Appendix H
(continued)
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This memorandum follows up on concerns that have been raised with Power Company of Wyoming LLC (PCW) regarding the Wyoming state and county permitting processes for the Chokecherry and Sierra Madre Wind Energy Project (the Project).

Specifically, it addresses the question of whether the permits that are expected to be issued by the state and county in the near future will negatively impact the ability of the U.S. Fish and Wildlife Service (Service) and Bureau of Land Management (BLM) to require future modifications to the Project based on additional environmental analysis and to enforce the modifications.

As set out in more detail below, the state and county processes have the procedural and statutory mechanisms in place to address Project modifications after the respective permits are granted. In addition, the state and county permits will both require compliance with federal standards. Thus, the situation in which the state and county permits are granted prior to the issuance of the BLM rights-of-way in no way impacts either the ability of the Service or BLM to require Project modifications or to enforce such modifications.
I. WYOMING STATE PERMITTING PROCESS

Pursuant to W.S. §35-12-106(a), PCW must obtain a permit from the Wyoming Industrial Siting Council (ISC) to construct and operate the Project. PCW completed the required jurisdictional meeting with the Industrial Siting Division (ISD) on April 25, 2012 and plans to submit an application for a permit in mid-November of 2012. Based on the statutory timeframes, if PCW submits its application in mid-November, the ISC will hold an administrative hearing in February 2013 and will issue a decision on the permit application at the end of March 2013.

When PCW submits its application to the ISC in November, it will include an overall Plan of Development as well as preliminary plans showing turbine layouts and infrastructure design (Project Plans). This complies with ISC rules that the application must include “preliminary site plans at an appropriate scale indicating the anticipated location for all major structures” Section 9 (b), ISC Rules. The Project Plans will represent PCW’s best planning to date in conformance with all of the conditions, commitments and constraints known at the time of the application by PCW. Because the BLM’s Record of Decision on the Project is expected prior to PCW’s submission of its ISC application, the Project Plans will conform with the mitigation measures identified in the BLMs Record of Decision, as well as the Eagle Conservation Plan, the Bird and Bat Conservation Strategy, and any other known site constraints.

The issuance of a permit by the ISC based upon the preliminary site plans in no way limits the BLM or the Service in requiring modifications to the Project. First, any permit issued by the ISC will contain a condition that PCW “shall obtain and maintain all required State and local permits and approvals in accordance with W. S. 35-12-109 (a) (xv), 35-12-113 (a) (i), and 35-12-115 during the term of this permit.”

The reference in the permit condition to W.S. 35-12-115(a)(i) is key because the statute specifically provides that the

department of environmental quality shall retain authority which it has or which it may be granted to determine compliance of the proposed facility with state and federal standards and implementation plans and to enforce those standards.

W.S. 35-12-115(a)(i).

Therefore, any ISC permit will require PCW comply with applicable federal standards, including obtaining all necessary approvals.

Second, the ISC process anticipates the potential need for modifications to the Project and the applicable statute W.S. 35-12-106, ISC Rules, and the ISC permit conditions, provide the mechanism and process for addressing modifications after issuance of the permit.

The Wyoming statute addresses the issue of amendment as follows:

(c) Except as provided in subsection (d) of this section, the council may allow the amendment of a permit or application for a permit for good cause if the holder demonstrates to the council at its next meeting that the requested change is in compliance
with local ordinances and applicable land use plans and will not significantly add to adverse environmental, social and economic impact in the impacted area.

(d) On an application for an amendment of a permit, the council shall hold a hearing in the same manner as a hearing is held on an application for a permit if in the council’s opinion the requested change in the facility would result in a significant adverse increase in any environmental, social or economic impact of the facility or a change in the location of all or a portion of the facility unless the change in location was specifically approved by the council in the permit.

W.S. 35-12-106(c) and (d)

ISC Rules implement the statute by requiring a permit amendment “if the applicant makes a significant change to the scope, purpose, size, or scheduling of the project; which would result in different impacts not within the scope of the approved permit.” ISC Rules, Section 16(a).

Then, the ISC Permit will contain the following condition:

The Permittee shall notify the ISD in advance of proposed changes to the scope, purpose, size or schedule of the project. The Director may authorize such changes if he or she finds that:

a. The change should not result in any significant adverse environmental, social, and economic impacts in the area of site influence; and
b. The Director has provided public notice of the proposed change and his intent to approve the request; and

c. No party nor Council Member has requested that the matter be heard before the Council in accordance with the permit procedures of W. S. 35-12-106 (c) and (d).

This condition authorizes administrative project changes by the DEQ Director, including approvals of project phases, changes in project scope, schedule, size or purpose, without formal ISC approval, following notice to the parties and consideration of possible impacts. The permit conditions are consistent with the general rule in the regulations and the statute that an ISC hearing for a permit amendment, comparable to the original permit hearing, is not required unless the project change will significantly add to environmental, social or economic impacts.

Because any modifications required by the BLM and/or Service will be to lessen impacts, PCW believes that the amendment process will be straightforward and most likely approved by the DEQ Director. As the developer, however, PCW bears the risk that modifications to the Project Plans could require a hearing.

The enforcement mechanism for project modifications required by the BLM and/or Service is two-fold. If PCW does not comply, the BLM will not issue the required rights-of-way grants nor the notice to proceed. In addition, PCW would be in violation of the ISC permit for not meeting the applicable federal standards.
PCW and ISD staff recognize that after the BLM issues the Record of Decision on the Project, PCW will be required to submit Project Plans (referred to as site-specific plans of development in the Final Environmental Impact Statement) to the BLM and that the BLM’s review may result in adjustments to the Project Plans submitted by PCW to the ISC.

On July 26, 2012, two representatives from the Service along with two representatives from the BLM, Carbon County’s Planning Director and representatives from PCW met with Tom Schroeder, Program Principal, Department of Environmental Quality, Industrial Siting Division and Tia Raamot, Principal Economist, Department of Environmental Quality, Industrial Siting Division.

During the meeting both Mr. Schroeder and Ms. Raamot assured the Service and BLM that the ISC has the tools to handle project modifications and that they did not see a problem and believe that the ISC process can accommodate amendments to the site plan and its features after an ISC decision.

II. CARBON COUNTY PERMITTING PROCESS

In addition to the ISC permit, PCW must obtain a Conditional Use Permit (CUP) from the Board of Carbon County Commissioners. Wyoming law provides that it “is unlawful to locate, erect, construct, reconstruct or enlarge a wind energy facility without first obtaining a permit from the board of county commissioners in the county in which the facility is located.” W.S. 18-5-502(a). The statutes relating to county regulation of wind energy projects are set out at W.S. 18-5-501 through W.S. 18-5-513 and require that board of county commissioners adopt standards that are not less stringent than the standards set out in the statute. W.S. 18-5-504 (a)(i).

A. Carbon County Zoning Resolution

In conformance with the applicable statutes, Carbon County has adopted comprehensive standards – set out in the Carbon County Zoning Resolution, April 5, 2011. PCW filed its application for a Conditional Use Permit with Carbon County on July 16, 2012. The next steps include: (1) a completeness determination by the County with respect to the application; (2) a Planning and Zoning Commission public meeting and recommendation regarding the application to the Commissioners; (3) a hearing on the application in front of the Carbon County Commissioners; and (4) a decision from the County Commissioners on the CUP application. PCW anticipates that Carbon County will issue a decision on the application by the end of 2012.

As with the ISC permit, the issuance of the county permit will not interfere with the ability of the BLM and/or the Service to require Project modifications. First, the Carbon County Zoning Resolution states that the county regulations will not supersede state and federal laws and, in fact, it requires compliance with all federal requirements. As set out in Chapter V, Section 5.11(d)(7):
a) Nothing in these Regulations is intended to preempt other applicable State and Federal laws or regulations. All WECS Project\(^1\) facilities shall be constructed to meet and be maintained in compliance with all Federal, State and County requirements, including all Wyoming Industrial Siting Council requirements, if applicable. If compliance issues arise at any time during the review, development or operational phases, the Applicant(s) or Owner(s), at the discretion of the County may be requested to provide additional studies or reports prepared by qualified professionals addressing the issues and mitigation measures that may be needed to maintain compliance.

Second, the Carbon County CUP process contemplates that State and Federal approvals may be granted following issuance of the CUP and mandates that the CUP be issued “subject to” obtaining the required approvals. Section 5.11(d)(1)(a)(8) setting forth the requirements for the CUP application provides:

\[
\text{(8) A list of all State and Federal agencies requiring approval and a copy of such approval, including all required studies, reports and certifications. In the event that a State or Federal Agency has not yet approved a required study, report or certification, then the conditional use permit shall be subject to receipt of a copy of such approval, unless good cause is shown to the satisfaction of the County;}
\]

Third, although a Project Plan is included with the application, the applicable Carbon County Planning and Zoning Resolution sections recognize that the application may be based on a “preliminary site plan”:

Chapter V, Section 5.11(d)(1)(a) states:

1. Commercial WEC Project
   The Conditional Use Permit application for a Commercial WEC Project shall contain, or be accompanied by, the following information:

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\(^1\) “Wind Energy Conversion System” (“WECS”) means all necessary devices that together convert wind energy into electricity, including the rotor, nacelle, generator, WECS Tower, electrical components, WECS foundation, transformer, and electrical cabling from the WECS Tower to Substation(s) and their support facilities, including collector systems.” Section 5.11(c).

“WECS Project” means the WECS and associated support facilities including, but not limited to, roads, substations, operation and maintenance buildings, and permanent towers as specified in the application, including the project area as defined by the Owner(s) and includes, but is not limited to a Wind Energy Facility. Section 5.11(c).
a) A WECS Project summary, including, to the extent available:

(1) A general description of the project, . . . including its approximate total name plate generating capacity; the potential equipment manufacturer(s), type(s) of WECS(s), number of WECS, and name plate generating capacity of each WECS; the maximum height of the WECS Tower(s) and maximum diameter of the WECS rotor(s); the general location of the project; and

(5) A preliminary site plan for the installation of a WECS Project showing the planned location of each WECS Tower, guy lines and anchor bases (if any), Primary Structure(s), property lines (including identification of adjoining properties), setback lines, public and private access roads and turnout locations, Substation(s), ancillary equipment, transmission lines, and layout of all structures within the geographical boundaries of any applicable setback.

Finally, “[i]f the application is granted, the board of county commissioners shall require that the project plan be revised to show the final location of all facilities.” W.S. 18-5-503(a)(viii).

III.  CONCLUSION

In sum, the state and county permitting processes do not negatively impact the federal permitting processes. They are distinct processes with their own requirements that do not conflict and, in fact, complement and further the goals of the BLM and the Service to avoid, minimize and mitigate the environmental impacts of the Project. Based on the applicable state statutes, rules, regulations, and standard permit conditions, the situation in which the state and county permits are granted prior to the issuance of the BLM rights-of-way in no way impacts either the ability of the Service or BLM to require Project modifications or to enforce them.
In Reply Refer To:
06E13000/WY12CPA0168

Mr. Garry L. Miller
Vice President, Land and Environmental Affairs
Power Company of Wyoming LLC
555 Seventeenth Street, Suite 2400
Denver, Colorado 80202

RE: Service Recommendations on Avoidance and Minimization for the Chokecherry Sierra Madre Wind Project

Dear Mr. Miller:

Thank you for the opportunity to discuss the avian protection plan (APP) for the Chokecherry Sierra Madre Wind Project (Project) on July 24, 2012. During the meeting, we identified a number of concerns with the July 17, 2012, Eagle and Raptor Avoidance Map (avoidance map) developed by Power Company of Wyoming (PCW), and we suggested several items for further analysis and possible study. This letter serves to articulate our concerns discussed during the meeting and to provide recommendations to PCW regarding development of an APP.

Our standard in evaluating the adequacy of an APP (in relation to BLM IM-2010-156) is that avoidance and minimization must be sufficient so that any remaining take (of eagles) is unavoidable. As such, the APP should identify and commit to avoid areas of high eagle use (both bald eagles and golden eagles) such as nests, areas of concentrated prey base, and movement corridors. While the avoidance map identifies and buffers a number of high eagle use areas (e.g., interior rim, Bolton Rim, and Rasmussen Lake), it does not address additional locations we have identified as areas of potential high eagle use. We are also concerned about the adequacy of the spatial coverage provided by the existing point counts and whether an adequate analysis of eagle use across the project area can be completed with the available data to inform adjustments in project layout and turbine siting.

Data

We only recently received raw data and shapefiles for the Project and are still becoming familiar with them; therefore, it is possible that some of our concerns will be addressed with better understanding of the data. We also look forward to reviewing the remaining data from 2012, as they should increase our knowledge about avian use of the Project area and may reduce
uncertainties. Examples of data sets we anticipate receiving from PCW include eagle flight paths for winter 2012-2013, raptor flight path data, and eagle and raptor nesting data from the summer of 2012. We also anticipate receiving other datasets we requested previously (e.g., flight paths for all raptors, passerine breeding bird densities, prey-base surveys and rodent concentrations). Please let us know if these do not exist or cannot be obtained. We anticipate that data collection will continue through at least March 2013 to be incorporated into the draft APP for Sierra Madre, and we strongly recommend that data collection continue through 2013 to provide further refinement in the APP. Similarly, we anticipate data collection will continue through 2014 to be incorporated into the draft APP for Chokecherry. Because PCW has determined that the radar data are not useful for understanding finer-scale habitat use by eagles, specific recommendations will be forthcoming from our office regarding more extensive coverage in future survey efforts. Finally, we appreciate your time and effort answering our questions and helping us understand the many datasets.

**Eagle Nests**

The avoidance map includes the Bolton Rim and the Hogback, two features that contain numerous golden eagle nests. We agree with your conclusion that wind turbines should not be placed in these areas; however, the current avoidance of important nesting areas is insufficient and we recommend further Project modification to avoid and minimize impacts to these areas. Nests indicate where high eagle use will occur during the breeding season, but they also suggest areas that could be occupied during fall and winter months because of available perching and foraging opportunities. Ideally, we would have detailed information about how eagles use the landscape around each nest, particularly during the breeding season; however, absent detailed information, we can use the one-half inter-mean distance as a surrogate for territory size and an expectation of high eagle use (Service 2011).

Using known, active nests within and near the Project area (year 2 for GOEA, year 3 for BAEA), we calculated a project-specific one-half mean inter-nest distance of 3,495 meters for golden eagles and 3,686 meters for bald eagles. We then buffered all active and inactive eagle nests as a starting point for evaluation of high eagle use areas. Because the one-half mean inter-nest distance is a surrogate for territory size and only approximates eagle use, we recommend that site-specific information be used to adjust buffers around eagle nests. For example, the one-half mean inter-nest distance around the bald eagle nest south of Rasmussen Lake does not extend to the north side of the lake, which is used by bald eagles during the breeding season and likely during fall and winter months too. In this case, site-specific information would elongate the buffer northward to encompass the entire lake and any surrounding areas of high use such as tall tree that serve as perch sites or roost locations, as your proposed avoidance map does. Site-specific information might also be used to shorten the one-half mean inter-nest buffer in other directions, provided enough is known about eagle use patterns of the area’s topographical features.

In other cases, site-specific data might provide a justification for reducing the one-half mean inter-nest distance, especially if the vast majority of the eagle use occurred outside of the Project area. This level of detailed information, however, is rarely available. For example, a golden eagle nest (#162) was active during the second year of monitoring on the southwest side of the Sierra Madre project area, but we do not have flight path data or eagle observations in this area when the nest was active. Without good habitat use data, we must assume this pair of eagles
actively defended its territory and foraged within the Project area to the north and east of the nest. Nest-specific data showing the birds did not fly or forage far within the Project area might provide biological support to reduce the one-half mean inter-nest distance buffer for this particular nest.

The project area contains a number of historic golden eagle nests along the Bolton Rim that were not active in 2008, 2011 or 2012. Unless conditions have changed (e.g., cliff subsided, habitat is no longer suitable), any of these nests could become active in future years. Without informed knowledge about how eagles at these historic nests might use the surrounding landscape during active years, placing turbines near the historic nests could create a source of eagle fatalities and result in nest abandonment. It may be impossible to gather the necessary information if the nests are not active during the period of study; however, additional evaluation and/or modeling of the geologic features and prey base might provide a scientific basis to reduce or eliminate the one-half mean inter-nest distance around the historic golden eagle nests.

Concentrated Prey Base

The Draft Eagle Conservation Plan Guidance recommends that wind projects, “Avoid siting turbines in areas where eagle prey are abundant” (Service 2011, p. 67), and “foraging areas” are included in the definition of important eagle use areas (50 CFR 22.3). Another issue of concern is the presence of concentrated prey base (i.e., white-tailed prairie dog towns and colonies) within much of the Sierra Madre portion of the Project area. Prairie dogs and other colonial rodents (e.g., Wyoming ground squirrel) are valuable food resources and provide important foraging areas for eagles and other raptors; therefore, it is possible to have many birds of prey concentrated around areas of colonial rodents.

Surveys conducted in 2008 identified small, scattered pockets of white-tailed prairie dogs, including colonies along the proposed access and utility corridors that would connect the Chokecherry and Sierra Madre areas (WEST 2008). The survey report also identified two general areas of relatively extensive white-tailed prairie dog colonies which covered more than 1,500 and 2,000 acres, respectively (WEST 2008). While the 2008 study found scattered pockets of prairie dogs, a study in 2010 identified a substantial prey base in the project area:

Based on BLM survey criteria, background literature, and field surveys, SMITH identified 198 [white-tailed prairie dog] towns across 352 sq mi of mostly BLM land within the Bolton Ranch [black-footed ferret] Complex Study Area...most of the [white-tailed prairie dog] towns exceeded [black-footed ferret] preferred densities 8 or 27 burrows per acre...Based on SMITH's analysis, sufficient [white-tailed prairie dog] towns exist that exceed both [black-footed ferret] criteria (7km and 1.5 km). SMITH believes that the Bolton Ranch Study area consists of suitable habitat characters for the [black-footed ferret]” (SMITH 2010, p. 19).

Both of these studies found white-tailed prairie dog colonies within and adjacent to the Project area, though they disagree somewhat on the densities of this prey base. Differences in the studies might be explained by survey methods or by variation in the prairie dog population over the course of three years. As we evaluate the adequacy of the APP, it is important for us to consider all of available scientific information and to consider the potential growth of prairie dog populations in the future (e.g., re-colonization, expansion). We understand that SWCA is
conducting surveys of potential white-tailed prairie dog colonies that may explain some of the apparent discrepancy in the two previous studies. At this time, we do not have information regarding SWCA’s survey methods or study design: it is important that methods from the study follow approved protocols and survey designs, and that surveyors are adequately trained. Based on the results of the SWCA study, in conjunction with WEST and SMITH studies, the Service will evaluate opportunities to avoid and minimize potential risks to eagles from areas of high density prey base.

**Kernel Analysis for Eagles**

Portions of the proposed eagle and raptor avoidance map were developed through a kernel estimator using eagle flight path data. Based on our initial analysis of the eagle flight path data, it appears that some areas of high eagle use (e.g., the interior rim) were included in the avoidance map, while others (e.g., Miller Hill) were excluded from the avoidance map. It is unclear how the kernel analysis was conducted: we ask that SWCA provide a complete description of the methods used including data, software, assumptions, estimator, and supporting documentation and literature.

We are concerned that the available eagle data may not be suitable for use in the kernel analysis. Because the kernel analysis depends on some likelihood of eagle presence, it is important that the observations of eagle activity closely align with actual eagle activity. One example is that the kernel estimator will treat areas of zero observations the same as areas of no eagle activity. Unfortunately, there are portions of the vast Project area where there are no recorded observations of eagle activity. While this could be due to the lack of eagle activity, it could also be due to the lack of survey effort in these locations. If true, this means portions of the Project area could have substantial eagle activity but would not be identified by the kernel estimator. Therefore, it might not be appropriate to use the kernel estimator to evaluate eagle use patterns, especially in areas of little or no data.

Another concern with the eagle data used in the kernel analysis is the assumptions about the ability for observers to detect eagles at greater distances. Point count surveys for eagles and other large raptors should not exceed 800 meters, and while observations can be recorded at distances greater than 800 meters, they should be analyzed separately (Service 2011; Strickland 2011). While it is true that approximately 60 percent of all eagle observations by SWCA occurred at distances greater than 800 meters, it is also true that 40 percent of the detections occurred in an area of just two square kilometers (km), while the remaining 60 percent occurred over an area of about 126 km² (assuming 6.4-km radius). Furthermore, based on the frequency of detections within 0.8 km, it appears the surveyors were detecting only about half of the eagles between 0.8 and 2.0 km, and were detecting only a quarter of the eagles between 2.0 and 4.0 km (Table 1). Detections beyond 4 km were a fraction of those observed near the survey point.
Table 1. Average number of eagle detections within grouped distances from the observer, based on similarity of detections. Percent detection is the average number of detections divided by the average number of detections within 800 meters (i.e., 72).

<table>
<thead>
<tr>
<th>Distance</th>
<th>Average Detection</th>
<th>Percent Detection</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 800 meters</td>
<td>72</td>
<td>100</td>
</tr>
<tr>
<td>801 to 2000 meters</td>
<td>35</td>
<td>49</td>
</tr>
<tr>
<td>2001 to 4000 meters</td>
<td>18</td>
<td>25</td>
</tr>
<tr>
<td>4001 to 7600 meters</td>
<td>1.9</td>
<td>2.6</td>
</tr>
</tbody>
</table>

The underlying assumption for the kernel analysis is that any difference in eagle activity is due to eagle use and not the detectability of the eagle. Determining how much of the observed eagle use (e.g., eagle flight paths) is due to non-random sample location (e.g., on ridgelines) and actual eagle use (e.g., higher use on and near ridgelines) and how much is due to observer detectability (i.e., distance) may present our biggest challenge in evaluating the eagle flight path data. If survey locations are situated in areas of high eagle use and with good vantage points, we should expect some increased level of detectability near the observer; however, that would not explain all of the lower detectability at greater distances. Consequently, we recommend more intensive survey efforts be conducted over the next year in order to provide finer scale data. The Service will provide survey recommendations in the near future.

**Miller Hill**

We are concerned that the proposed avoidance area near Miller Hill is not sufficient given the considerable use of the area by eagles and other raptors. For example, the eagle flight path data show Miller Hill receives similar use as the interior rim (Figures 1a and 1b). Also, a golden eagle nest is located in the southwest corner of Sierra Madre near Miller Hill and was active in the second year of surveys. Unfortunately, we do not have eagle use data (e.g., flight path data, foraging areas) from that year to evaluate how the pair and young used Miller Hill and the surrounding landscape, but we must assume the amount of use was greater when the nest was active than during the third year of surveys in which the eagle flight path data were collected. In addition, Miller Hill is immediately adjacent to (and apparently within) areas identified as white-tailed prairie dog towns and colonies (Smith 2010). White-tailed prairie dogs are an example of a concentrated prey base that is heavily used by eagles and other raptors. Other small rodents like Wyoming ground squirrels might be intermixed within the prairie dog colonies, increasing the density of the local prey base. In addition, there are numerous sage-grouse leks near Miller Hill, and sage-grouse can provide a valuable food resource for golden eagles. Finally, like bald eagles that regularly prey upon waterfowl, golden eagles will occasionally take waterfowl. It is possible that golden eagles (and bald eagles) may travel between Miller Hill and Rasmussen Lake, particularly in the fall as prairie dogs begin hibernating. Given the high eagle and raptor use of Miller Hill, the location of the active golden eagle nest on the border of Sierra Madre, the availability of concentrated prey base including prairie dogs, ground squirrels, sage-grouse and perhaps waterfowl, we recommend the proposed avoidance area be enlarged to include more of the high eagle and raptor use areas.
Summary of Specific Recommendations

(1) **Eagle Nests** (letters correspond to items in Figure 2)

(a) Add avoidance area around GOEA nest #162 at SW corner of Sierra Madre

(b) Confirm BAEA use around Rasmussen Lake and adjust avoidance area if necessary to protect eagles from nest #171 as well as fall and winter eagle use

(c) Based on eagle use and prey base densities, add an avoidance area around GOEA nest 199 on south end of Sierra Madre

(d) Collect additional data on eagle use of nests on the Bolton Rim, including foraging areas of any active nests. For inactive nests, describe likely foraging areas and potential use within Chokecherry portion of the project area. Adjust avoidance areas for confirmed or suspected use.

(e) Collect additional data on eagle use of nests on the northern rims, including foraging areas of active nests. For inactive nests, describe likely foraging areas and potential use within Chokecherry portion of the project area. Adjust avoidance areas for confirmed or suspected use.

(f) Collect additional data on eagle use at the GOEA nest in Chokecherry West, including foraging areas. If inactive, describe likely foraging areas and potential use within Chokecherry West. Expand avoidance area in NW to protect eagle use near the nest.

(g) Evaluate and/or model the geologic features and potential flight paths and foraging areas to estimate the areas of high eagle use in the event these inactive nests (territories) are reoccupied. Based on results of the modeling or site-specific evaluation, adjust the proposed avoidance area to protect areas of highest eagle use.

(2) **Concentrated Prey Base** (letters correspond to items in Figure 3)

(h) Previous studies came to different conclusions on prairie dog burrow densities in the project area. Determine current prairie dog activity, including burrow densities, following approved protocols, survey designs, and surveyor training. Ensure sampling effort provides adequate spatial coverage.

(i) The avoidance map includes an area in eastern Sage Creek Basin. Based on the available data, we agree that this area receives considerable eagle use and should be avoided; however, the avoidance area may need to be expanded. Only two eagle point counts are located in Sage Creek Basin, an area reported to contain high concentrations of prairie dog burrows. While eagle activity occurs in Sage Creek Basin, it appears highly correlated with the survey locations, suggesting the observed eagle activity patterns may be due to observer detectability rather than actual eagle activity. Given the reported high density prey base, we recommend (h) above as well as additional avian point count surveys in Sage Creek Basin to determine if eagles and other raptors are foraging within this area. Specific recommendations from the Service on the number and location of survey points will be forthcoming.
(3) Miller Hill (letters correspond to items in Figure 4). The avoidance map includes an area in Miller Hill; however, it is unclear how this avoidance area was determined as it does not correspond to high eagle use, high density prey base, other prey resources, and active eagle nests.

(j) Based on eagle exposure rates, RM14 had the third highest eagle use (similar to that of the Interior Rim) of all 15 eagle/raptor point count locations, and RM13 had the fourth highest use. Both of these points occur on the eastern side of the proposed avoidance area, suggesting additional survey data are needed in this location. We will provide survey recommendations in the near future.

(k) At least one study reported high density prairie dog colonies and towns occur on the western side of Miller Hill. Eagle flight path data on this side suggest lower eagle use than on the eastern side; however, additional survey data are also needed for this area due to potential high density prey base, and the presence of sage-grouse that are also prey items for golden eagles. We will provide survey recommendations in the near future.

(l) Monitor GOEA nest #162 at SW corner of Sierra Madre. If active in 2013, determine activity patterns of the eagles including flight paths, foraging locations, and roosts, and continue monitoring activity of the adults and fledglings.

(m) In evaluating eagle use on the western side of Miller Mountain (and at nest #162), monitor eagle use patterns at and near the greater sage-grouse leks, particularly while grouse are on leks.

(n) Determine if golden eagles are moving between Miller Hill and Rasmussen Lake in search of prey, particularly during the fall when prairie dog numbers decline and waterfowl and coot numbers increase.

(4) Recommendations for Additional Data Needs

We have not yet seen (i) the flight path data for raptors, (ii) the eagle flight path data for winter of 2013, (iii) the eagle use and flight path data for the spring and summer of 2013, including data for points added for 2012. These data may prove useful. For example, Not only will the raptor flight path data help identify raptor use as surrogates for eagles, activity use patterns of other raptors can help understand how eagles may move across the project area following areas of uplift for example.

Based on data we have seen, we do not have sufficient information to provide site-specific recommendations for avoidance areas or micro-siting of turbines. Given the lack of data coverage (e.g., only 3% of project area covered by 800-m point counts, based on second year of surveys), our initial recommendations are to avoid construction within the one-half mean internest distance around nests, and avoiding areas of concentrated prey base as well as flight/migration corridors and winter roosts. We recognize our proposed avoidance areas include large blocks of the proposed project area; therefore, we recommend additional data collection to reduce uncertainty and to allow refinement of avoidance areas.

We are working with the Region and Washington Offices to develop specific recommendations for data collection needs and design, to be provided in the near future.
If you have questions regarding this letter, please contact Nathan Darnall or Tyler Abbott of my office at the letterhead address or phone (307) 772-2374, extension 246 or 231, respectively.

Sincerely,

R. Mark Sattelberg
Field Supervisor
Wyoming Field Office

cc: SWCA, Jon Kehmeier (via e-mail)
BLM, Pam Murdock (via e-mail)
BLM, Mike Valle (via e-mail)
FWS, Pam Repp (via e-mail)
FWS, Casey Stemler (via e-mail)
References Cited


Figure 1a. Spatial distribution of eagle exposure rates (eagle minutes/[survey minutes*survey area]) at fifteen 800-m point count locations between April 2011 and April 2012. Exposure rates were highest at RMs 5, 11 and 14 and were lowest at RMs 12 and 15.
Figure 1b. Eagle exposure rates (eagle minutes/[survey minutes*survey area]) at fifteen 800-m point count locations between April 2011 and April 2012.
Figure 2. Location of the specific eagle nest recommendations. Letters in the figure correspond to recommendations described in the text.
Figure 3. Location of the specific concentrated prey base recommendations. Letters in the figure correspond to recommendations described in the text.
Figure 4. Location of the specific concerns near Miller Hill. Letters in the figure correspond to recommendations described in the text.
MEMORANDUM
BY ELECTRONIC MAIL

TO: Nathan Darnall, U. S. Fish and Wildlife Service
FROM: Garry L. Miller
DATE: August 10, 2012
RE: Response to August 8, 2012 Data Request

This memo responds to the data request sent by you to Jon Kehmeier and me via e-mail on August 8, 2012. Responses below correspond to the numbered requests.

