U.S. Fish and Wildlife Service

Bureau of Land Management

Environmental Assessment

Ocotillo Wind Energy Facility Eagle Conservation Plan

California

Finding of No Significant Impact

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I. Introduction

In accordance with the National Environmental Policy Act (NEPA) of 1969 (42 USC 4321 et seq.) and its implementing regulations (40 CFR 1506.6 and 43 CFR 46.300), we, the U.S. Fish and Wildlife Service (Service) and the Bureau of Land Management (BLM) prepared an Environmental Assessment (EA) analyzing the impacts to the human environment associated with permit issuance and ROW grant amendment (*Environmental Assessment –Ocotillo Wind Energy Facility Eagle Conservation Plan*) based on the Project's Eagle Conservation Plan (ECP) (Ocotillo 2018) (EA Appendix A), as well as other alternatives. The EA (EA) is incorporated by reference into this Finding of No Significant Impact (FONSI) and provided as Attachment 1.

This FONSI addresses the Service's issuance of an eagle incidental take permit pursuant to the Bald and Golden Eagle Protection Act (Eagle Act) (16 USC 668–668d) and its permitting regulations (50 CFR 22.26) for the operational Ocotillo Wind Energy Facility (Project), located in Imperial County, California. This FONSI also addresses the BLM's decision to amend the Project's right-of-way (ROW) grant to allow for discontinuation of the risk minimization system for golden eagles and installation of an aviation radar system, which would turn on the Federal Aviation Administration (FAA) -required flashing lights on turbines only when aircraft are in the area.

II. Consistency with Land Use Plans, Laws, Regulations and Policies

BLM: The BLM's purpose and need is to respond to a FLPMA ROW grant amendment application submitted by the applicant which seeks to modify or eliminate certain eagle protection measures within its currently required ECP that was evaluated in the FEIS/FEIR (BLM 2012a) and approved in the ROD (BLM 2012b).The Selected Alternative meets the BLM purpose and need because it responds directly to the Applicant's ROW grant amendment request. As described in the Project's FEIS/FEIR and the EA for this decision (Attachment 1), the Selected Alternative is in conformance with the application regulations and following the land use plan and BLM policies:

- BLM California Desert Conservation Area Plan of 1980, as amended by the Desert Renewable Energy and Conservation Plan 2016.
- Title V of the Federal Management and Policy Act (FLPMA) of 1976. 43 USC 1761, 1765.
- FLPMA right-of-way regulations, 43 CFR 2800.

Service: The Service's purpose and need is to respond to an eagle act take permit application submitted by the applicant. Issuance of a permit must comply with the Eagle Act and all related regulatory requirements. The Selected Alternative meets the Service's purpose and need because it responds directly to the Applicants eagle take permit request. As described in the EA for this decision (Attachment 1), the Selected Alternative is in conformance with the Service's permit issuance regulations and policies. We have determined under the Selected Alternative:

- any take authorized under the Eagle Act is compatible with the Eagle Act's preservation goal of maintaining stable or increasing breeding populations of eagles; and
- is in compliance with the Eagle Act and its implementing regulations and permit issuance criteria under 50 CFR 22.26 and 50 CFR 13.21.

III. Alternatives Considered

The EA evaluated a No-Action Alternative and three action alternatives. The following is a brief description of the alternatives considered. For a complete description of alternatives considered, see EA Section 2.2.

Offsetting Compensatory Mitigation

Under alternatives 2 and 4, the Applicant would provide compensatory mitigation for eagles by retrofitting electric distribution poles. The intent is to minimize the potential for golden eagle electrocutions in this area and ensure that the effects of take caused by the Project are offset.

Alternative 1: No Action – Operation of the Project without an Eagle Take Permit or ROW Grant Amendment, Continued Bio-Monitoring with Curtailment When Eagles Detected

Under the No-Action Alternative, the Service would either take no action or deny the permit application and not issue an eagle take permit; the BLM would not amend the ROW grant. The Project would continue to operate without an eagle take permit being issued. Under this scenario, the Applicant would continue to implement the minimization, avoidance, and monitoring practices that are currently ongoing, as described in the BLM's ROD and the 2012 ECP. The wind Project would continue to operate without a take permit, and the Applicant would be subject to law enforcement action if unauthorized take of golden eagles occurred during operations.

Alternative 2: Issue 5-Year Permit for Applicant's Revised ECP and Issue ROW Grant Amendment

Under this alternative, the Service would issue a 5-year permit to take up to two golden eagles under the Applicant's implementation of the ECP with associated conditions, as allowed by regulation. The permit would incorporate all conservation commitments and implementation of ACPs described in the revised ECP (EA Appendix A). Additionally, this alternative would involve removal of the DeTect Merlin radar system and installation of an aviation radar system, which would turn on the Federal Aviation Administration (FAA) -required flashing lights on the turbines only when aircraft are in the area. This would be a change from the existing lighting regime, which regularly flashes lights on the turbines regardless of whether aircraft are in the vicinity. The BLM would issue a ROW grant amendment authorizing the proposed modifications to the radar system and FAA lighting.

Alternative 3: Continued Operation of the Project without an Eagle Take Permit; Issue ROW Grant Amendment

Under this alternative, the Service would deny the eagle take permit application and would not issue an eagle take permit; the BLM would amend the ROW grant to lift the requirement for the eagle risk minimization ACP which includes the DeTect Merlin radar system and radar-controlled video tracking system and the aviation radar system would be installed for the FAA-required flashing lights. The wind Project would continue to operate without a take permit being issued, and the Applicant would be subject to law enforcement action if unauthorized take of golden eagles occurred during operations. Under this alternative, the BLM would require that unless or until an eagle take permit is obtained, that the Applicant continue full time bio-monitoring and associated curtailment during daylight hours. Furthermore, the BLM would require that fatality monitoring occur at the Project using Service-approved standards. The ROW grant amendment would include language indicating additional adaptive management measures that may be necessary if an eagle is taken without a take permit.

Alternative 4: Issue a 30-Year Permit for Applicant's Revised ECP with Additional Mortality Monitoring and Mitigation; Issue ROW Grant Amendment

Under this alternative, the Service would issue a 30-year permit to take up to nine golden eagles throughout the life of the permit with associated conditions, as allowed by regulation. The permit would incorporate all conservation commitments described in the ECP (EA Appendix A). The Service would evaluate the 30-year permit at 5-year intervals. To offset the cumulative take from human activities to golden eagle populations, this alternative would also require a mitigation rate of 1.2 to 1. This equates to a range of 32 to 74 power pole retrofits for the first five-year term; additional mitigation would be dependent on monitoring results at the first five-year review, with an anticipated maximum of 97 to 221 retrofit poles over 30 years. The BLM ROW grant amendment would refer to the 30-year eagle take permit for eagle fatality monitoring requirements. All other aspects of the ECP and BLM ROW grant amendment associated with Alternative 4 would be the same as those described under Alternative 2.

Evaluation of Alternatives

The EA evaluated potential impacts that could result from the issuance of the programmatic eagle take permit based on the proposed ECP or alternatives to the proposed ECP, as well as the potential impacts that could result from amending the ROW grant to allow discontinuation of the current eagle risk management system and installation of the aviation radar system. In the analysis of alternatives, we consider the degree to which each alternative would conform to the permit issuance criteria for take permits under the Eagle Act (50 CFR 22.26(f)(1–6) (2009 Eagle Rule) or required determinations under 50 CFR 22.26 (f)(1-7) (Eagle Rule 2016a).

IV. Selected Alternative

The Selected Alternative for issuance of a programmatic eagle take permit and ROW grant amendment for the Ocotillo Wind Energy Facility is Alternative 2 of the EA. The entirety of Alternative 2 without omissions, and without deletions, and without additions from other Alternative in the EA we find to have no significant impacts.

Effects of Implementation

As described in the EA, the implementation of any of the identified action alternatives would result in no significant impacts to any of the environmental resources identified in the EA. The amendment of the ROW grant allows the Applicant to reduce the high cost of the previous experimental golden eagle risk minimization system while still promoting conservation of eagles through the implementation of the revised ECP. Therefore, implementing Alternative 2 as the Selected Alternative would result in no significant impacts to any of the environmental resources identified in the EA. Our Selected Alternative is consistent with the purpose and need stated in the EA. A summary of the impact analysis, mitigation measures, EA conclusions, and effects on visual resources, migratory birds, and species listed under the ESA follows.

Eagles

In determining the significance of effects of each alternative on eagles, we screened each alternative against the Eagle Act's permit issuance criteria (EA Section 1.5.2) using the quantitative tools available in our ECP Guidance (Service 2013). The Service independently evaluated the potential impacts from Project operations along with the implications for direct, indirect, and cumulative effects. We developed conservative risk estimates for the Project and our cumulative effects analysis to be protective of the species.

Risk Estimate

In the ECP Guidance (Service 2013), we provide a mathematical model that estimates fatality risk at wind Project sites. Under the Selected Alternative, we estimate that up to two golden eagles will be taken over the duration of the 5-year permit. The predicted take of golden eagles conservatively estimates impacts to eagles. We have purposefully used these estimates to be protective of eagles and ensure that take authorization is not over-allocated across the population. The mortality monitoring requirements outlined in the ECP under the Selected Alternative will allow us to evaluate the Project's risk after the 5-year permit and provide statistically meaningful results.

Cumulative Effects

To evaluate cumulative impacts for the local-area population, we followed the guidance provided in Appendix F of the ECP Guidance (Service 2013) and as described in the 2016 PEIS (Service 2016b).Using this process, we estimated annual golden eagle fatality rates within a 109-mile radius around the Project area (EA Figure 1-2). We incorporated data provided by the Applicant, our own data on permitted take and other documented eagle mortalities in determining cumulative impacts to the Location Area Population (LAP).

Visual Resources

Under the Selected Alternative, the Applicant would install an aviation detection system that would result in the lit turbines flashing only when aircraft are in the area. The alternative would therefore affect the visual resources in the Project vicinity by reducing the occurrence of flashing lights to the time only when aircraft are in the area. Visual impacts would be altered as a result of a decrease in frequency of blinking FAA lights, which would only occur when aircraft are in the vicinity of the Project. This would reduce the visual impacts of night time lights to nearby residents, but the change is not significant.

Migratory Birds

As described in Section 4.6.2 of the EA (Attachment 1) there may be minor changes in the impacts to birds under the Selected Alternative. Potential adverse impacts to individual raptor at the wind facility could increase a small amount. The eagle risk minimization system will no longer curtail wind turbines when an eagle or large raptor whose identification was unconfirmed and turbines curtailed as a precaution. The compensatory mitigation, retrofitting power poles to prevent eagle electrocutions could also result in beneficial affects to individual raptors and small beneficial effects to raptor populations.

There is some potential for beneficial impacts to nocturnal migrating birds by reducing the occurrence of flashing lights, which would only flash when aircraft are in the vicinity of the Project.

Species Listed Under ESA

As described in EA Section 4.5.1 (Attachment 1) the effects of authorizing incidental eagle take and amending the ROW grant is not expected to have effects to species protected by the ESA.

V. Public Comment

The Service published a Notice of Availability of the Draft EA in the FR on November 1, 2018, opening a 30-day comment period.

We received four submissions; one from the Applicant, two from nongovernmental organizations (NGOs), and one from a Native American tribe. One NGO comment letter combined comments from three different environmental groups. Our responses to the comments on the Draft EA are presented in Attachment 2.

VI. Changes Made to EA

We made the following minor changes to the Draft EA based on comments received:

- Added information on the take evaluation under the curtailment program.
- Added information on the electric utility pole retrofit process for mitigation and explained why a range was provided for the number of retrofits needed.
- Added information about depositing funds into our NFWF Eagle Mitigation Account.

We also made some minor changes to the EA to improve clarity.

VII. Significance Criteria

The Selected Alternative will not have a significant effect on the human environment. This conclusion is based on an examination of the significance criteria defined in 40 CFR 1508.27, and on the analysis in the EA. In making this FONSI, the following criteria have been considered, in accordance with the CEQ, 40 CFR 1508.27.

Context

NEPA requires consideration of the significance of an action in several contexts, such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant in accordance with 40 CFR 1508.27(a). For purposes of analyzing the Selected Alternative, the appropriate context for potential impacts associated with the Selected Alternative is local and regional, because the Selected Alternative does not affect statewide or national resource values. The context of the Selected Alternative points to no significant unmitigated environmental impact considering the following (as discussed in EA Sections 4.3 through 4.6):

- The Applicant will offset golden eagle take though compensatory mitigation. This will ensure that the impacts of issuing an eagle take permit and amending the ROW grant on the local and regional golden eagle populations will be less than significant.
- The Selected Alternative may have a beneficial effect on visual effects, due to the replacement of the radar and video tracking system with an aviation detection system, which would limit the amount of flashing lights to periods when planes are in the vicinity of the Project, but this effect would not be anticipated to be significant.
- Migratory bird species may be affected by implementation the Selected Alternative. Some of these effects may be beneficial (i.e., some electrocution-prone non-eagle raptor species may benefit from power-pole retrofits) and some may be adverse (i.e., removal of the observer-curtailment program may increase the risk of non-eagle avian collisions with turbines). However, overall through implementation of the adaptive management plans in the ECP and the ABPP, impacts to migratory bird species of issuing an eagle take permit and amending the ROW grant will be less than significant.
- Authorizing incidental eagle take and amending the ROW grant is not expected to have effects to species protected by the ESA at the operational wind facility. With implementation of avoidance and minimization measures, the required eagle compensatory mitigation, retrofitting electric utility poles, is not likely to adversely affect ESA protected species. As described above in EA Section 4.5.1, the Service will evaluate the proposed mitigation once the location is selected, and if there is potential for impacts to species listed under the ESA that could not be minimized

and avoided as described, we would conduct an additional NEPA analysis and reinitiate our Intra-Service ESA Section 7 Consultation.

Intensity

The term "intensity" refers to the severity of a proposed action's impact on the environment. In determining the intensity of an impact, the NEPA regulations direct federal agencies to consider ten specific factors, each of which is discussed below in relation to the Selected Alternative for the Project.

1. *Impacts can be both beneficial and adverse and a significant effect may exist regardless of the perceived balance of effects.*

   While consideration of the intensity of Project impacts must include analysis of both beneficial and adverse effects, only a significant adverse effect triggers the need to prepare an environmental impact statement (EIS) (40 CFR 1508.27). The potential beneficial effects and adverse impacts of the Selected Alternative are discussed briefly below.

   Beneficial Effects. As described in Chapter 4 of the EA, issuance of a programmatic eagle take permit under the Selected Alternative would result in beneficial effects, primarily to golden eagle populations, but may also benefit other raptors impacted by wind energy generation. Our analysis is in comparison to the No-Action Alternative, under which the Project continues to operate without an eagle take permit's compensatory mitigation and adaptive-management and monitoring commitments. The impacts to visual resources that would occur by installing the aviation radar system would be anticipated to be overall beneficial, by reducing the occurrence of flashing lights, which would only flash when aircraft are in the vicinity of the Project. There is some potential for beneficial impacts to nocturnal migrating birds by installing the aviation radar system and reducing the occurrence of flashing lights. In addition, issuance of this permit will allow the Project to operate in compliance with the Eagle Act should eagle take occur.

   Adverse Effects. As described in detail in Chapter 4 of the EA, the operation and maintenance of the Project and the discontinuation of the eagle risk management system may result in adverse impacts primarily to individual raptors and golden eagles. All known adverse impacts have been mitigated to the extent practicable by designing the Selected Alternative to avoid risks raptors and golden eagles as much as possible. Even so, individual birds, including eagles, can be injured and killed by collision with wind turbines. The Applicant's revised ECP (EA Appendix A) and Avian and Bat Protection Plan (ABPP) (EA Appendix B) describe commitments to avoid, minimize, and otherwise mitigate impacts to eagles, birds and bats. Avian and bat mortality will be monitored and mitigated through an adaptive management plan that has been crafted to address impacts as operational data are gathered. There are no population level impacts to eagles, birds or bats. Mitigation included in the EA addresses and substantially reduces the potential impacts to less than significant levels under NEPA.

   Summary. The analysis in the EA and implementation of the measures identified in the Selected Alternative (including those in the ECP, ABPP, and previous commitments) support the conclusion that the Selected Alternative will not have a significant effect on the quality of the human environment.

2. *The degree to which the selected alternative will affect public health or safety.*

   As discussed in Chapter 1 of the EA, the proposed action is issuance of a programmatic eagle take permit to the operational Ocotillo Wind Energy Facility. This action will have no effect on public health or safety.

3. *Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farm lands, wetlands, wilderness, wild and scenic rivers, or ecologically critical areas.*

   Impacts to historic and cultural resources, parks lands, prime farmlands, wetlands, wild and scenic rivers, and ecologically critical areas were all considered in the EIR and EIS analyses conducted by the BLM in 2012. The relevant EIS analyses were incorporated by reference in the EA. Issuance of a programmatic eagle take permit to the operational Project would have no further impacts to these resources.

4. *The degree to which the effects on the quality of the human environment are likely to be highly controversial.*

   No effects of the Selected Alternative were identified as highly controversial. As a factor for determining within the meaning of 40 CFR 1508.27(b)(4) whether to prepare a detailed EIS, controversy is not equated with the existence of opposition to a use. The NEPA implementation regulations (43 CFR 46.30) define controversial as "circumstances where a substantial dispute exists as to the environmental consequences of the proposed action and does not refer to the existence of opposition to a proposed action, the effect of which is relatively undisputed." Comment letters we received on the EA provided no expert scientific evidence supporting claims that issuance of an eagle take permit or amendment to the ROW will have significant effects, or that it is highly controversial.

5. *The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.*

   As summarized in the ECP and EA, impacts of wind power generation to birds and bats, including eagles, have been previously analyzed in the FEIS/FEIR conducted by the BLM when a permit was sought to build and operate the Project in 2012. The revised ECP for the Project was developed to address any uncertainty regarding impacts to eagles. Post-construction mortality studies are underway at Ocotillo, as required by BLM's ROW grant, to determine Project-level impacts to birds and bats (monitoring 30 percent of the turbines twice per month).

   The adaptive management process will further reduce and monitor potential impacts to eagles by the Project. Implementation of the ECP and ABPP and issuance of the permit will prevent significant impacts to avian and bat populations.

   As a result, there are no predicted effects of the Selected Alternative on the human environment that are considered to be highly uncertain or involve unique or unknown risks.

6. *The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.*

   Issuance of an eagle take permit to Ocotillo Express LLC does not set precedent for, or automatically apply to other eagle take permit applications the Service is reviewing or could review in the future. Each permit request will be evaluated on a case-by-case basis. Therefore, the Selected Alternative does not establish precedents for future actions or represent a decision in principle about a future action. Moreover, this Project will not limit the Service's discretion when processing future eagle take permit applications under the Eagle Act's permitting regulations.

7. *Whether the action is related to other actions with individually insignificant but cumulatively significant impacts-which include connected actions regardless of land ownership.*

   Golden Eagles. We evaluated cumulative effects on golden eagles as required by NEPA (40 CFR 1508.8) and the Eagle Act's permitting regulations (see EA Section 4.3.6). Under 50 CFR 22.26 when

reviewing a permit application, the Service is required to evaluate and consider effects of take permits on eagle populations at three scales: (1) the eagle management unit/bird conservation region, (2) local area, and (3) Project area. Our evaluation also considers cumulative effects. We incorporated data provided by the Applicant, our own data on permitted take and other documented eagle mortalities, and additional available information on population-limiting effects, in determining cumulative impacts to golden eagles.

Our cumulative effects analysis contained within the EA (EA Section 4.3.4) estimated that issuance of a permit to the Applicant would result in 0.01% cumulative authorized take, and less than 5% cumulative unauthorized take of the LAP taken annually. Therefore, there are no significant adverse cumulative effects contributed under the Selected Alternative.

8. *The degree to which the action may adversely affect districts, sites, highways, structures, or other objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.*

   The action of amending the ROW grant and issuing a programmatic eagle take permit to the operational Project will have no adverse effect on significant scientific, cultural, or historical resources (see EA Section 1.8.2, BLM FEIS Section 5.2.3 [BLM 2012a] and BLM ROD Section 3.2.2 [BLM 2012b).

9. *The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973, or the degree to which the action may adversely affect a species proposed to be listed as endangered or threatened or proposed critical habitat.*

   Project site: Before construction and operations began, the BLM requested formal consultation from the Service on its proposed issuance of a ROW grant for the Project pursuant to Section 7 of the Endangered Species Act of 1973, as amended (16 USC 1531 et seq.). The BLM included a biological assessment in the FEIS/FEIR in which it assessed the effects of its proposed action on federally listed species identified in the Project area (BLM 2012a). The Service issued a biological opinion, dated April 26, 2012, in which we analyzed the effects of the proposed action on the federally endangered peninsular bighorn sheep and federally endangered least Bell's vireo. The Service concluded that the proposed action (granting of ROW and subsequent construction and operation of the Project) was not likely to jeopardize the continued existence or significantly impair the recovery of these species, and the ROD required that all terms and conditions in the Biological Opinion be followed. Issuance of a programmatic eagle take permit to the Project and amending the ROW grant under the Selected Alternative would have no additional impacts to species protected by the ESA.

   Compensatory Mitigation Effects. As described in EA Section 4.5.1 (Attachment 1) the effects of authorizing incidental eagle take to the Applicant would not have adverse effects to species protected by the ESA. The Service would require that the utility comply with the ESA and implement avoidance and minimization measures for all compensatory mitigation electric utility pole retrofit work.

10. *Whether the action threatens a violation of Federal, State, or local law requirements imposed for the protection of the environment.*

    The Selected Alternative will not violate any federal, state, or local law.

    Determination: Under the Selected Alternative, we estimate that 0.28 eagle will be killed annually, and up to two eagles will be killed over a 5-year period. The Selected Alternative includes an

adaptive-management procedure and continued fatality monitoring at the Project. Adaptive management measures will be implemented based on the number of fatalities. The Selected Alternative issues a ROW grant amendment to remove the golden eagle risk minimization system and allow for the installation of an aviation radar system to control the flashing lights on the turbines. Our Resource Equivalency Analysis shows that 32-74 retrofits (depending on type of retrofit used) will mitigate the loss of two eagles and addresses cumulative effects concerns to the local area eagle population. Based on the intensity and context of these effects and consideration of the elements associated with the Selected Alternative, issuance of a programmatic eagle take permit to Ocotillo as analyzed in the attached EA is not expected to result in significant adverse effects on the human environment.

VIII. Final Eagle Conservation Plan

The EA analyzed the revised ECP submitted in August 2018 (EA Appendix A). Issuance of a programmatic eagle take permit to Ocotillo will require implementation of the August 2018 ECP.

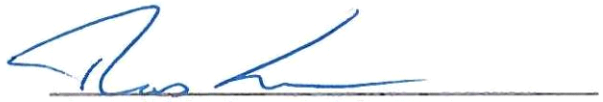
IX. Finding of No Significant Impact

The Service developed the EA and FONSI in cooperation with the BLM in accordance with the National Environmental Policy Act of 1969, as amended, and the Council on Environmental Quality's (CEQ) Regulations for Implementing the Procedural Provisions of NEPA (40 CFR 1500-1508). The Service and the BLM conclude that, with the implementation of the avoidance, minimization, and mitigation measures outlined in the EA, ECP, and ABPP, the Selected Alternative for issuance of an eagle take permit to the Ocotillo Wind Energy Facility and amending the ROW grant for the Project will result in no significant impacts to the quality of the human environment, individually or cumulatively with other actions in the general area.

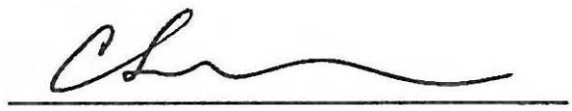
The Service's Migratory Bird Program and the BLM El Centro Field Office interdisciplinary review and analysis determined that the proposed action would not trigger significant impacts on the environment based on criteria established by regulations, policy, and analysis.

Based on the findings discussed herein, we, the Deputy Chief, Migratory Birds and the BLM Field Manager, conclude that the proposed action is not a major Federal action and will result in no significant impacts to the environment, individually or cumulatively with other actions in the general area. No environmental effects meet the definition of significance in context or intensity as defined in 40 CFR 1508.27 and do not exceed those effects described in applicable land use plans. Therefore, preparation of an EIS to further analyze possible impacts is not required pursuant to Section 102(2)(c) of NEPA.

This determination is based on the rationale that the significance criteria, as defined by the CEQ (40 CFR 1508.27) have not been met. "Significantly" as used in NEPA requires considerations of both context and intensity.



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Attachment 1
Environmental Assessment—Ocotillo Wind Energy Facility Eagle Conservation Plan

Attachment 2
Response to Comments on Draft Environmental Assessment

U.S. Fish and Wildlife Service

Environmental Assessment

Ocotillo Wind Energy Facility Eagle Conservation Plan

California

Prepared by:

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Acronyms and Abbreviations

ABDSP	Anza-Borrego Desert State Park
ABOCCC	Advanced Biological Observation Command and Control Center
ABPP	Avian and Bat Protection Plan
ACEC	Area of Critical Environmental Concern
ACP	advanced conservation practice
AMSL	above mean sea level
APP	Avian Protection Plan
Applicant	Ocotillo Express LLC
BCR	Bird Conservation Region
Eagle Act	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
C	Celsius
CDFW	California Department of Fish and Wildlife
CEC	California Energy Commission
CFR	Code of Federal Regulations
CPUC	California Public Utilities Commission
DRECP	Desert Renewable Energy Conservation Plan
EA	Environmental Assessment
ECP	Ocotillo Wind Energy Facility Eagle Conservation Plan
ECP Guidance	Eagle Conservation Plan Guidance Module 1: Land-based Wind Energy
EIR	Environmental Impact Report
EIS	Environmental Impact Statement
ESA	Endangered Species Act of 1973, as amended
F	Fahrenheit
FAA	Federal Aviation Analysis
FEIR	Final Environmental Impact Report
FEIS	Final Environmental Impact Statement
FLPMA	Federal Land Policy and Management Act
FONSI	Finding of No Significant Impact
FR	Federal Register
GHG	greenhouse gas
Holder	holder of the right-of-way grant
IPCC	Intergovernmental Panel on Climate Change
kV	kilovolt
MBTA	Migratory Bird Treaty Act

MW	megawatt(s)
NABCI	North American Bird Conservation Initiative
NEPA	National Environmental Policy Act of 1969
NFWF	National Fish and Wildlife Foundation
NHPA	National Historic Preservation Act
NRHP	National Register of Historic Places
PA	Plan Amendment
Permit	Eagle Take Permit
PG&E	Pacific Gas and Electric Company
Project	Ocotillo Wind Energy Facility
REA	resource equivalency analysis
Region 30	Sierras de Baja California
Region 32	Coastal California
Region 33	Sonoran and Mojave Desert
Region 40	Desierto de Baja California
PRBO	Point Reyes Observatory Conservatory Science
ROD	Record of Decision
ROW	right-of-way
SCE	Southern California Edison
Service	U.S. Fish and Wildlife Service
TAC	Technical Advisory Committee
TCP	Traditional Cultural Property
U.S.C.	United States Code
USGCRP	U.S. Global Change Research Program
USGS	U.S. Geological Survey
WEST	Western EcoSystems Technology, Inc.
WRA	Wind Resource Area
turbine	wind turbine generator

1 Purpose and Need

1.1 Introduction

We, the U.S. Fish and Wildlife Service (Service), have prepared this environmental assessment (EA) pursuant to the National Environmental Policy Act (NEPA) (42 United States Code [USC] 4321 et seq. 1970). This EA evaluates the effects of issuing a 5-year eagle take permit (permit) under the Bald and Golden Eagle Protection Act (Eagle Act) (74 FR 46877, Sept. 11, 2009, as amended at 79 FR 73725, Dec. 9, 2013; 81 FR 8004, Feb. 17, 2016; 81 FR 91551, Dec. 16, 2016) for take that is incidental to otherwise lawful activities associated with operation of the Ocotillo Wind Energy Facility (Project) as described in the Ocotillo Wind Energy Facility Eagle Conservation Plan (ECP). Our *Eagle Conservation Plan Guidance Module 1: Land-based Wind Energy* Version 2 (Service 2013; ECP Guidance) recommends that eagle take permit applications include an ECP, or similar documentation, that details the impacts of the Project on affected eagle species and how these impacts would be avoided, minimized, and mitigated in order to maintain stable or increasing populations of eagles.

The Bureau of Land Management (BLM) is a cooperating agency in development of this EA. Regulations implementing the procedural provisions of NEPA call for agency cooperation in the NEPA process with the ultimate goal of "…decisions that are based on understanding of environmental consequences, and… actions that protect, restore, and enhance the environment" (40 Code of Federal Regulations [CFR] 1500.1 1978). The regulations specifically define a cooperating agency as "…any Federal agency other than the lead agency which has jurisdiction by law or special expertise with respect to any environmental impact involved in a proposal (or a reasonable alternative) for legislation or other major Federal action significantly affecting the quality of the human environment" (40 CFR 1508.5).

The BLM El Centro Field Office has special expertise and responsibilities to manage their lands to conserve golden eagles in the course of siting, constructing, operating, and decommissioning wind energy facilities on public lands. Ocotillo Express LLC's (applicant) ECP for the Project was prepared in consultation with the Service, and BLM provided comments.

The applicant is requesting Eagle Act take coverage for operational activities associated with the Project. This company is a wholly owned subsidiary of Pattern Energy Group. The applicant has requested a 5-year take permit for golden eagles (*Aquila chrysaetos*) under the Eagle Act at the Project. The applicant's ECP (Appendix A) is the foundation of the permit application for the operational Project. The applicant worked closely with the Service and the BLM to develop and update the ECP to assure that it contains commitments to avoid, minimize, and mitigate adverse effects on eagles.

The applicant is also requesting an amendment to their BLM right-of-way (ROW) grant, to allow discontinuation of a system designed to minimize risk to eagles. The golden eagle risk minimization system includes a DeTect Merlin avian radar system, radar-controlled video tracking system, and a full time golden eagle biological monitor to observe any golden eagles flying within the wind facility and to curtail turbines when eagles are at risk of collision. This eagle risk minimization program was required as part of the ROW grant and associated Record of Decision (ROD) that was signed by the BLM on May 11, 2012.

Our consideration to issue an eagle take permit constitutes a discretionary Federal action that is subject to NEPA; the BLM's consideration to amend the ROW grant is also a discretionary action subject to NEPA. The applicant is requesting a permit for the take of up to two golden eagles over the 5-year duration of a permit, and to amend the ROW grant. This EA evaluates potential impacts that could result from the issuance of the eagle take permit based on the Project's ECP or alternatives to the proposed ECP. It is intended to assist us in evaluating effects on the human environment and in assessing the significance of the impacts that could result from the alternatives. "Significance" under NEPA is defined by regulation at 40 CFR 1508.27, and requires short-term and long-term consideration of both the context of a proposal and its intensity. As with

any NEPA process, if all components have undergone equal analysis, the final proposal may include all or some components of a single alternative. Or, it may include a combination of components from more than one alternative.

This EA partially tiers from the Service's Programmatic Environmental Impact Statement for the Eagle Rule Revision, December 2016 (PEIS; Service 2016). A programmatic NEPA review allows an agency to subsequently tier to the PEIS analysis, and focus analysis on narrower, site- or proposal-specific issues (CEQ 2014 from 40 CFR 1508.28). "Tiering has the advantage of not repeating information that has already been considered at the programmatic level so as to focus and expedite the preparation of the tiered NEPA review(s) (CEQ 2014 from 40 CFR 1508.28)." This EA incorporates by reference the analyses of the PEIS except for the eagle local-area population cumulative affects analysis. Due to known high impacts to eagles in this geographic region, this EA provides additional analysis beyond that conducted in the PEIS.

1.2 Background

In 2012, the BLM authorized the applicant to construct and operate a wind energy generation facility with up to 112 wind turbine generators (turbines), ancillary facilities, and supporting infrastructure that would generate up to approximately 315 megawatts (MW) of electricity on approximately 12,436 acres of public land in western Imperial County, California. The applicant installed 112 Siemens 2.37 MW turbines for a final installed capacity of 265 MW; commercial operations for 223 MW started in the fourth quarter of 2012, with the final 42 MW of the Project commencing in July 2013. The location of the Project is shown on Figure 1-1. Each turbine has a maximum blade tip height of approximately 428 feet above ground level.

The applicant received a Federal Land Policy and Management Act (FLPMA) Title V ROW Type 3 Grant and Plan Amendment (PA) on May 11, 2012, to construct, operate, maintain, and decommission the portion of the Project on BLM-administered lands. The BLM analyzed the environmental effects of its permit action to build and operate the Project in a Final Environmental Impact Statement/Final Environmental Impact Report (FEIS/FIER; BLM 2012a) and ROD (BLM 2012b) pursuant to FLPMA and NEPA. The analysis of the environmental effects of the Project on the human environment is referred to and incorporated by reference in this document. The BLM is a cooperating agency for this EA.

The BLM ROD authorized construction and operation of the Project to proceed without an eagle take permit because a February 29, 2012 memorandum issued by the Service stated that we had concluded our review of the Project's proposed conservation practices, monitoring protocol and mitigation measures described in the Avian and Bat Protection Plan (ABPP) and the Advanced Conservation Practice (ACP) as outlined in the 2012 ECP that was developed for the Project during the BLM permitting process. This ACP, including the use of a DeTect Merlin Radar avian radar system, video tracking system and a full time biological monitor to implement informed curtailment were designed to minimize or avoid risk of eagle take at the site; the ROD required that these ACPs be in use for the initial 10 years of Project operations. The ABPP and 2012 ECP provided the basis for a Technical Advisory Committee (TAC) made up of representatives of the BLM, the Service, and California Department of Fish and Wildlife (CDFW), to provide guidance to the applicant and the BLM based on the results of the post-construction monitoring studies conducted at the Project. Chapter 2 provides more information on the ACPs that have been implemented since operations started at the Project, as well as information on the potential changes to these ACPs as proposed by the applicant and alternatives to those proposed changes as analyzed in our NEPA review.

Our analysis in this EA addresses the expected impacts from our eagle take permitting decision on the human environment, with a focus on evaluating the Project's impacts to eagles and Native American cultural and religious practices. This EA also evaluates visual effects, impacts to migratory birds and protected plants and wildlife species. As a cooperating agency on this EA, the BLM is evaluating the potential impacts for removing the eagle risk minimization system, a combination of experimental ACPs that were evaluated in the FEIS/FEIR (BLM 2012a) and approved in the ROD (BLM 2012b). A list of permits and authorizations

relevant to this Project are provided in Table 1-1; all permits were required pre-construction and therefore were obtained by the applicant in 2012 or earlier.

TABLE 1-1
Summary of Permits and Authorizations Required for the Ocotillo Wind Energy Facility

Permit/Authorization	Responsible Agency
Federal Land Policy and Management Act (FLPMA) Title V Right-of-Way (ROW) Type 3 Grant and Plan Amendment (PA)	Bureau of Land Management (BLM)
Record of Decision	BLM
Jurisdictional Determination	U.S. Army Corps of Engineers
Determination of No Hazard	U.S. Department of Defense
National Pollutant Discharge Elimination System Permit/Stormwater Pollution Prevention Plan/Water Quality Certification	Colorado River Regional Water Quality Control Board Region 7
Streambed Alteration Agreement Notification No. 1600-2013-0002-R4	California Department of Fish and Wildlife
ROW Encroachment Permit/Transportation Permit	California Department of Transportation
National Historic Preservation Act (NHPA) Section 106 Consultation	State Historic Preservation Officer, Advisory Council on Historic Preservation
Consultation on Sacred Areas	Native American Heritage Commission, Indian Tribes
Power Purchase Agreement/Approval of SDG&E Switchyard and Loop-in	California Public Utilities Commission
Renewable Portfolio Standard Certification	California Energy Commission
Conditional Use Permit/ROW Encroachment Permit/Transportation Permit/Grading Permit	Imperial County

1.3 Purpose and Need for Action

The BLM and Imperial County comprehensively analyzed the impacts of the Project, including its construction and operation, in 2012, to comply with NEPA and the California Environmental Quality Act. The Service is now reviewing an application for a permit for take of eagles at the Project. Consistent with the Service's obligations under the Eagle Act and its implementing regulations, the Service has prepared this document to analyze the environmental impacts of issuing an eagle take permit, including by evaluating reasonable alternative mitigation measures to be incorporated into an eagle take permit, while incorporating by reference the previous environmental analyses by the BLM and Imperial County.

The need for this action is to make a permit decision in response to an eagle incidental take permit application from the applicant for the Project. The decision must comply with all applicable regulatory requirements, and be compatible with the preservation of eagles.

Issuance of a permit must comply with the Eagle Act and all related regulatory requirements. Denial of the permit must be based on the proposal not meeting issuance criteria under 50 CFR 22.26 and 50 CFR 13.21 (1974; general U.S. Fish and Wildlife Service permit issuance criteria) or because we have determined that the risk to eagles is so low that a permit is not necessary. In responding to the request for a permit, we must ensure: (1) that any take authorized under the Eagle Act is compatible with the Eagle Act's preservation goal of maintaining stable or increasing breeding populations of eagles; and (2) compliance with the Eagle Act and its implementing regulations and permit issuance criteria.

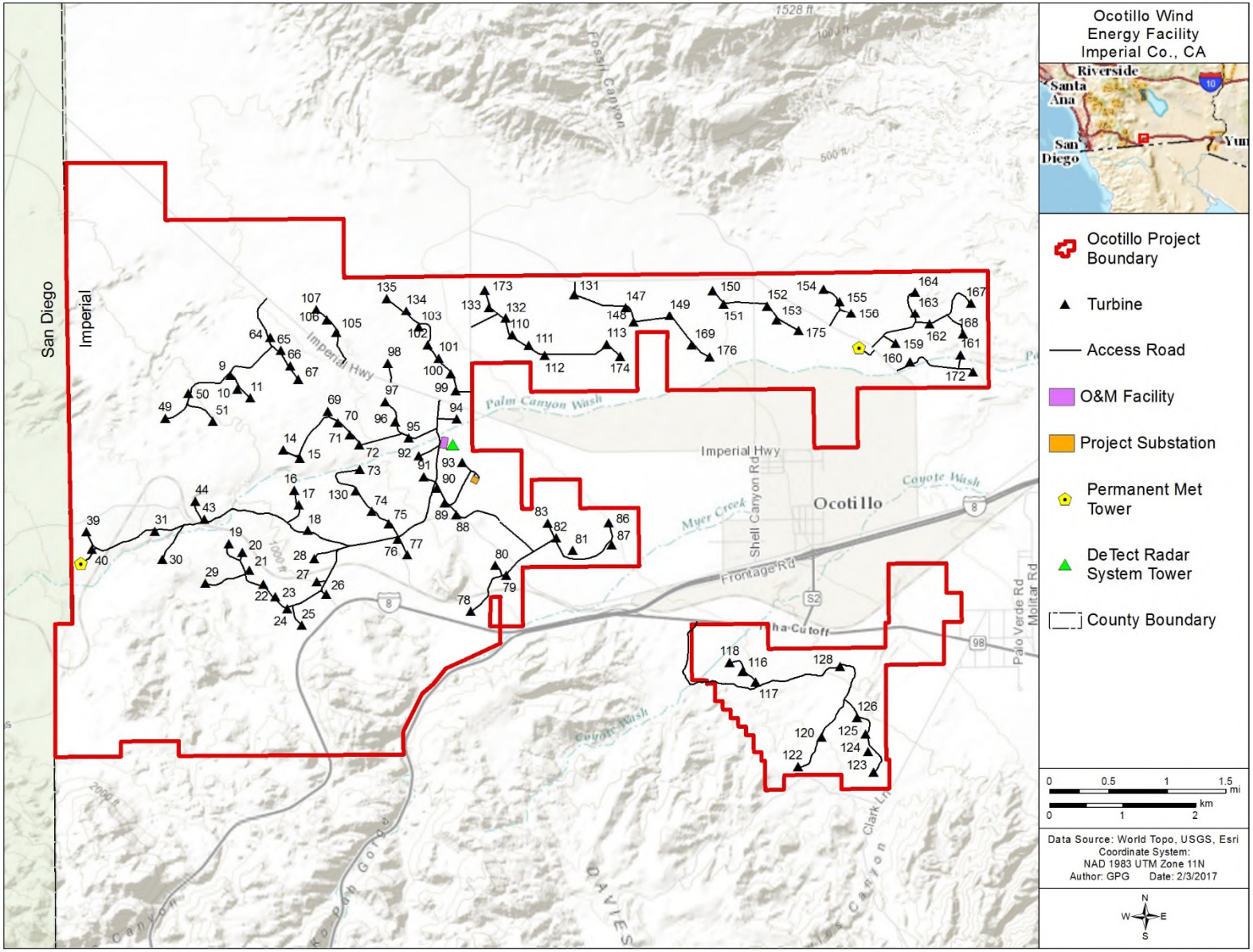


Figure 1-1 Project Location

The BLM's purpose and need for the Proposed Action is to respond to a FLPMA ROW grant amendment application submitted by the applicant which seeks to modify or eliminate certain eagle protection measures within its currently required ECP that was evaluated in the FEIS/FEIR (BLM 2012a) and approved in the ROD (BLM 2012b). The BLM would use this EA to decide whether to deny the proposed amendment, grant the amendment, or grant the amendment with modifications.

1.4 Regulatory Setting, Authorities, and Guidance

The Service has jurisdiction over a broad range of fish and wildlife resources. Service authorities are codified under multiple statutes that address management and conservation of natural resources from many perspectives, including, but not limited to the effects of land, water, and energy development on fish, wildlife, plants, and their habitats. This analysis is based on the Eagle Act (16 USC 668–668d 1940) and its regulations (50 CFR Part 22). The PEIS (Service 2016) has a full list of authorities that apply to this action (PEIS Section 1.6, pages 7-12), which are incorporated by reference here.

The National Historic Preservation Act (NHPA) and associated regulations and guidance under the NHPA are described further below.

1.4.1 Coordination with Tribal Governments

Tribal participation is an integral part of the NEPA and the National Historic Preservation Act (NHPA) process, as well as a key component of determining whether to issue an eagle take permit. In accordance with Executive Order 13175 (2000) and our Native American Policy, we consult with Native American tribal governments whenever our actions taken under authority of the Eagle Act may affect tribal lands, resources, or the ability to self-govern. This coordination process is also intended to ensure compliance with the NHPA and the American Indian Religious Freedom Act. To initiate consultation with Tribes regarding potential issuance of a eagle take permit, we sent letters to 41 Tribes located within 109 miles (the natal dispersal distance of golden eagles) of the Project. Comments are also encouraged and welcome during the 45-day comment period on the EA.

1.5 Scope of Analysis

This EA considers alternatives for issuance of a permit to take golden eagles at the Project. It analyzes the effects of our proposed issuance of a 5-year eagle take permit, as well as an alternative to issue a 30-year permit, on the human environment and evaluates impacts over the 30-year duration of the Project. The human environment as analyzed in this EA includes golden eagle populations, migratory bird populations, endangered and threatened species, visual resources, and Native American religious and cultural practices. Other aspects of the human environment, such as bat populations, climate change, human safety, the economy, and other cultural values have been addressed in the FEIS/FEIR (BLM 2012a), incorporated herein by reference.

As referenced in the Council on Environmental Quality's NEPA regulations regarding the contents of an EA (40 CFR 1508.9[b]), NEPA Section 102(2)(E) requires Federal agencies to develop, study, and briefly describe reasonable alternatives to any proposed action with the potential to result in unresolved resource conflicts. This EA evaluates the effects of the No-Action Alternative (Alternative 1), the applicant-proposed alternative (Alternative 2), and two other alternatives:

- Alternative 1: No Action - No Permit or ROW Grant Amendment for termination of bio-monitoring, Continued Bio-monitoring and Curtailment when Eagles are Detected
- Alternative 2: Issue 5-Year Permit for Applicant's Revised ECP; Issue ROW Grant Amendment
- Alternative 3: Continued Operation of the Project without an Eagle Take Permit; Issue ROW Grant Amendment

- Alternative 4: Issue a 30-Year Permit for Applicant's Revised ECP with Additional Mortality Monitoring and Mitigation; Issue ROW Grant Amendment

Each alternative's feasibility is evaluated for its ability to meet the Eagle Act permit issuance criteria as described in Section 1.5.2.

1.5.1 Geographic Extent

The geographic scale of the analyses for this EA is at the project level—the footprint of the Project and a 10-mile radius around it—and the local-area eagle population level. The local-area population for the species is defined by the dispersal distance of young—109 miles for golden eagles (Service 2016). The local-area population for golden eagles includes parts of two Federal Bird Conservation Regions (BCRs; North American Bird Conservation Initiative (NABCI) 2010) in the U.S.: BCR 32 (Coastal California) and BCR 33 (Sonoran and Mojave Deserts) as shown in Figure 1-2 and summarized in Table 4-1. In Mexico, the local-area population includes additional area in BCRs 32 and 33, as well as parts of BCR 39 (Sierras de Baja California) and 40 (Desierto de Baja California).

1.5.2 Permit Issuance Criteria

In the analysis of alternatives, we consider the degree to which each alternative would conform to the permit issuance criteria for take permits under the Eagle Act (50 CFR 22.26(f)(1–6) (2009 Eagle Rule) or required determinations under 50 CFR 22.26 (f)(1-7) (2016 Eagle Rule).

1.6 Previous Environmental Analysis

This proposal conforms with, and carries out, the management approach analyzed in, and adopted subsequent to, the Service's *Final Environmental Assessment Proposal to Permit Take as Provided Under the Bald and Golden Eagle Protection Act* (FEA, Service 2009) and the Service's *Programmatic Environmental Impact Statement for the Eagle Rule Revision, December 2016* (PEIS; Service 2016).

Previous environmental analyses were conducted for the Project; these analyses are available in the FEIS/FEIR (BLM 2012a) and ROD (BLM 2012b). These documents analyze most of the elements of the Project related to the human environment, and consequently allow the current analysis to focus on eagles. The analyses in the FEIS/FEIR (BLM 2012a) are hereby incorporated by reference into this EA.

1.7 Scoping and Public Participation

1.7.1 Internal Scoping

We engaged in an internal scoping process in the Pacific Southwest Region from January 2016 through March 2016. We worked with regional program leaders to determine the appropriate level of NEPA analysis for the Project's eagle take permit application and to develop a range of alternatives to the proposed action.

1.7.2 Public Scoping

This EA was made available to the public for a 30-day comment period. During the public scoping and comment period for the BLM's 2012 Draft EIS/Draft EIR (BLM 2012a) for the Project, numerous agencies, environmental advocacy organizations, Tribes and private citizens submitted recommendations that the Project have protective measures in place to protect golden eagles from potential fatalities. As a result, the project developed the 2012 ECP with our review and input. The 2012 ECP included BLM's requirement that the applicant implement eagle take minimization and monitoring measures as identified in the 2012 ECP. This substantially address the concerns that were raised during the scoping and BLM Draft EIS review period, and the revised ECP (Appendix A) as evaluated in this EA maintains the majority of the protective and monitoring measures committed to in the 2012 ECP.

