TECHNICAL MEMORANDUM

To	South Dakota Public Utilities Commission
Cc	South Dakota Game, Fish and Parks (SDGFP); U.S. Fish and Wildlife Service
From	Crowned Ridge Wind, LLC
Contributors	Crowned Ridge Wind, LLC; SDGFP; SWCA Environmental Consultants; and WEST, Inc.
Date	October 29, 2019
Subject	Crowned Ridge I Grouse Lek Monitoring Study Plan

BACKGROUND

Crowned Ridge Wind, LLC (Crowned Ridge), an indirect, wholly owned subsidiary of NextEra Energy Resources, LLC (NEER), is constructing the Crowned Ridge I Wind Energy Facility (the project) in Grant and Codington Counties, South Dakota (Figure 1). On July 26, 2019, the South Dakota Public Utilities Commission (SDPUC) issued a Final Decision and Order Granting Permit to Construct Facility; Notice of Entry with Permit Conditions for the project. In accordance with Permit Condition 45 of that document, Crowned Ridge will undertake two years of independently-conducted post-development prairie grouse (greater prairie-chicken [*Tympanuchus cupido*] and sharp-tailed grouse [*Tympanuchus phasianellus*]) lek monitoring to evaluate the effect of the project on the local prairie grouse population. Monitoring is expected to inform the body of scientific literature on the potential impacts of wind on prairie grouse and inform mitigation efforts if an effect is detected. However, in order to accurately assess the level of mitigation potentially required if an effect is detected, a thorough understanding of project impacts is necessary. The lack of pre-development prairie-grouse habitat selection and survival data limit baseline data to accurately evaluate impacts that would inform the level of mitigation. Nonetheless, pre-development lek attendance (i.e., counts of individual grouse attending leks) data has been collected at the project which can be used in a before and after impact study design to evaluate the potential effects of the project on lek attendance/persistence. While this study does not meet the rigor of a pre- and post-development telemetry study, it can provide some insight to the project's potential impact on individuals attending leks. The purpose of this study plan is to outline the study objectives, methods, and expected results from a pre- and post-development lek monitoring study that aligns with the Permit Condition. Mitigation will be addressed in a separate plan and is beyond the scope of this document.

PROJECT DESIGN

Scientific understanding of the effect of wind turbines on prairie grouse, specifically plains sharp-tailed grouse is not well understood. Three studies on the closely related Columbian sharp-tailed grouse (CSTG) and greater prairie-chicken (GRPC) have been conducted in Idaho (CSTG) and in Nebraska and Kansas (GRPC; see Coppes et al. 2019). The results from these studies indicated that nest site selection and nest survival were not impacted by proximity to wind turbines (McNew et al. 2014, Harrison et al. 2017, Proett et al. 2019). In addition, female survival was not negatively affected by wind turbines (Winder et al. 2014b, Smith et al. 2017). Greater prairie-chickens avoided habitats near wind turbines during the breeding season in Kansas but found no evidence of avoidance during the non-breeding period (Winder et al. 2014a). At this same study site, the probability of lek persistence ranged from approximately 0.5 for leks within one km from a turbine to 0.9 for leks within 3 km from a turbine suggesting leks closer to turbines had a lower probability of persistence but this probability also depended on the lek size (number of individuals attending) and surrounding habitat (Winder et al. 2015). Based on the body of literature, there is evidence to suggest that sage and prairie-grouse are being displaced by wind turbines from habitats they would have otherwise occupied but this displacement does not result in population level impacts (i.e., reduced nest, brood, and female survival; e.g., McNew et al.

2014, Winder et al. 2014a and b, Winder et al. 2015, Smith et al. 2016, Harrison et al. 2017, Smith et al. 2017, LeBeau et al. 2017a and b, Proett et al. 2019). However, these studies acknowledge some of the potential shortcomings in study duration and lack of pre-development data and all acknowledge more research is needed to thoroughly understand the impacts of wind energy development on grouse populations.

