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	* * * * * * * * * *	**DEUEL HARVEST WIND ENERGY SOUTH LLC'S RESPONSES TO ARLA POINDEXTER'S FIRST SET OF DATA REQUESTS** **EL24-023**

Deuel Harvest Wind Energy South LLC ("South Deuel Wind") provides the following responses to Arla Poindexter's First Set of Data Requests in the above-captioned matter.

1-1) Economic Assessment:

Monica Monterrosa: Please note that all tax figures listed in the responses below are estimates and may change based on final Project specifications and other factors, including the final nameplate capacity, actual electrical production, number of turbines constructed, and final Project layout. South Deuel Wind anticipates that the operational life of the Project will be approximately 30 years.

a) There seems to be large discrepancies about tax revenue in the economic study, the information presented at the local input meeting, and the discovery sent by Ms. Monterrosa on Sept. 10, 2024. What are the taxes expected for the school district?

Monica Monterrosa: The Project is anticipated to pay a total of approximately $13.17 million to school districts over the life of the Project. Under SDCL Sections 13-13-10.1(15) & 13-16-26, the school districts in which the Project is located will see a total increase in revenue of approximately $3 million in the first nine years of Project operations and the remainder will be considered "local effort" for purposes of the state funding formula (meaning these amounts offset/reduce the amounts the school district receives in aid from the state).

b) What are the taxes expected for Deuel County?

Monica Monterrosa: Taxes for Deuel County are anticipated to be approximately $9.2 million over the life of the Project.

c) What are the taxes expected for each of the townships?

Monica Monterrosa: The total amount of taxes allocated to townships over the life of the Project is approximately $3.95 million. Allocations to individual townships will vary depending on the final Project layout. Based on the proposed Project layout of 73 turbines, South Deuel Wind

anticipates that 34% of this revenue will be allocated to Brandt Township (≈$1.35 million), 36% to Norden Township (≈$1.41 million), and 30% to Scandinavia Township (≈$1.19 million). Please note that a maximum of 68 turbines will be constructed and tax allocations to townships may change accordingly.

d) What are the taxes expected for SD?

Monica Monterrosa: Taxes for the state of South Dakota are anticipated to be approximately $11.9 million over the life of the Project.

This figure does not include and is in addition to approximately $10.1 million in savings to the state over the life of the Project resulting from the reduced amount the state will have to pay the school districts in which the Project is located under the state funding formula (see response to Data Request # 1-1(a)).

e) Also, what does Invenergy expect to pay in taxes per tower?

Monica Monterrosa: Total taxes per turbine are anticipated to be approximately $561,000 over the life of the Project.

1-2) Grassland Assessment:

a) The last 2 projects had towers on grasslands. What changed where grasslands are omitted from the plan now?

Lisa Agrimonti: South Deuel Wind objects to this request as being vague ("last two projects" is undefined) and ambiguous (referring to unspecified changes) and because it does not seek information relevant to this proceeding.

b) What is the Company's policy of setbacks from grasslands? Why was that setback chosen?

Michelle Phillips: South Deuel Wind did not site turbines in potentially unbroken grasslands.

c) The physical inspection was completed in Oct of 2023. Why was one day only used for inspection? Why was a date toward the end of the grazing season used?

Michelle Phillips: In-field review for grassland assessment efforts occurred on October 10, 11, and 12, 2022 as well as July 31 and August 1, 2023. The timing of the field effort was completed either prior to the end of the growing season as determined by ground temperatures and when herbaceous species targeted for identification (as detailed in Appendix F of the Application) were still present and therefore are sufficient.

1-3) Noise Assessment:

a) The noise assessment seems to be per unit or per piece of construction equipment. What are noise levels going to be in realistic conditions? (ie: multiple trucks and payloaders on site or multiple towers within 1.25 miles of a residence)

Michael Hankard/Lisa Agrimonti: South Deuel Wind objects to this request as vague, i.e. the meaning of "realistic". To the extent the question seeks information regarding the noise levels from construction activities involving multiple pieces of equipment, noise levels at non-participating residences are anticipated to be approximately 50 dBA or less during construction.

b) What is the noise expected to be within 1 mile of each tower?

Michael Hankard: Applying the modeling methodology identified in the Noise Analysis, the noise level 1 mile from a V 163 - 3.5 turbine is anticipated to be 31 dBA; the noise level 1 mile from a SG 4.4 - 164 is anticipated to be 28 dBA; and the noise level 1 mile from a GE 3.8 - 154 is anticipated to be 32 dBA.

c) Are noise assessment completed on site or is modeling sufficient?

Michael Hankard: The modeling methodology used for this Project has been repeatedly demonstrated to over predict actual noise levels. In this light, post-construction noise measurements are not necessary, other than in the cases of specific and credible complaints.

d) Do towers develop more noise as they age?

Michael Hankard: I have seen no evidence that turbines develop more noise as they age, given adherence to proper maintenance schedules.

1-4) Microwave study:

This was completed prior to any potential towers added. What would the potential effects of tower placement be?

Alexandra Thomspon/Lisa Agrimonti: South Deuel Wind objects to this request as being ambiguous. Subject to this objection, South Deuel Wind responds that the turbine locations were selected to avoid impacts to all existing microwave paths.

1-5) Communication Study:

What is the effect of a wind tower on cell reception?

Alexandra Thomspon: Properly sited wind turbines do not cause interference with communication towers. South Deuel Wind has sited turbines in a manner that meets and exceeds the recommendations provided by Comsearch in the Communication Tower Study provided as Appendix Q to the Application.

1-6) Other livability questions:

a) Have any studies been completed about the effects of radiation of towers? Any effects of multiple towers? (ie: the town of Toronto would be completely surrounded by wind towers once this project is completed.)

Alexandra Thomspon: Magnetic fields are generated when electricity flows on an electrical conductor. The intensity of the magnetic field is dependent on the voltage and load on the line and rapidly decreases with the distance from the conductors. Considerable research has been conducted to determine whether exposure to 60 Hz (the electrical grid frequency in the United States) magnetic fields cause negative health effects. These studies have shown no statistically significant association. Magnetic fields anticipated by the Project are expected to be below levels associated with typical household electric appliances and tools. See Exhibit 1-6 for more information.

b) Any assessments about migration of birds or insects changing because of tower construction?

Michelle Phillips/Lisa Agrimonti: South Deuel Wind objects to this request as vague and ambiguous. Subject to this objection, South Deuel Wind states that details regarding the wildlife assessments performed for the Project over the past 9 years are provided in Section 9.3 of the Application. The Project conducted bird 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 to the Application. Potential impacts to migrating birds as a result of the Project are discussed in Appendix K to the Application.

The majority of insects in the Great Plains are residents of an area and are not migratory. These insects have populations based at a local or regional level. The Project conducted detailed assessments for habitat that may support protected insect species and has sited components to avoid those habitats. These efforts are detailed in various sections of the Application as well as in the appendices. As such, construction and operation are not anticipated to impact protected insect species. South Deuel Wind is not aware of any studies in South Dakota or the region demonstrating changes to insect migration due to turbine construction.

c) The US Fish and Wildlife Service is proposing to add protections to regal fritillary butterflies. These are common in Deuel County grasslands. How does the Company address newly protected species in its operations plan?

Michelle Phillips: The regal fritillary is currently proposed to be listed under the Endangered Species Act ("ESA") with the listing review underway by the USFWS. The Project has conducted detailed assessments for habitat that may support protected insect species and has sited components to avoid those habitats. These efforts are detailed in various sections of the Application as well as in the appendices. The regal fritillary may use similar or the same habitats to the Poweshiek skipperling and Dakota skipper. O&M personnel will be trained to perform operational duties using existing roads and Project access roads to minimize any disturbance to potential suitable habitat.

d) Any assessments about pressure pulsations? Any assessments about infrasound?

