 19:54	07:19 (T-33) 26	07:33 18:57	07:14 17:08	07:51 16:47
9	08:04 17:05	07:37 17:47	07:52 19:24	06:55 20:03	07:15 (T-33) 20:40	06:08 21:11	05:42 21:15	06:22 20:45	06:58 19:53	07:20 (T-33) 23	07:34 18:55	07:15 17:07	07:52 16:47
10	08:04 17:07	07:36 17:48	07:50 19:25	06:53 20:04	07:14 (T-33) 20:41	06:06 21:11	05:42 21:14	06:23 20:43	07:00 19:51	07:21 (T-33) 21	07:36 18:53	07:17 17:06	07:53 16:47
11	08:03 17:08	07:35 17:50	07:49 19:26	06:52 20:05	07:12 (T-33) 20:42	06:05 21:12	05:42 21:14	06:24 20:42	07:01 19:49	07:22 (T-33) 18	07:37 18:51	07:18 17:04	07:54 16:47
12	08:03 17:09	07:33 17:51	07:47 19:28	06:50 20:07	07:10 (T-33) 20:44	06:04 21:12	05:53 21:13	06:26 20:40	07:02 19:47	07:23 (T-33) 16	07:38 18:49	07:19 17:03	07:55 16:47
13	08:02 17:10	07:32 17:52	07:45 19:29	06:48 20:08	07:08 (T-33) 20:45	06:03 21:13	05:42 21:13	06:27 20:39	07:03 19:45	07:24 (T-33) 13	07:39 18:48	07:21 17:02	07:56 16:47
14	08:02 17:11	07:30 17:54	07:43 19:30	06:46 20:09	07:08 (T-33) 20:46	06:01 21:13	05:41 21:12	06:28 20:37	07:04 19:43	07:26 (T-33) 9	07:41 18:46	07:22 17:01	07:56 16:47
15	08:02 17:12	07:29 17:55	07:41 19:31	06:45 20:10	07:08 (T-33) 20:47	06:00 21:14	05:41 21:11	06:29 20:36	07:05 19:41	07:27 (T-33) 5	07:42 18:44	07:23 17:00	07:57 16:48
16	08:01 17:14	07:27 17:57	07:39 19:33	06:43 20:12	07:08 (T-33) 20:48	05:59 21:14	05:41 21:11	06:30 20:34	07:07 19:39	07:32 (T-24) 7	07:43 18:42	07:25 16:59	07:58 16:48
17	08:00 17:15	07:26 17:58	07:38 19:34	06:41 20:13	07:08 (T-33) 20:49	05:58 21:15	05:41 21:10	06:31 20:33	07:08 19:38	06:55 (T-24) 7	07:44 18:41	07:26 16:58	07:59 16:48
18	08:00 17:16	07:24 17:59	07:36 19:35	06:39 20:14	07:10 (T-33) 20:50	05:57 21:15	05:41 21:09	06:33 20:31	07:09 19:36	06:55 (T-24) 7	07:46 18:39	07:27 16:57	07:59 16:48
19	07:59 17:18	07:23 18:01	07:34 19:37	06:38 20:15	06:58 (T-24) 20:51	05:56 21:16	05:42 21:08	06:34 20:29	07:10 19:34	06:56 (T-24) 13	07:47 18:37	07:29 16:56	08:00 16:49
20	07:58 17:19	07:21 18:01	07:32 19:38	06:36 20:17	06:57 (T-24) 20:52	05:55 21:16	05:42 21:08	06:35 20:28	07:11 19:32	06:57 (T-24) 22	07:48 18:36	07:30 16:56	08:01 16:49
21	07:58 17:20	07:20 18:02	07:30 19:39	06:34 20:18	06:55 (T-24) 20:53	05:54 21:16	05:42 21:07	06:36 20:26	07:13 19:30	06:59 (T-24) 26	07:50 18:34	07:31 16:55	08:01 16:50
22	07:57 17:22	07:18 18:04	07:28 19:40	06:33 20:19	06:53 (T-24) 20:55	05:53 21:16	05:42 21:06	06:37 20:25	07:14 19:28	07:00 (T-24) 29	07:51 18:32	07:33 16:54	08:02 16:50
23	07:56 17:23	07:16 18:05	07:26 19:42	06:31 20:20	06:52 (T-24) 20:56	05:52 21:17	05:42 21:05	06:38 20:23	07:15 19:26	07:01 (T-24) 30	07:52 18:31	07:34 16:53	08:02 16:51
24	07:55 17:24	07:15 18:06	07:25 19:43	06:29 20:22	06:50 (T-24) 20:57	05:51 21:17	05:43 21:04	06:30 20:21	07:16 19:24	07:14 (T-33) 31	07:54 18:29	07:35 16:53	08:03 16:51
25	07:54 17:26	07:13 18:08	07:23 19:44	06:28 20:23	06:49 (T-24) 20:58	05:50 21:17	05:43 21:03	06:41 20:19	07:17 19:22	07:12 (T-33) 34	07:55 18:28	07:36 16:52	08:03 16:52
26	07:53 17:27	07:11 18:09	07:21 19:45	06:26 20:24	06:47 (T-24) 20:59	05:50 21:17	05:43 21:02	06:42 20:18	07:18 19:21	07:11 (T-33) 35	07:56 18:26	07:38 16:51	08:03 16:52
27	07:53 17:28	07:10 18:10	07:19 19:47	06:25 20:25	06:46 (T-24) 21:00	05:49 21:17	05:44 21:01	06:43 20:16	07:20 19:19	07:10 (T-33) 37	07:58 18:25	07:39 16:51	08:04 16:53
28	07:52 17:30	07:08 18:12	07:17 19:48	06:23 20:27	06:53 (T-24) 21:01	05:48 21:17	05:44 21:00	06:44 20:14	07:21 19:17	07:09 (T-33) 38	07:59 18:23	07:40 16:50	08:04 16:54
29	07:51 17:31	07:07 18:15	07:15 19:49	06:22 20:28	07:35 (T-33) 21:02	05:47 21:17	05:45 20:59	06:46 20:13	07:22 19:15	07:12 (T-33) 39	07:59 18:22	07:41 16:50	08:04 16:55
30	07:49 17:33	07:05 18:13	07:13 19:50	06:20 20:29	07:44 (T-33) 21:03	05:47 21:17	05:45 20:58	06:47 20:11	07:23 19:13	07:09 (T-33) 39	07:59 18:20	07:42 16:49	08:04 16:55
31	07:48 17:34	07:04 18:12	07:12 19:52	06:19 20:30	07:32 (T-33) 21:04	05:46 21:04	05:44 20:56	06:48 20:09	07:24 19:13	07:10 (T-33) 38	07:59 18:19	07:43 16:56	08:05 16:56
Potential sun hours	287	292	369	403	458	465	471	436	377	359	341	289	275
Total, worst case			41	737				432	359				
Sun reduction			0.59	0.63				0.72	0.67				
Oper. time red.			0.90	0.90				0.90	0.90				
Wind dir. red.			0.58	0.58				0.58	0.58				
Total reduction			0.31	0.33				0.38	0.35				
Total, real			13	242				162	126				

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invenergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-328 - R-328
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N	NNE	NE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum	
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

	January	February	March	April	May	June	July	August	September	October	November	December				
1	08:04	07:46	07:05	07:09	06:18	05:45	05:45	06:12	06:48	07:24	07:04	07:43				
	16:57	17:35	18:12	19:52	20:29	21:04	21:16	20:54	20:06	19:10	17:17	16:48				
2	08:04	07:45	07:04	07:07	06:16	05:44	05:45	06:13	06:49	07:25	07:05	07:44				
	16:58	17:36	18:14	19:53	20:31	21:04	21:16	20:53	20:05	19:09	17:15	16:48				
3	08:04	07:44	07:02	07:05	06:15	05:44	05:46	06:14	06:51	07:26	07:06	07:45				
	16:58	17:37	18:15	19:55	20:32	21:05	21:16	20:52	20:03	19:07	17:14	16:47				
4	08:04	07:43	07:00	07:03	06:14	05:43	05:47	06:16	06:52	07:27	07:08	07:46				
	16:59	17:39	18:16	19:56	20:33	21:06	21:15	20:51	20:01	19:05	17:12	16:47				
5	08:04	07:42	06:58	07:02	06:12	05:43	05:47	06:17	06:53	07:29	07:09	07:47				
	17:00	17:40	18:18	19:57	20:34	21:07	21:15	20:49	19:59	19:03	17:11	16:47				
6	08:04	07:40	06:57	07:00	06:11	05:43	05:48	06:18	06:54	07:30	07:10	07:48				
	17:01	17:42	18:19	19:58	20:36	21:08	21:15	20:48	19:57	19:01	17:10	16:47				
7	08:03	07:39	06:55	06:58	06:09	05:42	05:49	06:19	06:55	07:31	07:12	07:49				
	17:02	17:43	18:20	20:00	20:37	21:08	21:15	20:47	19:55	18:58	17:09	16:46				
8	08:03	07:38	07:53	06:56	06:08	05:42	05:49	06:20	06:56	07:32	07:13	07:50				
	17:04	17:45	18:22	20:01	20:38	21:09	21:14	20:45	19:54	18:56	17:07	16:46				
9	08:03	07:37	07:51	06:54	06:07	05:42	05:50	06:21	06:58	07:34	07:14	07:51				
	17:05	17:46	19:23	20:02	20:39	21:10	21:14	20:44	19:52	18:54	17:06	16:46				
10	08:03	07:35	07:50	06:53	06:05	05:41	05:51	06:22	06:59	07:35	07:16	07:52				
	17:06	17:47	19:24	20:03	20:40	21:10	21:13	20:42	19:50	18:52	17:05	16:46				
11	08:02	07:34	07:48	06:51	06:04	05:41	05:52	06:24	07:00	07:36	07:17	07:53				
	17:07	17:49	19:26	20:05	20:41	21:11	21:13	20:41	19:48	18:50	17:04	16:46				
12	08:02	07:32	07:46	06:49	06:03	05:41	05:52	06:25	07:01	07:37	07:18	07:54				
	17:08	17:50	19:27	20:06	20:43	21:12	21:12	20:40	19:46	18:49	17:03	16:46				
13	08:02	07:31	07:44	06:47	06:02	05:41	05:53	06:26	07:02	07:39	07:20	07:55				
	17:09	17:52	19:28	20:07	20:44	21:12	21:12	20:38	19:44	18:47	17:02	16:46				
14	08:01	07:30	07:42	06:46	06:01	05:41	05:54	06:27	07:03	07:40	07:21	07:56				
	17:11	17:53	19:29	20:08	20:45	21:13	21:11	20:36	19:42	18:45	17:00	16:47				
15	08:01	07:28	07:40	06:44	05:59	05:41	05:55	06:28	07:05	07:41	07:23	07:56				
	17:12	17:54	19:31	20:10	20:46	21:13	21:10	20:35	19:41	18:43	16:59	16:47				
16	08:00	07:27	07:39	06:42	05:58	05:41	05:56	06:29	07:06	07:42	07:24	07:57				
	17:13	17:56	19:32	20:11	20:47	21:14	21:10	20:33	19:39	18:42	16:58	16:47				
17	08:00	07:25	07:37	06:40	19:49 (T-53)	05:57	05:41	05:57	06:31	19:57 (T-53)	07:07	07:44	07:25	07:58		
	17:14	17:57	19:33	20:12	1	19:50 (T-53)	20:48	21:14	21:09	20:32	9	20:06 (T-53)	19:37	18:40	16:58	16:47
18	07:59	07:23	07:35	06:39	19:48 (T-53)	05:56	05:41	05:58	06:32	19:55 (T-53)	07:08	07:45	07:27	07:58		
	17:16	17:59	19:35	20:13	3	19:51 (T-53)	20:50	21:14	21:08	20:30	10	20:05 (T-53)	19:35	18:38	16:57	16:48
19	07:58	07:22	07:33	06:37	19:47 (T-53)	05:55	05:41	05:59	06:33	19:54 (T-53)	07:09	07:46	07:28	07:59		
	17:17	18:00	19:36	20:15	5	19:52 (T-53)	20:51	21:15	21:08	20:29	10	20:04 (T-53)	19:33	18:37	16:56	16:48
20	07:58	07:20	07:31	06:35	19:47 (T-53)	05:54	05:41	06:00	06:34	19:53 (T-53)	07:11	07:48	07:29	08:00		
	17:18	18:00	19:37	20:16	6	19:53 (T-53)	20:52	21:15	21:07	20:27	9	20:02 (T-53)	19:31	18:35	16:55	16:48
21	07:57	07:19	07:29	06:34	19:47 (T-53)	05:53	05:41	06:01	06:35	19:52 (T-53)	07:12	07:49	07:30	08:00		
	17:19	18:01	19:38	20:17	7	19:54 (T-53)	20:53	21:15	21:06	20:25	9	20:01 (T-53)	19:29	18:33	16:54	16:49
22	07:56	07:17	07:27	06:32	19:47 (T-53)	05:52	05:41	06:02	06:37	19:52 (T-53)	07:13	07:50	07:32	08:01		
	17:21	18:03	19:40	20:18	9	19:56 (T-53)	20:54	21:16	21:05	20:24	7	19:59 (T-53)	19:27	18:32	16:53	16:49
23	07:55	07:16	07:26	06:30	19:47 (T-53)	05:51	05:42	06:03	06:38	19:51 (T-53)	07:14	07:51	07:33	08:01		
	17:22	18:04	19:41	20:20	10	19:57 (T-53)	20:55	21:16	21:04	20:22	6	19:57 (T-53)	19:25	18:30	16:53	16:50
24	07:54	07:14	07:24	06:29	19:48 (T-53)	05:51	05:42	06:04	06:39	19:51 (T-53)	07:15	07:53	07:34	08:02		
	17:24	18:06	19:42	20:21	9	19:57 (T-53)	20:56	21:16	21:03	20:20	4	19:55 (T-53)	19:24	18:28	16:52	16:50
25	07:54	07:12	07:22	06:27	19:49 (T-53)	05:50	05:42	06:05	06:40	19:51 (T-53)	07:16	07:54	07:36	08:02		
	17:25	18:07	19:43	20:22	10	19:59 (T-53)	20:57	21:16	21:02	20:19	2	19:53 (T-53)	19:22	18:27	16:51	16:51
26	07:53	07:11	07:20	06:26	19:51 (T-53)	05:49	05:43	06:06	06:41	19:51 (T-53)	07:18	07:55	07:37	08:02		
	17:26	18:08	19:45	20:23	8	19:59 (T-53)	20:58	21:16	21:01	20:17	1	19:52 (T-53)	19:20	18:25	16:51	16:52
27	07:52	07:09	07:18	06:24	19:48 (T-53)	05:48	05:43	06:07	06:42	19:50 (T-53)	07:19	07:57	07:38	08:03		
	17:28	18:10	19:46	20:24	20:59	21:16	21:00	20:15	19:18	18:24	16:50	16:52	16:52	16:52		
28	07:51	07:07	07:16	06:22	19:47 (T-53)	05:47	05:43	06:08	06:44	19:50 (T-53)	07:20	07:58	07:39	08:03		
	17:29	18:11	19:47	20:26	21:00	21:16	20:59	20:13	19:16	18:22	16:49	16:53	16:53	16:53		
29	07:50		07:14	06:21	19:47 (T-53)	05:47	05:44	06:09	06:45	19:50 (T-53)	07:21	07:59	07:40	08:03		
	17:30		19:48	20:27	21:01	21:16	20:58	20:12	19:14	18:21	16:49	16:54	16:54	16:54		
30	07:49		07:13	06:19	19:47 (T-53)	05:46	05:44	06:10	06:46	19:50 (T-53)	07:22	08:01	07:42	08:03		
	17:32		19:50	20:28	21:02	21:16	20:57	20:10	19:12	18:19	16:48	16:55	16:55	16:55		
31	07:48		07:11		19:47 (T-53)	05:45	06:11	06:47	19:50 (T-53)	07:23	08:02	08:04	08:04	08:04		
	17:33		19:51		21:03	20:56	20:56	20:08	19:12	18:18	16:48	16:55	16:55	16:55		
Potential sun hours	287	292	369	403	458	465	471	436	377	341	289	275				
Total, worst case					68											
Sun reduction					0.63											
Oper. time red.					0.90											
Wind dir. red.					0.60											
Total reduction					0.34											
Total, real					23											