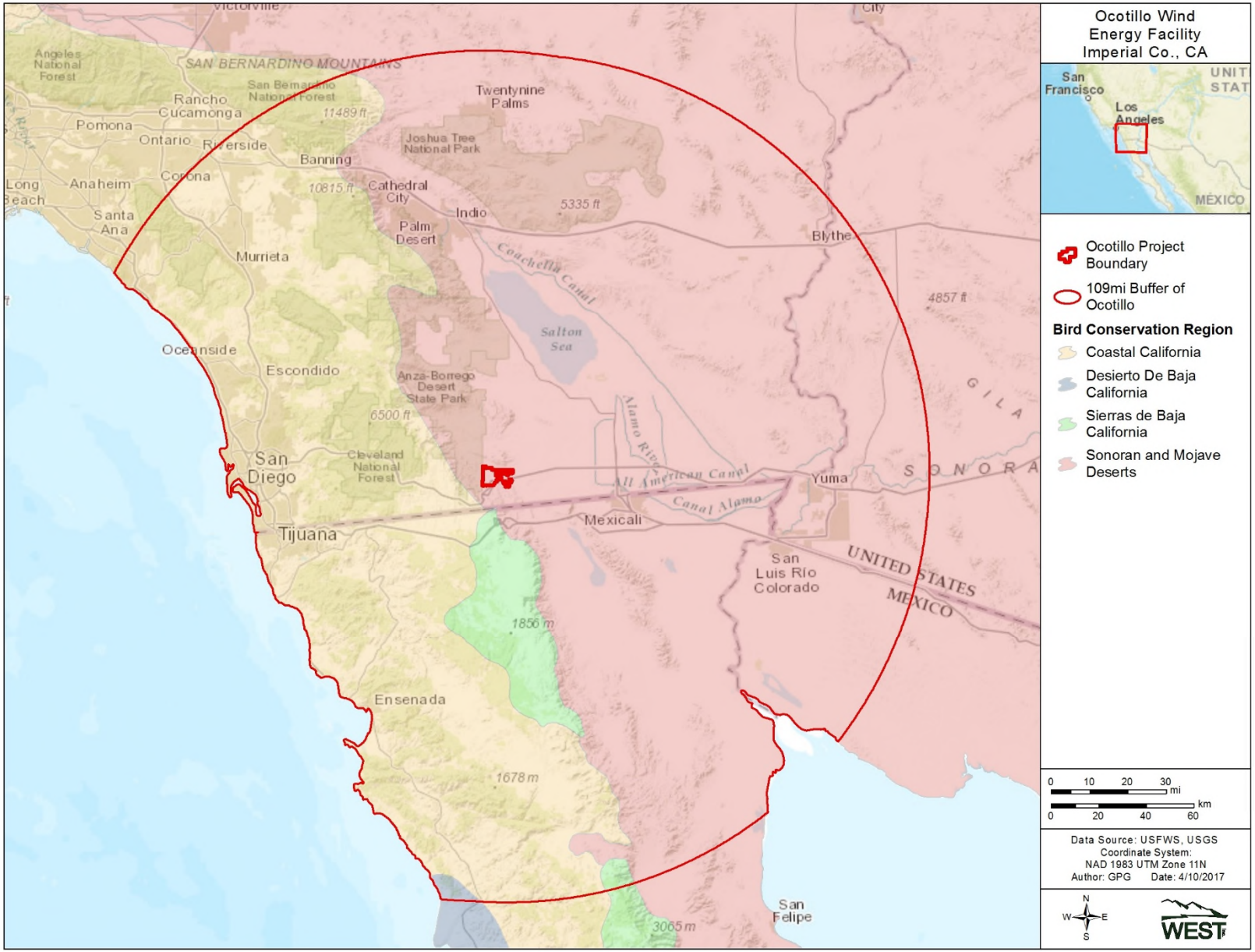


Figure 1-2 Geographic Scope of Analysis

1.8 Tribal Coordination

Tribal participation is an integral part of the NEPA process. In accordance with Executive Order 13175 and the Service's Native American Policy, we consult with Native American tribal governments whenever our actions may affect tribal lands, resources, or the ability to self-govern. In addition, we consult with Tribes in consideration of the unique traditional religious and cultural significance of eagles to Native American communities. Cultural and religious issues impacts were analyzed in our Eagle Rule Revision PEIS (Service 2016a). This EA incorporates by reference the analysis of the PEIS.

1.8.1 Service Tribal Coordination

We invited government to government consultation regarding the applicant's permit request through a letter sent on June 15, 2017 to the Federally Recognized Native American tribal governments located within a 109-mile radius of the Project and to tribal organizations consulted by the BLM. Our letter informed them of receipt of the eagle take permit application, the preparation of this EA, and requested assistance in identifying issues or concerns. Coordination and consultation with these tribal governments would be ongoing throughout the analysis and permitting process.

1.8.2 BLM Tribal Consultation

As described in detail in Chapter 5.2.3 of the original FEIS/FEIR for the Project and in summary in Section 3.2.2 of the ROD (BLM 2012b), the BLM conducted government-to-government consultation with federally recognized and other Native American Tribal groups in accordance with several authorities including, but not limited to, NEPA, the NHPA, the American Indian Religious Freedom Act, Executive Order 13175, and Executive Order 13007. As explained below, the BLM has engaged in extensive outreach in connection with the Project.

Initial tribal outreach by the BLM began in February 2010. Formal invitation letters were submitted to federally recognized Indian Tribes and one Tribal Organization (collectively referred to here as Tribes), informing them of the application submitted for a ROW to conduct wind testing and develop a wind energy generation facility at the site. The letters also requested assistance from the Tribes in identifying issues or concerns.

A second letter was sent to these Tribes in July 2010, providing an update on the environmental review process and cultural resources inventory, including a copy of the Class II & III Inventory Research Design and Work Plan, requested again their assistance in identifying concerns, issues or identification of sacred sites and places of traditional and cultural significance, and also notified the Tribes that the archaeological contractor would contact them to determine if they had tribal representatives who would participate in the inventory. Many Tribes responded to the BLM and the archaeological contractor, indicating they wanted to participate in the inventory of the area.

The BLM continued consultation with the Tribes throughout the NEPA process. Some Tribes commented as part of the comment period after the publication of the DEIS/DEIR (June 2011). Some identified the Project area as a Traditional Cultural Property (TCP), and other comments received during meetings and correspondence included concerns about potential effects to the recorded archeological sites including trails, geoglyphs, rock features, habitation areas, and sacred sites.

The BLM requested in writing and during in-person meetings additional information about the identified TCP, including information about the characteristics that would make the TCP eligible for inclusion in the National Register of Historic Places (NRHP) based on its associations with the cultural practices, traditions, beliefs, lifeways, arts, crafts or social institutions so the BLM could understand its significance to the Tribes and make the applicable determinations under Section 106. The BLM held multiple meetings and sent letters to Tribes in March and April 2012, including conducting field trips to visit requested archaeological sites within the Project area. Additionally, the BLM consulted with the Tribes on development of a Memorandum of Agreement, which documents the consultation and coordination that occurred under

Section 106 and reflected the measures identified to avoid, minimize or mitigate adverse effects of the Project on cultural resources.

As a result of the consultation with the Tribes, the BLM revised its original proposed determinations and expressly assumed the portion of the TCP within the Project is eligible for the NRHP, and acknowledged that the Project would result in adverse effects to the TCP that cannot be completely mitigated. In recognition of those effects, the Refined Project as approved eliminated 43 of the 155 turbines analyzed as part of the original proposed action in the EIS in order to respond to information from the Tribes regarding the spiritual and cultural significance of the Project site and surrounding area. Furthermore, the ROD stated that the BLM determined that the public lands outside of the Refined Project footprint (as defined and approved in the ROD) are unsuitable for wind energy development. Therefore, the BLM determined that, in consultation with the Tribes, it identified all practicable measures to avoid, minimize or mitigate the impacts of constructing and operating the Project on the cultural resources identified on the site, and that while adverse effects would remain, this did not require the BLM to deny the ROW application, and the BLM determined that approval of the Project is in the public interest.

1.9 ESA Consultation

The BLM requested formal consultation from the Service on its proposed issuance of a ROW grant for the Project pursuant to Section 7 of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 et seq.). The BLM prepared a biological assessment in which it assessed the effects of its proposed action on federally listed species identified in the Project area (BLM 2012a). In our biological opinion, dated April 26, 2012, we analyzed the effects of the proposed action on the federally endangered peninsular bighorn sheep and federally endangered least Bell's vireo (Service 2012). In our Biological Opinion, we concluded that the proposed action (granting of ROW and subsequent construction and operation of the Project) was not likely to jeopardize the continued existence or significantly impair the recovery of these species, and the ROD required that all terms and conditions in the Biological Opinion be followed.

The Service would conduct an internal Section 7 consultation process prior to any eagle take permit issuance and would consult with the BLM on the potential effects of the amendment to the ROW grant on listed species.

The Service's action, the potential issuance of an eagle take permit to an operational wind farm, is not likely to impact species listed under the ESA within the wind farm itself. The required compensatory mitigation, retrofitting electric utility poles (see Section 2.3.2 below) may occur within the range of listed species. A Section 7 consultation would evaluate impacts and identify appropriate minimization, avoidance and other mitigation measures.

2 Alternatives

2.1 Introduction

The Council on Environmental Quality's NEPA regulations (40 CFR 1508.9[b]) require EAs to develop, study, and briefly describe a reasonable range of alternatives to a federal action and evaluate how those alternatives can resolve resource conflicts.

Since the Project has been operational, the applicant has been implementing an eagle risk minimization system, an ACP defined in the 2012 ECP. The golden eagle risk minimization system includes a DeTect Merlin avian radar system, radar-controlled video tracking system, and a full time golden eagle biological monitor (bio-monitor) to detect and observe any golden eagles flying within the Project and to curtail turbines (i.e., stop the blades from spinning) when eagles are at risk of collision. The radar system is mounted on top of an approximately 50-foot tall Advanced Biological Observation Command and Control Center (ABOCCC) that is in the central portion of the site. The ABOCCC has been manned by trained site biologists during all daylight hours of operations since December 2012 to specifically monitor movements of eagles using available tools including the radar system, video tracking system and the visual scans of trained biologists.

As documented in Section 5.1 of the ECP, the bio-monitors have documented relatively few golden eagles at the Project since it became operational. Over 19,867 hours of bio-monitoring conducted from early December 2012 through June 30, 2017, 41 observations of golden eagles have occurred (0.002 golden eagles/hour). Turbines were curtailed as a result of these operations 16 times between December 2012 and the end of June 2017, for a total of 8.49 hours of curtailment over the 4.5-year period. Furthermore, the DeTect Merlin radar system was found to regularly display "false positives" or non-bird detections such as spinning turbine blades, vehicles, motorcycles, rain, and the applicant has communicated to the Service that they have not found it useful in aiding the bio-monitoring in detecting golden eagles. The applicant has submitted an updated ECP and has provided the Service additional information on the results of the radar system and biological monitoring as well as the results of the post-construction fatality monitoring that have been conducted at the site, in order to apply for an eagle take permit for the site. The applicant has requested take coverage for golden eagles within a 5-year permit term and an amendment to the BLM ROW grant associated with their proposal to discontinue using the eagle risk minimization radar, video-tracking and bio-monitoring curtailment system.

This chapter describes the alternatives we considered during preparation of this EA, including a No Action Alternative and three action alternatives.

2.2 Alternatives Analyzed in this EA

2.2.1 Alternative 1: No Action – Continued Operation of the Project without an Eagle Take Permit or ROW Grant Amendment, Continued Bio-monitoring with Curtailment When Eagles Detected

Under the No Action Alternative, we would deny the permit application and would not issue an eagle take permit; the BLM would not amend the ROW grant. The Project would continue to operate without a take permit being issued. Under this scenario, the applicant would continue to implement the minimization, avoidance, and monitoring practices that are currently ongoing, as described in BLM's ROD and the 2012 ECP. This includes the ACPs as required by their BLM ROW grant including biological monitoring during daylight hours and associated curtailment when eagles are observed in risk of collision for the remaining period of the initial 10 years of operation. Additionally, because no take permit would be granted, no off-setting mitigation would be required under this alternative. The BLM ROD stipulates compliance with the Eagle Act, which would not be possible if an unanticipated eagle take occurred under this alternative because any such take would not be authorized pursuant to an eagle take permit.

Under the No Action Alternative, the Service would deny the permit application because it fails to meet one or more of several issuing criteria under 50 CFR 22.26 as described in Section 1.5.2, or because we have determined that the risk to eagles at the Project under the action alternatives is so low that a take permit is unnecessary. If we deny the permit application, and the BLM denies the ROW amendment to allow the termination of the bio-monitoring, then under this alternative the applicant would continue the eagle risk minimization system at the Project for the remainder of the 10-year post-operation interval, per the requirement of the ROW grant and ROD.

2.2.2 Alternative 2: Issue a 5-Year Permit for Applicant's Revised ECP and Issue ROW Grant Amendment

Under this alternative, we would issue a 5-year permit under the 2009 Eagle Rule to take up to two golden eagles based on the applicant's implementation of the revised ECP (Appendix A) with associated conditions, as allowed by regulation. As described further in Section 2.3.2, we have determined that two golden eagles is the predicted level of take at the site over a 5-year permit term. The permit would incorporate all conservation commitments and the implementation of ACPs outlined in the revised ECP. Additionally, this alternative would involve removal of the DeTect Merlin radar system and installation of an aviation radar system which would turn on the Federal Aviation Administration (FAA) -required flashing lights on the turbines only when aircraft are in the area. This would be a change from the existing lighting regime, which regularly flashes lights on the turbines regardless of whether aircraft are in the vicinity. The BLM would issue a ROW grant amendment lifting the requirement for the eagle risk minimization ACP which includes the DeTect Merlin radar system, radar-controlled video tracking system and full time daylight monitoring for the curtailment system. The amendment would also include any other additional terms and conditions of a take permit for the Project that are within the authority of the BLM (as determined by the authorized officer) to inspect and enforce, in accordance with 43 CFR 2805.12(a)(16). BLM would further include fatality monitoring using Service-approved standards in accordance with permit requirements and would require the grant be subject to future guidance the Service develops to address impacts to eagles. At the end of the 5-year permit term, the BLM would require coordination between the applicant, the Service, and the BLM to determine if a subsequent eagle take permit process would be initiated. Should the grant holder (holder) not reapply for a permit, BLM would coordinate with the Service and the applicant to consider resuming the requirement for a daytime biological monitoring and curtailment or to consider if alternate eagle take avoidance and minimization measures and/or additional mortality monitoring would be appropriate. Finally, the grant would also be amended with the following language:

> If an eagle is taken by the Project without a take permit, the holder shall immediately notify the BLM and the Service. After consultation with the BLM and the Service, the holder may be required to implement limitations or restrictions of operations on its entire Project or specific facilities, by season or time of day as appropriate, or other adaptive management measures deemed necessary by the BLM, in coordination with the Service, to avoid further unauthorized take of eagles. The Service retains sole authority to seek enforcement action against the Project and the holder under the Eagle Act. Regardless of whether the Service seeks enforcement action, the BLM would retain its authority to suspend, terminate, or modify the Project's right-of-way authorization in accordance with 43 CFR 2807.16 and 2807.17. These restrictions would be replaced by the terms and conditions of an Eagle Act take permit, should the holder obtain one. All such measures should be identified and, after appropriate environmental review, incorporated into the ROW grant.

Under this alternative, the radar system and observer-curtailment system would no longer occur at the Project for the 5-year permit term, unless take exceeds predicted levels, in which case reinstallation of the observer-curtailment measure could be an adaptive management measure. The applicant would provide compensatory mitigation by retrofitting between 32 to 74 power poles (depending on the retrofit utilized as explained in Section 2.3.2), which is a mitigation ratio of 1.2 to 1. Under this alternative, the applicant's proposed adaptive management process as presented in Table 2-1 and one year of additional mortality

monitoring would be conducted. Mortality monitoring was conducted in 2018. This data would be analyzed along with future mortality monitoring efforts to estimate take at the Project.

TABLE 2-1
Summary of Advanced Conservation Practices using a Step-wise Approach

Step	Threshold or Trigger	Advanced Conservation Practices
Step I	One eagle taken in five year permit period	• Assess eagle fatality to determine if cause or risk factor can be determined (e.g., season, time of day, weather, presence of prey/carrion, fire, or other event) and management response is warranted. • Consult with Service. • Take is within the permitted level and fully mitigated
Step II	Two eagles taken in five year permit period	• Assess eagle fatalities to determine if cause or risk factor can be determined (e.g., season, time of day, weather, presence of prey/carrion, fire, or other event) and management response is warranted. • Consult with Service to determine if: Immediate response or management action is needed to ensure take remains within permitted levels such as implementation of ACPs based on discussions with Service. • Take is within permitted levels and is fully mitigated. Any additional mitigation would be determined in consultation with Service.

2.2.3 Alternative 3: Continued Operation of the Project without an Eagle Take Permit; Issue ROW Grant Amendment

Under this alternative, we would deny the eagle take permit application and would not issue an eagle take permit; the BLM would amend the ROW grant to lift the requirement for the eagle risk minimization ACP which includes the DeTect Merlin radar system, and radar-controlled video tracking system and the aviation radar system would be installed. The wind Project would continue to operate without a take permit being issued. Under this alternative, the BLM would require that unless or until an eagle take permit is obtained, that the applicant would continue full time bio-monitoring and associated curtailment during daylight hours. Furthermore, the BLM would require that fatality monitoring occur at the Project using Service-approved standards. Finally, the grant would also be amended with the following language:

> If an eagle is taken by the Project without a take permit, the holder shall immediately notify the BLM and the Service. After consultation with the BLM and the Service, the holder may be required to implement limitations or restrictions of operations on its entire Project or specific facilities, by season or time of day as appropriate, or other adaptive management measures deemed necessary by the BLM, in coordination with the Service, to avoid further unauthorized take of eagles. The Service retains sole authority to seek enforcement action against the Project and the holder under the Eagle Act. Regardless of whether the Service seeks enforcement action, the BLM would retain its authority to suspend, terminate, or modify the Project's right-of-way authorization in accordance with 43 CFR 2807.16 and 2807.17. These restrictions would be replaced by the terms and conditions of an Eagle Act take permit, should the holder obtain one. All such measures should be identified and, after appropriate environmental review, incorporated into the ROW grant.

2.2.4 Alternative 4: Issue a 30-Year Permit for Applicant's Revised ECP with Additional Mortality Monitoring and Mitigation; Issue ROW Grant Amendment

Under Alternative 4, we would issue a 30-year permit under the 2016 Eagle Rule, to take up to nine golden eagles over the permit. The permit would be based on the applicant's implementation of the revised ECP (Appendix A) with associated conditions, as allowed by regulation.

The Service would evaluate the 30-year permit at 5-year intervals. These evaluations would reassess fatality rates, effectiveness of measures to reduce take, the appropriate level of compensatory mitigation, and eagle population status.

To offset the cumulative take from human activities to golden eagle populations, this alternative would also require a mitigation rate of 1.2 to 1. This equates to a range of 32 to 74 power pole retrofits.

The BLM ROW grant amendment would refer to the 30 year eagle take permit for eagle fatality monitoring requirements. All other aspects of the ECP and BLM ROW grant amendment associated with Alternative 4 would be the same as those described under Alternative 2. This is to ensure that in the event that an eagle take permit is not in place at some time in the future, the BLM could require avoidance and minimization measures and/or additional mortality monitoring to be applied to the project.

Under this alternative, the radar system and observer-curtailment system would no longer occur at the Project, unless take exceeds predicted levels, in which case reinstallation of the observer-curtailment measure could be an adaptive management measure. The applicant would provide compensatory mitigation by retrofitting between 32 to 74 power poles (depending on the retrofit utilized as explained in Section 2.3.2), at the required higher mitigation ratio of 1.2 to 1. Under this alternative, the adaptive management process as presented in Section 2.3.2.

2.3 Key Elements of Alternatives

2.3.1 Key Elements of All Alternatives

Under all alternatives under consideration, the measures committed to in the 2012 ECP (Appendix L of the FEIS/FEIR) would continue to be followed; these are described in below.

2.3.1.1 Project Macro-siting

Macro-siting project design modifications were made in part to minimize potential impacts to eagles. The Project layout initially proposed by the applicant consisted of up to 155 turbines. However, the Refined Project, which was defined and approved in the ROD (BLM 2012b) eliminated 43 turbines for a final reduced number of 112.

2.3.1.2 Micro-siting of Project Features

Micro-siting project design modifications were made by the applicant to minimize potential impacts to eagles. Structures were not sited near high avian or eagle use flight zones according to pre-construction eagle use data, turbines were located at least three miles from golden eagle nests (historic or active), and the turbines are not sited in any areas containing high concentrations of ponds, streams or wetlands.

2.3.1.3 Minimizing Impacts

The design measures implemented to minimize direct impacts and potential take of golden eagles include: buried collector lines, free-standing (unguyed) lattice meteorological towers, monopole design for turbines, and power line configurations that minimize electrocution risk.

Measures to be implemented during the operation of the plant are described in the revised ECP and include: environmental training, removal of remains, removal or avoidance of creating prey-attracting features such as rock piles, and formal and informal biological monitoring.

2.3.2 Key Elements of Eagle Permit Issuance Alternatives

Applicant-committed mitigation, monitoring and adaptive management measures included in the revised ECP (Appendix A) would be applied to action alternatives that involve issuance of an eagle take permit (Alternatives 2 and 4); these are described further below.

2.3.2.1 Predicted Take

In the ECP Guidance (Service 2013), we provided a mathematical model that estimates fatality risk at wind project sites. The model relies on a logical assumption that there is a positive relationship between the number of minutes eagles are present in the air near turbines, the amount of hazardous air space, and the risk of collisions by eagles. The results of the model predict the number of eagles taken per year at the project site. The eagle mortality estimate helps the Service and the applicant develop an ECP that includes avoidance and minimization measures, monitoring, adaptive management, and compensatory mitigation.

We use the take estimate and other information to determine if the level of predicted take, with the offsetting measures proposed in the ECP, is compatible with the Eagle Act (50 CFR 22.26) permitting standards; to manage for stable or increasing breeding eagle populations, or "no net loss" (Service 2009).

The applicant's revised ECP contains a risk assessment cooperatively developed and validated by the Service (ECP Appendix A) This risk assessment incorporates the anticipated impacts of the Project on eagles based on the results of site-specific surveys and other available data. The ECP presents a range of fatality estimates based on two different approaches. For evaluating this permit request, we only refer to the risk prediction that used the Service-recommended Bayesian Collision Risk Model (Service 2013), (ECP Appendix A). Risk factors such as eagle use, interaction with other birds, prey availability, topography, absence of perch structures, residency status, and flight style were used to support the take prediction. Using the Bayesian model and assumptions as outlined in the ECP (Appendix A), we predict that the Project would result in the mortality of approximately 0.3 golden eagles per year during operations—rounded up to two eagles over a 5-year period under Alternative 2. This is based on the 80th quantile, indicating that we expect the number of eagle fatalities would be less than or equal to the prediction 80 percent of the time. Our independent analysis of eagle risk from using the Bayesian Collision Risk Model (Service 2013; Appendix A) is similar to the estimate prepared by the applicant in the revised ECP (Appendix A).

2.3.2.2 Compensatory Mitigation

To calculate compensatory mitigation, we used a Resource Equivalency Analysis (REA) to quantify the number of power pole retrofits needed to offset the take of golden eagles at a wind project (see Appendix G of the ECP Guidance [Service 2013]). We used utility pole retrofits to eliminate electrocutions because:

- High-risk power poles cause quantifiable adverse impacts (mortality through electrocution) to eagles;
- Retrofitting high-risk poles reduces the risk of electrocution;
- The "per eagle" benefits from high-risk power pole retrofitting are quantifiable and verifiable through accepted practices; and
- Success of and subsequent maintenance of retrofitting can be monitored.

We use informed modeling to estimate the potential for eagle take, as described in Stage 3 of the ECP Guidance (see Appendix D of the ECP Guidance [Service 2013]). This fatality prediction is one of several fundamental variables that we use to populate the REA (see Appendix G of the ECP Guidance [Service 2013]).

To address known human caused impacts to populations of golden eagles (Service 2016), Alternative 2 and 4 considers a 1.2 to 1 compensatory mitigation rate. This equates to a range of 32 to 74 power poles proposed to be retrofitted under Alternative 2 and for the first five year term of the 30-year permit term under Alternative 4. Our REA indicates that a minimum of 32 utility pole retrofits will offset direct impacts to eagles resulting from Project operations, if the retrofits are installed and properly maintained for 30 years. In order to account for the possibility that the retrofit materials may not be maintained properly for 30 years, we also calculated how many poles would be required to offset the take assuming the retrofit poles would be maintained for only 10 years; this would require 74 poles (maintained for 10 years) to sufficiently offset direct impacts to golden eagles. The level of mitigation for the remaining 25 years of the permit term that would occur under Alternative 4 would be determined at the first five-year permit check in and may

change based on mortality monitoring results, but it is anticipated to be a level of power pole retrofits to offset the take of up to nine golden eagles over 30 years. The total amount of power pole retrofits under Alternative 4 would range from 97 to 221.

Under each action alternative, the applicant would either contract with an electric utility company or deposit compensatory mitigation funds, calculated using the REA as described in our ECP Guidance (Service 2013), into a Bald and Golden Eagle Mitigation Account that the Service's Pacific Southwest Region has set up with the National Fish and Wildlife Federation.

Under Alternatives 2 and 4, which involve issuance of an eagle take permit, the applicant would provide compensatory mitigation for eagles by retrofitting electric poles. The intent is to minimize the potential for electrocutions within the eagle management unit (EMU) (Service 2016) and ensure that the effects of take caused by the Project are offset. As illustrated in Table 2-1, up to a range of 32 – 74 poles are proposed to be retrofitted under Alternatives 2 and 4. The number of retrofits was derived using our REA (Service 2013), based on the anticipated annual eagle fatalities.

We are currently coordinating with two utility companies to identify a site with high-risk utility poles that may be appropriate for eagle compensatory mitigation. We would ultimately select the Project mitigation site based on an area identified as having higher than average electrocution rates. The retrofits would not be duplicative of the utility company's other obligations to retrofit poles within their system as explained below.

In accordance with our most recent analysis of golden eagle populations (Service 2016), compensatory mitigation would occur within the appropriate eagle management unit (EMU). For this area, the EMU is the Pacific Flyway. The applicant would be required to either deposit money into our National Fish and Wildlife Foundation (NFWF) Eagle Mitigation Account or purchase credits from a Service approved in lieu fee mitigation bank within 30 days of permit issuance.

2.3.2.2.1 Effectiveness of Power Pole Retrofits

Power line structures provide perching, roosting, and nesting substrates for raptors and other birds. Power line structures can present electrocution hazards to birds when less than adequate separation exists between energized parts. Eagle and other raptor electrocutions have been well documented and studied since the 1970's (Avian Power Line Interaction Committee (APLIC) 2006). The *Suggested Practices for Avian Protection on Power Lines* manual (APLIC 2006) includes a thorough review of scientific literature and summarizes other non-published information available at the time of publication. Research on the topic is ongoing. In Colorado, a study determined that raptor electrocution rates decreased by 47% within a few years of a utility company implementation of a retrofit program (Lehman et al. 2010). In Spain, researchers compared electrocution-related mortality rates at a set of retrofitted poles and a set of poles that were not retrofitted. Retrofitted poles experienced a significant reduction in avian mortality rates whereas poles not made bird safe lacked reduction in electrocution mortality rates (Tintó et al. 2010). A long term study in Spain determined that the combination of constructing new power poles to be avian safe and retrofitting existing poles resulted in significantly fewer Spanish Imperial Eagle electrocutions. The decline in eagle electrocution rates occurred while population of eagles increased and the number of electric utility lines also increased (Lopez-Lopez 2011). In the western U.S., an electric utility, PacifiCorp, has conducted avian risk assessment surveys throughout its service territory for 16 years. Initial results of these surveys in the early 2000s led to changes in retrofitting products and techniques to improve effectiveness. For example, the industry has learned that perch discouragers are not an effective tool to prevent electrocutions and can actually increase the electrocution risk to eagles and other raptors (Guyonne et al. 2009, PacifiCorp, unpubl. data, personal communication, Sherry Liguori). Likewise, differences between other after-market avian protection products can influence retrofitting effectiveness and longevity. PacifiCorp has used adaptive management to refine its Avian Protection Plan (APP) to increase the effectiveness and durability of avian protection retrofits. In a subset of poles with initial surveys, retrofitting, and follow-up surveys conducted between 2008-2015 in Utah, Wyoming, and California (n=12,975), there was a 100% reduction in eagle

mortalities and a 71% reduction in overall bird mortalities (mortalities included both electrocutions and power line collisions; PacifiCorp, unpubl. data, personal communication, Sherry Liguori). Retrofitting effectiveness for overall bird mortalities was less than that for eagles largely because of common raven nests on retrofitted transformer poles, which increased fire and subsequent raven mortality risks. The introduction of a recent publication, *Power Pole Density Informs Spatial Prioritization for Mitigating Avian Electrocution* (Dwyer et al. 2016) further summarizes some of the recent scientific literature on avian electrocutions. Scientific literature and other available data validate the effectiveness of retrofitting electric utility poles at reducing eagle mortalities.

2.3.2.2.2 Utility Company's Avian Protection & Retrofitting Policy

Eagle take is a known problem on utility power lines and utility companies have their own responsibilities to rectify eagle take caused by electrocution and line collision. Therefore, prior to proposing a final mitigation package for the Project, we evaluated multiple candidate utility companies' avian protection policies. We found Southern California Edison (SCE) and Pacific Gas & Electric Company (PG&E) to be the best candidates to receive the applicant's mitigation funds to retrofit lines for the proposed permit because of their current avian policies and the presence of utility lines within southern California.

Both PG&E and SCE followed the Avian Power Line Interaction Committee model to develop their company-wide Avian Protection Plans (APP). The primary focus of the APP is to reduce raptor mortality while also improving system reliability. Once we determine which utility we would coordinate with to select and implement the Project mitigation, we would work with that utility to develop a methodology within their system for selecting candidate power poles for retrofit with the intent of reducing golden eagle mortality on the highest risk poles on the landscape. Under Alternative 4, for eagle take permit terms beyond the first 5 years, the Service may consider retrofit packages with other entities, or alternate forms of compensatory mitigation could become reasonable options. Under either of those potential scenarios, the Service would conduct additional NEPA and internal Section 7 consultations as warranted.

2.3.2.2.3 High Risk Pole Identification

We would work with the utility (SCE or PG&E) to identify high electrocution risk utility poles for appropriate eagle compensatory mitigation. Both utilities collect information about golden eagle incidents to support their reporting commitments and requirements of their APP and Federal permits. In addition, the Federal Special Purpose Utility Permit requires reporting to the Service whenever an eagle electrocution or collision incident is discovered. We anticipate using the available golden eagle incident data to identify candidate poles for retrofit with the primary objective of reducing golden eagle mortality.

2.3.2.2.4 Project Mitigation Site

As stated above, a specific location for the Project mitigation site has not been identified at the time of this EA. Once it is identified, we would work with the utility (SCE or PG&E) to minimize and avoid impacts associated with the retrofit work as much as possible. No ground disturbance is anticipated at the mitigation sites. Where roads are available the utility crew performing the work would utilize a bucket truck with outriggers and also a secondary smaller bucket truck. Other support vehicles may consist of smaller trucks (F450, F350, and F150 or similar). Where no roads exist, no new roads would be created to access pole retrofit locations. In areas without vehicle access, the crew would walk to those poles and climb them to install the pole retrofits. Therefore, no new roads would be created to access the poles subject to retrofit.

2.3.2.2.5

2.3.2.2.6 NFWF Eagle Mitigation Account

We established an Eagle Mitigation Account with the NFWF to facilitate the eagle permit process in our Pacific Southwest Region. Deposits to this account would be used to accomplish specified conservation practices as identified in permits issued under the Eagle Act. Under the action alternatives that involve issuance of an eagle take permit (Alternatives 2 and 4), the applicant would deposit compensatory

mitigation funds into the NFWF Eagle Mitigation Account. Within 30 days of permit issuance, the applicant would make the initial deposit into our NFWF Eagle Mitigation Account. Further deposits would be required if the funds run out before the required retrofits are completed. Under Alternative 4, for eagle take permit terms beyond the first 5 years, the Service may consider compensatory mitigation options that do not include use of the NFWF account.

2.3.2.2.7 Retrofit Effectiveness Monitoring

As required by the California Public Utilities Commission (CPUC), both PG&E and SCE established inspection cycles and record-keeping protocols for their utility distribution equipment. These requirements are set forth in General Order 165 (CPUC 1997). In general, utilities must patrol (walk, drive, or fly by) their systems once a year (in urban areas) or once every 2 years (in rural areas). The utilities must conduct detailed inspections every three to five years, depending on the type of equipment. For detailed inspections, utilities' records must specify the condition of inspected equipment, any problems found, and a scheduled date for corrective action. The utility submits an annual report summarizing inspections made, equipment condition observed, and repairs made. The Service finds this inspection schedule to be acceptable for the purposes of the Project's compensatory mitigation effectiveness monitoring.

2.3.2.2.8 Conclusion

Once the utility and specific mitigation site for the Project have been selected, we would assess the data available in order to confirm that the proposed retrofit poles would satisfy the compensatory mitigation requirement for the incidental eagle take permit.

2.3.2.3 Post-Construction Monitoring

As part of the requirements to obtain an Eagle Act permit, mortality monitoring and reporting is required to determine whether the estimated amount of eagle fatalities is consistent with predicted operational outcomes at the Project. Post-construction monitoring enables the applicant to document eagle fatalities and allow the Service to identify factors associated with eagle fatalities that might warrant additional ACPs or adaptive management measures to specifically address the identified risk factor. This information would be used for any future take estimate in the event the applicant applies for additional eagle take coverage after the 5-year permit term expires (Alternative 2), or in the case of Alternative 4, to determine if any changes to the permitted level for the remaining 25 years of the permit term are appropriate.

2.3.2.3.1 Mortality Studies

This project went into operation in 2013. To date, the applicant has conducted two years of post-operation bird and bat mortality studies at the Project, per the requirements of the ROW grant and following the ABPP for the Project. A third year of mortality studies is currently underway. In coordination with the Service, the applicant also initiated an eagle mortality study that is being conducted simultaneously with the third year of the bird and bat mortality study. While the methodology differs for the two studies, it was economically and logistically efficient for the applicant to conduct both at the same time. Under the action alternatives that involve issuance of an eagle take permit (Alternatives 2 and 4), the eagle mortality study would serve as the first year of eagle mortality monitoring as required for the permit. Depending on the study results, an additional year of eagle monitoring may be required within the first five years of permit issuance. Under Alternative 4, any future eagle mortality studies would be conducted by a third party monitor as required by the revised regulations (Service 2016). The goal of the eagle monitoring study is to evaluate if the risk assessment was correct. The studies are designed to provide us with sufficient statistical confidence that the number of eagles taken at the Project would be accurately estimated for permit compliance purposes. Mortality study results also would be used as part of an adaptive management framework to implement increasingly rigorous measures as described in the Table (Table 2-1).

2.3.2.4 Adaptive Management

Under the action alternatives that involve issuance of an eagle take permit (Alternatives 2 and 4), the applicant would implement ACPs or adaptive management as appropriate as described in Table 2-1. Each action alternative has stepwise adaptive management steps that would be taken as eagle mortality occurs. The stepwise approach provides a framework in the event that additional conservation measures or compensatory mitigation prove necessary. The stepwise approach outlines the thresholds at which the applicant would implement ACPs or adaptive management and relies on coordination with our staff. The table elaborates the management actions that are to be taken when specific take thresholds are reached; it is not intended to limit or preclude other equivalent measures that are identified in coordination with us, or that may be developed as a result of new information, techniques, or science. If a take threshold is reached, we would evaluate the corresponding step and determine the approaches necessary to maintain the "no net loss" standard for eagle populations. If take were to exceed the authorized amount of 2 eagles under Alterative 2 or 9 eagles under Alternative 4, the Project would be out of compliance with the eagle take permit. The Service would consult with the Project and BLM to evaluate appropriate avoidance and minimization measures and to consider if a permit amendment would be necessary.

2.4 Summary of Alternatives

Table 2-2 provides a summary of the commitments for each of the alternatives considered.

TABLE 2-2
Summary of Key Components of Alternatives

	Alternative 1 – No Action – No Permit or ROW Grant Amendment, Continued Bio-monitoring, Curtailment when Eagles are Detected	Alternative 2 – Issue 5-Year Permit for Applicant's Revised ECP; Issue ROW Grant Amendment	Alternative 3 – No Eagle Take Permit, Continued Bio-monitoring, Curtailment when Eagles are Detected; Issue ROW Grant Amendment	Alternative 4: Issue a 30-Year Permit for Applicant's Revised ECP with Additional Mortality Monitoring and Mitigation; Issue ROW Grant Amendment
Predicted Take:				
Total Authorized	0	2	2	9
5 Years (rounded up)	2*	2	2*	2 (30-year permit would cover up to 9 eagles [0.3 per year x 30 years])
Eagle Mortality Monitoring:				
Number of Years Post-ETP	1 additional year of monitoring in non-drought year, not necessarily eagle-specific	1 additional year of eagle-specific monitoring	1 additional year of monitoring in non-drought year, not necessarily eagle-specific	1 additional year of eagle-specific monitoring during the first 4 years of the permit; 2 years eagle specific monitoring year 6- 10 of the permit; 1-2 years of eagle specific monitoring every following 5-year term as determined necessary by the Service
Compensatory Mitigation	0 poles	32 to 74 poles	0 poles	32 to 74 poles for first five-year term; additional mitigation dependent on monitoring results at first five-year review, 97 to 221 poles maximum over 30 years.
Curtailment				
Implementation	Bio-monitor-curtailment system would continue as currently conducted	Considered following second eagle take	Bio-monitor-curtailment system would continue but radar system and camera components would be discontinued	Considered following second eagle take in a 5-year period
BLM ROW Grant Amendment**				
Change from current eagle risk management ACP requirements	No amendment	Amended to allow installation of aviation radar system and lifting requirement for the eagle risk minimization ACP***	Amended to allow installation of aviation radar system. Bio-monitoring would continue	Amended to allow installation of aviation radar system and lifting requirement for the eagle risk minimization ACP***

* Although it is anticipated that the level of take is reduced significantly by monitoring and curtailment under Alternatives 1 and 3, the data and modeling available does not allow us to accurately predict the reduction in risk. We have therefore assumed up to two golden eagles over five years as potential take under this scenario.

** The amendment would also include any other additional terms and conditions of a take permit for the Project that are within the authority of the BLM (as determined by the authorized officer) to inspect and enforce, in accordance with 43 CFR 2805.12(a)(16). BLM would further include fatality monitoring using Service-approved standards, and would require the grant be subject to future guidance the Service develops to address impacts to eagles.

***At the end of the 5-year permit term, (or, in the case of Alternative 4, if the applicant decides at some point in the 30-year term to no longer follow the eagle take permit), the BLM would require coordination between the applicant, the Service, and the BLM to determine if a subsequent eagle take permit process would be initiated. Should the grant holder not reapply for a permit, daytime biological monitoring and curtailment would resume.

3 Affected Environment

3.1 Introduction

This chapter provides background on the environmental resources that are evaluated in the context of the Federal action and alternatives. Specifically, this chapter describes the physical environment, visual resources (focusing on lighting), migratory bird species, ESA-listed species, and eagle use and demographics.

3.2 Setting Discussions

3.2.1 Physical Environment

The Project site is located in the Yuha Desert, which is in the Colorado Desert region of the larger Sonoran Desert. The seven million-acre Colorado Desert region extends from the border of the higher-elevation Mojave Desert in the north to the Mexican border in the south, and from the Laguna Mountains of the Peninsular Ranges in the west to the Colorado River in the east. The Yuha portion extends from the Jacumba Mountains in the west to the historic West Side Main Canal near El Centro, and from Plaster City in the north to south of Mount Signal in Mexico.

The Colorado Desert is a desert of much lower elevation than the Mojave Desert to the north, and much of the land lies below 1,000 feet above mean sea level (AMSL). Common habitat includes sandy desert, scrub, palm oasis, and desert wash. Summers are hot and dry, and winters are cool and moist. Anza-Borrego Desert State Park (ABDSP), located mostly in eastern San Diego County, but jutting into Imperial County, is the bioregion's largest recreation area, covering 600,000 acres.

Most of the Project is a designated BLM Limited Use Area in which all motorized vehicles are restricted to the use of marked, designated routes only. BLM designated routes exist throughout the Project, and one occurs along the existing 500-kV transmission lines which traverse the middle of the Project southwest to northeast. Illegal off-highway vehicle trails crisscross portions of the Project, and some areas are regularly used for camping and firearm activities. This area is also regularly patrolled by the U.S. Border Patrol. Despite the above-mentioned usage, the majority of the Project is relatively undisturbed.

Surrounding land uses include ABDSP to the west and BLM land to the north, east, and west. The Coyote Mountains Wilderness Area is located to the north, the Jacumba Wilderness Area is located to the south, and the Ocotillo Area of Critical Environmental Concern (ACEC) occurs adjacent to the Project and the Yuha Basin ACEC occurs to the southeast. The town of Ocotillo and several scattered residences outside of the town are located between Sites 1 and 2.

Elevations in the Project range from approximately 1,490 feet AMSL in the southwest portion of the Ocotillo Wind site to 300 feet AMSL in the northeast portion of the Ocotillo Wind site. Elevation generally decreases from the west to the east, with the Coyote Mountains to the north, and the Jacumba Mountains to the west and south. To the west, the flanks of the Jacumba Mountains create rugged, rocky topographical features, low hills, and eroded badlands.

The majority of the Project is comprised of desert scrub communities such as brittle bush scrub, creosote bush scrub, teddy bear cholla scrub, white bursage scrub, and Wolf's cholla scrub. Smoke tree woodland is also present on the site; it typically occurs in washes. Unvegetated areas include sand dunes, streambeds, and badlands.

3.2.2 Visual Resources

The FEIS/FEIR (Sections 3.19 and 4.18, BLM 2012a) for the Project provides a thorough review of the Project's overall effects on visual resources and is incorporated by reference.

The federal action and associated alternatives do not affect the placement, size or number of turbines in the Project and therefore would not affect those visual aspects of the Project. However, the applicant has

requested that an aviation detection system be installed at the Project; this would result in changing how often the lights would be flashing on some of the turbines.

Under current operating conditions, the turbine arrays are lit per FAA requirements, with 56 of the 112 turbines lit with red flashing lights that all flash at the same time.

The possible impact of the alternatives under consideration on visual resources is addressed in Section 4.

3.3 Biological Environment

3.3.1 Bald Eagle

Bald eagles are not known in the Project vicinity, and no bald eagles were observed during pre-construction surveys conducted in 2009 – 2011, or during any of the post-construction monitoring conducted to date. Bald eagles in southern California are associated with reservoirs, lakes, and rivers, where they winter and where their breeding range is expanding. These Southern California areas include the Channel Islands and inland water bodies (Lakes Cachuma, Lake Casitas, Lake Hemet, and lakes within the San Bernardino Mountains, among others). Because they have not been documented in or near the Project vicinity, the risk of their take is considered to be very low. Consequently, the potential for their take was not analyzed in the ECP and they are not considered further in this document. However, we would consider the need for bald eagle monitoring, studies, and permitting if bald eagles are observed in the Project area. If a bald eagle injury or fatality were to occur, the stepwise approach to ACPs would be applied, and we would work with the applicant to determine if there is a need to amend the eagle take permit to include bald eagles.

3.3.2 Golden Eagle

Golden eagle habitat typically includes rolling foothills, mountain areas, sage-juniper flats, and desert. Golden eagles feed primarily on small to mid-sized mammals, most commonly rabbits (*Sylvilagus* spp.), hares (*Lepus* spp.), and ground squirrels (*Spermophilus* spp.), among others (Kochert et al. 2002). Golden eagles may travel great distances during dispersal and migration but usually return to within 30 miles of their natal area to breed (Millsap et al. 2015). Breeding golden eagles occupy discrete territories, which are typically used continuously for many years (Kochert et al. 2002; Kochert and Steenhof 2012). Golden eagle pairs establish and defend breeding territories that may contain multiple alternative nests, and nesting territories are often occupied for many decades (Millsap et al. 2015). Re-use of individual nests within a territory is frequent, but some individual nests can go for decades between use (Kochert and Steenhof 2012). Breeding begins earlier at southern latitudes, but in general occurs with the start of courtship in many areas in January and extends through fledging of young, mostly in June and July in temperate latitudes but into August at the northern extent of the range (Kochert et al. 2002). For a complete discussion of golden eagle biology and population status, see the Service's PEIS (Service 2016).

Golden eagles are known to nest and forage throughout the 10-mile-radius of the local project area. Golden eagles are known to be at risk of collision with wind turbines (Hunt 2002). Based on data collected during the preconstruction avian surveys for the Project, three golden eagles were observed flying at the site in September 2009 during the year of avian point count surveys in and around the Project area, and 33 golden eagles (two of which were incidentally documented outside of set survey hours) were recorded during fall and spring migration surveys conducted from fall 2009 through spring 2011 (see Appendix A). Golden eagle pre-construction use at the site was 0.01 golden eagle observations per hour, which is relatively low when compared to other projects in California where similar methods were used to document use, such as High Winds Wind Resource Area (Kerlinger et al. 2005, 2006) and the Diablo Winds Wind Resource Area (WEST 2008), each of which had documented use of 0.3 eagles/30 minute survey.

3.3.2.1 Project-specific Golden Eagle Nest Surveys

Surveys for nesting golden eagles were conducted within the Project and a 10-mile buffer both pre- and post-construction, consistent with the *Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols and other Recommendations in Support of Golden Eagle Management and Permit Issuance* (Pagel

et al. 2010). The methods and results for the surveys are briefly described below. Detailed information for each survey or set of surveys can be found in the ECP (Appendix A).

3.3.2.1.1 Pre-construction Nest Surveys

To evaluate the Project area eagle population and identify if any eagle concentration areas exist within the Project area, surveys were conducted in 2010 (within 10 miles of the Project following the Pagel et al 2010 protocol). The 2010 surveys identified five golden eagle nesting territories, which are described in Table 3-1. None of the nests were within three miles of turbines, and the closest active nest identified in the pre-construction surveys was located 4.1 miles from turbines (Appendix A). The ECP also summarizes the results of the golden eagle nest surveys associated with Tule Wind Project, which covered four of the five territories (Mountain Springs was excluded) associated with the Project's 10 mile survey area. The locations of all known active and inactive eagle nests within 10 miles of the Project are shown in Appendix A. The objective of the surveys was to locate golden eagle nests and breeding territories where eagles may be subject to injury, mortality, disturbance or displacement effects from Project construction or operation.

TABLE 3-1
List of Golden Eagle Territories Identified during Eagle Nest Surveys

Territories	Territory Status by Year	Notes on Nests
Carrizo Gorge	Unoccupied/Inactive – 2010, 2011, 2014; Occupied but inactive 2013 and 2015; Occupied and active - 2017	Four nests in territory; none active in 2013 or 2015. In 2017, one active nest with 1 chick was observed
Coyote Mountains East	Unoccupied/Inactive – 2010, 2011, 2013, 2014, 2015 and 2017	Two nests in territory; none active in surveyed years
Coyote Mountains West	Occupied/Active – 2010, Occupied but inactive – 2011, 2013, 2015; Unoccupied/Inactive – 2014 and 2017	Nine nests in territory; one active nest in 2010, rest inactive
Table Mountain	Occupied/Active – 2010, 2011, and 2017; Unoccupied/Inactive – 2013, 2014 and 2015	Six nests in territory; two possibly active in 2010; in 2017, one active nest observed, which failed
Mountain Springs	Unoccupied/Inactive – 2010	No nests in territory

References: Ocotillo ECP (Appendix A), Tule Wind LLC 2011, Bloom Biological, Inc. 2018

Five territories comprising a total of twenty-one golden eagle nests were observed during the 2010 nest surveys; two of the five territories were identified as active. The 2011 surveys for Tule showed that the same two territories that were active in 2010 were again occupied in 2011, although only one territory had an active nest (Tule Wind LLC 2011). No active eagle nests were located within the Project boundary during the 2010 and 2011 surveys (see ECP Figure 4 in Appendix A).

3.3.2.1.2 Post-construction Nest Surveys

The applicant conducted three years of post-construction raptor nest surveys at the site as part of their original 2012 ECP. The primary objective of the surveys was to determine activity status and productivity of all raptor nests within the Project, with a focus on golden eagle nests within 10 miles of the site. Surveys were conducted from the ground, due to concerns over potential effects of helicopter surveys on bighorn sheep lambing. Surveys were conducted in 2013, 2014 and 2015. For all three years, activities associated with twenty of the twenty-one golden eagle nests observed in the pre-construction surveys were observable from the ground; one historic nest location was inaccessible. No new or previously unidentified golden eagle nests were identified in any of the three years of monitoring. One territory was documented as occupied, but no in-use/active golden eagle nests were identified in 2013. In 2014, no golden eagles were observed during monitoring, and none of the territories in the 10-mile area around the Project appeared to be

occupied. In 2015, two of the territories showed golden eagle use, but no in-use/active golden eagle nests were identified. Additionally, data from the 2017 Sunrise Powerlink golden eagle survey results were reviewed; these surveys overlapped all but the Mountain Springs territory (Bloom Biological, Inc. 2018). In 2017, the Carrizo Gorge and Table Mountain territories were active, while the Coyote Mountains East and West territories were inactive (Bloom Biological, Inc. 2018).

3.3.2.2 Project-specific Avian Use Surveys

Section 2.2 of Appendix A provides information on the methodology and results of the avian use surveys that were conducted at the Project. During the year of avian point count surveys conducted from September 2009 through August 2010, only three golden eagles (two adults and one juvenile) were observed. These were observed on September 2, 2009, flying north over the western portion of the site at approximately 1,000 feet above ground level (above the rotor swept area). The avian point count surveys were conducted in what we considered a typical year for region. The 2009-2010 time period was considered an average rainfall year and the region did not experience abnormally long hot, cold, wet, or dry periods during the 2009-2010 timeframe.