One issue I would like to address up-front is additional data collection going forward. As discussed on a number of prior occasions, Power Company of Wyoming’s (PCW’s) avian survey protocols were developed in conjunction with the U. S. Fish and Wildlife Service (Service) in 2010 and 2011. The protocols are based upon the Service’s strong recommendation to (1) sample eagle high-use areas and (2) employ an avian radar unit for sampling. PCW followed the Service’s recommendations explicitly. As a result, the ground survey data (long-watch raptor surveys) are biased towards high-use areas and significantly overstate eagle-minutes/hour/km² on a project-wide basis. In addition, the radar data (collected at a cost of several hundred-thousand dollars) are not suitable for use in the Service’s risk assessment model.

I understand the Service is meeting internally next week to discuss additional data needs. As stated during our telephone call on August 9, 2012, PCW wants to work collaboratively with the Service to identify data needs, survey methods, and sampling designs appropriate for use in the Service’s risk assessment model. PCW’s evaluation of the Service’s model is that the model makes important assumptions about the underlying sampling strategy used to collect data. Therefore, the Service’s risk assessment model is very sensitive to survey data inputs and requires further consideration of data collection methods and sampling designs. PCW/SWCA looks forward to meeting with the Service in the very near future to discuss additional data collection with the objective of obtaining robust data that are well-suited for the Service’s risk assessment model.
1. Request: Flight paths for all raptors.

Response: As set forth in my July 6, 2012 memo to the Service, SWCA Environmental Consultants, consultant to PCW, has not yet compiled flight path data for raptors other than eagles. This data will be compiled and included with the Bird and Bat Conservation Strategy. The BBCS is under development and will be submitted to the Service following submission of PCW’s Eagle Conservation Plan. A shapefile of all raptor observation locations from April 2011 through March 2012, in addition to other GIS data layers, was made available to the Service on July 6, 2012 by e-mail from me to Trish Sweanor, Tyler Abbot, Mark Sattleberg and Kevin Kritz. That e-mail contained a link to a PCW FTP site where the data were available for download. At a meeting on July 24, 2012 at the Service’s office in Cheyenne, the Service requested that this dataset be updated. On July 27, 2012 an e-mail was sent by Clint King of SWCA to you, Tyler Abbot, Trish Sweanor, Kevin Kritz and Tim Modde that contained a GIS data layer of all raptor observations from April 2011 to June 20, 2012. In addition, the eagle flight path data layer from April 2011 through March 2012 and an associated description of all the attributes contained therein was resubmitted at that time.

2. Request: Data for the 1 km² breeding bird densities.

Response: These data were previously requested and were provided to you, Tyler Abbot, Trish Sweanor, Kevin Kritz, Mark Sattleberg, and Tim Modde on July 18, 2012. Please let me know if the data need to be resubmitted.


Response: As stated in my July 6, 2012 Memo, no ungulate parturition areas have been identified by the Bureau of Land Management (BLM), Wyoming Game and Fish Department (WGF), or PCW/SWCA within the vicinity of the Chokecherry and Sierra Madre Wind Energy Project area (CCSM Project). See FEIS at page 4.14-111. Ungulate parturition areas do not provide foraging opportunities for eagles within the vicinity of the CCSM Project.

4. Request: Sage-grouse brood rearing habitat.

Response: As detailed in my July 6, 2012 memo, important sage-grouse brood rearing habitat is located within the Sage Grouse Core Population Areas established under the Wyoming Governor’s Executive Order 2011-5. PCW has committed to no development in Core Population Areas. See Appendix C - Applicant Committed Measures, FEIS, at page C-4. To the extent that important sage-grouse brood rearing areas provide significant eagle foraging opportunities, these areas will not be disturbed by development of the CCSM Project. In addition, PCW and its ranching affiliate have committed to place approximately 26,000 acres of private land located in Core Population Areas in a conservation easement in conjunction with construction and

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operation of the CCSM Project. The conservation easement will protect this important sage-grouse habitat in perpetuity. See attached Map delineating the proposed conservation easements as well as proposed eagle and raptor avoidance areas discussed at the July 24, 2012 meeting.

5. Request: Results from sage-grouse monitoring program.

Response: PCW is presently updating its CCSM Project Sage-Grouse Conservation Plan (January 2012) previously submitted to BLM as a part of the CCSM Project Plan of Operations. The updated Conservation Plan will contain demographic data that describe the current status of the greater sage-grouse population within the CCSM Project area and vicinity. The updated Conservation Plan will be submitted to the BLM by August 17, 2012. A copy will be provided to the Service upon submission to BLM.


Response: This topic has been discussed a number of times over the past several months. Due to the importance of the issue, I will provide a response by separate memo. The memo will address the current status of PCW/SWCA knowledge and best available scientific information. In the meantime, the FEIS contains the best available scientific information as of its release date (July 2, 2012). See FEIS at pages 3.15-1, 4.15-9, 4.15-20, 4.15-26, and 4.15-31. Notably, the FEIS did not rely on information from the Smith Report (2010) which both SWCA and BLM have now concluded is seriously flawed as the Report’s findings cannot be corroborated through independent field investigations and surveys. I understand that Heath Cline, biologist from the BLM’s Rawlins Field Office, will contact the Service and discuss the Smith Report (personal communication between Jon Kehmeier and Heath Cline). Mr. Cline recently accompanied SWCA staff on a site visit to investigate findings of the Smith Report.

7. Request: Rodent concentrations (e.g., ground squirrel).

Response: As detailed in my July 6, 2012 memo, over the course of the greater sage-grouse and avian studies SWCA’s field biologists record incidental observations of rodents within the CCSM Project area which may provide a qualitative assessment of relative abundance and spatial distribution. However, no rodent surveys have been undertaken by PCW/SWCA and PCW/SWCA are not aware of any other data sources. As previously mentioned and as will be detailed in the separate memo on prey-base data, PCW has recently engaged SWCA to undertake studies and surveys to examine the validity of the Smith Report (2010) and to provide better data. This data will be provided with SWCA’s report assessing prairie dog habitats within the CCSM Project area.

8. Request: Update on additional point count locations for 2012.

Response: The coordinates for Year Two and Year Three point count locations were made available to the Service on July 6, 2012 by e-mail from me to Trish Sweanor, Tyler Abbot, Mark
Sattleberg and Kevin Kritz. That e-mail contained a link to a PCW FTP site where the data were available for download.

Please let me know if you have any additional data needs or questions. Thank you.

Garry L. Miller

cc: Jon Kehmeier, Tyler Abbott, Trish Sweanor, Kevin Kritz, Tim Modde, Mark Sattelberg, Emily Bjerre, Brian Millsap, Mark Otto, Stephen Guertin, Noreen Walsh, Michael Thabault, Casey Stemler, David Cottingham, Clint King, Dr. Joshua Millspaugh, Pam Murdock
August 14, 2011

Tyler Abbott, Deputy Field Supervisor
U. S. Fish and Wildlife Service
Ecological Services Wyoming Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

Re: Chokecherry and Sierra Madre Wind Energy Project
   Eagle Conservation Plan

Dear Tyler:

The Power Company of Wyoming LLC (PCW) is pleased to provide the U.S. Fish & Wildlife Service (Service) with an updated Eagle Conservation Plan (ECP) for the Chokecherry and Sierra Madre Wind Energy Project in Carbon County, Wyoming (Wind Project). We believe that this ECP is best-in-class, fully adheres to the Service’s Land-based Wind Energy Guidelines (2012) and Draft Eagle Conservation Plan Guidance (2011), and in fact, sets the standard for characterizing and addressing risks to eagles.

As you know, the Wind Project is subject to a two-step approval process as outlined below:

First, Bureau of Land Management (BLM) has completed a “project-wide level” or “project-landscape level” Final Environmental Impact Statement (FEIS). Based on this FEIS, the BLM is expected to issue a Record of Decision (ROD). Before, however, the BLM will issue a ROD, BLM has indicated that it will require concurrence from the Service on the associated project-landscape level Eagle Conservation Plan (ECP) pursuant to IM 2010-156. The ROD and associated ECP will set out the basic parameters such as the boundaries of the wind development areas, and the applicable environmental and site constraints with which PCW must comply. The issuance of the ROD in this first step will form the basis for the second round of submissions from PCW, additional NEPA analysis, and project modification/refinement.

Second, following BLMs issuance of the ROD, PCW will finalize the siting of the wind turbine generators (WTGs) and submit site-specific Plans of Development (site-specific PODs) to the BLM. These site-specific PODs will be subject to additional NEPA analysis to ensure they conform to all the requirements of the ROD and consider any new
information that is available. For each site-specific POD with WTGs, PCW will submit a site-specific ECP to the Service. The site-specific ECPs will consider all current survey and modeling information and will include site-specific measures to avoid, minimize and mitigate adverse effects to eagles. In conformance with BLM Instructional Memorandum 2010-156, BLM will not issue PCW a Notice to Proceed with the construction outlined in the site-specific POD with WTGs until the Service reviews and concurs with the site-specific ECP.1

As a result of this two-step process, the Service will have the opportunity to review the site-specific ECPs with WTGs in light of the project-level ECP and to work with PCW on the final siting of the turbines using the best available data. PCW has voluntarily elected to prepare this ECP and to make the significant commitments outlined in the ECP. PCW also plans to voluntarily apply for a programmatic take permit under the Bald and Golden Eagle Protection Act (BGEPA). However, BLMs Record of Decision should not be conditioned on PCW obtaining a programmatic take permit. PCW should not be delayed in the commencement of construction of this critical renewable infrastructure Project pending the possible receipt of a programmatic take permit, particularly where the Service has never issued a programmatic take permit.

Moreover, as addressed in detail in Appendix D in the ECP, the state and county permits that are expected to be issued in the near future will not negatively impact the ability of the Service and the BLM to require future modifications or to enforce them. Both the state and county permits will require compliance with all applicable federal laws and standards and both the state and county processes have the procedural and statutory mechanisms in place to address Project modifications after the respective permits are granted.

In developing its Project and this ECP, PCW has complied with both the Service’s Draft ECP Guidance and the Service’s Land-Based Wind Energy Guidelines. A summary of PCWs compliance with both is set out in Table 11 of the ECP.

Stage 3 of the ECP Guidance requires the prediction of the annual number of fatalities for the Project. The FEIS for the Project uses Year One data and regression analysis to estimate fatalities for the Project at 46 to 64 eagles annually. This estimate is unreliable and should not form the basis for decisions relating to the Project or this ECP. First, the Year One data does not represent the best available science. There is more current data in that Year Two annual survey data is now available.2 Second, the Year One data was

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1 This initial project-landscape level ROD and associated ECP are analogous to a subdivision plat that sets out the location of infrastructure such as roads and building sites or lots along with the applicable zoning and building requirements that must be met. The subdivision plat is followed by specific building plans for each lot that must be reviewed to ensure that they conform to all the requirements of both the subdivision plat and any constraints particular to the site.

2 The regression analysis requires a full year of eagle use data; therefore, Year Two data are most appropriate for use in the model and for comparison to the WEST Year One data. Upon completion of Year Three surveys (Winter 2012-2013), comparisons using both Year Two and Year Three data will be made.
collected over only 3.2% of available daylight minutes in a year and cover only 4.9% of the likely turbine development areas. In contrast, the Year Two survey data account for approximately 49.4% of all available daylight minutes in a year and cover 97% of the likely turbine development areas. Using BLMs regression analysis with the more current Year Two data, annual eagle fatalities are predicted to be between 8 and 12 golden eagles.

The estimate of annual golden eagle fatalities of 8 to 12 is a more realistic estimate in light of the data collected on the resident population (18 to 28 individuals; Project Site plus 5 mile buffer), the eagle use patterns observed throughout the Wind Development Areas, and the fact that the Project Site is not a major eagle migration corridor. This range is also consistent with the estimate of 22 individuals generated using Bird Conservation Region 10 (BCR 10) eagle density values. Under the BGEPA Permit Final Environmental Assessment, annual take levels of 5% of the local area population (Project Site plus 10 miles plus 140 miles) is considered the maximum while annual take levels of 1% or less are deemed a benign harvest rate. For the Project’s local area population of 2,655 golden eagles, 5% take would equal 133 golden eagles per year and 1% take would equal 27 golden eagles per year. Therefore, at 8 to 12 golden eagles per year – even before the application of the Advanced Conservation Practices outlined in the ECP, the Project-level impacts will be consistent with conservation of eagle populations and will result in no measurable net-loss of golden eagles from the development of the Project.

As outlined in detail in the attached ECP, PCW has identified and commits to significant measures to avoid, minimize and mitigate the Project’s impact on eagles, including: (a) compliance with the significant and detailed Advanced Conservation Practices set out in Section 8.0 of the ECP; (b) compliance with the identified eagle and raptor avoidance areas and setbacks where the highest eagle use of the Project occurs based upon ground surveys and radar data which will substantially reduce risk to eagles and collision mortality; (c) granting conservation easements in conjunction with construction and operation of the Project on approximately 26,000 acres of private land.

The commitments in the ECP, in combination with the various applicant-committed conservation measures and conservation plans included in the Project Plan of Development and described in the ECP, along with the requirements outlined in the Environmental Impact Statement (EIS), promote the conservation of bald and golden eagles as well as many other avian, wildlife and fish species within the Project Site. Moreover, prior to the issuance of Project authorizations, PCW has proactively moved forward with a variety of science-based programs to both better understand wildlife habitats and use and to implement advanced conservation measures that will avoid,
minimize and mitigate adverse effects on wildlife and ecosystems. PCWs data collection, planning and conservation commitments are setting the standard for developing renewable resources in an environmentally responsible manner.

PCW requests that the Service review this ECP, work with PCW to include revisions that are consistent with the requirements of applicable statutes and the purpose of the Project, and issue a concurrence letter to BLM stating that the attached project-landscape level ECP satisfies the requirement set out in the BLMs IM 2010-156.

Sincerely,

Garry L. Miller
Vice President, Land and Environmental Affairs
VIA EMAIL: Tyler_Abbott@fws.gov

September 7, 2012

Tyler Abbott, Deputy Field Supervisor
U. S. Fish and Wildlife Service
Ecological Services Wyoming Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

Re: Chokecherry and Sierra Madre Wind Energy Project

Dear Tyler:

Attached is an Expert Report prepared by Dr. Joshua J. Millspaugh, O’Connor Distinguished Professor of Wildlife Management, Department of Fisheries and Wildlife Sciences, University of Missouri, concerning his review and analysis of the U. S. Fish and Wildlife Service’s Eagle Fatality Model, the eagle fatality estimates for the Chokecherry and Sierra Madre Wind Energy Project derived by the Service, the data on eagles that the Service used in the Model, and the use of the Service’s Model to estimate eagle fatalities on a re-designed project that excludes certain designated high eagle use areas.

As you know, and as detailed in the Eagle Conservation Plan prepared by PCW and submitted to the Service on August 14, 2012, based on the Service’s estimated eagle fatalities for the Project, PCW followed the Service’s Draft Eagle Conservation Plan Guidance (January 2011) and re-designed the Project. Data from field surveys were used to generate eagle use densities for identification of high use areas that were then used to develop the turbine no-build areas identified in PCW’s ECP.

In accordance with Stage 3 guidance, Dr. Millspaugh applied the Model to the Project as re-designed to evaluate the potential for take of eagles. Dr. Millspaugh concluded that applying the Model to the Project as re-designed results in an 80% quantile number estimate of 23 or fewer eagle fatalities. According to Dr. Millspaugh, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of fatalities for this scenario was 11 eagle fatalities.

In addition, Dr. Millspaugh opines that the Model run using the re-designed Project still likely overstates the impacts of the Project because the Model does not account for population abundance, turbine daylight operating hours, eagle flight height, and survey sampling bias. Dr. Millspaugh is preparing a separate report addressing some of the assumptions contained in the Model when applied at the Project area. This report will be provided to you as soon as available.
Nevertheless, based upon the Service’s Model, PCW’s Project re-design resulted in a 63.5% reduction in predicted eagle fatalities compared to the Service’s model run that did not consider the turbine no-build areas.

Please let me know if you should have any questions concerning the attached. Thank you.

Sincerely,

/s/ Garry L. Miller

Garry L. Miller
Vice President, Land and Environmental Affairs
Date: September 7, 2012

To: Garry Miller, Vice President, Land and Environmental Affairs, Power Company of Wyoming LLC, 555 Seventeenth Street, Suite 2400, Denver, CO 80202

From: Dr. Joshua J. Millspaugh, O'Connor Distinguished Professor of Wildlife Management, Department of Fisheries and Wildlife Sciences, University of Missouri, 302 Natural Resources Building, Columbia, MO 65211

Subject: Expert Report

I. Executive Summary and Expert Opinions

I was asked to perform a review and critical analysis of the U.S. Fish and Wildlife Service’s Eagle Fatality Model, the eagle fatality estimates for the Chokecherry and Sierra Madre Wind Energy Project derived by the Service, the data on eagles that the Service used in the Model, and the use of the Service’s Model to estimate eagle fatalities on a re-designed project that excludes certain designated high eagle use areas. My opinions are based upon my training, experience, education, and my expertise in wildlife ecology and the application of statistical techniques and tools to address conservation issues. In sum, my opinions are:

- For purposes of this report and analysis, no adjustments were made to the base assumptions used by the Service in the Service’s Eagle Fatality Model. However, the Service’s Eagle Fatality Model maintains some questionable assumptions when applied at the Project area. This conclusion will be explained in detail in a subsequent report, however, my examination of the Model has shown that it assumes (1) an infinite population of eagles exposed each year; (2) turbines operate during all daylight hours, all year long; (3) eagles are at risk whether their flight height is above, below, or at rotor height; and (4) data on eagle use were collected randomly with respect to space and time. By not considering the validity of these assumptions, the Model overestimates the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project. This conclusion will be explained in detail in a subsequent report.
Eagle data collected for the Project and used as input in the Model was biased in terms of its relationship to the eagle fatality models. My review of the input data suggests that sampling focused on presumed high use eagle areas. Sampling in this manner does not provide a representative sample of total eagle use of the project area. It results in an upward bias of eagle minutes and consequently, inflates the number of predicted eagle fatalities that would occur each year.

The kernel density maps prepared by SWCA Environmental Consultants (SWCA) are accurate in delineating high use areas from the available data.

Using the data for all land areas prior to the Project’s re-design to remove turbines from high eagle use areas results in an 80% quantile number estimate of 63 or fewer eagle fatalities. The output of the Service’s Model is a probability distribution representing a range of fatality estimates. This Model output should not be used to assert that there will be 63 eagle fatalities per year. Reliance on the 63 eagle fatality value is very conservative and Model results suggest the actual number of eagle fatalities is likely to be far fewer. For example, the median estimated number of fatalities for this scenario was 29 eagle fatalities. This conservative benchmark is added on top of the already risk averse approach taken by the Service in developing the Model.

Data clipped for use in the Eagle Fatality Model to estimate eagle fatalities for the project as re-designed was clipped accurately. The overall data set was appropriately modified to remove eagle use data for the areas removed from the wind farm (turbine no-build areas).

Using the clipped data in the Model representing the Project as re-designed results in an 80% quantile number estimate of 23 or fewer eagle fatalities. Again, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of fatalities for this scenario was 11 eagle fatalities.

II. Relevant Experience and Expertise

My experience and expertise are in wildlife ecology and the application of statistical techniques and models to address conservation issues. I have attached my Curriculum Vitae (see Attachment 1), but am providing a summary here of my relevant experience and expertise. Currently, I am a full professor and the Pauline O’Connor Distinguished Professor of Wildlife Management in the School of Natural Resources, Department of Fisheries and Wildlife Sciences, University of Missouri. I have a Ph.D. in Wildlife Ecology from the College of Forest Resources, University of Washington, Seattle. I did postdoctoral studies in quantitative ecology at the School of Aquatic and Fishery Sciences, University of Washington. Selected honors and awards are detailed on my C.V., however, they include a 2008 award from the U.S. Department of Agriculture for National Teacher of the Year, a 2007 award from the Wildlife Society for Best Article (with Steve Buskirk), and a 2005
award from the Missouri Department of Conservation for “Outstanding Research Collaborator of the Year.”

I have obtained about 55 grants and contracts as either PI or Co-PI since starting my faculty position in 1999 from diverse funding sources such as the U.S. Fish and Wildlife Service, National Fish and Wildlife Foundation, National Science Foundation, U.S. Forest Service, National Park Service, and the National Renewable Energy Lab. One recent grant is for the period 2011-2016 to study the *Ecology of Greater Sage-grouse in Relation to Wind Energy Development in Wyoming*. This study is being funded by the U.S. Forest Service, National Renewable Energy Lab, National Fish and Wildlife Foundation, Power Company of Wyoming (PCW), Wyoming Game and Fish Department, Bureau of Land Management, Western Association of Fish and Wildlife Agencies, and National Wind Coordinating Collaborative.

I have published 4 books and 160 peer-reviewed journal articles and book chapters. Three books are directly applicable: (1) *Models for Planning Wildlife Conservation in Large Landscapes*, 2009, Millspaugh, J.J. and F.R. Thompson, III, editors, Academic Press, 674 pages; (2) *Design and Analysis of Long-Term Ecological Monitoring Studies*, 2012, Gitzen, R.A., J.J. Millspaugh, A.B. Cooper, and D.S. Licht, editors. Cambridge University Press, 600 pages; and (3) *Wildlife Demography: Analysis of Sex, Age, and Count Data*, 2005, Skalski, J.R., K.E. Ryding, and J.J. Millspaugh, Elsevier Science, 656 pages. In addition to these publications, I have been an invited plenary speaker at national and international conferences to discuss the application of statistical techniques and models in wildlife ecology and management.

I have applied and evaluated statistical techniques and models in addressing conservation issues for a broad range of species, including mammals, avifauna, reptiles, and amphibians. For example, at the request of the Wisconsin Department of Natural Resources, I chaired an international panel of experts in evaluating data and models the agency uses to monitor and estimate white-tailed deer population demographics. Specifically, we evaluated the validity of the assumptions of their population reconstruction model, assessed adjustments made in the model by state personnel, and offered guidance on future applications. I was the senior author on a paper published in the *Journal of Wildlife Management* in 2009 that summarized our findings. A second example relates to my continued development of animal movement and habitat models. In addition to applying these statistical models to diverse taxa ranging from hellbenders to elephants, I have collaboratively developed new statistical approaches to analyzing such data and rigorously evaluated methodology. Specifically, my colleagues and I were among the first to apply discrete choice models in a wildlife context and we pioneered the development of resource utilization functions, both of which have become standard modeling tools for ecologists over the past decade. Thus, my experience and expertise are directly applicable to the analysis I was asked to perform.
III. Critical Analysis of Eagle Fatality Modeling for the Chokecherry and Sierra Madre Wind Energy Project

I was asked to perform a review and critical analysis of the U.S. Fish and Wildlife Service’s Eagle Fatality Model, the eagle fatality estimates for the Chokecherry and Sierra Madre Wind Energy Project derived by the Service, the data on eagles that the Service used in the Model, and the use of the Service’s Model to estimate eagle fatalities on a re-designed project that excludes certain designated high eagle use areas. My opinions are based upon my training, experience, education and my expertise in the application of statistical techniques and models to address conservation issues.

A. Documents and Data Examined and Scope of Review

In my review, I examined several documents, site-specific data used in the Model, sampling methodology used to collect site-specific eagle data, and the Service’s eagle fatality Model. Further, I considered my firsthand knowledge of the site, discussions with SWCA personnel, and two discussions with the Service about the Model. Below I detail the specific materials I reviewed and considered in my evaluation.

(1) Draft Eagle Conservation Plan Guidance released by the Service in January 2011 that describes a process for wind energy developers when preparing an Eagle Conservation Plan (ECP) to assess the risk of projects to eagles and assess how siting, design, and operational modifications can mitigate that risk, specifically, Appendix D, Description of the Service’s Model;

(2) Eagle Conservation Plan Guidance Module 1 Land-based Wind Energy Technical Appendices released by the Service in August 2012 that updated the technical appendices in the Draft Eagle Conservation Plan Guidance;

(3) Power Company of Wyoming’s Eagle Conservation Plan (August 2012);

(4) The site-specific eagle data collected at the Project site, including the sampling protocol used to select sites;

(5) Proposed re-design of the Project to include turbine no-build areas;

(6) Clipped data used as input in the Service’s Model which considered the turbine no-build areas;

(7) Service’s Model and the list of assumptions used by the Service in the Model;

(8) Service’s Model as applied to the Project and the Project as re-designed;

(9) Discussions with SWCA about sampling designs, data collection, and data analysis (including the kernel density analysis used to identify turbine no-build areas) and two discussions with the Service about the fatality Model;

(10) Papers that were cited by the Service as support for model development and assumptions.

B. Experience with the Project and Eagle Data Collected

I am familiar with the Chokecherry and Sierra Madre Wind Energy Project, how the eagle data were collected by SWCA and how the data were analyzed by SWCA.
I am currently leading a study at the Chokecherry and Sierra Madre Wind Energy Project that investigates the ecology of male Greater sage-grouse in relation to construction of the wind energy facility. I have also been collaborating on a companion female Greater sage-grouse project on the site since the spring of 2010 and leading the habitat component of that project. Given my role in these sage-grouse projects, I have made extensive site visits across the Project area. I currently supervise two graduate students, one research associate, and the activities of several seasonal research technicians on the site in association with this sage-grouse research. I have also made a few separate trips to Denver, Colorado to meet and discuss my collaborative sage-grouse research with SWCA and PCW personnel.

Because of site visits and my research activities at the Project site, I am knowledgeable of the topography, landscape, and location where the eagle data were collected. I was accompanied by SWCA personnel during most of my time on the Project area and we discussed how and where the eagle data were collected. I also saw the radar unit in operation at the Project site and developed a model to differentiate eagle observations from the radar unit data from other species.

I reviewed the raptor survey program implemented by SWCA including the long watch raptor survey methodology.

I discussed the development of the kernel density maps with SWCA and found their approach to be appropriate and accurate, given the available data. In addition to site visits and previous discussions which made me familiar with the eagle use data and how that information was collected, I also discussed their approach in creating the kernel density maps.

These site-specific surveys and associated protocols are detailed in the Project area ECP, which I reviewed.

C. Eagle Fatality Estimates for the Project Using the Service’s Eagle Fatality Model

Under the Service’s Draft ECP Guidance, Stage 3 of developing an ECP involves conducting a turbine-based risk assessment and an estimate of the fatality rate of eagles for the facility. Set out below is a discussion of the Service’s Eagle Fatality Model, the eagle data collected for the Project as used in the Model, the estimated fatality rate of eagles for the Project prior to re-design, and the estimated fatality rate of eagles for the Project after it was re-designed in the Stage 3 evaluation to remove turbines from certain designated high eagle use areas. For purposes of this report and analysis, no adjustments were made to the base assumptions used by the Service in the Service’s Eagle Fatality Model.

1. The Service’s Eagle Fatality Model

The Service uses a Bayesian model to predict the number of eagle fatalities for a wind-energy facility. The Service’s Model estimates annual eagle fatalities as the product of the rate of eagle exposure to turbine hazards (exposure rate), the probability that eagle exposure will result in a collision with a turbine (collision probability), and an expansion factor that
scales the resulting fatality rate to the project-specific affected potential exposure area and
time. Within a Bayesian framework, the Service defines prior distributions for the exposure
rate and collision probability. The expansion factor is constant. Using site-specific data, the
Service’s Model calculates the exposure posterior distribution using the observed data. The
number of predicted annual fatalities is estimated as the expanded product of the posterior
exposure distribution and collision probability prior. See Appendix D – Stage 3, Draft ECP
Guidance.

In reviewing the Model, I generated a list of model assumptions and assessed their validity
and sensitivity for the Project area, I ran the Model code provided by the Service to generate
the eagle fatality estimates, and I considered the validity of the Model and underlying data as
applied to the Project area. I will provide a list and discussion of assumptions in a separate
report.

During a conference call with the Service on August 9, 2012, we requested a list of model
assumptions (which was provided on August 23, 2012). We explicitly discussed the
assumption of an infinite eagle population and interpretation of the model output. The
Service acknowledged there was an assumption of an open population. With this
assumption, eagle fatalities do not reduce eagle abundance, in terms of the exposed
population. We discussed other assumptions during a conference call on September 5, 2012.

The Model maintains several useful properties. The use of a Bayesian model is appropriate
for incorporating variability in model input and output. The modeling approach is flexible
and allows for modification, which is advantageous because the Model can be updated as
additional information becomes available about eagle fatalities at wind energy facilities.
Further, it is possible to identify model assumptions because computer code is reviewable
and available.

I agree with many of the assumptions of the Model provided by the Service, but also found
that other assumptions were not identified. Below is a list of several assumptions that are of
concern. These will be addressed in more detail in a subsequent report.

(1) As stated in the Service’s assumptions that were provided on August 23, 2012, the
Service assumes an open population in the Model. It is more accurate to state that the
Model assumes an infinite number of eagles at the site, and immediate replacement of
an eagle with another eagle after a fatality event, because fatality due to turbine
collision does not reduce eagle abundance. The open population assumption might
provide a mechanism for the assumption of an infinite population and immediate
replacement due to a fatality, but what matters in the Model is that eagle abundance,
or more specifically potential eagle exposure, does not decline as a result of eagle
fatalities. This assumption has the practical influence of each eagle fatality resulting
in immediate replacement by another eagle (i.e., the exposure rate does not change
with an eagle fatality). The stated open population assumption assumes we know the
process that leads to an infinite population. The implication of this assumption is that
it is possible to predict more eagle fatalities on the site than eagles that exist currently
on the site.
(2) The Service appropriately identifies in their list of assumptions that eagles are only at risk of colliding with turbines during daylight hours. However, it is important to further acknowledge that the current model assumes rotors are moving during all daylight hours. If rotors do not rotate during all daylight hours, there would be a subsequent reduction in the risk of eagle collisions.