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-329 - R-329
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time

N NNE NE ENE E ESE SE SSE S SSW SW WSW W WNW NW NNW Sum
561 438 311 293 309 330 363 461 788 773 462 449 509 600 629 608 7,884

	January	February	March	April	May	June	
1	08:04 16:57 63	15:14 (T-74) 07:46 16:17 (T-74) 17:35 11 16:02 (T-74) 07:45	15:51 (T-74) 07:05 18:12 19:52	07:09 07:07	06:18 20:29	19:46 (T-67) 05:45 20:06 (T-67) 21:03 19	06:08 (T-71) 06:27 (T-71)
2	08:04 16:58 62	15:15 (T-74) 07:45 16:17 (T-74) 17:36	18:14 19:53	07:05 07:05	06:16 20:30	19:47 (T-67) 05:44 20:05 (T-67) 21:04 19	06:08 (T-71) 06:27 (T-71)
3	08:04 16:59 61	15:16 (T-74) 07:44 16:17 (T-74) 17:38	18:15 19:55	07:05 07:03	06:15 20:32	19:48 (T-67) 05:44 20:03 (T-67) 21:05 19	06:07 (T-71) 06:26 (T-71)
4	08:04 17:00 62	15:16 (T-74) 07:43 16:18 (T-74) 17:39	18:16 19:56	07:00 07:03	06:14 20:33	19:50 (T-67) 05:43 20:01 (T-67) 21:06 19	06:07 (T-71) 06:26 (T-71)
5	08:04 17:01 61	15:17 (T-74) 07:42 16:18 (T-74) 17:40	18:18 19:57	07:02 07:02	06:12 20:34	05:43 21:07	06:07 (T-71) 06:26 (T-71)
6	08:03 17:02 61	15:18 (T-74) 07:40 16:19 (T-74) 17:42	18:19 19:58	07:00 06:58	06:11 20:35	05:43 21:07	06:07 (T-71) 06:26 (T-71)
7	08:03 17:03 60	15:18 (T-74) 07:39 16:18 (T-74) 17:43	18:20 20:00	06:58 06:56	06:09 20:37	05:42 21:08	06:08 (T-71) 06:26 (T-71)
8	08:03 17:04 60	15:19 (T-74) 07:38 16:19 (T-74) 17:45	18:22 20:01	06:56 06:54	06:08 20:38	05:42 21:09	06:09 (T-71) 06:26 (T-71)
9	08:03 17:05 61	15:19 (T-74) 07:36 16:20 (T-74) 17:46	18:22 20:01	06:54 20:02	06:07 20:39	05:42 21:09	06:10 (T-71) 06:26 (T-71)
10	08:03 17:06 60	15:20 (T-74) 07:35 16:38 (T-72) 17:47	18:22 20:02	06:53 20:03	06:06 20:40	05:41 21:10	06:09 (T-71) 06:25 (T-71)
11	08:02 17:07 61	15:21 (T-74) 07:34 16:39 (T-72) 17:49	18:22 20:02	06:51 20:05	06:04 20:41	05:41 21:11	06:10 (T-71) 06:25 (T-71)
12	08:02 17:08 61	15:21 (T-74) 07:32 16:40 (T-72) 17:50	18:22 20:02	06:49 20:06	06:03 20:43	05:41 21:11	06:11 (T-71) 06:24 (T-71)
13	08:01 17:09 62	15:22 (T-74) 07:31 16:42 (T-72) 17:52	18:22 20:02	06:47 20:07	06:02 20:44	05:41 21:12	06:12 (T-71) 06:24 (T-71)
14	08:01 17:11 63	15:22 (T-74) 07:29 16:43 (T-72) 17:53	18:22 20:02	06:46 20:08	06:01 20:45	06:23 (T-71) 05:41 06:24 (T-71) 21:12 12	06:12 (T-71) 06:24 (T-71)
15	08:01 17:12 61	15:24 (T-74) 07:28 16:44 (T-72) 17:54	18:22 20:02	06:44 20:09	06:00 20:46	06:22 (T-71) 05:41 06:25 (T-71) 21:13 11	06:13 (T-71) 06:24 (T-71)
16	08:00 17:13 62	15:24 (T-74) 07:26 16:45 (T-72) 17:56	18:22 20:02	06:42 20:11	05:58 20:47	06:21 (T-71) 05:41 06:25 (T-71) 21:13 11	06:13 (T-71) 06:24 (T-71)
17	07:59 17:14 60	15:25 (T-74) 07:25 16:46 (T-72) 17:57	18:22 20:02	06:40 20:12	05:57 20:48	06:20 (T-71) 05:41 06:26 (T-71) 21:14 10	06:14 (T-71) 06:24 (T-71)
18	07:59 17:16 61	15:26 (T-74) 07:23 16:48 (T-72) 17:59	18:22 20:02	06:39 20:13	05:56 20:49	06:19 (T-71) 05:41 06:26 (T-71) 21:14 10	06:14 (T-71) 06:24 (T-71)
19	07:58 17:17 60	15:27 (T-74) 07:22 16:50 (T-72) 18:00	18:22 20:02	06:37 20:14	05:55 20:50	06:18 (T-71) 05:41 06:27 (T-71) 21:14 8	06:15 (T-71) 06:23 (T-71)
20	07:57 17:18 59	15:28 (T-74) 07:20 16:51 (T-72) 18:00	18:22 20:02	06:35 20:16	05:54 20:52	06:17 (T-71) 05:41 06:27 (T-71) 21:15 8	06:15 (T-71) 06:23 (T-71)
21	07:57 17:20 58	15:28 (T-74) 07:19 16:52 (T-72) 18:01	18:22 20:02	06:34 20:17	05:53 20:53	06:16 (T-71) 05:41 06:27 (T-71) 21:15 8	06:16 (T-71) 06:24 (T-71)
22	07:56 17:21 53	15:30 (T-74) 07:17 16:52 (T-72) 18:03	18:22 20:02	06:32 20:18	05:52 20:54	06:15 (T-71) 05:41 06:27 (T-71) 21:15 8	06:16 (T-71) 06:24 (T-71)
23	07:55 17:22 47	15:31 (T-74) 07:15 16:18 (T-74) 18:04	18:22 20:02	06:30 20:19	05:52 20:55	06:14 (T-71) 05:42 06:27 (T-71) 21:16 8	06:16 (T-71) 06:24 (T-71)
24	07:54 17:24 44	15:33 (T-74) 07:14 16:17 (T-74) 18:06	18:22 20:02	06:29 20:21	05:51 20:56	06:13 (T-71) 05:42 06:27 (T-71) 21:16 9	06:15 (T-71) 06:24 (T-71)
25	07:53 17:25 42	15:34 (T-74) 07:12 16:16 (T-74) 18:07	18:22 20:02	06:27 20:22	05:50 20:57	06:13 (T-71) 05:42 06:28 (T-71) 21:16 10	06:16 (T-71) 06:26 (T-71)
26	07:52 17:26 40	15:36 (T-74) 07:10 16:16 (T-74) 18:08	18:22 20:02	06:26 20:23	05:49 20:58	06:12 (T-71) 05:43 06:28 (T-71) 21:16 10	06:16 (T-71) 06:26 (T-71)
27	07:52 17:28 38	15:37 (T-74) 07:09 16:15 (T-74) 18:10	18:22 20:02	06:24 20:24	05:48 20:59	06:11 (T-71) 05:43 06:27 (T-71) 21:16 11	06:15 (T-71) 06:26 (T-71)
28	07:51 17:29 34	15:39 (T-74) 07:07 16:13 (T-74) 18:11	18:22 20:02	06:22 20:26	05:48 21:00	06:11 (T-71) 05:43 06:28 (T-71) 21:16 11	06:16 (T-71) 06:27 (T-71)
29	07:50 17:30 31	15:41 (T-74) 07:05 16:12 (T-74) 18:12	18:22 20:02	06:21 20:27	05:47 21:01	06:10 (T-71) 05:44 06:27 (T-71) 21:16 12	06:15 (T-71) 06:27 (T-71)
30	07:49 17:32 26	15:44 (T-74) 07:03 16:10 (T-74) 18:13	18:22 20:02	06:19 20:28	05:46 21:02	06:09 (T-71) 05:44 06:27 (T-71) 21:16 13	06:15 (T-71) 06:28 (T-71)
31	07:47 17:33 20	15:46 (T-74) 07:01 16:06 (T-74) 18:14	18:22 20:02	07:11 19:51	05:46 21:02	06:09 (T-71) 05:44 06:27 (T-71) 21:16 13	06:15 (T-71) 06:28 (T-71)
Potential sun hours	287	292	369	403	458	465	391
Total, worst case	1654	11		180		271	391
Sun reduction	0.58	0.58		0.63		0.66	0.73
Oper. time red.	0.90	0.90		0.90		0.90	0.90
Wind dir. red.	0.62	0.62		0.60		0.59	0.59
Total reduction	0.32	0.32		0.34		0.35	0.39
Total, real	533	4		62		96	152