3.3.2.3 Project-specific Raptor Migration Surveys

Section 2.3 of Appendix A provides information on the methodology and results of the raptor migration surveys that were conducted at the Project. The results of two years of raptor migration counts from fall 2009 through spring 2011 indicate that some golden eagles use the Project during the spring and fall migratory periods, but may not be part of a major migratory pathway for golden eagles (Appendix A). With the exception of Sugarloaf Mountain and the rocky terrain in the southwest portion of the site, the Project is generally flat and is located east of the Jacumba Mountains and south of the Coyote Mountains. The southwesterly prevailing wind direction would not appear to be conducive to creating updrafts in the Project that are often associated with high raptor migration areas. The site lacks a major ridgeline, water bodies, and large stands of mature trees. The closest major water body is the Salton Sea, which is 30 miles to the northeast of the site, and the irrigated agriculture fields near El Centro are approximately 15 miles to the west of Ocotillo. Therefore, the site does not appear contain the appropriate topography that has been observed to concentrate migrating raptors in other studies (Hoover and Morrison 2005).

3.3.3 Migratory Bird Species

The FEIS/FEIR (Sections 3.23 and 4.21, BLM 2012a) for the Project provides a thorough review of the Project's overall potential effects on migratory bird species and is incorporated by reference.

Additionally, the ABPP for the Project describes the pre-construction bird surveys that occurred prior to the Project (Appendix B). In the pre-construction surveys, 77 species and 6,387 individual observations were documented. House finches (*Haemorhous mexicanus*), black-throated sparrows (*Amphispiza bilineata*) and horned larks (*Eremophila alpestris*) were the most abundant species observed during the study. Sensitive species that were documented during the pre-construction surveys included the Swainson's hawk (*Buteo swainsoni*; state-listed as threatened), ferruginous hawk (*Buteo regalis*; watch list species), northern harrier (*Circus cyaneus*), loggerhead shrike (*Lanius ludovicianus*), yellow warbler (*Setophaga petechia*), Vaux's swift (*Chaetura vauxi*) and Le Conte's thrasher (*Toxostoma lecontei*), all of which are state Species of Special Concern.

During the two years of post-construction fatality monitoring that has occurred at the site as required by the ROD and ROW grant, 26 birds were found in the first year as documented fatalities and 37 birds were found as documented fatalities in the second year (WEST 2015, 2016). The most commonly documented species (five fatalities) in the first year was the white-throated swift (*Aeronautes saxatalis*; WEST 2015); in the second year, Townsend's warbler (*Setophaga townsendi*) was the most commonly documented fatality (four fatalities). Red-tailed hawks (*Buteo jamaicensis*) were the only raptors found as fatalities during the surveys (one in the first year and two in the second year). Two birds of conservation concern for BCR 33 were documented as fatalities at the Project: yellow warbler and Costa's hummingbird (*Setophaga petechia* and

Calypte costae, respectively; WEST 2015, 2016). The estimated overall bird fatality rate was 0.88 birds/MW/year (or approximately 233 birds per year at the entire 265 MW site) and 1.37 birds/MW/year (or approximately 363 birds per year at the site) in the first and second years' surveys, respectively. In the second year, the estimated raptor fatality rate was 0.04 raptors/MW/per year (approximately 10.6 raptors per year at the entire site). In the first year of the study, the only raptor fatality documented was a red-tailed hawk found incidentally, so no raptor fatality rate is available for the first year. These levels of bird and raptor fatalities are on the lower end of the range of those found at wind energy facilities in California (WEST 2015, 2016).

The possible impact of the alternatives under consideration on migratory bird species is addressed in Section 4.

3.3.4 Species Listed under ESA

The effects of authorizing incidental eagle take to the applicant is not expected to have affects to species protected by the ESA at the operational wind facility. The required eagle take permit compensatory mitigation, retrofitting electric utility poles, has the potential to affect species protected under the ESA. As discussed in Section 2.3.2 of this document, the compensatory mitigation site has not yet been identified. If the mitigation occurs on PG&E's system, the site would most likely be located within oak woodland savannah or agricultural habitats. If the mitigation occurs on SCE's system, affected species would likely be those found in the Mojave Desert. Tables C-1 and C-2 in Appendix C identifies likely species that might be present in areas where power poles may be identified for retrofitting in the oak woodland savannah and Mojave Desert habitats, respectively, according to the Service's Information for Planning and Consultation system. Aquatic species that may occur within the overall PG&E or SCE service areas are not included in these tables as it is assumed that poles that would be considered for retrofitting are in uplands. Note that these tables do not include aquatic animals or plants (such as fairy shrimp, fish, or aquatic plants), or flowering plants that are restricted to exposed dolomite bedrock outcrops in the San Bernardino Mountains (such as the Amargosa niterwort), since these species' habitats would not be anticipated to be affected by the retrofit work. Once the compensatory mitigation sites are selected, the Service would conduct an internal Section 7 Consultation and further analyze and address impacts and required compliance with the ESA. We anticipate that adverse effects to listed species will be avoidable by timing retrofits to avoid sensitive seasons, and/or through the use of other species-specific avoidance measures. However, if the determination of the Section 7 Consultation is that adverse effects were likely to occur to listed species, the Service would prepare additional NEPA documentation to supplement this EA.

4 Environmental Consequences

4.1 Introduction

The CEQ regulations implementing NEPA specify that agencies would examine whether a proposed action would have direct, indirect, or cumulative effects on the quality of the human environment. The regulations define "human environment" as including "the natural and physical environment and the relationship of people with that environment" (40 C.F.R. § 1508.14). "Effects" are defined generally as including ecological, aesthetic, historic, cultural, economic, social, or health effects (40 C.F.R. § 1508.8). Effects may be beneficial or adverse. More specifically, the CEQ regulations (40 C.F.R. § 1508.7, 1508.8) define the three types of effects as follows:

- "Direct effects" are defined as those effects "which are caused by the action and occur at the same time and place."
- "Indirect effects" are defined as those effects "which are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable."
- "Cumulative impact" is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions."

The discussion of effects for the permit program is provided in the PEIS (Service 2016) and is incorporated by reference here. This section would only analyze effects that may result from the issuance or denial of an eagle take permit for this project.

In this chapter, we describe the environmental consequences of the No Action Alternative and three action alternatives. The alternatives listed below are evaluated on the basis of the 30-year Project lifespan.

- Alternative 1: No Action - No Permit or ROW Grant Amendment for termination of bio-monitoring, Continued Bio-monitoring and Curtailment when Eagles are Detected for remainder of 10 year period
- Alternative 2: Issue 5-Year Permit for Applicant's Revised ECP; Issue ROW Grant Amendment
- Alternative 3: Continued Operation of the Project without an Eagle Take Permit; Issue ROW Grant Amendment
- Alternative 4: Issue a 30-Year Permit for Applicant's Revised ECP with Additional Mortality Monitoring and Mitigation; Issue ROW Grant Amendment

4.2 Impacts Analysis for Take of Golden Eagles

4.2.1 Approach and Methods

In determining how the issuance of a take permit would affect eagles, we screened permit issuance alternatives against the Eagle Act's Permit Issuance Criteria or Required Determinations (Chapter 1, Section 1.5.2). We used Service tools from the ECP Guidance (Service 2013), including: the Bayesian analysis (consistent with Appendix D, Stage 3—Predicting Eagle Fatalities); Resource Equivalency Analysis (consistent with Appendix G, Examples Using Resource Equivalency Analysis to Estimate the Compensatory Mitigation for the Take of Golden and Bald Eagles from Wind Energy Development); and Cumulative Effects Analysis (consistent with Appendix F, Assessing Project-Level Take and Cumulative Effects Analyses). We have also used some qualitative analysis based on our knowledge of the wind resource area, data available to the TAC, and studies of local eagle populations.

To address the effects of golden eagle take on cultural practices, we assessed whether the alternatives would substantially burden a Tribe's free exercise of its religion.

4.3 Effects Common to Alternatives

All alternatives have the potential to result in permitted or unpermitted take of eagles.

4.3.1 Direct and Indirect Effects

Under the eagle take permit issuance alternatives (Alternative 2 and 4), we estimate that two golden eagles may be taken within every 5 year period (Appendix A). We based this prediction on a conservative approach that is expected to overestimate annual and cumulative take at the outset of permit. We anticipate the prediction would decrease as we incorporate project-specific monitoring data into the prediction as part of the permit's adaptive management process. The proposed conservation measures include adaptive management that could result in additional monitoring and operational adjustments. As previously described, the applicant would provide compensatory mitigation (power pole retrofits) to fully offset the authorized take. The associated eagle fatality monitoring would allow the Service and applicant to estimate the total number of annual eagle fatalities. Monitoring is a critical component of adaptive management. Together, these conservation measures ensure there would be no significant impacts to golden eagles.

4.3.2 Local Effects

Up to three active nests were identified in 2010, and one active nest was identified in 2011 within 10 miles of the Project area: the nearest active nest was 4.1 miles to the north (Appendix A). No active nests were documented within 10 miles of the Project in post-construction nest monitoring conducted in 2013, 2014 or 2015. Inactive nests were also identified; the closest inactive nests were three miles to the north, with other inactive nests more than four miles to the southwest. Nesting survey results are detailed in the ECP (Appendix A). Although the surrounding territories appeared to be unoccupied in the latest nest survey (2015), it is possible that this is due to the drought conditions that were occurring in California at that time. Imperial County experienced severe drought conditions from 2013 through 2016, and is still experiencing moderate to severe drought as of April 2017 (Fuchs 2013, 2014, 2015, 2016; Bathke 2017). If drought or other conditions change and nests become active again in the vicinity of the Project during the 30 year operational life of the Project, nesting adults and juveniles from these nests are at risk of nest abandonment, injury, or mortality from Project operations. Migrating eagles, such as those documented during the two years of pre-construction migration surveys, would also be at risk of injury or mortality. Eagles generally hunt prey from favored perches near regular updrafts, which allow soaring to heights sufficient for them to efficiently scan their hunting areas (Johnsgard 1990). Prey studies were not conducted for the Project; however, eagles were observed relatively infrequently and no high use areas or concentration areas were identified at the site.

The specific fatality estimates for each alternative are described below in Section 4.6 under "Assessment of Alternatives."

Each action alternative that involves issuance of an eagle take permit (Alternatives 2 and 4) involves power pole retrofits as compensatory mitigation for take of eagles. Such retrofits are anticipated to protect eagles from electrocution. It is difficult to predict whether the birds saved would be breeding adults, juveniles, or floaters; however, our REA assumes that the losses to electrocution are proportional to the demographic distribution of the population. Avoided fatalities would help to offset Project-related fatalities (i.e., collisions with turbines or other facilities), thereby benefitting the eagle population as a whole. Pole retrofits associated with the action alternatives that involve issuance of an eagle take permit (Alternatives 2 and 4) are also expected to benefit other raptors that may be susceptible to electrocution.

4.3.3 Other Priority Uses

Other priority uses described in our regulations include safety emergencies, Native American use for rites and ceremonies, activities necessary to ensure public health and safety, renewal of nest-take permits, and

resource development or recovery operations (for inactive golden eagle nests only). Operation of the Project, including take of eagles, is not expected to interfere with other priority uses or permits because a no-net-loss standard is expected to be achieved under the action alternatives that involve issuance of an eagle take permit (Alternatives 2 and 4).

4.3.4 Cumulative Effects

This cumulative-effects section evaluates the cumulative effects on bald and golden eagles as required by NEPA (40 CFR 1508.8) and the Eagle Act's permitting regulations. As part of the permit application review process the Service also considers cumulative effects at the local area population (LAP) scale to evaluate whether the take to be authorized under the permit, together with other sources of permitted take and unpermitted eagle mortality may be incompatible with the persistence of the LAP. We incorporated data provided by the applicant, our own data on permitted take and other documented eagle mortalities, and additional available information on population-limiting effects, in determining cumulative impacts to the LAP. We do not anticipate the bald eagles will be affected, and so they are not considered further in this section. The scale of our analysis is a 109-mile radius around the project site (golden eagle natal dispersal distance). We conducted our cumulative effects analysis as described in ECP Guidance Appendix F (Service 2013). National estimates of golden eagle survival rates suggest that on average about 20% of golden eagles die each year, and about 56% of these mortalities are from anthropogenic causes. Thus, background levels of golden eagle anthropogenic mortality within an average LAP appear to be roughly 10% (Service 2016).

4.3.4.1 Local-Area Population Analysis

To assess cumulative impacts to the local-area population we followed methods outlined in Appendix F of the ECP Guidance (Service 2013) and as described in the 2016 Eagle Rule PEIS (Service 2016). We used our Cumulative Effects Tool to complete an analysis of the local area population. This analysis includes eagle mortality records available to us in the Service's eagle mortality database. A major caveat with our eagle mortality records is that they were obtained based on opportunistic or incidental reporting of eagle mortalities and they were not obtained from regular or systematic survey efforts to detect eagle mortalities using a statistically valid protocol or sampling methodology. Table 4-1 summarizes known unauthorized take within the LAP.

TABLE 4-1
Known Golden Eagle Mortalities within 109 Miles of the Ocotillo Wind Energy Facility, 1995 - 2017

Cause of Mortality	Reported Years	Reported Take Over Reported Period	Annual Take*
Electrocution	1995-2016	6	0.27
Shot	2004-2004	1	1.00
Collision with wind turbine	2002-2017	5	0.31
Poisoned	2014-2014	1	1.00
Collision with vehicle	2015-2015	1	1.00
Trauma	2016-2016	1	1.00
Trauma; Other	2016-2016	1	1.00
Starvation	2015-2016	2	1.00
Starvation; Other	2001-2014	2	0.14
Unknown	2005-2017	9	0.69
TOTAL		**29**	**7.42**

*Annual take for each reported cause of mortality is calculated by dividing the reported take by the number of reported years for each cause.

We conducted this analysis to determine if issuance of the permit would result in cumulative authorized take within the LAP exceeding 5% and to evaluate if background levels of unauthorized take exceed 10%. If issuance of this eagle take permit exceeded either of these benchmarks, we would consider requiring additional mitigation to offset to the local population (Service 2016). Our analysis determined that issuance of a permit to the applicant would result in 0.01% cumulative authorized take, and less than 5% cumulative unauthorized take of the LAP taken annually.

4.4 Effects Common to All Action Alternatives (Alternatives 2, 3, and 4)

4.4.1 Effects on Visual Resources

Under the action alternatives the applicant would install an aviation detection system that would result in the lit turbines flashing only when aircraft are in the area. All alternatives would therefore affect the visual resources in the Project vicinity by reducing the occurrence of flashing lights to the time only when aircraft are in the area.

4.5 Effects Common to Action Alternatives that Involve Issuance of an Eagle Take Permit (Alternatives 2 and 4)

4.5.1 Effects on Species Listed Under ESA

As stated above, the effects of authorizing incidental eagle take to the applicant is not expected to have effects to species protected by the ESA at the operational wind facility. The required compensatory mitigation, retrofitting electric utility poles, has the potential to affect protected species. As discussed in Section 2.3.2 of this EA, the compensatory mitigation sites have not yet been identified. If the mitigation occurs on SCE's system, affected species would likely be those found in the Mojave Desert. If the mitigation occurs on PG&E's system, the site would most likely be located within oak woodland savannah or agricultural habitats. Table C-3 in Appendix C identifies listed species that might be present and potential impacts that may occur.

Once the compensatory mitigation site is selected, the Service would conduct an internal Section 7 Consultation and further analyze and address what listed species may be affected, potential impacts and required compliance with the ESA. The following avoidance and minimization measures would likely be implemented for all retrofit work, regardless of the final location of the mitigation site:

- The retrofit work would be conducted during the dry season (July 1-October 31/or as long as dry season persists) to avoid potential impacts ESA species and breeding birds that may be in the area, including eagles. If wet weather patterns occur, work would not occur until 10 days after a rain event that resulted in 0.5 inches of rain or more.
- The retrofit work would not be conducted if poles are located in or adjacent to wetland or riparian areas. Alternate poles that are not located in or near these habitats would be selected for retrofits.
- The retrofit work would either not be conducted if poles are located on exposed bedrock areas in locations with known listed plant populations, or if high risk poles are identified on exposed bedrock, further evaluation would occur to identify any listed plants in the vicinity and develop plans to avoid impacts during the retrofit work.
- The retrofit work would not be conducted if poles are located in or adjacent to ponds or vernal pools.
- The retrofit work would not involve ground disturbing activities and vehicles would remain on existing public and private access roads to complete the work.
- Vehicles would maintain a speed limit of no more than 10 mph on roads within the ROW.

4.6 Assessment of Alternatives

In assessing whether there is a "significant" impact, we consider both the context and intensity of the action and its effects (40 CFR 1508.27). *Context* refers to the affected environment in which the proposed action takes place and may include the socioeconomic, legal, and political situation surrounding an action. *Intensity* refers to the severity of the proposed action's impact on the environment and may consider environmentally beneficial actions, public health, unique characteristics of the geographic area, controversy, uncertainty, precedent-setting elements, cumulative effects, cultural resource effects, effects on endangered species, and consistency with environmental laws (40 CFR 1508.27[b]). In the case of the Proposed Action—issuance of an eagle take permit—we have assumed that the context is operation of an approved wind energy facility, and that a certain amount of take of golden eagles already occurs in the local-area from wind energy projects. Consideration of intensity addresses the relative severity of effects on eagles, the possibility of the Federal action to establish a precedent for future eagle take permits, and the efficacy of the action in mitigating adverse cumulative effects.

4.6.1 Alternative 1: No Action

4.6.1.1 Effects on Eagles

Under the No Action Alternative, we would deny the permit application and would not issue a permit; the BLM would not issue an amendment to the ROW grant. Under the No Action Alternative, direct impacts of the Project on the golden eagle population would be minimized through continued use of the bio-monitoring and radar system for the remaining portion of the required initial 10 years of operation. After the initial 10 years of operation, the BLM would coordinate with the applicant and the Service to determine if an eagle take permit process should be reinvestigated, and/or if the eagle risk minimization system should be continued. The take estimate (likely conservative) for the 30 year life of the Project is up to nine golden eagles (0.3 golden eagles per year x 30 years). Because the revised ECP would not be implemented under this alternative, the proposed compensatory mitigation would not be provided. Therefore the beneficial impacts to eagles that would result from retrofitting power poles would not be realized under this alternative.

Under the No Action Alternative, the Project would continue to operate without a take permit, under the requirements of the 2012 ROW grant. Should take of eagles occur under the No-Action Alternative, the applicant would be in violation of the Eagle Act. Because no measures would be implemented to avoid or minimize risk to eagles under this No-Action Alternative, the risk to eagles is expected to be higher under this alternative as compared to the Proposed Action.

4.6.1.2 Effects on Migratory Birds

Under the No Action alternative, the eagle risk minimization program and curtailment system would continue, and the ABPP would continue to be implemented as required under the current ROW grant. Therefore no impact to migratory bird species compared to those that are currently occurring during operation of the Project would occur.

4.6.1.3 Effects on Visual Resources

Under the No Action alternative, the aviation detection system would not be installed, and the flashing lights would continue regular flashing per minimum FAA requirements regardless of whether planes are in the vicinity. Therefore no impact to visual resources compared to those that are currently occurring during operation of the Project would occur, and the beneficial effect of the aviation detection system would not be realized.

4.6.1.4 Effects on Species Listed under ESA

Under the No Action Alternative the Project would continue to operate as authorized under their current BLM ROW grant without an eagle take permit. The eagle risk minimization program would continue. No effects on listed species are anticipated.

4.6.2 Alternative 2: Issue a 5-Year Permit for Applicant's Revised ECP and Issue ROW Grant Amendment

4.6.2.1 Effects on Eagles

Under this alternative, we recognize that the Project is built, and that all applicant-committed measures, compensatory mitigation, and adaptive management requirements as outlined in the revised ECP (Appendix A) would be fulfilled; in addition we recognize that the original radar system would be removed, an aviation detection system would be installed and the eagle risk minimization program that includes full-time bio-monitoring and curtailment that is currently occurring would cease. We estimate that the Project would kill up to two eagles over the 5-year permit duration.

If the predicted eagle take threshold is reached within 4 or fewer years of permit issuance, the following experimental ACPs/adaptive management measures would be considered for implementation as described in Step II of the ECP's Step-wise table (Table 2-1) and summarized below:

- Studies to identify a risk factor (e.g., seasonality, time of day, weather, presence of attractants, etc.) and to determine if management response is warranted, and
- Other actions to minimize and compensate for effects

If unintended take were to reach or exceed our predicted or authorized levels, the Service would consider if curtailment, additional monitoring to inform ongoing curtailment schedules, focused eagle use and/or mortality monitoring, radar deployment and / or other measures deemed were appropriate.

At the end of the 5-year permit term, the BLM would require coordination between the applicant, the Service, and the BLM to determine if a subsequent eagle take permit would be sought, or if no subsequent permit would be sought and the eagle risk minimization system should be restarted. It is therefore likely that risk minimization measures and adaptive management approaches would continue at the Project past the 5-year permit term. Subsequent implementation of these measures could result in decreased eagle fatalities. Consequently, the fatalities that occur during the initial 5-year period (i.e., up to two fatalities, or an average annual rate of 0.3 eagles) cannot be extrapolated to determine a 30-year total because it is presumed that ACPs would reduce future fatalities should the ACPs continue to be implemented into the future after the 5-year permit term. This anticipated decline could reduce the 30-year take of eagles to something less than nine golden eagles. Up to 62 utility pole retrofits would be completed under this alternative.

The applicant's proposed approach would ensure no net loss to golden eagle populations. Based on the intensity and context of these effects and consideration of the elements associated with this alternative, Alternative 2 is not expected to result in significant adverse effects to the golden eagle population.

4.6.2.2 Effects on Migratory Birds

Under this alternative, the DeTect Merlin radar system would be removed and the observer based eagle risk minimization curtailment system would no longer be used. The power pole retrofits that would be required under this alternative may also serve to minimize electrocution risk to other large non-eagle raptors.

Potential adverse impacts would include possible increased risk to raptor species at the wind facility, as the current eagle risk minimization program uses a radar, camera and observer to curtail turbines if a large raptor or eagle is near a turbine. The eagle risk minimization system has primarily relied upon the biological observer as there were technological problems caused by interference from cactus with the radar system, and from heat waves with the cameras. The curtailment program has relied primarily upon biological observers. If this system is no longer in place, it is possible that raptor fatalities may increase over existing levels. Removal of the observer-curtailment system is not anticipated to result in adverse impacts to smaller migratory bird species compared to the existing conditions since there is no curtailment associated with non-raptor species.

Because the eagle risk minimization system has been in place since operations and during both years of post-construction mortality monitoring that have occurred to date, we do not have the data necessary to

determine if the relatively low raptor fatality rates are due to the curtailment system or simply a low level of baseline risk to raptors in this area. Mortality monitoring under this alternative would allow us to evaluate impacts to raptors in the absence of the curtailment program.

Potential beneficial impacts would include minimization of electrocution risk to other large raptors associated with the power pole retrofits that would be required as compensatory mitigation for eagle take under this alternative. While the potential benefit to non-eagle raptors may not necessarily offset the take at the Project, the power pole retrofits would likely have a beneficial impact on raptor populations.

There is some potential for beneficial impacts to nocturnal migrating birds by reducing the occurrence of flashing lights, which would only flash when aircraft are in the vicinity of the Project under this alternative. Nocturnal migrating birds are attracted to steady burning lights, and these types of lights have been associated with large-scale fatality events at lit communications towers as well as at wind farms when lighting associated with substations or operations buildings have been left on overnight. However, flashing lights have been shown to significantly decrease bird mortality rates compared to steady lights (up to 71% reduction; Gehring et al. 2009). Theoretically, unlit turbines are less attractive than turbines with flashing red lights (Evans et al. 2007); however, because mortalities at turbines with flashing red lights are generally low this difference may be difficult to demonstrate as was the case in the meta-analysis conducted by Kerlinger et al. (2010).

4.6.3 Alternative 3: Continued Operation of the Project without an Eagle Take Permit; Issue ROW Grant Amendment

4.6.3.1 Effects on Eagles

Under the this Alternative, we would deny the permit application and would not issue an eagle take permit; the BLM would issue an amendment to the ROW grant to allow the installation of the aviation radar system and lifting the requirement for the eagle risk minimization ACP which includes the DeTect Merlin radar system, and radar-controlled video tracking system. Under this Alternative, direct impacts of the Project on the golden eagle population would be minimized through continued use of the bio-monitoring and associated curtailment system for the remaining portion of the required initial 10 years of operation. After the initial 10 years of operation, the BLM would require that unless or until an eagle take permit is obtained, the applicant continue full time bio-monitoring and associated curtailment during daylight hours. Furthermore, the BLM would require that fatality monitoring occur at the Project using Service-approved standards. The take estimate (likely conservative) for the 30 year life of the Project is up to nine golden eagles (0.3 golden eagles per year x 30 years). Similar to the No Action Alternative, the revised ECP would not be implemented under this alternative, and the proposed mitigation would not be installed. Therefore the beneficial impacts to eagles that would result from retrofitting power poles would not be realized under this alternative.

Similar to the No Action Alternative, if the Project resulted in the take of eagles under this alternative, the applicant would be in violation of the Eagle Act and would thereby be subject to investigation and possible prosecution by our Office of Law Enforcement and the U.S. Department of Justice.

4.6.3.2 Effects on Migratory Birds

Under Alternative 3, the bio-monitoring program and curtailment system would continue, and the ABPP would continue to be implemented as required under the current ROW grant. Therefore no impact to migratory bird species compared to those that are currently occurring during operation of the Project would occur.

4.6.3.3 Effects on Listed Species

Under Alternative 3, the Project would continue to operate as authorized under their current BLM ROW grant without an eagle take permit. The bio-monitoring and curtailment program would continue, but power-pole retrofits would not be installed as mitigation. No effects on listed species are anticipated.

4.6.4 Alternative 4: Issue a 30-Year Permit for Applicant's Revised ECP with Additional Mortality Monitoring and Mitigation; Issue ROW Grant Amendment

4.6.4.1 Effects on Eagles

Under this alternative, we estimate that up to nine golden eagles would be killed over the 30-year permit duration (an average rate of 0.3 golden eagles per year over 30 years). The effects would be similar to those described in Alternative 2, across the 30 year permit term. The additional mortality monitoring would diminish the possibility of take occurring without being detected. Increased mortality monitoring associated with this alternative would help to ensure that fatalities are detected and would support validation of the take estimate. Increased monitoring also has the benefit of accelerating threshold-based ACPs and adaptive management (see ECP Table 15), thereby helping reduce future fatalities. Requiring additional compensatory mitigation under this alternative (up to 74 utility pole retrofits for the first five year period) would reduce the effects on golden eagles.

Risk minimization measures and adaptive management approaches would continue at the Project for the 30-year permit term. Implementation of these measures could reduce the 30-year total to something less than nine golden eagles. Alternative 4 is not expected to result in significant adverse effects on golden eagle populations because the compensatory mitigation would result in no net loss to the breeding population.

4.6.4.2 Effects on Migratory Birds

Similar to Alternative 2, this alternative would result in some potential minor adverse and potential beneficial effects on migratory birds.

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Appendix A
Eagle Conservation Plan

Appendix B
Avian and Bat Protection Plan

Appendix C
Listed Species and/or Their Critical Habitat Likely to Occur within Oak Woodland Savannah and Mojave Desert Habitats, and Potential Impacts

Appendix A
Eagle Conservation Plan

GOLDEN EAGLE CONSERVATION PLAN FOR THE OCOTILLO WIND ENERGY FACILITY

Ocotillo Express LLC
1600 Smith Street, Suite 4025
Houston, Texas 77002

August 9, 2018

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1.0 INTRODUCTION

1.1 Project Background

Pattern Energy, through Ocotillo Express LLC (OE LLC), owns and operates a wind energy facility known as the Ocotillo Express Wind Energy Facility (OWEF) near Ocotillo, California, in Imperial County (Figure 1). The OWEF was constructed in 2012 and 2013, with the Project becoming fully operational in the fall of 2013. The OWEF is located primarily on Bureau of Land Management (BLM) land and a small portion of private land. The OWEF is located on approximately 12,565 acres in the Project area and consists of 112 Siemens SWT – 2.3-108 wind turbines (approximately 315 megawatts [MW]) and associated infrastructure. The diameter of the circle swept by the blades is 354 feet (108 meters). Turbines are 440 feet (134 meters) in height. The OWEF connects to the new SDG&E Sunrise Powerlink 500-kilovolt (kV) transmission line. SDG&E constructed and operates a switchyard independently from OE LLC and as such, the post construction monitoring and mitigation measures identified for the OWEF do not apply to the SDG&E facilities. SDG&E switchyard and facilities meet APLIC standards for electrical equipment design. The collection lines connecting one turbine to the next and to the project substation are buried underground, generally adjacent to the interior turbine access roads.

The BLM issued a Record of Decision (ROD) approving the Project on May 11, 2012 and issued the right-of-way (ROW) grant on May 11, 2012. An Avian and Bat Protection Plan (ABPP) and an Eagle Conservation Plan (ECP) were developed for the OWEF in cooperation with the BLM and U.S. Fish and Wildlife Service (USFWS). The ABPP and ECP were finalized in early 2012 and approved as part of the overall BLM approval of the Project. The 2012 ECP included information on the risk of impacts to golden eagles (*Aquila chrysaetos*), as well as avoidance, minimization, and mitigation measures specific to golden eagles.

Since the 2012 ECP was finalized, the USFWS released the 2nd Version of the ECP Guidance (USFWS 2013). OE LLC has developed this ECP to reflect the recommendations contained in the latest 2013 ECP Guidance, as well as the new site-specific information that has been collected since construction and operation of the OWEF. The overarching purpose of the ECP is to re-evaluate risk to eagles at the OWEF given the 2013 ECP Guidance and all the site-specific information available as well as to revisit the avoidance, minimization, and mitigation measures implemented at the Project given the level of risk to eagles at the Project. The OWEF ECP evaluates the need for a programmatic eagle take permit and documents compliance with the regulatory requirements for a programmatic eagle take permit and the National Environmental Protection Act (NEPA) process that is associated with the granting of an incidental (i.e., non-purposeful) take permit for eagles, assuming it is determined that such a permit is warranted for the OWEF. The ECP provides detailed information on the OWEF and the mitigation measures OE LLC committed to and implemented during project siting, construction, and operations to avoid and minimize take of eagles.

This ECP was developed to support an application for an eagle take permit at the OWEF, should OE LLC decide to pursue a take permit for the Project. The 2012 OWEF ECP was developed in close coordination with Region 8 USFWS Migratory Bird Program staff and OE LLC intends to continue to coordinate with USFWS regarding the ECP, as well as decisions regarding potential eagle risk and the possibility of applying for an eagle take permit.

The 2013 USFWS ECP Guidance provides a process for conserving bald and golden eagles during siting, construction, and operation of wind energy facilities through a staged approach that is similar to the tiered

approach in the 2012 USFWS Land-based Wind Energy Guidelines (WEG). The ECP Guidance emphasizes the importance of implementing avoidance and minimization measures throughout all phases of wind energy development and operations. Although the OWEF was constructed prior to the release of the 2013 ECP Guidance, OE LLC developed the 2012 ECP in close coordination with the USFWS and based the ECP on the guidance available at the time. As such, OE LLC did consider avoidance and minimization measures for golden eagles during project siting, construction, and operations. However, given the 2013 ECP Guidance and the site-specific information collected to date, OE LLC is re-evaluating the risk to eagles posed by the OWEF and the appropriate avoidance, minimization, and mitigation measures, given the current understanding of the level of risk posed by the Project.

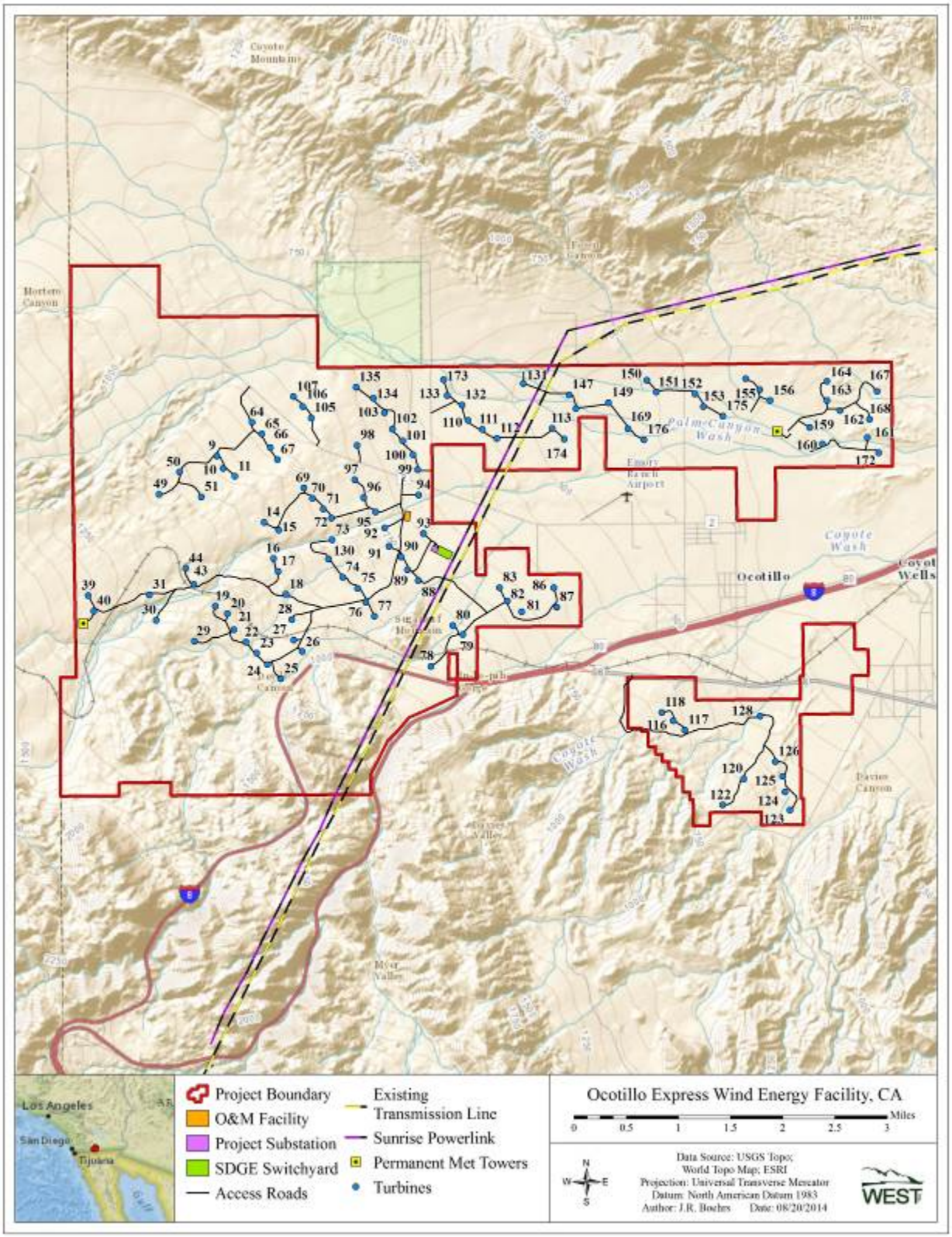


Figure 1. General location of the Ocotillo Wind Energy Facility.

1.2 Environmental Setting

The project site is located within four U.S. Geological Survey 7.5-minute quadrangle maps; Carrizo Mountain, Coyote Wells, In-Ko-Pah Gorge, and Painted Gorge. The northern portion of the site is generally situated north of Interstate 8 (I-8), with the western edge along the Imperial/San Diego County border, to approximately 1.5 miles northeast of the town of Ocotillo on its eastern edge. The northern area includes several distinct features, including a portion of the I-8 Island, which is undeveloped rocky and hilly terrain between the eastbound and westbound lanes of I-8, Sugarloaf Mountain, and a portion of the San Diego and Arizona Eastern railroad tracks. County Route (CR) S2 bisects the northern project area, and I-8 passes through the southern portion of the northern project area. The southern area is much smaller than the northern area and the majority is south of State Route (SR) 98.

Vegetation on site consists of a variety of desert scrub habitat types (National Land Cover Database [NLCD] 2001; Figure 2). Several dry desert washes cut through the site, generally from west to east: Palm Canyon Wash cuts through the center of the northern project area; Myer Creek Wash cuts through the southern portion of the northern project area; a portion of Coyote Wash cuts through the northwest portion of the southern project area; and several additional unnamed washes cut through the site.

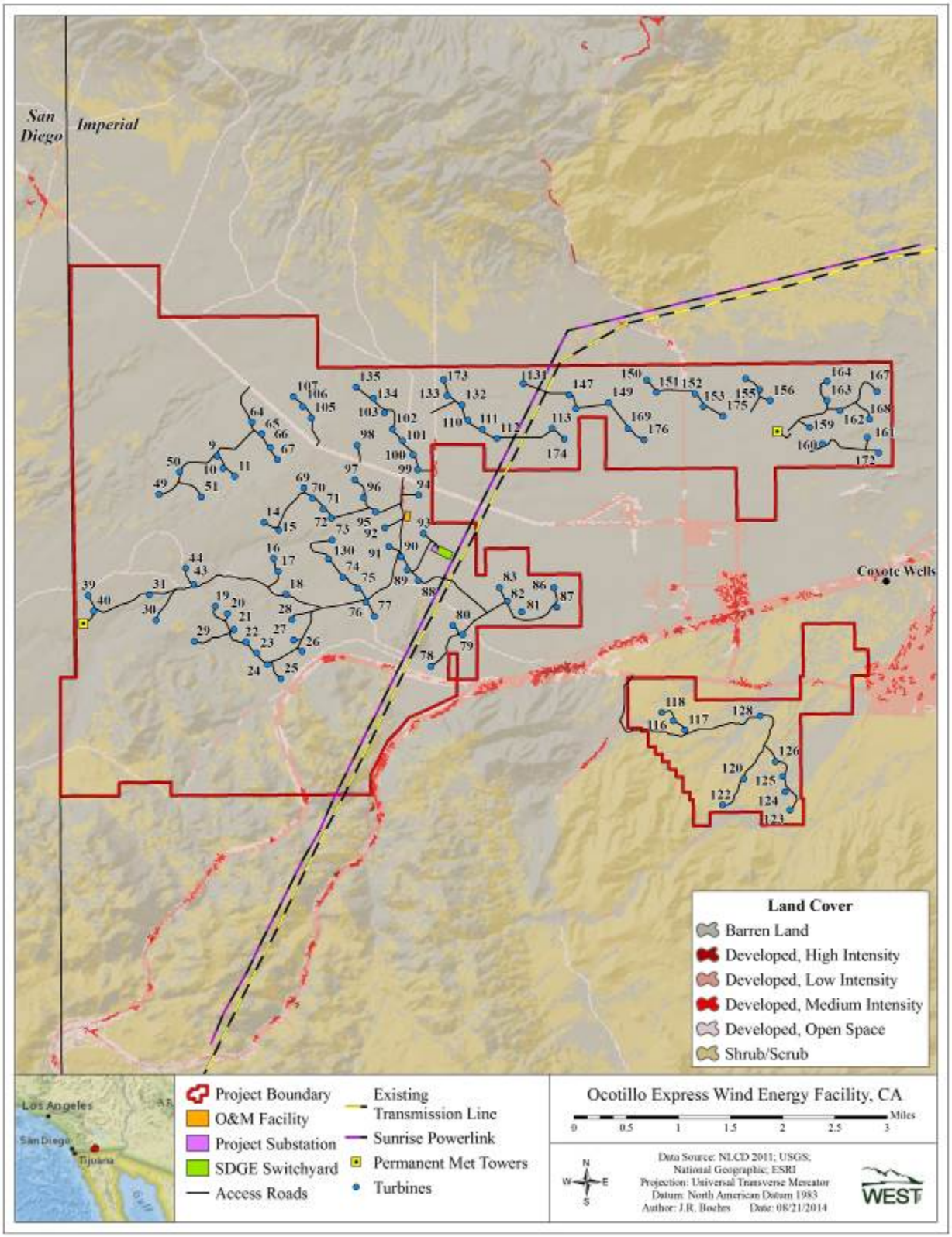


Figure 2. Landuse/Landcover information for the Ocotillo Wind Energy Facility (NLCD 2001).

Elevations on site range from approximately 300 feet above mean sea level (AMSL) in the northeast portion of the site to approximately 1,490 feet AMSL in the southwest portion of the site (Figure 3). The site generally slopes downward from the west to the east, with the Coyote Mountains to the north of the site, and the Jacumba Mountains to the west and south of the site.

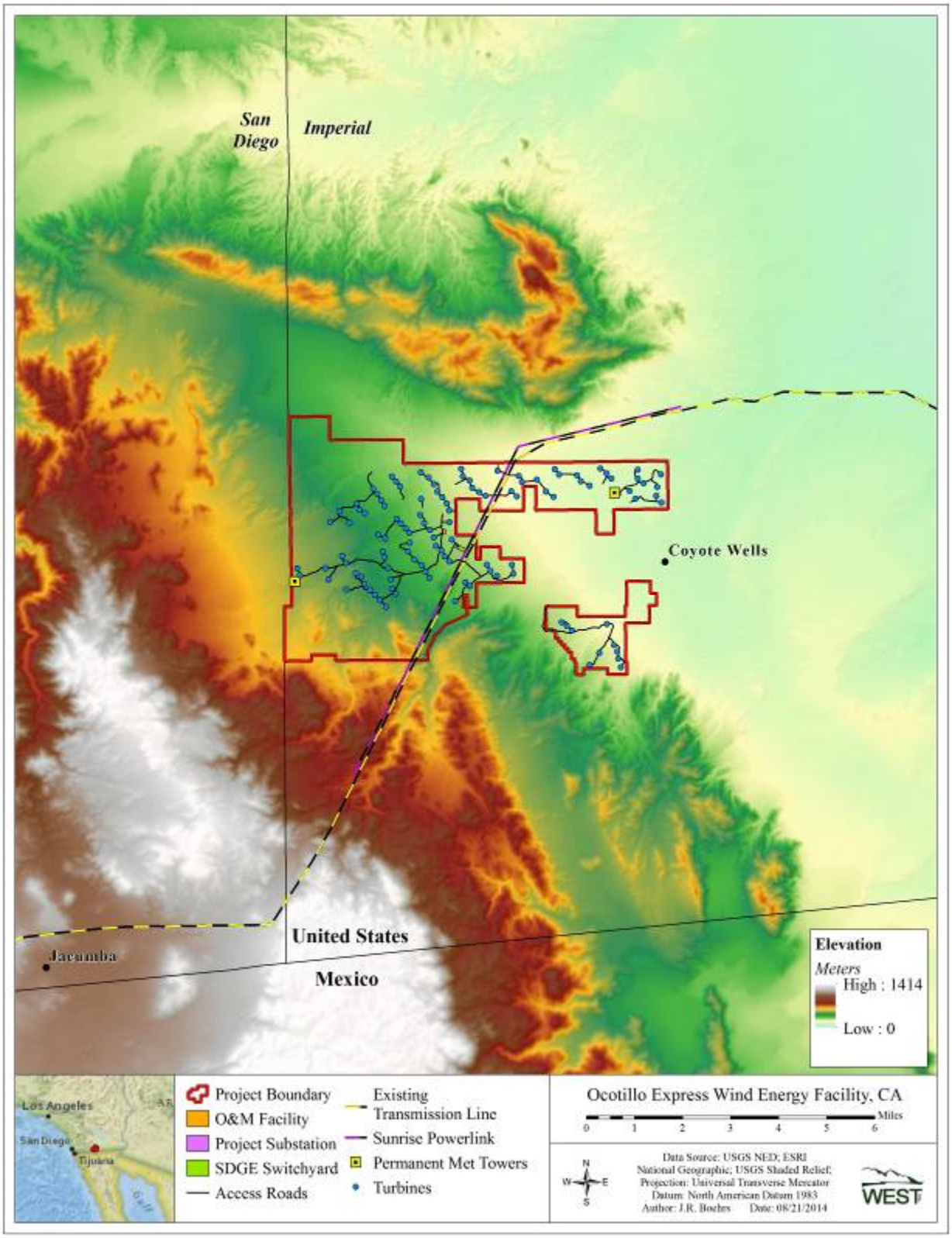


Figure 3. Digital elevation map of the Ocotillo Wind Energy Facility.

1.3 Regulatory Framework

1.3.1 Migratory Bird Treaty Act

The federal regulatory framework for protecting eagles includes the Migratory Bird Treaty Act (MBTA) (6 U.S.C. §§ 703-711) of 1918 and the Bald and Golden Eagle Protection Act (BGEPA) (16 U.S.C. §§ 668-668d) of 1940. The MBTA is the foundation of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide for international protection of migratory birds, and is a strict liability statute, meaning that proof of intent, knowledge, or negligence is not an element of an MBTA violation. The MBTA prohibits the take of migratory birds and does not include provisions for allowing unauthorized take. The statute's language is clear that actions resulting in the "taking" or possession (permanent or temporary) of a protected species, in the absence of a USFWS permit or regulatory authorization, are violations of the MBTA. The MBTA states, "Unless and except as permitted by regulations… it shall be unlawful at any time, by any means, or in any manner to pursue, hunt, take, capture, kill… possess, offer for sale, sell …purchase … ship, export, import …transport or cause to be transported… any migratory bird, any part, nest, or eggs of any such bird ….[The Act] prohibits the taking, killing, possession, transportation, import and export of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior" (16 U.S.C. 703). The word "take" is defined by regulation as "to pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to pursue, hunt, shoot, wound, kill, trap, capture, or collect" (50 CFR 10.12). The USFWS maintains a list of all species protected by the MBTA at 50 CFR 10.13. This list includes over one thousand species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and passerines.

1.3.2 Bald and Golden Eagle Protection Act

Under authority of the Bald and Golden Eagle Protection Act (BGEPA), 16 U.S.C. 668–668d, bald eagles and golden eagles are afforded additional legal protection. BGEPA prohibits the take, sale, purchase, barter, offer of sale, purchase, or barter, transport, export or import, at any time or in any manner, of any bald or golden eagle, alive or dead, or any part, nest, or egg thereof. BGEPA goes on to define take as to include "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb," and includes criminal and civil penalties for violating the statute. The USFWS further defined the term "disturb" to mean to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available: 1) injury to an eagle; 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.

On September 11, 2009 (*Federal Register,* 50 Code of Federal Regulations [CFR] 22.26 and 22.27), the USFWS set in place rules establishing two new permit types: 1) individual permits that can be authorized in limited instances of disturbance and in certain situations where other forms of take may occur, such as human or eagle health and safety; and 2) programmatic permits that may authorize incidental take that occurs over a longer period of time or across a larger area.

The 2012 OWEF ECP was developed to meet BLM and USFWS requirements for addressing BGEPA and the MBTA as it relates to eagles. As described in the USFWS Draft ECP Guidance dated January 2011, the USFWS recommended that project proponents prepare an ECP to avoid, minimize, and mitigate project-related impacts to eagles to ensure no-net-loss to the golden eagle population. Pursuant to BLM Instructional Memorandum (IM) 2010-156, the BLM requested "concurrence" from the USFWS that the ECP meets specific requirements. OE LLC developed the 2012 OWEF ECP in coordination with the BLM and USFWS and USFWS provided a letter to the BLM allowing the BLM to issue the ROD and ROW grant for the Project.

Since the 2012 OWEF ECP was finalized, the USFWS finalized the Eagle Conservation Plan Guidance - Module 1 - Land-based Wind Energy Version 2 in 2013 (USFWS 2013). If eagles are identified as a potential risk at a project site, developers are strongly encouraged to follow the ECP Guidance, which describes specific actions that are recommended to achieve compliance with the regulatory requirements in BGEPA for an eagle take permit. The ECP Guidance provides a national framework for assessing and mitigating risk specific to eagles through development of ECPs and issuance of programmatic eagle take permits for eagles at wind facilities, and strives to meet the goal of no-net-loss to eagle populations.

The ECP Guidance document was written to guide development of wind energy projects from their earliest conceptual planning phase and recognized that it may not be possible for projects already in the development or operational phase to implement all stages of the recommended approach. As such, the ECP Guidance recommends that project developers or operators with operating or soon-to-be operating facilities that are interested in obtaining a programmatic eagle take permit contact the USFWS to determine if the project might be able to meet the permit requirements in 50 CFR 22.26. The OWEF is an operational facility that was constructed in the fall of 2012, prior to finalization of the 2013 ECP Guidance, and therefore falls into this category of project. OE LLC has been communicating with the USFWS regarding the results of ongoing post-construction monitoring efforts and intends to continue communicating with USFWS.