The presence of prairie-grouse leks in close proximity to wind turbines provide an opportunity to add to the scientific knowledge of grouse and wind energy impacts. Capturing and monitoring individuals pre- and post-development would inform survival rates and displacement effects relative to wind turbines. However, we are limited to a lek monitoring study design due to the lack of pre-development habitat selection and survival data collected at the Project. The objective of lek monitoring study is to determine changes in lek persistence and the number of individuals attending leks from pre- to post-development of the project. Here we define lek persistence as the annual probability that a lek remains attended from one breeding season to the next (Winder et al. 2015).

METHODS

Field Methods

Project Leks

Ground-based lek counts (i.e., counts of males on leks) have served as the standard method for determining lek attendance for several decades (Johnson and Rowland 2007) and are still among the most widely used techniques to determine lek status and population trends (Walsh et al. 2004). Crowned Ridge conducted pre-development lek counts and proposes to use that same methodology for the two years of post-development monitoring consistent with the protocol provided by SDGFP. Crowned Ridge will conduct ground-based lek counts at known project leks located within the project (Figure 1). In the event a known lek is not found, observers will search within 2 kilometers of the known lek to determine if it moved. Ground counts will be conducted by qualified observers who have been approved by the SDGFP and PUC consistent with the permit conditions (Appendix A).

Observers will conduct ground-based lek counts during three separate visits between March 25 and May 5. Counts will be spaced at least seven days apart and must occur sometime between 30 minutes before sunrise to 90-minutes post sunrise Observers will scan each lek for a minimum of 10 minutes and count the total number of individuals attending the lek. Vantage points will optimize visibility of the lek, with observers using caution not to approach the lek too closely so as to disturb individuals that are present. Spotting scopes will be used to minimize disturbance of lekking individuals.

Lek counts will be conducted when the following weather conditions are met to optimize observations:

- clear to partly cloudy skies,
- winds less than 10 miles per hour, and
- no rain or snowstorms.

Observes will document the following information during surveys:

- Lek number (unique identifier code)
- Visit number (unique identifier code)
- Date of visit
- GPS Coordinates

- Time of visit
- Observer name
- Weather conditions including wind speed/direction, temperature, percent cloud cover, precipitation
- Species observed
- Number of males observed
- Number of females observed
- Number of birds of unknown sex
- Presence of predators by species, time, and activity
- Ground condition (e.g., dry, muddy, snow, etc.)

Along with above information, observers will document habitat types within 2 km of a lek as that is the distance from lek individual prairie-grouse are most likely to use throughout their annual life-cycle (Boisvert et al. 2005, Hoffman et al. 2015, Haukos and Zavaleta 2016). Habitat mapping will consist of identifying habitat types using aerial imagery while conducting ground lek surveys. This information will then be digitized in a GIS to summarize the variability in habitats associated with each monitored lek to be included in estimating the probability of lek persistence.

Off-site Leks

Post-development lek counts at the project will be compared to pre-development lek counts and post-development counts from off-site leks along an increasing gradient away from wind turbines (3 to 30 km from turbines). Crowned Ridge has voluntarily agreed to collaborate with South Dakota Game, Fish, and Parks (SDGFP) to identify areas to search along this gradient. SDGFP prairie-grouse occurrence models (Runia and Solem 2018) will primarily be used to identify blocks of suitable habitat prior to the start of the 2020 lekking season. Suitable habitat blocks will then be searched at the beginning of the 2020 lekking season to identify off-site leks for monitoring during the 2020 and 2021 lekking seasons. The searches will follow standard protocols that involves driving publically accessible roads stopping every 0.5 mile to listen for lekking prairie-grouse or walking through road-less areas. Once a lek is found, the observers will try and get visual confirmation or triangulate the auditory location. Follow-up visits to leks found during these searches will follow the same lek count monitoring protocols as lek surveys within the project.