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)



Project:
South Deuel Wind Project

Description:
Invernergy Deuel Harvest Wind in Deuel County, SD
Greenhouse Shadow Flicker Study
Project Turbines Only
L086 71 V163-4.5 WTGs on 98m HH
June 14, 2024

Licensed user:
Stantec Consulting Services Inc.
1165 Scheuring Road
US-DE PERE WI 54115
920 278 3215
Christiana Jansen / christiana.jansen@stantec.com
Calculated:
6/14/2024 3:58 PM/3.6.366

SHADOW - Calendar

Calculation: L086_V Shadow Flicker Assessment Shadow receptor: R-329 - R-329
Assumptions for shadow calculations
Sunshine probability S/S0 (Sun hours/Possible sun hours) []
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
0.58 0.58 0.59 0.63 0.66 0.73 0.75 0.72 0.67 0.56 0.48 0.52

Operational time																
N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW	Sum
561	438	311	293	309	330	363	461	788	773	462	449	509	600	629	608	7,884

		July	August	September	October	November	December
1	05:45	06:15 (T-71)	06:12	06:48	07:24	07:03	07:43
	21:16	13 06:28 (T-71)	20:54	20:06	19:10	17:17	16:48
2	05:45	06:15 (T-71)	06:13	06:49	07:25	07:05	07:44
	21:16	15 06:30 (T-71)	20:53	20:05	19:09	17:15	16:48
3	05:46	06:14 (T-71)	06:15	06:51	07:26	07:06	07:45
	21:15	16 06:30 (T-71)	20:52	20:03	19:07	17:14	16:47
4	05:47	06:14 (T-71)	06:16	06:52	07:27	07:07	07:46
	21:15	17 06:31 (T-71)	20:50	20:01	19:05	17:12	16:47
5	05:47	06:14 (T-71)	06:17	06:53	07:29	07:09	07:47
	21:15	18 06:32 (T-71)	20:49	19:59	19:03	17:11	16:47
6	05:48	06:13 (T-71)	06:18	06:54	07:30	07:10	07:48
	21:15	19 06:32 (T-71)	20:48	19:57	19:01	17:10	16:47
7	05:49	06:14 (T-71)	06:19	06:55	07:31	07:12	07:49
	21:14	19 06:33 (T-71)	20:46	19:55	18:58	17:09	16:47
8	05:49	06:14 (T-71)	06:20	20:01 (T-67)	06:56	07:32	07:50
	21:14	19 06:33 (T-71)	20:45	6 20:07 (T-67)	19:54	18:56	17:07
9	05:50	06:14 (T-71)	06:21	19:58 (T-67)	06:58	07:33	07:51
	21:14	19 06:33 (T-71)	20:44	12 20:10 (T-67)	19:52	18:54	17:06
10	05:51	06:15 (T-71)	06:23	19:57 (T-67)	06:59	07:35	07:52
	21:13	19 06:34 (T-71)	20:42	16 20:13 (T-67)	19:50	18:52	17:05
11	05:52	06:16 (T-71)	06:24	19:55 (T-67)	07:00	07:36	07:53
	21:13	19 06:35 (T-71)	20:41	19 20:14 (T-67)	19:48	18:50	17:04
12	05:52	06:17 (T-71)	06:25	19:54 (T-67)	07:01	07:37	07:54
	21:12	18 06:35 (T-71)	20:39	20 20:14 (T-67)	19:46	18:49	17:03
13	05:53	06:17 (T-71)	06:26	19:53 (T-67)	07:02	07:38	07:55
	21:12	18 06:35 (T-71)	20:38	20 20:13 (T-67)	19:44	18:47	17:02
14	05:54	06:18 (T-71)	06:27	19:52 (T-67)	07:03	07:40	07:56
	21:11	18 06:36 (T-71)	20:36	19 20:11 (T-67)	19:42	18:45	17:01
15	05:55	06:19 (T-71)	06:28	19:51 (T-67)	07:05	07:41	07:56
	21:10	17 06:36 (T-71)	20:35	18 20:09 (T-67)	19:41	18:43	17:00
16	05:56	06:20 (T-71)	06:30	19:50 (T-67)	07:06	07:42	07:57
	21:10	16 06:36 (T-71)	20:33	18 20:08 (T-67)	19:39	18:42	16:59
17	05:57	06:21 (T-71)	06:31	19:50 (T-67)	07:07	07:44	07:58
	21:09	16 06:37 (T-71)	20:32	16 20:06 (T-67)	19:37	18:40	16:58
18	05:58	06:22 (T-71)	06:32	19:50 (T-67)	07:08	07:45	07:58
	21:08	15 06:37 (T-71)	20:30	15 20:05 (T-67)	19:35	18:38	16:57
19	05:59	06:23 (T-71)	06:33	19:50 (T-67)	07:09	07:46	07:59
	21:07	14 06:37 (T-71)	20:29	14 20:04 (T-66)	19:33	18:37	16:56
20	06:00	06:24 (T-71)	06:34	19:50 (T-67)	07:11	07:47	07:59
	21:07	14 06:38 (T-71)	20:27	12 20:02 (T-66)	19:31	18:35	16:55
21	06:01	06:25 (T-71)	06:35	19:50 (T-67)	07:12	07:49	08:00
	21:06	13 06:38 (T-71)	20:25	10 20:00 (T-66)	19:29	18:33	16:54
22	06:02	06:26 (T-71)	06:37	19:50 (T-66)	07:13	07:50	08:01
	21:05	12 06:38 (T-71)	20:24	9 19:59 (T-66)	19:27	18:32	16:53
23	06:03	06:26 (T-71)	06:38	19:49 (T-66)	07:14	07:51	08:01
	21:04	11 06:37 (T-71)	20:22	8 19:57 (T-66)	19:25	18:30	16:53
24	06:04	06:27 (T-71)	06:39	19:48 (T-66)	07:15	07:53	08:01
	21:03	9 06:36 (T-71)	20:20	7 19:55 (T-66)	19:24	18:29	16:52
25	06:05	06:28 (T-71)	06:40	19:48 (T-66)	07:16	07:54	08:02
	21:02	8 06:36 (T-71)	20:19	5 19:53 (T-66)	19:22	18:27	16:51
26	06:06	06:29 (T-71)	06:41	19:48 (T-66)	07:18	07:55	08:02
	21:01	7 06:36 (T-71)	20:17	4 19:52 (T-66)	19:20	18:25	16:51
27	06:07	06:30 (T-71)	06:42	19:49 (T-66)	07:19	07:57	08:03
	21:00	5 06:35 (T-71)	20:15	2 19:51 (T-66)	19:18	18:24	16:50
28	06:08	06:32 (T-71)	06:44	07:20	07:58	07:39	08:03
	20:59	4 06:36 (T-71)	20:13	19:16	18:22	16:50	16:53
29	06:09	06:33 (T-71)	06:45	07:21	07:59	07:40	08:03
	20:58	2 06:35 (T-71)	20:12	19:14	18:21	16:49	16:54
30	06:10		06:46	07:22	08:01	07:41	08:03
	20:57		20:10	19:12	18:19	16:49	16:55
31	06:11		06:47		08:02		08:03
	20:55		20:08		18:18		16:56
Potential sun hours	471		436	377	341	289	276
Total, worst case			250			998	1926
Sun reduction	0.75		0.72			0.48	0.52
Oper. time red.	0.90		0.90			0.90	0.90
Wind dir. red.	0.59		0.60			0.62	0.62
Total reduction	0.40		0.39			0.27	0.29
Total, real	164		98			266	557

Table layout: For each day in each month the following matrix apply

Day in month	Sun rise (hh:mm)	First time (hh:mm) with flicker	(WTG causing flicker first time)
	Sun set (hh:mm)	Minutes with flicker	Last time (hh:mm) with flicker
			(WTG causing flicker last time)

REDACTED

Exhibit_JT-1, Page 605 of 643

Through

Exhibit_JT-1, Page 613 of 643

REDACTED

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF SOUTH DAKOTA

**IN THE MATTER OF THE
APPLICATION BY DEUEL HARVEST
WIND ENERGY SOUTH LLC FOR
ENERGY FACILITY PERMITS OF A
WIND ENERGY FACILITY AND A 345-
kV TRANSMISSION FACILITY IN
DEUEL COUNTY, SOUTH DAKOTA
FOR THE SOUTH DEUEL WIND
PROJECT**

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**DEUEL HARVEST WIND
ENERGY SOUTH LLC'S
RESPONSES TO STAFF'S
SECOND SET OF DATA
REQUESTS**

EI 24-023

Deuel Harvest Wind Energy South LLC (“Deuel Harvest South”) provides the following responses to Staff’s Second Set of Data Requests Nos. 1-4 in the above-captioned matter.

- 2-1) Please identify all non-participating residences within ¾ miles from a proposed turbine. For each residence identified, provide the name of the property owner, distance from closest turbine, receptor identifier in Appendix M - Noise Analysis, predicted noise levels for each turbine model, receptor identified in Appendix N – Shadow Flicker Analysis, and expected annual shadow flicker for each turbine model.

Alexandra Thompson: Please see Exhibit 2-1 for the requested information.

- 2-2) Regarding the Lake Cochrane Lake Park District setback on Page 38 of the Application:
- a) Please provide a map of the appropriate scale to show the Lake Cochrane Lake Park District and turbine locations 21, 22, and 49. Please provide a map similar to Page 88 of 156 of Staff Exhibit_JT-1 in Docket EL18-003 for Ms. Teresa Kaaz (<http://puc.sd.gov/commission/dockets/electric/2018/EL18-003/exhibits/staff/s1.pdf>).

Monica Monterrosa: Please see Exhibit 2-2 for the requested information.

- b) How many miles is turbine location 21 from the Lake Cochrane Lake Park District?

Alexandra Thompson: Turbine location 21 is located 3.59 miles from the Lake Cochrane Lake Park District.

- c) How many miles is turbine location 22 from the Lake Cochrane Lake Park District?

Alexandra Thompson: Turbine location 22 is located 3.18 miles from the Lake Cochrane Lake Park District.

- d) How many miles is turbine location 49 from the Lake Cochrane Lake Park District?

Alexandra Thompson: Turbine location 49 is located 3.11 miles from the Lake Cochrane Lake Park District.

- e) Regarding the Lake Cochrane Lake Park District 3-mile setback, what defines the Lake Cochrane Lake Park District area to which the 3-mile setback is applied? Is the boundary of the Lake Cochrane Lake Park District 1,000 feet from the Lake Cochrane high-water line? Please explain.

Monica Monterrosa: The Lake Park District is defined in Section 1103.02 of the Deuel County Zoning Ordinance as “All land, unless otherwise zoned, within one thousand (1,000) feet of the established normal high-water line of Lake Cochrane or any land which has been specifically zoned Lake Park by the Deuel County Commission.” The Lake Cochrane Lake Park District is shown in Exhibit 2-2 and can be viewed at <https://www.1stdistrict.org/deuelts/>.

- 2-3) Please provide a map that shows Mr. Josh Bekaert’s residence and all proposed turbine locations within 2 miles of his residence. Please provide a map similar to Page 88 of 156 of Staff Exhibit_JT-1 in Docket EL18-003 for Ms. Teresa Kaaz (<http://puc.sd.gov/commission/dockets/electric/2018/EL18-003/exhibits/staff/s1.pdf>).

Monica Monterrosa: South Deuel Wind provides the requested information in Exhibit 2-3.