The OWEF ECP is intended to support an application for a programmatic eagle take permit if it is determined that the OWEF should apply for a permit, while also reducing or eliminating the need for costly experimental ACPs at the project, given our current understanding of the level of risk to eagles based on the 2013 ECP Guidance and the collection of all site-specific data that is available.

1.3.3 National Environmental Protection Act

NEPA [42 U.S.C. 4321 et seq.] establishes national environmental policy and goals for the protection, maintenance, and enhancement of the environment and provides a process for implementing these goals within the federal agencies. NEPA ensures that the environmental impacts of federal actions and appropriate mitigations for those impacts are fully considered through a systematic interdisciplinary approach. All federal agencies are required to prepare detailed statements assessing the environmental impact of, and alternatives to, major federal actions that significantly affect the environment. Issuance of an eagle take permit by the USFWS constitutes a federal action and thus requires an assessment of the potential environmental impacts associated with the action and alternatives under NEPA. Because the OWEF is located on federal (BLM) lands, an Environmental Impact Statement (EIS) was completed by the BLM in accordance with NEPA requirements prior to project construction. Potential impacts to eagles were considered in the EIS, as well as in the ABPP and ECP. In addition, because the USFWS must complete a NEPA analysis before it can issue an eagle permit, an additional NEPA analysis would need to be completed in conjunction with the issuance of any eagle take permit that may be granted to OWEF.

1.4 Pattern Energy Policy and Commitment to Environmental Protection

Pattern Energy is an independent, fully integrated energy company that develops, constructs, owns, and operates wind power projects across North America and parts of Latin America. Pattern Energy commenced operations in June of 2009 as one of the most experienced and best capitalized renewable energy companies in the United States. OE LLC, through Pattern, is dedicated to delivering the highest values for their partners and the communities where they work, while exhibiting a strong commitment to promoting environmental stewardship and corporate responsibility. OE LLC is committed to building environmentally responsible renewable energy projects, and continues to work closely with environmental agencies to develop appropriate mitigation measures to reduce impacts to wildlife.

2.0 SITE SPECIFIC SURVEYS AND ASSESSMENTS (STAGE 2)

Baseline data were collected on golden eagles in the vicinity of the OWEF beginning in the fall of 2009. Golden eagle nest surveys, raptor migration surveys, and avian point counts were conducted (Helix 2010a, 2010b, 2011). Golden eagle nest surveys were conducted in the spring of 2010 by Wildlife Research Institute (WRI), a local firm that has extensive historical information on golden eagles nesting in the vicinity of the OWEF. Migration surveys were conducted by Helix Environmental Planning, Inc. (HELIX) in the fall of 2009, spring and fall of 2010, and spring of 2011. Avian use point counts were conducted weekly over a one-year period from September of 2009 to August of 2010. The following sections provide more details on the site-specific baseline golden eagle information collected for the OWEF. Additional data collection on eagles has been conducted since November of 2012 and is currently ongoing (see Section 5.0 – post-construction monitoring for additional details).

2.1 Golden Eagle Nest Surveys

2.1.1 Methods

HELIX contracted with WRI to conduct surveys of golden eagle (*Aquila chrysaetos*) nest sites in eagle territories that occur within 10 miles of the project site, in accordance with the guidance provided in the USFWS Inventory and Monitoring Protocols (Pagel et al. 2010). WRI conducted helicopter surveys in four known territories (referred to as Coyote Mountains West, Coyote Mountains East, Table Mountain, and Carrizo Gorge) in the spring of 2010. A hand-held GPS was used to record the helicopter flight path and the location of each nest site. Nest-specific information was documented by two eagle biologists in the helicopter, and each nest site was photographed. In addition to helicopter surveys, WRI conducted ground surveys of an additional suspected golden eagle territory (referred to as Mountain Springs) in the spring of 2010. Helicopter surveys were not allowed by USFWS in the Mountain Springs area because of potential disturbance to Peninsular bighorn sheep (*Ovis canadensis nelsoni*).

2.1.2 Results

Twenty-one golden eagle nests were observed in the five territories during nest surveys in 2010 (Figure 4). Two of the five territories were designated as active by WRI in 2010. One nest in the Coyote Mountains West territory was considered active. Two additional nests in the Table Mountain territory were considered as inactive/possibly active due to subtle signs of activity that were difficult to confirm. On September 15, 2010, a breeding pair of adult eagles was observed on the Table Mountain territory, providing further support for the active designation of this territory in 2010. The remaining three territories were designated inactive in 2010.

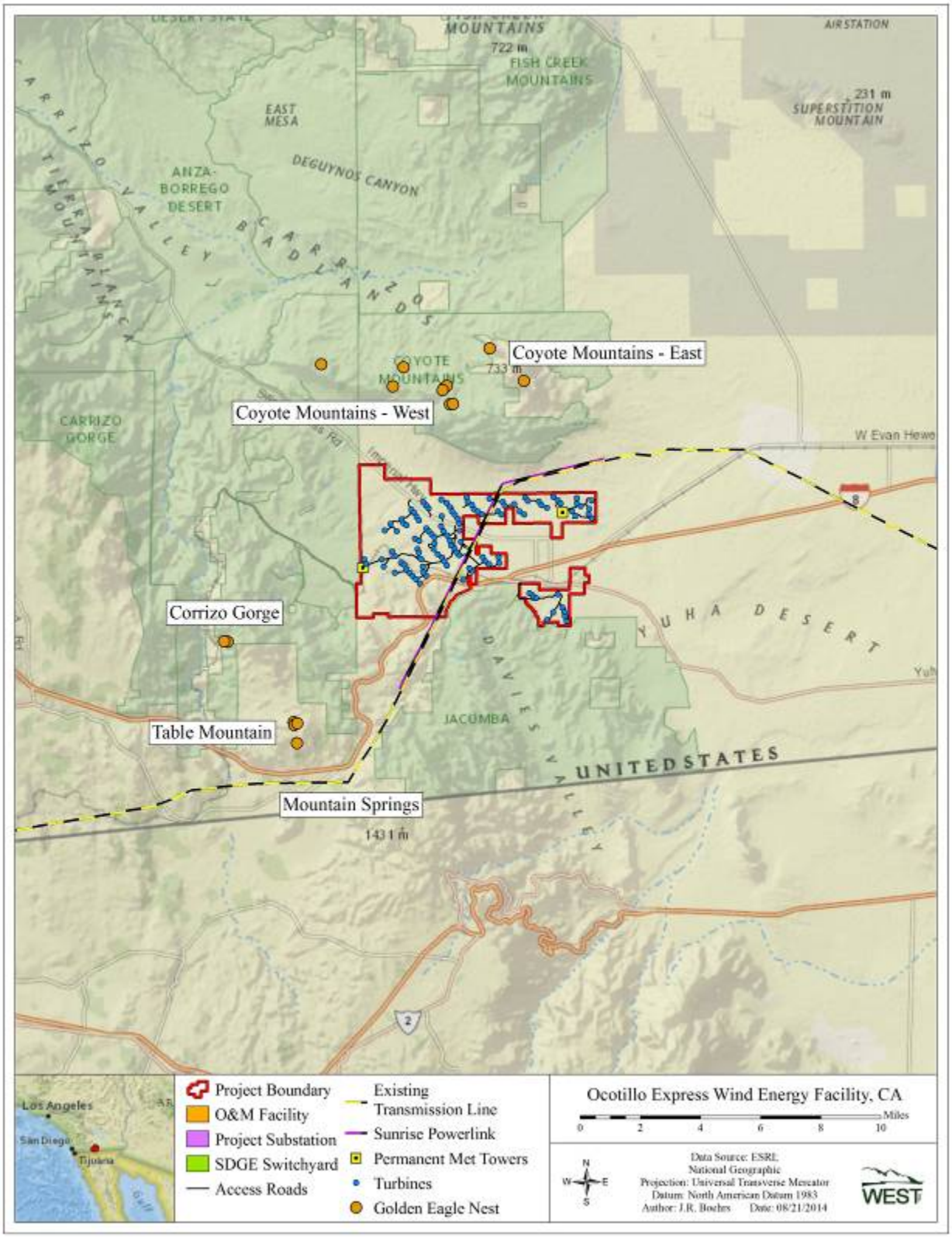


Figure 4. Location of golden eagle nests and territories within 10 miles of the Ocotillo Wind Energy Facility.

2.1.3 Discussion

According to information contained in the Avian and Bat Protection Plan (ABPP) for the Tule Wind Project, WRI conducted golden eagle nest surveys within four of the territories (excluding Mountain Springs) in 2011 (Tule Wind LLC 2011). Two of the territories (Coyote Mountains West and Table Mountain) were identified as active in 2011. Coyote Mountains West was determined to be occupied during the first round of golden eagle nest surveys. However, Coyote Mountains West was not confirmed to be productive in 2011 (Tule Wind LLC 2011).

Historical nesting information for some of the territories is available to provide further information on golden eagle activity within 10 miles of the OWEF (Helix 2010a, b). The historical nesting information has been compiled from previous work conducted by WRI and others including review of the BLM's historic documents and potentially relevant correspondence from resource agencies. Based on this historical information, the Coyote Mountain East territory has been inactive for several years. Table Mountain was successful in producing at least one chick in 2004 and Carrizo Gorge was successful in 2007. Coyote Mountain West is a newly identified territory. Mountain Springs had no sign of activity, although closer monitoring may be warranted in future years. Drought conditions and the timing of the 2010 golden eagle nest surveys limit the utility of the one year of baseline golden eagle nest surveys for anticipating impacts to nesting golden eagles from the OWEF. The long-term data help in understanding use of the territories in relation to the OWEF.

Based on the golden eagle nest data from 2010 as well as the 2011 results contained in the Tule Wind Project ABPP, none of the nests identified were within three miles of turbine locations. The closest active nest in either 2010 or 2011 was located 4.1 miles from turbine locations (Coyote Mountains West territory). Table Mountain was determined to be active in both 2010 and 2011. No other active territories were confirmed during the 2010 or 2011 raptor nest surveys conducted within 10 miles of the OWEF.

2.2 Avian Point Counts

2.2.1 Methods

HELIX conducted Avian Point Counts (APC's) approximately weekly over a one-year period (September 1, 2009 – August 31, 2010). The APC's were conducted in accordance with the survey protocols approved by BLM (HELIX 2010a) and generally in accordance with the bird use count methods described in the California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development (California Energy Commission [CEC] 2007). The goal of the APC's was to record bird species, abundance, behavior, and flight characteristics from selected sampling locations over a 30-minute period. A total of 50 weeks of point counts were conducted over the one-year period (APC's were not conducted the week of November 29-December 5, 2009, or the week of January 17-23, 2010). Each APC location was visited once per week (the one exception is that Location 13 was not surveyed the week of February 21-27, 2010).

Twenty-one APC locations were established approximately one mile apart throughout the approximately 15,000 acre site (Figure 5). The CEC Guidelines allow for locations to be 5,200 feet apart for large wind resource areas with good viewsheds, which is the case for the study area. The APC locations were chosen based on viewsheds, elevation, and habitat types. Each location had good visibility in all directions, with no major impediments impairing the range of view. Locations also covered a wide range of elevations, from approximately 340 ft AMSL (Location 4) to approximately 1,250 ft AMSL (Location 18). Finally, APC's were strategically located to sample different microhabitats. Although each of the locations occurred in desert scrub habitat, several of the locations were within and adjacent to dry desert washes

(e.g., Locations 6, 10, 13, 14, and 21) while others were located on or adjacent to hilly topography (e.g., Locations 2, 12, 18, and 19).

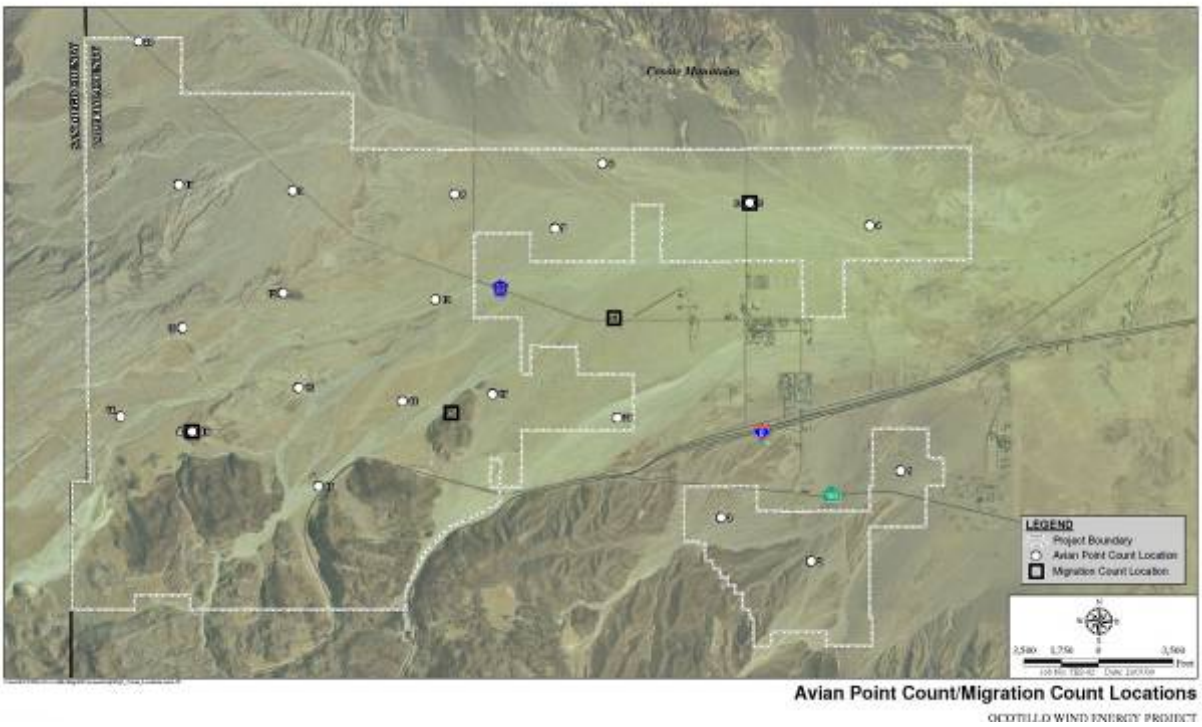


Figure 5. Avian and raptor migration point stations at the Ocotillo Wind Energy Facility.

At each APC location the species, number of individuals, flight height, flight direction, distance from observer, and behavior (e.g., directional flight, perched, flapping flight, soaring, etc.) was recorded over a 30-minute period. Weather conditions (e.g., temperature, wind speed and direction, and cloud cover) were recorded at the start and end of the 30-minute survey period using a hand-held Kestrel anemometer. Species were detected visually with the aid of binoculars and by identifying songs and call notes. All observations were recorded on standardized data sheets. APC's were conducted once per week at each location. Efforts were made to sequence observation times so that locations were surveyed both in the morning and in the afternoon and under varying weather conditions, in accordance with the CEC's Guidelines (CEC 2007).

2.2.2 Golden Eagle Results

Three golden eagles (two adults and one juvenile) were observed flying north over the western portion of the project area during Week One at approximately 1000 feet above ground level (outside the Rotor Swept Area [RSA]; Table 1; Figure 6). No other golden eagles were observed during weekly point counts, but golden eagles were observed during fall 2009 migration counts (see below; HELIX 2010).

Table 1. Summary of golden eagle observations during avian point counts at the Ocotillo Wind Energy Facility, September 1, 2009 – August 31, 2010.

Date	Time of Observation	# of Individuals	Age	Flight Height (ft above ground)	Distance From Observer (ft)	Total Length of Mapped Flight Path (m)	Length of Mapped Flight Path within Survey Plot (m)
2-Sep-09	1110 to 1112	3	2 Adults; 1 Juvenile	1,000	600	4,741.05	761.61

2.2.3 Discussion

The yearlong APC's were conducted in what was considered a typical year for the Colorado Desert. The 2009-2010 time period was considered an average rainfall year for the region and the region did not experience abnormally long hot, cold, wet, or dry periods during the 2009-2010 timeframe. As such, the results of the APC's would be considered typical for this area. The timing of migration, resident and migratory species composition and abundance, and bird behavior may vary during years when conditions are abnormally wet, dry, hot, or cold. Two years of raptor specific migration surveys (summarized below) are also used to assess golden eagle use.

Based on the data collected to date, the OWEF does not support large numbers of resident golden eagles. The site does not appear to be part of a major migration corridor for golden eagles. Golden eagles were seen only once during the point counts study (September 2, 2009) and were observed flying at a height above the RSA.

Some concerns have been expressed regarding the use of avian point count surveys for assessing eagle and/or raptor use. Avian point counts are commonly used to assess raptor use (including eagles) at WRA's (Strickland et al. 2011). Comparisons of use between concurrent raptor specific surveys and avian point counts have shown similar levels of use (when the level of effort has been standardized). One example is from the North Sky River (NSR) project in Kern County, CA. Spring eagle observation surveys at the NSR project estimated eagle use to be 0.055 eagles/30-minute survey and spring avian point count surveys at the NSR project estimated eagle use to be 0.05 eagles/30-minute survey (Erickson et al. 2011). Additional raptor specific migration surveys were conducted at the OWEF and are summarized below. The raptor migration surveys at the OWEF provide further support for the low levels of golden eagle use observed during the APC's.

2.3 Golden Eagle Migration Surveys

2.3.1 Methods

HELIX conducted migration counts in the spring and fall seasons during a two year period (over an eight calendar-week period during the 2009 fall migration period [September 24 – November 10, 2009], over a 10 calendar-week period during the 2010 spring migration period [March 22 – May 28, 2010], over a 12 calendar-week period during the 2010 fall migration period [August 23 – November 12, 2010], and over a 10 calendar-week period during the spring 2011 migration period [March 21 – May 27, 2011]). The methods of each survey were developed in coordination with the BLM and were based on the recommendations provided in the California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development (CEC 2007). The purpose of the migration study was to document diurnal raptor activity within the project area in order to provide a risk assessment for these species. HELIX stationed four surveyors throughout the site to scan the sky and record bird migration data. The four migration count locations (Locations A through D; Figure 5) were spaced approximately two miles apart,

generally along a southwest-northeast axis across the site. Migration count points were located to maximize the likelihood of detecting potential north-south and east-west migration through the site.

Migration counts were focused on the time of day when raptors were observed to be most active over the site (late morning to late afternoon). The migration counts were staggered to either begin shortly after sunrise or to conclude before sundown to cover the bimodal activity of diurnal bird migrants. During the fall of 2009 and the spring of 2010, migration counts were conducted approximately 8 hours per day; during the fall of 2010 and the spring of 2011, migration counts were conducted approximately 5.5 hours per day (typically from mid-morning to late afternoon).

2.3.2 Results

A total of 747.9 observation hours were logged during the fall of 2009. Nine golden eagle observations were recorded during the fall of 2009 (Table 2; Figure 6). A total of 930.2 observation hours were logged during the spring of 2010. No golden eagles were observed during spring migration counts; however, a single golden eagle was observed during a burrowing owl survey on the site on June 17, 2010 (Table 3; Figure 7). A total of 581.4 observation hours were logged in the fall of 2010, and 11 golden eagles were observed during the fall migration counts in 2010 (Table 4; Figure 8). A total of 486.1 observation hours were logged during the spring of 2011. Eleven golden eagles were observed during the spring migration counts in 2011, with just over one-third of the observations occurring on March 22, 2011 (four observations; Table 5; Figure 9).

Table 2. Summary of golden eagle observations during Fall 2009 raptor migration surveys at the Ocotillo Wind Energy Facility, September 24 – November 10, 2009.

Date	Time of Observation	# of Individuals	Age	Flight Height (ft above ground)	Distance From Observer (ft)	Total Length of Mapped Flight Path (m)	Length of Mapped Flight Path within Survey Plot (m)
25-Sep-09	1440 to 1442	1	Juvenile	30 – 800	300	16,564.20	1,666.17
25-Sep-09	1545 to 1555	1	Juvenile	400 – 4,000	5,200 – 8,000	4,035.75	NA
2-Oct-09	1315 to 1319	2	1 Adult; 1 Juvenile	800 – 1,200	1,000	7,359.15	NA
22-Oct-09	1145 to 1212	2	Unknown	200 – 500	7,000	9,074.18	1,028.68
30-Oct-09	1325 to 1335	1	Juvenile	200 – 1,000	3,000	11,494.10	NA
10-Nov-09	1230 to 1330	2[†]	1 Adult; 1 Juvenile	0 – 1,500	1,000 – 10,000	9,904.44	NA

[†]These eagles were determined to have been observed by more than one observer. Ranges in the table for flight height and distance include the range reported by all observers. Also, observations are treated as independent for estimating standardized eagle use estimates.

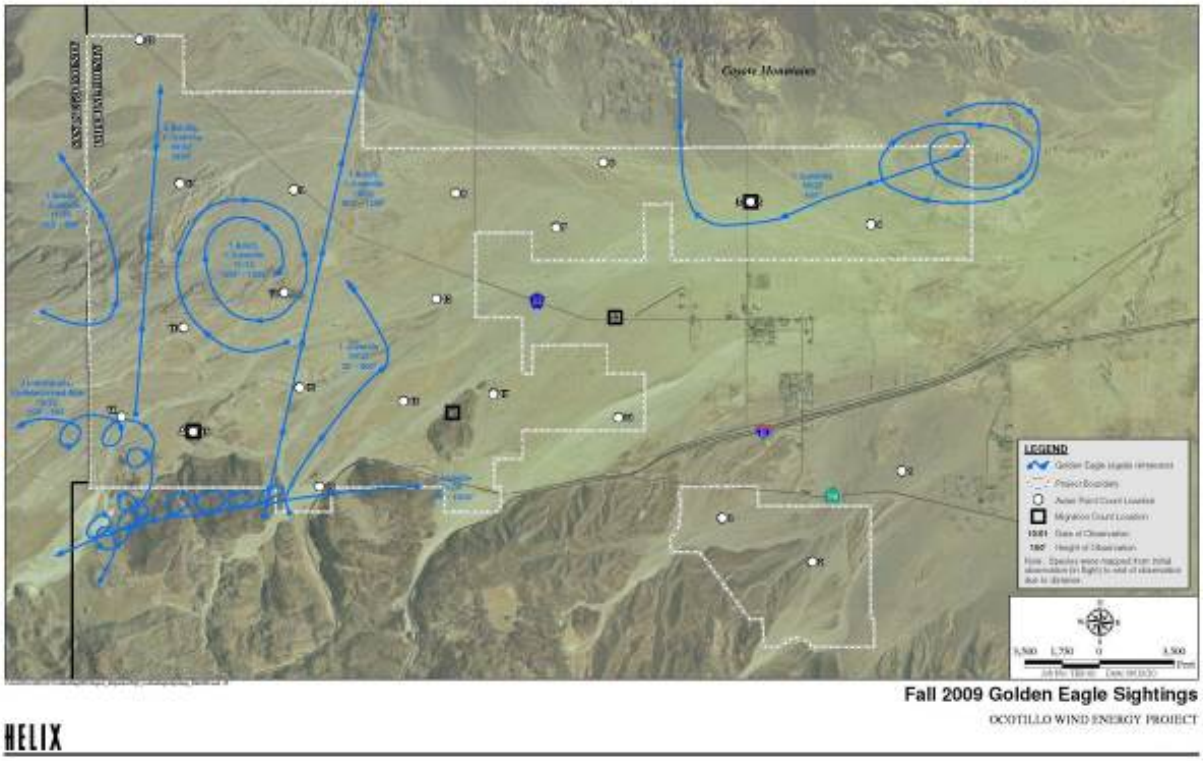


Figure 6. Mapped flight paths and perch locations for golden eagles observed during the fall of 2009 within the Ocotillo Wind Energy Facility.

Table 3. Summary of incidental golden eagle observations during Spring 2010 raptor migration surveys at the Ocotillo Wind Energy Facility, March 22 – May 28, 2010. No golden eagles were observed during Spring 2010 raptor migration surveys.

Date	Time of Observation	# of Individuals	Age	Flight Height (ft above ground)	Distance from Observer (ft)
17-Jun-10	0530 to 0532	1[†]	Adult	0 – 100	20
17-Jun-10	0630 to 0631	1[†]	Adult	0 – 20	200

[†] Determined to be the same individual observed separately by two biologists during burrowing owl surveys (Helix 2010b).

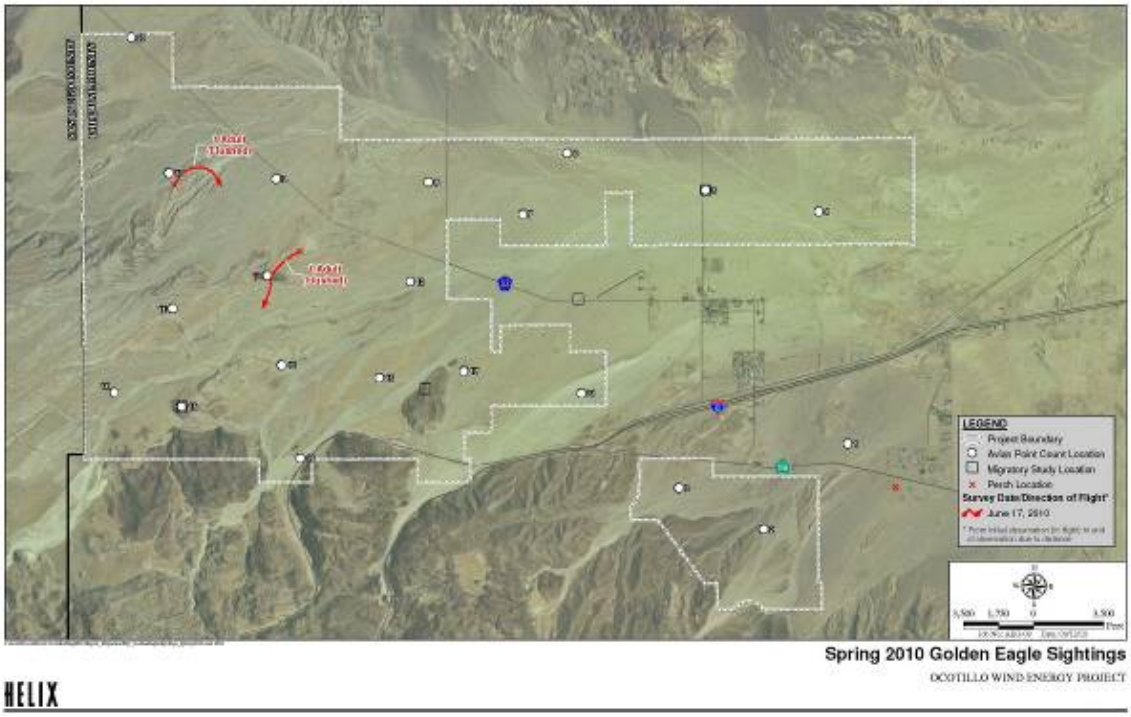


Figure 7. Mapped flight paths and perch locations for golden eagles observed during the spring of 2010 within the Ocotillo Wind Energy Facility.

Table 4. Summary of golden eagle observations during Fall 2010 raptor migration surveys at the Ocotillo Wind Energy Facility, August 23 – November 12, 2010.

Date	Time of Observation	# of Individuals	Age	Flight Height (ft above ground)	Distance From Observer (ft)	Total Length of Mapped Flight Path (m)	Length of Mapped Flight Path within Survey Plot (m)
21-Sep-10	1105-1300*	1†	Undetermined	500	4,000 – 9,000	7,455.66	NA
4-Oct-10	1053-1057	1	Juvenile	400 – 500	6,000	2,267.52	NA
13-Oct-10	1156-1214	1	Adult	35 – 3,000	200	5,164.82	NA
29-Oct-10	1050-1130	1†	Adult	100 – 800	5,000 – 7,500	14,500.70	NA
3-Nov-10	1145-1158	1	Undetermined	1,500 – 2,000	9,000	6,913.04	NA
5-Nov-10	1035-1048	1	Undetermined	200 – 400	3,000 – 9,000	8,415.28	NA
5-Nov-10	1220-1235	1†	Undetermined	100 – 600	200 – 1,000	4,620.72	NA
10-Nov-10	0940-0946	1†	Undetermined	400 – 1,250	400 – 8,000	17,348.70	NA
12-Nov-10	1225-1233	1†	Adult	150 – 500	2,000 – 3,000	3,450.36	NA
12-Nov-10	1235-1256	2†	1 Adult; 1 Juvenile	150 – 1,000	4,000 – 20,000	13,304.30	5403.05

*Includes time eagle was perched off site (80 minutes) as well as the additional time eagle was observed flying off site over the Jacumba Mountains (25 minutes).
†These eagles were determined to have been observed by more than one observer. Ranges in the table for flight height and distance include the range reported by all observers. Also, observations are treated as independent for estimating standardized eagle use estimates.

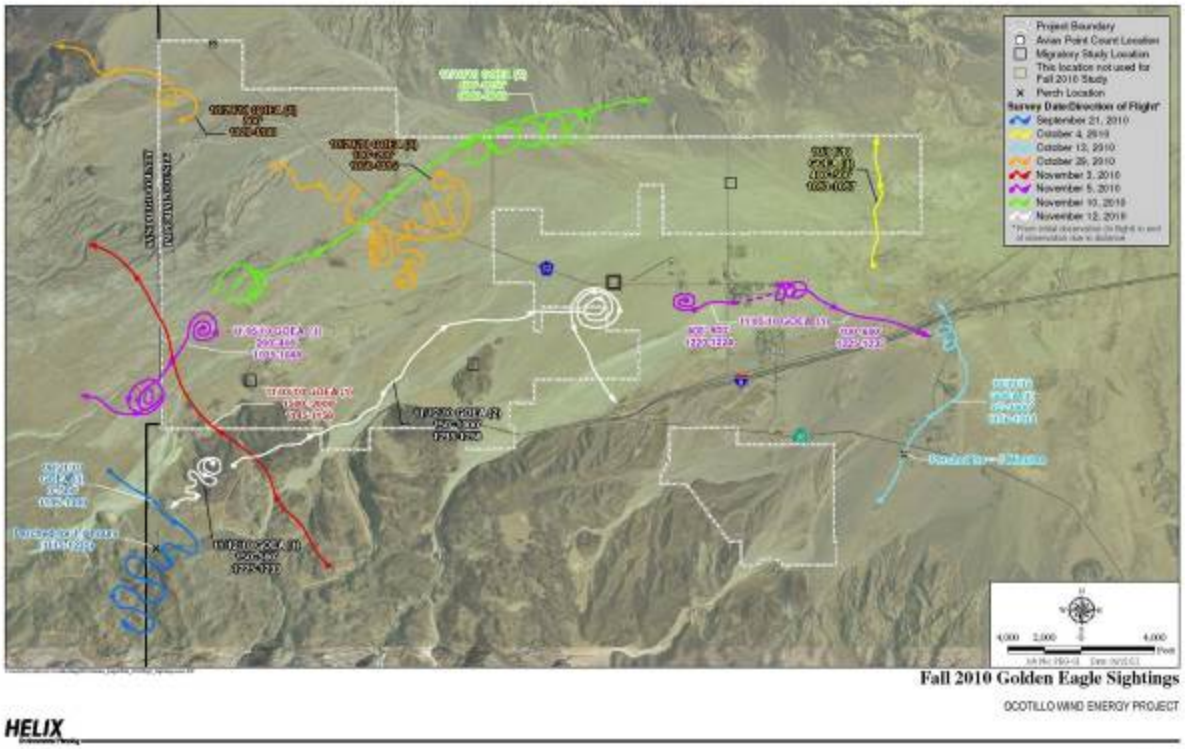


Figure 8. Mapped flight paths and perch locations for golden eagles observed during the fall of 2010 within the Ocotillo Wind Energy Facility.

Table 5. Summary of golden eagle observations during Spring 2011 raptor migration surveys at the Ocotillo Wind Energy Facility, March 21 to May 27, 2011.

Date	Time of Observation	# of Individuals	Age	Flight Height (ft above ground)	Distance From Observer (ft)	Total Length of Mapped Flight Path (m)	Length of Mapped Flight Path within Survey Plot (m)
22-Mar-11	1130-1135	1	Unk	200 – 1,000	1,500	7,005.83	NA
22-Mar-11	1326-1334	1	Juvenile	200 – 1,200	200 – 3,000	11,108.20	1,231.82
22-Mar-11	1410-1426	1†	Juvenile	1,000 - 1,500	3,000 – 6,000	14,803.20	NA
22-Mar-11	1450-1500	1	Juvenile	100 – 1,000	2,000	8,298.89	6227.3
23-Mar-11	0930-0940	1	Juvenile	300 - 1,000	1,700	6,281.99	1,364.99
30-Mar-11	1050-1055	1	Juvenile	300 – 1,200	3,000	3,867.49	179.80
6-Apr-11	1302-1315	1	Juvenile	500 - 1,000	6,000	12,049.50	6542.01
3-May-11	1055-1114	1†	Adult	0 - 500	4,000	5,965.67	NA
4-May-11	1232-1241	2	1 Adult; 1 Unk	100 – 2,000	7,500	15,394.30	NA
16-May-11	1309-1312	1	Juvenile	100 - 200	3,500	7,640.75	NA

†These eagles were determined to have been observed by more than one observer. Ranges in the table for flight height and distance include the range reported by all observers. Also, observations are treated as independent for estimating standardized eagle use estimates.

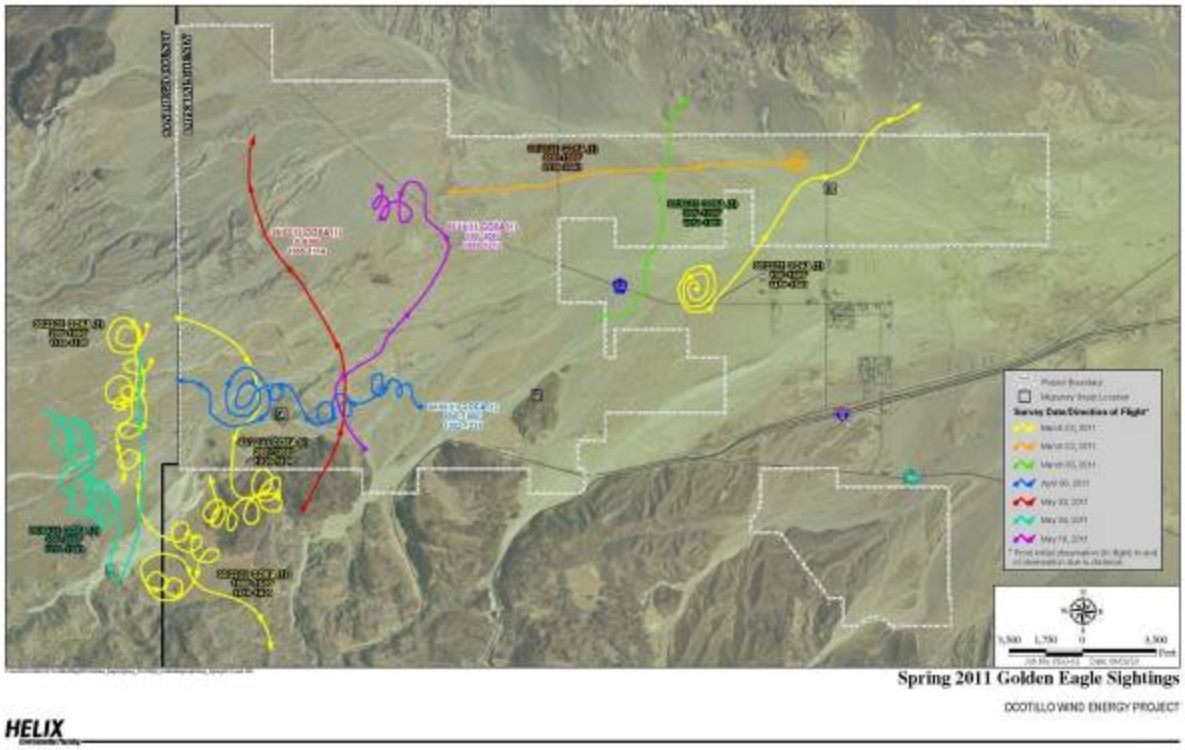


Figure 9. Mapped flight paths and perch locations for golden eagles observed during the spring of 2011 within the Ocotillo Wind Energy Facility.

2.3.3 Discussion

The OWEF is not located in a known raptor migration corridor (Aspen Environmental Group 2008; pers. comm.; Unitt 2007). The majority of the project site supports desert scrub vegetation and dry desert washes. The site does not contain the appropriate topography to funnel migrating birds through the site. With the exception of Sugarloaf Mountain and the rocky terrain in the southwest portion of the site, the project is generally flat and is located east of the Jacumba Mountains and south of the Coyote Mountains. The southwesterly prevailing wind direction would not appear to be conducive to creating updrafts in the project site that are often associated with high raptor migration areas. The site lacks a major ridgeline, water bodies, and large stands of mature trees. The closest major water body is the Salton Sea, which is 30 miles to the northeast of the site, and the irrigated agriculture fields near El Centro are approximately 15 miles to the west of Ocotillo. The results of HELIX's labor-intensive fall 2009, spring and fall 2010, and spring 2011 migration counts (two years of surveys) indicate that the OWEF site is not part of a major migratory pathway for golden eagles. Golden eagles were observed up to the end of the fall season during both the 2009 and 2010 raptor migration surveys. Results from the yearlong APC study (only 3 golden eagle observations on September 2, 2009) provide further support that the OWEF site is not part of a major migratory pathway and that the timing of the raptor migration surveys would not have missed any large influxes of migratory golden eagles (since no golden eagles were recorded during the APC surveys in November or December).

2.4 Pre-construction Golden Eagle Use

A total of 3,270.1 observation hours were logged and only 40 golden eagle observations (six of which were determined to be observations of the same eagle(s) by more than one observer) were recorded, resulting in 0.01 golden eagle observations per hour (Table 6). The golden eagle use estimates suggest relatively low use of the project site during the study period, especially when compared to other projects in California (where similar methods were used to document use), such as the High Winds Wind Resource Area (0.3 eagles/30-min survey during pre-construction surveys; Kerlinger et al. 2005, 2006) and the Diablo Winds Wind Resource Area (0.3 eagles/30-min survey during the post-construction period; WEST 2008).

Table 6. Summary of golden eagle observations, raptor observations*, sampling effort, and mean use at the Ocotillo Wind Energy Facility during raptor migration surveys and avian point counts, September 1, 2009 – November 10, 2010.

Season	Species Group	Observations	Sampling Effort (hours)	Mean Use (Obs/Hour)
Raptor Migration Surveys				
Fall 2009**	golden eagles	9	747.9	0.01
	raptors and vultures	165	747.9	0.22
	raptors	150	747.9	0.20
Spring 2010	golden eagles	0	930.2	0
	raptors and vultures	522	930.2	0.56
	raptors	206	930.2	0.22
Fall 2010	golden eagles	11	581.4	0.02
	raptors and vultures	451	581.4	0.78
	raptors	368	581.4	0.63
Spring 2011	golden eagles	11	486.1	0.02
	raptors and vultures	935	486.1	1.92
	raptors	479	486.1	0.98
All Seasons	golden eagles	31	2,745.6	0.01
	raptors and vultures	2,073	2,745.6	0.76
	raptors	1,203	2,745.6	0.44
Avian Point Counts				
1-Sep-09 through 31-Aug-10	golden eagles	3	524.5	0.01
	raptors and vultures	227	524.5	0.43
	raptors	139	524.5	0.27
All Surveys To Date				
1-Sep-09 through 12-Nov-10	golden eagles	36[†]	3270.1	0.01
	raptors and vultures	2,300	3270.1	0.70
	raptors	1,342	3270.1	0.41

*Raptor data reported by HELIX Environmental Planning, Inc. included turkey vultures (Helix 2010a, 2010b, 2011, unpublished data).

**Large numbers of raptors and turkey vultures were not documented during Fall 2009 raptor migration surveys (Helix 2010)

[†]Includes two incidental observations of the same individual during Spring 2010 burrowing owl surveys.

3.0 ASSESSING GOLDEN EAGLE RISK AND PREDICTING FATALITIES (STAGE 3)

3.1 Assessing Golden Eagle Risk at OWEF

The USFWS ECP Guidance uses a three category system in defining risk to eagles, and their definitions are provided verbatim below.

Category 1 – For sites with high risk to eagles, and potential to avoid and mitigate impacts is low

A project is in this category if it:

(1) has an important eagle-use area or migration concentration site within the project footprint; or

(2) has an annual eagle fatality estimate (average number of eagles predicted to be taken annually) > 5% of the estimated local-area population size; or

(3) causes the cumulative annual take for the local-area population to exceed 5% of the estimated local-area population size.

Category 2 – High or moderate risk to eagles, opportunity to mitigate impacts

A project is in this category if it:

(1) has an important eagle-use area or migration concentration site within the project area but not in the project footprint; or

(2) has an annual eagle fatality estimate between 0.03 eagles per year and 5% of the estimated local-area population size; or

(3) causes cumulative annual take of the local-area population of less than 5% of the estimated local-area population size.

Category 3 – Minimal risk to eagles

A project is in this category if it:

(1) has no important eagle use areas or migration concentration sites within the project area; and

(2) has an eagle fatality rate estimate of less than 0.03 eagles per year; and

(3) causes cumulative annual take of the local-area population of less than 5% of the estimated local-area population size.

Projects in category 3 pose little risk to eagles and may not require or warrant eagle take permits, but that decision should be made in coordination with the USFWS.

We discuss several risk factors and the information used to evaluate the risk characterization of the OWEF, including evaluating eagle use areas, calculation of the fatality estimate, and understanding local-area population size and cumulative annual take. Based on the data presented in the following sections, we conclude that the OWEF may meet the criteria of a Category 3 site or at the very least, an extremely low risk Category 2 site.

3.1.1 Nesting and Breeding

Based on the definitions used by WRI and for the purposes of the OWEF ECP, an active nest is a nest in good condition that has evidence of new material having been added during the season in which the survey was conducted. An active nest may or may not be occupied in the survey year. An occupied nest is an active nest in which an adult, young eagle, or new egg has been observed on the nest in the survey year. Lastly, an active territory is a territory for which an active or occupied nest was present or there have been observations of a breeding pair of adult eagles in the territory during the survey year.

The 2010 golden eagle nest surveys indicated that two of the five territories (Coyote Mountains West and Table Mountain; identified by WRI) were active in 2010, while the remaining three territories were considered to be inactive. Two nests in the Table Mountain territory were observed by WRI to show signs of possible activity in 2010 (i.e., shallow, poorly-formed bowls). One nest in the Coyote Mountains West territory was observed by WRI to have signs of activity, including white wash on the rock wall and a prominent bowl in the nesting materials. However, no occupied nests were identified, meaning that no incubating females, chicks, or eggs were noted within the nest sites at the time WRI conducted the helicopter and ground surveys in 2010. According to the Tule Wind Project ABPP, both Coyote Mountains West and Table Mountain were active again in 2011. Coyote Mountains West had an occupied nest in 2011, although no production was confirmed (Tule Wind LLC 2011). Appendix A shows the history of each of the four territories that have been monitored. It is clear these territories generally have not been consistently active, occupied, or productive for the last decade. These findings have been confirmed during post-construction eagle nest monitoring conducted in 2013, 2014, and 2015 (see section 5.0 below). Caution should be exercised when evaluating the status of eagle territories in the desert as it is well known that desert golden eagle territories are not as productive or active as they are in other habitats (USFWS personal communication).

Turbines have been sited greater than three miles from all of the 21 historic golden eagle nests identified within a 10-mile buffer of the project (Table 7). Nine of the historic nests have at least one turbine within a five-mile buffer. The maximum number of turbines within a five-mile buffer of an eagle nest is 61. The maximum number of turbines that are located within 10 miles of an eagle nest is 112 (Table 7).

The approach in the 2013 ECP Guidance for evaluating the potential disturbance impacts to occupied nests calls for measuring nearest neighbor distances from occupied nests (USFWS 2013). Since no occupied nests were identified and only one nest was considered active, this is not possible. Instead, three approaches were used to approximate territory size in the vicinity of the OWEF. Under the first approach, the average maximum nest distance between territories closest to one another was calculated for all five territories identified in Helix (2010). This assessment assumes that the nests within 10 miles of the OWEF have been correctly assigned to their respective territories. The distance to Mountain Springs was approximated, since the actual nest locations were unknown. Table 8 shows the maximum distances between nests in territories closest to one another. The average of these maximum distances is 4.97 miles, so half that distance (2.49 miles) was the buffer used from nests to determine territory overlap with the project and assess the potential for nest disturbance. While this approach does not fit exactly to the ECP guidance, it would appear to be a reasonable approach for defining a buffer to help evaluate the potential for nest disturbance (Figure 10). The second approach was based on the two active territories and used the maximum distance of active (or potentially active) nests between the two active territories (Coyote Mountains West and Table Mountain). The maximum distance between active/potentially active nests between the two territories is 12.36 miles, so half that distance is 6.18 miles, which was the buffer used from nests to determine territory overlap with the project under the second approach. The second approach provides a more conservative estimate of approximate territory size (Figure 10). A third estimate of territory size, based on the 6.2-mile inter-nest distance suggested in the 2011 Draft ECP Guidance, yields a buffer of 3.1 miles (Figure 10; USFWS 2011).

Table 7. The number of turbines within various buffers of all known nests in each of the five known territories within 10-miles of the Ocotillo Wind Energy Facility.

	Number of Turbines		
Territory-Nest #	**2-mi.**	**5-mi**	**10-mi**
Corrizo Gorge - Nest1	0	0	79
Corrizo Gorge - Nest2	0	0	79
Corrizo Gorge - Nest3	0	0	77
Corrizo Gorge - Nest4	0	0	77
Coyote Mtns. W - Nest1	0	0	98
Coyote Mtns. W - Nest2	0	0	98
Coyote Mtns. W - Nest3	0	28	112
Coyote Mtns. W - Nest4	0	11	111
Coyote Mtns. W - Nest5	0	42	112
Coyote Mtns. W - Nest6	0	44	112
Coyote Mtns. W - Nest7	0	46	112
Coyote Mtns. W - Nest8	0	61	112
Coyote Mtns. W - Nest9	0	61	112
Coyote Mtns. E - Nest1	0	1	112
Coyote Mtns. E - Nest2	0	34	112
Table Mtn. - Nest1	0	0	90
Table Mtn. - Nest2	0	0	90
Table Mtn. - Nest3	0	0	90
Table Mtn. - Nest4	0	0	87
Table Mtn. - Nest5	0	0	87
Mountain Springs – No nest locations known	0	0	Similar to Table Mountain

Table 8. Calculations of maximum distances between nests of territories closest to one another near the Ocotillo Wind Energy Facility.