Michael Hankard/Lisa Agrimonti: Deuel Harvest South objects to this request as being ambiguous. Subject to the objection, South Deuel Wind responds that a Noise Analysis for the Project is provided as Appendix M to the Application.

1-7) Questions regarding relationship to wind development and agricultural production:

a) How are aerial or drone applications of pesticides/herbicides affected by wind towers? Does the Company reimburse adjacent landowners for increased costs for production practice changes?

Monica Monterrosa/Lisa Agrimonti: South Deuel Wind objects to this request because it assumes as fact allegations that have not been proven. Subject to this objection, South Deuel Wind answers that there are many obstructions in the environment that aerial sprayers must navigate around and have successfully navigated around to apply pesticides and herbicides on agricultural fields, including cell towers, electric lines, and wind turbines. As noted in response to Staff Data Request # 1-54(b), South Deuel Wind is willing to agree to the following order 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.

The long-term disturbance impact of the Project is relatively minimal. In total, only 51 acres of the 34,339-acre Project Area are anticipated to be removed from agricultural use during operations.

b) Have any studies been completed about the effects of wind towers on livestock?

Monica Monterrosa: There is no reputable scientific evidence to suggest that wind turbines result in negative health effects on animals.

1-8) Other General Questions:

a) Why was continuous aircraft detection decided for this project?

Monica Monterrosa: The Project will employ an Aircraft Detection Lighting System, as required per SDCL 49-41B-25.2 as authorized by the Federal Aviation Administration.

b) What is the total capacity of the project's production?

Monica Monterrosa: The Project will have a nameplate capacity of up to 260 megawatts ("MW") and deliver up to 250 MW to the point of interconnection.

c) What is the expected storage capacity of the energy created?

Monica Monterrosa: The Project does not include an energy storage system.

d) What is the expected demand for energy produced? Has the Company entered into any production/sales contracts for the proposed project?

Monica Monterrosa: The purpose and demand for the Project is described in Section 2 of the Application. South Deuel Wind has not entered into any production/sales contract for the Project. South Deuel Wind, provided it receives permits from the SDPUC, may directly or indirectly through its affiliates, own, construct, and operate the Project by selling the power using long term power purchase agreements or other available options. Alternatively, 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.

e) Are other projects in Deuel County meeting current demand?

Lisa Agrimonti: South Deuel Wind objects to this request as being vague and ambiguous. South Deuel Wind is not able to ascertain what information is being sought.

f) What is the Company's plan for mitigating wildlife habitat on private land? Are there studies regarding fragmentation of habitat by service roads to towers?

Michelle Phillips/Lisa Agrimonti: South Deuel Wind objects to this request as being overly broad and ambiguous. Subject to this objection, South Deuel Wind states that the Project has conducted numerous assessments to identify wildlife habitat, and these are included in various sections of the Application as well as the appendices. South Deuel Wind does not propose any mitigation for wildlife habitats given infrastructure has been sited primarily on regularly disturbed agricultural lands. The Project has coordinated with SDGFP and the USFWS to characterize use of the site by wildlife as detailed in the Application. Further, there are no turbines or access roads planned on unbroken grasslands.

g) Who are the members of Invenergy LLC? What State are the members residing/incorporated in?

Lisa Agrimonti: Objection. The requested information is not relevant to the subject matter of this proceeding.

h) What is the policy of the Company regarding donations and training resources for local first responders?

Monica Monterrosa: South Deuel Wind will communicate regularly with local first response agencies and coordinate training meetings in accordance with the Project's Emergency Response Plan once established. Should 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. South Deuel Wind anticipates making regular donations of $10,000 per year to local first response agencies during operations.

Dated this 1st day of November 2024.

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ENVIRONMENTAL HEALTH

RESEARCH Open Access

Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern?

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Abstract

Background: The past five years has seen considerable expansion of wind power generation in Ontario, Canada. Most recently worries about exposure to electromagnetic fields (EMF) from wind turbines, and associated electrical transmission, has been raised at public meetings and legal proceedings. These fears have not been based on any actual measurements of EMF exposure surrounding existing projects but appear to follow from worries from internet sources and misunderstanding of the science.

Methods: The study was carried out at the Kingsbridge 1 Wind Farm located near Goderich, Ontario, Canada. Magnetic field measurements were collected in the proximity of 15 Vestas 1.8 MW wind turbines, two substations, various buried and overhead collector and transmission lines, and nearby homes. Data were collected during three operational scenarios to characterize potential EMF exposure: 'high wind' (generating power), 'low wind' (drawing power from the grid, but not generating power) and 'shut off' (neither drawing, nor generating power).

Results: Background levels of EMF (0.2 to 0.3 mG) were established by measuring magnetic fields around the wind turbines under the 'shut off' scenario. Magnetic field levels detected at the base of the turbines under both the 'high wind' and 'low wind' conditions were low (mean = 0.9 mG; n = 11) and rapidly diminished with distance, becoming indistinguishable from background within 2 m of the base. Magnetic fields measured 1 m above buried collector lines were also within background (≤ 0.3 mG). Beneath overhead 27.5 kV and 500 kV transmission lines, magnetic field levels of up to 16.5 and 46 mG, respectively, were recorded. These levels also diminished rapidly with distance. None of these sources appeared to influence magnetic field levels at nearby homes located as close as just over 500 m from turbines, where measurements immediately outside of the homes were ≤ 0.4 mG.

Conclusions: The results suggest that there is nothing unique to wind farms with respect to EMF exposure; in fact, magnetic field levels in the vicinity of wind turbines were lower than those produced by many common household electrical devices and were well below any existing regulatory guidelines with respect to human health.

Keywords: Electromagnetic fields, EMF, Wind turbines, Wind farms, Human health, Power lines, Transmission lines, Substation

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Background

Wind power has been harnessed as a source of electricity around the world for decades and reliance on this form of energy is increasing. Despite its long standing history in other parts of the world, use of wind energy is relatively new in Canada [1]. While public attitude is generally overwhelmingly in favor of wind energy in the province of Ontario, with polls suggesting that support for wind energy is high (89% 'supported' or 'somewhat supported' wind energy in their region) [2], this support does not always translate into local acceptance of wind projects. Opposition to local wind projects has been particularly strong in Ontario, where wind turbines are becoming increasingly common in rural areas with over 1,500 MW installed since 2006 and another 2,800 MW expected to be installed by 2015 [3].

This local opposition has led to a number of legal appeals, via the Environmental Review Tribunal (ERT) process in Ontario, of the Renewable Energy Approvals (REA) granted to individual wind energy projects by the Ontario Ministry of the Environment (MOE). Since 2010, over 19 ERTs have either been completed or are in progress in Ontario [4]. Under the current legal framework for wind energy development in Ontario, REAs can be appealed by any member of the public on two grounds: 1) proceeding with the project will cause serious harm to human health and 2) proceeding with the project will cause serious and irreversible harm to plant life, animal life or the natural environment. At the time of publication of this article, no appeals have been successful on the basis of serious harm to human health and in a number of cases, electromagnetic fields (EMF) from the projects have been posited by appellants as the cause of serious harm to human health (e.g., GREP, Erickson, Ostrander) [5-7]. Although to date these appeals have been unsuccessful, concerns about the human health effects of wind turbines and EMF persist for some. The authors spend a considerable amount of time at public information sessions for projects and EMF is frequently raised as a health concern by the public.