- 2-4) Refer to Arla Hamann Poindexter’s Application for Party Status filed on 8/15/2024. Is the Applicant aware of Ms. Hamann’s or Hamann Family Farms LLC’s residence within 2 miles of the proposed project? If yes, please provide a map that shows the residence and all proposed turbine locations within 2 miles of the residence. Please provide a map similar to Page 88 of 156 of Staff Exhibit_JT-1 in Docket EL18-003 for Ms. Teresa Kaaz (<http://puc.sd.gov/commission/dockets/electric/2018/EL18-003/exhibits/staff/s1.pdf>).

Monica Monterrosa: South Deuel Wind provides the requested information in Exhibit 2-4.

Dated this 4th day of October 2024.

By s/ Lisa Agrimonti

Lisa M. Agrimonti

Haley Waller Pitts

FREDRIKSON & BYRON, P.A.

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lagrimonti@fredlaw.com

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**Attorneys for Applicant Deuel Harvest
Wind Energy South LLC**

**BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF SOUTH
DAKOTA**

**IN THE MATTER OF THE
APPLICATION BY DEUEL HARVEST
WIND ENERGY SOUTH LLC FOR
ENERGY FACILITY PERMITS OF A
WIND ENERGY FACILITY AND A 345-
kV TRANSMISSION FACILITY IN
DEUEL COUNTY, SOUTH DAKOTA
FOR THE SOUTH DEUEL WIND
PROJECT**

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**DEUEL HARVEST WIND
ENERGY SOUTH LLC'S
RESPONSES TO STAFF'S FIRST
SET OF DATA REQUESTS**

EI 24-023

Deuel Harvest Wind Energy South LLC (“Deuel Harvest South”) provides the following responses to Staff’s Second Set of Data Requests No. 5 in the above-captioned matter.

- 2-5) Refer to Figure 4 in Appendix A of the Application and ARSD 20:10:22:12. Please explain the general criteria used to select turbine locations on the buildable area, reasons for selecting these criteria, and how the criteria were weighted.

Alexandra Thompson: The turbine siting process is iterative and considers many factors. After establishing the buildable area, as discussed in Section 5 of the Application, other primary considerations include wind resource and the accessibility and constructability of the turbines. Deuel Harvest South sought to capitalize on wind resource in the region by siting turbines where wind speeds, and therefore production, will be highest, based on our energy models. Turbines are spaced from each other to further optimize performance (minimize energy losses), as discussed in our answer to discovery question 1-20. In evaluating constructability, we consider whether an access road could be built off existing local roads and whether nearby intersections along a future haul route would allow for component delivery. We look to minimize impacts to environmentally sensitive areas, including the consideration of efficient access road and collection line routing between turbine sites. We look for flat land where possible, to reduce grading needs during construction. Throughout this process, we continue to monitor and ensure compliance with state and local regulations, such as shadow flicker and noise limits. With all these factors in mind, we continue to refine the site plan, with the goal of making best use of the vast wind resource at a cost-competitive price while also maintaining compliance with applicable federal, state, and local regulations, and avoiding or minimizing impacts to environmentally sensitive areas.

Dated this 7th day of October 2024.

By *s/ Lisa Agrimonti*

Lisa M. Agrimonti

Haley Waller Pitts

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Minneapolis, Minnesota 55402

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hwallerpitts@fredlaw.com

**Attorneys for Applicant Deuel Harvest Wind
Energy South LLC**

**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA**

IN THE MATTER OF THE APPLICATION BY)	
DEUEL HARVEST WIND ENERGY SOUTH LLC)	CERTIFICATE OF
FOR ENERGY FACILITY PERMITS OF A WIND)	SERVICE
ENERGY FACILITY AND A 345 KV)	
TRANSMISSION FACILITY IN DEUEL COUNTY,)	EL24-023
SOUTH DAKOTA FOR THE SOUTH DEUEL)	
WIND PROJECT	

Breann L. Jurek, of Fredrikson & Byron, P.A., hereby certifies that on the 7th day of October, 2024, true and correct copies of Deuel Harvest Wind Energy South LLC’s Response to Question 2-5 of Staff’s Second Set of Data Requests and this Certificate of Service were served electronically on the persons listed below:

Ms. Amanda Reiss
Staff Attorney
South Dakota Public Utilities Commission
500 E. Capitol Ave.
Pierre, SD 57501
amanda.reiss@state.sd.us

Mr. Darren Kearney
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South Dakota Public Utilities Commission
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Mr. Jon Thurber
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500 E. Capitol Ave.
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October 1, 2024

One South Wacker Drive | Suite 1800 | Chicago, Illinois 60606
 T 312-224-1400 | F 312-224-1444

EXHIBIT 2-1: Non-Participating Receptors Located Within 0.75 Miles of a Proposed Turbine Location

Data shown below for noise and shadow flicker is the same data from Appendix M – Noise Analysis and Appendix N – Shadow Flicker Analysis.

Receptor Identifier	Property Owner Name	Distance to Closest Turbine (Miles)	Noise (Leq dBA)			Shadow Flicker (Expected Annual Hours)		
			SG	Vestas	GE	SG	Vestas	GE
R-024	John S Vandyke & Andrea E Vandyke	0.70	38.0	40.6	41.7	0:00	0:41	0:36
R-025	Logan A Ruhd	0.47	40.9	43.2	44.4	17:15	18:19	16:13
R-026	Wade A & Samantha A Solem	0.47	39.9	42.3	43.4	3:23	5:50	5:15
R-064	Philip C Rogness & Colleen A Rogness	0.46	40.7	42.9	44.3	0:00	0:00	0:00
R-065	Philip C Rogness & Colleen A Rogness	0.48	40.5	42.8	44.0	0:00	0:00	0:00
R-068	Kevin P Berge	0.63	37.6	40.5	41.5	6:21	6:19	5:47
R-076	Marlo Mundahl Living Trust	0.46	39.5	41.8	43.0	12:36	13:18	12:19
R-077	Robert Carlson	0.52	41.2	43.5	44.7	29:23	29:33	27:10
R-081	Andrew J Johnson & Amber R Johnson	0.57	40.3	42.7	43.8	6:14	6:47	6:10
R-082	Thomas James Kielty & Melissa S Kielty	0.51	40.7	43.0	44.2	11:51	13:26	12:33
R-086	Larry D & Diane J Kjenstad	0.54	40.5	43.0	44.1	9:51	10:33	9:29
R-087	Mary E Christopherson	0.60	41.5	43.8	44.9	13:21	15:55	14:27
R-089	Michael J & Jennifer L Winter	0.53	41.8	43.9	45.0	9:05	10:14	9:18
R-090	Chad & Kayla Splettstoeszer	0.57	41.1	43.4	44.4	5:27	6:19	5:31



Receptor Identifier	Property Owner Name	Distance to Closest Turbine (Miles)	Noise (Leq dBA)			Shadow Flicker (Expected Annual Hours)		
			SG	Vestas	GE	SG	Vestas	GE
R-093	Cody R Eastman & Heidi Jo Eastman	0.75	35.3	38.5	39.5	0:00	0:00	0:00
R-155	Terry & Cherie Ruhd	0.47	41.4	43.6	44.8	16:53	18:00	16:26
R-157	Thomas D Gniffke	0.50	40.1	42.6	43.7	28:36	28:25	25:36
R-162	Donald Tvedt & Loretta Tvedt	0.46	40.3	42.6	43.8	19:13	20:22	18:36
R-164	Victor Robertson & Cathy Robertson	0.57	39.1	41.7	42.8	14:33	15:28	14:05
R-165	Tony A Quail & Jennifer J Quail	0.46	40.9	43.1	44.4	16:48	17:13	15:33
R-167	Russell Hamann & Gordon Hamann	0.66	38.1	40.8	41.9	0:00	0:00	0:00
R-171	Kristopher E Moyer & Kristen L Moyer	0.65	37.9	40.4	41.5	14:40	14:38	13:58
R-183	Cory & Kristin Goehring	0.69	37.4	40.4	41.4	5:30	5:54	5:14
R-187	Leann Jensen	0.65	38.4	41.1	42.2	0:00	1:21	1:10
R-188	Western Trust Company	0.75	38.0	40.9	41.8	6:28	6:27	5:49
R-194	Byron O Olson II & Nichole R Olson	0.50	37.5	39.7	41.0	9:52	9:49	8:32
R-195	Matthew R & Tamara D Baer	0.75	33.7	36.8	37.9	0:00	0:00	0:00
R-200	Landon H Prins & Michelle A Prins	0.49	41.1	43.1	44.4	12:22	12:18	11:24
R-204	Randy & Donna Stroschein Living Trust	0.48	38.8	41.0	42.3	12:13	12:56	11:43
R-205	Jason G Kerkvliet & Jennifer L Kerkvliet	0.50	40.8	42.9	44.2	7:27	7:23	6:42
R-216	Lorolia K Gruener Revocable Living Trust	0.71	35.0	37.7	38.8	8:11	8:09	7:32
R-228	Jesse Thompson	0.64	35.8	38.6	39.7	0:00	0:27	0:24



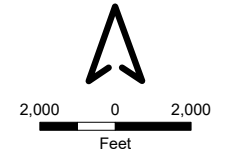
Receptor Identifier	Property Owner Name	Distance to Closest Turbine (Miles)	Noise (Leq dBA)			Shadow Flicker (Expected Annual Hours)		
			SG	Vestas	GE	SG	Vestas	GE
R-242	Craig Rogness and Cory Rogness	0.61	37.4	40.0	41.3	11:44	11:42	11:04
R-252	Cory Ivan Rogness & Craig Howard Rogness	0.63	38.3	40.9	42.6	6:03	6:40	6:07
R-253	Todd K Johnson & Mary B Johnson	0.67	35.1	37.9	39.8	9:55	10:36	9:44
R-255	Dennis & Deborah Kanengieter	0.48	38.1	40.2	42.5	12:11	13:50	15:55
R-256	Dale E Roth & Sherry Roth	0.46	37.7	40.0	44.0	1:47	2:14	24:57
R-257	Joshua Lee Bekaert & Jacqueline Nicole Bekaert	0.49	39.2	41.4	44.4	12:36	12:54	11:46
R-283	Stewart & Stephanie Kessen Revocable Trust	0.46	39.7	42.0	43.4	19:43	20:00	18:17
R-286	DK Overby LLP	0.57	37.4	39.9	41.2	0:00	0:00	0:00
R-290	Tony J & Danay E Nielsen	0.53	41.3	43.7	44.9	21:32	25:29	22:58
R-291	Samuel Dunn & Taylor Dunn	0.57	37.3	40.0	41.1	0:00	2:14	1:56
R-305	Bryon K & Sheila J Monnier	0.73	37.0	39.8	40.8	0:00	0:00	0:00
R-306	Bryon Monnier & Sheila Monnier	0.67	37.4	40.1	41.1	2:48	2:47	2:27
R-321	Marlen R Kasemodel	0.53	37.4	39.8	41.1	15:13	15:09	13:51
R-322	Jacob D Stonefield	0.45	39.0	41.1	42.4	0:48	1:15	1:05
R-325	Dale E Roth & Sherry Roth	0.46	37.9	40.2	44.1	1:45	2:11	28:35
R-326	Thomas James Kielty & Melissa S Kielty	0.53	40.5	42.9	44.1	10:59	12:15	11:22
R-327	Randy & Donna Stroschein Living Trust	0.55	37.5	39.9	41.1	8:34	9:02	8:16



Receptor Identifier	Property Owner Name	Distance to Closest Turbine (Miles)	Noise (Leq dBA)			Shadow Flicker (Expected Annual Hours)		
			SG	Vestas	GE	SG	Vestas	GE
R-061*	Jerold & Lonnie Milton LE Randy & John Milton, Michelle, Emily, Lyn	0.49	38.4	40.8	42.0	3:11	3:52	3:28