(3) The Model does not account for heterogeneous use of eagle use on the site and is therefore spatially blind. Examination of maps of eagle flights demonstrates heterogeneous use of the project area by eagles. Violation of this assumption could lead to an overestimation of fatality risk in low use areas and underestimation of flight risk in high use areas.

(4) The Service correctly identifies an assumption that pre-construction eagle use data used to estimate eagle exposure are spatially and temporally representative. My review of the input data suggests that sampling focused on presumed high use eagle areas. Sampling in this manner is biased and results in an upward bias of eagle minutes and consequently, inflates the number of predicted eagle fatalities that would occur each year.

(5) The Model assumes that each count of eagle minutes per hour per km$^2$ is independent. In the Service’s Eagle Conservation Plan Guidance Module 1 Land-based Wind Energy Technical Appendices released by the Service in August 2012, they explicitly suggest that eagle counts be conducted for 1, 2, or more hours (page 16, second full paragraph). However, the Model assumes that each count of eagle minutes per hour per km$^2$ is independent. It is important to recognize that the model implicitly is considering each 1 hour per km$^2$ as a discrete, independent exposure event. That is, there is no accommodation for different lengths of survey periods because the Model assumes each count of eagle minutes per hour per km$^2$ is independent. If input data includes a count from 2 consecutive survey hours per km$^2$ at a sample unit, the model treats this identical to two randomly selected 1 hour per km$^2$ survey counts, independently selected in space and time. However, counts conducted for 2 or more hours do not result in independent eagle minutes when expressed on a per hour per km$^2$ in space or time. For example, hour 1 and 2 in a 2-hour long survey would be dependent and thus violate the assumptions of the Model. If input data do not meet this assumption, there will be an overly precise estimate of the distribution of the exposure rate. The magnitude of bias associated with this assumption was not addressed in this report, but could have implications to eagle fatality estimates.

(6) The Service assumes that the hazardous area is the 2-dimensional rotor-swept area around a turbine or proposed turbine. For clarification, the Service assumes that eagles are at risk for a collision if they are within 50 horizontal meters of the rotors, regardless of eagle height or rotor orientation. This assumption incorrectly means that eagles flying above or below the rotor blades are at risk of collision.
Output of the Service’s Model is a probability distribution of predicted eagle fatalities on an annual basis. The Service has used the 80% quantile as a basis for interpretation. During our conference call on August 9, 2012, the Service acknowledged that focus on the 80% quantile is conservative and was a policy decision. Most importantly, the interpretation of a value at the 80% quantile means there is an 80% chance that \( x \) number of eagles or fewer are predicted to be removed at the wind energy site. The value at the 80% quantile should not be interpreted to mean that value equates to the number of eagle fatalities. This conservative benchmark is added on top of the already risk-averse approach taken by the Service in developing the Model.

2. The Data Used by the Service to Estimate Eagle Fatalities

SWCA completed an extensive survey program on the Project area using a combination of several approaches. The long watch raptor surveys are most pertinent to our consideration of eagle fatalities and application of the Service’s Model. These long watch raptor surveys were conducted at 15, 4,000-m radius plots distributed across the Project. Fixed-point surveys were conducted in a 4,000-m radius to maximize areal coverage for identifying high use areas while maintaining observer confidence in species identification. Between April 2011 and April 2012, SWCA collected 2,162.5 hours of eagle use data at these 15 sites. These data were used to identify eagle use areas associated with topographic features, movement corridors, foraging areas, and nesting territories. To comply with the data requirements of the Service’s Model, these survey data were truncated to include only those observations that occurred within 800-meters of each survey site. I applied these data in the Service’s Model to estimate the number of eagle fatalities. This analysis is detailed in the following section.

My evaluation of the sampling locations revealed that the selected sites to survey eagles were biased because they were not selected according to the underlying assumptions of the Model. Rather, sampling sites were selected because they were presumed to be high use eagle sites. This is a fundamental sampling flaw. The Model assumes that the count of eagle minutes that updates the prior distribution on expected eagle minutes per hour per km\(^2\) is collected randomly with respect to space and time. Therefore, if these presumed high use areas had higher eagle activity than other portions of the Project area, the sampling strategy used will inherently result in an overestimate of eagle minutes when applied to the entire Project area. The result is that eagle fatalities would be overestimated. The Model cannot account for heterogeneous use of the Project area by eagles and thus assumes eagle minute use data were collected randomly with respect to space and time (i.e., the Model is spatially blind and therefore assumes a simple random sampling protocol for eagle minutes). In this case, areas of expected high use were oversampled relative to their availability, which results in an upward bias (i.e., more eagle minutes which equates to more predicted fatalities when applied to the entire area). Future sampling design needs to more directly consider the underlying assumptions of the Service’s fatality Model and to follow fundamental principles of survey sampling.

The following sections outline the results of applying the Service’s Model to estimate the number of eagle fatalities based on data representing two Project configurations: (1) the
Project including areas of high eagle use; and (2) the Project as re-designed to exclude areas of high eagle use that will be designated as turbine no-build areas. Although I have summarized some issues related to the assumptions used by the Service in the Model, for the two applications of the Model set out below, I used the same assumptions used by the Service.

3. Eagle Fatality Estimates for the Project Including Areas of High Eagle Use

I applied the baseline Service’s Model using site-specific 800-meter survey data from the Project area as collected by SWCA and described above. Specifically, I used the number of golden eagle flight minutes observed and the hour/km² of survey observations. The baseline 800-meter survey data, without consideration of the turbine no-build areas, recorded 731.7 eagle minutes for the Project area (which includes 2.7 minutes for unidentified eagle species). The survey effort is based on 2,162.5 survey hours. Because each survey point consisted of an 800 m (0.80 km) radius circle, survey effort equals 2162.5 observation hours * 0.80² * 3.14… km² = 4,348 observation hours-km². With 15 survey points, this is equal to:

\[ \sum_{i=1}^{15} \text{observation hours at survey point } i \times \text{area}_{\text{plot } i, \text{km}^2} \]

where the plot area = (0.80 km)² * 3.14… for all survey points. Survey minute totals are shown in Table 1. Table 2 provides the eagle minutes of eagle flight time when only the 800-meter survey data are included. Applying this information in the Service’s eagle fatality estimate leads to an estimated fatality distribution with quantiles 0.50 = 29 fatalities, 0.80 = 63 fatalities, 0.90 = 87 fatalities, and 0.95 = 111 fatalities (Figure 1).

The Service uses the 80% quantile from the distribution of predicted fatalities to infer risk. This is a very conservative approach because the most likely number of fatalities, when one considers the probability distribution in Figure 1, is much lower. The resulting probability distribution should not be used to assert that there will be 63 eagle fatalities a year. These results indicate that 80% of the time, it is predicted that 63 or fewer eagles would be removed. Thus, it is highly unrealistic to expect 63 eagles would be removed. For example, the median estimated number of fatalities for this scenario was 29 eagle fatalities. Further, this conservative benchmark is added on top of the already risk averse approach taken by the Service in developing the Model.

4. Eagle Fatality Estimates for the Project as Re-Designed with Eagle Turbine No-build Areas

Based on the estimated eagle fatalities for the Project, PCW followed the ECP Draft Guidance and re-designed the Project. Using the kernel density maps, which I find accurately represent the high eagle use areas based on available data, PCW re-designed the Project to exclude turbines from certain designated high eagle use areas. A map of the re-designed Project with the turbine no-build areas is attached (Figure 2).
To evaluate the effect of this Project re-design on the estimated number of eagle fatalities, the next step involved clipping the data to eliminate the turbine no-build areas from the Project footprint. Data clipped for use in the Eagle Fatality Model to estimate eagle fatalities for the project as re-designed was clipped accurately and appropriately modified to remove eagle use data for the areas removed from the wind farm facility (turbine no-build areas).

To calculate eagle use in these areas, the number of eagle flight minutes and survey minutes were calculated using only those observations that occurred within the remaining survey buffer. As a result, eagle flight minutes per hour of survey time per km² was calculated and used as the input data in the Service’s eagle fatality Model. Data used as model input are summarized in Tables 1 and 3.

Observed eagle minutes outside the turbine no-build area were recalculated as described above after excluding eagle minutes occurring in portions of plots within the turbine no-build area. This leads to a count of 189 eagle minutes observed in the portions of the 15 Project area survey plots outside the turbine no-build area (Table 3). These non-avoidance plot segments were surveyed for 2,162.5 total survey hours (Table 1), but because the proportion of each plot within the turbine no-build area varied, survey effort was recalculated as:

\[
\sum_{i=1}^{15} \left( \text{observation hours at survey point } i \times \text{area-outside-avoidance-zone}_{\text{plot } i, \text{ km}^2} \right)
\]

producing a revised effort of 3,073.9 observation hours-km².

I used these revised estimates in the Service’s Model to estimate eagle fatalities when incorporating the identified turbine no-build areas. Using the revised survey effort and eagle minutes outside the turbine no-build areas, the estimated fatality distribution (Figure 3) had quantiles 0.50 = 11 fatalities, 0.80 = 23 fatalities, 0.90 = 32 fatalities, and 0.95 = 41 fatalities. Thus, using the clipped data in the Model representing the Project as re-designed results in an 80% quantile estimate of 23 or fewer eagle fatalities. Again, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of fatalities for this scenario was 11 eagle fatalities.

The distribution in Figure 3 is based on applying the baseline Service Model, with revised eagle minutes =189 (Table 3). Because total observation hours-km² is calculated in the Service’s CollisionModelv2.11.R file rather than the project-specific input file, we also modified the collision model file to specify "SmpHrKM2<-3073.923", which replaces the default calculation of this variable in the Model.

IV. Conclusion

In conclusion, based on my expertise in wildlife ecology and the application of statistical techniques and tools to address conservation issues, my opinions are those set out and described above and include that:
• There are a number of assumptions inherent in the Service’s eagle fatality Model that should be evaluated further for the Project. Several of these assumptions will be the topic of a separate report.

• The kernel density maps prepared by SWCA are accurate, based on the available data.

• The data clipped for use in the Eagle Fatality Model to estimate eagle fatalities for the Project as re-designed was clipped accurately and appropriately modified for application in the Service’s Model.

• Using the clipped data representing the Project as re-designed in the Model, without revising the assumptions used by the Service, results in an 80% quantile number estimate of 23 or fewer eagle fatalities. Again, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of fatalities for this scenario was 11 eagle fatalities.

• As will be described in a subsequent report, addressing the Service’s assumptions used in the Model will result in an even lower estimate of eagle fatalities for the Project.

Dr. Joshua J. Millspaugh
O’Connor Distinguished Professor of Wildlife Management
Department of Fisheries and Wildlife Sciences
University of Missouri
Table 1. Survey minute totals for all sites in spring, summer, fall, and winter seasons during year two at the Project area.

<table>
<thead>
<tr>
<th>Site</th>
<th>Spring</th>
<th></th>
<th>Summer</th>
<th></th>
<th>Fall</th>
<th></th>
<th>Winter</th>
<th></th>
<th>Total</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mins</td>
<td>Hrs</td>
<td>Mins</td>
<td>Hrs</td>
<td>Mins</td>
<td>Hrs</td>
<td>Mins</td>
<td>Hrs</td>
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<td>Hrs</td>
</tr>
<tr>
<td>RM1</td>
<td>3,534</td>
<td>58.9</td>
<td>720</td>
<td>12.0</td>
<td>3,435</td>
<td>57.3</td>
<td>1,200</td>
<td>20.0</td>
<td>8,889</td>
<td>148.2</td>
</tr>
<tr>
<td>RM2</td>
<td>3,483</td>
<td>58.1</td>
<td>720</td>
<td>12.0</td>
<td>3,213</td>
<td>53.6</td>
<td>1,190</td>
<td>19.8</td>
<td>8,606</td>
<td>143.4</td>
</tr>
<tr>
<td>RM3</td>
<td>2,974</td>
<td>49.6</td>
<td>720</td>
<td>12.0</td>
<td>3,479</td>
<td>58.0</td>
<td>0*</td>
<td>0*</td>
<td>7,173</td>
<td>119.6</td>
</tr>
<tr>
<td>RM4</td>
<td>2,867</td>
<td>47.8</td>
<td>724</td>
<td>12.1</td>
<td>3,440</td>
<td>57.3</td>
<td>1,140</td>
<td>19.0</td>
<td>8,171</td>
<td>136.2</td>
</tr>
<tr>
<td>RM5</td>
<td>3,422</td>
<td>57.0</td>
<td>738</td>
<td>12.3</td>
<td>3,255</td>
<td>54.3</td>
<td>1,065</td>
<td>17.8</td>
<td>8,480</td>
<td>141.3</td>
</tr>
<tr>
<td>RM6</td>
<td>2,925</td>
<td>48.8</td>
<td>631</td>
<td>10.5</td>
<td>4,305</td>
<td>71.8</td>
<td>1,180</td>
<td>19.7</td>
<td>9,041</td>
<td>150.7</td>
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<tr>
<td>RM7</td>
<td>3,120</td>
<td>52.0</td>
<td>675</td>
<td>11.3</td>
<td>2,835</td>
<td>47.3</td>
<td>1,160</td>
<td>19.3</td>
<td>7,790</td>
<td>129.8</td>
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<tr>
<td>RM8</td>
<td>3,403</td>
<td>56.7</td>
<td>730</td>
<td>12.2</td>
<td>3,608</td>
<td>60.1</td>
<td>1,172</td>
<td>19.5</td>
<td>8,913</td>
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<tr>
<td>RM9</td>
<td>3,704</td>
<td>61.7</td>
<td>720</td>
<td>12.0</td>
<td>3,725</td>
<td>62.1</td>
<td>1,141</td>
<td>19.0</td>
<td>9,290</td>
<td>154.8</td>
</tr>
<tr>
<td>RM10</td>
<td>3,614</td>
<td>60.2</td>
<td>720</td>
<td>12.0</td>
<td>3,233</td>
<td>53.9</td>
<td>1,162</td>
<td>19.4</td>
<td>8,729</td>
<td>145.5</td>
</tr>
<tr>
<td>RM11</td>
<td>4,001</td>
<td>66.7</td>
<td>720</td>
<td>12.0</td>
<td>3,352</td>
<td>55.9</td>
<td>1,240</td>
<td>20.7</td>
<td>9,313</td>
<td>155.2</td>
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<td>RM12</td>
<td>2,790</td>
<td>46.5</td>
<td>670</td>
<td>11.2</td>
<td>3,417</td>
<td>57.0</td>
<td>1,093</td>
<td>18.2</td>
<td>7,970</td>
<td>132.8</td>
</tr>
<tr>
<td>RM13</td>
<td>3,999</td>
<td>66.7</td>
<td>720</td>
<td>12.0</td>
<td>3,530</td>
<td>58.8</td>
<td>2,314</td>
<td>38.6</td>
<td>10,563</td>
<td>176.1</td>
</tr>
<tr>
<td>RM14</td>
<td>2,985</td>
<td>49.8</td>
<td>725</td>
<td>12.1</td>
<td>3,354</td>
<td>55.9</td>
<td>1,200</td>
<td>20.0</td>
<td>8,264</td>
<td>137.7</td>
</tr>
<tr>
<td>RM15</td>
<td>3,345</td>
<td>55.8</td>
<td>720</td>
<td>12.0</td>
<td>3,245</td>
<td>54.1</td>
<td>1,248</td>
<td>20.8</td>
<td>8,558</td>
<td>142.6</td>
</tr>
<tr>
<td>Total</td>
<td>50,166</td>
<td>836.1</td>
<td>10,653</td>
<td>177.6</td>
<td>51,426</td>
<td>857.1</td>
<td>17,505</td>
<td>291.8</td>
<td>129,750</td>
<td>2162.5</td>
</tr>
</tbody>
</table>

* Due to winter access and safety issues, surveys at RM3 were not completed during winter months.
Table 2. Minutes of eagle flight time within 800-meters of each raptor monitoring location at the Project area. These data relate to eagle fatality estimates for the Project including areas of high eagle use.

<table>
<thead>
<tr>
<th>Site</th>
<th>Spring</th>
<th>Summer</th>
<th>Fall</th>
<th>Winter</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM1</td>
<td>23</td>
<td>12</td>
<td>6</td>
<td>0</td>
<td>41</td>
</tr>
<tr>
<td>RM2</td>
<td>16</td>
<td>8</td>
<td>25</td>
<td>10</td>
<td>59</td>
</tr>
<tr>
<td>RM3</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>RM4</td>
<td>12</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>21</td>
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<td>RM5</td>
<td>23</td>
<td>21</td>
<td>17</td>
<td>19</td>
<td>80</td>
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<tr>
<td>RM6</td>
<td>47</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>47</td>
</tr>
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<td>RM7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>24</td>
<td>4</td>
<td>78</td>
</tr>
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<td>RM9</td>
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<td>11</td>
<td>0</td>
<td>11</td>
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<td>6</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>13</td>
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<td>RM11</td>
<td>59</td>
<td>0</td>
<td>55</td>
<td>35</td>
<td>149</td>
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<tr>
<td>RM12</td>
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<td>0</td>
<td>12</td>
<td>8</td>
<td>32</td>
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<tr>
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<td>24</td>
<td>16</td>
<td>51</td>
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<tr>
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<td>15</td>
<td>37</td>
<td>99</td>
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<tr>
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<td>5</td>
<td>35</td>
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<tr>
<td>Total</td>
<td>290</td>
<td>71</td>
<td>227</td>
<td>141</td>
<td>729</td>
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</table>
Table 3. Minutes of eagle flight time outside of turbine no-build areas within 800-meters of each raptor monitoring location at the Project area. These data relate to eagle fatality estimates for the Project as re-designed with turbine no-build areas.

<table>
<thead>
<tr>
<th>Site</th>
<th>Spring</th>
<th>Summer</th>
<th>Fall</th>
<th>Winter</th>
<th>Total</th>
</tr>
</thead>
<tbody>
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<td>RM1</td>
<td>2</td>
<td></td>
<td></td>
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</tr>
<tr>
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<td>RM8</td>
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<td></td>
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<td>RM9</td>
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<td>7</td>
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<td></td>
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</tr>
<tr>
<td>RM13</td>
<td>10</td>
<td>5</td>
<td>4</td>
<td></td>
<td>19</td>
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<td>10</td>
<td>4</td>
<td>10</td>
<td>19</td>
<td>43</td>
</tr>
<tr>
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<td>4</td>
<td>5</td>
<td>4</td>
<td></td>
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</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>13</td>
<td>66</td>
<td>48</td>
<td>189</td>
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</table>
Figure 1. Eagle fatality estimates for the Project including areas of high eagle use. Fatality probability distribution for the Project area (CCSM – Chokecherry and Sierra Madre) based on observed eagle minutes and survey effort which include areas of high eagle use.
Figure 2. Identified eagle use avoidance areas and 800-meter survey perimeters outside of turbine no-build areas on the Project area.
Figure 3. Eagle fatality estimates for the project as re-designed with turbine no-build areas. Fatality probability distribution for the Project area (CCSM – Chokecherry and Sierra Madre) based on observed eagle minutes and survey effort as re-designed with turbine no-build areas.
ATTACHMENT 1

Curriculum Vitae of

Joshua J. Millspaugh, Ph.D.
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EDUCATION

1995  M.S., Wildlife Science.  Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, South Dakota
1991  B.S., Environmental and Forest Biology.  State University of New York, College of Environmental Science and Forestry, Syracuse, New York

ACADEMIC POSITIONS

2009-present  Pauline O’Connor Distinguished Professor of Wildlife Management
1999-present  Professor of Wildlife Conservation, School of Natural Resources, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia (2009-Present); Associate Professor (2005-2009); Assistant Professor (1999-2005)
1999-2010  Director, Thomas S. Baskett Wildlife Research and Education Center, School of Natural Resources, University of Missouri, Columbia, Missouri
1999  Postdoctoral Fellow, School of Aquatic and Fishery Sciences, University of Washington, Seattle, Washington
1995-1999  Graduate Research and Teaching Assistant, College of Forest Resources, University of Washington, Seattle, Washington
1992-1995  Graduate Research Assistant, Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, South Dakota

SELECTED HONORS AND AWARDS

2011  Appointed to University of Missouri Research Board
2009  Appointed as O’Connor Distinguished Professor
2009  Keynote Speaker, Game Monitoring Conference: providing a knowledge basis for sustainable hunting and biodiversity conservation, Uppsala, Sweden
2009  Missouri Governor’s Award for Excellence in Teaching
2008  U.S.D.A. National Teacher of the Year (U.S. Department of Agriculture, Excellence in College and University Teaching Award in the Agricultural Sciences)
2007  The Wildlife Society Award for Best Article (with Steve Buskirk)
2006  Superior Teaching Award from the University of Missouri Chapter of Gamma Sigma Delta
2005  Missouri Department of Conservation “Outstanding Research Collaborator of the Year”
2005  William T. Kemper Fellowship for Excellence in Teaching, University of Missouri
2003  Provost’s Outstanding Junior Faculty Teaching Award, University of Missouri
2003  College of Agriculture, Food, and Natural Resources “Golden Apple” Award for Teaching Excellence
2003  Plenary Speaker, First International Conference on Resource Selection Functions, Laramie, Wyoming
2002, 2008 Student Council “Outstanding Faculty Member”, School of Natural Resources, University of Missouri

RESEARCH SCHOLARSHIP

My research focuses on vertebrate population ecology at three scales: physiological processes, individual space use and resource selection, and population-level dynamics. Many of these topics overlap within individual studies and include several themes. At each scale, my focus is on rigorous development and evaluation of field and statistical methods and application of these methods to help answer important conservation issues. My research is motivated by an interest to identify practical management solutions and provide applicable tools to solve pressing conservation problems. I work with a broad range of taxa, from salamanders to elephants, to address these applied questions.

Selected Recent Grants

I have obtained about 55 grants and contracts as either PI or Co-PI since 1999 from diverse funding sources such as the National Science Foundation, National Park Service, U.S. Forest Service, U.S. Fish and Wildlife Service, National Fish and Wildlife Foundation, U.S. Department of Energy, several state management agencies, and private industry. Total Amount in Grants since 1999 is about $13.5 million. Selected recent, representative grants shown below.

2012-2017  *Mule deer response to oil and gas development in western North Dakota* funded by the Bureau of Land Management, North Dakota Game and Fish, Mule Deer Foundation, and Oil and Gas Research Program in North Dakota. Amount: $688,000. With B. Stillings.


2011-2016  *Ecology and management of reintroduced elk in Missouri* funded by the Missouri Department of Conservation, Amount: $1,915,000. With L. Hansen.
2011-2014  *Processes determining the abundance of terrestrial wildlife communities across large spatial scales* funded by the National Science Foundation, Amount: $1,200,000. With R. Kays, R. Costello, Z. He, and B. McShea.

2011-2014  *ABI Innovation: Computational and informatics tools for supporting collaborative wildlife monitoring and research* funded by the National Science Foundation, Amount: $845,000. With R. Kays and Z. He.

2010-2013  *Effects of commercial harvest on river turtle population dynamics* funded by the Missouri Department of Conservation, Amount: $170,659. With J. Briggler.


2009-2014  *Predicting and monitoring impacts of climate change, disturbance and land use and management on forests and wildlife in the central hardwood region* funded by the U.S. Forest Service, Amount: $152,195. With F. Thompson and H. He.


2006-2010  *Survival, movements, and resource selection of hellbenders in Missouri* funded by the Missouri Department of Conservation, Amount: $193,000. With J. Beringer and J. Briggler.

2005-2013  *Mourning dove demographics in Missouri* funded by the Missouri Department of Conservation, Amount: $331,912. With J. Schulz.

2005-2008  *DeerNet: Wireless sensor networking for wildlife monitoring* funded by the National Science Foundation, Amount: $1,050,000. With M. Fang and Z. He.


**Publications**

I have published 4 books, ~160 peer-reviewed journal articles and book chapters. Representative publications are presented below. Complete list available upon request.

**Books**

Journal Articles and Book Chapters


Selected Invited Seminars and Symposia

2011 Elk ecology and management in Missouri. Presented to Missouri Conservation Commission (and presented again in 2012)

2009 Harmonizing game statistics: North American experience. Game Monitoring Conference: providing a knowledge basis for sustainable hunting and biodiversity conservation, Uppsala, Sweden, Uppsala, Sweden (Keynote speaker)

2009 Reconstructing historical bison demographics in the Northern Great Plains. Iowa State University, Ames, IA

2008 Population modeling and migratory birds. U.S. Fish and Wildlife Service and the Association of Fish and Wildlife Agencies, Denver, CO


2007 Integrated camera and sensor system for wildlife monitoring: present and future applications. NSF sponsored workshop. Princeton University, NJ (with H. He)
Selected Conference Presentations and Abstracts

Since arriving at MU, my students and I have presented ~160 papers at state, regional, national, and international meetings. Some representative examples from the past 5 years are below.


Mong, T. W., J. H. Schulz, R. Bredesen, J. J. Millspaugh, and D. Dey. 2007. Using agroforestry and lease hunting to increase the economic viability of agricultural landscapes. Missouri Natural Resources Conference, Osage Beach, Missouri.


Schulz, J. H., R. Reitz, S. Sheriff, and J. J. Millspaugh. 2007. Attitudes of Missouri small game hunters toward nontoxic shot regulations. Missouri Natural Resources Conference, Osage Beach, Missouri.

Professional and Academic Memberships

The Wildlife Society (State, Regional, National)
The Wildlife Society Biometrics Working Group
The Wildlife Society College and University Education Group
Xi Sigma Pi Academic Honor Society
Gamma Sigma Delta Academic Honor Society
Boone and Crockett Club

TEACHING SCHOLARSHIP

Teaching Experience

Courses Taught (University of Missouri)

Spring 2003-present Animal Population Dynamics, 3 credits, undergraduate, required course for undergraduate students, every spring (except 2009)
Fall 2000-2008 Wildlife Research and Management Techniques, 4 credits, undergraduate, writing intensive (each fall from 2000-2004, then alternate years)
Winter 2000-2002 Natural Resources Practicum, 3 credits, undergraduate (with H.
Student Advising

In addition to serving as Chair of graduate committees, I have served as a member on > 50
gradient student committees in several departments (Statistics, Biological Sciences) and
universities (University of Washington, University of Nebraska). A total of 17 graduate students
have completed their degrees with me at MU.

Dissertation or Thesis Advisor (Current)

Thomas Bonnot (Ph.D.). Dissertation topic: Ecoregional landscape population models for
conservation planning in response to climate change (with F. Thompson)
Jaymi LeBrun (Ph.D.). Dissertation topic: Climate and ecosystem restoration modeling and
impacts to wildlife in forested systems (with F. Thompson)
Christopher Rota (Ph.D.). Dissertation topic: Black-backed woodpecker space use and
demographics in the Black Hills, South Dakota (with D. Kesler)
Amy Bleisch (M.S.). Thesis topic: Ecology of reintroduced elk in Missouri
Stephanie Zimmer (M.S.). Thesis topic: Effect of commercial harvest on river turtle populations
in Missouri
Leslie Schreiber (M.S.). Thesis topic: Wind energy development and sage-grouse in Wyoming
Aleshia Fremgen (M.S.). Thesis topic: Wind energy development and sage-grouse in Wyoming
Trenton Smith (M.S.). Thesis topic: Ecology of reintroduced elk in Missouri

Undergraduate Advising and Mentoring:

I advise 20-25 undergraduate students enrolled in the Fisheries and Wildlife Sciences
curriculum. I have mentored ~20 undergraduate student research projects and have employed
over 150 students on my funded research projects.

Teaching Publications and Presentations

Peer-Reviewed


Selected Invited Workshops and Teaching Presentations

Millspaugh, J. J. 2011. Professor’s perspective. 4-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2011.


Millspaugh, J. J. 2010. Professor’s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2010.


Millspaugh, J. J. 2009. Professor’s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2009.


Millspaugh, J. J. 2008. Professor’s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2008.


Millspaugh, J. J. 2001. Getting the most from undergraduate research projects. One-half day workshop at the Annual Conference of The Wildlife Society. At Workshop: Developing tomorrow’s professionals: teaching the skills they will need. Fall 2001.

**Teaching Conference Presentations and Workshops**


Millenbah, K., and J. J. Millspaugh. 2002. Infusing experiential learning into a wildlife curriculum: two models for one course. 4th Biennial Conference on University Education in Natural Resources. Forestry Department, North Carolina State University, Raleigh,

SERVICE AND PROFESSIONAL ACTIVITIES

Selected Major Professional Service

2010 Science Review Team, Review of Pronghorn Monitoring Plan for University of Wyoming Cooperative Fish and Wildlife Research Unit
2009-present Associate Editor, Journal of Wildlife Management
2007-2010 Associate Editor, Ecological Applications
2007 Ecological Biology Program Advisory Panel, National Science Foundation
2007-2008 Associate Editor for the book Neotropical Cervidology (hormone chapter)
2005-2007 Chair and Panel Member, Review of White-tailed Deer Population Estimates and Management, Wisconsin Department of Natural Resources
2005-2006 Member of Science Review Team, Wind Cave National Park, South Dakota
2005-2009 Member of Peninsular Bighorn Sheep Recovery Team, U.S. Fish and Wildlife Service, California
2005-2007 Member of Science Review Team, Theodore Roosevelt National Park, ND
2004-2006 Associate Editor, Wildlife Society Bulletin
2004-2006 Secretary, University Education Working Group, The Wildlife Society
2003-2004 Secretary, Biometrics Working Group, The Wildlife Society
2002-2003 Wildlife Program Chair for 64th Midwest Fish and Wildlife Conference and Executive Committee Member, Kansas City, MO
2000-present Chair, Missouri Chapter of The Wildlife Society Education Committee
1997-present Reviewed papers for ~ 55 professional journals and review regularly for national and international grants (NSF, National Geographic, etc.)