The issue of EMF exposure and potential health effects predates the prevalence of wind energy in Canada. Early studies of residential exposure to EMF suggested a higher incidence of leukemia and brain cancer in children living near power lines having high wire configuration; however, more recent studies, which have improved upon the methods previously used, have been at best inconsistent [8]. The International Agency for Research on Cancer (IARC), an agency of the World Health Organization (WHO), has categorized EMF as a Class 2B possible human carcinogen, based on a weak association of childhood leukemia and chronic exposure to magnetic field strength above 3–4 mG [9]. This classification is based on the fact that there is limited evidence of carcinogenicity in humans and inadequate evidence of carcinogenicity in experimental animals. The human studies are weakened by various methodological problems that the WHO has identified as a combination of selection bias, some degree of confounding and chance [10]. There are also no globally accepted mechanisms that would suggest that low-level exposures are involved in cancer development. Thus, the WHO has stated (based on approximately 25,000 articles published over the past 30 years) that the evidence related to childhood leukemia is not strong enough to be considered causal [11].

There is a growing list of self-reported health symptoms that some individuals attribute to wind turbines specifically with respect to audible noise, low frequency noise and infrasound, shadow flicker and EMF. A study published in 2013 by Chapman et al., has reported over 200 symptoms, for example (but not limited to) difficulty sleeping, fatigue, depression, irritability, aggressiveness, cognitive dysfunction, nausea, dizziness, tinnitus, skin irritations, nosebleeds ringing in ears, headaches, lack of concentration, vertigo and sleep disruption [12]. In 2011, Havas and Colling claimed that exposure to EMF from wind turbines could be the cause this myriad of health issues in individuals considered to have 'Electrohypersensitivity' [13]; however, nowhere in their publication did Havas and Colling provide measured levels of EMF surrounding active wind turbines. Similar claims are frequently repeated on the internet. Although the relationship between these health issues and audible noise, low frequency noise and infrasound has been investigated in the scientific literature [14-24], limited research has been conducted with respect to EMF and wind turbines. Indeed, we are aware of only one study [25] where some characterization of EMF in proximity to wind turbines was reported. Israel et al. (2011) measured EMF levels 2 to 3 m from a wind energy park in Bulgaria consisting of 55 Vestas V90 3 MW towers and just outside nearby villages. The authors found that EMF was either below detection or was so small as to be considered "insignificant compared to the values found in other measurements in residential areas and homes" [25]. In their study, the EMF levels were measured between 0.133 and 0.225 mG. These values are well below the International Commission on Non-Ionizing Radiation Protection (ICNIRP) guideline of 2,000 mG for the protection of health of the general public.

This study was conducted to characterize EMF (as magnetic flux density) in the vicinity of an active wind farm in Ontario to address the heightened anxiety by some around EMF, wind turbines and human health. Measurements were taken at distances ranging from 0 to 500 m from turbines, and were collected under three operating conditions (i.e., turned on and generating

power (high wind), turned on, drawing power and not generating power (low wind), and turned off and not drawing power from the grid (shut off)). Measurements were also collected in the vicinity of below and above ground electrical infrastructure (collector lines and substation), a 500 kV transmission line, and outside of a number of local homes in the wind farm area. Results are compared to EMF levels commonly encountered elsewhere in Canada and to existing guidelines.

Methods

The study was carried out at the Kingsbridge 1 Wind Farm located near Goderich, Ontario, Canada. Spot measurements of magnetic field (i.e., magnetic flux density measured in units of milliGauss or mG) were obtained using a factory calibrated F.W. Bell ELF Gauss/Tesla Meter (model number 4180). The technical specifications of this meter include a minimum resolution of 0.1 mG and a measuring range of 0.1 mG to 599 mG with an accuracy of ± 2%. The field study, including equipment, standard measurement methodologies (e.g., 1 m above ground), and other considerations (e.g., distance, humidity, multiple sources), was developed in accordance with international protocols such as the Institute of Electrical and Electronics Engineers (IEEE) "Standard Procedures for Measurement of Power Frequency Electric and Magnetic Fields from AC Power Lines" [26-28]. All measurements were collected in 3-axis mode (XYZ), which provides a summation of the maximum magnetic flux density from all three dimensions surrounding the meter, and offers an indication of overall magnetic field level. For each measurement, the EMF meter was held 1 m above ground level and was allowed to stabilize for 5 seconds before the highest reading was recorded. Approximately 10% of measurements were collected in duplicate for quality assurance and control.

Magnetic field measurements were taken in the vicinity of 15 Vestas 1.8 MW wind turbines (Figure 1). One of the turbines was non-operational; this allowed measurements that could be used as a control. For each of the 15 turbines, the same series of measurements were taken. An initial reading was taken at the base of each turbine near the access door and another reading was taken 0.5 m away from the base, on the opposite side of the underground collector line. Subsequent measurements were taken at 2 m, 5 m, 10 m, 50 m, 100 m, 150 m and 200 m from the turbine. In a few instances, the surroundings allowed us to measure magnetic field levels at greater distance (i.e., up to 500 m) from the base of the turbine. Distances from the turbines were measured using a rangefinder (Cabela's 800 by Bushnell). All of the turbines were located on agricultural land and surrounded by crops.

Measurements were collected under three different operational scenarios. In the first scenario ('high wind'), measurements were collected when the wind was blowing at a sufficient speed to rotate the turbine blades and allow for power generation. In the second scenario ('low wind'), the measurements were taken when the wind speed was insufficient to generate power, but the turbine was drawing power from the grid to ensure general maintenance and operations. For the third scenario ('shut off'), measurements were collected when the turbines and associated collector lines were powered off completely.

In addition to the turbines, readings were taken above the buried collector lines (27.5 kV) for each turbine, beneath the overhead power lines (27.5 kV) and at the two wind farm substations. In addition, measurements were taken at the 500 kV line running from the Bruce Nuclear plant through the wind farm. For the 500 kV line, measurements were taken 1 m above ground moving away from the line at 5 m increments until background levels (0.2-0.3 mG) were reached. EMF readings were also taken immediately outside of seven project-participating homes (with landowner permission) in the study area that were 512–656 m to the closest wind turbine.

All magnetic field measurements were collected between 8 am and 6 pm on July 29th and 30th, 2013. Measurements associated with the high wind scenario were collected on the first day since wind conditions in the area were ideal for power generation (average wind speed of 5.4 m/s; range = 3.3 – 7.6 m/s). The low wind and shut off scenario measurements were collected on the second day when wind speeds were lower (average speed 3.3 m/s; range = 0.2 – 4.9 m/s). The temperature for both days ranged from 15-21°C and weather conditions varied from overcast and rainy to sunny over the course of the study, with a relative humidity at 3.5 m above ground surface of 76% on July 29th and 69% on July 30th. All wind speed and temperature data for the study were provided by Zephyr North from two meteorological (MET) towers in the area [29].

Results

Over 600 magnetic field measurements were collected at various distances from the wind turbines, homes, collector/transmission lines, and substations within the Kingsbridge 1 Wind Farm near Goderich, Ontario. Out of the 15 turbines measured, three were excluded since they were located in close proximity to other sources of EMF that caused interference (e.g., 500 kV transmission line), and one turbine was measured as a control since it is still standing but no longer operational. Where duplicate measurements were taken, the higher of the two values was used in the data analysis to maintain conservatism. There was excellent agreement between the duplicate samples, with readings either being identical or varying by ± 0.1 mG.