Statistical Analysis Methods

Monitoring results will be summarized in tabular format. Two response variables will be measured; changes in maximum individuals attending leks within a year and lek persistence where an attended lek = 1 and an unattended lek = 0. An unattended lek would have less than two males. Multiple variables will be considered while evaluating the variability in lek persistence and lek attendance on the landscape relative to wind turbines. These variables will include information collected during each lek count survey such as weather and number of individuals but will also incorporate landscape characteristics within 2 km of each lek such as proportion of various land cover types and existing level of fragmentation. We also will incorporate various measures of the project's disturbance such as distance to and density of infrastructure. Lek locations often move on an annual basis due to changes in various existing landscape features such as grass height. To account for this annual movement, we will incorporate annual lek to lek distances as a covariate to help explain changes in lek locations relative to wind turbines. If large annual movements are occurring at the project compared to leks located farther from wind turbines, then those movements should be captured in this covariate. The response variables and explanatory covariates will be incorporated in a logistic or linear

regression. We propose to employ standard model selection techniques to determine the most parsimonious model explaining lek persistence and lek attendance in the comparisons between pre- and post-development along with the comparisons between post-development within the project and off-site leks. In addition, state trends from leks that have been consistently monitored over the last decade by SDGFP will be incorporated into the analysis to further inform potential impacts of the project on lek persistence. The expected outcome will be a measure of probability of lek persistence and changes in lek attendance relative to both project and non-project influences. Capturing habitat and existing landscape fragmentation at both project and off-site leks will assist in developing an understanding of the relative contribution of project and non-project impacts on lek persistence and lek attendance.

DELIVERABLES

Annual reports documenting the results of the post-development lek monitoring will be submitted to SDGFP, the USFWS, and PUC. The first annual report documenting the results of the 2020 season will be a simple summary of the data and will be submitted before the end of 2020. The final post-development lek monitoring report using two full years of data and incorporating the statistical analysis will be prepared after the completion of the second year of monitoring and submitted to SDGFP, the USFWS, and the PUC prior to the end of 2021. Two full years of post-development monitoring will be the minimum duration of information used to assess the potential impacts of the project on lek persistence as indicated in the permit condition.

REFERENCES

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Coppes, J., V. Braunisch, K. Bollmann, I. Storch, P. Mollet, V. Grünschachner-Berger, J. Taubmann, R. Suchant, and U. Nopp-Mayr. 2019. The Impact of Wind Energy Facilities on Grouse: A Systematic Review. Journal of Ornithology: doi: 10.1007/s10336-019-01696-1.

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Haukos, D. A., and J. C. Zavaleta. (eds). 2016. Habitat. Pages 99-132 in D. A. Haukos and C. W. Boal (eds). 2016. Ecology and Conservation of Lesser Prairie-Chickens. Studies in Avian Biology (no. 48), CRC Press, Boca Raton, Florida.

Hoffman, R. W., K. A. Griffin, J. M. Knetter, M. A. Schroeder, A. D. Apa, J. D. Robinson, S. P. Espinosa, T. J. Christiansen, R. D. Northrup, D. A. Budeau, and M. J. Chutter. 2015. Guidelines for the Management of Columbian Sharp-Tailed Grouse Populations and Their Habitats. Western Agencies Sage and Columbian Sharp-tailed Grouse Technical Committee, sponsored by the Western Association of Fish and Wildlife Agencies (WAFWA). June 24, 2015. Available online: https://cpw.state.co.us/Documents/WildlifeSpecies/SpeciesOfConcern/Columbian-ST-Guidelines.pdf

Johnson, Douglas H. and Mary M. Rowland. 2007. The Utility of Lek Counts for Monitoring Greater Sage-Grouse. Accessed at https://www.fws.gov/southwest/es/documents/R2ES/LitCited/LPC_2012/Johnson_and_Rowland_2007.pdf on August 26, 2019.

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LeBeau, C. W., G. D. Johnson, M. J. Holloran, J. L. Beck, R. M. Nielson, M. E. Kauffman, E. J. Rodemaker, and T. L. McDonald. 2017b. Greater Sage-Grouse habitat selection, survival, and wind energy infrastructure. The Journal of Wildlife Management 81:690–711.

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Winder, V. L., L. B. McNew, A. J. Gregory, L. M. Hunt, S. M. Wisely, and B. K. Sandercock. 2014a. Space use by female greater prairie-chickens in response to wind energy development. Ecosphere 5(1):3

Winder, V., L. B. McNew, L. M. Hunt, A. J. Gregory, S. M. Wisely, and B. K. Sandercock. 2014b. Effects of wind energy development on seasonal survival of greater prairie-chickens. Journal of Applied Ecology 51:395–405.