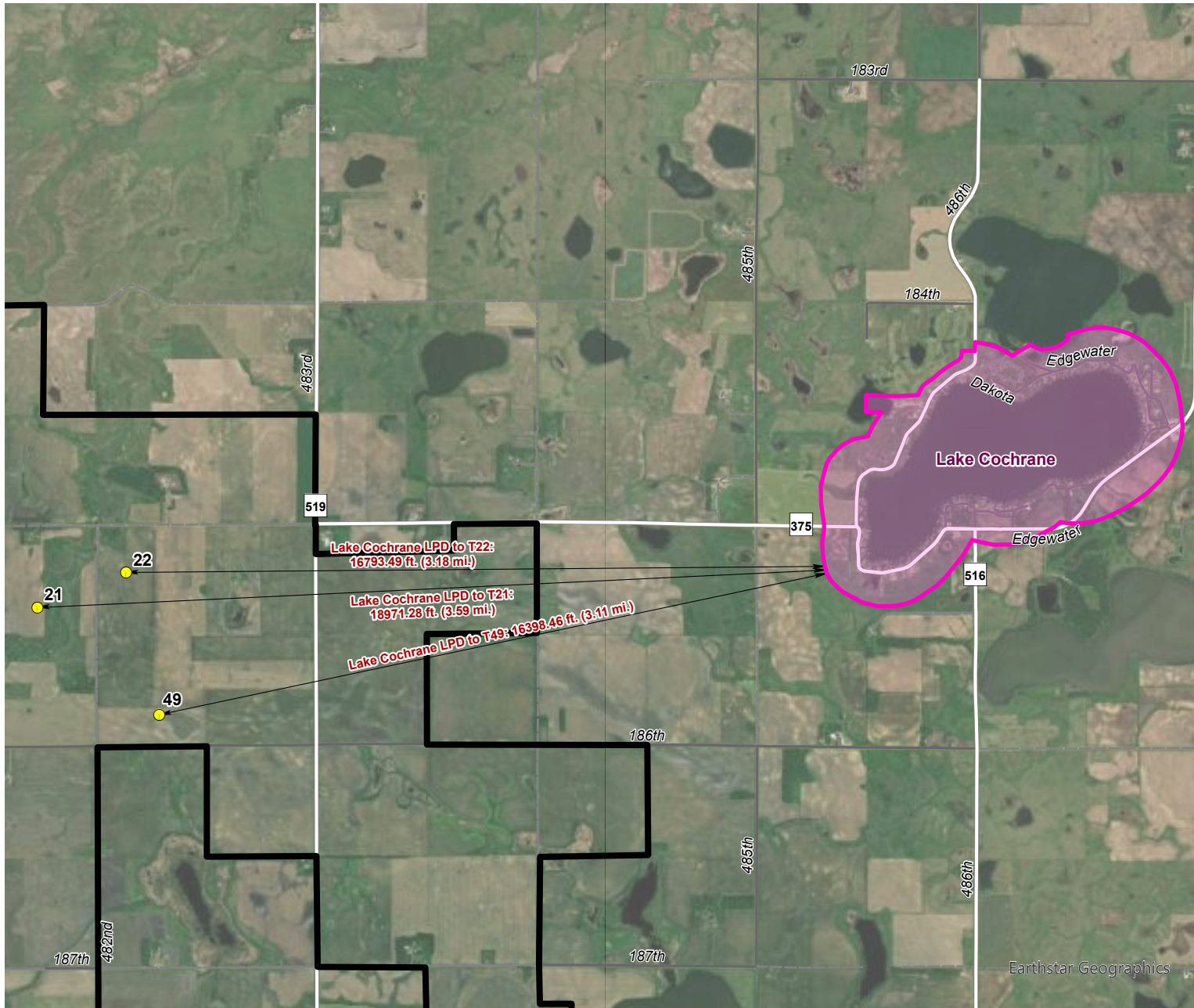
** At the time of the application submission to the South Dakota Public Utilities Commission for Energy Facility Permits, receptor R-061 was a non-participating receptor. Since this submission, receptor R-061 has signed an agreement with Deuel Harvest Wind Energy South LLC (“South Deuel Wind”) and is now a participating receptor. Despite now being a participating receptor, South Deuel Wind has included it in this Exhibit 2-1 to clarify the change in its status.*

Exhibit 2-2



Legend

- Turbine Location
 - Lake Cochrane LPD
 - Project Area
- Road Classification**
- US/State Route
 - County Road
 - Local Road
 - Dirt/Unpaved Road



Turbine Proximity: Lake Cochrane Lake Park District

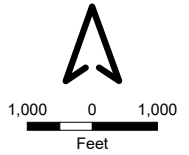
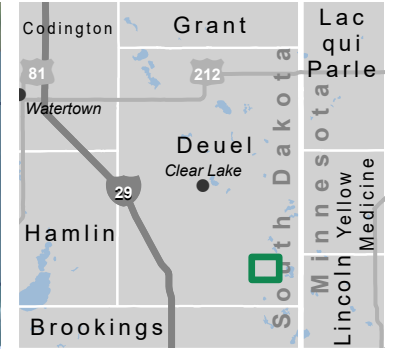
South Deuel Wind Energy Center | Deuel County, South Dakota

September 30, 2024

Invenergy

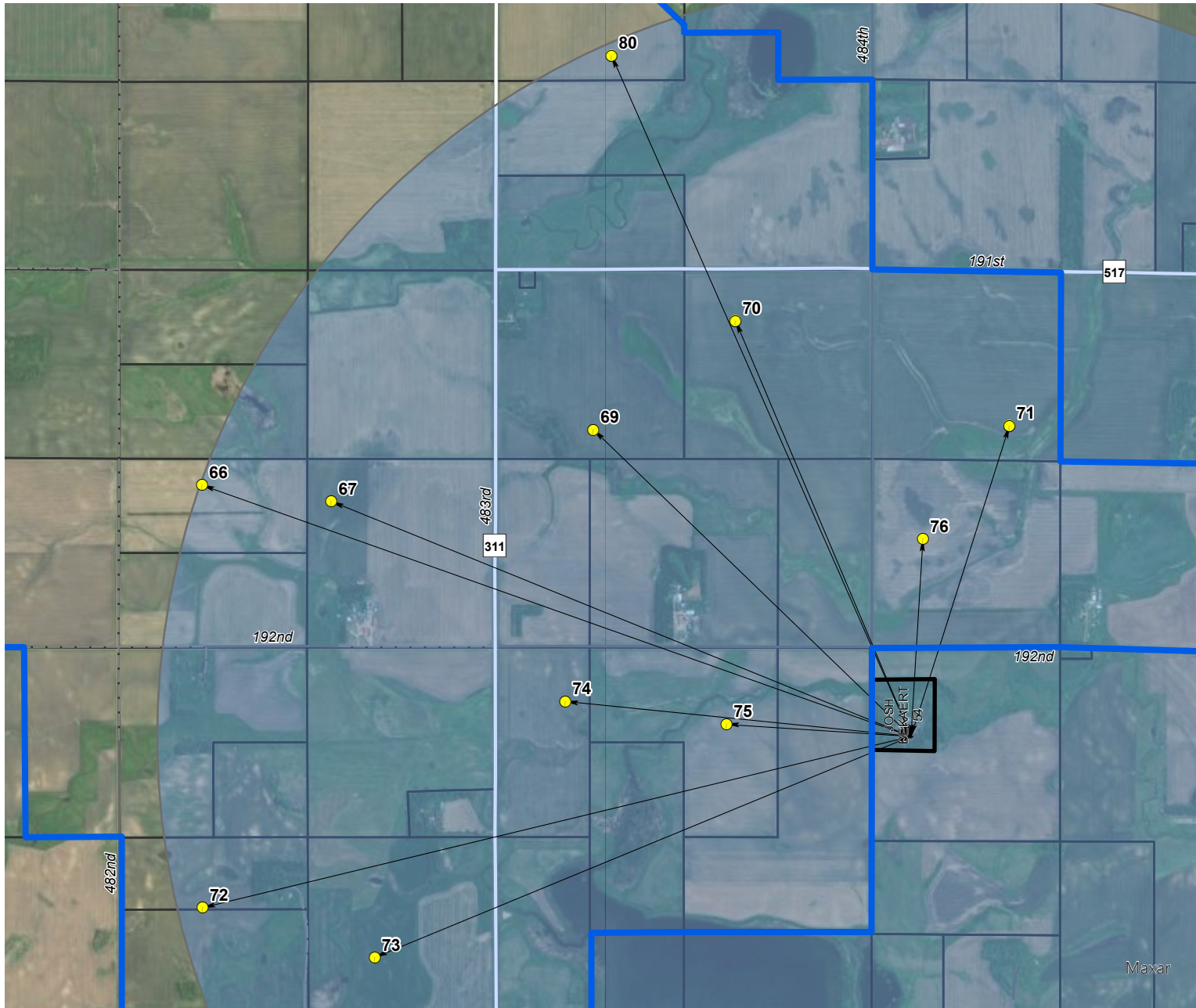
Exhibit_JT-1, Page 623 of 643

Exhibit 2-3



Legend

- Turbine Location
 - Landowner Parcel
 - Search Area (2 mile)
 - Project Area
 - Parcel Boundary
- Road Classification**
- County Road
 - Local Road
 - Dirt/Unpaved Road



Turbine	Distance (feet)	Distance (miles)
73	8113.15	1.54
75	2580.34	0.49
74	4856.26	0.92
72	10199.07	1.93
67	8748.35	1.66
66	10523.6	1.99
69	6164.22	1.17
76	2752.82	0.52

Turbine Proximity: JOSH BEKAERT

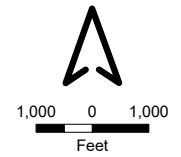
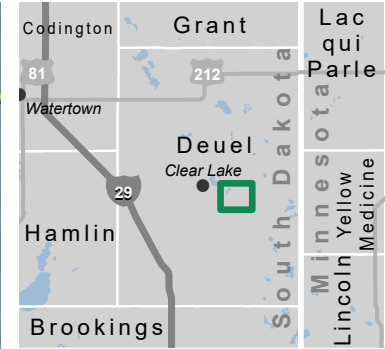
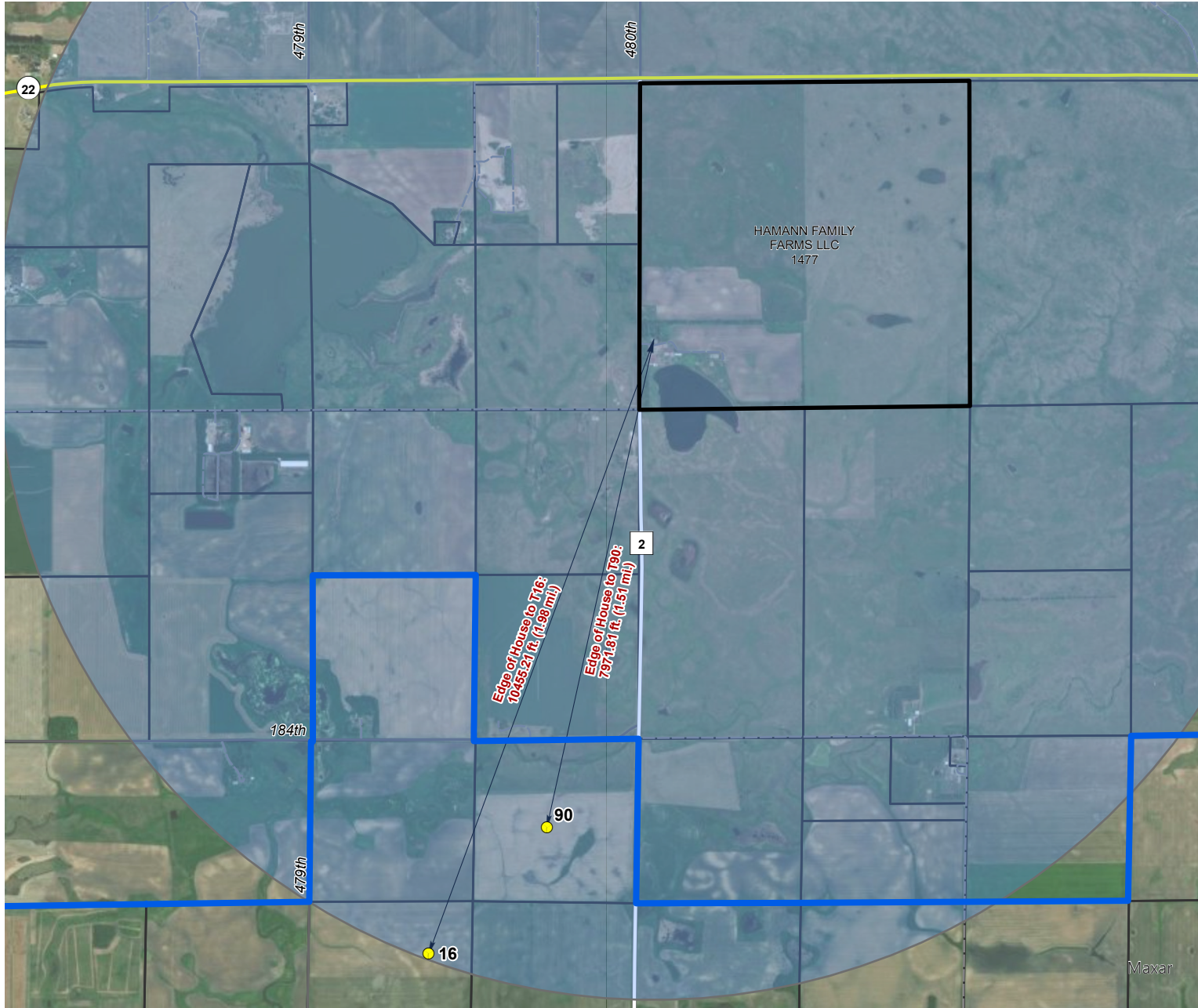
South Deuel Wind Energy Center | Deuel County, South Dakota