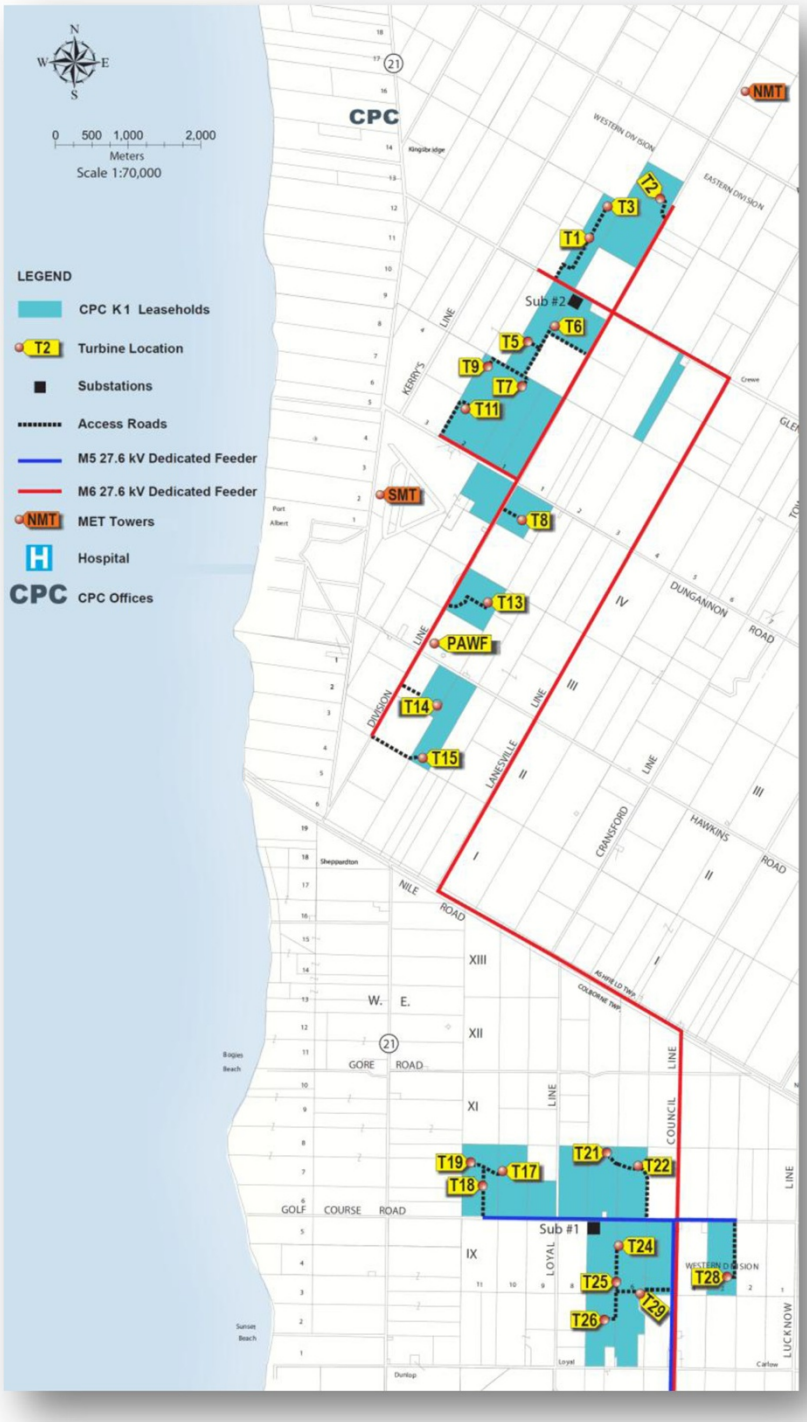

Figure 1 Map of the study area. The Kingsbridge (K1) Wind Farm near Goderich, Ontario, Canada. Included are the two substations, collector lines and turbine locations (samples collected around T1-T3, T6, T7, T11, T17, T18, T22, T25 and T29). Samples were also collected around T19, which was non-operational (not connected to the grid) and was used in this study as a control.

Measurements taken around the turbines under the 'shut off' scenario were considered representative of baseline or background conditions given that they were not located in the proximity of any other known EMF sources. This baseline value was approximately 0.3 mG, regardless of distance from the turbines (Figure 2). Similar values (ranging from 0.2 to 0.3 mG) were also observed in proximity to the control (non-operational) turbine. Higher levels (mean: 0.9 mG; maximum: 1.1 mG) were detected at the base of the turbine under both the 'high wind' and 'low wind' conditions, but as expected based on the inverse power law, these levels rapidly diminished with distance from the turbine, becoming indistinguishable from background within approximately 2 m of the base of the turbines (Figure 2). In one case (not shown) magnetic fields were measured out to 500 m from the turbine where they remained within background levels. The lack of difference in magnetic field levels between the turbines operating under 'high wind' (generating power) and 'low wind' (not generating power) scenarios suggests that the measured magnetic fields are related to the power drawn by the turbine for maintenance and operations, rather than due to electricity generated by the turbine when it is spinning. Simply put, the low level measurements of EMF immediately adjacent to the access door of the turbines at their base were the same irrespective of the operating condition of the turbine.

For the seven houses assessed in this study, magnetic field measurements taken immediately outside (within 1 m) of the homes were consistently 0.4 mG, with the exception of one house that was vacant and had no power connections (0.2 mG). It is believed that this slight elevation above background is related to EMF generated within the home (i.e., wiring and use of electric devices). This is based on the fact that measurements collected outside of a home with no power connection were within background levels (0.2 mG). Despite this slight difference, all of the measurements taken outside of homes were <0.5 mG and considered to be very low.

Magnetic fields were also measured immediately above the buried 27.5 kV collector lines associated with each of the wind turbines included in the study. The readings were taken 1 m above ground and were consistently within measured study area background levels (0.2-0.3 mG). The overhead lines (27.5 kV) running along various roadways where the collector lines from the turbines went above ground and connected to the substations were also measured at 8 locations within the study area. Immediately beneath the power lines, magnetic field levels ranged from 0.3-16.5 mG (mean = 4.1 mG) and decreased to background within 10–25 m.

Additionally, magnetic field measurements were collected immediately beneath the 500 kV transmission lines that run through the wind farm and are not at all associated with the wind project. Measurements were collected at various distances away until background levels were reached. Directly under the line, the magnetic field was approximately 46 mG, decreasing to 13 mG by 20 m, and reaching background (0.3 mG) by 115 m. The magnetic fields associated with the 500 kV power line were compared to the levels measured near wind turbines, where EMF levels immediately beneath the 500 kV line were almost 50 times higher than directly below the wind turbines operating under the 'high wind' scenario (Figure 3).

The two substations located within the study area were also measured to characterize potential magnetic field exposure. This was undertaken based on our awareness that

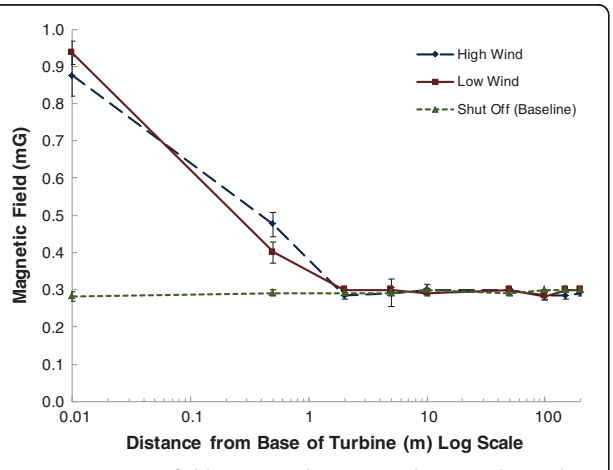

Figure 2 Magnetic fields measured at various distances (log scale) from wind turbines under three different operational scenarios. Mean magnetic field values have been provided (n = 11) in milligauss (mG). Error bars represent standard error of the mean. The three operational scenarios include turbines generating power (high wind), turbines not generating power but still connected to the power grid (low wind), and turbines and collector lines shut off completely (no wind).