Winder, V. L., A. J. Gregory, L. B. McNew, and B. K. Sandercock. 2015. Responses of male greater prairie-chickens to wind energy development. Condor 117: 284–2

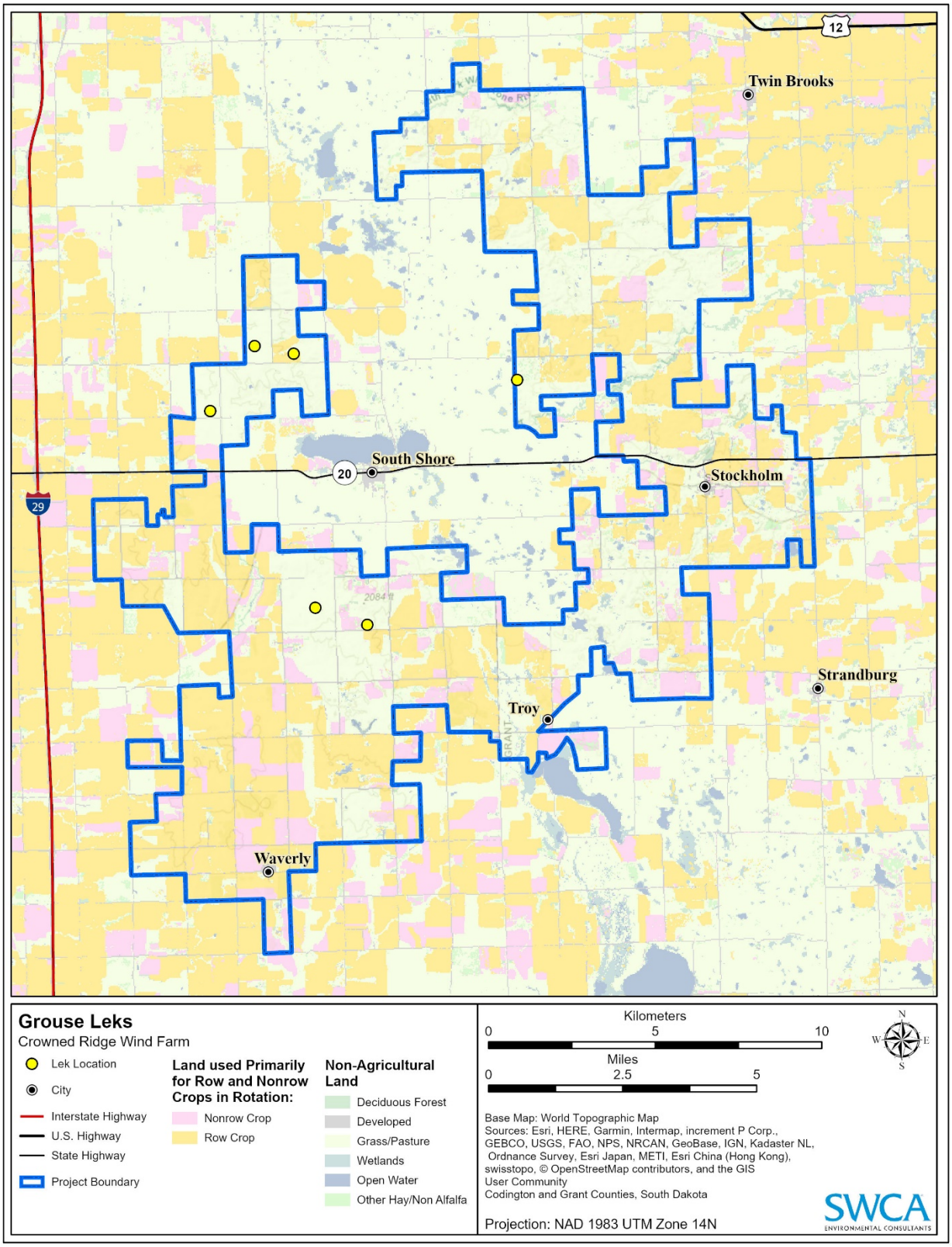

Figure 1. Grouse Leks within the Crowned Ridge I Wind Energy Facility.