Territory	**Nearest Territory**	**Maximum Distance**
Coyote Springs West	Coyote Springs East	6.77 miles
Carizo Gorge	Table Mountain	4.16 miles
Mountain Springs	Table Mountain	3.02 miles
Table Mountain	Carizo Gorge	4.16 miles
Coyote Springs East	Coyote Springs West	6.77 miles
	Average	**4.97 miles**
	Buffer (1/2 average)	**2.49 miles**

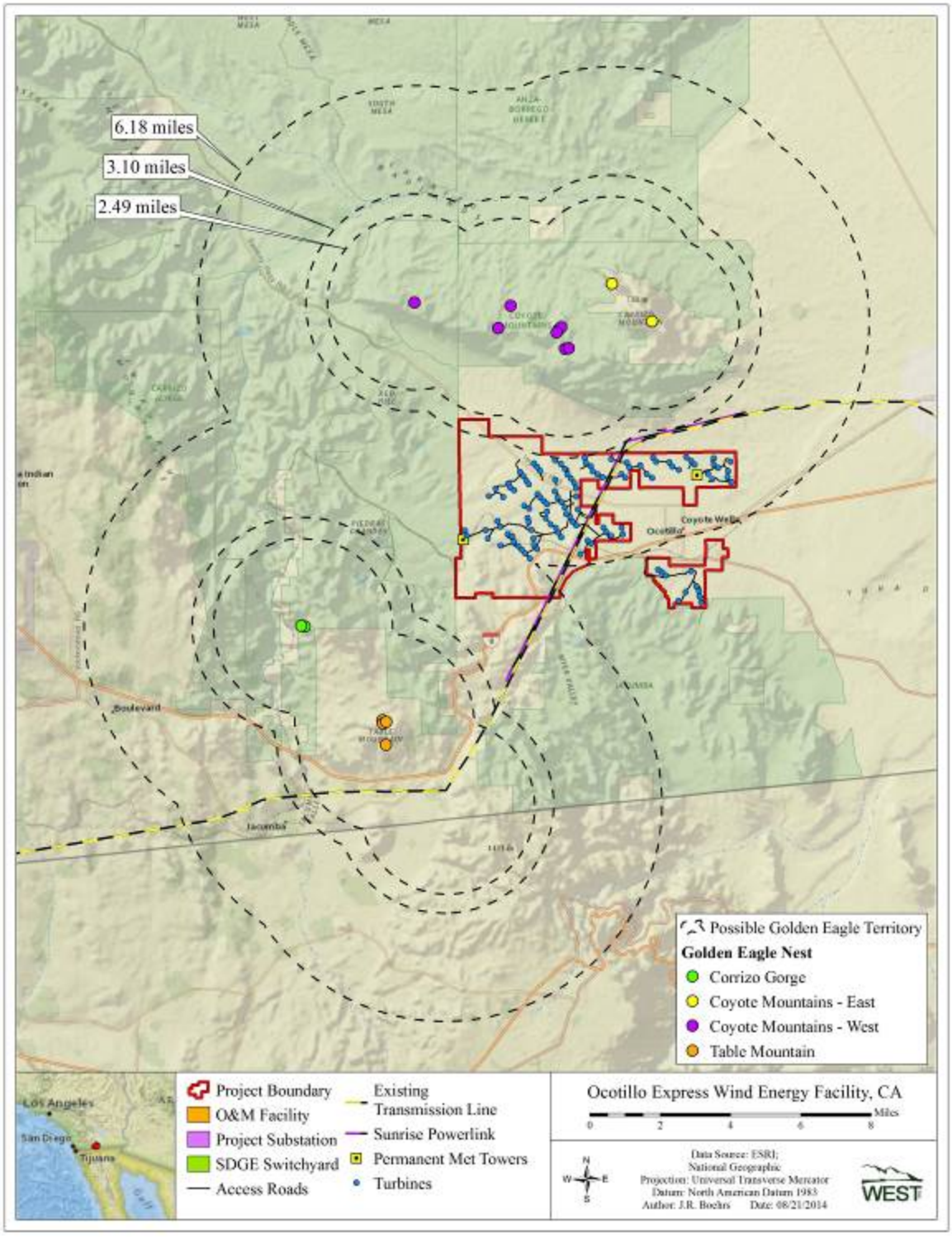


Figure 10. Nest buffers for the eagle territories within 10 miles of the Ocotillo Wind Energy Facility. A buffer distance of 2.49 miles was used based on average maximum distances between nests of territories closest to one another. A second buffer distance of 6.18 miles is also depicted and is based on ½ the maximum distance between active or potentially active nests within the two active territories. A third buffer distance of 3.1 miles, suggested in the 2011 Draft ECP Guidance, is also depicted here.

3.1.2 Concentration Areas (Communal roosts, foraging areas, migration corridors, and migration stopovers)

The golden eagle data collected prior to development of the Project suggested that golden eagles use the OWEF on a limited basis for foraging and during the migration season. The data suggested that there were no high golden eagle use areas or golden eagle concentration areas, including communal roosts or concentrated foraging areas, within the OWEF. The migration counts conducted suggested that the OWEF was not an important migration corridor or migration stopover for golden eagles. The results of post-construction monitoring efforts provide further support for the conclusions based on the pre-construction survey efforts (see Section 5.0 below).

3.1.3 Eagle Risk Factors

An assessment of the factors known or thought to be associated with increased probability of collisions between eagles and other raptors and wind turbines (from the 2013 ECP Guidance) for the OWEF is provided in Table 9 (located at the end of this section). The risk factors and the science behind the risk factors have been adopted from the 2013 USFWS ECP Guidance (USFWS 2013). In addition to abundance, the two main risk factors identified in the 2013 USFWS ECP Guidance are 1) the interaction of topographic features, season, and wind currents that create conditions for high-risk flight behavior near turbines; and 2) behavior that distracts eagles and presumably makes them less vigilant (e.g., active foraging or inter- and intra-specific interactions such as territorial defense).

TOPOGRAPHY AND WIND

The topography of the OWEF at a landscape scale is provided in Figure 3. The topography of the site is highest in the southwest corner and falls away towards the northeast. A rose diagram depicting the prominent wind direction at the OWEF is provided in Figure 11. The prominent wind direction at the OWEF is strongly oriented in a northeast direction. The orientation of the overall topography at a landscape scale and the prominent wind direction in relation to the OWEF suggest that the OWEF should be less risky to golden eagles since the OWEF is sited on the downwind side of the Jacumba Mountains and would be less likely to have conditions suitable for strong updrafts of wind.

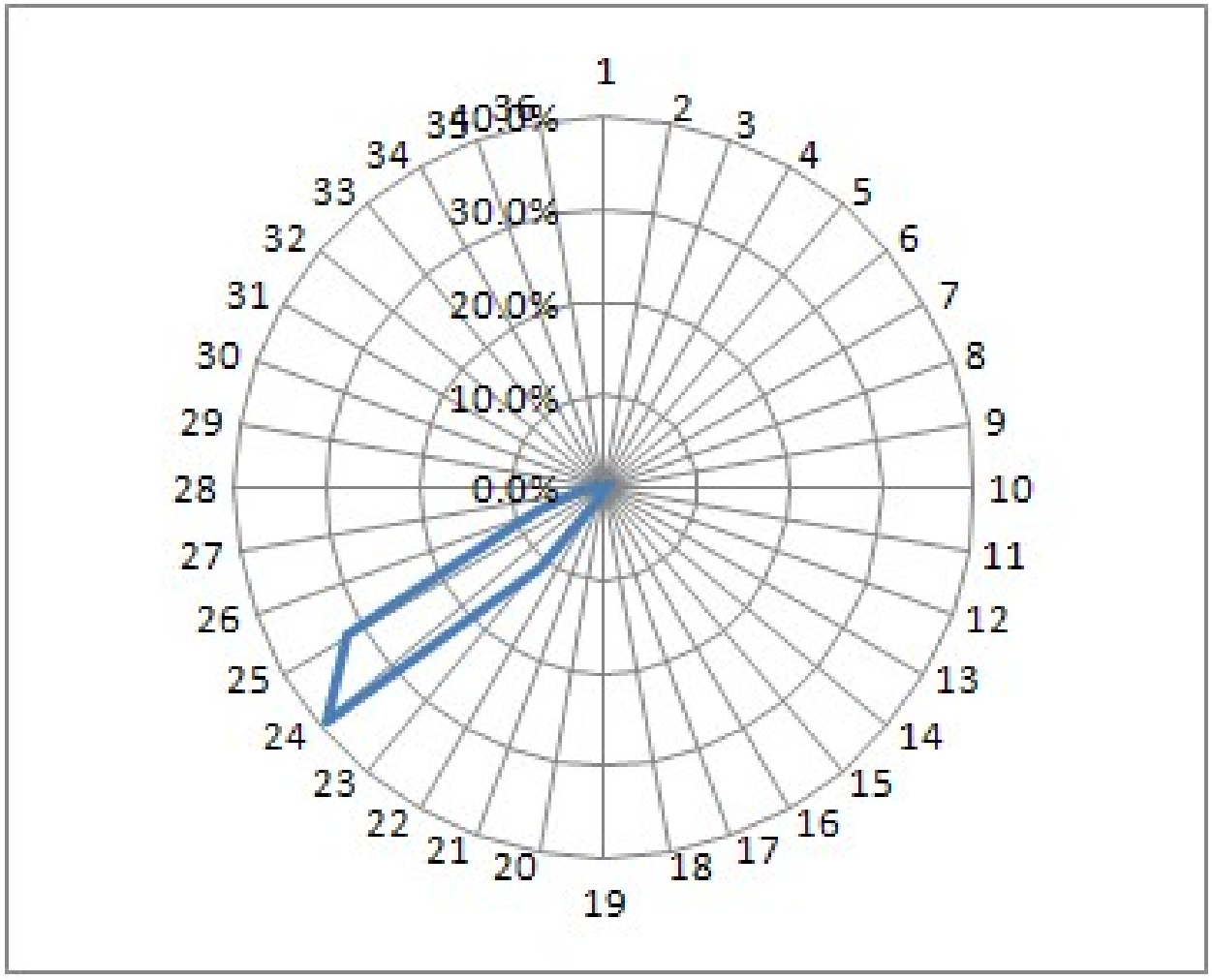


Figure 11. Rose diagram of prominent wind at the Ocotillo Wind Energy Facility.

The slope and aspect of individual turbines were reviewed and assessed on an individual turbine basis within the OWEF. Some research has suggested turbines in saddles or canyons or on the upwind side of ridges may potentially be of more risk to golden eagles. Figures 12 and 13 show the current layout relative to the slope and aspect within 0.25 miles (400 meters) of turbines. Based on limited scientific study, it is assumed turbines on steeper slopes, especially on upwind sides of ridges and turbines in saddles or low-lying areas may be more risky. Generally, none of the turbines are located in low-lying areas, steep slopes, saddles, or on upwind slopes (southwest and westerly aspects). Appendix B contains a list of turbines and the estimated slope, aspect, and elevation of the turbines. Only two turbines are estimated to occur on a slope greater than five percent (turbine 16 and turbine 29), and aspect is east (~73 degrees) and southeast (~155 degrees; respectively). Numerous turbine locations were eliminated from these types of areas or moved to avoid these areas. For example, no turbines were placed in the saddles/drainages between turbines 30 and 31, 19 and 43, 15 and 16, 72 and 73, 95 and 92. There are no turbines sited on southwesterly aspects, and very few turbines are sited on westerly or southern aspects. Based on the information provided above, turbines have been sited in areas that would not be considered high risk locations within the project.

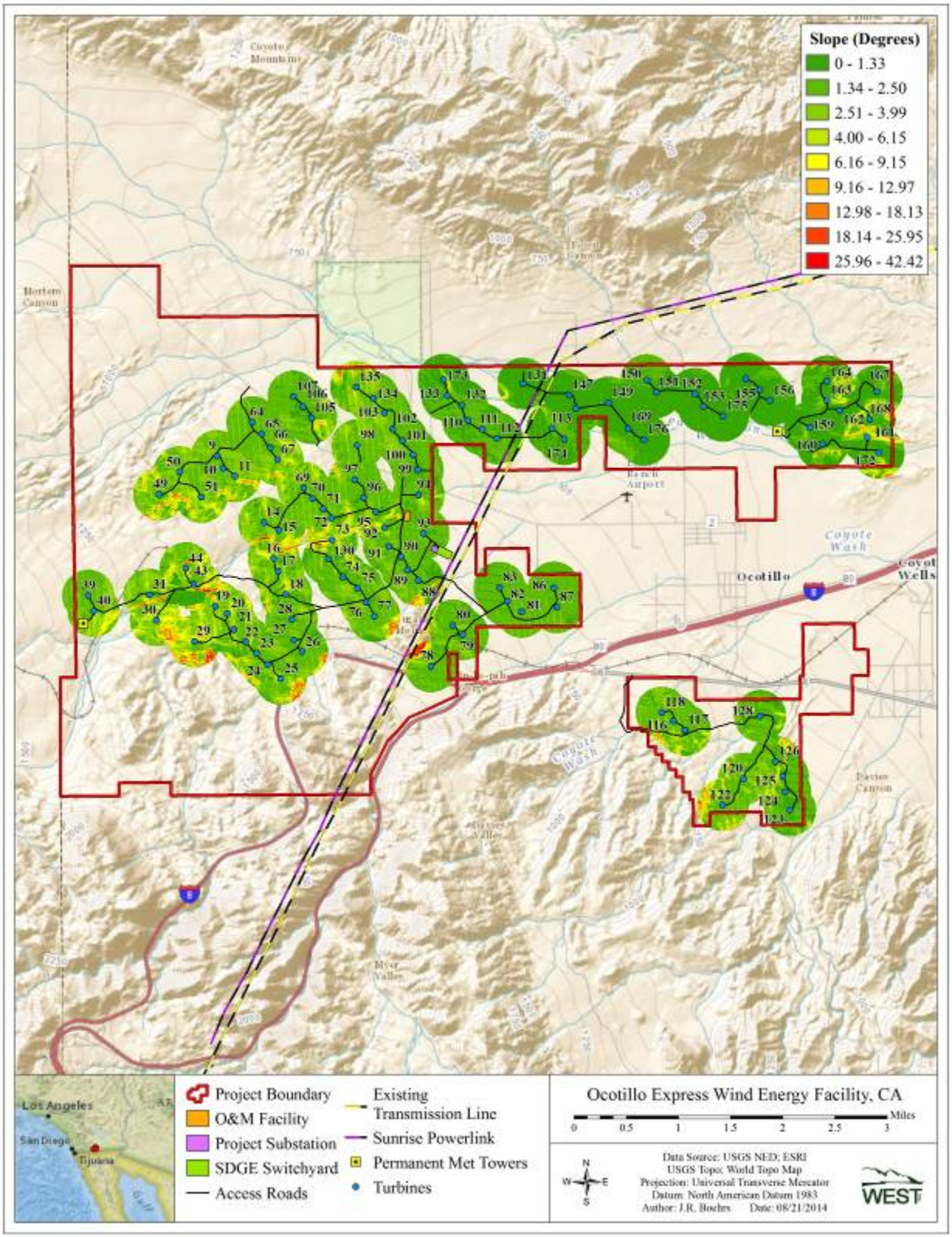


Figure 12. Slope calculations for areas within 0.25 miles (400 m) of turbines at the Ocotillo Wind Energy Facility.

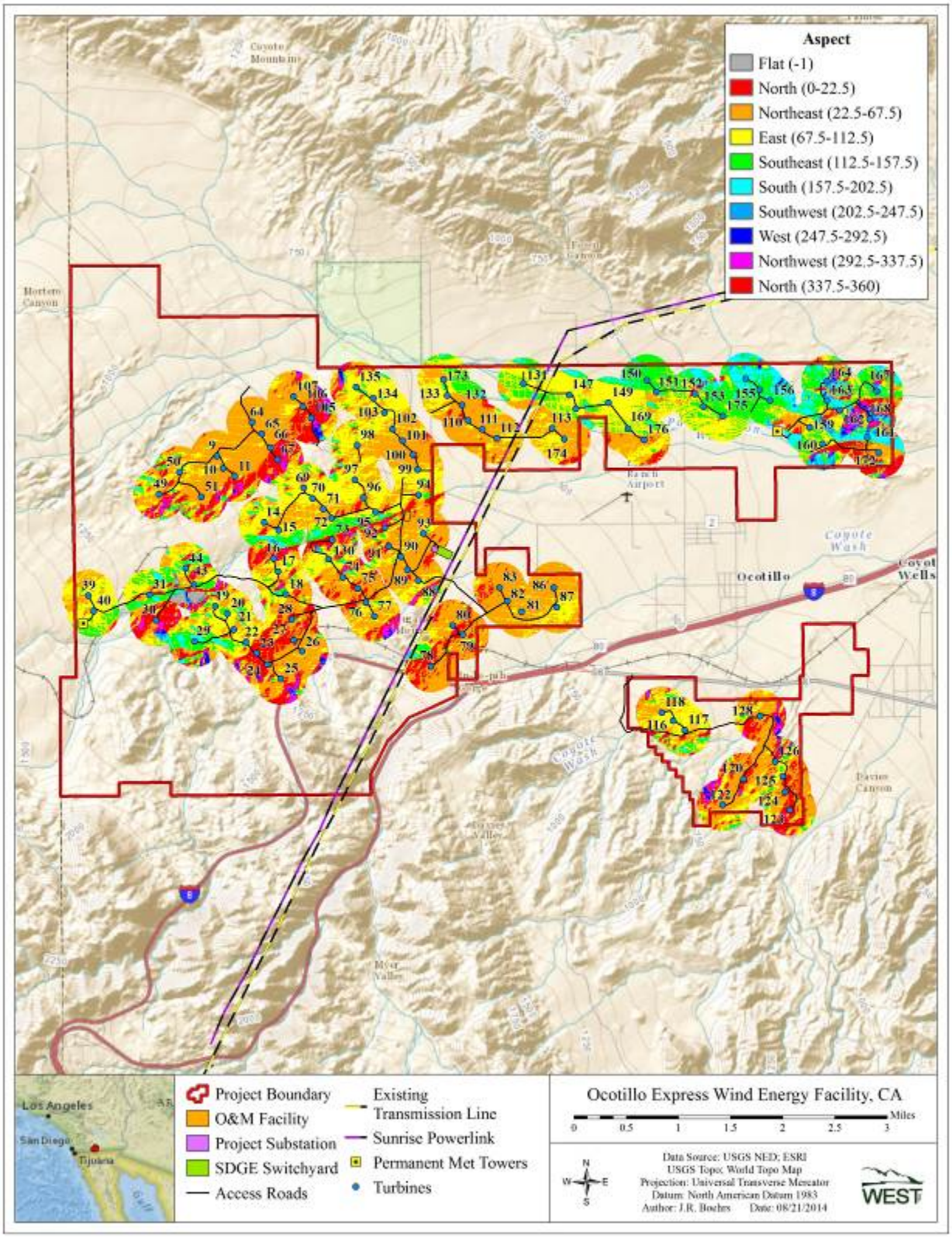


Figure 13. Aspect for areas within 0.25 miles (400 m) of turbines at the Ocotillo Wind Energy Facility.

The results of the landscape-scale assessment of topography and wind, as well as the individual turbine assessment suggest that topography and wind conditions at the OWEF are a low risk to golden eagles overall in relation to facility and individual turbine siting.

INTRA-SPECIFIC INTERACTIONS AND FORAGING BEHAVIOR

Assuming that intra-specific competition and territorial defense increases collision risk, the project area has some potential for having these behaviors occur on the project between the territories to the north of the project and south of the project. While we agree that this may be a plausible risk factor, we are not aware of any studies that have clearly demonstrated that intra-specific interactions increase risk to golden eagles.

As indicated above, the golden eagle data collected prior to development of the Project suggested that golden eagles may utilize the OWEF on a limited basis for foraging. The data suggested that there were no high golden eagle use areas or golden eagle concentration areas, including concentrated foraging areas, within the OWEF. The results of post-construction monitoring efforts provide further support for the conclusions based on the pre-construction survey efforts (see Section 5.0 below; Appendix C).

Table 9. Risk factors listed in the Draft Golden Eagle Conservation Plan Guidance and a discussion of these factors for this project.

Risk Factor	Scientific Evidence/Support	Citations	OWEF Situation	Qualitative Assessment
Bird Density	Mixed findings; likely some relationship but other factors have overriding influence across a range of species	Barrios and Rodriguez (2004), De Lucas et al. (2007), Hunt (2002), Smallwood et al. (2009), Ferrer et al. (2011)	Golden eagle use (abundance) of the OWEF was determined to be less than 0.02 eagle obs./hr based on preconstruction data and is approx. 0.002 eagle obs/hr based on the operational biological monitoring (see section 5.0 below)	Low
Bird Age	Mixed findings. Higher number of fatalities among sub-adult and adult golden eagles in one area. Higher fatalities among adult white-tailed eagles in another	Hunt (2002), Nygard et al. (2010)	Data collected to date suggest a fairly even mix of adults and sub-adult eagle with fewer juveniles observed at the OWEF.	Moderate
Proximity to Nests	White-tailed eagle nesting areas close to turbines have been observed to have low nest success and be abandoned over time.	Nygard et al (2010)	There are no turbines sited within 3 miles of a known/historic eagle nest. Further, known territories within 10 miles of the Project generally have not been consistently active, occupied, or productive for the last decade.	Low
Bird Residency Status	Mixed findings. Higher risk to resident adults in Egyptian vultures (*Neophron percnopterus*). Higher number of mortalities among sub-adults and floating adults in golden eagles in one other study	Barrios and Rodriguez (2004), Hunt (2002)	Data collected to date is insufficient to address this potential risk factor. However, the low use numbers in general suggest few floating birds around	Unknown
Season	Mixed findings. In some cases for some species, risk appears higher in seasons with greater propensity to use slope soaring (fewer thermals) or kiting flight (windy weather) while hunting.	Barrios and Rodriguez (2004), De Lucas et al. (2008), Hoover and Morrison (2005), Smallwood et al. (2009)	Golden eagles appear to be most abundant in the winter and fall due to slightly higher use based on site-specific data collection (both pre-construction and operational biomonitoring).	Abundance is higher in winter and fall relative to other seasons; however abundance is still low in all seasons
Flight Style	Species most at risk perform more frequent flights that can be described as kiting, hovering, and diving for prey.	Smallwood et al. (2009)	Some potential for these flight behaviors within the Project; however, observations during operational biomonitoring indicate eagles are rarely observed kiting, hovering, or diving for prey in the Project area.	Low
Interaction with Other	Higher risk when interactive behavior is occurring.	Smallwood et al. (2009)	Based on the average nearest-neighbor distance of all nests in the two territories identified as occupied in 2010, there is low	Low, needs further study to determine actual

Table 9. Risk factors listed in the Draft Golden Eagle Conservation Plan Guidance and a discussion of these factors for this project.

Risk Factor	Scientific Evidence/Support	Citations	OWEF Situation	Qualitative Assessment
Birds			potential for territorial defense to occur where turbines are sited.	influence to risk
Active Hunting/Prey Availability	High risk when hunting close to turbines, across a range of species	Barrios and Rodriguez (2004), De Lucas et al. (2008), Hoover and Morrison (2005), Hunt (2002), Smallwood et al. (2009)	Although no specific prey surveys were conducted, overall prey availability within the OWEF is considered low throughout the majority of the year due to the harsh arid conditions and the fact that prey availability is low throughout much of the desert. Exception would be a few months in the spring following the raining season. However, spring use of the site by eagles is very low based on site-specific data collection. No concentrated prey resources have been identified in the Project and only rarely has active hunting been observed in the vicinity of the Project during three years of operational biomonitoring	Low
Turbine Height	Mixed, contradictory findings across a range of species	Barclay et al. (2007), De Lucas et al. (2008)	25 of 36 eagle observations during pre-construction and 13 of 41 eagle observations during operational biomonitoring within RSH but overall numbers still very low	Moderate
Rotor Speed	Higher risk associated with higher blade-tip speed for golden eagles in one study, but this finding may not be generally applicable.	Chamberlain et al. (2006)	State of the art technology, low RPM's, more space between rotor sweeps, however tip speeds generally the same	Low
Rotor-swept Area	Meta-analysis found no effect, but variation among studies clouds interpretation.	Barclay et al. (2007),	25 of 36 eagle observations recorded during pre-construction and 13 of 41 eagle observations during operational biomonitoring within the RSH. However, larger rotors generally have more space and time between sweeps. More research is needed to understand this risk factor.	Unknown
Topography	Several studies show higher risk of collisions with turbines on ridge lines and on slopes. Also a higher risk in saddles that present low-energy ridge crossing points.	Barrios and Rodriguez (2004), De Lucas et al. (2008), Hoover and Morrison (2005), Smallwood and	Based on the prevailing wind direction in relation to topography including slope, aspect, and elevation.	Low

Table 9. Risk factors listed in the Draft Golden Eagle Conservation Plan Guidance and a discussion of these factors for this project.

Risk Factor	Scientific Evidence/Support	Citations	OWEF Situation	Qualitative Assessment
		Thelander (2004)		
Wind Speed	Mixed findings; probably locality dependent	Barrios and Rodriguez (2004), Hoover and Morrison (2005), Smallwood et al. (2009)	Based on the prevailing wind direction in relation to topography including slope, aspect, and elevation.	Low

3.2 Fatality Predictions

The models being used to predict eagle fatality rates at wind energy projects (e.g., USFWS Bayesian model) are based on the assumption that eagle use is positively correlated to fatality rates. In their analysis of avian fatalities at the Tehachapi Pass wind complex, Anderson et al. (2004) found a direct relationship between raptor use and raptor fatalities: areas with the most raptor use had more fatalities than areas with the least raptor use.

The first approach looks at the level of mortality observed at wind projects in the western U.S. in comparison to the level of golden eagle use measured during pre-construction surveys. The paired use and mortality studies included in this assessment were also included in a peer-reviewed publication that provides a collision risk prior distribution for modeling eagle mortality (Bay et al. 2016). Survey protocols were generally similar in that points were selected to provide a good viewshed, suggesting reasonable comparability. The following criteria were used to determine if pre-construction studies should be included in comparisons: 1) must have three of four seasons of data; 2) observations were standardized to 800 m; 3) used fixed-point survey methodology; and 4) all use values were standardized to 20 minutes. The following criteria were used to determine if post-construction studies should be included in comparisons: 1) appropriate bias trials (searcher efficiency and carcass removal) were used to determine fatality estimates; and 2) seasons in which species were expected to be present were surveyed (all four seasons surveyed), although the study may have small gaps in the summer.

Projects reported to have very low and low golden eagle use have not had reported golden eagle fatalities, whereas sites with relatively high golden eagle use have reported golden eagle fatalities (Figure 14). Although this data does not include information from all projects that have documented eagle fatalities (see Pagel et al. 2013), as survey data may not be publicly available or comparable, it does provide support for the common sense premise that eagle use is positively correlated to eagle risk. It is not intended to suggest that facilities with low eagle use estimates will not incur an eagle take over the life of the project, but rather low-use facilities are likely to incur low levels of take (if any occurs) relative to high-use facilities.

As previously described, Table 6 summarizes all the observations during the large effort that occurred during the 2009, 2010, and 2011 surveys. These observations result in a golden eagle use estimate of 0.01 golden eagles per observation hour. Overall mean golden eagle use at the OWEF, adjusted for 20-min surveys in 2009, 2010, and 2011 is low compared with other wind-energy facilities that implemented similar protocols (Figure 14).

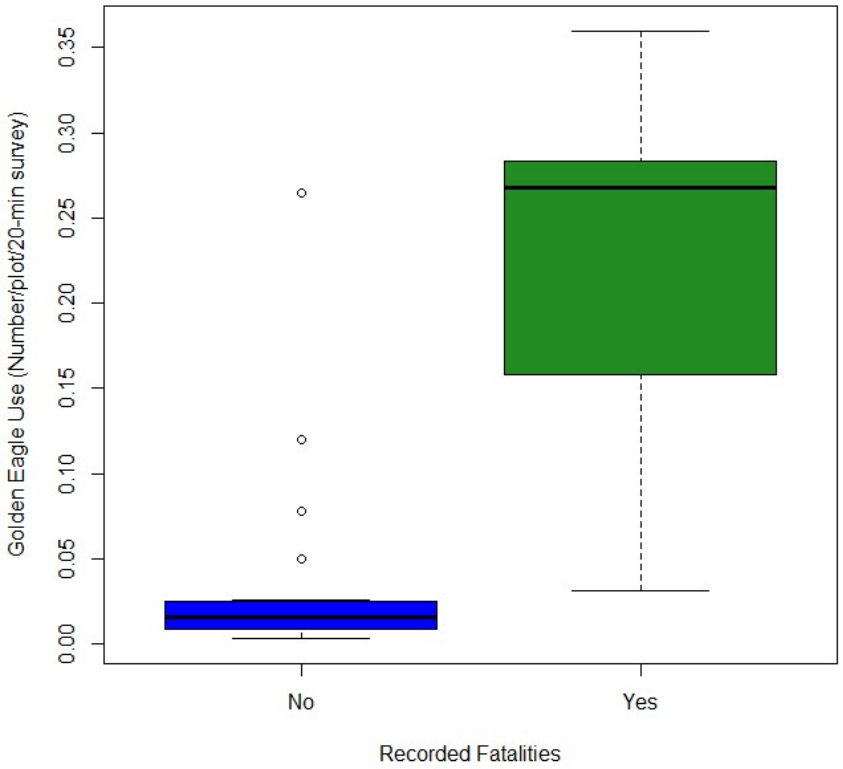


Figure 14. Average pre-construction golden eagle use values for facilities with and without observed golden eagle fatalities.

Data from the following sources:

Wind Energy Facility	Use Estimate	Fatality Estimate
Alta I, CA	Erickson and Chatfield 2009	A. Chatfield, WEST, Inc., unpubl. data
Alta II – V, CA	Erickson and Chatfield 2009	A. Chatfield, WEST, Inc., unpubl. data
Campbell Hill, WY	Taylor et al. 2008	K. Taylor, WEST, Inc. unpubl. Data
Combine Hills, WA	Young et al. 2003c	Young et al. 2006
Diablo Winds, CA	WEST 2006	WEST 2006, 2008
Dry Lake, AZ	Young et al. 2007	Thompson and Bay 2012
Elkhorn, OR	WEST 2005	Jeffery et al. 2009, Enk et al. 2011
Foot Creek Rim Phase I, WY	Johnson et al. 2000	Young et al. 2003b
Foot Creek Rim Phases II and III, WY	Johnson et al. 2000	Young et al. 2003d
High Winds, CA	P. Kerlinger, Curry and Kerlinger, LLC, unpubl. Data	Kerlinger et al. 2006a
Hopkins Ridge, WA	Young et al. 2003	Young et al. 2007
Kittitas Valley, WA	Erickson et al. 2003c	Stantec Consulting Services, Incorp unpubl. data
Klondike, OR	Johnson et al. 2002	Johnson et al. 2003
Leaning Juniper, OR	Kronner et al. 2005	Kronner et al. 2007; Gritski et al. 2008
Nine Canyon, WA	Erickson et al. 2001	Erickson et al. 2003
Shiloh I, CA	Kerlinger et al. 2006b	Kerlinger et al. 2009
Shiloh II, CA	Kerlinger et al. 2006b	Kerlinger et al. 2010
Stateline, OR/WA	Erickson et al. 2002	Erickson et al. 2004b
Tuolumne, WA	G. Johnson, WEST, Inc. unpubl. Data	T. Enz and K. Bay, WEST, Inc., unpubl. data
Vansycle, OR	Erickson et al. 2002	Erickson et al. 2000
Vantage, WA	Jeffrey et al. 2007	Ventus Environmental Solutions, unpubl. data
Vasco, CA	Brown et al. 2013	Brown et al. 2013
Wessington Springs, SD	C. Derby, WEST, Inc., unpubl. Data	C, Derby, WEST, Inc. unpubl. Data
White Creek, WA	G.D. Johnson, WEST, Inc.	S. Downes and R. Gritski, NWC, Incorporated,

	Unpub. Data	unpubl. Data
Wild Horse, WA	Erickson et al. 2003b	Erickson et al. 2008
Windy Flats, WA	Johnson et al. 2007	T. Enz, unpubl. Data

The information in Figure 14 suggests that we would expect low golden eagle mortality in any given year at the OWEF. A conservative prediction would be an average of less than one eagle fatality per year, assuming the level of use observed during the pre-construction studies continued. The likelihood of mortality in a given year might be influenced by whether the territories near the project are occupied and are successful. Based on the recent past, these territories are often unoccupied and production has been very low. As of June 2017, there have been no eagle fatalities identified at the OWEF to date (which is approx. 4 ½ years since the first turbine was spinning and approx. 3 ½ years since the entire 112 turbine Project became fully operational) suggesting that the eagle fatality rate will be low (i.e., considerably less than one per year) over the longer term.

In the second approach, data collected during avian point count surveys and migration surveys at the OWEF were used with the current USFWS Bayesian Collision Risk Model (USFWS 2013) to calculate golden eagle fatality estimates. Collision risk modeling estimates the number of annual eagle fatalities that are expected at a proposed wind-energy facility from eagle use minutes recorded during on-site eagle use surveys. Assuming that eagle mortality is proportional to pre-construction eagle activity, a Bayesian correction factor has been established by the USFWS based on pre- and post-construction golden eagle surveys conducted at four wind energy facilities, as reported in Whitfield 2009. Bayesian analyses incorporate a prior belief (or best guess estimate) regarding model parameters as supporting evidence in determining a posterior distribution of eagle exposure and mortality. In order to obtain an estimate of eagle fatalities at the OWEF using the USFWS methodology, the following information was used: 1) an estimate of the number of golden eagle flight minutes recorded within 800 m from observers based on an analysis conducted by USFWS; 2) an estimate of annual daylight hours at the OWEF; 3) the quantity of turbines and rotor radius of the turbines at the OWEF; and 4) the prior Bayesian collision correction factor as recommended by the USFWS (USFWS 2013). Tables 10 through 12 contain parameters used to calculate models of collision risk based on turbine specifications provided by OE LLC for the turbine types in operation at the OWEF.

In total, 3,271.1 hours of pre-construction avian use and raptor migration surveys were completed at the OWEF (see Section 2.0 above; Table 10 below). No eagle flight minutes were recorded during these surveys; therefore, a USFWS estimate of golden eagle flight minutes based on the duration of pre-construction eagle observations and length of mapped flight paths was used for modeling. The USFWS estimate of eagle flight minutes was 47 minutes (see Appendix D).

Exposure Rate Calculations

Exposure rate (λ), as defined by the USFWS (2013), is the expected number of flight minutes below 200 m per daylight hour across the surveyed area (km^2). Based on the USFWS analysis, 47 golden eagle flight minutes are assumed for modeling (Table 10). A $Gamma(\alpha = 0.97, \beta = 2.76)$ prior distribution with mean (0.35) and standard deviation (0.357) is recommended by the USFWS. A posterior distribution of golden eagle use at the OWEF was estimated as a $Gamma$ distribution with the α parameter equal to the

sum of the prior α and total flight minutes below 200 m, and the β parameter equal to the sum of the prior β and effort (hours of surveys x km^2 of area surveyed), respectively:

$$Posterior\ \lambda \sim Gamma[\alpha + (U_{GE})(n_{surveys})(flight\ minutes), \beta + (survey\ length\ in\ hrs) \cdot (n_{surveys}) \cdot 2.01]$$

For all the golden eagle observations combined, this resulted in a posterior distribution for exposure rate of *Gamma* (47.97, 6,579.697) with mean 0.007 eagle flight minutes observed per hour of survey per square km for the baseline data (Table 10).

Table 10. Values used to calculate exposure rate (λ).

Variable	Value
1) Estimated Flight Minutes	47
2) Length of Surveys	Combination
3) Survey Hours	3,271.10
4) Survey Radius (meters)	800
5) Eagle Flight Minutes (alpha: Line 1 + 0.97)	47.97
6) Effort (Beta; survey hours x sq km of area surveyed)	6,579.697
7) Mean Exposure Rate (Line 5 / Line 6)	0.007

Expansion Factor

A facility-specific expansion factor is multiplied by the eagle exposure rate $\left(\frac{\text{eagle flight minutes}}{\text{hour} \cdot \text{km}^2}\right)$ to estimate the potential annual eagle-wind turbine interactions (minutes of flight within the turbine hazardous area). The expansion factor scales the exposure rate to annual daylight hours (τ) across the total hazardous areas (δ_i) surrounding all existing turbines (n_t; USFWS 2013):

$$\varepsilon = \tau \sum_{i=1}^{n_t} \delta_i$$

The USFWS defined the turbine hazardous area (δ_i) as the rotor-swept area around each turbine or proposed turbine location (km^2; USFWS 2012). The expansion factor (ε) was calculated for the combined pre-construction raptor migration surveys and avian point count surveys for the 112 turbines in operation at the OWEF (Table 11).

Table 11. Values used to calculate expansion factor (ε).

Variable	Value
8) Estimated Daylight Hours	4,445.74
9) Rotor Radius (meters)	54
10) Turbine Hazardous Area (pi * radius of turbine in km^2)	0.009
11) Number of Turbines	112
12) Expansion Factor (Line 8 x Line 10 x Line 11)	4561.416

Collision Correction Factor

The collision correction factor (collision probability; C) was defined as the probability of an eagle colliding with a turbine given each minute of eagle flight in the turbine hazardous area. The prior distribution for collision probability was developed by the USFWS using the four previous fatality studies (Foote Creek Rim, WY; San Gorgonio, CA; Tehachapi, CA; and Altamont, CA) reported in Whitfield (2009). A mean of the estimated golden eagle flight minutes within the turbine hazardous area to recorded golden eagle collision events at those facilities was used to determine a *Beta* (2.31, 396.69) prior distribution for collision probability with mean and standard deviation of 0.0058 and 0.0038 eagle fatalities per minute of flight in the turbine hazardous area, respectively (Table 12). WEST has also applied the model using an updated collision correction factor developed from pre- and post-construction studies at 24 modern facilities (Bay et al. 2016). The updated collision prior is *Beta* (9.28, 3,224.51) or collision probability with mean of 0.00287 eagle fatalities per minute of flight in the turbine hazardous area (Table 12). At this time, the estimates do not incorporate site specific information regarding collision probability. A posterior, site specific, estimate of collision probability might be estimated based on the post-construction monitoring that has been conducted for the Project; however, the biological monitoring program and curtailment of turbines when eagles are at risk of collisions (see Section 5.0 below) complicates the ability to update the collision probability for the OWEF.

Table 12. Values used to calculate collision correction factor (*C*)

Variable	USFWS	Bay et al. 2016
13) Prior Fatalities	2.31	9.28
14) Prior Exposure Events Not Resulting in Fatality	396.69	3,224.51
15) Prior Mean Collision Correction Factor (Line 13/(Line 13 + Line 14))	0.0058	0.00287

Estimation of Take

The USFWS Bayesian collision risk model (USFWS 2013) assumes that higher site-specific eagle flight activity corresponds to higher annual eagle mortality once the wind energy facility is operational. Under this assumption, predictions of annual eagle mortality (F) were modeled as the pre-construction measure of eagle exposure (λ) within areas of potential eagle-wind turbine interactions (ε) multiplied by a collision correction factor (C):

$$F = \varepsilon \lambda C$$

Credible intervals (i.e., a Bayesian confidence interval) were calculated using a simulation of 10,000 Monte Carlo draws from the posterior distribution of eagle exposure (λ) and the collision probability distribution $(C;$ Manly 1991). The product of each of these draws with the exposure area was used to estimate the distribution of possible fatalities at the OWEF. The upper 80th percentile of this distribution is recommended by the USWFS as a conservative estimate of take for the project of interest (USFWS 2013).

Predicted eagle mortalities per year using the USFWS Bayesian Collision prior are 0.19 golden eagle/year (point estimate) and 0.28 golden eagle/year (upper 80th credible interval; Table 13). The predicted number of eagle mortalities per year using the Bay et al. 2016 collision prior is 0.095 (upper 80th = 0.12; Table 13). To date, there have been no golden eagle carcasses identified at the OWEF.

Table 13. Predicted eagle fatalities per survey effort and within rotor swept height only (F)

	Predicted Estimate	
Variable	**USFWS**	**Bay et. al 2016**
Estimated Annual Eagle Fatalities (Line 8 x Line 13 x Line 16)	0.19	0.095
Upper 80th Percentile	0.28	0.12

The upper 80th percentile calculations would result in an estimate of 1.4 golden eagle fatalities in five years based on the original USFWS prior collision probability distribution and an estimate of 0.6 golden eagle fatalities in five years based on the Bay et al. 2016 prior collision probability distribution.

The methods used for estimating eagle fatalities suggest a low level of eagle fatality (if any) at the OWEF. The Bayesian modeling approach suggests up to 1.4 golden eagles in five years using the original USFWS prior collision probability distribution. The models are predicated on several assumptions, including eagle use continuing to be low as measured during the two years of pre-construction work (the results of post-construction monitoring efforts conducted to date further support the low level of eagle use observed pre-construction; see Section 5.0 below). A conservative approach might be to assume an average of two eagles taken per five year period. If nesting/territory occupancy and production were much higher than observed during the past 10 years in this region, then actual mortality of eagles may be higher.

3.3 Cumulative Impacts

3.3.1 Population Status and Local Area Population Thresholds

The project lies within the Sonoran and Mojave Desert Bird Conservation Region (BCR). According to the 2013 USFWS ECP Guidance, golden eagle density estimates within the Sonoran and Mojave Desert BCR are 0.0063 golden eagles per mi^2 with an estimated population size of 600 golden eagles within the Sonoran and Mojave Desert BCR (USFWS 2013).

The USFWS has previously identified annual take levels of 5% of annual production to be sustainable for a range of healthy raptor populations, and annual take levels of 1% of annual production as a relatively benign harvest rate over at least short intervals, when population status was uncertain (Millsap and Allen 2006; USFWS 2013). This was the approach used to establish take thresholds at the eagle management unit scale (BCR level for golden eagles and Bald Eagle Management Units for bald eagles; USFWS

2009). However, in 2009, the USFWS determined that golden eagle populations might not be able to sustain any additional unmitigated mortality, and as a result, set the thresholds for golden eagles to zero at the eagle management unit (BCR) scale. Given a threshold of zero at the eagle management unit scale, USFWS have determined that any new authorized take of golden eagles must be offset by compensatory mitigation.

The USFWS has identified take rates of between 1% and 5% of the estimated total eagle population size at the local-area population scale (140-mile buffer surrounding the Project for golden eagles) as benchmarks; with 5% being at the upper end of what might be appropriate under the BGEPA preservation standard, whether offset by compensatory mitigation or not (USFWS 2013). The 2013 USFWS ECP Guidance (USFWS 2013) recommends calculating the local-area 5% benchmark as follows:

(Local-area * Regional Eagle Density) * 0.05.

A 140-mile buffer surrounding the Project encompasses the following areas within two BCR's in the United States: Coastal California (14,181.46 mi^2) and Sonoran and Mojave Desert (32,739.44 mi^2). According to the USFWS ECP Guidance, regional density estimates for resident golden eagles are (0.0150 eagles/mi^2) in the Coastal California BCR and (0.0063 eagles/mi^2) in the Sonoran and Mojave Desert BCR. Using the equation above, the Project's estimated local area population size (including only those areas within the United States) is approximately 419 golden eagles. Based on this analysis, the local-area 5% benchmark would be 21 golden eagles annually. Assuming a mortality rate of 0.28 golden eagles per year, this amount of mortality comprises less than 0.1% of the total estimated local area population and less than 2.0% of the local-area 5% benchmark for golden eagle mortality.

3.3.2 Assessment of Cumulative Impacts Due to Other Projects

As described in the Environmental Impact Report (EIR)/EIS for the OWEF, a cumulative impacts assessment was conducted for a geographic area extending throughout western Imperial County and southeastern San Diego County. The assessment assumed that all projects would be built and operating during the operating lifetime of the OWEF. Fourteen current projects or projects considered reasonably foreseeable, including other proposed or approved renewable energy projects, various BLM authorized actions/activities, proposed or approved projects within the counties jurisdictions, and other actions/activities that lead agencies consider reasonably foreseeable were including in the assessment. For golden eagles, the cumulative impact assessment included a 10-mile buffer surrounding the OWEF.

Direct and indirect impacts to golden eagle associated with the OWEF combined with impacts associated with past, present, and future projects are considered a cumulative impact to golden eagle because the impacts have a potential to reduce the extent and population size of golden eagle in the cumulative impacts analysis area and because compensation for those impacts may not be achievable. Although some of the current and reasonably foreseeable projects would result in impacts to golden eagle nest sites, the OWEF would not impact golden eagle nest sites and, therefore, the OWEF would not contribute to cumulative impacts to such nest sites.

Impacts to golden eagle foraging habitat associated with the OWEF combined with losses associated with past, present, and future projects are considered a cumulative impact to golden eagle because the impacts have a potential to limit the extent of the species within the cumulative impacts analysis area. The magnitude of the cumulative impact to golden eagle foraging habitat is small given that there is over 250,000 acres of suitable foraging habitat within the cumulative impacts analysis area. The OWEF's permanent impacts to 122.1 acres of habitat amounts to less than 0.1 percent of the available foraging habitat for the species within the cumulative impacts analysis area. The OWEF and the other projects could be required to mitigate impacts to golden eagle foraging habitat. Implementation of mitigation

measures (if warranted as identified in this ECP and the EIR/EIS) would reduce the OWEF's contribution to this cumulative impact.

Resident and migratory golden eagles are at risk of collision with project features associated with the OWEF and past, current, and reasonably foreseeable projects in the cumulative analysis area. These features include such structures as wind turbines, meteorological towers, and overhead transmission lines. Impacts to golden eagle associated with the OWEF combined with losses associated with past, present, and future projects are considered a cumulative impact to golden eagles because the impacts have potential to limit the population of golden eagles within the cumulative impacts analysis area. The OWEF and the other projects could be required to minimize potential collision risk by implementing mitigation measures. For the OWEF, the development and implementation of this ECP as well as other mitigation measures identified in the EIR/EIS would reduce the OWEF's contribution to this cumulative impact.

Overhead transmission lines associated with the OWEF and many of the other current and reasonably foreseeable projects also pose an electrocution risk for golden eagles (APLIC 2006). Impacts to golden eagles associated with the OWEF combined with losses of individual birds from electrocution associated with past, present, and future projects are considered a cumulative impact to these species because the impacts have the potential to limit populations of the species within the cumulative impacts analysis area. For the OWEF, potential impacts associated with electrocution would be minimized through the development and implementation of this ECP, the OWEF ABPP, and designing transmission towers and lines to conform with APLIC standards. The other current and reasonably foreseeable projects would be required to implement similar mitigation to reduce potential electrocution impacts. Implementation of the OWEF's mitigation measures would reduce the OWEF's contribution to this cumulative impact.

Given the low level of eagle mortality anticipated at the OWEF, the avoidance and minimization measures, compensatory mitigation, and the adaptive management strategy being implemented to ensure any unforeseen impacts are addressed, we anticipate that the project will result in no net loss of golden eagles within a regional population level.

3.4 Categorizing Site according to Risk

Based on a "weight of evidence" approach using the 2013 USFWS ECP Guidance, the site specific data collected to date and the risk assessments, it appears that the OWEF may meet a Category 3 designation or a very low risk Category 2 designation.

4.0 AVOIDANCE AND MINIMIZATION OF RISK USING CONSERVATION MEASURES AND COMPENSATORY MITIGATION (STAGE 4)

The site-specific golden eagle data collected for the OWEF suggests the site might receive a Category 3 designation or at least a very low risk Category 2 designation according to the 2013 USFWS ECP Guidance. However, OE LLC is currently implementing a variety of Conservation Measures and Advanced Conservation Practices (ACPs) to reduce the risk to golden eagles from the project. Given the 2013 USFWS ECP Guidance, and the current understanding of golden eagle risk at the OWEF, OE LLC would like to revisit the experimental ACPs that are being implemented at the Project (see Section 6.0 Adaptive Management below). The following Conservation Measures and ACPs have been or are being implemented at the OWEF during the pre-construction, construction, and operation phase of the project.

4.1 Conservation Measures Pre-Construction

OE LLC collected available site-specific information on golden eagle use to guide project siting to avoid and minimize impacts to golden eagles. The golden eagle data collected to date did not provide strong evidence for modifying any of the preliminary turbine locations to avoid/minimize potential impacts to golden eagles. Other conservation measures implemented during the pre-construction phase of the OWEF include:

- The area and intensity of disturbances was minimized during pre-construction monitoring and testing activities.
- Existing roads and transmission corridors were used to the extent possible while developing site plans.
- Structures are not sited near any high avian use areas or high use flight zones.
- The Avian Power Line Interaction Committee (APLIC) guidance on power line siting (APLIC 1994) was followed while planning.
- Site plans minimized the extent of the road network needed for the OWEF.
- No lattice or structures that are attractive to birds for perching were included in the OWEF facility designs other than two SDG&E replacement structures needed to accommodate the switchyard.
- No guy wires were included on permanent MET towers.
- Lighting plans for the facility were minimized while still meeting requirements.
- All security lighting is motion or heat activated, instead of being left on throughout the night.
- All security lighting is down-shield and related to infrastructure lights.
- The facility was not sited in any areas containing high concentrations of ponds, streams, or wetlands.

4.2 Conservation Measures during Construction

The following conservation measures were implemented at the OWEF during construction:

- The area and intensity of disturbance was minimized to the extent possible during construction.
- Existing roads were used for access during construction to the extent possible.
- Non-operational MET towers were dismantled during construction.
- Powerlines were buried to the extent possible to reduce avian collision and electrocution.
- The Avian Power Line Interaction Committee (APLIC) guidance on power line construction (APLIC 2006) was followed.
- A transportation plan was implemented during construction that included road design, locations and speed limits to minimize habitat fragmentation and wildlife collisions, and minimize noise effects. This helped to minimize carrion availability for golden eagles.
- A minimum of a two mile spatial and seasonal buffer was implemented from turbines to protect all currently known nest sites and/or known roost sites during construction, such as maintaining a buffer between activities and nests/communal roost sites and keeping natural areas between the project footprint and the nest site or communal roost by avoiding disturbance to natural landscapes.