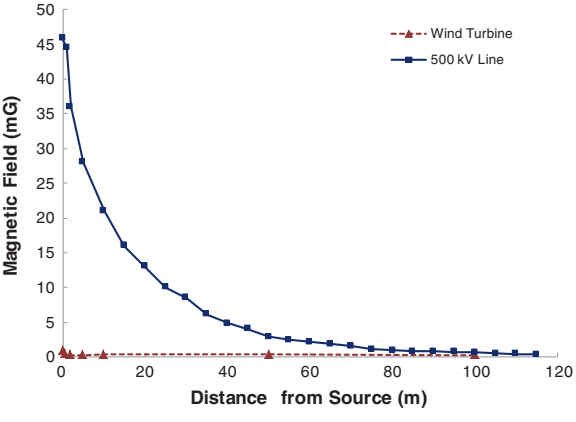

Figure 3 Comparing magnetic fields around wind turbines and a 500 kV transmission line. Mean magnetic field values have been provided (n = 11) in milligauss (mG). The 'high wind' turbine scenario is presented where conditions were sufficient for power generation.

there are a number of individuals that claim living nearby wind turbine project substations could adversely impact health. Each substation was surrounded by a metal fence; therefore, proximity measurements were limited to the fence line that was from 1.5 - 8 m away from the substation structure. This was considered acceptable since the fence prevents anyone from coming closer to the substation, thus fence line measurement would be the best way to characterize potential exposure. The magnetic field levels at the substations ranged from 0.2-4.1 mG when the turbines were operating under the 'high wind' scenario and ranged from 0.3-1.9 mG under the 'shut off' scenario.

Discussion

EMF, radio waves, microwaves, visible light and x-rays are components of the electromagnetic spectrum. Each one of these forms of energy travels in waves and the strength of their energy is directly related to their wavelength [30]. For example, EMF associated with electricity is called extremely low frequency (ELF) because it is found below 300 Hz. In other words this type of energy moves at less than 300 waves per second. More specific to Canada, EMF associated with electricity is called power frequency EMF and travels at 60 Hz. ELF EMF has very little energy. In comparison, microwaves can travel at several billion waves per second and have enough energy to heat tissues.

Power frequency EMF are invisible lines of force that you cannot feel that surround electrical equipment, power cords, wires that carry electricity and outdoor power lines. Electric and magnetic fields can occur together or separately and are a function of voltage and current [30]. When an appliance is plugged into the wall, an electric field is present (there is voltage but no current); when that applicance is turned on, electric and magnetic fields are present (there is both voltage and current). Both electric and magnetic fields decrease with distance; however, electric fields are also dissipated by objects such as building materials, whereas magnetic fields can pass through most materials without being diminished. On a daily basis people around the world are exposed to ELF EMF as a result of using electricity [30].

To our knowledge this study is the first to provide quantitative measurements of EMF around wind turbines in Canada. One potential limitation of this study is that the transformers associated with the Kingsbridge 1 Wind Farm were located in the hub of the turbines, approximately 80 m above ground. There are a number of wind turbines that have pad mounted transformers located at ground level, which could potentially generate higher localized levels of EMF. However, preliminary data collected at a 110 Vestas V82 wind turbine with a pad mounted transformer from a nearby project location, suggests that although magnetic field levels tend to be higher at the base of the turbine transformer (67 mG), they drop off to background (0.2-0.3 mG) within 8 to 10 m. This indicates that despite the type of wind turbine (i.e., hub vs. pad mounted transformer) the EMF levels in the vicinity of wind turbines, especially at distances associated with typical residential setbacks, are considerably lower than the ICNIRP guideline for the general public (2,000 mG) [31].

Measurements collected in the vicinity of the 27.5 kV and 500 kV power lines were consistent with, if not lower than, those reported for typical 27.5 kV and 500 kV power lines by the US National Institute of Environmental Health Sciences (NIEHS). They report that a typical EMF level beneath a 500 kV line would be 86.7 mG, reducing to 1.4 mG at a distance of 91 m from the center of the line [30]. Additionally, the measurements taken at nearby homes (0.4 mG) are below the level that IARC originally used for the classification of EMF as a Class 2B possible human carcinogen (3–4 mG), which was based on limited evidence of carcinogenicity in humans and inadequate evidence of carcinogenicity in experimental animals [9]. Moreover, given the limited levels of EMF measured around the wind farm, human exposure to EMF from wind turbines is negligible in comparison to common household exposures. For example, typical magnetic field levels associated with common household appliances reported by the NIEHS at six inches from the source, include 40 mG for a refrigerator, 50 mG for a ceiling fan, 100 mG for a dishwasher, 300 mG for a microwave, 600 mG for an electric shaver and 700 mG for a hairdryer (Figure 4) [30].

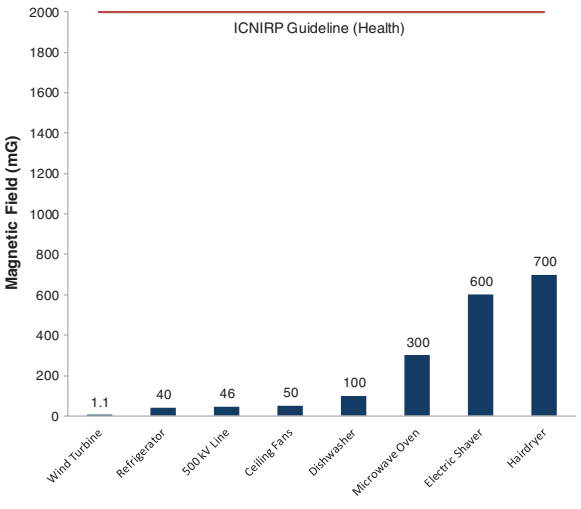

Figure 4 Comparing magnetic fields from wind turbines and 500 kV power lines with common household electrical devices. 'Wind Turbine' represents the maximum magnetic field (mG) measured at the base of wind turbines (n = 11) in the Kingsbridge 1 Wind Farm. '500 kV Line' represents the maximum magnetic field measured beneath the 500 kV power line located within the study area. All other household electrical device data at six inch distance was taken from NIEHS [30]. The international regulatory standard published by ICNIRP [31] for EMF exposure protective of human health is provided for comparison.

Overall, our results support the official position of Health Canada, in that: "Health Canada does not consider that any precautionary measures are needed regarding daily exposures to EMFs at ELFs. There is no conclusive evidence of any harm caused by exposures at levels found in Canadian homes and schools, including those located just outside the boundaries of power line corridors" [32].

Conclusions

The mean EMF level (characterized here by magnetic flux density) measured were 0.9 mG (n = 11) at the base of the wind turbines and dropped off to background levels (0.2-0.3 mG) within 2 m with levels consistently remaining at background out to 200 m and as far afield as 500 m. Additionally, magnetic fields measured at 1 m above buried collector lines were at background (0.2-0.3 mG), and readings taken below overhead 27.5 kV and 500 kV lines were consistent with other power distribution systems in North America. These results suggest that there is nothing unique to wind farms with respect to EMF exposure. In fact, magnetic field levels in the vicinity of wind turbines are lower than levels that people are exposed to on a daily basis in homes, offices and schools, and much lower than exposure we receive from many common household electrical devices (Figure 4). Our findings are consistent with those EMF measurements collected by Israel et al. (2011). Furthermore, when compared to ICNIRP guidelines, the levels of EMF measured around wind turbines were all well below levels known to cause harm to human health (Figure 4).