APPENDIX A

APPROVED QUALIFIED OBSERVERS

STEVEN HORVATH, B.S., BIOLOGICAL FIELD TECHNICIAN

Mr. Horvath is a biological field technician experienced in natural resource field surveys for energy clients in the Midwest and Mountain West regions of the United States. He has conducted various preconstruction avian use and eagle surveys, lek monitoring studies, and post-construction bat and avian fatality monitoring and carcass persistence trials across the country. Prior to his time at SWCA, Mr. Horvath worked as a wildlife field technician for Colorado Parks and Wildlife, where he extensively researched, monitored, and surveyed several species to support relocation efforts and population or colony mapping. Mr. Horvath is fluent in avian species identification and has extensive avian use survey experience. In addition, he is experienced in monitoring vegetation transects through talus slopes and high elevations and has worked with threatened and endangered species.

YEARS OF EXPERIENCE

2

EXPERTISE

Avian identification and surveys

Natural resource field surveys

Extensive handling of wildlife, including small mammals and migratory birds in the field

Telemetry and GPS tracking

Trip and plot planning using topography maps and GPS units for conservation surveys in high alpine environments

EDUCATION

B.S., Wildlife Biology and Conservation; Western State Colorado University, Gunnison; 2018

SELECTED PROJECT EXPERIENCE

Pumpkin Creek Wind Energy Project - Sharped-Tailed Grouse Lek Surveys; Invenergy Wind Development, LLC; Carbon County, Kansas. SWCA is conducting sharped-tailed grouse lek surveys for the second year for the Pumpkin Creek Wind Energy Project. *Role: Avian biological technician. Conducts lek surveys.*

Centroid Wind Energy Development; Confidential Client; Multiple Counties, Kansas. SWCA conducted Tiers 1 and 2 Site Characterization and Tier 3 preconstruction surveys and reporting. *Role: Biological technician. Conducted natural resources surveys and reporting.*

Cheyenne Ridge; Xcel Energy; County, Colorado. SWCA is in the process of conducting preconstruction surveys for the Cheyenne Ridge wind farm. Surveys include wildlife surveys, aquatic resources surveys, and historic and cultural resources surveys. *Role: Biological technician. Completes natural resources field survey planning and implementation.*

Confidential Project; Confidential Client; Converse County, Wyoming. SWCA conducted wildlife surveys for oil well pad and access roads. *Role: Biological technician. Completed natural resources field survey planning and implementation.*

Diamond Vista Avian Mortality; Enel Green Power North America, Inc.; Marion County, Kansas. SWCA is in the process of providing bird and bat conservation strategy training, a post-construction mortality survey work plan, and post-construction mortality surveys. *Role: Biological technician. Completes natural resources field survey planning and implementation.*

Hilltopper Wind Project Post- Construction Monitoring; Enel Green Power North America, Inc.; Logan County, Illinois. SWCA is currently conducting post-construction surveys to comply with Bird and Bat Conservation Strategies. *Role: Biological technician. Completes natural resources field survey planning and implementation.*

Confidential Wind Energy Project; Confidential Client; Wyoming. SWCA is providing biological survey work in support of county, state, and federal permitting of the Rock Creek Wind Energy Project. *Role: Biological technician. Completes natural resources field survey planning and implementation.*

Confidential Wind Energy Project; Confidential Client; Colorado. SWCA conducted avian use surveys for an existing wind farm. *Role: Biological technician. Designed and completed avian use surveys.*

Confidential Wind Energy Project; Confidential Client; Multiple Counties, Kansas. SWCA conducted and completed biological work, including habitat assessments and surveys, wetlands work, cultural work, a phase I ESA, county permitting-required studies, and general project support for a proposed wind farm in Kansas. SWCA was also involved in agency consultation. *Role: Biological technician. Completed natural resources field survey planning and implementation.*