September 30, 2024

Invenergy

Exhibit_JT-1, Page 624 of 643

Exhibit 2-4



Legend

- Turbine Location
 - Landowner Parcel
 - Search Area (2 mile)
 - Project Area
 - Parcel Boundary
- Road Classification**
- US/State Route
 - County Road
 - Local Road
 - Dirt/Unpaved Road

Turbine Proximity: HAMANN FAMILY FARMS LLC

South Deuel Wind Energy Center | Deuel County, South Dakota

September 30, 2024

Invenergy

Exhibit_JT-1, Page 625 of 643

**BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF SOUTH
DAKOTA**

**IN THE MATTER OF THE
APPLICATION BY DEUEL HARVEST
WIND ENERGY SOUTH LLC FOR
ENERGY FACILITY PERMITS OF A
WIND ENERGY FACILITY AND A 345-
kV TRANSMISSION FACILITY IN
DEUEL COUNTY, SOUTH DAKOTA
FOR THE SOUTH DEUEL WIND
PROJECT**

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**DEUEL HARVEST WIND
ENERGY SOUTH LLC'S
RESPONSES TO STAFF'S THIRD
SET OF DATA REQUESTS**

EI 24-023

Deuel Harvest Wind Energy South LLC (South Deuel Wind) provides the following responses to Staff's Third Set of Data Requests in the above-captioned matter.

3-1) Refer to the comment submitted by Brad St. Aubin on September 11, 2024. Mr. Aubin stated the "Lake Cochrane/Lake Park District setback requirements set by the county in 2017, already had significant input from the community and were set with that input in mind. This setback has greatly affected the northeast area of the project where my land is located. Some turbines were already removed from the project as a result of this setback."

a) How many turbines were removed from the original proposal to comply with the Deuel County setback from the Lake Cochrane Lake Park District?

Alexandra Thompson: Three turbine locations (identified as 46, 47 and 50) were removed from the Project layout to comply with Deuel County setback requirements from the Lake Cochrane /Lake Park District.

b) Please provide a map of the original turbine layout around the Lake Cochrane area before the setback was adopted by Deuel County.

Alexandra Thompson: For clarification, the Lake Cochrane Lake Park District 3-mile setback was implemented as part of the WES Ordinance revisions adopted on May 23, 2017 by the Deuel County Board of Commissioners. Turbine locations 46, 47 and 50 were presented to Deuel County's Board of Adjustment South Deuel Wind's Conditional Use Permit Application in the summer of 2023. Exhibit 3-1(b) is a map from the Conditional Use Permit application showing the three locations.

3-2) Refer to the Section 15.4.1.2, Page 109 of the Application regarding Aviation. The Applicant states "seventy-one of the 73 proposed turbine locations in the Project Layout have been submitted to the FAA to obtain Determinations of No Hazard. South Deuel

Wind anticipates submitting the remaining two turbine locations to the FAA to obtain Determinations of No Hazard in July 2024.”

- a) Have all 73 locations been submitted to the FAA to obtain Determination of No Hazard?

Alexandra Thompson: 71 turbine locations have been submitted to the FAA. The remaining two turbine locations are expected to be submitted Q4 2024.

- b) Has the Applicant received determinations from the FAA regarding the turbine locations? If no, does the Applicant expect to receive determinations prior to the hearing on January 21, 2025?

Alexandra Thompson: No, South Deuel Wind has not yet received determinations from the FAA. Invenergy’s experience has been that receipt of determinations from the FAA can be variable. South Deuel Wind believes determinations from the FAA may be received prior to the evidentiary hearing.

- c) If the FAA determines any turbine location will pose a hazard to aviation, does the Applicant agree that it will not construct a turbine at that location? Please explain.

Alexandra Thompson: Yes, South Deuel Wind will not construct any turbine location that has received a final determination of hazard.

3-3) Refer to the Section 9.3.2.1, Page 78 of the Application regarding the whooping crane.

- a) Has the Applicant proposed any mitigation measures to address potential impacts to whooping cranes? Please explain.

Michelle Phillips: South Deuel Wind does not propose any mitigation measures given that whooping cranes are unlikely to occur in the Project area. The Project is not within the US Fish & Wildlife Service (USFWS) whooping crane observation corridor, which is located approximately 85 miles west of the Project area. The whooping crane does not appear in USFWS Information for Planning and Consultation (IPaC) results for the Project area nor was there any record of occurrence identified within 5 miles of the Project area in the South Dakota Natural Heritage Database query results. No whooping cranes were observed during any of the site visits or throughout the multiple years of avian surveys. The South Dakota Game Fish and Parks (SDGFP) concluded that the Project likely does not pose a substantial risk to whooping cranes and neither the USFWS nor South Dakota Game Fish and Parks has recommended mitigation measures for potential impacts to whooping cranes.

- b) Has the US Fish and Wildlife Service or South Dakota Game Fish and Parks recommended any mitigation measures to address potential impacts to whooping cranes?

Michelle Phillips: Please see response to 3-3a.

- c) In Docket EL19-026, for the Tatanka Ridge Wind Project in Deuel County, the Commission ordered the following condition regarding whooping cranes:

Applicant shall establish a procedure for preventing whooping crane collisions with turbines during operations by establishing and implementing formal plans for monitoring the project site and surrounding area for whooping cranes during spring and fall migration periods throughout the operational life of the project and shutting down turbines and/or construction activities within 2 miles of whooping crane sightings. The South Dakota Game, Fish, and Parks will be consulted on the procedure to minimize impacts to whooping cranes.

Would the Applicant agree to the permit condition above should the Commission issue a permit for the project? If no, please explain why not.

Michelle Phillips: South Deuel Wind does not believe the above permit condition is appropriate because whooping cranes are unlikely to occur in the Project area and therefore would not agree to the condition. The Project is not located within the USFWS whooping crane observation corridor, which is located approximately 85 miles west of the Project area. The whooping crane does not appear in USFWS IPaC results for the Project area nor was there any record of occurrence identified within 5 miles of the Project area in the South Dakota Natural Heritage Database query results. No whooping cranes were observed during any of the site visits or throughout the multiple years of avian surveys. Due to being outside of the observation corridor, whooping cranes are unlikely to occur in the Project area.

- 3-4) Refer to ARSD 20:10:22:16. ARSD 20:10:22:16 requires the applicant to “provide ... an analysis of the impact of construction and operation of the proposed facility on the ... pathways of migration.” Please describe the impact of the operation of the proposed facility on the migration of ducks and geese through the area.

Michelle Phillips: The Project conducted avian surveys in the Project area as prescribed by the USFWS and SDGFP. The survey methods and results were shared with those agencies and are available in Appendices G and K filed with the PUC Application. While ducks and geese in South Dakota migrate at high altitudes, the Project coordinated with the USFWS and SDGFP to minimize infrastructure near suitable waterfowl stopover habitat. Therefore, the Project does not anticipate having an impact on the migration of ducks and geese in the area.

Dated this 15th day of October 2024.

By *s/ Lisa Agrimonti*

Lisa M. Agrimonti

Haley Waller Pitts

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**Attorneys for Applicant Deuel Harvest Wind
Energy South LLC**

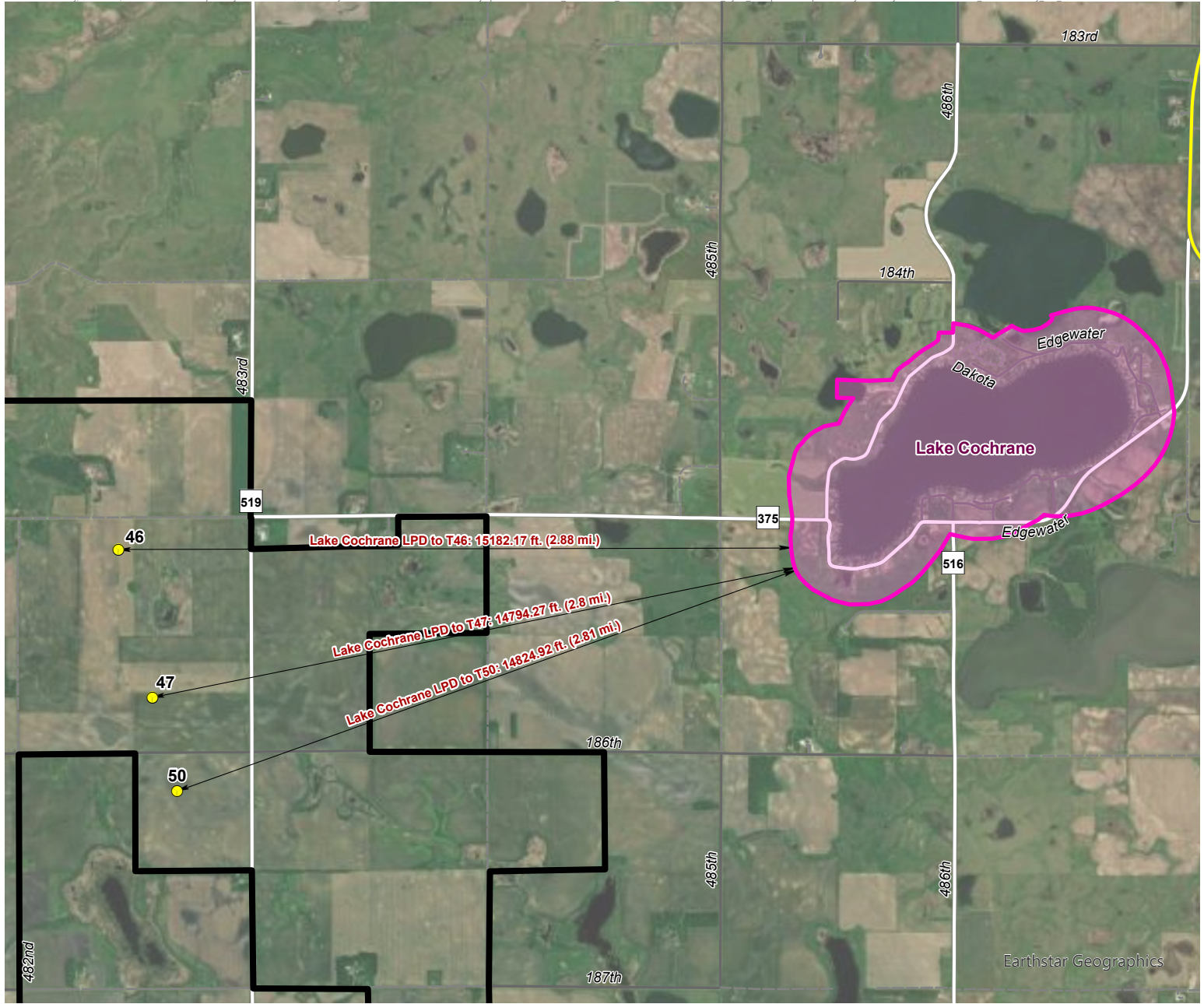
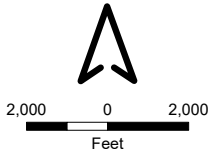
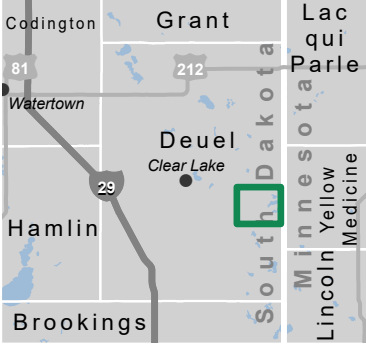