Collectively, these results suggest that the EMF surrounding wind turbines and their distribution systems (i.e., 27.5 and 500 kV power lines) are similar or lower than those commonly found throughout Ontario and across Canada. There was nothing unique about the EMF readings surrounding the wind turbines. Furthermore, the magnetic fields associated with power distribution systems, including those found in the vicinity of wind farms, are below levels that are expected to cause harm to human health based on international regulatory guidelines. Overall, our results do not support a potential causal link between power-frequency EMF and human health impacts at the low levels measured in the vicinity of the wind turbines.

Abbreviations

ELF: Extremely low frequency; EMF: Electromagnetic Field; ERT: Environmental Review Tribunal; IARC: International Agency for Research on Cancer; ICNIRP: International Commission on Non-Ionizing Radiation Protection; kV: kilovolt; MET: Meteorological; mG: milligauss; MOE: Ontario Ministry of the Environment; MW: Megawatt; NIEHS: US National Institute of Environmental Health Sciences; REA: Renewable Energy Approval; WHO: World Health Organization.

Competing interests

In terms of competing interests (financial and non-financial), the authors work for a consulting firm and have worked with wind power companies. The study was funded in part by Capital Power, Samsung and Pattern and the authors are actively working in the field of wind turbines and human health. Dr. Ollson and Dr. Knopper have acted as expert witnesses for wind power companies during a number of legal hearings. Although we make this disclosure, we wish to reiterate that as independent scientific professionals our views and research are not influenced by these contractual obligations. The authors are environmental health scientists, trained and schooled, in the evaluation of potential health risks to people and the ecosystem through exposure to environmental issues such as wind turbines.

Authors' contributions

LCM, CAO and LDK designed the study methodology and LCM and CAO were responsible for data collection. LCM and MWA conducted the data analysis and interpretation. LCM researched and wrote the manuscript and all authors, including GMF in his oversight of the group, reviewed and approved the final version.

Acknowledgements

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Below, please find Deuel Harvest Wind Energy South LLC's ("South Deuel Wind") First Set of Data Requests to Arla Hamann Poindexter. Please submit responses within 10 business days or promptly contact the undersigned to discuss an alternative arrangement.

1-1) Provide copies of all data requests submitted by PUC staff or any other party to you in this proceeding and copies of all responses to those data requests. Provide this information to date and on an ongoing basis.

Please see the attachments to the email for responses to PUC staff data requests and corresponding briefing paper submitted with that data request.

1-2) Identify the address of your permanent residence (where you reside).

My current permanent residence is at 18280 480th Ave, Clear Lake, SD 57226.

My husband and I have another address at 19491 346th Ave, Ree Heights, SD 57371. However, because of my mother's health and need for 24 hour/day supervision, I haven't spent more than 10 nights at the Ree Heights address in the last year.

1-3) Identify all property you own, or Hamann Family Farms LLC owns within one-half mile of the South Deuel Wind Project ("Project") Area and the location (by section, township, and range) of such property. Identify the location of any habitable buildings on the property.

Hamann Family Farms LLC owns the following within the project area
15-114-49 NE ¼ Less N747.75 E610.5 & Less Hwy (Brandt Township)

Hamann Family Farms LLC owns the following within ½ mile of the project area
32-115-48 SE ¼ (Clear Lake Township)
32-115-48 NE ¼ (Clear Lake Township)
33-115-48 W ½ (Herrick Township)
34-115-48 SW ¼ (Herrick Township)
35-115-48 S1/2 SE ¼ &SW ¼ Less OL1 &OL2 (Herrick Township)
35-115-48 OL2 in S ½ SW ¼ (Herrick Township)
2-114-48 Gov Lots 2-3-4 &SW ¼ NW ¼ (Norden Township
3-114-48 Gov Lots 3-4 & S1/2 NW1/4 (Norden Township)
4-114-48 Gov Lots 3-4 S1/2 NW1/4 (Norden Township)

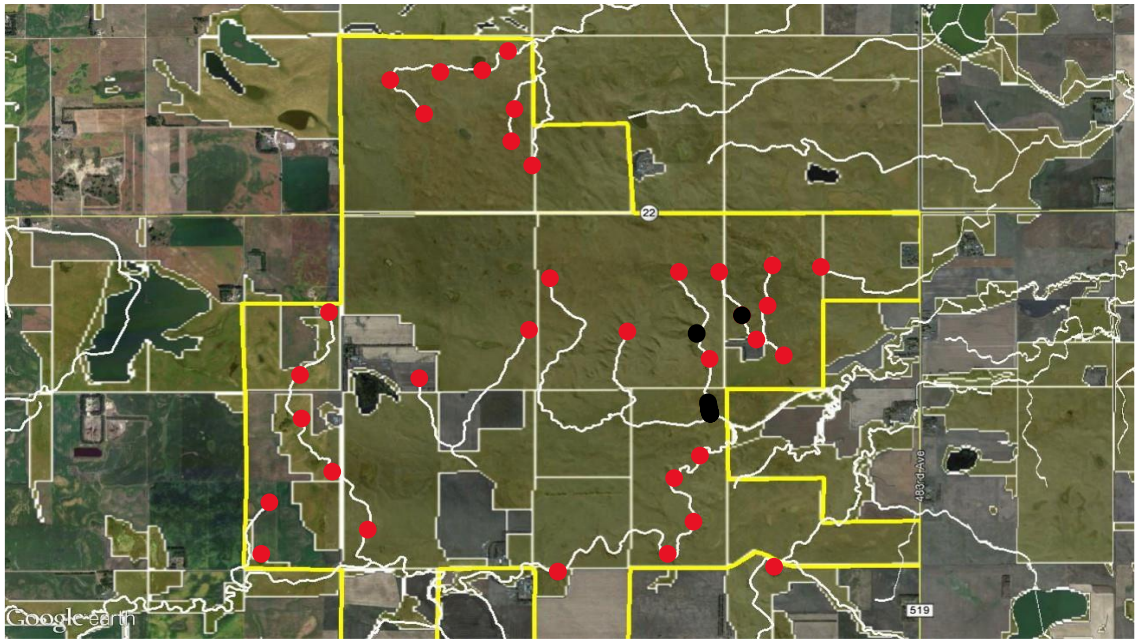
No building sites are on the above property.

1-4) Identify any sensitive or unique features of your property that you assert would be impacted by the Project.

Land owned by Hamann Family Farms LLC is home to several unique features. There are freshwater springs that are the headwaters of creeks that are prominent in Deuel County. The map below shows the ranch in 2017 (some land in Norden Township has

been added since then). Red dots represent freshwater springs. Black dots represent calciferous fens which are explained in the next paragraph.