University of Missouri

2011-present Appointed to University of Missouri Research Board
2010-2012 Chair, Promotion and Tenure Committee, School of Natural Resources
2010 Member “Celebration of Teaching and Learning Planning Committee” for university-wide teaching conference
1999-2010 Director, Thomas S. Baskett Wildlife Research and Education Area, School of Natural Resources
2009-present CAFNR Graduate Education Committee
2005-2012 Director of Graduate Studies, Department of Fisheries and Wildlife Sciences, University of Missouri
2005-2012 Chair, Graduate Programs Committee, Fisheries and Wildlife Sciences
2006-present Member, College of College of Agriculture, Food, and Natural Resources, International Programs Committee
2005-2007 Chair, College of College of Agriculture, Food, and Natural Resources, Learning Improvement Committee
2005-2006 CAFNR Week Steering Committee, Faculty Advisor
2003-2006 Graduate Fellowship Coordinator, Conservation Biology Program
2002-2004, Faculty Advisor for Univ. of Missouri Student Chapter of The Wildlife Society
2005-2006
2000-present Co-Coordinator, Undergraduate Fisheries and Wildlife Scholarships
2000-2003 Conservation Biology Program Secretary and Executive Committee

Representative Media and Community Outreach

2011 Quoted in USA Today regarding pronghorn migrations and Discovery Channel about deer-vehicle collisions
2010 Bloomberg Business News interview about deer-vehicle collisions
2009 Participated in History Channel expedition and production about feral dogs in St. Louis
2008 Participated in History Channel expedition and production about feral hogs
2007 On April 30, 2007, we offered a live, standards-based, interactive session to middle school and high school students from urban and rural areas of Missouri. Programs were available via videoconference, online streaming, and, in limited areas, cable television. We captured a deer live during the broadcast, equipped it with a camera, and answered questions from students, as we conducted our field research
2006 My research was highlighted in National Science Foundation Special Report, “Secret Lives of Wild Animals” (www.nsf.gov/news/special_reports/animals/)
2006 Interview on CBS Evening News about deer and vehicle collisions (26 Feb 2006)
2006 PBS interview about Wisconsin deer population estimation
2005 Live interview on NBC Today show (29 October) about “Deercam” project; Additional news coverage and interviews included the following: Front page, Science Section, New York Times; Discovery channel; and hundreds of newspapers across country
2002 Interview on elk and human activities appeared in Science (296:1784-1785)
VIA EMAIL: Tyler_Abbott@fws.gov

September 13, 2012

Tyler Abbott, Deputy Field Supervisor
U. S. Fish and Wildlife Service
Ecological Services Wyoming Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

Re: Chokecherry and Sierra Madre Wind Energy Project

Dear Tyler:

Attached is a second Expert Report prepared by Dr. Joshua J. Millspaugh, O’Connor Distinguished Professor of Wildlife Management, Department of Fisheries and Wildlife Sciences, University of Missouri, concerning his review and analysis of the assumptions used by the Service in the U.S. Fish and Wildlife Service’s Eagle Fatality Model as applied to the Chokecherry and Sierra Madre Wind Energy Project as re-designed to include Turbine No-Build Areas.

As you know, Dr. Millspaugh’s first expert report dated September 7, 2012, applied the Service’s Model - using the Service’s assumptions - to the Project as re-designed to evaluate the potential for take of eagles. Dr. Millspaugh concluded that applying the Model to the Project as re-designed results in an 80% quantile number estimate of 23 or fewer eagle fatalities. According to Dr. Millspaugh, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of fatalities for this scenario was 11 eagle fatalities. Therefore, based upon the Service’s Model, PCW’s Project re-design resulted in a 63.5% reduction in predicted eagle fatalities compared to the Service’s model run that did not consider the Project as re-designed with Turbine No-Build Areas.

Dr. Millspaugh also opined that the Model run using the re-designed Project still likely overstates the impacts of the Project because the Model does not account for population abundance, turbine daylight operating hours, eagle flight height, and survey sampling bias. As indicated, Dr. Millspaugh prepared a second report addressing some of these assumptions contained in the Model when applied at the Project area.

In his second report, Dr. Millspaugh opines that:

- There are a number of assumptions inherent in the Service’s eagle fatality Model that are questionable for the Project site and modification of these assumptions as used in the
Model results in a more realistic estimate of eagle fatalities because the modifications more realistically reflect Project conditions. In particular, the Service’s Model assumes (1) that there is an infinite population of eagles exposed on the site; (2) that turbines operate during all daylight hours, all year long; and (3) that eagles are at risk whether they fly above, below, or at rotor height. By not considering the validity of these assumptions, the Model overestimates the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project.

• The Service’s Model can be modified to reflect more realistic assumptions for the Project site. Doing so maintains the structure and general approach taken by the Service in developing and applying the Model. However, doing so makes the Model a more realistic reflection of Project conditions.

• When considering the Project re-design, which excludes certain high eagle use areas deemed turbine no-build areas, Dr. Millspaugh estimates that when (1) accounting for the assumption of an infinite population, the estimated number of eagle fatalities would be reduced to 16 or fewer per year (median value of 9); (2) modifying the assumption that turbines do not rotate all day, the estimated number of eagle fatalities would be reduced to 22 or fewer per year (median value of 10); (3) accounting for the proportion of time eagles fly at rotor height, the estimated number of eagle fatalities would be reduced to 9 or fewer per year (median value of 4); and (4) when all assumptions are considered in the Model, he estimates that 8 or fewer eagle fatalities would occur annually (median value of 4).

• By modifying the Service’s Model to account for three questionable assumptions, based on the Project re-design, which excludes certain designated high eagle use areas or turbine no-build areas, Dr. Millspaugh predicts 8 or fewer eagle fatalities per year at the 80% quantile of the probability distribution. The median estimated number of annual fatalities for this scenario was 4.

• Even just considering the Project as re-designed and modifying only one assumption, the proportion of time eagles fly at rotor height, reduces the estimated number of fatalities at the 80% quantile to 9 or fewer eagles annually. The median estimated number of annual fatalities for this scenario was 4.

• These results indicate that eagle fatality estimates are reduced greatly when the Project is re-designed and the Model is modified to more realistically reflect project conditions. Dr. Millspaugh’s opinion is that Model estimates when assumptions are modified results in a more realistic estimate of eagle fatalities for the Project.
Dr. Millspaugh’s report dated September 12, 2012, is attached. Dr. Millspaugh, Jon Kehmeier and I will be happy to discuss this with you and your colleagues. Please let me know if you would like to arrange a meeting or conference call.

Sincerely,

/s/ Garry L. Miller

Garry L. Miller
Vice President, Land and Environmental Affairs
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Date: September 12, 2012

To: Garry Miller, Vice President, Land and Environmental Affairs, Power Company of Wyoming LLC, 555 Seventeenth Street, Suite 2400, Denver, CO 80202

From: Dr. Joshua J. Millspaugh, O'Connor Distinguished Professor of Wildlife Management, Department of Fisheries and Wildlife Sciences, University of Missouri, 302 Natural Resources Building, Columbia, MO 65211

Subject: Expert Report – Assumptions of the U.S. Fish and Wildlife Service’s Eagle Fatality Model

I. Executive Summary and Expert Opinions

I was asked to perform a review and critical analysis of the assumptions of U.S. Fish and Wildlife Service’s Eagle Fatality Model and the eagle fatality estimates derived by the Service for the Chokecherry and Sierra Madre Wind Energy Project. Given issues I identified with assumptions of the Service’s Model, as applied to the Project site, which were first outlined in my report dated September 7, 2012, I modified the Service’s Model to make the assumptions more realistic for the Project site and to provide a more realistic estimate of eagle fatalities. I compared these eagle fatality estimates from the modified Model to previous estimates based on the Project design that included high eagle use areas and on a re-designed Project that excluded certain designated high eagle use areas or turbine no-build areas. My opinions are based upon my training, experience, education, and expertise in wildlife ecology and the application of statistical techniques and tools to address conservation issues. In sum, my opinions are:

The Service’s Eagle Fatality Model maintains a number of questionable assumptions when applied to the Project. My examination has shown that the Model assumes: (1) an infinite population of eagles exposed on the site; (2) that turbines operate during all daylight hours, all year long; and (3) that eagles are at risk whether they fly above, below, or at rotor height. By not verifying the validity and reasonableness of these assumptions, the Model overestimates the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project. I focused on these 3 assumptions because (1) they are questionable; (2) data are available to address these assumptions; and (3) the Service’s Model requires only slight modification to account for these assumptions.
My assessment of the Service’s Model and assumptions indicated that the Model is a highly conservative prediction tool which errs on the side of over-predicting the number of eagle fatalities. By repeatedly deriving model assumptions with a high emphasis of being risk averse rather than on hypothesized biological reality, the Service’s predictions are known to be highly conservative, but for which the degree of conservativeness is unknown. The degree of risk that is tolerable should be made transparent when evaluating alternatives based on objective prediction about consequences of alternatives, not embedded repeatedly in the building of a model to predict outcomes. It is a basic principle in transparent decision-making that predictions about potential consequences of a decision alternative should be based on facts and best available science, and should be separated from subsequent consideration of values and risk tolerance. It is important to avoid confusing best scientific practices with policy when developing a model.

Using the Service’s Model as a basis for estimating annual eagle fatalities, I modified the Service’s Model to make the assumptions more realistic for the Project site and therefore provide a more realistic estimate of eagle fatalities. I maintained the structure and general approach taken by the Service in developing the Model, but made biologically reasonable and supportable modifications to modify these assumptions. To address these assumptions, and to develop a more realistic reflection of the Project conditions, I did the following: (1) to account for the infinite population assumption, I modified the Service’s Model to directly account for abundance on the site (the number of fatalities is a function of the number of eagles at risk of death); (2) to account for turbines not operating during all daylight hours, I adjusted the daylight hour expansion by considering the proportion of daylight hours turbines are expected to rotate at the Project site; and (3) to account for eagle flights above or below the rotors, I adjusted the area expansion to consider the proportion of time eagles flew at rotor height within the Project site.

I produced eagle fatality estimates both by modifying assumptions one at a time and by modifying all assumptions simultaneously. I then compared Model output when assumptions were made more realistic for the Project site to previous eagle fatality estimates that I generated using the Model with the Service’s assumptions under the previous Project design with high eagle use areas included and the Project as re-designed to exclude certain eagle high use areas (turbine no-build areas). As outlined in my first report dated September 7, 2012, I previously determined that using the Service’s Model without modification and without any re-design of the Project, the 80% quantile estimate was 63 or fewer eagle fatalities. The median estimated number of annual fatalities for this scenario was 29. When considering the Project re-design, which excludes certain designated high eagle use areas, deemed turbine no-build areas, I previously determined the 80% quantile number estimate was 23 or fewer eagle fatalities. The median estimated number of annual fatalities for this scenario was 11.

The modeling results detailed below are based on the data for the Project as re-designed and with modified assumptions. Further, eagle fatality numbers below are at the 80% quantile, which is used by the Service to estimate risk to eagles. The median number of estimated fatalities is also provided. The interpretation of a value at the 80% quantile means there is an 80% chance that x number of eagles or fewer are predicted to be removed at the wind energy
The value at the 80% quantile should not be interpreted to mean that value equates to the number of eagle fatalities that will occur each year. Reliance on the 80% quantile value is very conservative and model results suggest the actual number of eagle fatalities is likely to be fewer than the 80% quantile value in most model runs. This conservative benchmark is added on top of the already risk-averse approach taken to develop the Model.

When I modified just the assumption in the Model that considers eagle abundance at the site (i.e., specifying a finite population), the 80% quantile estimate was 16 or fewer eagle fatalities. The median estimated number of annual fatalities for this scenario was 9. I assumed a mean abundance of 30 eagles on the site which was an appropriate number based on survey work conducted by SWCA Environmental Consultants (SWCA). I demonstrated that application of the Service’s Model without modification for a finite population is equivalent to assuming there is an infinite number of eagles on the Project site.

When I modified just the assumption in the Model to account for turbines not rotating all day and all year at the Project site, the 80% quantile value was 22 or fewer eagle fatalities. The median estimated number of annual fatalities for this scenario was 10.

When I modified just the assumption in the Model to consider only the proportion of time eagles fly at rotor height at the Project site, the 80% quantile estimate was 9 or fewer eagle fatalities. The median estimated number of annual fatalities for this scenario was 4.

When all 3 assumptions were modified to more realistically reflect Project conditions, the 80% quantile estimate was 8 or fewer eagle fatalities. The median estimated number of annual fatalities for this scenario was 4. The table below summarizes these results.

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Number of eagles at 80% quantile</th>
<th>Median value</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Service baseline</td>
<td>63</td>
<td>29</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Turbine No-Build Areas excluded only – Service’s assumptions used</td>
<td>23</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Finite population*</td>
<td>16</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Turbines do not rotate all day*</td>
<td>22</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Proportion of time eagles fly at rotor height*</td>
<td>9</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Finite population, turbines not rotating all day, proportion of time eagles fly at rotor height*</td>
<td>8</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

*These Model results assume that the Project has been re-designed to exclude certain designated high eagle use areas deemed turbine no-build areas.

When considering data for the Project as re-designed and modifying the Service’s Model to account for 3 questionable assumptions, the estimated number of eagle fatalities using the
Service’s Model, the 80% quantile estimate is 8 or fewer eagle fatalities each year. The median estimated number of annual fatalities for this scenario was 4. The estimates derived from the Service’s Model are only as reliable as the data and assumptions upon which it is based. In my opinion, model estimates when assumptions are modified to reflect Project conditions results in a more realistic estimate of eagle fatalities for the Project site.

II. Relevant Experience and Expertise

My experience and expertise are in wildlife ecology and the application of statistical techniques and models to address conservation issues. I have attached my Curriculum Vitae (see Attachment 1), but am providing a summary here of my relevant experience and expertise. Currently, I am a full professor and the Pauline O’Connor Distinguished Professor of Wildlife Management in the School of Natural Resources, Department of Fisheries and Wildlife Sciences, University of Missouri. I have a Ph.D. in Wildlife Ecology from the College of Forest Resources, University of Washington, Seattle. I did postdoctoral studies in quantitative ecology at the School of Aquatic and Fishery Sciences, University of Washington. Selected honors and awards are detailed on my C.V., however, they include a 2008 award from the U.S. Department of Agriculture for National Teacher of the Year, a 2007 award from the Wildlife Society for Best Article (with Steve Buskirk), and a 2005 award from the Missouri Department of Conservation for “Outstanding Research Collaborator of the Year.”

I have obtained about 55 grants and contracts as either PI or Co-PI since starting my faculty position in 1999 from diverse funding sources such as the U.S. Fish and Wildlife Service, National Fish and Wildlife Foundation, National Science Foundation, U.S. Forest Service, National Park Service, and the National Renewable Energy Lab. One recent grant is for the period 2011-2016 to study the Ecology of Greater Sage-grouse in Relation to Wind Energy Development in Wyoming. This study is being funded by the U.S. Forest Service, National Renewable Energy Lab, National Fish and Wildlife Foundation, Power Company of Wyoming (PCW), Wyoming Game and Fish Department, Bureau of Land Management, Western Association of Fish and Wildlife Agencies, and National Wind Coordinating Collaborative.

I have published 4 books and 160 peer-reviewed journal articles and book chapters. Three books are directly applicable: (1) Models for Planning Wildlife Conservation in Large Landscapes, 2009, Millspaugh, J.J. and F.R. Thompson, III, editors, Academic Press, 674 pages; (2) Design and Analysis of Long-Term Ecological Monitoring Studies, 2012, Gitzen, R.A., J.J. Millspaugh, A.B. Cooper, and D.S. Licht, editors. Cambridge University Press, 600 pages; and (3) Wildlife Demography: Analysis of Sex, Age, and Count Data, 2005, Skalski, J.R., K.E. Ryding, and J.J. Millspaugh, Elsevier Science, 656 pages. In addition to these publications, I have been an invited plenary speaker at national and international conferences to discuss the application of statistical techniques and models in wildlife ecology and management.
I have applied and evaluated statistical techniques and models in addressing conservation issues for a broad range of species, including mammals, avifauna, reptiles, and amphibians. For example, at the request of the Wisconsin Department of Natural Resources, I chaired an international panel of experts in evaluating data and models the agency uses to monitor and estimate white-tailed deer population demographics. Specifically, we evaluated the validity of the assumptions of their population reconstruction model, assessed adjustments made in the model by state personnel, and offered guidance on future applications. I was the senior author on a paper published in the *Journal of Wildlife Management* in 2009 that summarized our findings. A second example relates to my continued development of animal movement and habitat models. In addition to applying these statistical models to diverse taxa ranging from hellbenders to elephants, I have collaboratively developed new statistical approaches to analyzing such data and rigorously evaluated methodology. Specifically, my colleagues and I were among the first to apply discrete choice models in a wildlife context and we pioneered the development of resource utilization functions, both of which have become standard modeling tools for ecologists over the past decade. Thus, my experience and expertise are directly applicable to the analysis I was asked to perform.

### III. Review and Critical Analysis of the Assumptions of the Eagle Fatality Modeling for the Chokecherry and Sierra Madre Wind Energy Project

I was asked to perform a review and critical analysis of the assumptions of U.S. Fish and Wildlife Service’s Eagle Fatality Model and the eagle fatality estimates for the Chokecherry and Sierra Madre Wind Energy Project derived by the Service. Given issues I identified with assumptions of the Service’s Model, as applied to the Project site, I modified the Service’s Model to make these assumptions more realistic and reflective of Project conditions to estimate eagle fatalities. I compared these eagle fatality estimates from the modified Model to previous estimates based on the Model using the Service’s assumptions for the original Project design including high eagle use areas and on a re-designed Project that excluded certain designated high eagle use areas or turbine no-build areas. My opinions are based upon my training, experience, education and my expertise in wildlife ecology and the application of statistical techniques and tools to address conservation issues.

#### A. Documents and Data Examined and Scope of Review

In my review, I examined several documents, site-specific data used in the Model, sampling methodology used to collect site-specific eagle data, and the Service’s Model. Further, I considered my firsthand knowledge of the site, discussions with SWCA personnel, and two discussions with the Service about the Model. Below I detail the specific materials I reviewed and considered in my evaluation.

(1) Draft Eagle Conservation Plan Guidance released by the Service in January 2011 that describes a process for wind energy developers when preparing an Eagle Conservation Plan (ECP) to assess the risk of projects to eagles and assess how siting, design, and operational modifications can mitigate that risk, specifically, Appendix D, Description of the Service’s Model;
(2) Eagle Conservation Plan Guidance Module 1 Land-based Wind Energy Technical Appendices released by the Service in August 2012 that updated the technical appendices in the Draft Eagle Conservation Plan Guidance;
(3) Power Company of Wyoming’s Eagle Conservation Plan (August 2012);
(4) The site-specific eagle data collected at the Project site, including the sampling protocol used to select sites;
(5) Proposed re-design of the Project to include turbine no-build areas;
(6) Clipped data used as input in the Service’s Model which considered the turbine no-build areas;
(7) Service’s Model and the list of assumptions used by the Service in the Model;
(8) Service’s Model as applied to the Project and the Project as re-designed;
(9) Discussions with SWCA about sampling designs, data collection, and data analysis (including the kernel analysis used to identify turbine no-build areas) and two discussions with the Service about the fatality Model;
(10) Papers that were cited by the Service as support for model development and assumptions; and
(11) A report from AWS Truepower that provided the annual average percentage of daylight hours that the proposed Chokecherry and Sierra Madre Wind Project is expected to generate energy.

B. Experience with the Project and Eagle Data Collected

I am familiar with the Chokecherry and Sierra Madre Wind Energy Project, how the eagle data were collected by SWCA and how the data were analyzed by SWCA.

I am currently leading a study at the Chokecherry and Sierra Madre Wind Energy Project that investigates the ecology of male Greater sage-grouse in relation to construction of the wind energy facility. I have also been collaborating on a companion female Greater sage-grouse project on the site since the spring of 2010 and leading the habitat component of that project. Given my role in these sage-grouse projects, I have made extensive site visits across the Project site. I currently supervise two graduate students, one research associate, and the activities of several seasonal research technicians on the site in association with this sage-grouse research. I have also made a few separate trips to Denver, Colorado to meet and discuss my collaborative sage-grouse research with SWCA and PCW personnel.

Because of site visits and my research activities at the Project site, I am knowledgeable of the topography, landscape, and location where the eagle data were collected. I was accompanied by SWCA personnel during most of my time on the Project site and we discussed how and where the eagle data were collected. I also saw the radar unit in operation at the Project site and developed a model to differentiate eagle observations from the radar unit data from other species.

I reviewed the raptor survey program implemented by SWCA including the long watch raptor survey methodology.
I discussed the development of the kernel density maps with SWCA and found their approach to be appropriate and accurate, given the available data. In addition to site visits and previous discussions which made me familiar with the eagle use data and how that information was collected, I also discussed their approach in creating the kernel density maps.

These site-specific surveys and associated protocols are detailed in the Project site ECP, which I reviewed.

C. Description of and Assumptions Used in the Service’s Eagle Fatality Model

Under the Service’s Draft ECP Guidance, Stage 3 of developing an ECP involves conducting a turbine-based risk assessment and an estimate of the fatality rate of eagles for the facility. Set out below is a discussion of the Service’s Eagle Fatality Model and the assumptions of the Model as provided by the Service. I discuss a few of these assumptions and compare my interpretation of them to the Service’s description of assumptions and briefly discuss the implications (if known) of violating these assumptions, and their relevance to the Project. This section identifies modifications to the Service’s Model that are required to ensure the Model is more realistically applied to the Project.

1. The Service’s Eagle Fatality Model

The Service uses a Bayesian model to predict the number of eagle fatalities for a wind-energy facility. The Service’s Model estimates annual eagle fatalities as the product of the rate of eagle exposure to turbine hazards (exposure rate), the probability that eagle exposure will result in a collision with a turbine (collision probability), and an expansion factor that scales the resulting fatality rate to the project-specific affected potential exposure area and time. Within a Bayesian framework, the Service defines prior distributions for the exposure rate and collision probability. The expansion factor is constant. Using site-specific data, the Service’s Model calculates the exposure posterior distribution using the observed data. The number of predicted annual fatalities is estimated as the expanded product of the posterior exposure distribution and collision probability prior. See Appendix D – Stage 3, Draft ECP Guidance.

In reviewing the Model, I generated a list of model assumptions and assessed their validity for the Project site, I ran the Model code provided by the Service to generate the eagle fatality estimates, and I considered the validity of the Model and underlying data as applied to the Project site. My review of the validity of the underlying data as applied to the Project before and after the designation of turbine no-build areas has been detailed in a separate report dated September 7, 2012, which is incorporated as if set out fully by this reference.

During a conference call with the Service on August 9, 2012, we requested a list of model assumptions (which was provided on August 23, 2012). We explicitly discussed the

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1 Also participating in the call were Garry Miller of Power Company of Wyoming LLC and Jon Kehmeier from SWCA Environmental Consultants.
assumption of an infinite eagle population and interpretation of the model output. The Service acknowledged there was an assumption of an open population. With this assumption, eagle fatalities do not reduce eagle abundance, in terms of the exposed population. We discussed this and other assumptions during a conference call on September 5, 2012.

The Model maintains several useful properties. The use of a Bayesian model is appropriate for incorporating variability in model input and output. The modeling approach is flexible and allows for modification, which is advantageous because the Model can be updated as additional information becomes available about eagle fatalities at wind energy facilities. Further, it is possible to identify model assumptions because computer code is reviewable and available.

2. Assumptions of the Service’s Eagle Fatality Model

The Service’s Model makes a number of assumptions when estimating eagle fatalities that might occur at a wind facility site. Below is the list of assumptions received from the Service on August 23, 2012.

- All eagle collisions with wind turbines are fatal.
- Eagles are only at risk of colliding with turbines during daylight hours (flight in proximity to turbines does not occur during non-daylight hours). This can be specified further on a project-by-project basis where there are supporting data.
- Open population – eagles move between project site and surrounding areas, therefore the removal of an eagle does not result in a permanent change in eagle abundance.

Exposure
- Pre-construction eagle use data used to estimate eagle exposure are spatially and temporally representative of the stratum (or project if strata are not identified). Eagle exposure is eagle flight time in the project footprint per unit area per unit time.
- There is a predictable relationship between pre-construction eagle exposure and subsequent fatalities with a given amount of hazardous area around turbines. The project footprint is the minimum-convex hull that encompasses the wind-project area inclusive of the hazardous area around all turbines and any associated utility infrastructure.
- The prior distribution Gamma (0.97, 2.76) is appropriate for describing exposure rate and includes the range of possible exposure rates at potential sites.
- Eagle flight minutes observed in the project footprint follow a Poisson or similar distribution. This could be modified where appropriate given the data.
- Eagle exposure rate is uniform across a stratum (or project if strata are not identified).

Collision Probability
- There is a predictable relationship between the hazardous area around a turbine and subsequent fatalities given an exposure rate. Hazardous area is the 2-dimensional rotor-swept area around a turbine or proposed turbine.
The prior collision probability Beta (1.2, 176.7) is appropriate for collision probability and includes the range of possible collision probabilities across sites and various risk scenarios.

The collision probability is uniform for all hazardous area and among turbines within a stratum (or project if strata are not identified).

**Fatality Rate**

- The fatality rate is constant for all hazardous area within a given stratum (or project if strata are not identified).
- The fatality rate is constant for a temporal/seasonal stratum (or all time periods if strata are not identified).

Prior to receiving the list of assumptions from the Service, I generated a list of assumptions I determined were associated with the Service’s Model. I developed this list of assumptions after reading the Service’s documentation of the Model, running and evaluating the Model code, and after discussing the Model with the Service on August 9, 2012. The assumptions I identified were being used by the Service in the Model were mostly consistent with the list later provided by the Service; however, in this section I discuss a few of these assumptions and compare my interpretation of them to the Service’s description of assumptions. I also briefly discuss the implications (if known) of applying the assumptions in the Model, their relevance to the Project, and how they compare with the Service’s list of assumptions.

(1) **There is an infinite population of eagles exposed on the site.** As stated in the Service’s assumptions that were provided on August 23, 2012, the Service assumes an open population in the Model. It is more accurate to state that the Model assumes an infinite number of eagles at the site, and immediate replacement of an eagle with another eagle after a fatality event, because in the Model fatality due to turbine collision does not reduce eagle abundance. The open population assumption might provide a mechanism for the assumption of an infinite population, and immediate replacement due to a fatality, but what matters in the Model is that eagle abundance, or more specifically potential eagle exposure, does not decline as a result of eagle fatalities. This assumption has the practical influence of each eagle fatality resulting in immediate replacement by another eagle (i.e., the exposure rate does not change with an eagle fatality). The stated open population assumption assumes we know the process that leads to an infinite population and immediate replacement due to an eagle fatality. The implication of this assumption is that it is possible to predict more eagle fatalities on the site than eagles that exist currently on the site.

(2) **Eagles are assumed to be at risk for a collision if they are within 50 horizontal meters of the rotors, regardless of eagle height or rotor orientation.** The Service assumes that the hazardous area is the 2-dimensional rotor-swept area around a turbine or proposed turbine (see above). For clarification, the Service assumes that eagles are at risk for a collision if they are within 50 horizontal meters of the rotors, regardless of eagle height or rotor orientation. This assumption incorrectly means that eagles flying above or below the rotor blades are at risk of collision. Thus, the estimate of hazardous area used in the Model is questionable. Inclusion of this assumption in the Model will result in an overestimate of fatality risk of eagles.
(3) **Turbine blades are rotating during all daylight hours, 365 days a year.** The Service appropriately identifies in their list of assumptions that eagles are only at risk of colliding with turbines during daylight hours. However, it is important to further acknowledge that the Service’s Model assumes the turbine blades are moving during all daylight hours. If turbine blades do not rotate during all daylight hours, there would be a subsequent reduction in the risk of eagle collisions. Therefore, inclusion of this assumption in the Model when turbine blades will not rotate during all daylight hours will result in an overestimate of the predicted number of eagle fatalities.

(4) **Each count of eagle minutes per hour per km$^2$ is independent.** At the Project site, counts of eagle minutes were conducted over an approximately 2 km$^2$ for several hours at the same site. Thus, counts of eagle minutes when expressed on a per hour per km$^2$ basis in the Model are not independent in space or time. Therefore, this assumption will lead to overly precise estimates of the distribution of the exposure rate.

In the Service’s Eagle Conservation Plan Guidance Module 1 Land-based Wind Energy Technical Appendices released by the Service in August 2012, the Service suggests that eagle counts be conducted for 1, 2, or more hours (page 16, second full paragraph). However, the Model assumes that each count of eagle minutes per hour per km$^2$ is independent. It is important to recognize that the Model implicitly is considering each 1 hour per km$^2$ as a discrete, independent exposure event. That is, there is no accommodation for different lengths of survey periods because the Model assumes each count of eagle minutes per hour per km$^2$ is independent. If input data includes a count from 2 consecutive survey hours per km$^2$ at a sample unit, the model treats this identical to 2 randomly selected 1 hour per km$^2$ survey counts, independently selected in space and time. However, counts conducted for 2 or more hours do not result in independent eagle minutes when expressed on a per hour per km$^2$ in space or time. For example, hour 1 and 2 in a 2-hour long survey would be dependent and thus violate the assumptions of the Model. If input data do not meet this assumption, there will be an overly precise estimate of the distribution of the exposure rate. The magnitude of bias associated with this assumption is not addressed in this report, but could have implications to eagle fatality estimates.