Exhibit 3-1(b)



Legend

- Deuel Conditional Use Permit Turbine Locations
- ▭ Lake Cochrane LPD
- ▭ Project Boundary
- Road Classification**
- US/State Route
- County Road
- Local Road
- Dirt/Unpaved Road

Turbine Proximity: Lake Cochrane LPD

South Deuel Wind Energy Center | Deuel County, South Dakota

October 14, 2024



**BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF SOUTH DAKOTA**

IN THE MATTER OF THE APPLICATION BY)	
DEUEL HARVEST WIND ENERGY SOUTH LLC)	CERTIFICATE OF
FOR ENERGY FACILITY PERMITS OF A WIND)	SERVICE
ENERGY FACILITY AND A 345 KV)	
TRANSMISSION FACILITY IN DEUEL COUNTY,)	EL24-023
SOUTH DAKOTA FOR THE SOUTH DEUEL)	
WIND PROJECT	

Breann L. Jurek, of Fredrikson & Byron, P.A., hereby certifies that on the 15th day of October, 2024, true and correct copies of Deuel Harvest Wind Energy South LLC's Responses to Staff's Third Set of Data Requests and this Certificate of Service were served electronically on the persons listed below:

Ms. Amanda Reiss
Staff Attorney
South Dakota Public Utilities Commission
500 E. Capitol Ave.
Pierre, SD 57501
amanda.reiss@state.sd.us

Mr. Darren Kearney
Staff Analyst
South Dakota Public Utilities Commission
500 E. Capitol Ave.
Pierre, SD 57501
darren.kearney@state.sd.us

Mr. Logan Schaeffbauer
Staff Attorney
South Dakota Public Utilities Commission
500 E. Capitol Ave.
Pierre, SD 57501
Logan.Schaeffbauer@state.sd.us

Mr. Jon Thurber
Staff Analyst
South Dakota Public Utilities Commission
500 E. Capitol Ave.
Pierre, SD 57501
jon.thurber@state.sd.us

**BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF SOUTH
DAKOTA**

**IN THE MATTER OF THE
APPLICATION BY DEUEL HARVEST
WIND ENERGY SOUTH LLC FOR
ENERGY FACILITY PERMITS OF A
WIND ENERGY FACILITY AND A 345-
kV TRANSMISSION FACILITY IN
DEUEL COUNTY, SOUTH DAKOTA
FOR THE SOUTH DEUEL WIND
PROJECT**

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**DEUEL HARVEST WIND ENERGY
SOUTH LLC’S RESPONSES TO
STAFF’S FOURTH SET OF DATA
REQUESTS**

EL24-023

Deuel Harvest Wind Energy South LLC (“South Deuel Wind”) provides the following responses to Staff’s Fourth Set of Data Requests in the above-captioned matter.

- 4-1) Refer to Figure 13 of the Application. Is the Fox Lake State Recreation Area or Singsass State Conservation Area shown on Figure 13? If yes, please provide additional clarification where the conservation lands are located on the map. If no, please submit a revised map identifying the conservation lands.

Michelle Phillips: Small portions of the Fox Lake State Recreation Area and Singsass State Conservation Area are located within the Project Area. Due to their limited extent within the Project Area, the Project Area scale of the map, and the order in which the layers are displayed in the map, the Project Area line covers the portions of the Fox Lake State Recreation Area and Singsass State Conservation Area that are located within the Project Area. Please see Exhibit 4-1 for a map containing callouts specifically for the Fox Lake State Recreation Area and Singsass State Conservation Area.

- 4-2) Refer to Figure 14 and Page 89 of the Application. The Application states there is one cemetery within the Project Area, approximately 0.5 miles west of the town of Brandt.

- a) How far is turbine location 31 from the cemetery 0.5 miles west of the town of Brandt?

Monica Monterrosa: Turbine location 31 is located 0.89 miles from the Highland Lutheran Cemetery.

- b) Did Deuel County consider setbacks from cemeteries as part of its county zoning ordinance? Please explain.

Monica Monterrosa/Lisa Agrimonti: The Deuel County Zoning Ordinance does not establish any setback from cemeteries for wind energy systems. South Deuel Wind is not able to address whether Deuel County considered setbacks for cemeteries when it adopted requirements for wind energy systems in its zoning ordinance.

- c) Does Invenergy have any internal guidelines for setbacks from cemeteries? If yes, please provide. If no, please explain why it is not necessary to establish a setback from cemeteries.

Monica Monterrosa: South Deuel Wind applied a cemetery setback guideline of four times tip height of the turbines as practicable. All turbine locations meet this setback.

- 4-3) Refer to Figure 13 and Pages 88 and 89 of the Application. On Page 88 of the Application, the Applicant states “the USFWS administers approximately 1,211 acres of land defined as Deuel County Waterfowl Production Areas (“WPAs”) within the Project Area. Project infrastructure is sited within three of these parcels. The Project coordinated with the USFWS Madison Wetland Management District to map the boundaries of the easements within the parcels.” On Section 11.2.2, Page 89 of the Application, the Applicant states that no Project Facilities are sited within the USFWS WPAs or SDGFP GPAs.”

Please clarify whether Project Facilities are sited within the USFWS WPA, defined as the Deuel County Waterfowl Production Area. Based on Figure 13, it appears as though turbine locations H and J, and electrical collection systems are sited on USFWS WPAs.

Michelle Phillips: South Deuel Wind has sited Project Facilities to avoid impacts to USFWS easements. For each of the three WPA parcels where infrastructure is sited, the wetland easement is specific to the delineated wetland feature; the easement does not apply to the full parcel. The wetland easement areas would not be impacted through siting and construction techniques outlined in the Application.

- 4-4) Refer to Page 92 of the Application regarding Noise Regulations.

- a) Does the Deuel County zoning ordinance limit sound levels at participating residences? Please explain.

Lisa Agrimonti: No, the Deuel County Zoning Ordinance does not limit sound levels at participating residences.

- b) When a participating landowner signs an easement, do they provide a waiver of all applicable noise regulations? Please explain.

Monica Monterrosa: When signing a lease and easement agreement, the participating landowner is granting an easement for wind activities, including sound.

- 4-5) Refer to Page 92 of the Application regarding Sound Impacts. The Applicant states that “to minimize the impact of construction sound, the Project will limit any necessary nighttime work near residences to quiet activities such as finishing, maintain equipment to manufacturers’ specifications, and minimize backing up on site of delivery trucks.”

- a) Please define “near residences” in the above statement. Specifically, how many feet from the nearest residence?

Monica Monterrosa: South Deuel Wind does not anticipate performing significant noise-causing construction activities during nighttime but may as needed to maintain construction schedule. South Deuel Wind will exercise best judgement to not cause prolonged, significant noise impacts to residences within ½ mile (2,560 feet) during nighttime.

- b) Does Invenergy have a company policy regarding nighttime work? If yes, please provide.

Monica Monterrosa: Invenergy does not have a company policy regarding nighttime work. All OSHA guidelines for safety lighting will be followed.

- 4-6) Refer to Page 93 of the Application regarding Acoustical Modeling Results. The Applicant states “cumulative sound from the Project and the Tatanka Ridge Wind Farm was also analyzed. The maximum predicted Leq sound pressure levels at each receiver are provided in Appendix M. The results show a maximum sound level of 46 dBA at non-participating residences. The maximum sound level at participating residences is 48 dBA.”

- a) Did Deuel County review the cumulative sound modeling prior to approving the conditional use permit and determine that a sound level of 46 dBA at a non-participant residence complies with the zoning ordinance? If no, please provide any documentation that would support the Applicant’s belief that a 46 dBA cumulative sound level associated with wind facilities at a non-participating residence complies with the Deuel County zoning ordinance?

Monica Monterrosa/Lisa Agrimonti: The Deuel County Zoning Ordinance does not limit sound levels at participating residences. Also, based on discussions with the Deuel County Zoning Officer, the county’s sound limit is a source-only limit, not a cumulative sound limit. This understanding was confirmed by Deuel County on October 28, 2024, see Exhibit 4-6a.

- b) Please describe the Applicant’s engagement with participating landowners to ensure that the landowner understands the impact of sound levels in the 46 to 48 dBA range and expectations are set accordingly.

Monica Monterrosa/Lisa Agrimonti: South Deuel Wind objects to this request as vague and ambiguous with respect to the meaning of impacts. Subject to this objection, South Deuel Wind responds that throughout the development of the Project, South Deuel Wind has spoken with landowners about the anticipated noise

levels from the Project and shared information about common sound sources to help contextualize the approximate sound levels as appropriate.

Dated this 1st day of November 2024.

By s/ Lisa Agrimonti

Lisa M. Agrimonti

Haley Waller Pitts

FREDRIKSON & BYRON, P.A.

60 South 6th Street, Suite 1500

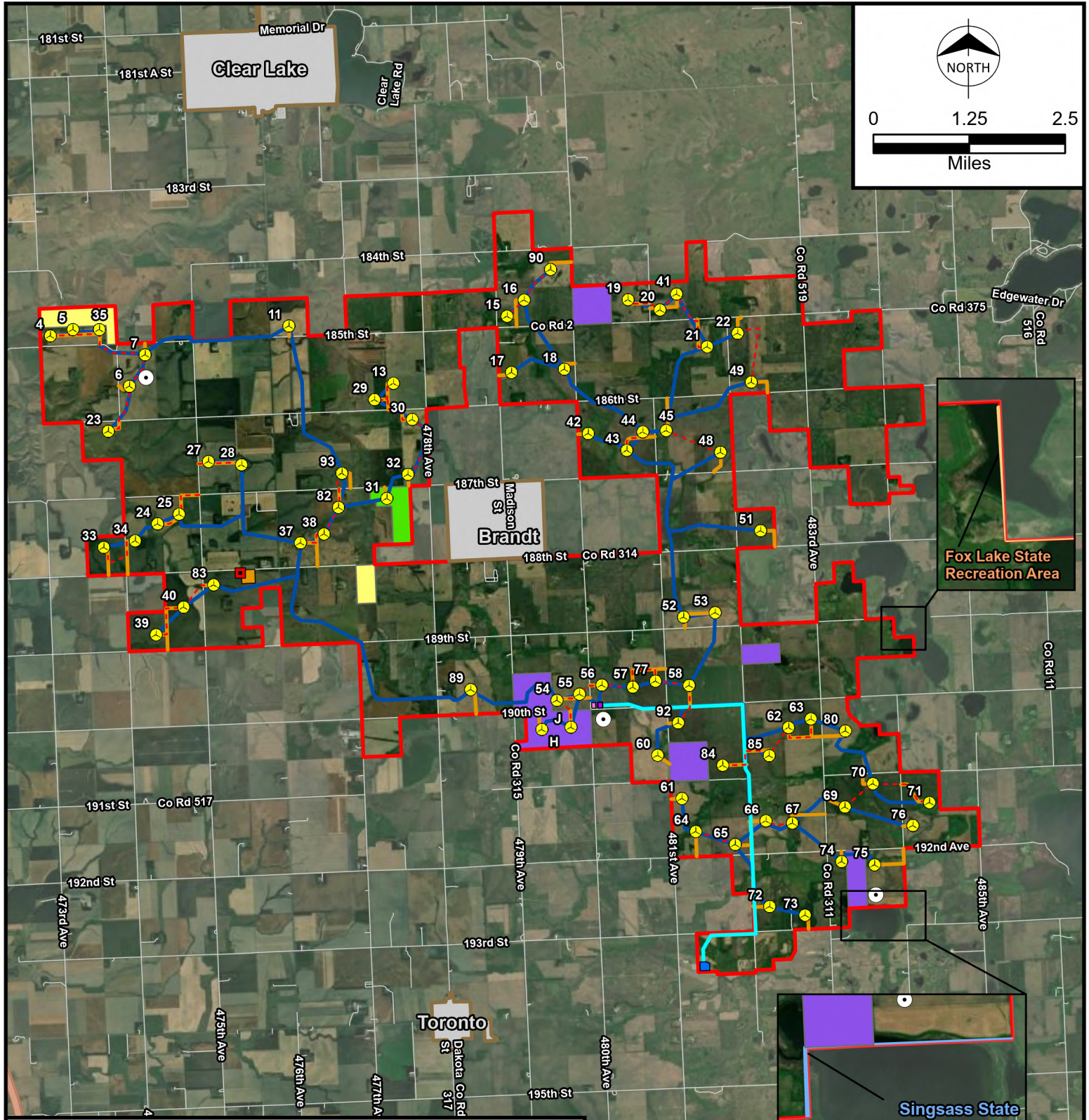
Minneapolis, Minnesota 55402

(612) 492-7344

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hwallerpitts@fredlaw.com

**Attorneys for Applicant Deuel Harvest Wind
Energy South LLC**



Public/Conservation Lands

- Dakota Tallgrass Prairie Wildlife Management Area
- Deuel County Waterfowl Production Area
- Fox Lake State Recreation Area
- Singsaas State Conservation Area
- SDGFP Walk-In Hunting Area

 Turbine Location	 Gen-Tie Line
 Meteorological Tower	 Access Road
 Aircraft Detection Lighting System Tower	 Crane Path
 Interconnection Switchyard	 Municipal Boundary
 Collector Substation	 Project Area
 General Construction Laydown Yard	
 O&M Facility	



Exhibit 4-1
Public Lands/Conservation Land Map
South Deuel Wind Project
Deuel County, South Dakota

Source: ESRI, Census TIGER Data, PADUS, Invenergy, Burns & McDonnell

From: Deuel Zoning <dczoning@itctel.com>
Sent: Monday, October 28, 2024 4:52 PM
To: Agrimonti, Lisa <LAgrimonti@fredlaw.com>; 'Craig Evenson' <craigevenson@itctel.com>
Subject: RE: Deuel Harvest South Wind Energy
Importance: High

CAUTION: EXTERNAL E-MAIL

Lisa:

#1) The Noise Level is measured from the non-participating residences. The ordinance makes no mention of participating residences. There could be practical matters to consider, however, those are beyond the scope of the county's ordinance .