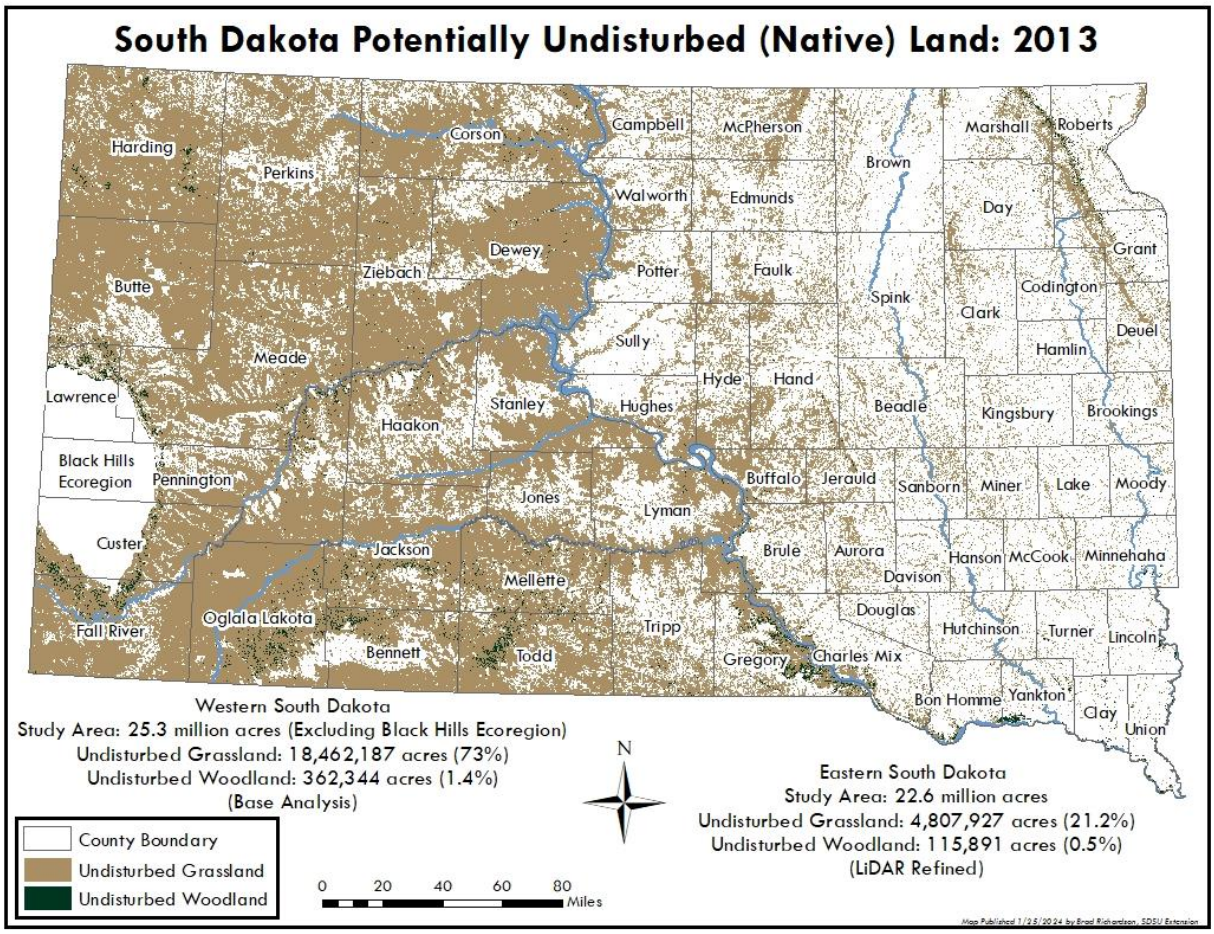
Blue Bell Ranch: 13 Headwaters/Freshwater springs in red, Fens in black



Deuel County has several calciferous fens. We know of at least 3 on land owned by Hamann Family Farms LLC (in black on above map). For perspective, the Sate of MN has only about 200 known fens. To quote the MN Department of Natural Resources webpage (Calcareous Fens | Minnesota DNR), these peat wetlands are "amazing, rare, irreplaceable". The fens need a constant supply of upwelling groundwater that is rich in calcium and other minerals. Because it is calcium rich, there is a highly diverse unique rare plant community that can tolerate a low oxygen environment, calcium carbonate deposits, low nutrient availability and relatively cold organic soil. Calciferous fens are found in glacial outwash so the Coteau hills are prime locations. South Dakota Magazine published an article about these "Pearls on the Prairie" in the July/Aug 2021 magazine (Pearls on the Prairie). Minnesota has protected fens specifically in their drainage statutes because of the uniqueness that supports 7 endangered plants.

The fact that Hamann Family Farms LLC has unbroken sod is unique. According to research done by Pete Bauman, SDSU Extension Natural Resources and Wildlife Field Specialist, 1 of every 5 acres of eastern SD land is unbroken native sod. In the image below, we can see how the Coteau hills are essentially the last remaining acres in eastern SD. Land owned by Hamann Family Farms LLC is near the southern edge of the swath of unbroken prairie. The Audubon Society has called grasslands one of America's most endangered habitats (Five Facts about Grasslands that Will Blow You Away | Audubon) while the World Wildlife Fund has called grasslands a critically

imperiled habitat worldwide (Saving Our Grasslands: Why They Matter, Why We Are Losing Them, and How We Can Save Them | Publications | WWF). Although the proposed project won't use grasslands for towers, I believe the wildlife and plant species deserve further setbacks to ensure their viability.



I am the 3rd generation in 70 years to operate the acres owned by Hamann Family Farms LLC. But in the last 25 years, we have become increasingly proactive in conservation for biodiversity. We've changed to a rotational grazing system and moved to May/June calving on pasture. On the grassland acres that are unbroken sod, we've seen diversity and plant populations increase. On grassland acres that were farmed prior to 1960, we've seen more native grasses and forbs. We've taken the most unproductive farmed acres and replanted native grasses. The ranch is protected through a permanent grassland easement through the US Fish and Wildlife Service. We donated the easement on land less than a mile into Minnesota to help USFWS Prairies Without Borders project protect more grassland acres in SD and MN.

The ranch is locally known as the Blue Bell Ranch (a traditional throwback paying homage to the Blue Bell Medicine Co that owned the ranch in the 1930s). In 2017, we

won the SD Leopold Conservation Award which recognizes a farming or ranching family annually for implementing the 5 principles of soil health: soil cover, limited disturbance, living roots, diversity and integrating livestock. These 5 principles are the cornerstones to healthy soil and water quality that promotes biodiversity and wildlife habitat (Soil Health Organization in Pierre, SD | South Dakota Soil Health Coalition). As part of the annual recognition, there's a YouTube video that spotlights some of the unique work on land owned by Hamann Family Farms LLC (2017 South Dakota Leopold Conservation Award ~ Blue Bell Ranch). Tom Tornow, who we worked with during his time at US Fish and Wildlife, is quoted in the video saying "there's upwards of 200 different species of different grasses and forbs in the native grass". Those native species provide resources for the hundreds of species in the animal kingdom and unknown amount of microbes working under the soil to permanently sequester carbon.

1-5) Describe, in detail, your concerns regarding the Project.

My main concern is that the community doesn't want the project. Several of the towers are going on property owned by property owners who do not reside in Deuel County. More residences in the project area are "non-participants" than "participants". Tower easements won't be an economic driver to Deuel County because so much of the land is owned by people outside of Deuel County; easement money likely won't be used here. There seems to be conflicting information about the taxes that will stay in Deuel County because of the project. Is Deuel County stuck with a 20-30 year project for only a decade's worth of tax revenue?

Most residents are non-participants. Yet they have to bear the burden of the project. Their roads will be used by semi trucks and heavy equipment. The residents will have to choke on dust from extra traffic on gravel roads. Their livestock and pets will get sick from pollutants from extra traffic. Residents won't get a respite from the sound of construction. And once construction is complete, residents will never see the horizon without flashing red lights and never listen to the sound of complete silence.

Complicating the construction phase of the wind tower is road construction. SD Hwy 15 south of Clear Lake isn't expected to be complete until sometime in 2025; wind project traffic will be diverted to county and township roads.