4.3 Conservation Measures during Operation

OE LLC has been implementing an intensive operational golden eagle monitoring and research program for the OWEF. A detailed protocol was developed for the golden eagle monitoring and research program that identified specific hypothesis to be tested through the program. The golden eagle monitoring and research program included implementation of a full time golden eagle biological monitor to observe any golden eagles flying within the OWEF and to curtail turbines when eagles are at risk of collision. Observations have been conducted from a biological monitoring tower that is centrally located at the facility. OE LLC has staffed biologists on site during the day year-round to monitor the movements of eagles and other wildlife through the site with a current commitment extending for the first ten years of operations; however in light of the December 2013 eagle permit rule change, the 2013 USFWS ECP Guidance, and our current understanding of risk to eagles at the site, OE LLC would like to revisit the need to implement this costly experimental ACP at the OWEF. It is still the goal of OE LLC to implement a monitoring system and an adaptive management program that can respond to any unforeseen impacts to eagles and results in no net loss of golden eagles from the OWEF over the life of its operations. While OE LLC does not believe there is a reasonable scientific basis to implement the existing experimental ACP at the OWEF, OE LLC believes that we can and should learn from the program that has been implemented at the facility. Results of the intensive operational golden eagle monitoring and research program that has been implemented at OWEF are provided in Section 5.0 below (results of post-construction monitoring efforts). These experimental ACPs and this research are likely not feasible or practical at all facilities, but there are opportunities to learn and evaluate the effectiveness of the monitoring program in reducing mortality.

In addition to the intensive monitoring and research program, the following conservation measures are being implemented during operation of the OWEF:

- Management activities such as seeding forbs or maintaining rock piles that attract potential prey are avoided.
- Parts and equipment which may be used as cover by prey are not stored in the vicinity of wind turbines.
- Under the appropriate permit/authorizations, any carcasses (with the exception of carcasses being used for post-construction bias trials) found within the OWEF are removed immediately.
- Low level speed limits (< 25 mph) are maintained on all roads within the OWEF.
- Personnel are trained to be alert for wildlife at all times, especially during low visibility conditions.
- Personnel, contractors, and visitors are instructed to avoid disturbing wildlife, especially during the breeding seasons and seasonal periods of stress.
- Fire hazards are reduced from vehicles and human activities (e.g., use spark arrestors on power equipment, avoid driving vehicles off roads, and allow smoking in designated areas only).
- Federal and state measures for handling toxic substances are followed.
- Effects to wetlands and water resources are minimized by following provisions of the Clean Water Act (1972).

4.4 Re-evaluation of Risk Considering ACPs

Given the current understanding of risk to eagles at the OWEF along with the 2013 ECP Guidance, OE LLC believes the site may qualify for a Category 3 designation (or at a minimum a very low risk Category 2 designation) without the need for the implementation of the intensive monitoring and research

program but, rather an adaptive management strategy (see Section 6.0 below) to address any unforeseen impacts, ensuring no net loss to eagles.

4.5 Compensatory Mitigation

Compensatory mitigation occurs in the eagle permitting process if the conservation measures and ACP's do not remove the potential for take, and the projected take exceeds calculated thresholds for the species-specific eagle management unit in which the project is located. For new wind development projects, if compensatory mitigation is necessary, the compensatory mitigation action (or a verifiable, legal commitment to such mitigation) will be required up front before project operations commence because projects must meet the statutory and regulatory eagle preservation standard before the USFWS may issue a permit (USFWS 2013).

OE LLC will develop a compensatory mitigation plan in communication with the USFWS to offset predicted eagle take as determined through eagle fatality modeling for the Project. Following the resource equivalency analysis (REA) example in the USFWS ECP Guidance (2013), OE LLC has calculated the number of power-pole retrofits needed to offset the anticipated level of golden eagle take at the Project given the results of the modeling efforts. To be conservative, OE LLC is assuming two eagles taken in a five year period. The following assumptions were included in the analyses: 1) the power pole retrofits would occur prior to taking golden eagles; 2) Project life is 30 years; and 3) life of the retrofits is 30 years and/or the retrofits will be maintained for 30 years. Under these assumptions, the REA analysis indicates that 26 poles will need to be retrofitted upfront to offset two eagles during the first five years of operations.

If observed take is less than mitigated take after a five-year review period, the excess take will be credited to the OWEF. If take is higher, increased mitigation will be required. In either case, compensatory mitigation for the subsequent five-year period would be re-evaluated based on actual results as compared with permitted levels of take.

Based upon communication with the USFWS, OE LLC will also consider other options for compensatory mitigation to offset eagle take, as appropriate. Other options for compensatory mitigation might include a lead abatement program, a carcass removal program along highways, or funding mitigation banking efforts. However, a resource equivalency analysis would first need to be developed for any alternative compensatory mitigation options, to demonstrate that the amount of anticipated eagle take from the Project would be fully offset by the alternative mitigation measures. USFWS would not accept any alternative compensatory mitigation options until a credible analysis was completed and accepted.

5.0 POST-CONSTRUCTION MONITORING (STAGE 5)

A post-construction monitoring program is being implemented at the OWEF. The post construction monitoring described in this ECP is for the OWEF only and does not apply to the SDG&E switchyard. SDG&E constructed and operates the switchyard independently from OE LLC. The observations made during post-construction monitoring have been and will be reported to USFWS, which may respond with appropriate management decisions depending on the results of the monitoring program. Notwithstanding the foregoing, the parties acknowledge that fatality reduction or other measures may be required pursuant to applicable law, inc1uding but not limited to the federal Endangered Species Act (1973), Bald and Golden Eagle Protection. Act (1940), Migratory Bird Treaty Act (1918) or the California Endangered Species Act (California Fish and Game Code, §§ 2050, *et seqJ*).

Since post-construction monitoring methods are constantly improving as researchers develop new and more accurate methods of survey, the USFWS and OE LLC should consider recommendations to adopt new survey techniques and protocols as they become available. Post-construction monitoring includes collecting field data on behavior, utilization, and distribution patterns of affected avian and bat species, in addition to fatalities. The final post-construction monitoring protocol was developed and approved in consultation with the USFWS prior to implementation. Results of the post-construction monitoring efforts conducted to date can be found in Appendix C.

5.1 Biological Monitoring

Since December of 2012, OE LLC staffed biologist(s) on site to monitor eagle and other wildlife activity in real time anytime turbines were in operation during the day year-round throughout the site. A protocol was developed to guide the implementation of the biological tower monitoring efforts. The methods were developed to facilitate the biological monitor(s) in processing targets and actions to be taken; however, it was anticipated that the methods might be refined over time to maximize the effectiveness of the process. Essentially, the biological monitors utilized the tools available to detect eagles over the entire OWEF and surrounding vicinity. In the event that an eagle or a possible eagle was detected, turbines were curtailed when that eagle or possible eagle was determined to be at risk (within a ½ mile buffer of a turbine). While the primary duty of the biological monitor was to utilize all available tools to reduce the likelihood of golden eagle mortality at the OWEF, as time warranted, the bio-monitor(s) also collected information on any large bird target detected. Data collected included the following: date, start and end time of observation period, species or best possible identification, number of individuals, sex and age class, estimated distance, mapping of flight paths or perch locations, behavior, habitat, flight direction, height, and weather information (e.g. temperature, wind speed, wind direction, cloud cover).

No golden eagle carcasses have been identified within the OWEF between commencement of operation and the date of this ECP. From early December of 2012 through June 30, 2017, the biological monitors have spent approximately 19,687 hours conducting observations from the biological monitoring tower during daylight hours (i.e. 19,687 hours of survey effort). Through June 30, 2017, a total of 41 golden eagle observations including 48 individuals (approximately 0.002 golden eagles/hour irrespective of distance from the tower) were recorded (Table 14; Figure 15). Of these 35 golden eagle observations, turbines were shut-down 16 times for a total of 8.49 hours with the average length of shut-down equal to approximately 31.8 minutes (Table 14).

As mentioned previously, given the current understanding of risk to eagles at the OWEF along with the 2013 ECP Guidance, OE LLC intends to work with the USFWS to pursue an eagle take permit as long as obtaining the permit will enable the BLM ROW grant to be amended to discontinue the existing experimental ACP program at the OWEF and implement an adaptive management program to address any unforeseen impacts to eagles. In spite of this, OE LLC believes that there are opportunities to learn from the program that was implemented at the facility and it is anticipated that lessons learned from the experimental ACP program at the OWEF may be used to help inform similar research programs at other wind facilities.

Table 14. Golden eagle observations recorded during bio-monitoring efforts from December 2012 through June 2017 at the Ocotillo Wind Energy Facility, Imperial County, California.

Unique ID	Number of Individuals	Age	Date	Time	Wind Direction	Wind Speed (km/hr)	Shutdown Time (min)	Activity
1	2	juv; unk	12/9/12	13:28	E	8	NA[1]	soaring
2	1	1-3 yrs	12/2512	12:48	E	11	32	flapping, soaring
3	1	unk	1/4/13	13:48	NE	2	NA	flapping
4	1	1-3 yrs	1/8/13	10:06	S	7	22	circling
5	1	adult	1/9/13	12:27	SE	4	NA	flapping, soaring
6	1	unk	1/16/13	12:33	SE	7	NA	flapping, soaring
7	1	unk	1/26/13	11:56	E	9	56	flapping, soaring, stooping
8	1	unk	2/6/13	11:03	SE	5	NA	flapping, soaring
9	1	1-3 yrs	3/5/13	16:05	SW	15	30	soaring
10[2]	1	unk	3/8/13	15:08	SW	28	NA	soaring
11	1	unk	4/28/13	10:58	SE	3	NA	soaring
12	1	unk	4/30/13	10:39	SW	10	32	soaring, flapping, hunting
13	1	adult	7/17/13	9:45	SSE	6	29	soaring
14	3	adult; juv	8/30/13	13:07	E	6	43	soaring, flapping
15	1	1-3 yrs	9/7/13	11:20	E	6	50	soaring, perched, flapping, being mobbed
16	1	1-3 yrs	9/11/13	9:17	E	3	NA	soaring, flapping
17	1	adult	9/13/13	13:00	S	0-5	20	soaring, flapping, diving
18	1	1-3 yrs	9/18/13	13:54	SW	10	25	flapping, soaring
19	1	adult	9/23/13	14:00	E	4	35	circling
20	1	1-3 yrs	10/5/13	10:48	NE	13	NA	soaring, being mobbed
21	1	adult	10/16/13	13:40	E	6	NA	soaring
22	1	adult	12/6/2013	11:24	E	8	23	soaring
23[3]	1	adult	12/6/13	11:37	E	8	NA	soaring
24	2	unk; unk	3/13/2014	11:55	E	6	NA	soaring
25	1	1-3 yrs	3/28/2014	16:22	E	9	13	soaring
26[2]	1	1-3 yrs	4/9/2014	11:37	E	7	NA	soaring
27	1	adult	5/23/2014	15:24	E	10	NA	soaring, flapping, being mobbed
28	1	unk	0/29/2014	17:38	E	10	NA	soaring
29	1	1-3 yrs	10/17/2014	10:48	SW	21	NA	soaring, flapping
30	1	adult	12/21/2014	13:38	E	10	35	soaring

Table 14. Golden eagle observations recorded during bio-monitoring efforts from December 2012 through June 2017 at the Ocotillo Wind Energy Facility, Imperial County, California.

Unique ID	Number of Individuals	Age	Date	Time	Wind Direction	Wind Speed (km/hr)	Shutdown Time (min)	Activity
31	1	1-3 yrs	2/14/2015	11:25	E	9	NA	soaring, stooping, mobbing, flapping
32[2]	2	unk	2/26/2015	8:46	NE	8	NA	soaring
33	1	adult	5/25/2015	14:38	E	13	40	soaring
34	1	adult	7/30/2015	15:45	SW	19	24	soaring, flapping
35	1	adult	11/19/2015	12:52	E	9	NA	soaring, flapping
36	2	juv; adult	02/07/2016	14:14	N	16	NA	soaring
37	1	adult	06/10/2016	17:14	E	28	NA	soaring
38	1	adult	06/21/2016	7:10	W	6	NA	soaring
39	1	unk	09/26/2016	10:04	NE	16	NA	soaring
40	2	juv; adult	11/19/2016	14:36	E	13	NA	soaring, flapping
41	1	adult	02/14/2017	14:46	E	7	NA	soaring

[1] Turbines were shut-down anytime an eagle was identified within ½ mile of spinning turbines.
[2] Flight paths were not mapped as the observations were off the datasheet.
[3] This is believed to be the same individual as observation 22 however, the observer lost sight of the eagle and then re-sighted. The turbines were already shutdown as a result of observation #22.

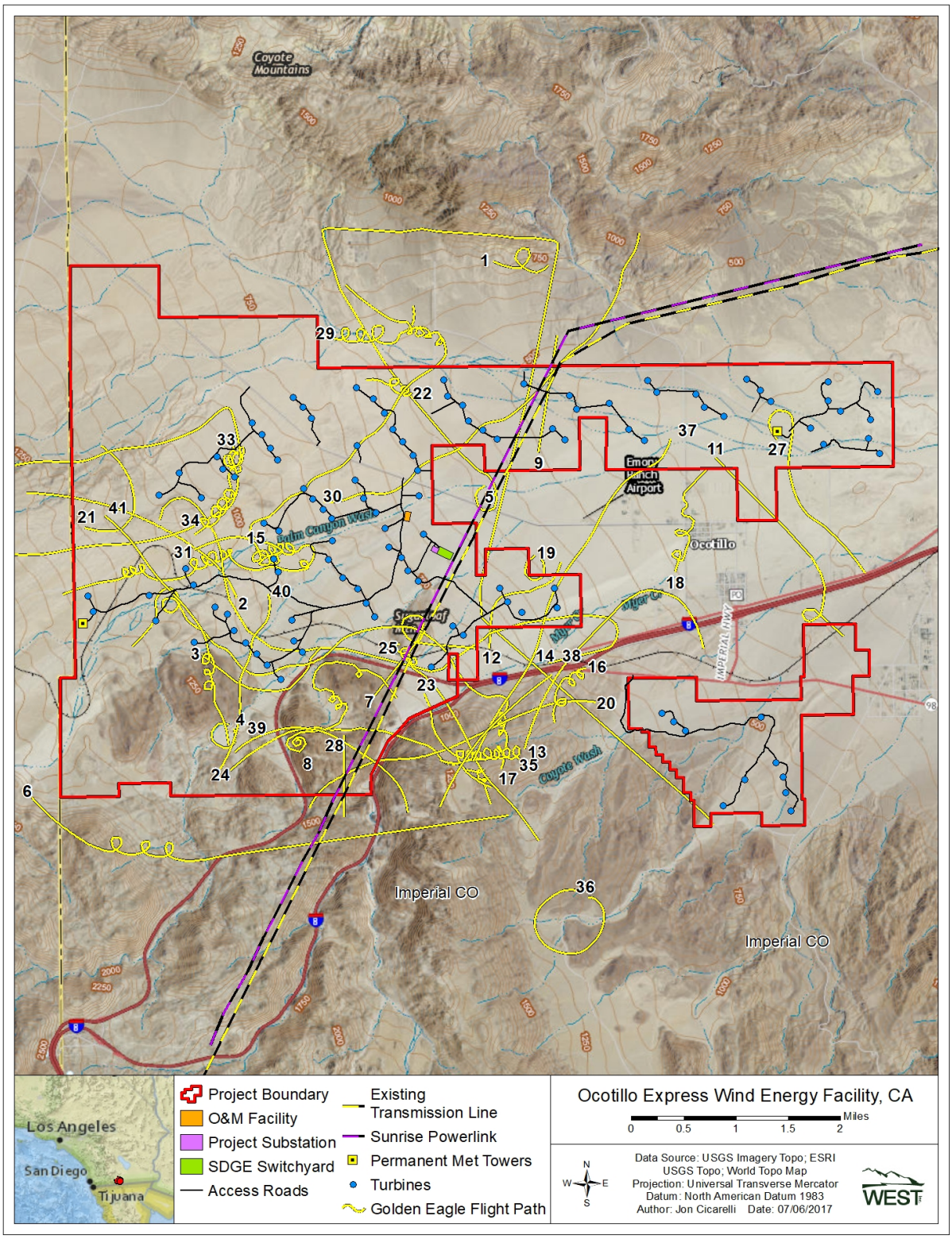


Figure 15. Location of mapped golden eagle flight paths recorded during bio-monitoring efforts from December 2012 through June 2017 at the Ocotillo Wind Energy Facility, Imperial County, California. *Note that the flight path for observations #10, #26, and #32 were not mapped as the observations were off the data sheets.

To date, the majority of golden eagle observations have occurred in September (seven observations) followed by January, December, and February (five observations per month; Table 14). Four golden eagle observations have been recorded in March, three observations in October, two golden eagle observations were recorded in both May, July, November, and June and one golden eagle observation was recorded in August. The majority of observations (68%) occurred between the hours of 10 a.m. and 2:00 p.m. and none of the eagle observations were recorded before 7:00 am or after 5:45 p.m. (Table 14). Of the 41 eagle observations, 21 were recorded during easterly winds, six during southwesterly winds, five during southeasterly winds, four during northeasterly winds, two during southerly winds, one during northerly winds, and one during westerly winds. Figure 15 depicts the locations of mapped flight paths for all eagle observations recorded from December of 2012 through June 2017.

As no golden eagle carcasses have been discovered at the OWEF, implementation of the first year of the biological tower monitoring efforts should be considered a success. However, due to the extremely low use of the area by golden eagles, the potential for impacts to golden eagles is considered very low even without implementation of the biological monitors. Based on a USFWS estimate of golden eagle flight minutes from the pre-construction data, we predict approximately 1.4 golden eagle fatalities in five years.

5.2 Fatality Monitoring

OWEF has completed two years of post-construction mortality monitoring (there have been no eagle mortalities at the Project) and is planning to conduct a third year of mortality monitoring beginning in 2018. As part of these mortality surveys, the searcher efficiency rate (i.e., the ability of a surveyor to locate a mortality) and carcass removal rate (i.e., the average time that a carcass persists before a scavenger removes it) have been or will be determined through experimental bias trials. The frequency of monitoring is informed based on the results of the carcass removal studies and is designed to meet the objectives of the monitoring program. During the first two years of mortality monitoring, a subset of 30% of the turbines was searched twice per month along with additional interim eagle/large bird searches at turbines located greater than 2.5 miles from the biological monitoring tower. For the third year of mortality monitoring, the same subset of 30% of the turbines will be searched consistent with the methods implemented during the first two years of study; however, additional eagle-specific searches will be conducted at the remaining 79 turbines. The eagle specific searches will be conducted once a month by walking transects spaced up to 20 m apart within square search plots measuring 160 m in size.

If an additional year of mortality monitoring is determined to be necessary during the five year term of the eagle take permit, the mortality monitoring plan will be designed specifically to search for eagles and approved by BLM and USFWS.

5.3 Golden Eagle Nest Surveys

Three years of golden eagle nest surveys have been conducted since the Project began operations. Due to concerns over bighorn sheep lambing, ground based golden eagle nest surveys were conducted within a 10-mile buffer of the project area focused on historic/known eagle nests. Monthly follow-up surveys were completed for identified golden eagle or potential golden eagle nests. Nest locations found during surveys were documented by noting the species, dates of activity, Universal Transverse Mercator (UTM) NAD 83 coordinates, nest contents (when possible), and behavior. The data have been provided to the USFWS. The results of the eagle nest monitoring during the first three years of operations supported the pre-construction eagle nest monitoring efforts which indicated that the territories located within 10 miles of the Project have not been consistently active, occupied, or productive for the last decade. However, caution should be exercised when evaluating the status of eagle territories in the desert as it is well known

that desert golden eagle territories are not as productive or active as they are in other habitats (USFWS personal communication).

5.4 Reporting

The Monitor has prepared and submitted interim, annual monitoring reports of the first two years of mortality monitoring, and shall prepare and submit a final three year Monitoring Report within six months of completing three years of post-construction monitoring.

All monitoring reports, including all raw monitoring data upon which the reports are based, shall be made available to USFWS. All monitoring reports shall report annual fatalities for golden eagles on a per-turbine, per-megawatt, and per-megawatt hour basis. The monitoring reports also summarize the results of the golden eagle nesting, behavior and use studies, as applicable. The Monitor shall supplement the final three year Monitoring Report with subsequent monitoring data collected. As part of the reporting process, all mortalities will be reported to the USFWS Law Enforcement Branch BIMRS mortality database and all eagle injuries or fatalities will be reported to USFWS within 24 hours of discovery for their direction on collection and/or sending carcasses to the national eagle repository.

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6.0 ADAPTIVE MANAGEMENT

The adaptive management techniques described in this section have been revised given the current understanding of eagle risk at the OWEF, along with the 2013 USFWS ECP Guidance. The adaptive management program at the OWEF has been developed to ensure that potentially significant levels of mortality from operation of the OWEF are effectively avoided or mitigated if necessary. This section describes the adaptive management process that will be applied for golden eagles. Changes in federal status for golden eagles may result in the addition of, or changes to, adaptive management strategies, as determined by OE LLC and USFWS recommendations.

6.1 Adaptive Management Process

The USFWS was provided a running mortality count once a month for review during the two years of standardized mortality monitoring and will be provided the results of the third year of mortality monitoring for eagles. OE LLC will meet with USFWS to discuss mitigation needs if it is determined that a unique or significant event has occurred. If OE LLC and USFWS determine that mitigation is necessary, USFWS and OE LLC will work together to identify and recommend suitable mitigation(s). One or more mitigation measures may be applied if a unique or significant event occurs or if a golden eagle fatality is realized at the OWEF during the five year permit period. A summary of ACPs is provided in Table 15.

Table 15. Summary of adaptive management process for eagle take at the Ocotillo Express Wind Energy Facility. Based on a permitted take rate of two eagles in five years.

Step	Trigger or Threshold	Advanced Conservation Practices
Step 1	One eagle taken in a five year review period.	• Assess eagle fatality to determine if cause or risk factor can be determined (e.g., season, time of day, weather, presence of prey/carrion, fire, or other event) and management response is warranted. • Consult with USFWS. • Take is within the permitted level and fully mitigated.
Step 2	Two eagles taken in the five year permit period.	• Assess eagle fatalities to determine if cause or risk factor can be determined (e.g., season, time of day, weather, presence of prey/carrion, fire, or other event) and management response is warranted. • Consult with USFWS to determine if: Immediate response or management action is needed to ensure take remains within permitted levels such as implementation of ACPs based on discussions with USFWS. • Take is within the permitted level and fully mitigated. Any additional mitigation will be determined in consultation with USFWS.

6.2 Agency Interaction

The development of an effective and successful ECP for the OWEF will depend on frequent coordination between agency biologists and OE LLC. Many of the conservation measures and ACPs implemented at the OWEF are being tested for the first time and will need to be reviewed and evaluated for effectiveness. As the OWEF was one of the first projects that implemented the USFWS draft ECP guidance (2011), and the process has continued to evolve with the 2013 USFWS ECP Guidance and the December 2013 eagle

permit rule change, OE LLC believes modifications to the process are warranted in light of the current understanding of eagle risk at the OWEF. OE LLC maintains the commitment to ensure that the goal of stable or increasing breeding populations of eagles is achieved. As suggested in the 2013 USFWS ECP Guidance, OE LLC plans to continue to allow service personnel access to the site to monitor the effects and effectiveness of the conservation measures that have been implemented.

7.0 PUBLIC OUTREACH

OWEF will continue to coordinate with key interest groups within the community to determine how capital contributions from the project can go toward worthwhile community projects. In addition, a project fact sheet describing the project and measures that have been put in place to address avian and bat issues has been prepared and is available at the local BLM El Centro District Office.

8.0 CONCLUSION

The OWEF ECP was written to provide guidance for all required golden eagle conservation measures and monitoring during ongoing and future operations of the OWEF. The OWEF ECP builds upon the 2012 OWEF ECP that was developed under the 2011 USFWS ECP Guidance and included golden eagle conservation measures that were: 1) developed prior to construction; 2) implemented during construction, and during the initial years of operations. The measures described in this document are intended to help protect and reduce potential impacts to golden eagles, as well as to monitor potential impacts to golden eagles during operation of the OWEF. The OWEF ECP will adaptively manage potential impacts to golden eagles resulting from the OWEF, as needed, in conjunction with USFWS and BLM.

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Appendix A: History of Golden Eagle Territories within 10 Miles of the OcotilloWind Energy Facility provided by Wildlife Research Institute (WRI).

Appendix A. History of golden eagle territories within 10 miles of the Ocotillo Wind Energy Facility provided by Wildlife Research Institute (WRI).

Carrizo Gorge

Dates/Earliest Record	Name on Record	Egg Collection/ Number of Young	Nest Location/ Nest Number	Young Banded/Type of Transmitter
1995	Mike Graham	?	Adult GEs seen on a regular basis; YNG seen	N
1996	P. Jorgenson	?	Adult GEs seen hunting 1 mi South of the mouth of Carrizo Canyon	N
1997	R West/IO	?	Walked the RR tracks from the south near I-8 and saw GE's and Randy reported seeing a nest	N
1998	R West	1 YNG	Walked the RR tracks and found a nest and saw a young in the nest	N
1999	JDB/ J Muench	0 YNG	Flew in Park Plane to find the nests	N
2000	JDB/ J Muench	0 YNG	Flew in Park Plane to find the nests	N
2001	JDB/ J Muench	0 YNG	From Park Plane we found nests but no young	N
2002	JDB/ R. West	0 YNG	Aerial survey found 5 nests; nest located above RR trestle (R. West, ground)	N
2003			Not surveyed	N
2004			Not surveyed	N
2005	JDB	1 YNG	3 wks old in nest on South face	N
6-Apr-2006	JD Bittner	1 YNG + Egg	aerial survey; 1 2wk old YNG and 1 egg; banding attempted, but failed due to hiking difficulty	N
11-May-2007	JDB/JH	1 YNG + Egg	used higher of the two nests; 1 egg and 1 YNG	Y - VHF
9-Apr-2008	JDB	0 YNG	5 nests; all empty. Bighorn sheep herd by nests	N
28-Apr-2009	JDB/JW/CM	0 YNG	5 inactive nests	N
6-Apr-2010	JDB	0 YNG	5 nests; red-collared Bighorn ewe near nests	N

Coyote Mountain

Dates/Earliest Record	Name on Record	Egg Collection/ Number of Young	Nest Location/ Nest Number	Young Banded/ Type of Transmitter
1970s	Culver	?	T15 S., R8 E., SE.35, SE.1/4 on side of mountain	
1992	JD Bittner/Culver	0 YNG	report adult GEs on territory	
2001	JDB/J. Oakley	0 YNG	Aerial Survey found 6 nests-none active; nests on all sides of the mtn.	
2002	JDB/J. Oakley	0 YNG	1 Nest RTH	
2003	JDB/J. Oakley	0 YNG	Aerial survey found nest activity but no young	
2004		?	Not surveyed	
2005		?	Not surveyed	
2006		?	Not surveyed	
11-May-2007	JDB/JH	0 YNG	1 nest, two raven nests on Mtns	
2008		?	Not surveyed	
28-Apr-2009	JD Bittner	0 YNG	1 GE nest; 2 Prairie Falcons in pothole; additional GE territory found to the West (Coyote Mtn West)	
30-Mar-2010	JDB/CM/RR	0 YNG	aerial (heli) survey: 2 nests	

Coyote Mountain - West

Dates/Earliest Record	Name on Record	Egg Collection/ Number of Young	Nest Location/ Nest Number	Young Banded/ Type of Transmitter
28-Apr-2009	JDB	0 YNG	Discovered by helicopter survey; unknown in the past	
30-Mar-2010	JDB/CM/RR	0 YNG	aerial (heli) survey: 9 nests, one active (new material); Bighorn Sheep and 2 pairs of Prairie Falcons on territory	

Table Mountain

Dates/ Earliest Record	Name on Record	Egg Collection/ Number of Young	Nest Location/ Nest Number	Young Banded/Type of Transmitter
1920s	Bittner/West/J. Oakley	?		
1991	JD Bittner/J. Oakley	1 YNG	3 nests on cliffs	
1992	JDB/JO	2 YNG		
1993	JBD/JO	1 YNG		
1994	JBD/JO	0 YNG		
1995	JBD/JO	2 YNG		
1996	JBD/JO	1 YNG	Adults seen early in nesting season; shooters at cliff during nesting season; chick died.	
1997	JBD/JO	0 YNG		
1998	JBD/JO	0 YNG		
1999	JBD/JO	1 YNG		Y- no transmitter
2000	JBD/JO	0 YNG		
2001	JBD/JO	1 YNG		Y- no transmitter
2002	JDB/JH	2 YNG	1 YNG shot on nest	
2003	JDB	1 YNG	Nest with 1 young located by fixed wing aerial survey-Anza Borrego St. Pk	N
14-Mar-2004	JH/ B Erickson	1-2 YNG	RTH nesting in southernmost GE nest	
13-Feb-2005	JH	0 YNG	3 new nests discovered 3/4 mile SW of old nests; extensive whitewash is evidence of 2004 nesting; RTH courting around old GE nest sites	
6-Apr-2006	JD Bittner	0 YNG	6 nests checked	N
13-Mar2007	JH	0 YNG	2 new nests southwest of old nest sites; 3 nests checked	N
9-Apr-2008	JDB	0 YNG	Nests present at old nest site; RTH on one; 6 nests checked	N
28-Apr-2009	JDB/JW/CM	0 YNG	7 nests; RT Hawk nesting on north set of nests	N
6-Apr-2010	JDB	0 YNG	6 nests; GHO w/ yng on old GE nest	

Appendix B: Elevation, Slope, and Aspect Characteristics of Proposed Turbines at Ocotillo.

Appendix B. Elevation, slope, and aspect characteristics of proposed turbines at Ocotillo.

Turbine	Elevation (m)	Slope (Degrees)	Aspect (Degrees)	Aspect (Direction)
9	283.72	2.55	56.26	Northeast
10	284.82	2.29	37.54	Northeast
11	285.03	0.97	31.70	Northeast
14	289.31	1.33	76.47	East
15	284.20	2.01	87.62	East
16	286.18	5.61	73.29	East
17	288.57	4.12	88.83	East
18	287.63	3.56	106.71	East
19	336.52	2.79	91.59	East
20	327.17	2.21	121.32	Southeast
21	323.32	4.04	75.20	East
22	318.97	0.84	104.44	East
23	318.51	2.07	353.24	North
24	323.38	2.95	16.79	North
25	324.28	1.94	58.44	Northeast
26	305.75	1.80	52.18	Northeast
27	304.19	2.27	27.69	Northeast
28	294.82	1.09	56.12	Northeast
29	343.17	5.53	154.88	Southeast
30	362.77	4.07	27.09	Northeast
31	358.51	1.64	119.37	Southeast
39	400.02	1.88	71.03	East
40	399.70	2.95	73.10	East
43	334.25	1.74	130.11	Southeast
44	333.74	2.49	31.26	Northeast
49	326.91	1.96	58.54	Northeast
50	308.97	2.59	63.18	Northeast
51	308.72	3.62	49.62	Northeast
64	252.76	2.42	40.80	Northeast
65	253.40	1.98	52.24	Northeast
66	253.93	1.62	40.63	Northeast
67	260.74	3.23	355.52	North
69	260.53	1.47	76.21	East
70	255.55	1.92	78.79	East
71	251.77	2.98	71.71	East
72	248.71	2.75	84.55	East
73	248.99	3.71	348.86	North
74	258.49	1.79	28.93	Northeast
75	257.46	2.50	23.12	Northeast
76	261.30	1.94	61.82	Northeast
77	260.67	1.85	48.40	Northeast
78	255.68	2.57	15.17	North

Appendix B. Elevation, slope, and aspect characteristics of proposed turbines at Ocotillo.

Turbine	Elevation (m)	Slope (Degrees)	Aspect (Degrees)	Aspect (Direction)
79	233.90	1.60	46.63	Northeast
80	231.71	2.09	48.33	Northeast
81	203.97	2.73	68.54	East
82	207.35	2.16	38.52	Northeast
83	204.47	2.12	29.90	Northeast
86	183.82	1.59	40.24	Northeast
87	187.02	1.45	79.53	East
88	230.68	2.71	72.44	East
89	230.14	1.60	40.39	Northeast
90	228.98	2.04	63.90	Northeast
91	232.45	1.88	26.11	Northeast
92	226.61	2.57	11.96	North
93	210.95	2.16	77.29	East
94	200.69	2.95	57.44	Northeast
95	223.34	1.63	89.76	East
96	227.89	1.92	34.77	Northeast
97	228.45	1.64	69.02	East
98	220.19	1.80	93.00	East
99	198.87	1.28	74.39	East
100	195.50	1.92	20.67	North
101	194.06	1.44	46.66	Northeast
102	195.21	1.64	66.82	Northeast
103	196.86	2.36	77.07	East
105	230.93	0.85	318.45	Northwest
106	228.62	0.65	21.07	North
107	228.64	1.92	42.46	Northeast
110	171.00	1.76	46.72	Northeast
111	168.28	1.28	61.35	Northeast
112	165.68	1.36	76.39	East
113	146.16	1.63	54.64	Northeast
116	187.87	1.80	67.28	Northeast
117	182.17	1.38	86.89	East
118	193.99	2.57	70.14	East
120	181.88	2.23	13.57	North
122	201.98	2.32	36.72	Northeast
123	169.30	1.68	8.83	North
124	164.01	1.63	17.81	North
125	158.21	0.87	71.26	East
126	162.16	1.67	59.85	Northeast
128	148.51	1.94	54.48	Northeast
130	259.75	2.08	83.20	East
131	150.50	0.87	114.99	Southeast

Appendix B. Elevation, slope, and aspect characteristics of proposed turbines at Ocotillo.

Turbine	Elevation (m)	Slope (Degrees)	Aspect (Degrees)	Aspect (Direction)
132	166.73	1.70	40.89	Northeast
133	169.89	1.80	76.29	East
134	201.71	2.69	76.81	East
135	212.47	2.83	110.74	East
147	139.07	1.13	96.37	East
148	136.74	0.95	99.33	East
149	130.61	0.70	105.24	East
150	125.75	1.20	154.61	Southeast
151	121.65	0.85	153.86	Southeast
152	117.57	0.20	80.49	East
153	115.15	1.04	122.12	Southeast
154	113.75	0.84	172.68	South
155	109.83	1.00	154.04	Southeast
156	106.26	0.96	164.69	South
159	99.72	1.18	111.66	East
160	97.22	0.44	112.48	East
161	95.04	4.28	185.95	South
162	97.75	0.36	342.34	North
163	100.41	2.05	162.39	South
164	105.22	1.02	256.33	West
167	95.37	1.87	134.11	Southeast
168	102.11	1.33	288.51	West
169	125.93	0.63	109.92	East
172	92.21	1.06	73.56	East
173	172.18	1.01	58.86	Northeast
174	143.45	1.07	72.27	East
175	110.30	1.04	149.53	Southeast
176	123.47	0.83	38.81	Northeast

Appendix C: Post-Construction Monitoring Efforts at the Ocotillo Wind Energy Facility

First Annual Report of Post-Construction Wildlife Studies at the Ocotillo Express Wind Energy Facility Imperial County, California

August 26, 2013 – September 29, 2014

Final Report



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January 8, 2014

EXECUTIVE SUMMARY

Pattern Energy, through Ocotillo Express Wind LLC (OE LLC) owns and operates the Ocotillo Express Wind Energy Facility (OWEF or Project) in Imperial County, California, which consists of 112 Siemens 2.3-megawatt (MW) wind turbines. An Environmental Impact Statement (EIS) / Environmental Impact Report (EIR) was prepared for the Project. The Final EIS/EIR was released in February of 2012 and in May of 2012. The Bureau of Land Management (BLM) released a Record of Decision (ROD) approving the development of the OWEF. The OWEF was constructed in 2012 and 2013, with the Project becoming fully operational in the fall of 2013.

In accordance with BLM Instruction Memorandum No. 2010-156, an Avian and Bat Protection Plan (ABPP) and an Eagle Conservation Plan (ECP) were developed for the project in consultation with the appropriate agencies and identified measures that OWEF would implement to avoid, minimize, and mitigate project-related impacts to birds and bats.

The Final EIS/EIR and associated ABPP and ECP identified post-construction monitoring studies and associated protocols for the OWEF. The ABPP required multiyear, formal year-long mortality monitoring studies, raptor nest surveys, and avian use monitoring surveys. This report includes the results of the first full year of post-construction wildlife monitoring studies for the OWEF including the first standardized year-long fatality monitoring study and avian use studies as well as comparisons of the first-year fatality rates to reported fatality rates at wind energy facilities for which publicly available data exist. Separate stand-alone raptor and eagle nest monitoring reports have been prepared and provided to the Technical Advisory Committee (TAC). In addition, additional carcass discoveries that occurred prior to the start of the standardized year-long survey or during the separate interim/large bird searches are not presented herein, but a comprehensive list of all carcass discoveries at the facility are provided to the agencies on a monthly basis.

The OWEF consists primarily of BLM land and a small portion of private land consisting of approximately 12,565 acres (5,085 hectares), and is located approximately five miles (eight kilometers) west of Ocotillo, California. Topography within the OWEF is generally considered flat, although there are several desert washes that cut throughout the site and there is more abrupt topography outside of the Project to the west and north. Land cover generally consists of a variety of desert scrub habitat types.

The first year of standardized year-long fatality monitoring began at the OWEF in October, 2013. Standardized carcass searches were conducted at 33 of the 112 turbines twice a month for a full year (October 2013 - September 2014). Two different plot sizes were searched during the study, including 160 X 160-meter (m; 525 X 525-foot [ft]) plots at 28 turbines and 270 X 270-m (886 X 886-ft) plots at five turbines. Searcher efficiency trials were conducted to develop estimates of the proportion of casualties which were not detected by searchers (searcher detection bias). Searcher efficiency trials were conducted throughout the year to encompass

variable field conditions that may affect surveyor carcass detection. Carcass removal trials were conducted to estimate the average length of time a carcass remained in the search plots and was available for detection by searchers. Carcass removal trials were conducted throughout the year to incorporate the effects of varying field conditions on scavenger densities.

Twenty-four rounds of searches were conducted at the 33 designated search turbines, for a total of 792 turbine searches. In total, 40 fatalities (14 bats and 26 birds) were documented from October 4, 2013, through September 29, 2014, during the first standardized year-long mortality monitoring study or incidentally during the study period. White-throated swift was the most commonly identified bird fatality (five fatalities), while no more than two fatalities were documented for other identified bird species. One red-tailed hawk (discovered incidentally) was the only raptor fatality identified during the study. One Bird of Conservation Concern in Bird Conservation Region 33 (yellow warbler) was identified during the study and no other sensitive bird species were identified. Cumulatively, no more than three bird fatalities were documented at a single turbine during the year of surveys. There was no strong pattern in the spatial distribution of bird fatalities within the project. Bird fatalities were documented throughout much of the year, although there were no fatalities identified during the summer period.

A total of 14 bat fatalities were found during the first year of standardized year-long fatality monitoring studies, with nine bats documented during scheduled turbine searches and five documented incidentally (two of the incidental bat discoveries were within standardized search plots and three were outside of standardized search plots). Mexican free-tailed bat was by far the most commonly documented fatality (11 fatalities); while canyon bat (two fatalities) and unidentified Lasiurus bat (one fatality) were the only other bat species identified as fatalities during the study. There were no sensitive bat species identified during the first standardized year-long mortality monitoring study or incidentally during the study period. No more than two bat fatalities were identified at any one turbine during the study and there were no strong patterns in the spatial distribution of bat fatalities identified during the study. Temporally, bat fatalities were concentrated in the late spring and late summer – early fall seasons.

Searcher efficiency trials included 129 small bird and 53 large bird trial carcasses. Bat carcasses were not used during searcher efficiency trials due to the small number of bats available from the site, and as such, searcher efficiency trial data for small birds was used for bats. The overall searcher efficiency rate for small birds (and bats) was 73.4%, while the efficiency rate for large birds was 94.3%. Carcass removal trials included 76 large bird, 100 small bird, and four bat carcasses. Average removal times did not differ significantly for small birds and bats in the spring season, therefore, removal times for small birds and bats were combined into a single estimate. In addition, average removal times did not differ significantly among the spring, summer, and fall seasons, therefore, average removal times were calculated across the three seasons for each size class (small birds/bats and large birds) for use in the analyses. Average removal times did differ for small birds in the winter season and so only the winter removal trials were applied to the winter season for small birds. No bat carcasses were discovered in the winter season. During the spring, summer, and fall seasons, the average

removal time for small birds/bats was 3.45 days, while the average removal time for large birds was 8.8 days. During the winter season, the average removal time for small birds was 5.5 days.

Fatality estimates and 90% confidence intervals were calculated for birds and bats. For small birds and bats in the spring, summer, and fall, the probability that a carcass would remain in a search plot and be found by a searcher was 0.17. For small birds and bats in the winter, the probability that a carcass would remain in the search plot and be found by a searcher was 0.25. For large birds, the probability was 0.45 across all seasons. Annual fatality rates for all birds, adjusted for searcher efficiency and carcass removal, was 0.88 fatalities/MW/year, and the annual adjusted fatality rate for bats was 0.90 fatalities/MW/year.

The estimated overall bird fatality rate of 0.88 birds/MW/year was low compared to other wind energy facilities in California and the desert southwest with publicly available data, where estimates have ranged from 0.55 to 8.3 birds/MW/year. The overall bird fatality rate at the OWEF ranked 2nd lowest compared to 12 other studies at facilities in California and the desert southwest. Based on the data, it is unlikely that operation of the OWEF will result in significant impacts to local or regional bird populations.

The estimated overall bat fatality rate at the OWEF (0.90 bats/MW/year) was also low compared to other wind energy facilities in California and the desert southwest with publicly available bat fatality data, where bat fatality rates ranged from 0.08 to 3.92 bats/MW/year. Based on the relatively small estimate of bat mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bat populations.

Twenty-six rounds of fixed-point avian use surveys were conducted at twenty-one survey stations from August 26, 2013, through September 29, 2014, resulting in 546 fixed-point surveys. Twenty-nine unique bird species were documented, but common raven, black-throated sparrow, and house finch accounted for a majority (43%) of all observations. Raptor use was low throughout all seasons, and varied from 0.05 raptors per 800-m (2,625-ft) plot per 30-min survey during the fall to 0.09 raptors/800-m plot/30-min survey during the spring. Red-tailed hawk accounted for the majority of observed raptor use. Passerine use varied from a low of 0.56 birds/100-m plot/30-min survey in the summer to a high of 1.1 birds/100-m plot/30-min survey in the spring. Black-throated sparrow, cactus wren, house finch, and rock wren were the most commonly observed small bird/passerine species, and accounted for between 17% and 56% of passerine use across all seasons.

During the 2013-2014 avian use study, common raven, black throated sparrow, house finch, cactus wren, and rock wren were the most abundant bird species. All of these species were also among the most abundant species observed during the pre-construction studies. However, avian abundance was significantly lower during the 2013-2014 study compared to the pre-construction study. There are a number of factors that may influence the observed results including the use of different observers and environmental conditions (e.g. drought conditions).

The results of the first year of standardized studies have provided new insights into the effects of the OWEF on wildlife, which are primarily supportive of the low level of predicted risk of the project on wildlife. The first year of studies found that impacts to birds (including raptors) and bats were low and that the operation of the OWEF is unlikely to result in significant impacts to local or regional bird or bat populations.

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INTRODUCTION

Pattern Energy, through Ocotillo Express LLC (OE LLC) owns and operates the Ocotillo Express Wind Energy Facility (OWEF or Project) in Imperial County, California (Figure 1). An Environmental Impact Statement (EIS) / Environmental Impact Report (EIR) was prepared for the Project. The Final EIS/EIR was released in February of 2012 and in May of 2012 the Bureau of Land Management (BLM) released a Record of Decision (ROD) approving the development of the OWEF. The OWEF was constructed in 2012 and 2013 with the Project becoming fully operational in the fall of 2013.

In accordance with BLM Instruction Memorandum No. 2010-156, an Avian and Bat Protection Plan (ABPP) and an Eagle Conservation Plan (ECP) were developed for the project and incorporated as Appendices to the Final EIS/EIR. The ABPP and ECP were developed in consultation with the appropriate agencies and identify measures that OWEF will implement to avoid, minimize, and mitigate project-related impacts to birds and bats.

The ABPP included provisions for a Technical Advisory Committee (TAC) that was formed to monitor OWEF activities, including mortality data, and to evaluate the need for any avoidance/minimization or mitigation measures. The TAC consists of representatives from the BLM, U.S. Fish and Wildlife Service (USFWS), and California Department of Fish and Wildlife (CDFW). The TAC has reviewed and approved the post-construction wildlife monitoring protocols, and has and will continue to review monitoring results, and provide advice and recommendations to the BLM Authorized Officer on developing and implementing effective measures to monitor, avoid, minimize, and mitigate impacts to avian and bat species and their habitats related to operations.

The Final EIS/EIR and associated ABPP and ECP identified post-construction monitoring studies and associated protocols for the OWEF. The ABPP required multiyear, formal year-long mortality monitoring studies, raptor nest surveys, and avian use monitoring surveys. This report includes the results of the first full year of post-construction wildlife monitoring studies for the OWEF including the first standardized year-long fatality monitoring study and avian use studies, as well as comparisons of the first-year fatality rates to reported fatality rates at wind energy facilities for which publicly available data exist. Separate stand-alone raptor and eagle nest monitoring reports have been prepared and provided to the TAC. In addition, additional carcass discoveries that occurred prior to the start of the standardized year-long survey or during the separate interim/large bird searches are not presented herein, but a comprehensive list of all carcass discoveries at the facility are provided to the agencies on a monthly basis.

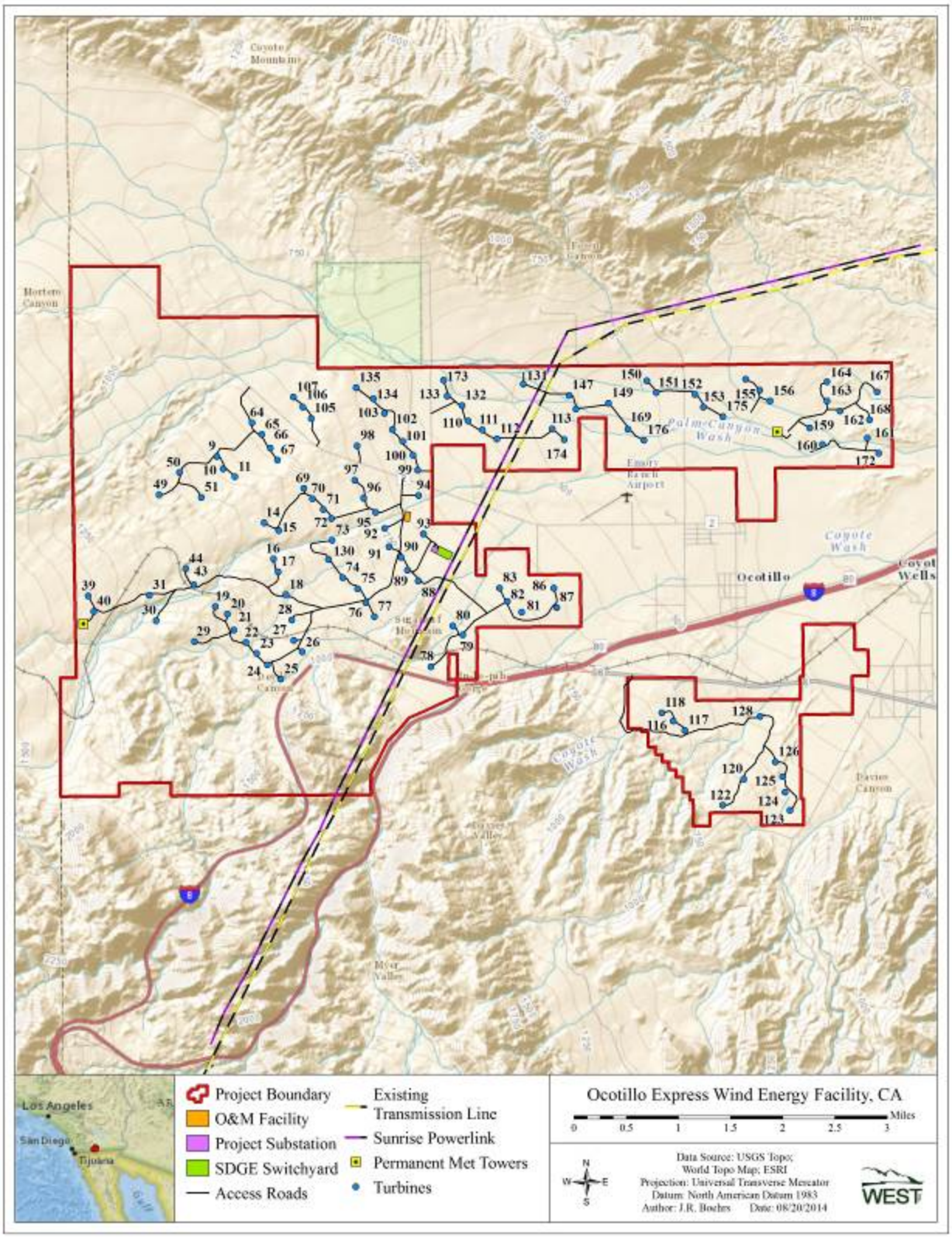


Figure 1. Location of the Ocotillo Express Wind Energy Facility in Imperial County, California.