(5) **The count of eagle minutes that updates the prior distribution on expected eagle minutes per hour per km$^2$ is collected randomly with respect to space and time.** Further, it is assumed that the number of eagle minutes is evenly distributed in space and time. If the first part of this assumption is violated, a model that assumes random sampling both spatially and temporally (e.g., assuming a Poisson model for counts of eagle minutes) will produce biased estimates. The second part of this assumption, related to eagle minutes being evenly distributed in space and time, is not met. Examination of eagle flight path data collected by SWCA shows heterogeneous use of the Project site by eagles. Additionally, we might expect flight paths to differ by season. Therefore, this assumption could lead to an overestimation of fatality risk in low use areas and underestimation of flight risk in high use areas.

My evaluation of the sampling locations revealed that the selected sites to survey eagles were biased because they were not selected according to the underlying assumptions of the Model.
Rather, sampling sites were selected because they were presumed to be high use eagle sites. The Model assumes that the count of eagle minutes that updates the prior distribution on expected eagle minutes per hour per km\(^2\) is collected randomly with respect to space and time. Therefore, if these presumed high use areas had higher eagle activity than other portions of the Project site, the sampling strategy used will inherently result in an overestimate of eagle minutes when applied to the entire Project. The result is that eagle fatalities would be overestimated. The Model cannot account for heterogeneous use of the Project by eagles and thus assumes eagle minute use data were collected randomly with respect to space and time – the Model is spatially blind and therefore assumes a simple random sampling protocol for eagle minutes. In this case, areas of expected high use were oversampled relative to their availability, which results in an upward bias (i.e., more eagle minutes which equates to more predicted fatalities when applied to the entire area). Future sampling design needs to more directly consider the underlying assumptions of the Service’s Model and to follow fundamental principles of survey sampling.

(6) As noted by the Service, it is assumed that eagle minutes per hour per km\(^2\) is a Poisson random variable. The Service also appropriately acknowledges that this assumption could be modified should data be available. Examination of counts of eagle minutes on the Project site is zero-inflated and overdispersed relative to a theoretical Poisson model. Violation of this assumption will lead to biased estimates of the distribution of the exposure rate. The direction and magnitude of this bias has not been investigated here.

(7) The collision probability is constant for all eagles. The Service’s Model assumes that all eagles are equally vulnerable to collision with wind turbines. However, if one segment of the population (e.g., juveniles) is more susceptible to collision than another (e.g., adults), this assumption would be violated. Violation of this assumption might lead to an overestimation of fatality risk for groups of birds less prone to collision and underestimate fatality risk for groups of birds that are more prone to collision. If the proportion of individuals in each group is not equal, violations of this assumption will not equal out.

(8) The Service assumes that the 80% quantile is an appropriate measure of the risk of eagle fatalities on a site. Output of the Service’s Model is a probability distribution of predicted eagle fatalities on an annual basis. The Service has used the 80% quantile as a basis for interpretation. During our conference call on August 9, 2012, the Service acknowledged that focus on the 80% quantile is conservative and was a policy decision. Most importantly, the interpretation of a value at the 80% quantile means there is an 80% chance that \(x\) number of eagles or fewer are predicted to be removed at the wind energy site. The value at the 80% quantile should not be interpreted to mean that value equates to the number of eagle fatalities. This conservative benchmark is added on top of the already risk averse approach taken by the Service in developing the Model.

Given the assumptions and approach taken to build the Model, it is a highly conservative prediction tool which errs on the side of over-predicting the number of likely eagle fatalities. By repeatedly deriving model assumptions with a high emphasis of being risk averse rather than on hypothesized biological reality, the Service ends up with predictions known to be highly conservative, but for which the degree of conservativeness is unknown. This
strategy may be far more risk averse than the Service intended, and includes a risk valuation that is not transparent. The degree of risk that is tolerable should be made transparent when evaluating alternatives based on objective prediction about consequences of alternatives, not embedded repeatedly in the building of a model to predict outcomes. This modeling philosophy is emphasized in the literature on structured decision making. It is a basic principle in transparent decision-making that predictions about potential consequences of a decision alternative should be based on facts and best available science, and should be separated from subsequent consideration of values and risk tolerance (R. Gregory et al. 2012, Structured decision making: A practical guide to environmental management choices, Wiley-Blackwell). The best scientific practice would be to develop the most realistic model possible, apply the model, and explain to the policy makers how to interpret and use model output as they determine the acceptable degree of risk. It is important to avoid confusing best scientific practices with policy when developing a model.

In conclusion, my examination of the Service’s Eagle Fatality Model revealed that a number of the assumptions are questionable when applied to the Project. This report, however, focuses on 3 specific assumptions made by the Service’s Model (1) that there is an infinite population of eagles exposed on the site each year; (2) that turbines operate during all daylight hours, all year long; and (3) that eagles are at risk whether they fly above, below, or at rotor height. By not verifying the validity and reasonableness of these assumptions, the Model overestimates the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project. I focused on these 3 assumptions because (1) they are questionable; (2) data are available to address these assumptions; and (3) the Service’s Model requires only slight modification to account for these assumptions so that they more realistically reflect the Project conditions, resulting in a more realistic estimate of eagle fatalities for the Project.

IV. Eagle Fatality Modeling for the Chokecherry and Sierra Madre Wind Energy Project: Consideration of Assumptions

Given the discussion above about model assumptions, I used the Service’s Model as a basis for estimating annual eagle fatalities, but I produced fatality estimates both by modifying questionable assumptions one at a time and by modifying all assumptions simultaneously. I maintained the structure and general approach taken by the Service in developing the Model, but made biologically reasonable and supportable modifications to address these assumptions.

A. Overview, Scope of Analysis and Background

I focused on the following 3 specific assumptions made by the Service’s Model (1) that there is an infinite population of eagles exposed on the site each year; (2) that turbines operate during all daylight hours, all year long; and (3) that eagles are at risk whether they fly above, below, or at rotor height. By not verifying the validity and reasonableness of these assumptions, the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project. I focused on these 3 assumptions because (1) they are questionable; (2) data are available to address these assumptions; and (3) the Service’s Model requires only
slight modification to account for these assumptions so that they more realistically reflect the Project conditions, resulting in a more realistic estimate of eagle fatalities for the Project.

To address these assumptions, I did the following: (1) to account for the infinite population assumption, I modified the Service’s Model to directly account for abundance on the site (the number of fatalities is a function of the number of eagles at risk of death); (2) to account for turbines not operating during all daylight hours, I adjusted the daylight hour expansion by considering the proportion of daylight hours turbines are expected to rotate; and (3) to account for differential flights of eagles, I adjusted the area expansion to consider the proportion of time eagles flew at rotor height in the Project. I compared Model output when assumptions were modified one at a time and when assumptions were simultaneously modified to previous eagle fatality estimates that I generated under the Project before and after consideration of turbine no-build areas that excluded certain designated high eagle use areas.

As background, I previously determined that using the Service’s Model without modification to the Service’s assumptions and without any re-design of the Project, the 80% quantile estimate was 63 or fewer eagle fatalities (Figure 1). The output of the Service’s Model is a probability distribution representing a range of fatality estimates. This Model output should not be used to assert that there will be 63 eagle fatalities per year. Reliance on the 63 eagle fatality value is very conservative and Model results suggest the actual number of eagle fatalities is likely to be far fewer. For example, the median estimated number of annual fatalities for this scenario was 29. This conservative benchmark is added on top of the already risk averse approach taken in developing the Model.

When considering the Project re-design, which excludes certain designated high eagle use areas, or turbine no-build areas, I previously estimated the 80% quantile number estimate of 23 or fewer eagle fatalities (Figure 2). Again, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of annual fatalities for this scenario was 11.

The modeling results discussed below are based on the Project as re-designed to exclude certain designated high eagle use areas, deemed Turbine No-Build Areas.

B. Data Used in Eagle Fatality Estimates

SWCA completed an extensive survey program on the Project site using a combination of several approaches. The long watch raptor surveys are most pertinent to our consideration of eagle fatalities and application of the Service’s Model. These long watch raptor surveys were conducted at 15, 4,000-m radius plots distributed across the Project. Fixed-point surveys were conducted in a 4,000-m radius to maximize areal coverage for identifying high use areas while maintaining observer confidence in species identification. Between April 2011 and April 2012, SWCA collected 2,162.5 hours of eagle use data at these 15 sites. These data were used to identify eagle use areas associated with topographic features, movement corridors, foraging areas, and nesting territories. To comply with the data requirements of the Service’s Model, these survey data were truncated to include only those
observations that occurred within 800-meters of each survey site. I applied these data in the Service’s Model, with the modifications described below, to estimate the number of eagle fatalities.

These data were appropriately clipped and applied in the Service’s Model to account for the Project re-design which excluded designated high eagle use areas (Figure 3). The methods of analysis are detailed in Appendix A. These are the data that I used in the Model modifications described subsequently.

C. Eagle Fatality Estimates

Beyond the two model runs that were applied (1) without modification to the Model’s assumptions and before Project re-design and (2) without modification to the Model’s assumptions but after the Project was re-designed to include turbine no-build areas, which excluded certain high eagle use areas, I completed 4 additional model runs that modified the 3 assumptions described above. All of these simulations identified below assume that the turbine no-build areas are excluded. I compared model output when assumptions were modified one at a time and by modifying all assumptions simultaneously. These included:

1. Eagle Fatality Estimates for the Project Accounting for a Finite Population of Eagles

To account for the infinite population assumption, the Service’s Model was directly modified to directly consider abundance. More specifically, the Service’s Model was made to explicitly make the number of fatalities a function of the number of eagles at risk of death. Variables used are defined as follows

\[
\begin{align*}
\lambda &= \text{the expected number of eagle minutes per hour per km}^2 \\
C &= \text{collision probability per eagle minute spent in hazardous areas} \\
A &= \text{abundance of eagles in the project site} \\
DH &= \text{the total number of daylight hours in a year} \\
HA &= \text{the total hazardous area in units of km}^2 \\
F &= \text{number of eagle fatalities} \\
\pi &= \text{proportion of time turbines are rotating} \\
\alpha &= \text{proportion of time flying at rotor height}
\end{align*}
\]

Both \( \lambda \) and \( C \) are specified by the same distributions outlined in Appendix D – Stage 3 document of the Draft ECP Guidance. \( A \) can be specified as a distribution or as a constant. For purposes of this report, I have assumed a mean abundance of 30 eagles, which was estimated by SWCA during their monitoring program.
The probability a single eagle collides with a turbine per eagle-minute spent in hazardous areas is:

\[ \gamma = 1 - (1 - C) \frac{\lambda}{A}. \]

Note that the expected number of eagle minutes per hour per km\(^2\) is divided by the total abundance so the collision probability is represented on a per-eagle basis. Assuming the collision probability is constant across space and time, the annual probability of a single eagle colliding with a wind turbine is:

\[ \psi = 1 - (1 - \gamma)^{DH \times HA}. \]

Finally, assuming a constant annual collision probability across all eagles:

\[ F \sim binomial(A, \psi). \]

In addition to other assumptions made in the Service’s Model, our binomial model assumes that eagle minutes are evenly spread among all eagles in the Project site. The abundance is assumed to be known or is known with some level of certainty. Specifying an unreasonably large abundance (e.g., infinite population) will overestimate fatality risk, while specifying an unreasonably small abundance (e.g., 1 eagle) will underestimate fatality risk.

In summary, this approach is identical to the Service’s Model but this modification allows an explicit representation of the number of eagles at risk of death. Using the Service’s Model which assumes an infinite number of trials, it was modified as an equivalent binomial model without altering any other aspect of the Service’s Model except for the mean abundance which is made explicit. Such an approach allows for the evaluation of the effect of a more realistic value of abundance on estimated eagle fatalities rather than assuming an infinite population of eagles exposed on the site and immediate replacement of an eagle with another eagle after a fatality event.

When assuming a mean population abundance of 30, application of this modified model results in an estimated 16 or fewer eagle fatalities at the 80% quantile (Figure 4). The median estimated number of annual fatalities for this scenario was 9.

Appendix B, which is attached, demonstrates that when you input an eagle abundance of 1 million into the modified model (i.e., when you approach \(\infty\)), results match the distribution predicted by the Service’s baseline model. Thus, application of the Service’s Model without modification for a finite population is equivalent to assuming there is an infinite number of eagles on the Project site.
2. **Eagle Fatality Estimates for the Project When Turbines Do Not Rotate All Day**

Wind turbines are not expected to operate during all daylight hours. To account for reduced risk of collisions when turbines are not operating, we adjusted the daylight hour ($DH$) expansion (which represents the total number of daylight hours in a year) as:

$$DH_{\text{adjusted}} = DH \times \pi.$$  

Where the $\pi$ represents the monthly generation, the proportion of daylight hours turbines are expected to rotate. The parameter $\pi$ was estimated from a report prepared by AWS Truepower that provided the annual average percentage of daylight hours that the proposed Chokecherry and Sierra Madre Wind Project is expected to generate energy. It was estimated that the annual average percentage of daylight hours that the Chokecherry and Sierra Madre Project site is expected to generate energy is 97.1%. This value was obtained from the report from AWS Truepower. See Attachment 2, AWS Truepower Report dated 9-05-2012.

Applying this modification to the model reduced the predicted eagle fatalities to 22 or fewer fatalities per year at the 80% quantile (Figure 5). The median estimated number of annual fatalities for this scenario was 10.

3. **Eagle Fatality Estimates for the Project Accounting for Proportion of Time Spent Flying at Rotor Height**

Eagles must fly at the height of rotating turbines to be at risk of collision. To account for reduced risk of collisions when flying above or below rotating turbines, we adjusted the hazard area ($HA$) expansion (which is defined as the total hazardous area in units of km$^2$) as:

$$HA_{\text{adjusted}} = HA \times \alpha.$$  

The parameter $\alpha$ is estimated from observations of golden eagle flight heights at the Project site. SWCA recorded 40.7% of their eagle minute observations in the 30-150 m height category which is the height of rotors and height where eagles are at risk of collision. SWCA recorded 25.4% of their observations in the 0-30 m category and 33.9% in the 150+ m category.

Applying this modification to the Model reduced the predicted eagle fatalities to 9 or fewer fatalities per year at the 80% quantile (Figure 6). The median estimated number of annual fatalities for this scenario was 4.
4. Eagle Fatality Estimates for the Project Assuming All Assumptions Modified

Last, I ran a model that incorporated all of the modifications above. This simulation resulted in an estimated fatality of 8 or fewer eagles at the 80% quantile (Figure 7). The median estimated number of annual fatalities for this scenario was 4.

A summary of these results is below:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Number of eagles at 80% quantile</th>
<th>Median value</th>
<th>Figure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Service baseline</td>
<td>63</td>
<td>29</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Turbine No-Build Areas excluded only – Service’s assumptions used</td>
<td>23</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Finite population*</td>
<td>16</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>Turbines do not rotate all day*</td>
<td>22</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>5</td>
<td>Proportion of time eagles fly at rotor height*</td>
<td>9</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Finite population, turbines not rotating all day, proportion of time eagles fly at rotor height*</td>
<td>8</td>
<td>4</td>
<td>7</td>
</tr>
</tbody>
</table>

*These Model results assume that the Project has been re-designed to exclude certain designated high eagle use areas deemed turbine no-build areas.

V. Conclusion

In conclusion, it is my opinion that:

- There are a number of assumptions inherent in the Service’s eagle fatality Model that are questionable for the Project site and modification of these assumptions as used in the Model results in a more realistic estimate of eagle fatalities because the modifications more realistically reflect Project conditions. In particular, the Service’s Model assumes (1) that there is an infinite population of eagles exposed on the site; (2) that turbines operate during all daylight hours, all year long; and (3) that eagles are at risk whether they fly above, below, or at rotor height. By not considering the validity of these assumptions, the Model overestimates the number of predicted eagle fatalities for the Chokecherry and Sierra Madre Wind Energy Project.

- The Service’s Model can be modified to reflect more realistic assumptions for the Project site. Doing so maintains the structure and general approach taken by the Service in developing and applying the Model. However, doing so makes the Model a more realistic reflection of Project conditions.
When considering the Project re-design, which excludes certain high eagle use areas deemed turbine no-build areas, I estimate that when (1) accounting for the assumption of an infinite population, the estimated number of eagle fatalities would be reduced to 16 or fewer per year (median value of 9); (2) modifying the assumption that turbines do not rotate all day, the estimated number of eagle fatalities would be reduced to 22 or fewer per year (median value of 10); (3) accounting for the proportion of time eagles fly at rotor height, the estimated number of eagle fatalities would be reduced to 9 or fewer per year (median value of 4); and (4) when all assumptions are considered in the Model, I estimate that 8 or fewer eagle fatalities would occur annually (median value of 4).

By modifying the Service’s Model to account for three questionable assumptions, based on the Project re-design, which excludes certain designated high eagle use areas or turbine no-build areas, I predict 8 or fewer eagle fatalities per year at the 80% quantile of the probability distribution. The median estimated number of annual fatalities for this scenario was 4.

Even just considering the Project as re-designed and modifying only one assumption, the proportion of time eagles fly at rotor height, reduces the estimated number of fatalities at the 80% quantile to 9 or fewer eagles annually. The median estimated number of annual fatalities for this scenario was 4.

These results indicate that eagle fatality estimates are reduced greatly when the Project is re-designed and the Model is modified to more realistically reflect project conditions. My opinion is that Model estimates when assumptions are modified results in a more realistic estimate of eagle fatalities for the Project.

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Figure 1. Probability distribution of eagle fatality estimates for the Project including areas of high eagle use. This fatality probability distribution for the Project site (CCSM – Chokecherry and Sierra Madre) was based on observed eagle minutes and survey effort which include areas of high eagle use.
Figure 2. Probability distribution of eagle fatality estimates for the project as re-designed with turbine no-build areas. This fatality probability distribution for the Project site (CCSM – Chokecherry and Sierra Madre) was based on observed eagle minutes and survey effort as re-designed with turbine no-build areas.
Figure 3. Identified high eagle use areas and 800-meter survey perimeters outside of turbine no-build areas on the Project site.
Figure 4. Probability distribution of eagle fatality estimates for the project as re-designed with eagle avoidance areas and assuming a finite population of eagles. These simulations assumed a mean population size of 30 eagles on the site. $\bar{N}$ represents the mean abundance over all simulations.
Figure 5. Probability distribution of eagle fatality estimates for the project as re-designed with eagle avoidance areas and accounting for turbines not rotating all day. Monthly generation was the proportion of daylight hours turbines are expected to rotate. This value was estimated from a report from AWS Truepower that provided the annual average percentage of daylight hours that the proposed Chokecherry and Sierra Madre Wind Project is expected to generate energy.
Figure 6. Probability distribution of eagle fatality estimates for the project as re-designed with eagle avoidance areas and accounting for the proportion of time eagles spent flying at rotor height in the Project site. To account for reduced risk of collisions when flying above or below rotating turbines, we adjusted the hazard area expansion (the total hazardous area in units of km$^2$). SWCA recorded 40.7% (Prop. Rotor Height = 0.407) of their eagle minute observations in the 30-150 meter height category, which is the height of rotors and height where eagles are at risk of collision.
Figure 7. Probability distribution of eagle fatality estimates for the project as re-designed with eagle avoidance areas, assuming a mean population size of 30 eagles, accounting for turbines not rotating all day, and accounting for the proportion of time eagles spent flying at rotor height in the Project site. These simulations assumed a mean population size of 30 eagles on the site. $\bar{N}$ represents the mean abundance over all simulations. Monthly generation was the proportion of daylight hours turbines are expected to rotate. This value was estimated from a report from AWS Truepower that provided the annual average percentage of daylight hours that the proposed Chokecherry and Sierra Madre Wind Project is expected to generate energy. To account for reduced risk of collisions when flying above or below rotating turbines, we adjusted the hazard area expansion (the total hazardous area in units of km$^2$). SWCA recorded 40.7% (Prop. Rotor Height = 0.407) of their eagle minute observations in the 30-150 meter height category, which is the height of rotors and height where eagles are at risk of collision.
Appendix A: Eagle fatality estimates for the Project including areas of high eagle use and for the Project as re-designed with turbine no-build areas, which excludes turbines from certain designated high eagle use areas. These methods and results were provided in a separate report, but are provided here in support of material presented in this report.

1. Eagle Fatality Estimates for the Project Including Areas of High Eagle Use

I applied the baseline Service’s Model using site-specific 800-meter survey data from the Project site as collected by SWCA and described above. Specifically, we used the number of golden eagle flight minutes observed and the hour/km² of survey observations. The baseline 800-meter survey data, without consideration of the turbine no-build areas, recorded 731.7 eagle minutes for the Project site (which includes 2.7 minutes for unidentified eagle species). The survey effort is based on 2,162.5 survey hours. Because each survey point consisted of an 800 m (0.80 km) radius circle, survey effort equals 2162.5 observation hours * 0.80²*3.14...km² = 4,348 observation hours-km². With 15 survey points, this is equal to:

$$\sum_{i=1}^{15} \text{(observation hours at survey point i} \times \text{area}_{\text{plot i, km}^2})$$

where the plot area = (0.80 km)²*3.14... for all survey points. Survey minute totals are shown in Table 1. Table 2 provides the eagle minutes of eagle flight time when only the 800-meter survey data are included. Applying this information in the Service’s eagle fatality estimate leads to an estimated fatality distribution with quantiles 0.50 = 29 fatalities, 0.80 = 63 fatalities, 0.90 = 87 fatalities, and 0.95 = 111 fatalities (Figure 1).

The Service uses the 80% quantile from the distribution of predicted fatalities to infer risk. This is a very conservative approach because the most likely number of fatalities, when one considers the probability distribution in Figure 1, is much lower. The resulting probability distribution should not be used to assert that there will be 63 eagle fatalities a year. These results indicate that 80% of the time, it is predicted that 63 or fewer eagles would be removed. Thus, it is unrealistic to expect 63 eagles would be removed. For example, the median estimated number of fatalities for this scenario was 29 annual eagle fatalities. Further, this conservative benchmark is added on top of the already risk averse approach taken to develop the Model.

2. Eagle Fatality Estimates for the Project as Re-Designed with Eagle Turbine No-build Areas

Based on the estimated eagle fatalities for the Project, PCW followed the ECP Draft Guidance and re-designed the Project. Using the kernel density maps, which I find accurately represent the high eagle use areas based on available data, PCW re-designed the Project to exclude turbines from certain designated high eagle use areas. A map of the re-designed Project with the turbine no-build areas is attached (Figure 3).

To evaluate the effect of this Project re-design on the estimated number of eagle fatalities, the next step involved clipping the data to eliminate the turbine no-build areas from the Project
footprint. Data clipped for use in the Eagle Fatality Model to estimate eagle fatalities for the project as re-designed was clipped accurately and appropriately modified to remove eagle use data for the areas removed from the wind farm facility (turbine no-build areas).

To calculate eagle use in these areas, the number of eagle flight minutes and survey minutes were calculated using only those observations that occurred within the remaining survey buffer. As a result, eagle flight minutes per hour of survey time per km$^2$ was calculated and used as the input data in the Service’s eagle fatality Model. Data used as model input are summarized in Tables 1 and 3.

Observed eagle minutes outside the turbine no-build area were recalculated as described above after excluding eagle minutes occurring in portions of plots within the turbine no-build area. This leads to a count of 189 eagle minutes observed in the portions of the 15 Project site survey plots outside the turbine no-build area (Table 3). These non-avoidance plot segments were surveyed for 2,162.5 total survey hours (Table 1), but because the proportion of each plot within the turbine no-build area varied, survey effort was recalculated as:

$$\sum_{i=1}^{15} \text{observation hours at survey point } i \times \text{area-outside-avoidance-zone}_{\text{plot } i, \text{km}^2}$$

producing a revised effort of 3,073.9 observation hours-km$^2$.

I used these revised estimates in the Service’s Model to estimate eagle fatalities when incorporating the identified turbine no-build areas. Using the revised survey effort and eagle minutes outside the turbine no-build areas, the estimated fatality distribution (Figure 2) had quantiles $0.50 = 11$ fatalities, $0.80 = 23$ fatalities, $0.90 = 32$ fatalities, and $0.95 = 41$ fatalities. Thus, using the clipped data in the Model representing the Project as re-designed results in an 80% quantile estimate of 23 or fewer eagle fatalities. Again, this is a probability distribution and should not be used to assert that there will be 23 eagle fatalities per year. The median estimated number of annual fatalities for this scenario was 11.

The distribution in Figure 2 is based on applying the baseline Service Model, with revised eagle minutes =189 (Table 3). Because total observation hours-km$^2$ is calculated in the Service’s CollisionModelv2.11.R file rather than the project-specific input file, we also modified the collision model file to specify "SmpHrKM2<-3073.923", which replaces the default calculation of this variable in the Model.
Table 1. Survey minute totals for all sites in spring, summer, fall, and winter seasons during year two at the Project site.

<table>
<thead>
<tr>
<th>Site</th>
<th>Spring Mins</th>
<th>Spring Hrs</th>
<th>Summer Mins</th>
<th>Summer Hrs</th>
<th>Fall Mins</th>
<th>Fall Hrs</th>
<th>Winter Mins</th>
<th>Winter Hrs</th>
<th>Total Mins</th>
<th>Total Hrs</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM1</td>
<td>3,534</td>
<td>58.9</td>
<td>720</td>
<td>12.0</td>
<td>3,435</td>
<td>57.3</td>
<td>1,200</td>
<td>20.0</td>
<td>8,889</td>
<td>148.2</td>
</tr>
<tr>
<td>RM2</td>
<td>3,483</td>
<td>58.1</td>
<td>720</td>
<td>12.0</td>
<td>3,213</td>
<td>53.6</td>
<td>1,190</td>
<td>19.8</td>
<td>8,606</td>
<td>143.4</td>
</tr>
<tr>
<td>RM3</td>
<td>2,974</td>
<td>49.6</td>
<td>720</td>
<td>12.0</td>
<td>3,479</td>
<td>58.0</td>
<td>0*</td>
<td>0*</td>
<td>7,173</td>
<td>119.6</td>
</tr>
<tr>
<td>RM4</td>
<td>2,867</td>
<td>47.8</td>
<td>724</td>
<td>12.1</td>
<td>3,440</td>
<td>57.3</td>
<td>1,140</td>
<td>19.0</td>
<td>8,171</td>
<td>136.2</td>
</tr>
<tr>
<td>RM5</td>
<td>3,422</td>
<td>57.0</td>
<td>738</td>
<td>12.3</td>
<td>3,255</td>
<td>54.3</td>
<td>1,065</td>
<td>17.8</td>
<td>8,480</td>
<td>141.3</td>
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<tr>
<td>RM6</td>
<td>2,925</td>
<td>48.8</td>
<td>631</td>
<td>10.5</td>
<td>4,305</td>
<td>71.8</td>
<td>1,180</td>
<td>19.7</td>
<td>9,041</td>
<td>150.7</td>
</tr>
<tr>
<td>RM7</td>
<td>3,120</td>
<td>52.0</td>
<td>675</td>
<td>11.3</td>
<td>2,835</td>
<td>47.3</td>
<td>1,160</td>
<td>19.3</td>
<td>7,790</td>
<td>129.8</td>
</tr>
<tr>
<td>RM8</td>
<td>3,403</td>
<td>56.7</td>
<td>730</td>
<td>12.2</td>
<td>3,608</td>
<td>60.1</td>
<td>1,172</td>
<td>19.5</td>
<td>8,913</td>
<td>148.6</td>
</tr>
<tr>
<td>RM9</td>
<td>3,704</td>
<td>61.7</td>
<td>720</td>
<td>12.0</td>
<td>3,725</td>
<td>62.1</td>
<td>1,141</td>
<td>19.0</td>
<td>9,290</td>
<td>154.8</td>
</tr>
<tr>
<td>RM10</td>
<td>3,614</td>
<td>60.2</td>
<td>720</td>
<td>12.0</td>
<td>3,233</td>
<td>53.9</td>
<td>1,162</td>
<td>19.4</td>
<td>8,729</td>
<td>145.5</td>
</tr>
<tr>
<td>RM11</td>
<td>4,001</td>
<td>66.7</td>
<td>720</td>
<td>12.0</td>
<td>3,352</td>
<td>55.9</td>
<td>1,240</td>
<td>20.7</td>
<td>9,313</td>
<td>155.2</td>
</tr>
<tr>
<td>RM12</td>
<td>2,790</td>
<td>46.5</td>
<td>670</td>
<td>11.2</td>
<td>3,417</td>
<td>57.0</td>
<td>1,093</td>
<td>18.2</td>
<td>7,970</td>
<td>132.8</td>
</tr>
<tr>
<td>RM13</td>
<td>3,999</td>
<td>66.7</td>
<td>720</td>
<td>12.0</td>
<td>3,530</td>
<td>58.8</td>
<td>2,314</td>
<td>38.6</td>
<td>10,563</td>
<td>176.1</td>
</tr>
<tr>
<td>RM14</td>
<td>2,985</td>
<td>49.8</td>
<td>725</td>
<td>12.1</td>
<td>3,354</td>
<td>55.9</td>
<td>1,200</td>
<td>20.0</td>
<td>8,264</td>
<td>137.7</td>
</tr>
<tr>
<td>RM15</td>
<td>3,345</td>
<td>55.8</td>
<td>720</td>
<td>12.0</td>
<td>3,245</td>
<td>54.1</td>
<td>1,248</td>
<td>20.8</td>
<td>8,558</td>
<td>142.6</td>
</tr>
<tr>
<td>Total</td>
<td>50,166</td>
<td>836.1</td>
<td>10,653</td>
<td>177.6</td>
<td>51,426</td>
<td>857.1</td>
<td>17,505</td>
<td>291.8</td>
<td>129,750</td>
<td>2162.5</td>
</tr>
</tbody>
</table>

* Due to winter access and safety issues, surveys at RM3 were not completed during winter months.
Table 2. Minutes of eagle flight time within 800-meters of each raptor monitoring location at the Project site. These data relate to eagle fatality estimates for the Project including areas of high eagle use.