I have concerns about the risk of fire from wind towers. All fire departments in Deuel County receive tax money. But that alone is not enough for a department to operate annually. Fire departments are all volunteers and need adequate equipment and training; they especially need additional resources to be prepared for fires in and around towers. According to conversations with volunteer firefighters, Invenergy hasn't provided fire departments funding beyond taxes.

My second concern is the lack of complete information available to Deuel County residents. Only pre-project data is available. The wind industry has grown worldwide and yet there are few studies on the effects of wind towers at 1 year, 5 years, 10 years or 20 years post construction. Of the projects in Deuel County alone, the only "data" we have is hearsay and rumors. Invenergy hasn't provided us with any county wide production numbers, let alone implications to the environment.

A couple of incomplete reports caught my attention. The grassland assessment that was attached to the application relies on one date in one year at the end of the traditional grazing season. The person completing the assessment used warm season grasses as a metric; cool season species were completely ignored because of the date. Because the assessment was completed after a killing frost in October, all native forbs had gone to seed and were most likely invisible during the assessment. The person who completed the assessment never left public roadways to accurately describe the species present on grasslands. In the real estate comparisons, several properties weren't exactly comparable sales. Housing built dates were sometimes several decades apart; several sale dates were more than a year apart.

All information about potential concerns is based on 1 turbine. There is no information based on the health, safety or livability based on realistic projections. Several non-participant residences will have more than 4 towers within 1 ½ mile of the residence. What are the realities of construction or lifetime use of the turbines for this resident? Also, what is the effect of the project on small towns like Brandt and Toronto? These towns will be essentially completely surrounded by turbines. I could understand this lack of information if this was the first Invenergy project, but this will be Invenergy's third project in Deuel County alone. The lack of information seems deceptive at worst and incomplete at best.

I have several personal concerns as well. I'm concerned that the gravel will be taken from the pit north of my/my mother's residence. I'm worried about the safety of my mom's caregivers as they share the road with extra traffic. My mom has lived in that house for over 50 years. Even as dementia has taken her cognitive and physical skills, her heart is a true rancher and conservationist. She loves watching the birds migrate and use the lake just south of the yard. She enjoys riding in the UTV and checking cattle. She expects that I know every vehicle that drives by. I worry the stress of the construction phase will cause her sleep problems, anxiety, and depression. I worry that she won't understand why the horizon has become an industrial site and not an agricultural paradise.

I am concerned that 25 years of conservation efforts will be undone by construction and use of wind turbines. When we changed to May calving and rotational grazing, we saw better pasture utilization, more diversity of plant species, more species of birds and insects and more overall wildlife. The water is cleaner and more supportive to all non-vertebrate populations. Will my cattle graze the same patterns post construction

as now? Will they remain as healthy? Will the red wing blackbird that always follows me on "his" hill still have a home?

Please allow me to explain why soil health and water quality are so important to the acres I use. Conservation groups like to use fence line comparisons to visualize how a management practice can affect soil health and water infiltration within a few feet of a property line (Rainfall Management on Doug Sieck's Ranch in North Central South Dakota shows the differences on just one owner's property). I saw this first hand when Hamann Family Farms LLC purchased a property in Section 2 of Norden Township in 2023. The previous owner used that property for haying and fertilized heavily. We were astonished in 2023 how few cool season grasses were present. There were essentially no forbs or warm season grasses. We used a rotational grazing plan on that property. In 2024 were surprised to see more plant diversity already. There were at least 4 prevalent warm season grasses and at least 10 forb species. The plants per square foot had increased substantially so there was almost no bare ground between plants. Unfortunately (but expectedly), we haven't seen an increase in wildlife or bird populations yet. Based on our past experience implementing changes, I would expect to see an increase in about 2028. But the biggest surprise was the effect in Herrick Township. The calves in that pasture were 20-40 pounds heavier than other years and with less sickness. A positive change in Norden Township saw positive effects in Herrick Townships. So this begs the question: if we can make positive changes to the environment in 1-2 years, how fast can negative changes happen?

1-6) Describe what mitigation measures you believe would address the concerns you identified in response to Request 1-5.

The best mitigation measure would be for Invenergy to withdraw the application.

1-7) Identify any witnesses, including expert witnesses, you plan to have testify on your behalf. For each witness (including expert witnesses), please provide a resume or statement of qualifications of the witness(es), identify the subject matter regarding which the witness will testify, and identify and provide any exhibits the witness will refer to or introduce.

Unfortunately, I have not found any expert witnesses willing to risk losing their employment by testifying on my behalf. I do plan to submit published articles and research as appropriate.

1-8) With respect to your statements at the August 22, 2024, public input hearing, state all facts that support the statements you made and produce copies of all documents that support statements you made

I went to the PUC website and listened to the recording. So for clarity sake, I will note times with my comments and questions.

38:38 I introduced myself.

At 39:00 I made the comment about the grouse SD Game Fish and Parks found in our pasture 8 miles north of Highmore that had been identified under the wind towers about 7 miles south of Highmore the summer before.

My husband was leaving for work at about 8am and met a Game Fish and Parks employee at the door. My husband was literally opening the door as the GFP employee was going to knock; my husband was so surprised, he forgot to get a business card. I wasn't home at that time, but my husband called me immediately after he talked to GFP. The GFP employee asked for permission to go onto our property and ensure that the grouse was indeed there and see if the grouse had made a home there. The GFP was granted permission. Neither my husband nor I can remember the day or even the year, but it was in the spring and earlier than the 10 of June because there weren't any cattle in that pasture yet. My husband is willing to sign an affidavit that this conversation happened. Regardless, this grouse's experience seems to be consistent with the briefing paper that was attached to the discovery the PUC asked of me in Sept.

At 40:50 I asked about Invenergy paying for an independent environmental study.

At 41:04 I continued with a follow up comment about a personal experience with the person doing the study making the point that the study was only as good as the person doing the study.

Here's the backstory to that comment. Prior to any wind towers being built north of Toronto, there was a vehicle parked in one of our approaches on 480th Ave. I was on a 4 wheeler, but I stopped to make sure the occupant of the vehicle didn't have trouble with her pickup. I waited for about 5 minutes for her to get off her phone. When she did, I asked if she was having trouble. She explained that she was hired to do the bird survey and explained the basics of the survey. I asked about her education and her career goals. She seemed very knowledgeable about birds, but she seemed bored by the prospect of being in a vehicle with no one to talk to. As I left, I asked her to let us know if she saw anything unusual or unique. I never saw her again.

At 41:47 I asked about noise level and what a dBA was. I forgot to get the paper about noise levels after I asked my remaining questions.

At 42:40 I asked about the taxes that were staying in Deuel County and the school districts.

At 43:50 I asked who paid for upgrades to the roads because "some of these roads are barely roads". This is personal experience on the road between Clear Lake and Norden Township and Herrick and Norden Township. These roads are minimally maintained. Although no towers will be constructed using these roads, they are the only access

points to participating properties in the project. These roads are also adjacent to Hamann Family Farms LLC and I avoid them with a pickup after any weather event until I've traveled them with a ATV or UTV first. As I write this response on the 29th of Oct., there's grass that grew in the middle of these roads. They had standing water on them most of May and June.

At 45:25 I asked how many Invenergy employees lived in Deuel County which the project manager couldn't answer.

At 45:48 my final question was how close to your employees live to a wind tower. And then my questions were complete and I was past my allowed 5 minutes.

Dated this 31st Day of October, 2024

Arla R Hamann Poindexter