STUDY AREA

The OWEF is located primarily on BLM land and a small portion of private land consisting of approximately 12,565 acres (5,085 hectares [ha]). The Project includes 112 Siemens SWT – 2.3-108 wind turbines (approximately 315 megawatts [MW]) and associated infrastructure (Figure 1). The diameter of the circle swept by the blades is 354 feet (ft; 108 meters [m]) and turbines are 440 ft (134 m) tall in height from the base of the tower to the fully extended blade tip. In addition to the 112 wind turbines, other above-ground infrastructure includes an Operations and Management (O&M) building, two permanent meteorological (met) towers, an electrical substation, and the Sunrise Powerlink transmission line.

The project site is located within four U.S. Geological Survey (USGS) 7.5-minute quadrangle maps; Carrizo Mountain, Coyote Wells, In-Ko-Pah Gorge, and Painted Gorge. The northern portion of the site is generally situated north of Interstate 8 (I-8), with the western edge along the Imperial/San Diego County border to approximately 1.5 miles (2.4 kilometers [km]) northeast of the town of Ocotillo on its eastern edge. The northern area includes several distinct features, including a portion of the I-8 Island, which is undeveloped rocky and hilly terrain between the eastbound and westbound lanes of I-8, Sugarloaf Mountain, and a portion of the San Diego and Arizona Eastern railroad tracks. County Route (CR) S2 bisects the northern project area, and I-8 passes through the southern portion of the northern project area. The southern area is much smaller than the northern area and the majority is south of State Route (SR) 98.

Vegetation on site consists of a variety of desert scrub habitat types (USGS National Land Cover Database [NLCD] 2001; Figure 2). Several dry desert washes cut through the site, generally from west to east: Palm Canyon Wash cuts through the center of the northern project area, Myer Creek Wash cuts through the southern portion of the northern project area, a portion of Coyote Wash cuts through the northwest portion of the southern project area, and several additional unnamed washes cut through the site.

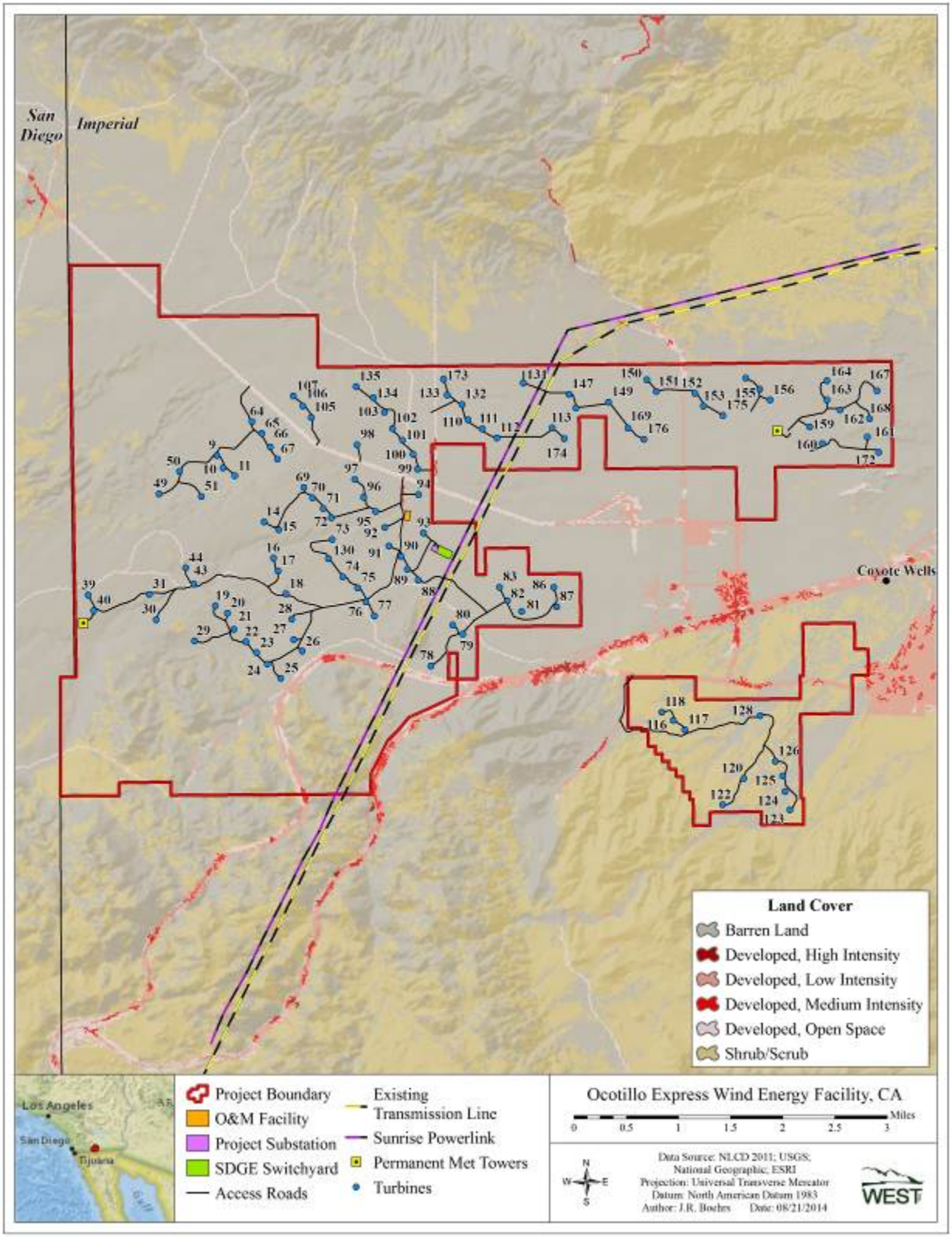


Figure 2. Landuse/landcover information for the Ocotillo Express Wind Energy Facility (USGS NLCD 2001).

METHODS

Year-Long Mortality Monitoring

The primary objective of the standardized mortality monitoring study is to estimate annual levels of avian and bat mortality at the OWEF.

Study Design

The four primary components of the standardized mortality monitoring study are: 1) standardized carcass searches, 2) searcher efficiency trials, 3) scavenger removal trials, and 4) data analyses and reporting.

Standardized Carcass Searches

Mortality surveys consisted of standardized carcass searches at 33 of the turbines (about 30% of 112 total turbines at least twice per month throughout the year (Table 1). A systematic sample with a random start was used to select the 33 search turbines out of the turbines that were determined to be available for searching (i.e., those turbines for which it was determined there were not cultural concerns).

Table 1. Turbines selected for Year 1 mortality surveys at the Ocotillo Express Wind Energy Facility.

Search Turbine Number		
22	86	147
24	87	148
27	89	149
28	93	151
31	111	152
43	112	153
44	113	156
71	118	169
75	124	176
76	130	173
82	133	174

Standardized carcass searches were conducted within 160 X 160 m (525 X 525-ft) plots centered on the turbine for 28 of the 33 turbines and 270 X 270 m (886 X 886-ft) plots centered on the turbine for the remaining five turbines (turbines 24, 82, 93, 133, and 149; Figure 3). Trained field technicians systematically searched each plot for avian and bat fatalities by walking parallel transects spaced approximately six m (about 20 ft) apart and scanning both sides of the transect for carcasses. For the purposes of the mortality surveys, the condition of carcasses found by searchers was classified according to the following criteria:

- **Intact** - a carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger;

- **Scavenged** – an entire carcass that shows signs of scavenging or is heavily infested by insects, or portion(s) of a carcass in one location (e.g., wings);
- **Feather Spot** - 10 or more feathers (or two or more primary feathers) at one location indicating predation or scavenging.

Handling of bird and bat carcasses was conducted under the appropriate agency permits. All bird and bat carcasses found during the standardized searches were labeled with a unique number, bagged, and stored in a freezer at the OWEF O&M building. A data sheet was completed for each carcass to record species, sex and age (when possible), date and time collected, location (Global Positioning System [GPS] coordinates), carcass condition, habitat type, suspected cause of death, and any comments. All casualties were photographed in the field and the location was plotted on a map that showed the location of the carcass in relation to the nearest turbine and other facilities (e.g., overhead power lines).

There are three scenarios under which casualties may have been found at the OWEF: 1) within search plots during the standardized carcass searches; 2) within search plots while searchers are on site but not conducting a standardized search; and 3) by project personnel during other activities, such as turbine maintenance. All casualties found by study personnel were recorded in accordance with the methods described above. It is assumed that casualties found incidentally within search plots (by searchers or project personnel) would have been found by searchers and these casualties have been included in fatality estimates. Casualties found incidentally by searchers or project personnel outside the formal search plot have been reported as incidental discoveries and are not included in fatality estimates.

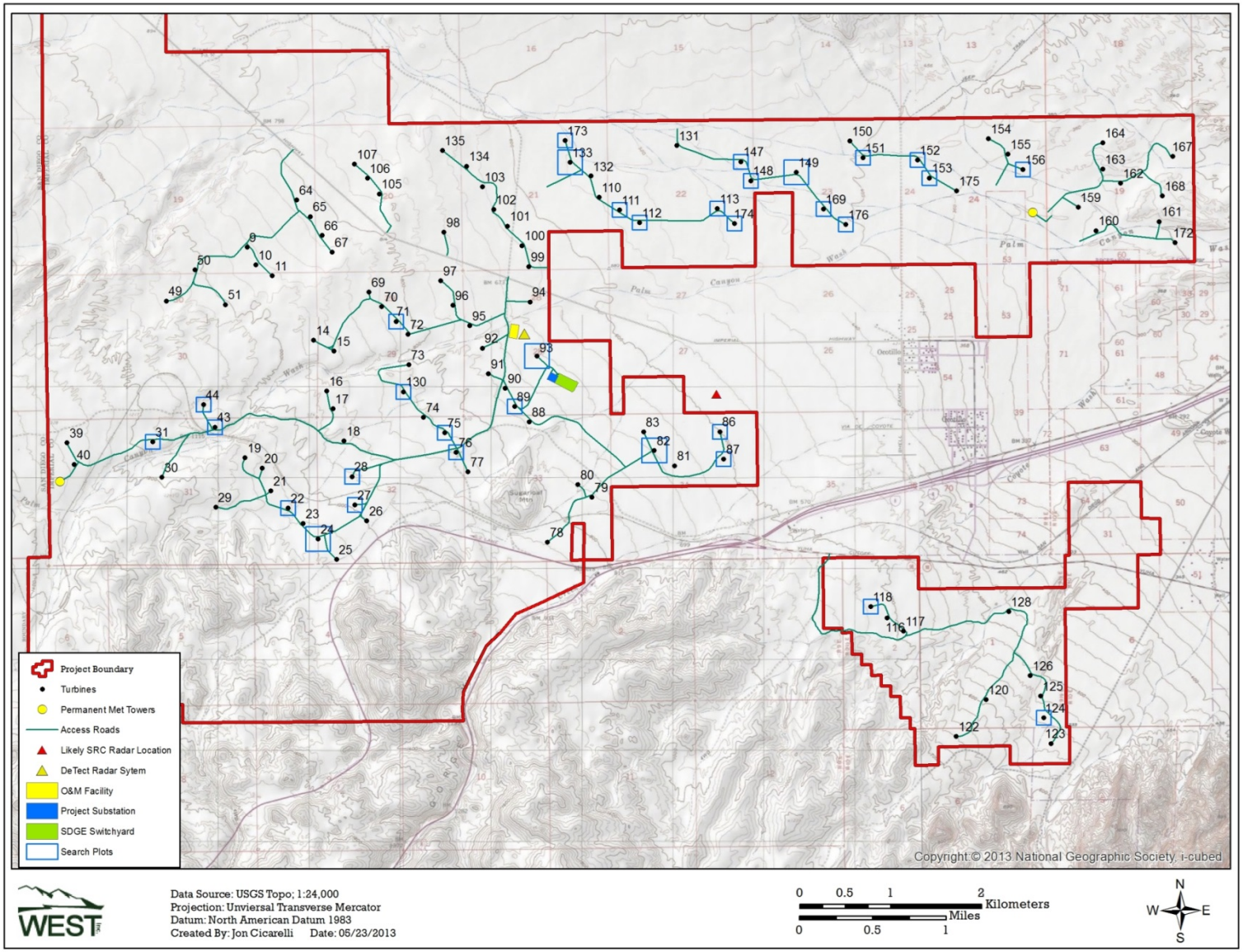


Figure 3. Turbines selected for the Year 1 mortality monitoring study at the Ocotillo Express Wind Energy Facility.

Experimental Bias Trials

Experimental bias trials were conducted to develop estimates of the proportion of casualties which were not detected by searchers. As a result of these estimates, correction factors have been applied to observed carcass discoveries to provide an annual estimate of mortality per turbine and per MW. Two types of experimental bias trials were conducted: 1) searcher efficiency trials, and 2) carcass removal trials.

Searcher Efficiency Trials

Searcher efficiency trials were conducted to develop estimates of the proportion of casualties which were detected by searchers (searcher detection bias). Searcher efficiency trials were conducted throughout the year to encompass variable field conditions that may have affected surveyor carcass detection. A minimum of two searcher efficiency trials were conducted in each of the four seasons, for a total of eight trials annually.

Each trial consisted of placing approximately 20 carcasses divided among two size classes (small and large) in search plots. Carcasses utilized for searcher efficiency trials consisted of birds and bats found during standardized carcass searches at OWEF and/or non-native or commercially-available species. Large birds were represented by species such as mallard (*Anas platyrhynchos*) or ring-necked pheasant (*Phasianus colchicus*), while small birds included species such as house sparrow (*Passer domesticus*) and rock pigeon (*Columba livia*). Small brown birds (e.g., house sparrows) were used in lieu of bat carcasses, if necessary.

Searcher efficiency trials were conducted simultaneously with mortality searches. Trial carcasses were randomly placed within turbine search plots by a field supervisor immediately prior to a scheduled carcass search. Searchers were not told when or where trials were being conducted to minimize potential bias. Each trial carcass was discreetly marked to distinguish it from an actual fatality. Carcasses were dropped from waist height and allowed to land in a variety of postures. Searchers recorded the location of each trial carcass found during standardized carcass searches. Immediately following completion of the search, the field supervisor retrieved all carcasses not found by searchers to determine the number of carcasses that remained available for detection but were not found. Searcher efficiency trial data were analyzed to develop estimates of detection bias to adjust annual estimates of bird and bat mortality rates.

Carcass Removal Trials

The objective of the carcass removal trials was to estimate the average length of time a carcass remained in the search plot (was not removed by scavengers) and was available for detection by searchers. Carcass removal trials were initiated when carcass search studies began, and were conducted throughout the year to incorporate the effects of varying field conditions and scavenger densities. Carcasses were placed on a minimum of two dates during each season for a minimum total of eight trial initiation dates. For each trial, carcasses were discreetly marked and placed in the field. Small brown birds (e.g., house sparrows) were used in lieu of bat

carcasses, if necessary. All trial carcasses were handled with disposable gloves to minimize human scent on the carcasses.

Observers conducting carcass searches monitored the trial birds over a minimum of a 30-day period according to the following schedule as closely as possible. Carcasses were checked every day for the first four days, and then on days seven, 10, 14, 18, 24, and 30. This schedule varied slightly due to logistical constraints. At each visit, the observer noted the condition of the carcass (e.g., intact, scavenged, feather spot [i.e., more than 10 feathers], or absent [less than 10 feathers]). Removal trial carcasses were left at the location until the end of the trial or until the carcass was removed entirely by scavengers. After the trial, any remaining evidence of the carcasses was removed. Carcass removal trial data were analyzed to develop separate removal estimates for large birds, small birds, and bats, and the results were used to adjust annual estimates of bird and bat mortality rates.

Statistical Methods for Calculating Mortality Estimates

Adjusted annual mortality estimates were developed for all birds, all bats, small birds, large birds, and raptors. Estimates of facility-related mortalities are based on:

1) Observed number of carcasses found during standardized searches during the monitoring year for which the cause of death is either unknown or is probably facility-related;
2) Non-removal rates, expressed as the estimated average probability a carcass is expected to remain in the study area and be available for detection by the searchers during removal trials; and
3) Searcher efficiency, expressed as the proportion of placed carcasses found by observers during the searcher efficiency trials.

Fatality estimates were provided for a minimum of five categories: 1) all birds, 2) small birds, 3) large birds, 4) raptors, and 5) bats. The number of avian and bat fatalities attributable to operation of the facility, based on the number of avian and bat fatalities found at the facility whose death appears related to facility operation, were reported. All carcasses located within areas surveyed or incidentally, regardless of species, were recorded and, if possible, a cause of death was determined based on a cursory field necropsy. If the cause of death was not apparent, a “worst case” estimate was made by attributing the mortality to facility operation. The total number of avian and bat carcasses attributable to the facility was estimated by adjusting for removal and searcher efficiency biases.

Definition of Variables

The following variables are used in the equations below:

c_i the number of carcasses detected at plot *i* for the study period of interest (e.g., one monitoring year) for which the cause of death is either unknown or is attributed to the facility

n the number of search plots

k the number of turbines searched (including the turbines centered within each search plot)

$\bar{c}$ the average number of carcasses observed per turbine per monitoring year

s the number of carcasses used in removal trials

s_c the number of carcasses in removal trials that remain in the study area after 30 days

se standard error (square of the sample variance of the mean)

t_i the time (in days) a carcass remains in the study area before it is removed, as determined by the removal trials

$\bar{t}$ the average time (in days) a carcass remains in the study area before it is removed, as determined by the removal trials

d the total number of carcasses placed in searcher efficiency trials

p the estimated proportion of detectable carcasses found by searchers, as determined by the searcher efficiency trials

I the average interval between standardized carcass searches, in days

A proportion of the search area of a turbine actually searched

$\hat{\pi}$ the estimated probability that a carcass is both available to be found during a search and is found, as determined by the removal trials and the searcher efficiency trials

m the estimated annual average number of fatalities per turbine per year, adjusted for removal and searcher efficiency biases.

Observed Number of Carcasses

The estimated average number of carcasses ($\bar{c}$) observed per turbine per monitoring year is:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{k \cdot A} \quad (1)$$

Estimation of Carcass Non-Removal Rates

Estimates of carcass non-removal rates are used to adjust carcass counts for removal bias. Mean carcass removal time ($\bar{t}$) is the average length of time a carcass remains in the study area before it is removed:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c} \qquad (2)$$

Estimation of Searcher Efficiency Rates

Searcher efficiency rates are expressed as *p,* the proportion of trial carcasses that are detected by searchers in the searcher efficiency trials. These rates will be estimated by carcass size and season.

Estimation of Facility-Related Fatality Rates

The estimated per turbine annual fatality rate (*m*) is calculated by:

$$m = \frac{\bar{c}}{\hat{\pi}} \qquad (3)$$

where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and searcher efficiency bias. Data for carcass removal and searcher efficiency biases will be pooled across the study to estimate $\hat{\pi}$.

The final reported estimates of *m* and associated standard errors and 90% confidence intervals for the OWEF were calculated using bootstrapping (see Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics. For each bootstrap sample, $\bar{c}$, $\bar{t}$, *p*, $\hat{\pi}$, and m are calculated. A total of 1,000 bootstrap samples were used. The reported estimates are the mathematical means of the 1,000 bootstrap estimates that were sampled and the standard deviation of the bootstrap estimates is the estimated standard error. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates are estimates of the lower limit and upper limit of 90% confidence intervals for the reported estimates that will be reported.

Avian Monitoring

The ABPP requires that avian monitoring be conducted twice each month during the first two years of operation using the same methods as pre-construction studies. The ABPP states that "general use point-count data will be collected to provide an accurate comparison between pre- and post-construction use to inform our understanding of avian exposure and probability of mortality as well as behavioral responses to the facility". The avian monitoring was initiated at the same time as the year-long standardized mortality monitoring (i.e., once all 112 turbines were operating).

Fixed-Point Avian Use Surveys

Fixed-point avian use surveys were conducted at the 21 pre-construction avian point count locations located within and adjacent to the OWEF (Figure 4). The 21 avian use points were selected during the OWEF pre-construction phase to survey representative habitats and topography while also providing relatively even coverage of the OWEF. Fixed-point circular plots were used for both passerine and raptor surveys following the field methods described by Reynolds et al. (1980).

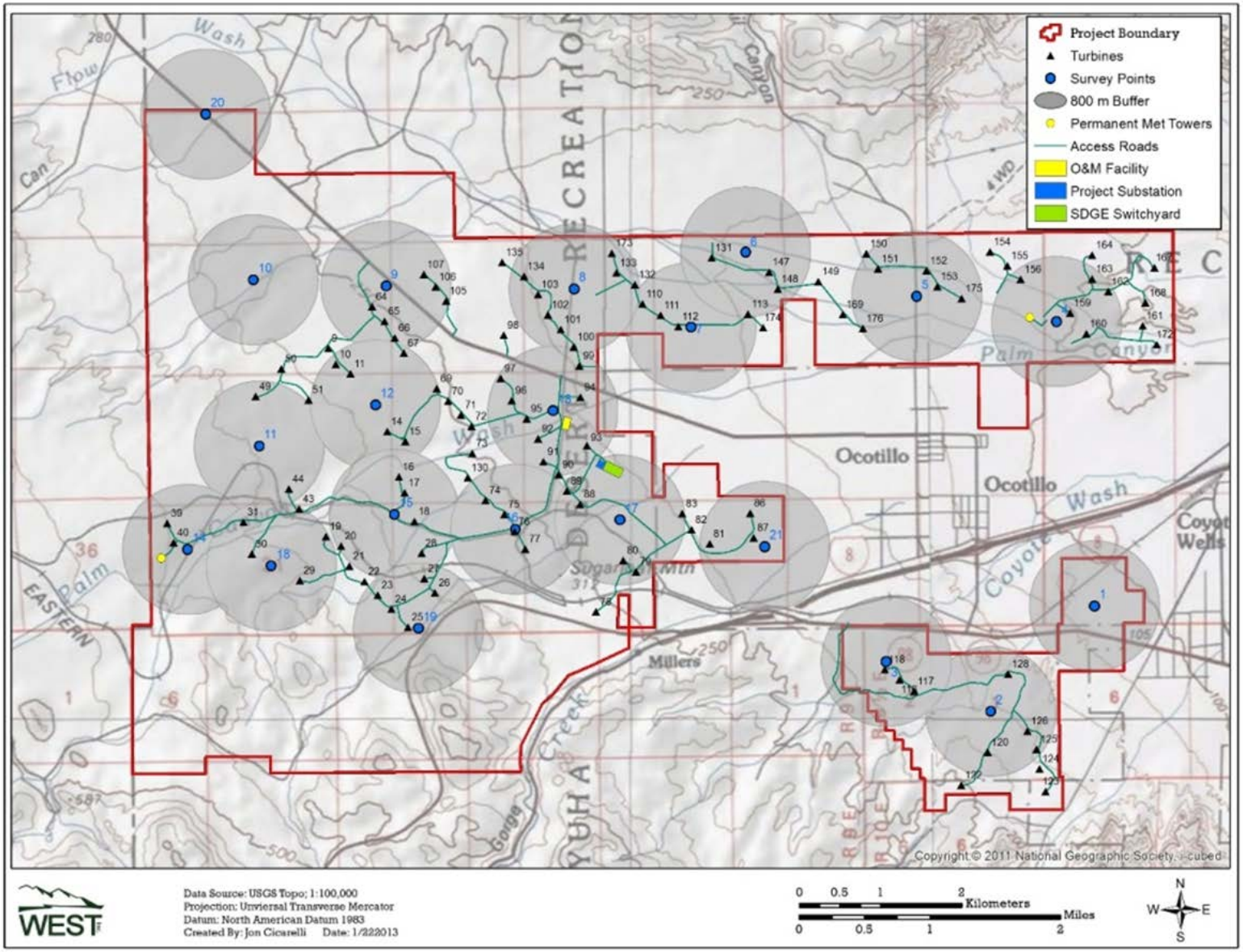


Figure 4. Fixed point locations for avian use surveys at the Ocotillo Express Wind Energy Facility.

Each observation point was surveyed for 30 minutes (min) twice a month. The survey viewsheds included an 800-m (2,625-ft) radius plot for large birds and 100-m (328-ft) radius plot for small birds. All birds observed during each fixed-point survey were recorded regardless of distance from observer. Due to potential for classification error, observations of large birds beyond 800 m and small birds beyond 100 m of the point were recorded but excluded from statistical analyses (e.g., not used for calculating standardized use estimates per plot). Flight paths of all raptors were recorded on paper maps and later digitized with a Geographic Information System (GIS). For this study, large birds included waterbirds, waterfowl, rails/coots, shorebirds, raptors, owls, vultures, upland game birds, doves/pigeons, and large corvids. Small birds included passerines (excluding large corvids), swifts/hummingbirds, woodpeckers, and cuckoos.

For analysis purposes, a visit was defined as the required length of time, in days, needed to survey all of the plots once within the study area. Visits were assigned according to the following criteria: 1) a single visit had to be completed in a single season; and 2) a visit could be spread across multiple dates, but a single date could not contain surveys from multiple visits.

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. Potentially erroneous data was identified using a series of database queries. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

Data Compilation and Storage

A Microsoft® ACCESS database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined protocol to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for reference.

Bird Diversity and Species Richness

Bird diversity was illustrated by the total number of unique species observed. Species lists (with the number of observations and the number of groups) were generated by season and included all observations of birds detected, regardless of their distance from the observer. In some cases, the tally of observations may represent repeated sightings of the same individual. Species richness by season was calculated by first averaging the total number of species observed within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. Overall species richness was calculated as a weighted average of seasonal values by the number of days in each season. Species diversity and richness were compared among seasons for fixed-point bird use surveys.

Bird Use, Percent of Use, and Frequency of Occurrence

For the standardized fixed-point bird use estimates, large birds detected within the 800-m radius plot at any time were used in the analysis; small birds recorded within a 100-m radius at any time were included. The metric used to measure mean bird use was number of birds per plot per 30-min survey. These standardized estimates of mean bird use were used to compare differences between bird types, seasons, survey points, and other studies where similar methods were used. Mean use by season was calculated by first averaging the total number of birds seen within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. Overall mean use was calculated as a weighted average of seasonal values by the number of days in each season.

Exposure to facility infrastructure is affected by how much a species utilizes an area (percent of use), as well as how often use occurs (frequency of occurrence). Frequency of occurrence and percent of use provide relative measures of species exposure to the proposed facility. Percent of use was calculated as the proportion of large or small bird mean use that was attributable to a particular bird type or species. Frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. For example, flocks of waterfowl, waterbirds, and shorebirds can be comprised of several hundred, thousand, or tens of thousands of individual birds, which would result in a very high percentage of use. However, examining the percent of use alone would not account for the acute exposure to the facility associated with a small number of very large flocks (low frequency of occurrence). A high percent of use may indicate that a species has higher exposure relative to other species, but when the exposure is acute, the species may be less likely to be affected. Conversely, a species that has a low percentage of use and a high frequency of occurrence would have long-term exposure to the facility, increasing the likelihood that this species may be affected by the facility. Exposure to facility infrastructure is more accurately assessed by evaluating both percent of use and frequency of occurrence.

Bird Flight Height and Behavior

Bird flight heights are important metrics to assess potential exposure. Flight height information was used to calculate the percentage of birds observed flying within the rotor-swept height (RSH; 25-150 m [82-492 ft] above ground level) for turbines likely to be used at the expansion area. The flight height recorded during the initial observation was used to calculate the percentage of birds flying within the RSH and mean flight height. The percentage of birds flying within the RSH at any time was calculated using the lowest and highest flight heights recorded.

Bird Exposure Index

The bird exposure index is used as a relative measure of how often birds fly at heights similar to blades of modern wind turbines. A relative index of bird exposure (R) was calculated for bird species observed during the fixed-point bird use surveys using the following formula:

$$R = A*P_f*P_t$$

where A equals mean relative use for species *i* (large bird observations within 800 m of the observer or 100 m for small birds) averaged across all surveys, P_f equals the proportion of all

observations of species *i* where activity was recorded as flying (an index to the approximate percentage of time species *i* spends flying during the daylight period), and P_t equals the proportion of all initial flight height observations of species *i* within the likely RSH.

Spatial Use

Large bird flight paths were qualitatively compared to study area characteristics (e.g., topographic features). The objective of mapping observed large bird locations and flight paths was to identify areas of concentrated use by diurnal raptors and other large birds and/or consistent flight patterns within the study area.

RESULTS

Year-Long Mortality Monitoring

Turbine searches for the year-long mortality monitoring began on October 4, 2013, and continued through September 29, 2014. Twenty-four complete rounds of searches were conducted at the 33 designated search turbines during this period, for a total of 792 turbine searches. Data in the following results includes carcasses discovered during the standardized year-long mortality monitoring study and incidental discoveries from the same study period. Carcasses discovered during interim large bird searches and/or incidental discoveries outside of the study period are not included in the results presented herein. In total, 40 fatalities (26 birds and 14 bats) were documented during the first-year mortality monitoring studies from October 4, 2013 through September 29, 2014 (Table 2). A complete listing of all fatalities identified during the first standardized year-long fatality study or incidentally during the study period is provided in Appendix A. Twenty-six of the fatalities were documented during scheduled searches, while 14 fatalities were documented incidentally (Table 2). Two of the incidental bat carcass discoveries were located on search plots; therefore, these fatalities were included in analyses used to estimate annual fatality rates. All other incidental discoveries were located off search plots and were not included in analyses used to estimate annual fatality rates.

Bird Fatalities

During the study, 19 birds comprising nine identifiable species were found during scheduled searches (Table 2). An additional seven bird fatalities representing five species were found incidentally outside of search plots (Table 2), while no bird fatalities were found incidentally within search plots. Thirteen identifiable species were documented as fatalities during the study, as well as five unidentified large birds and three unidentified small birds (primarily bones or bone fragments). The bird species most commonly found during the study, either during scheduled searches or incidentally, was white-throated swift (*Aeronautes saxatalis*; five fatalities). Fatalities of all other species consisted of either one or two individuals (Table 2). One raptor (red-tailed hawk; *Buteo jamaicensis*) was discovered incidentally during the first year-long mortality monitoring study (Table 2). Yellow warbler (*Setophaga petechia*; a Bird of Conservation Concern (BCC) in Bird Conservation Region (BCR) 33 [see USFWS 2008]) was the only sensitive avian species identified as a fatality during the first year-long mortality monitoring study.

Table 2. Numbers and composition of bird and bat casualties discovered at the Ocotillo Express Wind Energy Facility during the year-long standardized searches and incidentally from October 4, 2013 – September 29, 2014.

	Fatalities during Scheduled Searches		Incidentals (on search plots)		Incidentals (off search plots)[1]		Total	
Species	**Total**	**Total**	**Total**	**%Comp.**	**Total**	**%Comp.**	**Total**	**%Comp.**
Birds								
unidentified large bird[2]	5	26.3	0	0	0	0	5	19.2
unidentified small bird	3	15.8	0	0	0	0	3	11.5
white-throated swift	2	10.5	0	0	3	42.8	5	20.8
domestic chicken[2]	2	10.5	0	0	0	0	2	7.7
greater roadrunner	1	5.3	0	0	0	0	1	3.8
mallard	1	5.3	0	0	0	0	1	3.8
Swainson's thrush	1	5.3	0	0	0	0	1	3.8
Townsend's warbler	1	5.3	0	0	0	0	1	3.8
warbling vireo	1	5.3	0	0	0	0	1	3.8
Wilson's warbler[2]	1	5.3	0	0	0	0	1	3.8
yellow warbler	1	5.3	0	0	0	0	1	3.8
mourning dove	0	0	0	0	1	14.3	1	3.8
red-tailed hawk	0	0	0	0	1	14.3	1	3.8
house finch	0	0	0	0	1	14.3	1	3.8
western meadowlark	0	0	0	0	1	14.3	1	3.8
Overall Birds	**19**	**100**	**0**	**0**	**7**	**100**	**26**	**100**
Bats								
Mexican free-tailed bat	7	77.8	1	50	3	100	11	78.6
canyon bat	2	22.2	0	0	0	0	2	14.3
unidentified Lasiurus bat	0	0	1	50	0	0	1	7.1
Overall Bats	**9**	**100**	**2**	**100**	**3**	**100**	**14**	**100**

[1] Incidental discoveries found off search plots were excluded from the annual fatality estimates.
[2] One unidentified large bird, one of the domestic chicken discoveries, and the Wilson's warbler discovery were found outside of the 160 X 160-m plot, but were within the larger 270 X 270-m plots.

The greatest number of bird fatalities found at any one search plot was three fatalities found at three turbines (turbines T75, T113, and T149); two bird fatalities were found at each of two turbines (T93 and T130); and single fatalities were found at six other search turbines (Figure 5 and Figure 6a). One bird fatality was found at the laydown yard/parking lot for the O&M building (western meadowlark; *Sturnella neglecta*) and was not associated with turbines. The lack of strong patterns in the spatial distribution of bird fatalities suggests no large differences in bird mortality by location within the project. Of the bird fatalities, about half (47.4%) were found within 60 m (197 ft) of the turbine and only two were found beyond 90 m (295 ft) from a turbine (Table 3). Three of the 19 bird carcasses discovered within search were located outside of the 160 X 160-m plots, but were within the larger 270 X 270-m plots. Temporally, bird fatalities were distributed throughout much of the year, although no fatalities were documented during the summer period (Figure 6b).

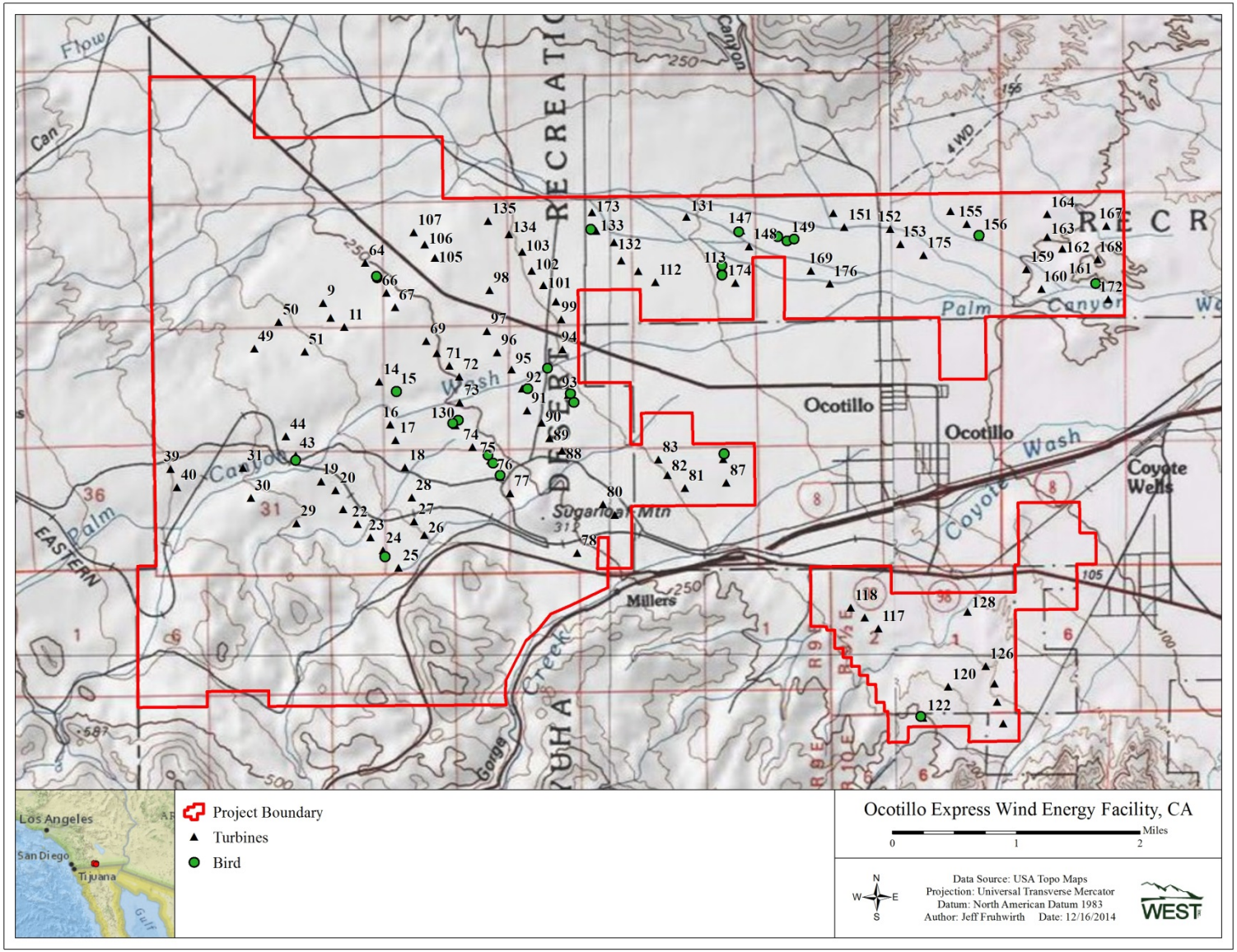


Figure 5. Location of all bird carcasses found during the first standardized year-long fatality study or incidentally during the study period at the Ocotillo Express Wind Energy Facility.

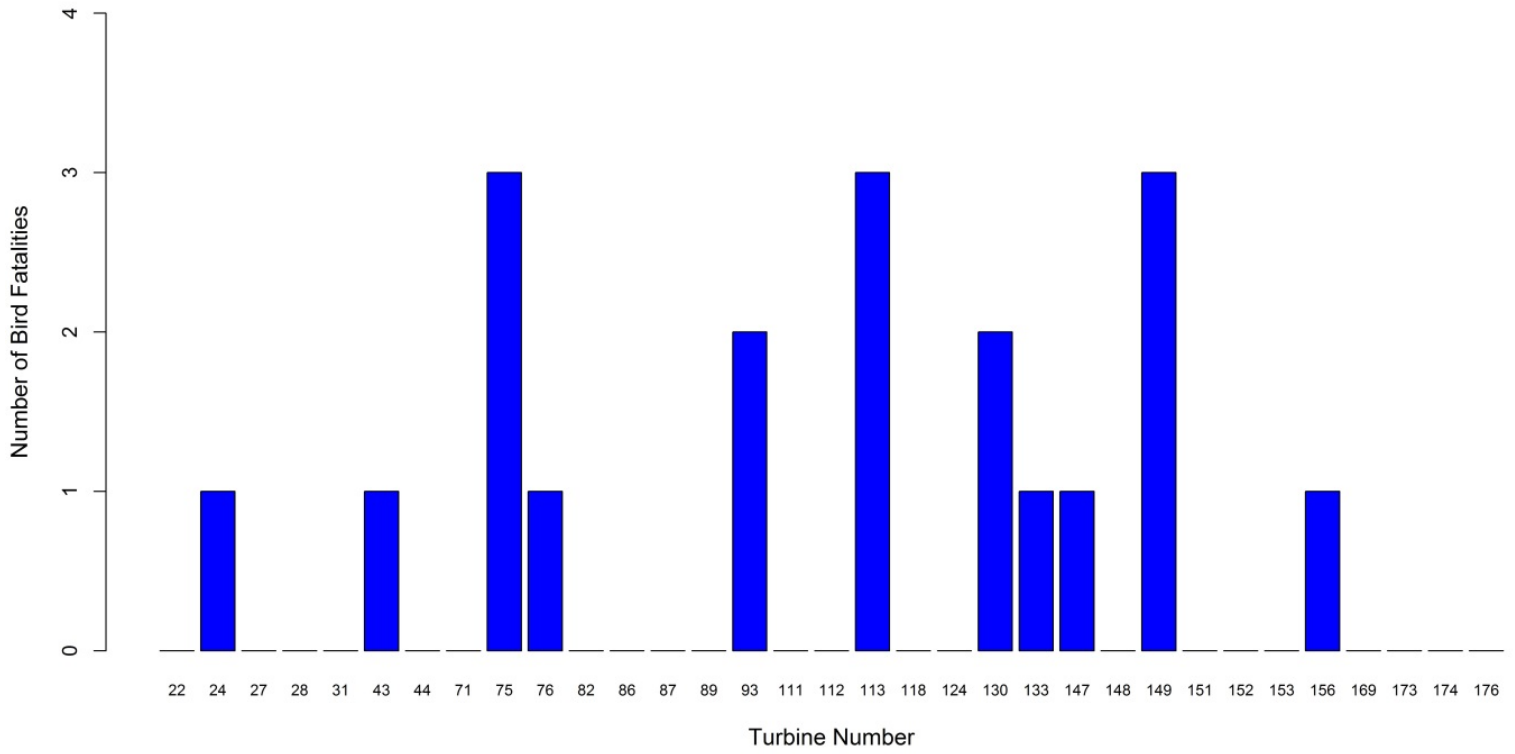


Figure 6a. Number of bird fatalities by turbine found during year-long standardized searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

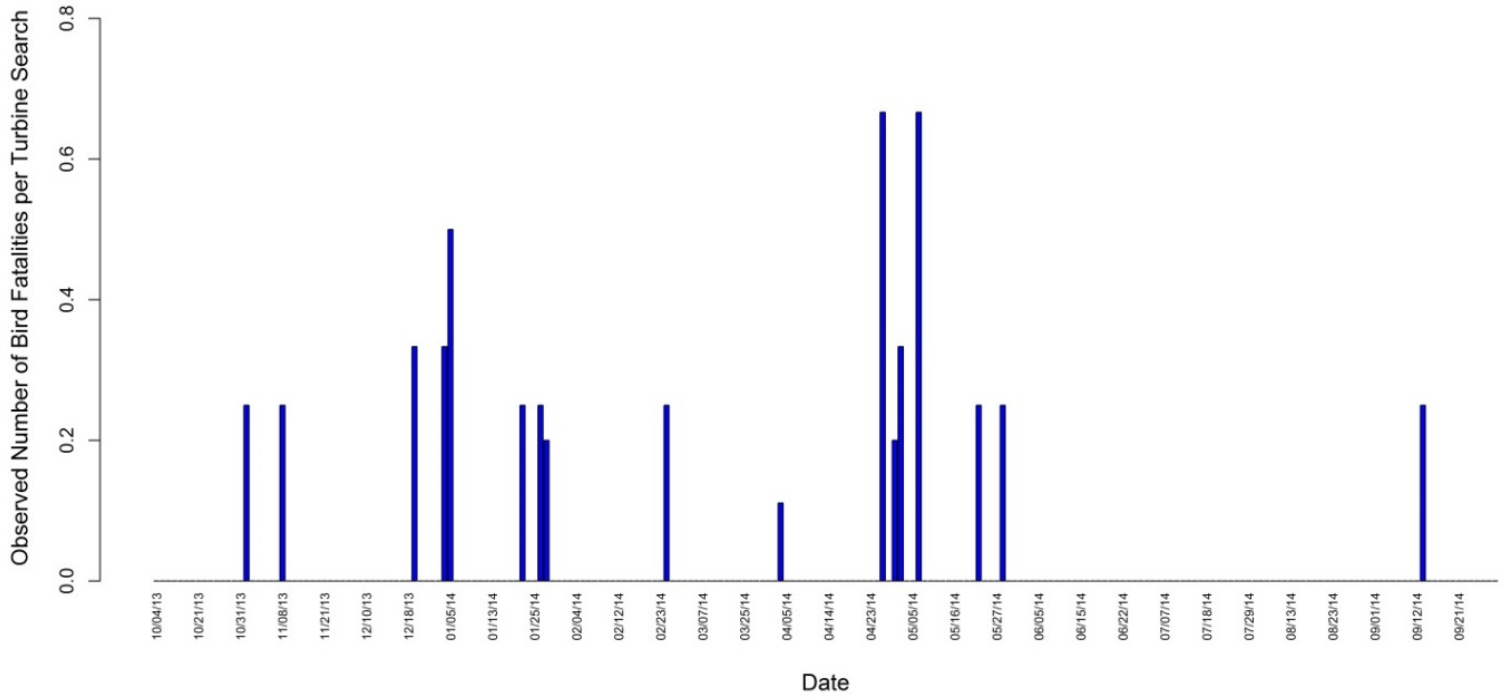


Figure 6b. Timing of bird fatalities by turbine found during scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

Table 3. Distribution of distances from turbines of bird and bat casualties found during year-long standardized searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

Distance to Turbine (m)	% Bird Casualties	% Bat Casualties
0 to 10	0.0	18.2
10 to 20	5.3	18.2
20 to 30	15.8	18.2
30 to 40	5.3	9.1
40 to 50	10.5	18.2
50 to 60	10.5	9.1
60 to 70	5.3	9.1
70 to 80	15.8	0.0
80 to 90	21.1	0.0
>90	10.5	0.0

Bat Fatalities

A total of 14 bat fatalities were found during the first standardized year-long fatality monitoring study or incidentally during the study period, with nine documented during scheduled turbine searches and five documented incidentally (two inside and three outside of search plots; Table 2). The bat species most commonly found during the study, either during scheduled searches or incidentally, was Mexican free-tailed bat (*Tadarida brasiliensis*; 11 fatalities). Canyon bat (*Parastrellus hesperus*; two fatalities) and unidentified Lasiurus bat (*Lasiurus* spp.; one fatality) were the only other bat species identified. None of the bat species identified during the first standardized year-long fatality or incidentally during the study period are considered sensitive species.

Two bat fatalities were found at each of two turbines (T133 and T148); and single fatalities were found at seven other search turbines (Figure 7a and Figure 8). The lack of strong patterns in the spatial distribution of bat fatalities suggests no large differences in bat mortality by location within the project. Of the bat fatalities, 81.9% were found within 50 m (164 ft) of the turbine, and no bat fatalities were found greater than 70 m (230 ft) from a turbine (Table 3). Temporally, bat fatalities were concentrated in the late spring (March and April) and late summer – early fall (mid-August into early October; Figure 7b).