<table>
<thead>
<tr>
<th>Site</th>
<th>Spring</th>
<th>Summer</th>
<th>Fall</th>
<th>Winter</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM1</td>
<td>23</td>
<td>12</td>
<td>6</td>
<td>0</td>
<td>41</td>
</tr>
<tr>
<td>RM2</td>
<td>16</td>
<td>8</td>
<td>25</td>
<td>10</td>
<td>59</td>
</tr>
<tr>
<td>RM3</td>
<td>0</td>
<td>0</td>
<td>13</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>RM4</td>
<td>12</td>
<td>9</td>
<td>0</td>
<td>0</td>
<td>21</td>
</tr>
<tr>
<td>RM5</td>
<td>23</td>
<td>21</td>
<td>17</td>
<td>19</td>
<td>80</td>
</tr>
<tr>
<td>RM6</td>
<td>47</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>47</td>
</tr>
<tr>
<td>RM7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>RM8</td>
<td>50</td>
<td>0</td>
<td>24</td>
<td>4</td>
<td>78</td>
</tr>
<tr>
<td>RM9</td>
<td>0</td>
<td>0</td>
<td>11</td>
<td>0</td>
<td>11</td>
</tr>
<tr>
<td>RM10</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>RM11</td>
<td>59</td>
<td>0</td>
<td>55</td>
<td>35</td>
<td>149</td>
</tr>
<tr>
<td>RM12</td>
<td>12</td>
<td>0</td>
<td>12</td>
<td>8</td>
<td>32</td>
</tr>
<tr>
<td>RM13</td>
<td>11</td>
<td>0</td>
<td>24</td>
<td>16</td>
<td>51</td>
</tr>
<tr>
<td>RM14</td>
<td>26</td>
<td>21</td>
<td>15</td>
<td>37</td>
<td>99</td>
</tr>
<tr>
<td>RM15</td>
<td>5</td>
<td>0</td>
<td>25</td>
<td>5</td>
<td>35</td>
</tr>
<tr>
<td>Total</td>
<td>290</td>
<td>71</td>
<td>227</td>
<td>141</td>
<td>729</td>
</tr>
</tbody>
</table>
Table 3. Minutes of eagle flight time outside of avoidance areas within 800-meters of each raptor monitoring location at the Project site. These data relate to eagle fatality estimates for the Project as re-designed with Turbine No-Build Areas.

<table>
<thead>
<tr>
<th>Site</th>
<th>Spring</th>
<th>Summer</th>
<th>Fall</th>
<th>Winter</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>RM1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<tr>
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<td>RM5</td>
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<td>RM6</td>
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<tr>
<td>RM7</td>
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<td>0</td>
</tr>
<tr>
<td>RM8</td>
<td>6</td>
<td>6</td>
<td>1</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>RM9</td>
<td></td>
<td>7</td>
<td></td>
<td></td>
<td>7</td>
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<td>RM10</td>
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<td>3</td>
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<td>RM11</td>
<td>6</td>
<td>11</td>
<td>9</td>
<td></td>
<td>26</td>
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<tr>
<td>RM12</td>
<td>5</td>
<td>3</td>
<td>7</td>
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<td>RM13</td>
<td>10</td>
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<td></td>
<td>19</td>
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<td>43</td>
</tr>
<tr>
<td>RM15</td>
<td>4</td>
<td>5</td>
<td>4</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>Total</td>
<td>62</td>
<td>13</td>
<td>66</td>
<td>48</td>
<td>189</td>
</tr>
</tbody>
</table>
Appendix B. To illustrate how the assumption of a finite population (i.e., binomial model) affects the probability distribution of eagle fatalities, we ran the model using several different assumed abundance values of eagles (i.e., 25, 50, 100, 1,000, and 1,000,000). The finite population model converges to the Service’s fatality Model as abundance → ∞ (i.e., 1 million). Application of the Service’s Model without modification for a finite population is equivalent to assuming there is an infinite number of eagles available for exposure on the Project site.
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EDUCATION


1995  M.S., Wildlife Science. Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, South Dakota

1991  B.S., Environmental and Forest Biology. State University of New York, College of Environmental Science and Forestry, Syracuse, New York

ACADEMIC POSITIONS

2009-present  Pauline O’Connor Distinguished Professor of Wildlife Management

1999-present  Professor of Wildlife Conservation, School of Natural Resources, Department of Fisheries and Wildlife Sciences, University of Missouri, Columbia (2009-Present); Associate Professor (2005-2009); Assistant Professor (1999-2005)

1999-2010  Director, Thomas S. Baskett Wildlife Research and Education Center, School of Natural Resources, University of Missouri, Columbia, Missouri

1999  Postdoctoral Fellow, School of Aquatic and Fishery Sciences, University of Washington, Seattle, Washington

1995-1999  Graduate Research and Teaching Assistant, College of Forest Resources, University of Washington, Seattle, Washington

1992-1995  Graduate Research Assistant, Department of Wildlife and Fisheries Sciences, South Dakota State University, Brookings, South Dakota

SELECTED HONORS AND AWARDS

2011  Appointed to University of Missouri Research Board

2009  Appointed as O’Connor Distinguished Professor

2009  Keynote Speaker, Game Monitoring Conference: providing a knowledge basis for sustainable hunting and biodiversity conservation, Uppsala, Sweden

2009  Missouri Governor’s Award for Excellence in Teaching

2008  U.S.D.A. National Teacher of the Year (U.S. Department of Agriculture, Excellence in College and University Teaching Award in the Agricultural Sciences)
2007   The Wildlife Society Award for Best Article (with Steve Buskirk)
2006   Superior Teaching Award from the University of Missouri Chapter of Gamma Sigma Delta
2005   Missouri Department of Conservation “Outstanding Research Collaborator of the Year”
2005   William T. Kemper Fellowship for Excellence in Teaching, University of Missouri
2005   Provost’s Outstanding Junior Faculty Teaching Award, University of Missouri
2003   College of Agriculture, Food, and Natural Resources “Golden Apple” Award for Teaching Excellence
2003   Plenary Speaker, First International Conference on Resource Selection Functions, Laramie, Wyoming
2002, 2008 Student Council “Outstanding Faculty Member”, School of Natural Resources, University of Missouri

RESEARCH SCHOLARSHIP

My research focuses on vertebrate population ecology at three scales: physiological processes, individual space use and resource selection, and population-level dynamics. Many of these topics overlap within individual studies and include several themes. At each scale, my focus is on rigorous development and evaluation of field and statistical methods and application of these methods to help answer important conservation issues. My research is motivated by an interest to identify practical management solutions and provide applicable tools to solve pressing conservation problems. I work with a broad range of taxa, from salamanders to elephants, to address these applied questions.

Selected Recent Grants

I have obtained about 55 grants and contracts as either PI or Co-PI since 1999 from diverse funding sources such as the National Science Foundation, National Park Service, U.S. Forest Service, U.S. Fish and Wildlife Service, National Fish and Wildlife Foundation, U.S. Department of Energy, several state management agencies, and private industry. Total Amount in Grants since 1999 is about $13.5 million. Selected recent, representative grants shown below.

2012-2017 Mule deer response to oil and gas development in western North Dakota funded by the Bureau of Land Management, North Dakota Game and Fish, Mule Deer Foundation, and Oil and Gas Research Program in North Dakota. Amount: $688,000. With B. Stillings.
2011-2016 Ecology and management of reintroduced elk in Missouri funded by the Missouri Department of Conservation, Amount: $1,915,000. With L. Hansen.
2011-2014  Processes determining the abundance of terrestrial wildlife communities across large spatial scales funded by the National Science Foundation, Amount: $1,200,000. With R. Kays, R. Costello, Z. He, and B. McShea.

2011-2014  ABI Innovation: Computational and informatics tools for supporting collaborative wildlife monitoring and research funded by the National Science Foundation, Amount: $845,000. With R. Kays and Z. He.

2010-2013  Effects of commercial harvest on river turtle population dynamics funded by the Missouri Department of Conservation, Amount: $170,659. With J. Briggler.


2009-2014  Predicting and monitoring impacts of climate change, disturbance and land use and management on forests and wildlife in the central hardwood region funded by the U.S. Forest Service, Amount: $152,195. With F. Thompson and H. He.


2006-2010  Survival, movements, and resource selection of hellbenders in Missouri funded by the Missouri Department of Conservation, Amount: $193,000. With J. Beringer and J. Briggler.

2005-2013  Mourning dove demographics in Missouri funded by the Missouri Department of Conservation, Amount: $331,912. With J. Schulz.

2005-2008  DeerNet: Wireless sensor networking for wildlife monitoring funded by the National Science Foundation, Amount: $1,050,000. With M. Fang and Z. He.


Publications

I have published 4 books, ~160 peer-reviewed journal articles and book chapters. Representative publications are presented below. Complete list available upon request.

Books

Academic Press, San Diego, California, USA. 467 pages.


**Journal Articles and Book Chapters**


**Selected Invited Seminars and Symposia**

2011  Elk ecology and management in Missouri. Presented to Missouri Conservation Commission (and presented again in 2012)


2009  Reconstructing historical bison demographics in the Northern Great Plains. Iowa State University, Ames, IA

2008  Population modeling and migratory birds. U.S. Fish and Wildlife Service and the Association of Fish and Wildlife Agencies, Denver, CO


2007  Integrated camera and sensor system for wildlife monitoring: present and future applications. NSF sponsored workshop. Princeton University, NJ (with H. He)
2006 Quantitative advancements of wildlife space use and demographic studies. State University of New York, College of Environmental Science and Forestry, Syracuse, NY
2005 Reconstructing historical bison demographics in the Northern Great Plains. Fisheries and Wildlife Sciences seminar series, University of Missouri
2005 Reconstructing historical bison demographics in the Northern Great Plains. Ecology and evolution seminar series, Division of Biological Sciences, University of Missouri
2005 Using physiological measures to assess costs of wildlife habituation. Invited by National Park Service to present at The Wildlife Society Conference, Madison, WI
2005 Natural herd demographics and effects of population control strategies in National Park Service bison and elk herds. National Park Service. Badlands National Park, SD
2004 Using discrete choice modeling and utilization distributions to assess resource selection. Winemiller Statistics Symposium, Department of Statistics, University of Missouri
2004 Recent quantitative advancements in wildlife habitat studies. U.S. Forest Service, Rocky Mountain Research Station, Rapid City, SD
2003 Wildlife management in South African Reserves. Kansas State University, Student Chapter of The Wildlife Society, Manhattan, KS
2003 Humans, stress, and elephants in South African Reserves. Kansas State University, Biological Sciences, Manhattan, KS
2003 Stress management of elephants in South African Reserves. State University of New York, Adirondack Ecological Center, Newcomb, NY
2003 Noninvasive assessment of stress in wild animal populations. Missouri Life Sciences Week, Conservation Biology Forum, University of Missouri
2003 What’s available? Techniques to address this problematic question in resource selection studies. First International Conference on Resource Selection Functions, University of Wyoming, Laramie, WY (Plenary Speaker)
2002 Stressed out: the effects of humans on charismatic megafauna. Dalton Cardiovascular Research Center Science Teachers Symposium, University of Missouri
2001 Wildlife conservation in South Africa National Parks. University of Missouri, Department of Fisheries and Wildlife Sciences (with M. Ryan and M. Larson)
2001 Noninvasive measurement of stress in free-ranging vertebrates. School of Life & Environmental Sciences, University of Natal, Durban, South Africa
2001 Noninvasive measurement of stress in wild animals. University of Missouri, Department of Physiology

**Selected Conference Presentations and Abstracts**

Since arriving at MU, my students and I have presented ~160 papers at state, regional, national, and international meetings. Some representative examples from the past 5 years are below.


Mong, T. W., J. H. Schulz, R. Bredesen, J. J. Millspaugh, and D. Dey. 2007. Using agroforestry and lease hunting to increase the economic viability of agricultural landscapes. Missouri Natural Resources Conference, Osage Beach, Missouri.


Schulz, J. H., R. Reitz, S. Sheriff, and J. J. Millspaugh. 2007. Attitudes of Missouri small game hunters toward nontoxic shot regulations. Missouri Natural Resources Conference, Osage Beach, Missouri.

**Professional and Academic Memberships**

The Wildlife Society (State, Regional, National)
The Wildlife Society Biometrics Working Group
The Wildlife Society College and University Education Group
Xi Sigma Pi Academic Honor Society
Gamma Sigma Delta Academic Honor Society
Boone and Crockett Club

**TEACHING SCHOLARSHIP**

**Teaching Experience**

**Courses Taught (University of Missouri)**

Spring 2003-present  Animal Population Dynamics, 3 credits, undergraduate, required course for undergraduate students, every spring (except 2009)

Fall 2000-2008  Wildlife Research and Management Techniques, 4 credits, undergraduate, writing intensive (each fall from 2000-2004, then alternate years)

Winter 2000-2002  Natural Resources Practicum, 3 credits, undergraduate (with H.
Bhullar, J. Dwyer, and D. Hammer)

Spring 2002, Fall 2007 Quantitative Fish and Wildlife Assessment, 4 credits, graduate
Fall 2004, Spring 2005 Wildlife Management and National Park Service Policy, 2 credits, graduate
Fall 2003, 2011 Resource Use and Model Selection, 3 credits, graduate
Fall 2001, 2006, 2009 Professionalism and Communications, 2-3 credits, graduate (with Mark Ryan)
Fall 2010 Energy Development and Wildlife Management, 2 credits, graduate
Spring 2012 Harvest Management, 3 credits, graduate

Student Advising

In addition to serving as Chair of graduate committees, I have served as a member on > 50 graduate student committees in several departments (Statistics, Biological Sciences) and universities (University of Washington, University of Nebraska). A total of 17 graduate students have completed their degrees with me at MU.

Dissertation or Thesis Advisor (Current)

Thomas Bonnot (Ph.D.). Dissertation topic: Ecoregional landscape population models for conservation planning in response to climate change (with F. Thompson)
Jaymi LeBrun (Ph.D.). Dissertation topic: Climate and ecosystem restoration modeling and impacts to wildlife in forested systems (with F. Thompson)
Christopher Rota (Ph.D.). Dissertation topic: Black-backed woodpecker space use and demographics in the Black Hills, South Dakota (with D. Kesler)
Amy Bleisch (M.S.). Thesis topic: Ecology of reintroduced elk in Missouri
Stephanie Zimmer (M.S.). Thesis topic: Effect of commercial harvest on river turtle populations in Missouri
Leslie Schreiber (M.S.). Thesis topic: Wind energy development and sage-grouse in Wyoming
Aleshia Fremgen (M.S.). Thesis topic: Wind energy development and sage-grouse in Wyoming
Trenton Smith (M.S.). Thesis topic: Ecology of reintroduced elk in Missouri

Undergraduate Advising and Mentoring:

I advise 20-25 undergraduate students enrolled in the Fisheries and Wildlife Sciences curriculum. I have mentored ~20 undergraduate student research projects and have employed over 150 students on my funded research projects.

Teaching Publications and Presentations

Peer-Reviewed


Selected Invited Workshops and Teaching Presentations

Millspaugh, J. J. 2011. Professor’s perspective. 4-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2011.


Millspaugh, J. J. 2010. Professor’s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2010.


Millspaugh, J. J. 2009. Professor’s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2009.


Millspaugh, J. J. 2008. Professor’s perspective. 3-50 minute talks to entering freshman and parents (400 each talk). Summer Welcome, University of Missouri, Summer, 2008.


Millspaugh, J. J. 2001. Getting the most from undergraduate research projects. One-half day workshop at the Annual Conference of The Wildlife Society. At Workshop: Developing tomorrow’s professionals: teaching the skills they will need. Fall 2001.

Teaching Conference Presentations and Workshops


Millenbah, K., and J. J. Millspaugh. 2002. Infusing experiential learning into a wildlife curriculum: two models for one course. 4th Biennial Conference on University Education in Natural Resources. Forestry Department, North Carolina State University, Raleigh,

SERVICE AND PROFESSIONAL ACTIVITIES

Selected Major Professional Service

2010 Science Review Team, Review of Pronghorn Monitoring Plan for University of Wyoming Cooperative Fish and Wildlife Research Unit
2009-present Associate Editor, Journal of Wildlife Management
2007-2010 Associate Editor, Ecological Applications
2007 Ecological Biology Program Advisory Panel, National Science Foundation
2007-2008 Associate Editor for the book Neotropical Cervidology (hormone chapter)
2005-2007 Chair and Panel Member, Review of White-tailed Deer Population Estimates and Management, Wisconsin Department of Natural Resources
2005-2006 Member of Science Review Team, Wind Cave National Park, South Dakota
2005-2009 Member of Peninsular Bighorn Sheep Recovery Team, U.S. Fish and Wildlife Service, California
2005-2007 Member of Science Review Team, Theodore Roosevelt National Park, ND
2004-2006 Associate Editor, Wildlife Society Bulletin
2004-2006 Secretary, University Education Working Group, The Wildlife Society
2003-2004 Secretary, Biometrics Working Group, The Wildlife Society
2002-2003 Wildlife Program Chair for 64th Midwest Fish and Wildlife Conference and Executive Committee Member, Kansas City, MO
2000-present Chair, Missouri Chapter of The Wildlife Society Education Committee
1997-present Reviewed papers for ~ 55 professional journals and review regularly for national and international grants (NSF, National Geographic, etc.)

University of Missouri

2011-present Appointed to University of Missouri Research Board
2010-2012 Chair, Promotion and Tenure Committee, School of Natural Resources
2010 Member “Celebration of Teaching and Learning Planning Committee” for university-wide teaching conference
1999-2010 Director, Thomas S. Baskett Wildlife Research and Education Area, School of Natural Resources
2009-present CAFNR Graduate Education Committee
2005-2012 Director of Graduate Studies, Department of Fisheries and Wildlife Sciences, University of Missouri
2005-2012 Chair, Graduate Programs Committee, Fisheries and Wildlife Sciences
2006-present Member, College of College of Agriculture, Food, and Natural Resources, International Programs Committee
2005-2007 Chair, College of Agriculture, Food, and Natural Resources, Learning Improvement Committee

2005-2006 CAFNR Week Steering Committee, Faculty Advisor

2003-2006 Graduate Fellowship Coordinator, Conservation Biology Program

2002-2004 Faculty Advisor for Univ. of Missouri Student Chapter of The Wildlife Society

2005-2006

2000-present Co-Coordinator, Undergraduate Fisheries and Wildlife Scholarships

2000-2003 Conservation Biology Program Secretary and Executive Committee

**Representative Media and Community Outreach**

2011 Quoted in USA Today regarding pronghorn migrations and Discovery Channel about deer-vehicle collisions

2010 Bloomberg Business News interview about deer-vehicle collisions

2009 Participated in History Channel expedition and production about feral dogs in St. Louis

2008 Participated in History Channel expedition and production about feral hogs

2007 On April 30, 2007, we offered a live, standards-based, interactive session to middle school and high school students from urban and rural areas of Missouri. Programs were available via videoconference, online streaming, and, in limited areas, cable television. We captured a deer live during the broadcast, equipped it with a camera, and answered questions from students, as we conducted our field research

2006 My research was highlighted in National Science Foundation Special Report, “Secret Lives of Wild Animals” (www.nsf.gov/news/special_reports/animals/)

2006 Interview on CBS Evening News about deer and vehicle collisions (26 Feb 2006)

2006 PBS interview about Wisconsin deer population estimation

2005 Live interview on NBC Today show (29 October) about “Deercam” project; Additional news coverage and interviews included the following: Front page, Science Section, New York Times; Discovery channel; and hundreds of newspapers across country


2002 Interview on elk and human activities appeared in *Science* (296:1784-1785)
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ATTACHMENT 2
INTRODUCTION

The Power Company of Wyoming, LLC (PCW) has asked AWS Truepower, LLC, to evaluate the annual average percentage of daylight hours that the proposed Chokecherry and Sierra Madre Wind Project is expected to generate energy. The proposed Chokecherry and Sierra Madre Wind Project is located approximately 20 km south of Rawlins, Wyoming and about 210 km west-northwest of Cheyenne, Wyoming. The gross energy production of the plant was simulated by the openWind® software’s time series energy capture module using 8,760 hourly datasets of observed meteorological data from a representative number of onsite meteorological masts. This memo summarizes the methodology that was used to derive the annual average percentage for the project from this simulated production data.

EXPLANATION OF METHODOLOGY

For the purpose of this analysis, the Chokecherry and Sierra Madre Wind Project was divided into 14 sub-regions of turbines, based on the wind resource characteristics they are expected to experience. The project area contains 34 monitoring mast locations; however it was determined that one representative mast from each sub-region was sufficient to resolve the intent of this analysis. The 2011 calendar year was chosen for this study since it is currently the only 12-month period when each of the selected 14 representative masts are in operation at the same time.

10-minute average wind speed, wind direction, turbulence intensity, and temperature data for the 1 January – 31 December 2011 time period from the 14 representative masts were validated to remove any erroneous values caused by icing, equipment failures, and tower shadow. Each dataset was then hourly averaged and any omitted hourly records were reconstructed using windTrends. windTrends is a simulated hourly time series developed using Mesoscale Atmospheric Simulation System (MASS) model output. It is essentially a controlled regional reanalysis dataset developed by AWS Truepower that differs from conventional reanalysis data because it is computed at a finer resolution (20 km) and it relies on fixed observational data (rawinsonde). The model output can be interpolated to the exact location of a meteorological mast. Once a complete 8,760 time series (every hourly record for a full year) was established for each of the 14 masts, the wind speed data were extrapolated to hub height using instantaneous shear values and the temperature data were extrapolated to hub height using the standard atmospheric lapse rate of 6.5 K per 1000 m. The wind speed data were then scaled to each...

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1 openWind is a software program developed by AWS Truepower as an aid for the design, optimization, and assessment of wind power projects. Its energy capture and wake losses have been validated with those from the WindFarmer model developed by Garrad Hassan.

mast's expected long-term wind speed. The resulting hub height wind speed, wind direction, turbulence intensity, and temperature data time series for each mast were then input into the openWind software along with the wind resource grid and details of the project design such as the turbine locations, hub height, power curve, and thrust coefficients. Specific power curve and thrust coefficient information for this analysis was based on the Vestas V112 3.0-MW 84-m hub height turbine. The cut-in speed for the Vestas V112 is 3 m/s, which is similar to cut-in speeds for other commercial turbines. openWind’s time series energy capture process was then used to produce an 8,760 hourly gross energy production time series for each of the 14 predefined sub-regions of the project. Each of the resulting time series was representative of the gross energy production of a single turbine in the respective sub-region over the one-year timeframe of the inputted mast data.

Using the 14 gross energy production time series and time estimates for sunrise and sunset for each month (rounded to the nearest half hour), the amount of time throughout the year that energy was being produced within each sub-region during daylight hours was calculated. Energy production is being used as a proxy for rotating turbines; no energy is produced if the wind speed is below cut-in or above cut-out, during which times the turbines would not rotate. The exception would be at low speeds below cut-in, when the turbines may rotate slightly but produce no energy; these times are not included in this analysis due to the very low speed of rotation. The annual total number of hours in each sub-region when the turbines are producing energy during daylight hours was then divided by the total number of possible daylight hours. The results for the sub-regions range from 96.0% to 98.7%. The project-wide average was then calculated by weighting the individual sub-region results by the number of turbines within each sub-region. The resulting annual average percentage of daylight hours that the Chokecherry and Sierra Madre Wind Project is expected to generate energy is 97.1%.
Mr. Garry L. Miller  
Vice President, Land and Environmental Affairs  
Power Company of Wyoming LLC  
555 Seventeenth Street, Suite 2400  
Denver, Colorado 80202  

Dear Mr. Miller:

On August 14, 2012, we received an updated eagle conservation plan (ECP) from the Power Company of Wyoming (PCW) for the Chokecherry and Sierra Madre Wind Energy Project in Carbon County, Wyoming (Project). If a project proponent submits an application for a Federal permit for non-purposeful eagle take (50 CFR 22.26), the ECP serves as an attachment to the application package. Consequently, the ECP should include a level of information and detail necessary for the U.S. Fish and Wildlife Service (Service) to give the permit application full consideration. The Service’s Land-based Wind Energy Guidelines (2012) and Draft Eagle Conservation Plan Guidance (2011) help inform the development of the ECP. Moreover, close and consistent communication with the Service is imperative. We reviewed the ECP from August 14, 2012, and find it begins to address a number of important topics, however we identify numerous deficiencies in the ECP that should be addressed in order for the Service to fully assess the proposed project. Even though our review of the ECP is incomplete, the Service articulates several major concerns below. The following issues should be addressed prior to submitting an application for a programmatic eagle take permit (50 CFR 22.26).

At the outset, the Service feels the cover letter does not correctly describe the relationship between the Service’s decision on the August 14, 2012, ECP and the BLM’s action to issue a Record of Decision (ROD) for the “project-landscape level” final environmental impact statement (FEIS). As we understand the BLM instructional memorandum, IM-2010-156, the BLM cannot issue a “Notice to Proceed” without a decision by the Service on the avian protection plan (also known as a bird and bat conservation strategy or BBBCS). For this Project,

\[1\] While the IM specifically mentions an avian protection plan—and PCW has indicated that one will be developed for this Project—the avian protection plan will be supplemented with an ECP due to the high likelihood of eagle take associated with the Project.
however, the ROD does not serve as a notice to proceed; instead, the BLM will tier additional NEPA review (e.g., environmental assessments) for each site-specific plan of development to the FEIS and ROD. After completion of the additional NEPA on the site-specific plans of development, the BLM would then be in a position to issue a notice to proceed.

**Major Points of Concern**

- The Service believes that there are additional opportunities to avoid and minimize impacts to eagles and other migratory birds that have yet to be included in the ECP or fully explained as to why they are either unnecessary or that they cannot be implemented.

- Data collection efforts to date provide minimal spatial coverage of the project footprint. The Service’s Eagle Conservation Plan Guidance Version 2 Appendices (2012) recommends at least 30% of the area within 1 km of turbines be considered as the total km² area to be covered by 800-m radius point count plots (with a sample area for each plot of 2 km²).

- Although the Service understands that this project-landscape level ECP cannot provide final eagle fatality estimates for several reasons, please be advised that all subsequent site-specific ECP’s submitted with any eagle take permit applications must include final eagle fatality predictions. Site-specific ECP’s also must include separate fatality predictions for both golden eagles and bald eagles.

- The Service understands that this project-landscape level ECP cannot provide a detailed analysis that demonstrates how predicted eagle fatalities will be offset through compensatory mitigation. However, all future site-specific ECP’s submitted with any eagle take permit application must include a thorough analysis including the efficacy and extent of compensatory mitigation necessary to completely offset predicted golden eagle fatalities, as well as firm commitments to implement the compensatory mitigations and a demonstrated ability to do so.

- The current ECP does not anticipate the need for or propose compensatory mitigation (e.g., power pole retrofits) until after eagles have been killed and not until “anticipated impact levels [e.g., fatalities] are exceeded” which is inconsistent with Service policy and regulations.

- The ECP lacks a full assessment of potential impacts to bald eagles.

**Avoidance and Minimization**

On August 10, 2012, the Service issued a letter to PCW that identified locations within the Project area that the Service believes are potential high eagle use areas. The proposed avoidance areas in the ECP include some areas of high eagle use but do not include or address all areas identified in the Service’s letter. For example, the ECP would allow numerous turbines to be built adjacent to an active golden eagle nest in the southwest corner of Sierra Madre portion of the Project. Currently, the ECP does not propose avoidance and minimization measures for this
nest; therefore, the risk for eagle fatalities and nest abandonment is extremely high. This and several additional examples presented in the Service’s August 10, 2012, letter should be addressed by the ECP. The Service believes that there are additional opportunities to avoid and minimize impacts to eagles and other migratory birds that have yet to be included in the ECP. If PCW believes that any of the specific eagle and migratory bird concerns raised by the Service—including related recommendations to avoid and minimize potential impacts—are unfounded, then PCW should provide specific information as to why this is the case. Similarly, if PCW believes that avoidance and minimization is not possible and that associated take is unavoidable, then PCW should provide information supporting why such take is unavoidable.

The kernel density approach forms the basis for the avoidance areas (pp. 90-91); however, from a statistical standpoint, the underlying data used to develop the kernel analysis are insufficient. In particular, the point count locations and subsequent eagle flight path data do not provide adequate spatial coverage of the Project area. Because large portions of the Project area were not surveyed, it is possible there are additional areas of high eagle use not currently included in the avoidance areas identified in the ECP. Assuming the kernel analysis has merit, a visual comparison does not appear to show a clear relationship between the kernel analysis and all areas of high density eagle use. For example, the kernel analysis identified an area of high eagle use around Miller Hill (p. 74), but this area was not included in the avoidance map and did not result in modifications to turbine layout. Because avoidance and minimization must reduce the take of eagles to a level that is “unavoidable” (50 CFR 22.26), the ECP should identify and include all areas of high eagle use in avoidance areas or explain why such areas cannot be avoided. If PCW believes that avoidance and minimization is not possible and that associated take is unavoidable, then a clear explanation should be provided.