#2) The county's interpretation is that the ordinance is a source related ordinance. We do not believe this to be ambiguous, however, please keep in mind, we cannot make a representation regarding how the ordinance would be treated by a court. In addition to the county's requirements, your company must meet the requirements of the PUC. The county makes no representation about the regulations or requirements of the PUC proceedings. (The county is frankly unaware of the PUC's requirements.)

Sincerely

Jodi Theisen
Deuel County Zoning Officer
Phone 605-874-8562

From: Jodi <jodit@itctel.com>
Sent: Monday, October 28, 2024 9:43 AM
To: Deuel Zoning <dczoning@itctel.com>
Subject: Fwd: Deuel Harvest South Wind Energy

Sent from my iPhone

Begin forwarded message:

From: "Agrimonti, Lisa" <LAgrimonti@fredlaw.com>
Date: October 25, 2024 at 11:57:05 AM CDT
To: jodit@itctel.com
Subject: Deuel Harvest South Wind Energy

Dear Jodi,

In the PUC proceeding, PUC Staff has issued discovery asking about Deuel County's sound requirements for wind energy systems. Can you please advise if the Project' interpretation of the requirement below is consistent with the County's?

13. Noise and Shadow Flicker.

- a. Noise level for non-participating residences shall not exceed 45 DBA, average A-Weighted Sound pressure. The noise level is to be measured at the perimeter of existing non-participating residences.

First, Deuel County does not have a sound limit at participating residences. Is this correct?

Second, Deuel County will determine compliance with the 45 dBA limit for non-participating residences based on the sound levels produced solely by the Project, i.e. it is a source limit. Is this correct?

Thank you.

Lisa
Lisa Agrimonti
Fredrikson & Byron, P.A.

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF SOUTH DAKOTA

IN THE MATTER OF THE APPLICATION BY DEUEL HARVEST WIND ENERGY SOUTH LLC FOR ENERGY FACILITY PERMITS OF A WIND ENERGY FACILITY AND A 345-KV TRANSMISSION FACILITY IN DEUEL COUNTY, SOUTH DAKOTA FOR THE SOUTH DEUEL WIND PROJECT

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DEUEL HARVEST WIND ENERGY SOUTH LLC'S RESPONSES TO STAFF'S FIFTH SET OF DATA REQUESTS

EI 24-023

Deuel Harvest Wind Energy South LLC ("South Deuel Wind") provides the following responses to Staff's Fifth Set of Data Requests in the above-captioned matter.

- 5-1) Regarding visual impacts, does the Applicant expect more visual impacts when the proposed wind turbines are between 574 ft. and 589 ft. in tip height and the other installed wind turbines in Deuel County are below 500 ft. in tip height? Please explain.

Monica Monterrosa: South Deuel Wind believes that taller turbines can produce greater visual impacts than shorter turbines but that the difference between turbines that are 500 feet tall and turbines that are 589 feet tall does not materially change the aesthetic impacts of a turbine. Additionally, taller turbines can capture more of the wind resource, producing greater electrical output, resulting in fewer turbines required to achieve a project's nameplate capacity.

- 5-2) Refer to Page 99 of the Application. The Applicant states that "after filing all possible turbine locations with the FAA in April 2023, the DoD is conducting a radar impact study, and South Deuel Wind will work with the DoD to mitigate any concerns."

- a) Has the Department of Defense completed its radar impact study? If yes, were any radar impacts identified? If no, when does the Applicant anticipate the completion of the study?

Alexandra Thompson: The Department of Defense has reviewed and completed its study of the Project Layout for potential radar and military impacts. The Department of Defense determined that no modifications to the turbine locations are necessary to mitigate radar impacts. Nonetheless, South Deuel Wind is currently in the process of obtaining a mitigation agreement. The agreement will require a voluntary monetary contribution as mitigation. The agreement will also limit the Project to utilizing turbines with a maximum height of 594 feet above ground level, to construct no more than three permanent MET towers with a maximum height not to exceed the hub height of the turbines, and to construct no more than one ADLS tower.

- b) What type of actions can be completed to mitigate the Department of Defense concerns? Please explain.

Alexandra Thompson: Please see the response to Data Request # 5-2(a).

- 5-3) Refer to Page 99 of the Application regarding military airspace. The Applicant states that “based on conversations with the DoD, mitigation measures are not anticipated to impact proposed turbine locations.” What type of mitigation measures were discussed?

Alexandra Thompson: Please see the response to Data Request # 5-2(a).

- 5-4) Refer to Page 100 of the Application regarding NEXRAD. The Applicant states that “further due diligence of NEXRAD impacts is underway and South Deuel Wind is working with the NOAA to mitigate any concerns.” Has the Applicant completed its due diligence of NEXRAD impacts? If yes, what mitigation measures are being implemented to address their concerns.

Lisa Agrimonti: SDPUC staff confirmed that Data Request # 5-4 is withdrawn as of 10/29/24 as the information was provided in previous discovery.

- 5-5) Refer to Page 101 of the Application regarding the Road Use Agreement. Has the Applicant obtained a Road Use Agreement with Deuel County? If no, please provide an update on its status.

Monica Monterrosa: South Deuel Wind has continued to engage with Deuel County regarding the negotiation of a Road Use Agreement and anticipates executing an agreement in the next 1-2 months.

- 5-6) Refer to Page 110 of the Application regarding aviation. Are any permits or approvals required from the South Dakota Aeronautics Commission for each turbine prior to construction? Please explain.

Alexandra Thompson: No permits from the South Dakota Aeronautics Commission are required. South Deuel Wind will comply with SDCL 50-9-1 and provide the South Dakota Aeronautics Commission with determinations of no hazard issued by the FAA prior to the start of construction.

- 5-7) Refer to Page 119 of the Application regarding decommissioning. The Applicant states that “the Vestas 163-4.5 turbine model was chosen because, at the time of the Decommissioning Plan, the turbine model is anticipated to be the most optimal turbine for the site.” What makes the Vestas 163-4.5 turbine model the most optimal turbine for the site? Is the Vestas 163-4.5 turbine model still the most optimal turbine for the site? Please explain.

Alexandra Thompson: Turbine performance, commercial readiness, construction logistics, and project economics are considered when determining the most optimal

turbine model for a site. To-date, the Vestas 163-4.5 has been assessed as the most optimal turbine model holistically for the site.

- 5-8) Refer to Page 120 of the Application. The Applicant states that “South Deuel Wind respectfully requests that the Commission authorize the posting of a bond for financial assurance for decommissioning costs for the Project.” Please provide the draft surety bond that the Applicant is proposing with all relevant terms for Commission review.

Monica Monterrosa: Please see Exhibit 5-8.

- 5-9) Refer to ARSD 20:10:22:33.02(13). Please provide the depth of burial of underground connection facilities.

Alexandra Thompson: Collector circuits and fiber optic cables will be installed at least 48 inches below ground surface except for locations where collector circuits connect to aboveground Project Facilities. See also Section 4.4.5 of the Application.

Dated this 8th day of November 2024.

By s/ Lisa Agrimonti

Lisa M. Agrimonti

Haley Waller Pitts

FREDRIKSON & BYRON, P.A.

60 South 6th Street, Suite 1500

Minneapolis, Minnesota 55402

(612) 492-7344

lagrimonti@fredlaw.com

hwallerpitts@fredlaw.com

**Attorneys for Applicant Deuel Harvest Wind
Energy South LLC**

South Deuel Wind Decommissioning Bond

Bond # _____

KNOW ALL MEN BY THESE PRESENTS: That Deuel Harvest Wind Energy South LLC (hereinafter called the “Principal”), and _____ (hereinafter called the “Surety”), are held and firmly bound unto Public Utilities Commission of the State of South Dakota (hereinafter called the “Obligee”), in the full and just sum of _____ (\$ _____), the payment of which sum, well and truly to be made, the said Principal and Surety bind themselves, and each of their heirs, administrators, executors, and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Principal was granted Energy Facility Permits (hereinafter called the “Permit”) by the Obligee on the (Date of Permit) for the construction of the South Deuel Wind Project.

WHEREAS, pursuant to the Permit, Principal is required to maintain a decommissioning bond.

WHEREAS, the Obligee has agreed to accept a bond guaranteeing the decommissioning obligations of said Permit.

NOW, THEREFORE, THE CONDITIONS OF THE ABOVE OBLIGATION IS SUCH, that if the Principal shall well and truly perform each and every decommissioning obligation in said Permit at the time and in the manner specified during the term of this bond, and shall reimburse said Obligee for any loss which said Obligee may sustain by reason of failure or default on the part of said Principal, than this obligation shall be void, otherwise to remain in full force and effect.

PROVIDED, HOWEVER, that this bond is subject to the following conditions:

1. This bond is for the term beginning _____ and expiring _____. The bond will automatically renew for a one-year period upon the expiration date set forth above and upon each anniversary of such date, unless at least thirty (30) days prior to such expiration date, or prior to any anniversary of such date, Surety provides written notice to both the Obligee and Principal of its intention to non-renew this bond. Neither non-renewal by the Surety, nor failure, nor inability of the Principal to file a replacement bond shall constitute a default by the Principal recoverable by the Obligee under this bond.
2. In the event of default by the Principal, Obligee shall deliver to Surety by certified mail, a written statement of the facts of such default, within thirty (30) days of the occurrence. In the event of default, the Surety will have the right and opportunity, at its sole discretion, to: a) cure the default; b) assume the remainder of the Permit and to perform or sublet same; c) or to tender to the Obligee funds sufficient to pay the cost of completion up to an amount not to exceed the penal sum of the bond. In no event shall the Surety be liable for fines, penalties, liquidated damages, or forfeitures assessed against the Principal.

3. No claim, action, suit or proceeding, except as hereinafter set forth, shall be had or maintained against the Surety on this instrument unless same be brought or instituted upon the Surety within one (1) year from termination or expiration of the bond term.
4. No right of action shall accrue on this bond to or for the use of any person or corporation other than the Obligee named herein or the heirs, executors, administrator or successors of Obligee.
5. The aggregate liability of the Surety is limited to the penal sum stated herein regardless of the number or amount of claims brought against this bond and regardless of the number of years this bond remains in force.
6. If any conflict or inconsistency exists between the Surety's obligations or undertakings as described in this bond and as described in the Permit, then the terms of this bond shall prevail.
7. The Obligee's acceptance of this bond and reliance upon it as security constitutes its acknowledgement and agreement as to the explicit terms stated herein under which it is offered and issued by the Surety.

Signed and sealed this _____ day of _____, 202_.

PRINCIPAL: _____ SURETY: _____

_____ (seal) _____ (seal)

(Name & Title)

_____, Attorney-in-Fact