MARCEL SUCH, B.S., BIOLOGICAL FIELD TECHNICIAN

Marcel Such is a biologist working for SWCA as a wildlife field technician, specializing in avian ecology and botany in the Rocky Mountain and Great Plains regions. With sixteen years of experience in ornithology, he is skilled in the identification of all regularly occurring bird species of the Interior West and Midwest, by sight and sound, and has worked with federal threatened and endangered species including the Gunnison sage-grouse and Preble's meadow jumping mouse. Mr. Such's in-field experience includes proficiency in many established survey protocols and techniques, including post-construction mortality surveys on wind farms; excellence in safe backcountry and off-road navigation by foot, ski, and four-wheel drive vehicles; and use of GIS hardware technologies such as Garmin GPS units and Android tablets. He is proficient in training field technicians in avian identification and survey protocol; has produced post-fieldwork reports for various government and academic agencies; and has published several papers in peer-reviewed ornithological journals on a variety of subjects.

EXPERTISE

Lifelong student of ornithology, highly experienced in visual and auditory bird identification in North America

Ten years' experience conducting various avian surveys, including bird banding, breeding bird surveys, point counts, distance-sampling techniques, and lek surveys

Experienced in botanical anatomy, lab- and field-based plant identification

Five years' experience conducting vegetation surveys in the Interior West, including point-intersect fuels surveys and general species inventories

Experienced in report preparation and review, has provided reports to several government, academic, and private institutions

EDUCATION

B.S., Environmental Biology and Ecology; Western State Colorado University; Gunnison, Colorado; 2018

B.S., Mathematics; Western State Colorado University; Gunnison, Colorado; 2018

TRAINING

Yellow-billed Cuckoo Training Workshop, U.S. Fish and Wildlife Service; 2015

SELECTED PROJECT EXPERIENCE (∗ denotes project experience prior to SWCA)

Confidential Wind Energy Development; Various Counties, Kansas. *Role: Biological Technician. Avian point counts, avian use surveys, greater prairie-chicken lek surveys, data quality control.*

*Siskadee; Western State Colorado University; Gunnison County, Colorado. *Role: Volunteer Gunnison sage-grouse lek monitor. Four seasons. Lek counts, habitat restoration, public watchable wildlife lek liaison, interpretive naturalist.*

Confidential Year 2 Environmental Surveys; Confidential Client; Wyoming. *Role: Biological Technician. Data quality control, report preparation, avian point count and use surveys.*

Pioneer Wind Park Post Construction Monitoring; Pioneer Wind Park I, LLC; Converse County, Wyoming. SWCA provided post-construction avian and bat monitoring as well as Phase I ESA and worker environmental training support for the Pioneer Wind Park in compliance with the approved Project Conservation Plan and Eagle Conservation Plans (ECP). *Role: Biological Technician. Data quality control, post-construction mortality surveys.*

Pumpkin Creek Wind; Invenergy Wind Development, LLC; Carbon County, Kansas. *Role: Biological Technician. Multiple years - avian point count and large bird surveys.*

Rattlesnake Creek Avian Mortality; Enel Green Power North America, Inc.; Nebraska. *Role: Biological Technician. Administered bird and bat fatality training, conducted post-construction mortality surveys.*

Diamond Vista Avian Mortality; Enel Green Power North America, Inc.; Kansas. *Role: Biological Technician. Administered bird and bat fatality training, conducted post-construction mortality surveys.*

Confidential Wind Energy Development; Colorado. *Role: Biological Technician. Avian point count and large bird surveys.*

XTO RNPU 197-23A SSPS Monitor; XTO Energy; Meeker, Rio Blanco County, Colorado. *Role: Biological Technician. Botanical monitor for pipeline construction project.*

*Bird Conservancy of the Rockies; Colorado Parks and Wildlife; Montrose,

Chad LeBeau, *Research Biologist*

PROFESSIONAL EXPERIENCE

2009-Present *Research Biologist,* Western EcoSystems Technology, Inc., Cheyenne, Wyoming
2007-2009 *Field Technician,* Western EcoSystems Technology, Inc., Cheyenne, Wyoming
2006-2008 *Research Aide,* Ruckelshaus Institute, ENR, Laramie, Wyoming