The ECP makes conclusions regarding eagle foraging locations, foraging behavior, and value of foraging areas, however there is little actual data or supporting documentation regarding prey items being used, foraging locations, and foraging behavior. However, there are conservation measures described in the draft ECP which propose to protect the prey base and are tied to specific locations. This lack of supporting information makes it unclear if the conservation measures proposed will be effective.

In our letter of August 10, 2012, we expressed concerns about the state of knowledge regarding eagle foraging areas and concentrated prey base and how these may influence avoidance areas. Based on new information from ongoing prey base surveys (p. 41), the avoidance areas in the ECP may need further consideration, including the realignment or removal of turbines. Because of ongoing efforts to collect data on the prey base, the Service cannot adequately fully analyze PCW’s efforts to avoid important foraging areas for eagles.

The ECP does not identify whether efforts were made to detect winter roost sites. If PCW has collected these data, it should be included in the ECP. If PCW has not made this effort, they should consider implementing a protocol to collect information on roost sites. Based on the information from these efforts, avoidance and minimization measures should be developed accordingly and included in the ECP.
The ECP provides avoidance and minimization measures that are unproven (e.g., adjusting turbine cut-in speeds) and others that have the potential to harm eagles (e.g., installing sound devices to disorient eagles). Avoidance and minimization measures included in the ECP should be limited to those for which a benefit to eagles has been demonstrated.

The Service does not support moving eagle nests that are near areas of desired turbine placement. In addition, removing the nest does not address the underlying issue that the habitat is desirable to eagles, and would likely continue to attract eagles and receive continued use in the future.

The ECP does not specifically address eagle disturbance issues, as “disturb” is a form of take under the Bald and Golden Eagle Protection Act (16 U.S.C. 668-668d). One particular example is the golden eagle nest in the Southwest corner of Sierra Madre, in which turbines are proposed to be built in close proximity to the nest. Based on the location of these turbines, nest abandonment is possible. Also, while the ECP discusses the juxtaposition of nests with likely/proposed turbine locations, it does not with respect to other project developments such as roads, staging areas, and power lines.

Data Collection

The ECP describes the collection of radar data and cites how these data helped provide up to 100 percent coverage of the project area as well as a “detailed assessment of patterns of spatial and seasonal use across the entire Project Site” (p. 65). However, the Project proponent stated in a meeting at the FWS Regional Office in Lakewood, CO that results from the radar work have limited utility and should not be used. The ECP should be very clear about the limitations of the radar data. If the radar data are used to support conclusions in the ECP, the use of the radar data, including limitations, should be described in the ECP.

The ECP concludes that it is appropriate to use observations of eagles out to 4,000 meters from the observer to identify areas of high eagle use, even though the highest detection probabilities occurred within 1,000 meters of the observer (p. 35). Observations out to 4,000 meters are used to assert that the long-watch data (with radar data) provide 100 percent coverage of the Project area. Additionally, these data were used to “complete a kernel density analysis to identify areas with the highest probability for eagle and other raptor use” (p. 65). The underlying assumption in using these data to identify areas of the highest eagle use is that any difference in the observed eagle activity is due to actual eagle use and not the detectability of the eagle. However, it is just as likely that a significant portion of the difference in eagle activity, and hence the identification of high eagle use areas, is actually due to the observer’s ability (or inability) to detect eagles at distances up to 4,000 meters.

Recommendations in the draft ECPG and in other literature (e.g., Strickland 2011) establish that point count surveys for eagles and other large raptors should not exceed 800 meters (0.5 mile). While observations can be recorded at distances greater than 800 meters, they should be analyzed separately to avoid concerns about observer bias (Service 2011; Strickland 2011). Because the ECP uses data collected out to 4,000 meters to inform the kernel density analysis, it is possible the ECP has not identified all areas of high eagle use.
In addition, there are portions of the vast Project area where there are no recorded observations of eagle activity. While this lack of observation could be due to the lack of eagle activity, it is equally plausible the void is due to lack of survey effort in these locations. If the latter is true, this means portions of the Project footprint may have areas of high eagle use that are not identified in the kernel density analysis. Overlooking one or more areas of high eagle use due to inadequate survey effort will lead to a flawed assessment of avoidance areas and could lead to higher than predicted eagle fatalities.

Based on the Service’s evaluation, only 3.5 percent of the Project’s 215,233 acres (871 square kilometers) (p. ii) were covered by the fifteen 800-meter point counts during Year 2 surveys. This is substantially less than the minimum spatial coverage of at least 30 percent of the project footprint recommended in the ECPG (Service 2012) and is far from the 100 percent coverage described in the ECP. Additional data collection is ongoing, including an effort to survey at least 30 percent of the Project footprint with 800-meter point counts using a spatially-balanced design. Increasing spatial coverage of the Project area will reduce uncertainties about eagle use across the landscape and will better inform the models used to predict eagle fatalities.

**Predicted Eagle Fatalities**

The ECP predicts that the Project will result in eight to twelve eagle fatalities per year. This estimate is considerably lower than both the range of predicted fatalities provided in the BLM’s FEIS of 46 to 64 eagles annually (BLM 2012) and the mean number of annual fatalities predicted by the Service using a Bayesian method described in the appendices to the draft ECPG (Service 2012).

The ECP acknowledges that the parties continue to work on the fatality estimates, including additional data collection, validation of the fatality models, and refinement of the fatality estimates based on avoidance and minimization. Because these efforts are ongoing, the Service understands that this project-landscape level ECP cannot provide the final eagle fatality predictions or the related detail on the compensatory mitigation required to offset the predicted take. However, in order for the Service to process an eagle permit application, all future sitespecific ECP’s must include a final eagle fatality prediction, with separate eagle fatality predictions for both golden and bald eagles.

The fatality estimate provided in the ECP raises several concerns. First, the ECP criticizes the WEST regression analysis that was used to calculate the fatality estimates in the BLM FEIS (pp. 76-79), concluding that it “does not represent the best available science for purposes of eagle fatality estimation” (p. 78). However, the ECP goes on to use the WEST regression model to develop the estimate of eight to twelve eagle fatalities per year using “Year 2” data rather than the “Year 1” data that were presented in the FEIS. The Service is concerned about this apparent discrepancy in the use of the WEST data and the issue should be resolved before any subsequent analysis.

At this point, we will not comment on whether the WEST regression does or does not represent the best available science; however, the Service has developed a model to predict eagle fatalities
at wind projects in conjunction with numerous experts and with peer review. The Service will continue to make science based and data dependent refinements to its model as more information becomes available, including post-construction monitoring data for operational wind facilities. A review of all available fatality models to date suggests that the Service’s model best addresses numerous uncertainties and that it can be used to meet the regulatory permitting requirements.

Lastly, there are concerns about the adequacy of the data used to run the models. For example, only one year (i.e., labeled as “Year 2”) of data were included in the model of projected eagle fatalities; “Year 3” surveys are underway but the ECP does not include this information (p. 34). Although the ECP references “Year 1,” “Year 2,” and “Year 3” surveys, only one full year of surveys (i.e., “Year 2”) is actually completed and available for use in the fatality prediction. The ECP describes “Year 1” surveys as pilot surveys to help design latter surveys, and the ECP acknowledges that the information gathered in “Year 1” is not compatible with data from later years. “Year 3” surveys began in late spring 2012 and are designed to extend to spring 2013. Consequently, information in the ECP from “Year 3” represents only a few months; these surveys are substantially incomplete. Because data are still being collected that will inform the models and ultimately the amount of compensatory mitigation, it is premature to finalize a fatality estimate for this project-landscape level ECP using the existing data.

Compensatory Mitigation

When the Service considers an application to take eagles the Service evaluates avoidance and minimization measures in an ECP as well as a detailed analysis and description of the compensatory mitigation necessary to completely offset golden eagle fatalities resulting from the Project. We recognize PCW and the Service have not agreed to fatality estimates for the project and therefore that identifying the amount or type of compensatory mitigation is not possible at this time. Hence, the Service recognizes why this project-landscape level ECP does not include a commitment to implement specific measures of compensatory mitigation and does not describe the amount, type, methods and monitoring of the compensatory mitigation. We understand that subsequent ECP’s will be submitted by PCW on a site specific basis in association with eagle take permit applications for future development. Consequently, we stress the importance that a complete analysis and description of compensatory mitigation be included in any future site-specific ECP’s. Additionally, these site-specific ECPs should include provisions for how PCW will address the possibility that actual eagle fatalities from the Project exceed the predicted number of eagle fatalities in the ECP.

The current ECP does not anticipate the need for or propose compensatory mitigation (e.g., power pole retrofits) until after eagles have been killed and not until “anticipated impact levels [e.g., fatalities] are exceeded” (p. 100). This approach is contrary to guidance in the draft Eagle Conservation Plan Guidance (ECPG), which states that compensatory mitigation must occur prior to a wind project becoming operational (Service 2011, p. 30). It is very important to note, for golden eagles, the maximum cumulative take is zero (Service 2009); therefore, compensatory mitigation is required up front because wind projects must meet the statutory and regulatory

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2 At this point, we do not anticipate the need to provide compensatory mitigation for bald eagle fatalities that might result from the Project; however, this does not eliminate the need for PCW to avoid and minimize bald eagle fatalities to the maximum extent practicable (50 CFR 22.26).
eagle preservation standard of stable or increasing breeding populations (Service 2011, p. 30). While the ECP can include provisions for additional compensation to address unforeseen or extremely unlikely events, for the Service to issue an eagle take permit the ECP must include compensatory mitigation that will completely offset predicted eagle fatalities prior to the project becoming operational.

For any future site-specific ECP’s developed as part of an eagle take permit application the Service recommends that all proposed compensatory mitigation measures, such as power pole retrofits, should be supported by a resource equivalency analysis (REA) or other quantitative methods. The Service recognizes the REA as a reliable, transparent, reproducible, and cost-effective tool to expedite wind power permits, while ensuring sufficient compensatory mitigation; however, project developers may use different compensatory mitigation modeling methods (Service 2012, p. 65). Regardless of the methods used, future site-specific ECP’s will need to provide sufficient evidence and tools (if necessary) to ensure that the Service can provide appropriate review of the results to ensure the proposed compensatory mitigation for the Project meets the regulatory permitting requirements.

If power pole retrofits, or other mitigation actions deemed appropriate by the Service, are used for all or part of compensatory mitigation included in future site-specific ECP’s then these documents also should demonstrate a commitment to implement those actions. Knowing what compensatory mitigation opportunities are available for implementation and having the ability to complete the compensatory mitigation are two separate issues. In future site-specific ECPs, PCW will need to clearly identify how much of any given type of compensatory mitigation is needed, and should demonstrate the ability to implement these mitigation actions.

**Bald Eagles**

The ECP does not adequately address bald eagles; of particular concern because it appears bald eagle activity within and near the Project area has increased in recent years (pp. 49-51). If bald eagle numbers and use of the site continue to increase, it will be important to identify high use and avoidance areas specifically for the bald eagle (other than Rasmussen Lake). For example, greater sage-grouse were found in bald eagle nests (p. 95), presumably as prey items; therefore, it would be important to understand where bald eagles are foraging for the grouse and whether proposed turbines would be located in flight paths between bald eagle nests and/or roosts and foraging areas (e.g., fish, grouse, waterfowl, carrion). Information about bald eagle use of the Project area, such as foraging areas and travel corridors, will help inform avoidance areas and other avoidance and minimization measures for bald eagles.

As currently presented, it is unclear whether the kernel density approach lumped golden eagle and bald eagle data together. If species observations are lumped, the areas currently identified as high eagle use areas might not fully address bald eagle use of the Project site. This is especially true if golden eagle observations overwhelmed bald eagle sightings in the kernel estimator (see additional concerns above about the kernel density analysis). The ECP should ensure that avoidance and minimization measures and avoidance areas are valid for bald eagles. Additionally, subsequent site-specific ECPs, associated with future project-related development, will need to provide a bald eagle fatality prediction.
Interpretation of Service Policy Documents

The ECP states that this Project is a Category 2 project (p. vii). The document further states the Service agrees with this by citing the Service’s April 2011 letter to BLM stating we agreed development of an APP would be an appropriate action to take. We do not believe PCW has correctly interpreted our letter of April 2011. The letter stated that preparing an APP would be an appropriate mechanism to address impacts to migratory birds and eagles, provided that we had three years of data collection and that the Project included sufficient avoidance and minimization (e.g., 4-mile buffer around eagle nests); it did not suggest that the Project was a Category 2 project. As we clearly stated in these comments, the ECP does not yet include sufficient avoidance and minimization as described in the letter of August 10, 2012.

Many of the advanced conservation practices (ACPs) in the ECP are simply best management practices. The ECPG acknowledges the difficulty of developing scientifically based ACPs, and states that they will be developed with input from the Service (Service 2011). The Service stands ready to assist PCW in this effort.

We are concerned that the ECP repeatedly makes statements or generalizations about eagles but does not provide data or literature for support.

The ECP states, “The ACPs outlined in this section meet the Stage 4 objectives in the Draft ECP Guidance” (p. 87). The Service respectfully disagrees with that assertion at this time.

The ECP calculates a Project-area population of 18 to 28 eagles (p. 82), which is comprised of adults and young from active nests during 2011 and 2012, as well as a few floater eagles. Based on the low number of sub-adult eagles in the Project area and data suggesting little migratory behavior, the ECP suggests that only 18 to 28 eagles are at risk (p. 82). The ECP assumes these birds are year-round residents; however, the ECP presents little evidence to support this assumption, and it does not account for the possibility that neighboring eagles could venture within the Project area. The Service is unaware of any population study designed to estimate the number of eagles (resident or migrant) in the Project area.

Post-Construction Monitoring and Adaptive Management

The ECP presents methods for post-construction monitoring but does not provide the length of time they intend to do this. This is an important consideration in evaluating the adequacy of the ECP. Also, the post-construction monitoring plan should be developed in coordination with the Service.

The ECP has not fully developed the adaptive management process (for risk reduction), and the tiered approach to reduce risk to eagles is inadequate and even runs counter to regulations and the draft Eagle Conservation Plan Guidance (January 2011):

- For example, Tier 2 measures will be implemented if anticipated impacts (i.e., eagle fatalities) are exceeded. Tier 2 measures include utility power pole retrofits and carcass
removal on surrounding highways; however, these are examples of compensatory mitigation that must be implemented prior to eagle fatalities rather than after the fact;

- In addition, placement of these measures in Tier 2 (i.e., after eagles have been killed), is another example of how the ECP does not anticipate the need for compensatory mitigation in an application for an eagle take permit; and

- The removal and relocation of eagle nests is included as a Tier 3 measure to reduce risk; however, as stated earlier, this is not appropriate as it is another form of take and removing the nest does not address the underlying issue that the habitat is desirable to eagles.

Additional Data Gaps

The ECP states that the Project avoids the North Platte River area because that area provides important foraging and wintering habitat (p. 57). Documentation or data should be provided in the ECP to support these statements.

The ECP’s reference to concentrated eagle use of the central basin (p.65) is not documented in the ECP.

The ECP asserts that key foraging areas are located outside of the wind development areas (p. 68); however, information to support this conclusion is not provided. Statements concerning activity and movements within the wind development areas are characteristic of movement between nests and roosting and foraging locations isn’t supported with information (e.g., roosts and foraging locations are not identified).

The ECP reports some discrepancies exist in reported survey results for fossorial prey (pp. 68-69); this issue needs a definitive resolution.

The statement that sage grouse “core areas represent the most important foraging locations” within the vicinity of the Project is not supported by information presented in the ECP (p. 71).

The ECP states winter eagle use is closely tied to the availability of winterkill carcasses along area highways (p.74). This seems like an intuitive assumption, but no information is given to support this conclusion.

The ECP states foraging locations fall outside of the wind development areas (p. 74); however, no quantified or objective information on foraging locations is given. The ECP also states very little foraging behavior occurs within the wind development areas, but is unclear how this type of information was collected and no documentation is provided.

The Service recognizes development of an ECP is a rigorous, yet necessary endeavor given the high standards required for our consideration of any subsequent Eagle Take permit application. Therefore, we stand ready to discuss these issues with you and Regional leadership at our regional office in Lakewood, Colorado at your convenience. If you would accept this invitation,
please contact our office in Cheyenne to secure a meeting date and time. If you have specific questions regarding this letter, please contact Tyler Abbott of my office at the letterhead address or phone (307) 772-2374, extension 231.

Sincerely,

R. Mark Sattelberg
Field Supervisor
Wyoming Field Office

cc: SWCA, Jon Kehmeier (via e-mail)
    BLM, Pam Murdock (via e-mail)
    BLM, Mike Valle (via e-mail)
    FWS, Pam Repp (via e-mail)
    FWS, Casey Stemler (via e-mail)

Referenced Cited


VIA EMAIL: Tyler_Abbott@fws.gov

September 26, 2012

Tyler Abbott, Deputy Field Supervisor
U. S. Fish and Wildlife Service
Ecological Services Wyoming Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

Re: Chokecherry and Sierra Madre Wind Energy Project

Dear Tyler:

Attached is a Supplement to Eagle Conservation Plan Addressing Estimated Eagle Fatalities for the Chokecherry and Sierra Madre Wind Energy Project. This Supplement to the Eagle Conservation Plan addresses: (a) eagle use data for the Project; (b) the eagle fatality estimates for the Project derived by the Service using its Eagle Fatality Model (Service’s Model); (c) the eagle fatality estimates for the Project as re-designed with turbine no-build areas using the Service’s Model; and (d) the assumptions used in the Service’s Model, including eagle flight heights.

The Supplement describes the process utilized to analyze data and estimate eagle fatalities based upon PCW’s re-designed project and the company’s commitment not to place turbines in designated turbine no-build areas as set forth in the Eagle Conservation Plan submitted to the Service on August 14, 2012 and the attached ECP Supplement. The Supplement also incorporates the September 7, 2012 and September 12, 2012 expert reports of Dr. Joshua J. Millspaugh, which have been previously provided to the Service.

If you should have any questions, please let me know. Thank you.

Sincerely,

/s/ Garry L. Miller

Garry L. Miller
Vice President, Land and Environmental Affairs
Mr. Garry L. Miller  
Vice President, Land and Environmental Affairs  
Power Company of Wyoming LLC  
555 Seventeenth Street, Suite 2400  
Denver, Colorado 80202

RE: Eagle Use Sampling Considerations and Recommendations for the proposed  
Chohecherry-Sierra Madre Wind Energy Development Project

Dear Mr. Miller:

On July 24, 2012, the U.S. Fish & Wildlife Service’s (Service) Wyoming Field Office met with the Power Company of Wyoming (PCW) to discuss the Chohecherry Sierra Madre Proposed Wind Energy Facility. During that meeting—and in a subsequent letter of August 10, 2012—the Wyoming Field Office expressed concern about the spatial coverage provided by the small number of survey data points during previous sampling efforts that were used to characterize eagle use across the entire project landscape. Of particular concern was the utility of these data to inform modifications in project design and turbine siting for avoidance and minimization of project-related impacts to eagles and their habitat.

This letter transmits the Service’s survey recommendations that we committed to provide in our letter of August 10, 2012. Additionally, we include comments on the proposed 2012-2013 800-meter Raptor Survey Protocols provided by PCW on August 31, 2012. In order to clarify differences between our survey recommendations and the protocol proposed by PCW, we include a comparison between these two: while some of our recommendations included in this letter are already found in the protocol provided by PCW, we provide recommendations to address any differences that still remain.

The overall purpose of these recommendations is to facilitate collection of additional avian survey data that will: (a) confirm or refine eagle and raptor avoidance areas by increasing our understanding of eagle and raptor use across the project area, and (b) increase spatial coverage of data collection within the proposed project area in order to better characterize eagle use within the project site. These data, in conjunction with previously collected data, will be useful to inform conservation measures developed to avoid and minimize impacts to eagles within the proposed project area, and will be incorporated into the Service’s eagle fatality model. To this end, we provide the following recommendations:
(1) We recommend focusing sampling efforts within the most recently proposed project footprint in order to quantify eagle use in areas where turbines are planned for location. By collecting eagle and raptor use data in areas of likely development, we believe it will be easier to obtain a more reliable estimate of risk to eagles in these areas, from which more informed, site-specific, predictions can be made.

(2) Although we recommend concentrating sampling effort within the project footprint as stated above, we believe it also would be prudent to establish additional sample points outside of the currently proposed footprint in areas of potential development. Adding points in areas of possible alternative turbine layouts will provide data to assess the impact of those alternatives, which may be necessary if survey results identify areas of high eagle use within areas currently proposed for development. Without eagle use data outside of the proposed footprint, it would be difficult to show that the relocation of turbines outside of the currently proposed project footprint would avoid and minimize impacts to eagles. Without these data, the only likely alternatives would be a reduction in the total number of turbines, or a reduction in the spacing between turbines in areas where avian and raptors surveys were conducted.

(3) We recommend resampling at least fifty percent of the raptor point counts from previous years: this will help distinguish between apparent changes in documented eagle use caused by different point locations and associated differences in detectability, versus actual changes in habitat use. This is an important consideration, because the number of eagles and their location on the landscape is likely to vary across years (e.g., not every nest is active every year), making it difficult to account for inter-annual variability, which might lead to inaccurate conclusions about the risk of eagle fatalities. For example, observing fewer eagles at a second set of survey points could be misinterpreted as an area of lower eagle use, when in fact the number of eagles and eagle use across the landscape decreased due to other factors. In this example, the use (and hence risk) might have been the same for all survey points, but sampling different points across years would lead to the erroneous conclusion. Resampling some points across years can reduce this uncertainty by creating an index or allow for scaling of observations across years.

(4) Previous long-watch raptor surveys were based on an unlimited radius, and analysis of data from these surveys suggests that the detectability of eagles dropped off after 600 to 800 meters. We recommend using a distance of no more than 800 meters for point counts intended to collect data on eagles and other large raptors. This recommendation is found in our draft Eagle Conservation Plan Guidance (Service 2012, Appendix C, p. 18) and in other literature (e.g., Strickland et al. 2011). While it is acceptable to collect data on eagles and other raptors beyond 800 meters (e.g., location, flight height, flight path)—since they may be useful to identify travel corridors and areas of eagle use—the collection of this information should not distract surveyors from collecting data within the 800-meter point count. In addition, because only those data collected within 800 meters will be used in the models to predict eagle fatalities, data collected at distances more than 800 meters should be separated from data collected within 800 meters.
(5) Based on recommendations in the draft Eagle Conservation Plan Guidance, the sampling goal should provide a “minimal spatial coverage of at least 30% of the project footprint” (i.e., the total area sampled in any given year should be thirty percent of the total project footprint) (Service 2012, Appendix C, p. 18). We recognize that even this level of effort will not provide specific information for seventy percent of the project area; however, it may be assumed that the information is representative of the remaining project area, provided the sample points are appropriately located (e.g., stratified and spatially-balanced). To achieve the desired goal of at least 30 percent coverage of the Chokecherry Sierra Madre Proposed Project footprint, we calculate up to 70 survey points are needed, depending on how the project footprint is portrayed.

(6) We recommend sample locations be stratified by features of the landscape that may influence eagle and raptor activity, such as distinct geographic/topographic elements (e.g., escarpments), vegetation (if appropriate), and concentrated prey base. Doing so will allocate sampling points across the project in proportion to their occurrence on the landscape. A common sampling design in use today is the generalized random tessellation stratified sampling design (GRTS). We remain concerned that there is insufficient information about eagle habitat use associated with important eagle use areas including: active nests; concentrated prey base including grouse leks, prairie dog colonies, and reservoirs; as well as topographic features such as Miller Hill. Therefore, we recommend that some sample points be located near these important eagle use areas. Doing so would help with identifying additional avoidance areas or alleviating concerns for increased risk associated with these areas.

(7) Based on recommendations in the Service’s Eagle Conservation Plan Guidance, count periods should be one to two hours long (Service 2012, Appendix C, p. 18). If longer survey periods are used (e.g., four to six hours), the surveys should be divided into smaller units such as one or two hour blocks (or the actual time of eagle observations recorded), so that the influence of time of day can be evaluated (e.g., in relation to when turbines are inactive).

(8) We recommend the protocol include a representative distribution of sampling events across all daylight hours across all point locations and seasons. Collecting data “evenly” across time and space should reduce any potential bias associated with locations, seasons, and time of day. This may also make it possible to evaluate how time of day influences eagle use of the site or when eagles are more likely to use specific topographic features. In addition, surveys should include multiple sampling events in each season per point.

(9) We recommend locating survey sampling points at least 800 meters (0.5 mile) from active eagle and ferruginous hawk nests to limit disturbance. It may be possible to reduce this distance if topographic features create a visual barrier between observers and the nest.

(10) We recommend data collection include identification of eagle species and their flight minutes within the 800-meter point count. Additional data collection could include, but should not necessarily be limited to (in relative order of importance): age and sex (if
possible), flight path, flight behavior (e.g., soaring, kiting), activity (e.g., territory defense, foraging), interactions with other birds, flight height, obvious prey items, time observed outside of the 800-meter point count, and time perched. It is acceptable to record detections beyond 800-meter as these can provide additional information about eagle and raptor use of the project area. However, collecting data beyond 800-meters should not detract from observations made within the 800-meter point count.

(11) We recommend collecting data on all raptors to the extent feasible; however, collecting data on other raptors should not preclude the collection of data on eagles.

(12) Based on eagle use data collected between April of 2011 and April of 2012, eagle activity relative to sampling effort appears to be higher in the winter and summer periods (Table 1). Higher eagle activity in the summer likely corresponds to the time during which adults are actively feeding young and when young are learning to fly. Higher eagle activity in the winter may be related to the presence of migrant eagles, or could be due to the location of survey points. Because data were not collected following the above recommendations during the summer of 2012, we recommend the collection of eagle and raptor use data continue through the 2013 nesting season (at least through August of 2013) to evaluate this potential season of higher use.

Table 1. Seasonal point count data for April 2011 through April 2012.

<table>
<thead>
<tr>
<th>Season</th>
<th>Minutes of Observation</th>
<th>Eagle Minutes 800 m</th>
<th>Eagle Minutes 6400 m</th>
<th>Eagle Minutes/Unit Effort 800 m</th>
<th>Eagle Minutes/Unit Effort 6400 m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring</td>
<td>50,166</td>
<td>290</td>
<td>245</td>
<td>0.0058</td>
<td>0.0049</td>
</tr>
<tr>
<td>Summer</td>
<td>10,653</td>
<td>71</td>
<td>43</td>
<td>0.0067</td>
<td>0.0040</td>
</tr>
<tr>
<td>Fall</td>
<td>51,426</td>
<td>227</td>
<td>409</td>
<td>0.0044</td>
<td>0.0080</td>
</tr>
<tr>
<td>Winter</td>
<td>17,505</td>
<td>141</td>
<td>316</td>
<td>0.0081</td>
<td>0.0181</td>
</tr>
<tr>
<td>Total</td>
<td>129,750</td>
<td>729</td>
<td>1,013</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comparison with Service Recommendations

The methods described in the “2012-2013 800-meter Raptor Survey Protocols” provided by PCW already include many of the recommendations provided above, such as the use of 800-meter point counts, survey duration of two hours, and survey coverage across all daylight hours. There are, however, a few differences between our recommendations and the protocols submitted by PCW that should be addressed as follows:

(1) Consistent with the draft Eagle Conservation Plan Guidance, we recommend a minimum of 30 percent coverage of the project footprint. This could include up to 70 points depending on how much area is included in the project footprint. Using information from the document (i.e., 65 points = 34.7 percent of the area), we calculate that 54 survey points would be needed to reach 30 percent coverage rather than the 40 points described in the document. Increasing the number of survey points will provide fine-scale data to better understand habitat use of the site by eagles, which is important in developing
avoidance areas and in siting turbines. It is also important to consider, in advance, how the data from the sampling scheme will be extrapolated to the Project site; therefore, we recommend providing a description of this in the protocol.

(2) Similar to the protocol submitted by PCW, we recommend focusing sampling efforts on the proposed project footprint; however, we also recommend including some survey points in areas outside of the current footprint to identify alternative locations if turbines need to be relocated away from areas currently proposed for development. These would be additional points, however, and should not replace survey data points needed to obtain the 30 percent coverage of the project footprint.

(3) We also recommend resampling at least fifty percent of the raptor point counts from previous years to allow comparison of eagle use across years. Based on Figure 1 of the protocol submitted by PCW, it may be possible to move some survey points a short distance so that they overlap with previous counts, but it may be necessary to incorporate some of the previously sampled points into the design.

(4) We recommend a spatially balanced design, such as stratification by landscape features, particularly the landscape features that influence eagle and raptor behavior. See recommendation number 6 above for details. This approach may already be included in the protocol provided by PCW, but it should be described explicitly.

(5) At present, surveys are tentatively planned to occur once per month between December 2012 and March 2013. We do not believe that this level of effort is sufficient to document winter eagle use, especially if there are short windows of higher use. We understand the need for safety and recognize that some locations may be inaccessible. However, results from the previous year suggest winter is also the season with the highest eagle use (Table 1), so it is important to collect data across the Project site to assess this use, otherwise predictions of use and fatalities may be inaccurate. To address concerns with limited survey data during winter months, we recommend all locations be sampled multiple times and that at least half of the locations be sampled at least twice per month. In addition, we encourage surveyors to record eagle observations while moving between survey points to help identify specific areas that receive eagle use during the winter months.