SPECIALTY AREAS

Grouse Research: Mr. LeBeau is an Ecological Society of America certified ecologist and has over 10-years of experience conducting and coordinating research projects for state and federal agencies, as well as industry and non-governmental organizations. Designed and implemented multiple studies specific to the conservation of sage-grouse and prairie grouse throughout their range. Worked with state and local governments to develop management plans specific to sage-grouse conservation and mitigation. Conducted multiple monitoring studies specific to grouse across their range that include habitat assessments, population abundance surveys, and breeding surveys. His research is highlighted by conducting the first study evaluating the effects of wind energy development on greater sage-grouse. In addition, he identified the conservation value of the first ever greater sage-grouse conservation bank. Over his years of research, he has capture and monitored over 400 greater sage-grouse and lesser prairie-chickens in four different States.

Ecological Modeling: Expert at analyzing data to address complex ecological issues that inform management guidelines using resource selection functions and survival models. He generated the first resource selection function from GPS monitored golden eagles. He has developed resource selection functions and survival models for moose in Alaska, pronghorn in Wyoming, and mule deer in New Mexico that aided conservation planning.

Wind-Energy Research: Designed**, c**oordinated, and managed over 30 studies of wind energy and wildlife interactions across the US. These studies consist of pre-construction risk assessments and post-construction studies of fatality rates. His current research focuses on evaluating the effects of wind energy developments on lesser prairie-chickens in Kansas. In addition, he serves as a technical expert for multiple Habitat Conservation Plans and Candidate Conservation Agreements.

SELECTED PROFESSIONAL PUBLICATIONS

LeBeau, **C**., M. Holloran, J. Beck, M. Kauffman, and G. Johnson. 2019. Greater sage-grouse habitat function relative to 230-kV transmission lines. Journal of Wildlife Management 83: 1773-1786.

LeBeau, C., G. D. Johnson, and D. Strickland. 2018. A landscape scale approach to conserving a keystone species: A habitat conservation bank for greater sage-grouse. Rangeland Ecology and Management 71:149-158.

LeBeau, **C**., G. Johnson, M. Holloran, J. Beck, R. Nielson, M. Kauffman, E. Rodemaker, and T. McDonald. 2017. Greater sage-grouse habitat selection, survival, and wind energy infrastructure. Journal of Wildlife Management 81:690-771.

LeBeau, C., J. L. Beck, G. D. Johnson, R. M. Nielson, T. L. McDonald, M. J. Holloran, and K. G. Gerow. 2017. Greater sage-grouse male lek counts relative to wind energy development. Wildlife Society Bulletin 41:17-26

LeBeau, C. W., R. M. Nielson, E. C. Hallingstad, and D. P. Young, Jr. 2015. Daytime Habitat Selection by Resident Golden Eagles (*Aquila chrysaetos*) in Southern Idaho, U.S.A. Journal of Raptor Research 49:29-42.

LeBeau, C., J. L. Beck, G. D. Johnson, and M. J. Holloran. 2014. Short-Term Impacts of Wind Energy Development on Greater Sage-Grouse Fitness. Journal of Wildlife Management 78:522-530.

EDUCATION

M.S.
University of Wyoming
Laramie, Wyoming
2012
Ecosystem Science & Management

B.S.
University of Wyoming
Laramie, Wyoming
2008

Wildlife & Fisheries Biology Management, Environmental & Natural Resources

SCIENTIFIC ORGANIZATION MEMBERSHIPS

The Wildlife Society

Ecological Society of America

SELECTED PROFESSIONAL PRESENTATIONS

The Wildlife Society - Utah 2009 and New Mexico 2017

North American Ornithological Conference – Vancouver BC 2014

Invited presenter for U.S. Fish and Wildlife Land-Based Wind Energy Guidelines Broadcast #5, April 2014, Shepherdstown, West Virginia.

Sage and Columbian Sharp-tailed Grouse Workshop – Colorado 2012 (28th), Wyoming 2016 (30th), Utah 2018 (31st)

Wind Wildlife Research Meeting National Wind Coordinating Committee Meeting – 2012, 2016, and 2018