(6) The document anticipates survey efforts through March 2013 with the possibility of surveys beyond this month. Because of higher use during the summer months (i.e., during the breeding season), and because of the extremely low amount of temporal coverage during these months in 2012, we recommend sampling efforts continue through at least August 2013 to cover the breeding season. Without data from 2013, it would be necessary to use the limited data collected in 2012 to calculate eagle use during the late spring and summer months (i.e., April through August).
Comments on the “2012-2013 800-meter Raptor Survey Protocols” from PCW, dated August 31, 2012

(1) In several locations, the document states that it was “fully compliant” with recommendations by the U.S. Fish and Wildlife Service (Service). First, it is important to understand that the draft Eagle Conservation Plan Guidance is voluntary; consequently we prefer to use the term “consistent with” rather than “compliant with” when describing recommendations found within the Eagle Conservation Plan Guidance. Second, we do not believe that the protocol provided by PCW is, in fact, consistent with the Eagle Conservation Plan Guidance for numerous reasons, one key reason being that the limited number of 800-meter survey points do not provide the recommended minimum 30 percent coverage of the project footprint. Additionally, we do not believe it is scientifically justifiable to combine survey points from multiple years in order to meet the minimum recommended standard of 30 percent coverage: the minimum 30 percent coverage should occur within each individual year.

(2) The document makes a definitive statement about “unrealistic projections” concerning eagle risk. This statement is based on several assumptions, including that previous survey efforts correctly identified areas of high eagle use. One of the reasons for increasing the spatial coverage in 2012-2013 is to increase our confidence in understanding eagle and raptor use across the Project area. Because substantial uncertainty exists as a result of the limited amount of spatial and temporal survey coverage used to document impacts and relative risk to eagles, the Service believes our projections concerning risk to eagles are realistic and clearly demonstrate the need for increased coverage. In addition, our letter of August 10, 2012, identified numerous areas of potential high eagle use that are not currently included in the avoidance areas, such as the golden eagle nest in the southwest corner of Sierra Madre. Our letter also identified the presence of high density prey base, proximity of sage grouse leks and other habitat features that are used by eagles. Because these habitat features (and others) are not included in the proposed avoidance areas, the projections of risk and high eagle fatalities identified by the Service are possible.

(3) The document states that 34.7 percent coverage of the project site and that this is greater than the 30 percent recommended by the Service. As stated above, we do not believe that it is scientifically justifiable to combine survey points from multiple years in order to meet the recommended minimum standard of 30 percent coverage; the minimum 30 percent coverage should occur within each individual year.

(4) The data sheet attached to the protocol provided by PCW does not appear to have a means of recording flight path in data. It should be clear how flight path data will be collected on the existing data sheet, or additional datasheets should be included if there is more than one.
If you have specific questions regarding this letter, please contact Tyler Abbott of my office at the letterhead address or phone (307) 772-2374, extension 231.

Sincerely,

R. Mark Sattelberg
Field Supervisor
Wyoming Field Office

cc: SWCA, Jon Kehmeier (via e-mail)
    BLM, Pam Murdock (via e-mail)
    BLM, Mike Valle (via e-mail)
    FWS, Pam Repp (via e-mail)
    FWS, Casey Stemler (via e-mail)
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Mr. Garry L. Miller
Vice President, Land and Environmental Affairs
Power Company of Wyoming LLC
555 Seventeenth Street, Suite 2400
Denver, Colorado 80202

Dear Mr. Miller:

This letter provides the U.S. Fish and Wildlife Service’s (Service) recommendations to avoid and minimize impacts to golden eagles at the proposed Chokecherry Sierra Madre Wind Energy Facility (CCSM). Our goal in providing these recommendations to the Power Company of Wyoming (PCW) is to contribute to maintaining stable or increasing breeding populations of golden eagles by implementing conservation measures that will maintain golden eagle breeding territories and by minimizing impacts to important eagle use areas (e.g., eagle nests, foraging areas, and communal roosts; 50 CFR, Part 22). These recommendations also should benefit numerous other raptor species, because many raptor species use the same habitats and features as golden eagles. While we outline our overall avoidance and minimization framework for golden eagles, we also provide examples of how these recommendations should be applied to the CCSM. We encourage PCW to follow these recommendations and take all steps necessary to avoid and minimize take of eagles to the maximum degree practicable such that any remaining take is unavoidable despite application of advanced conservation practices developed in coordination with the Service.

The recommendations in this letter are similar to those we provided in our letter of August 10, 2012. We acknowledge your response letter of December 11, 2012, and we appreciate your comments and explanations therein. Our August 10th letter did not specify the size of buffers or identify specific areas to avoid, though we suggested using an estimate of the average golden eagle territory size as a starting point for buffering active nests. In an attempt to be more explicit in our approach and recommendations, we reiterate many of our previous overarching recommendations below in greater detail and clarity.
Because CCSM has important eagle-use areas within its project footprint, the CCSM project falls into a category of projects considered high risk to eagles, or a Category 1 project (Eagle Conservation Plan Guidance Module 1 – Land-based Wind Energy Version 2, April 2013 [ECPG 2013], p. 25). In addition, the Final Environmental Impact Statement for CCSM predicts an annual fatality estimate of 46 to 64 eagles per year (BLM 2012). While the number of predicted eagle fatalities may be lower due to PCW’s proposed avoidance areas (i.e., turbine no-build areas), the proposed avoidance areas still allow the placement of turbines near numerous golden eagle nests (i.e., Category 1). “Construction of projects at sites in category 1 is not recommended” and “projects or alternatives in category 1 should be substantially redesigned if they are to at least meet the category 2 criteria” (ECPG 2013, p. 25). The Service offers a process for wind power developers to receive authorization to take eagles under the Bald and Golden Eagle Protection Act. This process requires developers to avoid and minimize the take of eagles to the maximum degree practicable and that any remaining take be unavoidable. This includes, among other things, the proper siting of turbines. Implementing the following recommendations should allow CCSM to move forward toward being eligible for a programmatic eagle take permit as a Category 2 project (ECPG 2013, p. 25).

RECOMMENDATIONS FOR AVOIDANCE AND MINIMIZATION

OCCUPIED NESTS

For occupied golden eagle nests, we recommend a turbine no-build buffer within the project-specific ½-mean inter-nest distance (½-MIND). The ½-MIND buffer approximates the average territory size and is based on an average distance among all occupied nests within a given year. Eagle pairs that nest within one-half the mean project-area inter-nest distance are potentially susceptible to disturbance take and blade strike mortality, as these pairs and offspring may use the project footprint (ECPG 2013, p. 14). The ½-MIND can be adjusted at individual nests if site-specific data (e.g., telemetry data, prey analysis, other data) are adequate to show eagle activity around the nest is non-circular or that the territory is larger or smaller than the ½-MIND.

For CCSM, the project-specific ½-MIND is 3,500 meters (about 2.2 miles), which is based on data from 2011, the year with the highest number of occupied nests. Absent sufficient data, turbines should not be built within 3,500 meters of occupied nests.

In applying this recommendation, we define occupied golden eagle nests as nest sites that were occupied at least once during the last five years or last five years of field surveys. An occupied nest is a nest structure at which any of the following is observed: (1) an adult eagle in an incubating position, (2) eggs, (3) nestlings or fledglings, (4) occurrence of a pair of adult eagles (or sometimes subadults) at or near a nest through at least the time incubation normally occurs, (5) a newly constructed or refurbished stick nest in the area where territorial behavior of an eagle had been observed early in the breeding season, or (6) a recently repaired nest with fresh sticks, fresh boughs on top, and/or droppings and/or molted feathers (ECPG 2013, p. 64). In years when food resources are scarce, it is not uncommon for a pair of eagles to occupy a nest yet never lay eggs; such nests are considered occupied (ECPG 2013, p. 64). Because golden eagles

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often will use the same nest in multiple years there is a high likelihood these nests could be
occupied again during the life of a project. Nests form the center of activity during the breeding
season and are often centers of activity during the non-breeding season as well. Buffering or
otherwise protecting eagle nests should substantially decrease the probability of lethal take, as
well as disturbance take, of eagles. Other raptors using the same nesting habitats as golden
eagles (e.g., prairie falcon) also will benefit from protection of golden eagle nest sites.

Based on information in your letter of December 11, 2012, adjustments to the $\frac{1}{2}$-MIND buffer
may be appropriate at some occupied nests. For example, point count data, observational data in
conjunction with radar data, and an evaluation of foraging locations (based on prey availability)
all suggest eagle activity at occupied nests along the Bolton Rim occurs primarily south of the
Bolton Rim, away from proposed turbine development. If the additional data being collected
through 2013 confirm these findings, the $\frac{1}{2}$-MIND buffer could be reduced on the northern side
of the three occupied golden eagle nests along the Bolton Rim to accommodate the currently
proposed turbines. Any reduction in the buffer, however, should not result in disturbance or
territory abandonment; therefore, we anticipate the buffer would still be no less than the PCW-
proposed avoidance area, which places turbines more than 1,600 meters (1.0 mile) from the
nests.

Another example of possible site-specific adjustments is nest #199. This is an individual nest
south of the project area that blew off the cliff in 2012. The area where the nest was located will
be monitored in 2013 and will continue to be monitored in future years for evidence of nest
reconstruction (PCW, December 11, 2012, p. 11). If the nest becomes active in 2013, we
recommend applying the project-specific $\frac{1}{2}$-MIND buffer of 3,500 meters; however, this buffer
could be adjusted if adequate data are available to determine that the territory, including foraging
locations and travel corridors, does not overlap proposed turbines, the closest turbines being
about 2,400 meters (1.5 miles) away from the nest.

For some occupied nests, adequate data are not yet available and making downward adjustments
to the $\frac{1}{2}$-MIND buffer is not recommended. For example, observational data show eagle activity
occurs east and southeast of nest #162 in southwest Sierra Madre, but eagle activity was not
observed west and northwest of the nest. While it is possible that eagles only fly in those
directions, it is likely that the lack of eagle observations west and northwest of the nest is related
to the location of the observation point rather than eagle activity; therefore, adjusting the $\frac{1}{2}$-
MIND around nest #162 is not recommended without additional specific data supporting an
adjustment.

Eagle activity south of nest #145 in NW Chokecherry was low during 2012, and possible
foraging locations for eagles at this nest may be north and northwest of the nest, outside of the
project area (PCW, December 11, 2012, p. 5). Because the nest was not occupied in 2012, we do
not know how eagles from this nest will use the landscape, which may include use of the project
area west, south and east of the nest. Therefore, we recommend the 3,500-meter buffer. It may
be appropriate to reduce the size of the buffer to the south and southwest if data from 2013
confirm eagle use does not occur south of the nest; however, we anticipate a minimum buffer
will be needed around the nest to avoid disturbance and to reduce the likelihood of fatalities associated with eagle movement between the nest area and the interior rim of Chokecherry.

**UNOCCUPIED NESTS**

We recommend that turbines not be constructed within 800 meters (0.5 mile) of any unoccupied (historic) golden eagle nest, and that all turbines between 800 meters and 1,600 meters (1.0 mile) of any unoccupied nest are curtailed during each year starting 15 January until 1 May, or until adequate nest surveys demonstrate that the nests are unoccupied. Further, if the nest becomes occupied, turbines within the ¼-MIND of the nest should be curtailed during the breeding season until the young fledge and are no longer dependent on the nest or until the nest becomes unoccupied.

In applying this recommendation, we define unoccupied golden eagle nests as historic nest sites that were not occupied during the last five years or last five years of field surveys. It should be noted that occupied nests can be incorrectly assigned as unoccupied if the nests are not repeatedly surveyed during the same nesting season. Even if a nest was unoccupied in one or more years, it is possible that eagles will reuse that nest in future years, especially since the intervals between nest use can be lengthy. Given that the anticipated life of a wind project is 30 years (though repowering could extend that indefinitely) it is likely that some unoccupied nests will become occupied during the life of the project. In addition, nests usually occur in areas of historical eagle use (due to topographic features and prey resources) and represent areas where eagles are expected to return in the future.

**AREAS OF CONCENTRATED PREY RESOURCES**

We recommend that turbines not be constructed in areas of concentrated prey resources unless it is demonstrated that the areas of concentrated prey resources do not overlap or are not immediately adjacent to other important eagle use areas (i.e., eagle nests, foraging areas, and communal roosts; 50 CFR 22.3), and where sufficient data are available to confirm that the concentrated prey resources are not in areas of project-specific eagle activity areas (e.g., areas for which sufficient data suggest high eagle activity). Areas of concentrated prey resources may be used by golden eagles during the entire year, including the nesting season, spring and fall migrations, and during the wintering period.

For CCSM, the areas of concentrated prey resources include white-tailed prairie dog towns. Because white-tailed prairie dogs hibernate during the winter months, the concentrated prey resources are not available year round; however, white-tailed prairie dogs are still available during the nesting season and during part of the fall migration period. Therefore, turbines should not be placed in white-tailed prairie dog towns unless the towns do not overlap or are not immediately adjacent to eagle nests, other foraging areas, communal roosts, or project-specific eagle activity areas (e.g., areas for which sufficient data suggest high eagle activity).
OTHER PROJECT-SPECIFIC EAGLE ACTIVITY AREAS

We recommend applying buffers for other project-specific eagle activity areas identified by survey data (e.g., 800-meter point counts). These are different than “important eagle use areas” (as defined in regulations and the ECPG 2013, p. 35) which are limited to nests, foraging areas, and communal roost sites. Other project-specific eagle activity areas include migration corridors, migration concentration sites, stopover sites, perches, specific areas where eagles gain uplift for foraging and other movements, movement corridors, etc. They include all types of eagle use areas except the “important eagle use areas.” Although project-specific, these other project-specific eagle activity areas are typically used by eagles; therefore, it is appropriate to identify these areas and provide buffer recommendations for them. In applying this recommendation, we will focus on areas where there is an intersection of geographic relief (e.g., cliff features used for nesting, ridge features used for migration, rims used for orthographic lift) and documented project-specific eagle activity areas. Furthermore, the recommended buffers for geographic features would vary based on the value and use of those features by eagles, with those having greater value and use by eagles receiving larger buffers.

In many respects, this recommendation follows the approach used by PCW to identify areas such as the Interior Rim in Chokecherry as proposed avoidance areas (i.e., turbine no-build areas). However, we have identified additional areas for avoidance. For example, based on the high level of eagle activity remaining outside of the proposed avoidance area along the Interior Rim, we recommend extending the buffer eastward along this geologic feature (Interior Rim). Other examples include the rim in Sage Creek Basin and portions of Miller Hill.

We look forward to discussing these recommendations with you, and addressing any questions or comments that you may have, during our meeting scheduled for May 15, 2013. If you have specific questions regarding this letter in the interim, please contact Tyler Abbott of my office at the letterhead address or phone (307) 772-2374, extension 231.

Sincerely,

R. Mark Sattelberg
Field Supervisor
Wyoming Field Office

cc SWCA, Principal Ecologist, Broomfield, CO (J. Kehmeier) (jkehmeier@swca.com)
BLM, Supervisory RECO Coordinator, Cheyenne, WY (M. Valle) (mvalle@blm.gov)
BLM, RECO Project Manager, Rawlins, WY (H. Schultz) (hschultz@blm.gov)
FWS, Chief, Lakewood, CO (P. Repp) (pam_repp@fws.gov)
FWS, Chief - Bird Habitat Conservation, Lakewood, CO (C. Stemler) (casey_stemler@fws.gov)
MEMORANDUM
BY ELECTRONIC MAIL

TO: U.S. Fish and Wildlife Service
FROM: Power Company of Wyoming LLC
DATE: August 30, 2013
RE: PCW’s Development Plan

This memo addresses the question posed by the U.S. Fish and Wildlife Service (the Service) about how PCW’s planned submission of site-specific development plans and its phased construction approach comports with the Bureau of Land Management’s Final Environmental Impact Statement (FEIS) and Record of Decision (ROD) for the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project).

Background

The CCSM Project analyzed by the BLM in the FEIS and the subject of the ROD was summarized in the Executive Summary of the FEIS as follows:

- A 2,000- to 3,000-megawatt (MW) wind farm consisting of approximately 1,000 wind turbine generators (WTGs) with a nameplate capacity ranging from 1.5- to 3-MW;
- Development of step-up transformers, underground and overhead electric collection and communication lines, electric substations, rail distribution facility (RDF), operations and maintenance facilities, and laydown areas;
- Haul road and transmission connection between the two sites;
- Construct new roads and upgrade existing roads; and
- Power from the wind farms would be transmitted via overhead electric transmission lines that would connect to a new substation in the Application Area.

FEIS at ES-1. This summary of the CCSM Project remains accurate. In addition to the CCSM Project facilities described above, PCW will reopen an onsite quarry that will supply base aggregate for construction of the CCSM Project. The BLM will include the quarry in its environmental analysis of the rail facility and haul road.
BLM prepared a project-wide EIS based on a Plan of Development prepared by PCW (Appendix B of the ROD). The Plan of Development included a conceptual project with specific turbine and facility site locations and a conceptual construction sequence that implemented the Plan of Development. The conceptual project provided BLM with the information it needed to prepare its overall impacts analysis which assumed the “greatest potential for disturbance” (ROD at p. 3-1). The BLM’s project-wide EIS did not authorize site-specific construction associated with the siting/location of individual project components. Instead, a detailed procedure is outlined in the ROD under which PCW will submit site-specific plans of development to the BLM for subsequent NEPA analysis tiered “to the analysis and site-specific terms and conditions described in the ROD associated with the project-wide EIS” (ROD at p. C-1). The ROD provides that “BLM will closely evaluate the site-specific plans of development (SPODs) to determine whether the impacts exceed the disturbance estimates from the conceptual layouts that served as the basis for determining significance of impacts in the project-wide level EIS.” (ROD at p. 3-1).

As outlined in the ROD, BLM determined two areas on the Overland Trail Ranch were suitable for wind energy development: the Chokecherry wind development area, and the Sierra Madre wind development area. The Sierra Madre development area consists of two distinct areas divided by Hwy 71 - with the majority of the wind development acreage located west of Hwy 71. (ROD, App. B at 4-26, Figure 4-10 also inserted below). The portion of Sierra Madre located west of Hwy 71 is referred to as Miller Hill and the portion of Sierra Madre located east of Hwy 71 is referred to as Sage Creek Basin. (ROD, App. B at 4-25 and 4-26, Figure 4-10 also inserted below). The Chokecherry wind development area is located entirely east of Hwy 71, but is divided into Western and Eastern Chokecherry based on topography. (ROD, App. B at 4-26, Figure 4-10 also inserted below).

![Figure 4-10](image-url)

PCW’s conceptual construction sequence provided for the construction of turbines to occur first in the Miller Hill area in line with PCW’s goal of developing the highest-quality wind resources first (ROD, App. B at 1-8). Turbine construction then occurred in both the Sage Creek Basin and Western Chokecherry areas simultaneously (ROD, App. B at 4-25, Table 4-1). Finally, under the conceptual construction sequence, Eastern Chokecherry would be developed last. (ROD, App. B at 4-25, Table 4-1). Thus, the conceptual sequence of construction was: (1) Miller Hill; (2) Sage Creek Basin and Western Chokecherry simultaneously; and (3) Eastern Chokecherry.
PCW’s Plan of Development also clearly states that “construction approaches will not be finalized until the detailed design of the Project is complete. Additional details will be provided in site-specific PODs” (ROD, App. B at p. 4-1). The Plan of Development further provides that the “Project design will continue to be updated and refined to utilize the best data and information available” (ROD, App. B at P. 4-1).

PCW’s Plan of Development noted that PCW originally planned to build the CCSM Project over three years; however, to mitigate potential socioeconomic effects caused by a large labor force, PCW agreed to a four-year schedule. In the EIS, BLM evaluated a five-year construction period for the CCSM Project which was incorporated as a mitigation measure. This five-year construction period was to construct the entire CCSM Project – all 1,000 turbines in both Sierra Madre and Chokecherry.

In sum, the project-wide EIS and ROD contemplated that “conceptual” construction plans would be refined and become “final” plans or site-specific plans of development, and those final SPODs would once again be evaluated by the BLM prior to it granting PCW any ROWs. This process provides the ability for PCW to work with the Service in submitting refined turbine layouts in the SPODs that implement further eagle avoidance and minimization measures.

**PCW’s Current Development Plan**

The CCSM Project consisting of approximately 1,000 wind turbine generators and 2,000 to 3,000 MW, as analyzed by the BLM and summarized in the FEIS remains the same. As outlined above, both the BLM and PCW contemplated and understood that there would be updates, adjustments, and refinements to the conceptual project included in the Plan of Development that was considered in the FEIS and ROD; this is reflected in the FEIS and ROD as well as the Plan of Development. As envisioned, PCW is making some adjustments with respect to when and where construction in the wind development areas will occur.

- First, instead of submitting the site-specific development plans for all 1000 turbines in both wind development areas simultaneously, PCW will submit a site-specific development plan for 500 turbines or 1500 MW (Phase I), to be followed at a later date by a second submission of a site-specific development plan for the remaining 500 turbines or 1500 MW (Phase II). Construction of Phase I will take place over a 36 to 39 month period.

- Second, instead of the construction sequence of: (1) Miller Hill; (2) Sage Creek Basin and West Chokecherry simultaneously; and (3) Eastern Chokecherry, Phase I will include only Miller Hill and West Chokecherry. (ROD, App. B, 4-26, Figure 4-10 also included above). Phase II will include Sage Creek Basin and Eastern Chokecherry. This construction sequence comports with PCW’s goal of developing the highest-quality wind resources first and the only change in sequence is the decision not to develop West Chokecherry and Sage Creek Basin simultaneously.

Neither of these adjustments - the phasing of construction or the areas initially constructed - affect the analysis of CCSM Project impacts set out in the FEIS that was based on a **conceptual** project included in the Plan of Development (ROD at Appendix B) and the “greatest potential for disturbance” (ROD at p. 3-1). Phasing of construction was also recommended by the Service to allow PCW time to incorporate adaptive management techniques into Phase II. PCW will seek separate Eagle Take Permits for Phase I and for Phase II.
In sum, the overall CCSM Project scope, major elements and areas of wind development remain the same. PCW’s current approach to submitting its site-specific plans of development and its phased construction of the wind development areas comports with the overall EIS and ROD analyses and conditions.
Gary,

Thank you for fulfilling PCW's commitment to provide the most current concentrated prey resource data and report to the Service by the mutually agreed-upon time frame. In accordance with our agreement, with this transmittal the Service is fulfilling our commitment for a 2-week turnaround time: attached please find the Service's final recommendations regarding areas of concentrated prey resources for the proposed Chokecherry Sierra Madre Wind Facility. These recommendations represent both the Service's Regional Migratory Bird Management Office and the Wyoming Ecological Services Field Office.

As Nathan has indicated below, attached are two maps and a narrative that illustrate and describe three areas identified in the recommendations. Also, Nathan has attached zip files of the GIS layers.

If you have any questions, please feel free to contact myself or Nathan.

Thank you, Tyler

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Tyler Abbott, Deputy Field Supervisor
U.S. Fish and Wildlife Service
Wyoming Ecological Services Field Office
5353 Yellowstone Road, Suite 308A
Cheyenne, WY 82009
Office: (307) 772-2374 x 231
Cell: (307) 286-7242
tyler_abbott@fws.gov

--------- Forwarded message ---------

From: Nathan Darnall <nathan_darnall@fws.gov>
Date: Fri, Sep 27, 2013 at 4:01 PM
Subject: Recommendations for Areas of Concentrated Prey Resources
To: Tyler Abbott <tyler_abbott@fws.gov>

Tyler,

Here are the joint Ecological Services-Migratory Bird recommendations for
avoidance and minimization concerning areas of concentrated prey resources. I've attached two maps and a write-up that show/describe the three areas in the recommendations. I've also attached zip files of the GIS layers for them.

Nathan

Nathan Darnall
Section 7 and Conservation Planning Assistance Coordinator
U.S. Fish and Wildlife Service
Wyoming Ecological Services Office
Office: (307) 772-2374 x 246
Work Cell: (307) 286-1334
Fax: (307) 772-2358
nathan_darnall@fws.gov
http://www.fws.gov/wyominges/Index.html
http://www.fws.gov/mountain-prairie/es/
Figure 3. Concentrated Prey Resource Recommendations for Northern Lower Miller Hill

Legend
- Turbine Locations (July 2012)
- Dashed lines: County Road
- Solid lines: Eagle Flight Paths
- Crosshatch: WTPD North Colony Buffer
- Crosshatch with dots: WTPD High Density Buffer
- Pink: PCW Raptor Avoidance Areas
- Blue: Historic Prairie Dog Mapping
- Orange: Prairie Dog Burrow Density
  - High
  - Med.
  - Low
- Black: Project Boundary

Created By: USFWS, Wyoming ES
Map Date: 09/27/2013
Source: ESRI | SWCA | FWS | BLM
Figure 2. Concentrated Prey Resource Recommendations for Southern Lower Miller Hill

Legend
- Turbine Locations (July 2012)
- County Road
- Eagle Flight Paths
- WTPD Colony Buffer
- WTPD High Density Buffer
- PCW Raptor Avoidance Areas
- Historic Prairie Dog Mapping
- Prairie Dog Burrow Density
  - High
  - Med.
  - Low
- Project Boundary

Created By: USFWS, Wyoming ES
Map Date: 09/27/2013
Source: ESRI | SWCA | FWS | BLM
Recommendations for Avoidance and Minimization for the Chokecherry Sierra Madre Wind Energy Facility

C. AREAS OF CONCENTRATED PREY RESOURCES

Turbines should not be constructed in areas of concentrated prey resources unless it can be demonstrated that the areas of concentrated prey resources do not overlap or are not immediately adjacent to other important eagle use areas (i.e., eagle nests, foraging areas, and communal roosts; 50 CFR 22.3), and where sufficient data are available to confirm that the concentrated prey resources are not in areas of project-specific eagle activity areas (e.g., areas for which sufficient data suggest high eagle activity).

Data used in Analysis

White-tailed Prairie Dog Data:
- Mapping provided by SWCA from 2013
- WGFD layer of non-block cleared area

Eagle Flight Path Data:
- April – June 2011
- July – August 2011
- September – October 2011
- May – July 2012
- September – October 2012
- April – June 2013
- June – August 2013

RECOMMENDATIONS FOR THE EAGLE CONSERVATION PLAN

Recommendations for Lower Miller Hill

(A) South – West of Rasmussen Lake is a relatively dense cluster of white-tailed prairie dog towns that collectively intersect at least eight eagle flight paths and that lie within a white-tailed prairie dog colony mapped by the Wyoming Game and Fish Department (WGFD). While the towns are not large individually (largest is 44.5 acres), due to their close proximity to each other they may collectively (317 acres) create a geographic unit with overall higher density of prey resources than adjoining areas, and therefore attract eagles and other raptors.

Towns Excluded from the Analysis

Other relatively large towns north of the cluster (487, 488 and 49) are separated from the group by more than two and a half times the average distance between the towns within the cluster (average = 353 meters). These three towns were not included in the cluster but will be treated separately due to their size and density of burrows. However, if the area between the cluster and the three towns was not surveyed in 2013 and if more towns are present, the cluster should be enlarged to include these towns.
One large town east of the cluster (2942) was not included, because it was inactive in 2013 and is about 0.5 kilometer from the group; however, including this town may be recommended as it could become reoccupied in the future and doing so would only impact one additional turbine.

Finally, several small towns west of the cluster (485, 84, 3797, 3796, 3744, and 1728) were not included in the cluster, because of their small size and location outside of the WGFD polygon, and also due to inactivity at some towns and the lack of observed eagle flight paths.

Analysis

Once the towns to include in (or exclude from) the cluster were identified using the criteria presented above (Table 1), the Minimum Bounding Geometry tool in ArcMap (Geometry type: convex hull; Group option: all) was used to define the spatial extent of the avoidance area. Depending on how the buffer is applied (or expanded), 15 to 20 turbines are impacted.

Table 1. Object ID (from GIS), burrow density (high, medium, low) and size (acres) of white-tailed prairie dog towns included in the cluster analysis. All of the towns were active in 2013 except 886 and 3354(*).

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Recommendations for Chokecherry

There are no white-tailed prairie dog towns inside the project boundary for Phase 1 of Chokecherry (Nevins Ridge); therefore, we developed no recommendations for this area of the project. Prairie dog towns occur north of the Chokecherry boundary near the Interior Rim, an area identified by PCW as a no-build location. Recommended no-build areas are also located west southwest of the towns due to occupied and unoccupied nests.

Recommendations for Upper Miller Hill

There are a few small prairie dog towns on the top of Miller Hill at the west side of the project. We developed no recommendations for this area due to the small size of the towns and the general lack of eagle activity near the towns.
**RECOMMENDATIONS FOR THE BIRD AND BAT CONSERVATION STRATEGY**

**(B) South** – West of Rasmussen Lake are three relatively large white-tailed prairie dog towns with high density of burrows/animals (487, 488 and 49). As discussed previously, these three towns are separated from the cluster in **A** by more than two and a half times the average distance between the towns in the cluster. Other data, such as observed eagle flight paths, do not strongly suggest these towns are heavily used by eagles as foraging locations. However, compared to other towns, these are relatively large with a high burrow density, suggesting that white-tailed prairie dogs might be locally abundant and may attract eagles and other raptors.

The recommendation is to buffer these three towns by 120 meters (396 feet), the approximate height of the “typical” wind turbine. This recommendation impacts 4 turbines from the July 18, 2012 layout.

**(C) North** – The north side of lower Miller Hill contains some of the largest and most dense white-tailed prairie dog towns mapped in 2013, with a total area of about 1 square mile (Table 2). While no demonstrated important eagle use areas or multiple eagle flight paths overlap these towns, we recommend this area be included in avoidance and minimization under the Bird and Bat Conservation Strategy (BBCS) to protect other raptors. In addition, ACPs could be developed for eagles. Measures might include: (1) turbine removal, (2) seasonal curtailment, and (3) additional study to determine how the area is used by raptors and eagles. The 120-meter buffer is based on the height of a “typical” wind turbine. This recommendation impacts approximately 17 turbines from the July 18, 2012 layout.

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