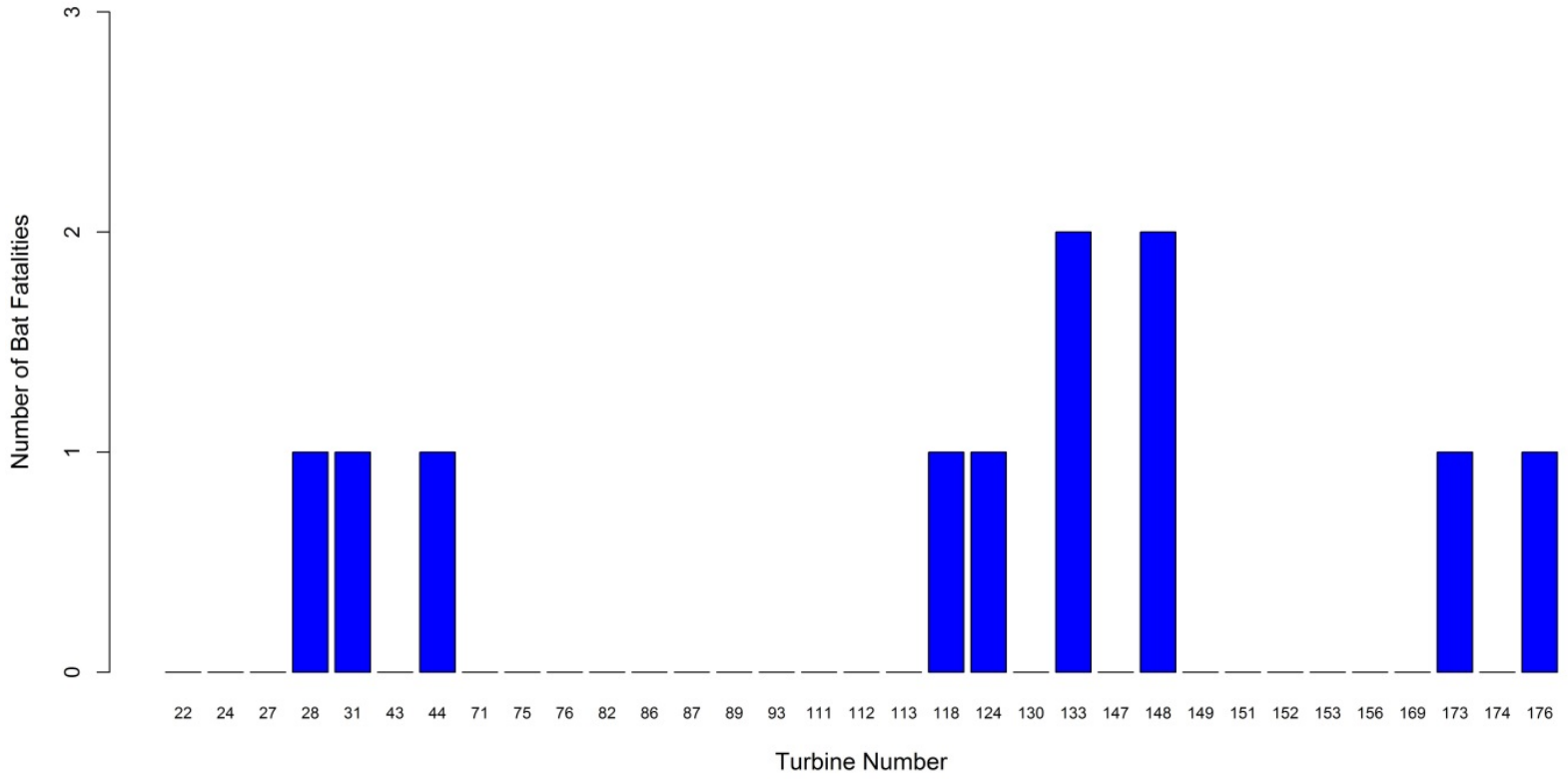


Figure 7a. Number of bat fatalities by turbine found during year-long scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

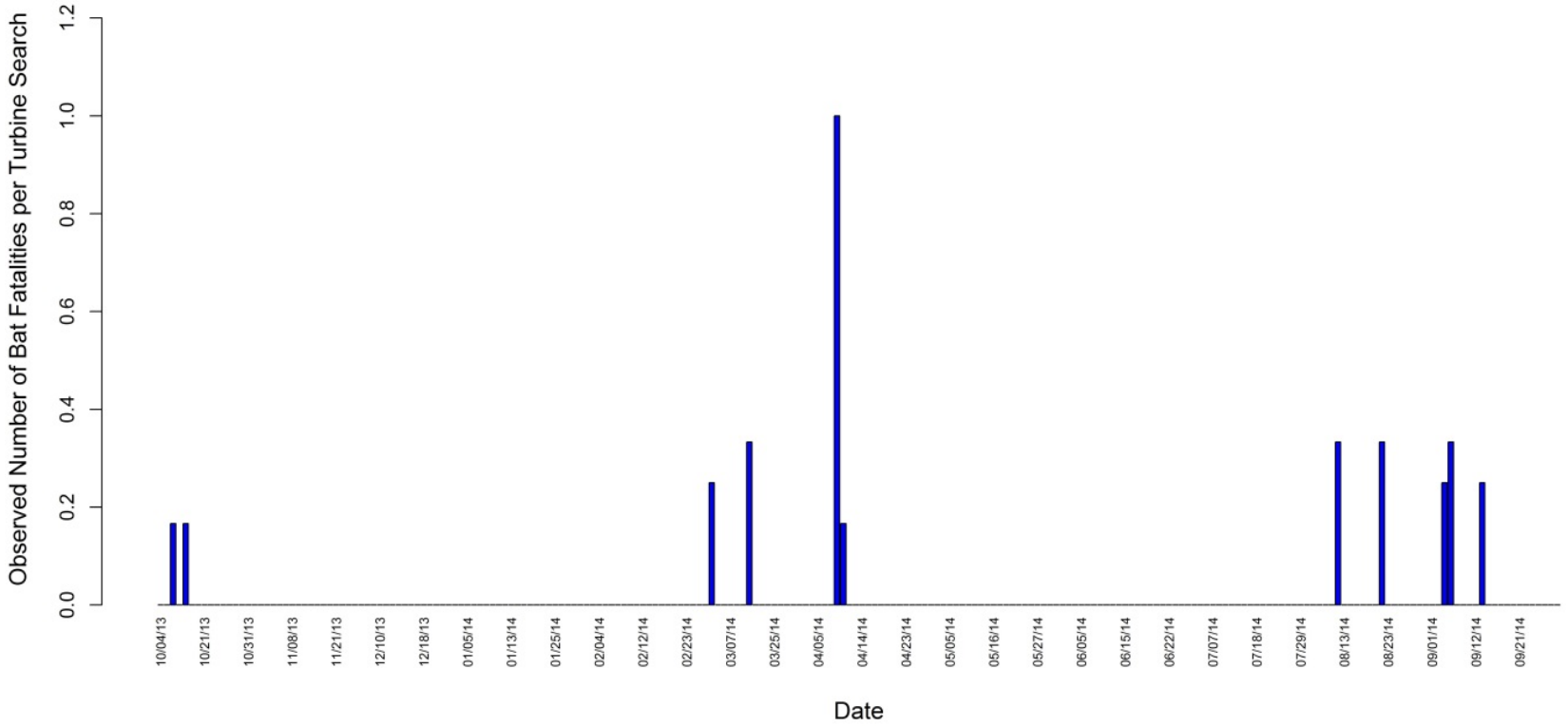


Figure 7b. Timing of bat fatalities by turbine found during scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

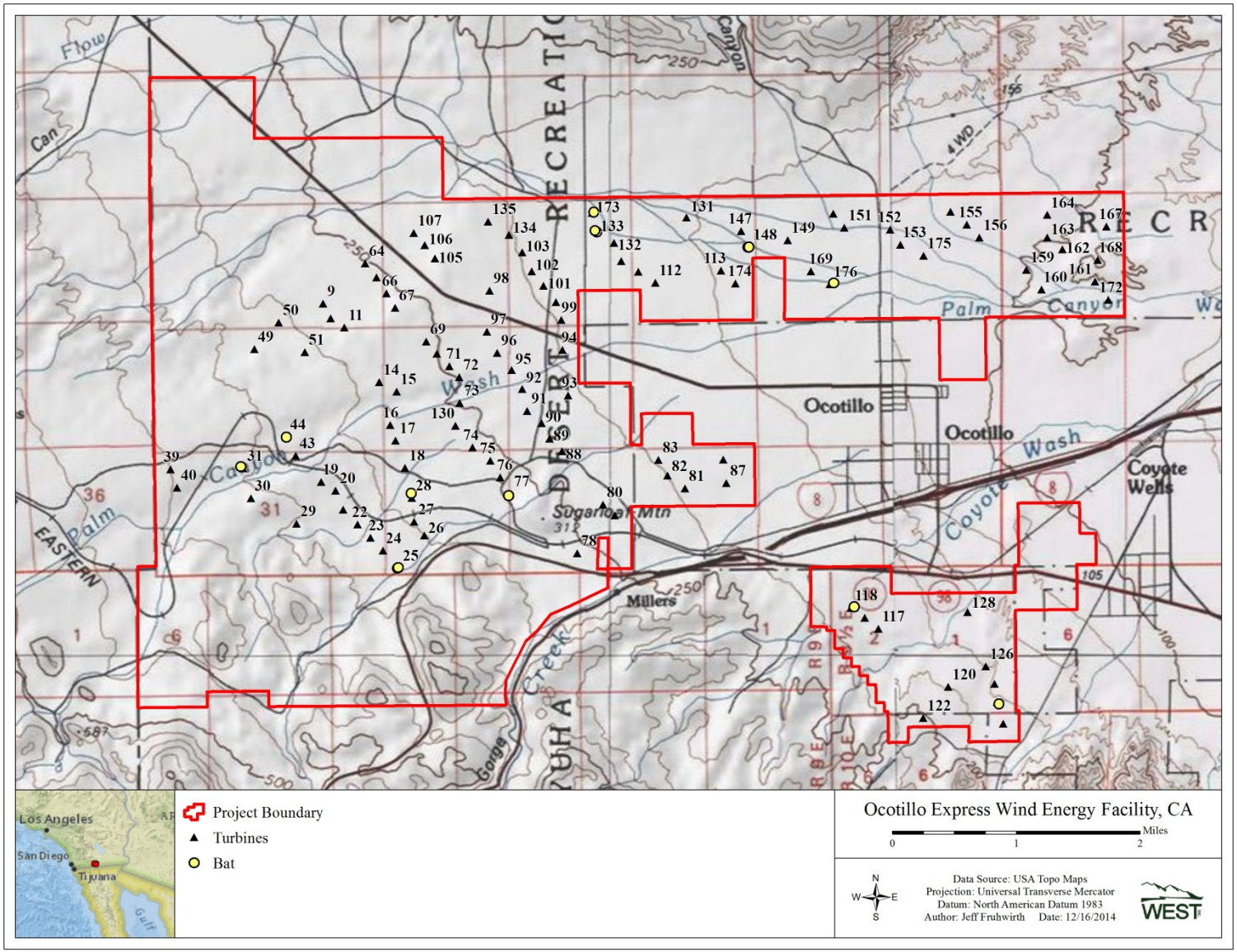


Figure 8. Location of all bat carcasses found during the first standardized year-long fatality study or incidentally during the study period at the Ocotillo Express Wind Energy Facility.

Searcher Efficiency Trials

Searcher efficiency trials were conducted throughout the year-long study period and included 129 small bird and 53 large bird trial carcasses. As bats were not used during searcher efficiency trials due to sample sizes and the small number of bats available from the site, efficiency trial data for small birds was used for bats (Table 4). The overall searcher efficiency rate for small birds (and bats) was 73.4%, while the efficiency rate for large birds was 94.3%. Efficiency rates did not differ significantly across seasons; therefore data were pooled and a single rate was used for each size class (small birds/ bats and large birds).

Table 4. Searcher efficiency results at the Ocotillo Express Wind Energy Facility by date and carcass size.

Size	Date	# Placed	# Available	# Found	% Found
Small Birds	11/21/2013	16	16	13	81.3
	1/24/2014	18	18	13	72.2
	3/3/2014	18	17	12	70.6
	5/17/2014	14	14	6	42.9
	6/22/2014	13	13	9	69.2
	8/2/2014	16	16	13	81.3
	9/27/2014	15	15	13	86.7
	11/8/2014	19	19	15	78.9
Total		**129**	**128**	**94**	**73.4**
Large Birds	11/21/2013	11	11	11	100
	1/24/2014	10	10	9	90.0
	3/3/2014	9	9	8	88.9
	5/17/2014	4	4	3	75.0
	6/22/2014	5	5	5	100
	8/2/2014	5	5	5	100
	9/27/2014	4	4	4	100
	11/8/2014	5	5	5	100
Total		**53**	**53**	**50**	**94.3**

Carcass Removal Trials

Fifteen carcass removal trials were conducted throughout the study period. In total, 76 large bird, 100 small bird, and four bat carcasses were used during removal trials (Table 5). Trials were distributed throughout the seasons. Average removal times did not differ significantly for small birds and bats in the spring season; therefore, small birds and bats were combined into a single estimate. In addition, average removal times did not differ significantly among the spring, summer, and fall seasons; therefore average removal times were calculated across the three seasons for each size class (small birds/bats and large birds) for use in the analyses. Average removal times did differ for small birds in the winter season and so only the winter removal trials were applied to the winter season for small birds. No bat carcasses were discovered in the winter season. During the spring, summer, and fall seasons, the average removal time for small birds/bats was 3.45 days, while the average removal time for large birds was 8.8 days (Figure 9 and Appendix B).During the winter season, the average removal time for small birds was 5.5 days (Appendix B).

Table 5. Carcass removal trials conducted at the Ocotillo Express Wind Energy Facility, November 22, 2013 – September 18, 2014.

Start Date	# Large Birds Placed	# Small Birds Placed	# Bats Placed
11/22/2013	7	13	0
1/3/2014	6	13	0
2/3/2014	4	13	0
4/4/2014	6	13	0
5/22/2014	5	2	2
5/23/2014	4	2	2
5/26/2014	4	4	0
6/26/2014	3	4	0
7/2/2014	7	6	0
7/15/2014	3	3	0
7/18/2014	2	5	0
7/21/2014	0	2	0
7/24/2014	5	0	0
8/19/2014	10	10	0
9/18/2014	10	10	0
Total	**76**	**100**	**4**

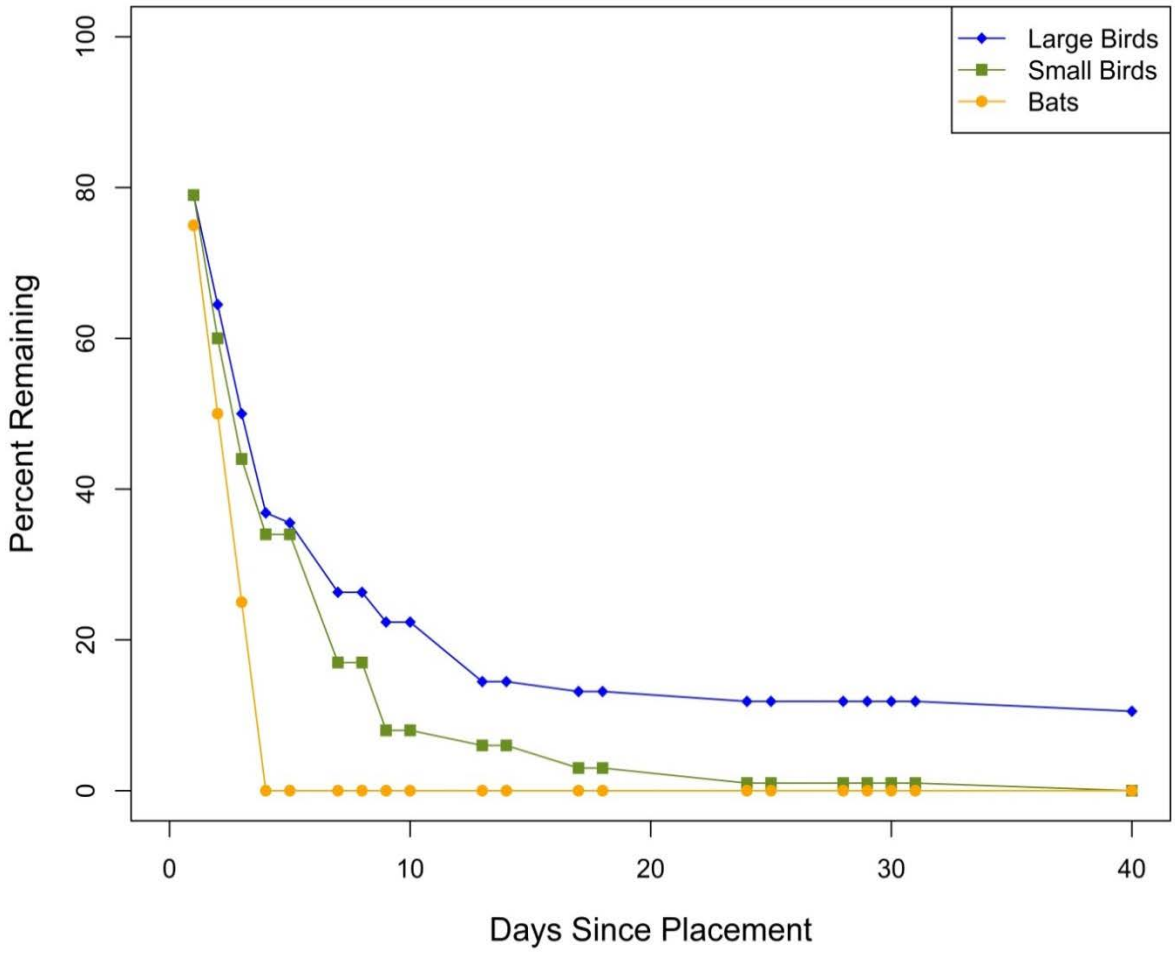


Figure 9. Carcass removal rates at the Ocotillo Express Wind Energy Facility.

Adjusted Fatality Estimates

Fatality estimates and 90% confidence intervals were calculated for birds and bats (Table 6, Appendix B). The fatality estimates were adjusted based on the corrections for carcass removal and observer detection bias (Appendix B). Searcher efficiency rates were consistent throughout the entire study period and therefore the same rates were applied across all seasons. However, since removal rates differed in the winter for small birds, two rates were applied to estimate annual small bird/bat fatalities (5.51 days in the spring, summer, fall seasons, and 3.45 days in the winter season; Appendix B). For small birds and bats in the spring, summer, and fall, the probability that a carcass would remain in a search plot and be found by a searcher was 0.17. For small birds and bats in the winter, the probability that a carcass would remain in the search plot and be found by a searcher was 0.25. For large birds, the probability was 0.45 across all seasons (Appendix B).

Since the study consisted of two different plot sizes, we estimated two different sets of annual fatality rates (one using data from 33 160 X 160-m plots and one using data from only the five 270 X 270-m plots). The resulting annual fatality estimates from the larger plots were lower than

the annual fatality estimates for the smaller plots across all categories (small birds, large birds, and bats). In order to facilitate comparison with other studies, the results presented here include only the annual fatality estimates resulting from the 33 160 X 160-m plots (Table 6). However, additional details of the two different plot sizes are provided in the discussion section below.

Table 6. Adjusted bird and bat fatality estimates for the Ocotillo Express Wind Energy Facility from October 4, 2013 – September 29, 2014.

	Corrected Fatality Estimates*	
Species Category	**# fatalities/turbine/study period**	**90% Confidence Intervals**
Small birds	1.55	0.69-2.61
Large birds	0.47	0.21-0.80
All birds	2.02	1.11-3.13
Bats	2.06	1.09-3.37
Species Category	**# fatalities/MW/study period**	**90% Confidence Intervals**
Small birds	0.68	0.30-1.13
Large birds	0.20	0.09-0.35
All birds	0.88	0.48-1.36
Bats	0.90	0.47-1.46

*For details concerning correction factors and confidence intervals for both bird and bat fatality estimates, refer to Appendix B.

Small Birds

The estimated annual fatality rate for small birds was 1.55 fatalities/turbine/year or 0.68 fatalities/MW/year. A detailed breakdown of fatality rates and the associated correction factors is presented in Appendix B.

Large Birds

The estimated annual fatality rate for large birds was 0.47 fatalities/turbine/year or 0.20 fatalities/MW/year. A detailed breakdown of fatality rates and the associated correction factors is presented in Appendix B.

All Birds

The estimated annual fatality rate for all birds was 2.02 fatalities/turbine/year or 0.88 fatalities/MW/year. A detailed breakdown of fatality rates and the associated correction factors is presented in Appendix B.

Raptors

While one red-tailed hawk was discovered incidentally during the study period, there were no raptor carcasses identified within the search plots. Therefore, an estimate of annual raptor fatalities was not calculated for the first standardized year-long fatality study.

Bats

The estimated annual fatality rate for all bats was 2.06 fatalities/turbine/year or 0.90 fatalities/MW/year. A detailed breakdown of bat fatality rates and the associated correction factors is presented in Appendix B.

Avian Monitoring

Fixed-Point Avian Use Surveys

Twenty-six rounds of fixed-point avian use surveys were conducted at 21 survey stations from August 26, 2013, through September 29, 2014, resulting in 546 fixed-point surveys (Table 7). Two viewsheds were utilized for all calculations: 800 m for large birds and 100 m for small birds.

Table 7. Species richness (species/plot[a]/30-min survey), and sample size by season and overall during the fixed-point bird use surveys at the Ocotillo Express Wind Resource Area from August 26, 2013 to September 29, 2014.

Season	Number of Visits	# Surveys Conducted	# Unique Species	Species Richness	
				Large Birds	Small Birds
Fall	8	168	17	0.17	0.54
Winter	8	168	19	0.18	0.81
Spring	5	105	18	0.42	0.81
Summer	5	105	14	0.12	0.35
Overall	**26**	**546**	**29**	**0.22**	**0.64**

[a] 800-m radius for large birds and 100-m radius for small birds.

Bird Diversity and Species Richness

Twenty-nine unique bird species were observed during fixed-point surveys (Table 7). The most abundant species observed were common raven (*Corvus corax*; 118 observations; 15.2% of all observations), black-throated sparrow (*Amphispiza bilineata*; 113 observations; 14.5% of all observations), and house finch (*Haemorhous mexicanus*; 103 observations; 13.3% of all observations; Appendix C). Species richness (i.e., the number of species observed per plot per survey) was greatest in the spring for large birds, and greatest in both the winter and spring for small birds, whereas species richness was lowest in the summer for both large and small bird types (Table 7).

Bird Use

Diurnal raptor use was relatively low throughout all seasons and varied from 0.05 raptors/800-m plot/30-min survey during the fall to 0.09 raptors/800-m plot/30-min survey during the spring (Appendix D1). Diurnal raptor use was fairly consistent across seasons, with red-tailed hawk accounting for the majority of the raptor use observed. Red-tailed hawk accounted for 100% of raptor use during fall and summer (Appendix D1), almost 100% of raptor use during winter, and more than half of all raptor use during spring (Appendix D1). American kestrel (*Falco sparverius*) was the only other raptor seen during winter (Appendix D1), and unidentified raptors accounted for the remainder of raptor use in the spring (Appendix D1).

Passerine use varied from a low of 0.56 birds/100-m plot/30-min survey in the summer to a high of 1.1 birds/100-m plot/30-min survey in the spring (Appendix D2). Passerine use was dominated by black-throated sparrows, cactus wrens (*Campylorhynchus brunneicapillus*), house finches, and rock wrens (*Salpinctes obsoletus*). Black-throated sparrow accounted for 20.9% of passerine use in fall, 23.6% in spring, and 55.7% in summer (Appendix D2). Cactus wren accounted for 17.1% of passerine use in fall and 21.3% in summer. House finch accounted for

41.2% of passerine use in winter, and rock wren accounted for 18.6% of passerine use in fall (Appendix D2).

Bird Exposure Index

A relative exposure index based on initial flight height observations and relative abundance (defined as the use estimate) was calculated for each bird species. Those species that had exposure to the RSH are listed in Appendices E1 and E2. All other species observed had exposure indices of zero, as none were observed flying within the RSH at the point of initial observation. The exposure index does not account for other possible collision risk factors, such as foraging or courtship behavior, nor does it account for avoidance behaviors. Hence, although common raven had the highest exposure index of any species (0.09; Appendix E1), no common ravens were found as fatalities during the first standardized year-long fatality study. Red-tailed hawk, turkey vulture (*Cathartes aura*), mourning dove (*Zenaida macroura*), and American kestrel were the only other identified large bird species with exposure indices greater than zero (ranging from less than 0.01 to 0.02; Appendix E1). Small birds with an exposure index greater than zero included black throated sparrow, white-throated swift, and house finch (all with exposure indices of less than 0.01; Appendix E2).

Spatial Use

For all large bird species combined, use was generally considered low throughout but was highest at Point 17 (0.85 birds/plot/30-min survey); Appendix F). Large bird use at other points ranged from zero to 0.62 birds/30-min survey (Appendix F). The mean use estimate for Point 17 was largely due to relatively high corvid use (0.58 birds/plot/30-min survey; Appendix F). Diurnal raptor use was also highest at Point 17 (0.27 birds/plot/30-min survey; Appendix F). Point 17 was located in close proximity to transmission towers with active common raven and red-tailed hawk nests and it is likely that the relatively higher use was due to the proximity to active nests. Point 7, with corvid use of 0.54 birds/plot/30-min survey (Appendix F), was also located in close proximity to a transmission tower with an active common raven nest. Small bird use, dominated by passerines, was greatest at Point 17 (2.54 birds/plot/30-min survey) compared to other points, where it ranged from 0.23 to 1.69 birds/plot/30-min survey (Appendix F).

Flight paths of diurnal raptors were digitized and mapped (Appendix G). Based on the fixed-point survey data, no obvious flyways or concentration areas were observed for any raptor species, which suggests that no particular portion of the OWEF seems to be of greater risk to flying raptors than other areas within the OWEF.

DISCUSSION

Year-Long Mortality Monitoring

The approach used for calculating adjusted fatality estimates is consistent with the approach outlined by Shoenfeld (2004) and Erickson (2006), and accounted for search interval, searcher efficiency rates, and carcass removal rates. It is hypothesized that scavenging could change through time at a given site and must be accounted for when attempting to estimate fatality

rates. We accounted for this by conducting scavenging trials throughout the year. We also estimated searcher efficiency rates throughout the study period to account for potential biases associated with changes in conditions that could have influenced searcher efficiency.

There are numerous factors that could contribute to both positive and negative biases in estimating fatality rates (Erickson 2006) and the overall design of this study incorporates several assumptions or factors that affect the results of the fatality estimates. First, all bird casualties found within the standardized search plots, either during a scheduled search or incidentally, were included in the analysis. Second, it was assumed that all carcasses found during the study on search plots were a result of collision with wind turbines; the true cause of death is unknown for most of the fatalities. It is likely that some of the bird fatalities were caused by predators and that some of the fatalities included in the data were potentially due to natural causes (background mortality). For example, it is unlikely that the domestic chicken carcass discoveries, the mallard, and the greater roadrunner (*Geococcyx californianus*) were due to collision with turbines; however, to be conservative, they were included in the estimates. It is less likely that bat fatalities were due to factors unrelated to interactions with wind turbines.

There are some other potential negative biases. For example, no adjustments were made for fatalities possibly occurring outside of the plot boundaries. While this could potentially lead to an underestimate of fatalities, to help address this issue, two different plot sizes were searched during the study (160 X 160-m and 270 X 270-m plots). The estimates of annual fatalities using the data from the larger plots were lower than the estimates from the smaller plot sizes (0.56 small birds/turbine/year compared to 1.55 small birds/turbine/year, 0.26 large birds/turbine/year compared to 0.47 large birds/turbine year, 0.82 all birds/turbine year compared to 2.02 all birds/turbine/year, and 0.37 bats/turbine/year compared to 2.06 bats/turbine/year). However, the 90% confidence intervals between the estimates from the different plot sizes overlapped for large birds, suggesting no statistically significant difference, while all other estimates were significantly lower using the data from the larger search plots.

Regardless of plot size, a total of 30 carcasses (19 birds and 11 bats) were found within standardized search plots. At the five turbines for which larger plots were searched, a total of nine carcasses were found (seven birds and two bats) and of those, three bird carcasses were found in the portion of the plot that did not overlap with a smaller 160 X 160-m plot. No bat carcasses were found beyond 70 m from a turbine. If we assume that on average the distribution of bird carcasses by distance is similar across the Project, we would expect to have found approximately 17 additional bird carcasses if we would have searched all 33 turbines at 270 X 270-m plots, which would equate to annual bird fatality estimates that are roughly two times higher than the estimates from the smaller plots (i.e., approximately three small birds/turbine/year, approximately one large bird/turbine/year, and approximately four all birds/turbine/year). However, this assessment evaluates estimates from 270 X 270-m plots, which are not necessarily comparable to the vast majority of publicly available fatality studies as smaller plots are typically searched during fatality monitoring studies.

While there are a number of factors that could be influencing the observed results (e.g. sample sizes, specific search plots, one year of data), given the level of estimated annual fatality and taking into account fatalities that might be expected to fall outside of the smaller 160 X 160-m plots, searching the larger plots does not change the overall assessment that estimated annual fatality rates at the OWEF are considered low relative to other comparable studies (see the discussion of comparisons to other fatality rates below).

Other potential biases are associated with the experimental carcasses used in searcher efficiency and carcass removal trials and whether or not they are representative of actual carcasses. This may occur for example, if the types of birds used are larger or smaller than the carcasses of fatalities or more or less cryptic in color than the actual fatalities. Rock pigeons, mallards, Coturnix quail (*Coturnix japonica*), and house sparrows were used to represent the range of bird fatalities expected. It is believed that this variety of species approximates the range of sizes and other characteristics of actual fatalities and should be a reasonable representation of scavenging rates for birds as a group. A few bats were also used during the spring removal trials, although the sample size was low due to the low numbers of bats discovered during the study.

Concern has also been raised regarding how the number of carcasses placed in the field for carcass removal trials on a given day could lead to biased estimates of scavenging rates. Hypothetically, this would lead to underestimating true scavenging rates if the scavenger densities are low enough such that scavenging rates for placed carcasses are lower than for actual fatalities (Smallwood 2007, Smallwood et al. 2010). The logic is that if the trials are based on too many carcasses being placed on a given day, scavengers are unable to access all trial carcasses, whereas they could access all wind turbine collision fatalities. If this is the case, and the trial carcass density is much greater than actual turbine fatality density, the trials would underestimate scavenging rates compared to rates on actual fatalities. Carcass removal trials were conducted throughout the year with limited numbers of carcasses of each size class placed in the field during each trial. No more than 13 small bird and 10 large bird carcasses were placed in the field during an individual trial. Carcasses were placed throughout the Project to maintain dispersion and eliminate attraction of scavengers and/or overwhelming the local scavenger population.

Bird Fatalities

A total of 26 bird fatalities were found during the first standardized year-long fatality monitoring study, with 19 of those found during scheduled searches. With the exception of white-throated swift (five fatalities found), a maximum of two individuals were found for each of the other 12 species identified. No state- or federal-listed threatened or endangered bird species were documented as fatalities. One BCC species in BCR 33 (yellow warbler) was documented as a fatality during the study. Only one raptor fatality was documented incidentally within the OWEF during the study (red-tailed hawk). While red-tailed hawks are protected under the Migratory Bird Treaty Act (MBTA), the red-tailed hawk is not considered a sensitive species in California.

The estimated overall bird fatality rate of 0.88 birds/MW/year was low compared to other wind energy facilities in California and the desert southwest where estimates have ranged from 0.55 to 8.3 birds/MW/year (Figure 10, Appendix H1). The overall bird fatality rate at the OWEF ranked 2nd lowest compared to 12 other studies at facilities in California and the desert southwest (Figure 10). Based on the relatively small estimate of avian mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bird populations.

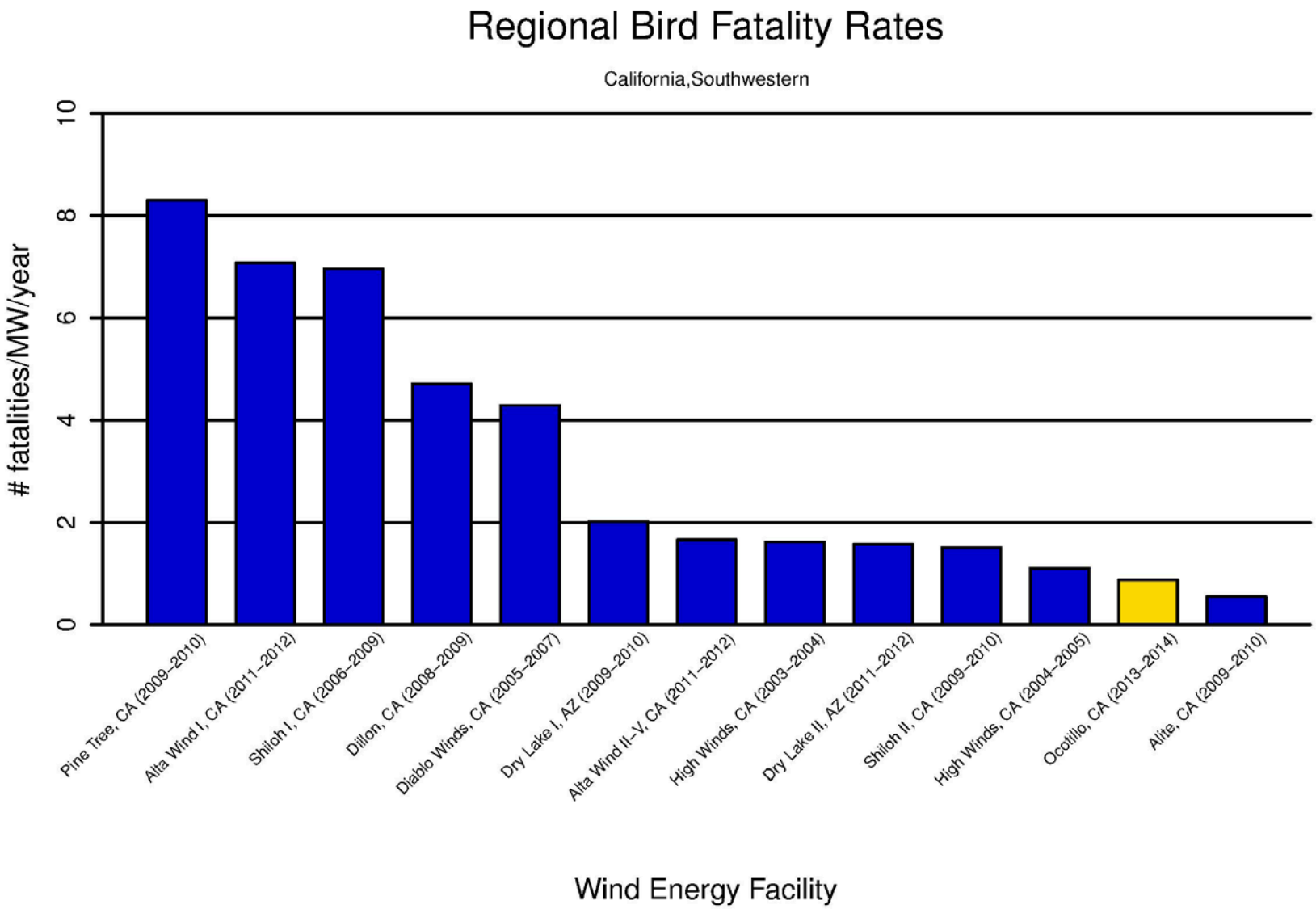


Figure 10. Fatality rates for all birds (number of birds per MW per year) from publicly-available studies of wind energy facilities in California and the desert southwest.

Figure 10 (*continued*). Fatality rates for all birds (number of birds per MW per year) from publicly-available studies of wind energy facilities in California and the desert southwest.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Ocotillo, CA (13-14)	This study.				
Pine Tree, CA (09-10)	BioResource Consultants 2010	Diablo Winds, CA (05-07)	WEST 2006, 2008	Dry Lake II, AZ (11-12)	Thompson and Bay 2012
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Dry Lake I, AZ (09-10)	Thompson et al. 2011	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Shiloh I, CA (06-09)	Kerlinger et al. 2009	Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	High Winds, CA (04-05)	Kerlinger et al. 2006
Dillon, CA (08-09)	Chatfield et al. 2009	High Winds, CA (03-04)	Kerlinger et al. 2006	Alite, CA (09-10)	Chatfield et al. 2010b

Bat Fatalities

A total of 14 bats (including nine found during standardized searches, two incidentals on search plots, and three incidentals off plots) were discovered during the first year-long fatality monitoring study. Mexican free-tailed bats accounted for 78.6% of all documented bat fatalities, while canyon bat accounted for 14.3%, and unidentified Lasiurus bat accounted for 7.1%. None of the bat species identified during the first year-long fatality study are considered sensitive in California. The estimated overall bat fatality rate at the OWEF (0.90 bats/MW/year) was low compared to other wind energy facilities in California and the desert southwest with publicly available bat fatality data (Figure 11, Appendix H3). Bat fatality rates at these other facilities in California and the desert southwest ranged from 0.08 to 3.92 bats/MW/year (Appendix H3). Based on the relatively small estimate of bat mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bat populations.

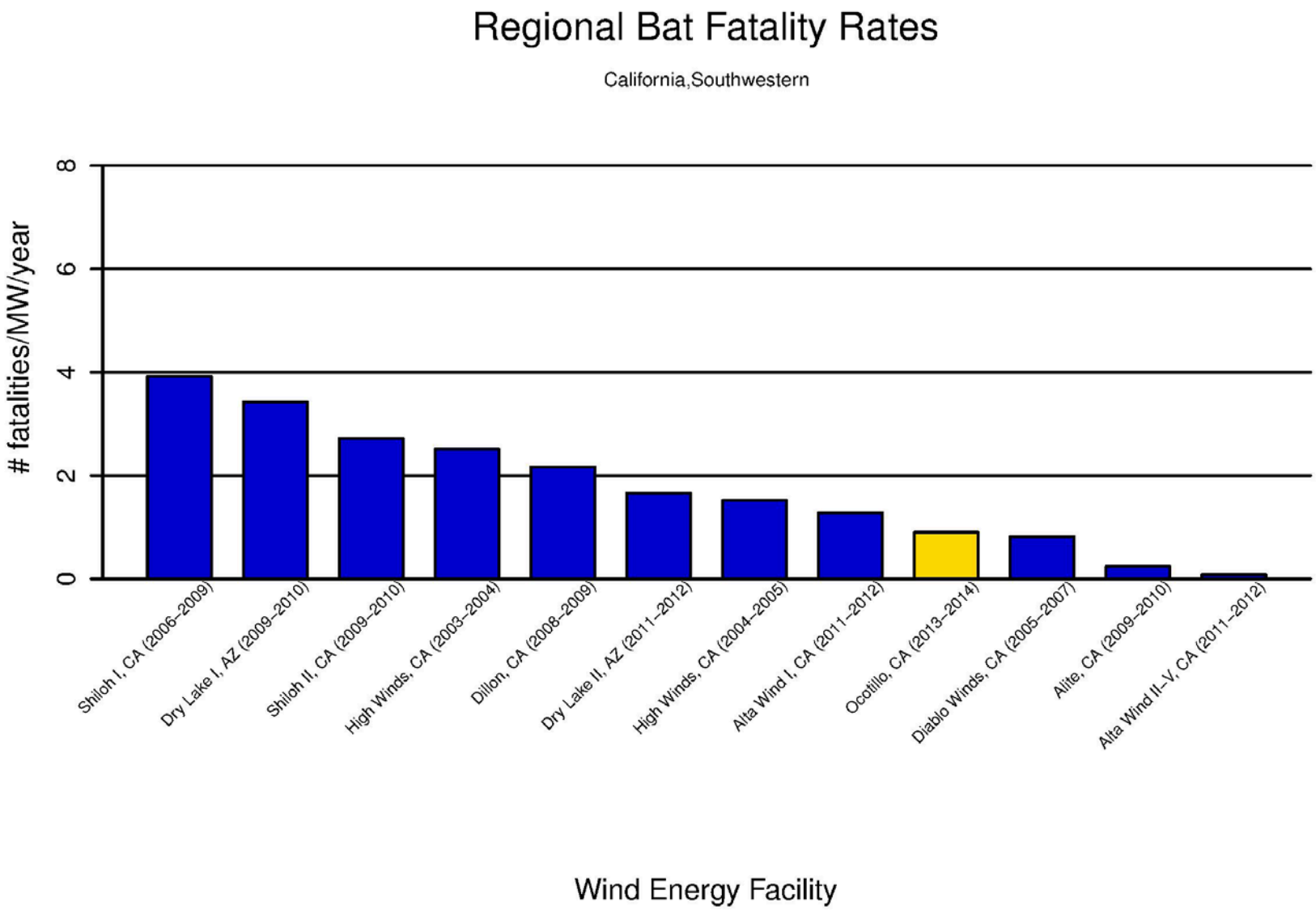


Figure 11. Fatality rates for bats (number of bats per MW per year) from publicly-available studies at wind energy facilities in California and the desert southwest.

Figure 11 (*continued*). Fatality rates for bats (number of bats per MW per year) from publicly-available studies of wind energy facilities in California and the desert southwest.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Ocotillo, CA (13-14)	This study.				
Shiloh I, CA (06-09)	Kerlinger et al. 2009	Dillon, CA (08-09)	Chatfield et al. 2009	Diablo Winds, CA (05-07)	WEST 2006, 2008
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Alite, CA (09-10)	Chatfield et al. 2010b
Shiloh II, CA (09-10)	Kerlinger et al. 2010b	High Winds, CA (04-05)	Kerlinger et al. 2006	Alta Wind II-V, CA (11-12)	Chatfield et al. 2012
High Winds, CA (03-04)	Kerlinger et al. 2006	Alta Wind I, CA (11-12)	Chatfield et al. 2012		

Avian Monitoring

Fixed-Point Avian Use Surveys

Based on the 2013-2014 avian use data, it appears that raptor use was greatest in the spring (0.09 raptors/800-m plot/30-min survey), compared to the rest of the seasons (range 0.05 – 0.09 raptors/800-m plot/survey). The relatively higher raptor use measured in spring was primarily due to use by red-tailed hawk (more than 50% of use). Red-tailed hawk had the highest exposure index of any raptor species and was also the only raptor species identified as a fatality (incidentally on a non-search turbine) during the first year-long fatality monitoring study. The only other raptors observed during the 2013-2014 avian use study were American kestrel and unidentified raptor. Overall, raptor use was low compared to other California and desert southwest projects where similar data have been collected (Figure 12). The low raptor use observed was in line with the low overall raptor fatalities observed during the first standardized year-long fatality study.

Small bird use was greatest in the winter and spring (1.21 birds/100-m plot/30-min survey during both seasons) and lowest in the summer (0.58), with fall use being moderate compared to the other seasons (0.77). This pattern of use by small birds was consistent with the observed bird fatalities, which were dispersed throughout the winter, spring, and fall seasons, with no fatalities identified during the summer season. The most common small bird species identified as a fatality during the study was white-throated swift, which had the second highest exposure index for small birds based on the avian use data.

During the 2013-2014 avian use study, common raven, black-throated sparrow, house finch, cactus wren, and rock wren were the most abundant bird species. All of these species were also among the most abundant species observed during the pre-construction studies. However, avian abundance was significantly lower during the 2013-2014 study compared to the pre-construction study. There are a number of factors that may influence the observed results, including the use of different observers and environmental conditions (e.g. drought conditions).

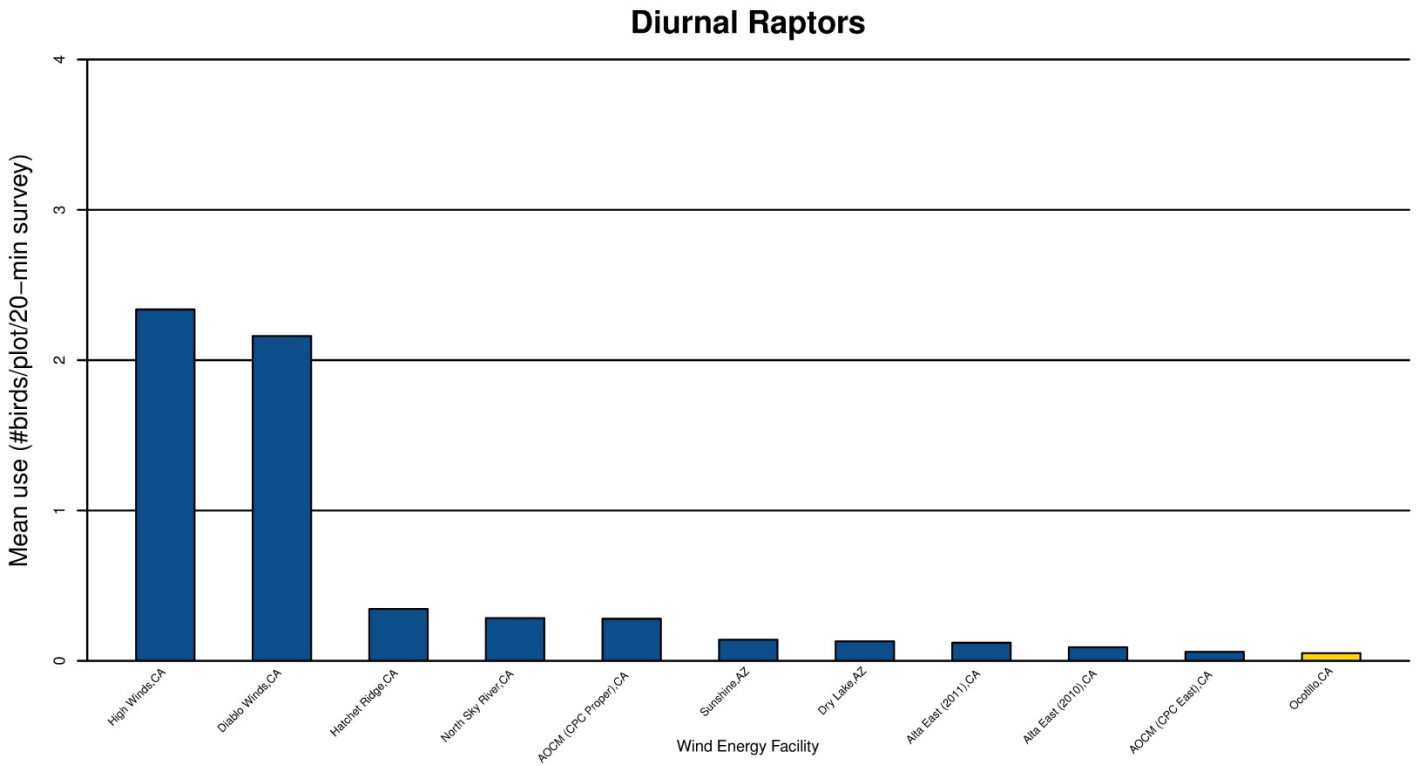


Figure 12. Comparison of estimated annual diurnal raptor use (raptors/800-m plot/20-min survey) during fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014, and diurnal raptor use at other California and desert southwest wind resource areas with three or four other seasons of raptor use data.

Data from the following sources:

Study and Location	Reference	Study and Location	Reference	Study and Location	Reference
Ocotillo, CA	This Study				
High Winds, CA	Kerlinger et al. 2005	AOCM (CPC Proper), CA	Chatfield et al. 2010a	Alta East (2010), CA	Chatfield et al. 2011
Diablo Winds, CA	WEST 2006	Sunshine, AZ	WEST and the CPRS 2006	AOCM (CPC East), CA	Chatfield et al. 2010a
Hatchet Ridge, CA	Young et al. 2007b	Dry Lake, AZ	Young et al. 2007c		
North Sky River, CA	Erickson et al. 2011	Alta East (2011), CA	Chatfield et al. 2011		

CONCLUSIONS

The first standardized year-long fatality monitoring study and avian use study at the OWEF were completed in the fall of 2014, with the conclusion of the 12 months of mortality surveys. This report presents only the results of the first full year of standardized fatality surveys and avian use surveys. Additional carcass discoveries that occurred prior to the start of the standardized year-long survey or during the separate interim/large bird searches are not presented herein, but a comprehensive list of all carcasses discoveries at the facility are provided to the agencies on a monthly basis. The results of the first year of standardized studies have provided new insights into the effects of the OWEF on wildlife, which are primarily supportive of the low level of predicted risk of the Project on wildlife. The first year of studies found that impacts to birds (including raptors) and bats were low compared to other wind energy projects in the California and the desert southwest. No federal or state listed species or BLM sensitive species were identified during the first year-long standardized fatality monitoring study. One BCC species in BCR 33 (yellow warbler) was identified as a fatality during the study. Based on the relatively small estimates of avian and bat mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bird or bat populations.

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Appendix A. Complete Fatality Listing for Carcasses Discovered During the First Year of Standardized Year-Long Fatality Monitoring and Incidentally at the Ocotillo Express Wind Energy Facility, October 4, 2013 – September 29, 2014

Appendix B. Complete fatality listing for the Ocotillo Wind Energy Facility.

Date	Common Name	Location	Distance from Turbine	Type of Find	Survey Type	Condition
10/8/2013	Mexican free-tailed bat	173	32	Scheduled Carcass Search	Year-long	Intact
10/11/2013	Mexican free-tailed bat	176	52	Scheduled Carcass Search	Year-long	Intact
11/1/2013	greater roadrunner	75	48	Scheduled Carcass Search	Year-long	Feather Spot
11/8/2013	unidentified large bird	133	76	Scheduled Carcass Search	Year-long	Dismemberd
12/5/2013	house finch	161	35	Incidental Find	Year-long	Intact
12/13/2013	white-throated swift	15	2	Incidental Find	Year-long	Intact
12/19/2013	unidentified bird (small)	130	77	Scheduled Carcass Search	Year-long	Dismemberd
12/19/2013	white-throated swift	65	15	Incidental Find	Year-long	Intact
12/19/2013	white-throated swift	65	17	Incidental Find	Year-long	Intact
12/26/2013	red-tailed hawk	122	20	Incidental Find	Year-long	Intact
1/4/2014	unidentified large bird	43	56	Scheduled Carcass Search	Year-long	Dismemberd
1/5/2014	unidentified large bird	24	81	Scheduled Carcass Search	Year-long	Dismemberd
1/23/2014	unidentified bird (small)	75	75	Scheduled Carcass Search	Year-long	Feather Spot
1/29/2014	domestic chicken	149	158	Scheduled Carcass Search	Year-long	Feather Spot
1/30/2014	domestic chicken	147	30	Scheduled Carcass Search	Year-long	Feather Spot
2/12/2014	Mexican free-tailed bat	77	3	Incidental	Year-long	Intact
2/24/2014	mallard	156	30	Scheduled Carcass Search	Year-long	Feather Spot
3/2/2014	Mexican free-tailed bat	31	41	Scheduled Carcass Search	Year-long	Intact
3/10/2014	western meadowlark	94	311	Incidental Find	Year-long	Dismemberd
3/10/2014	canyon bat	124	27	Scheduled Carcass Search	Year-long	Intact
3/31/2014	unidentified large bird	93	110	Scheduled Carcass Search	Year-long	Scavenged
4/8/2014	canyon bat	118	46	Scheduled Carcass Search	Year-long	Intact
4/10/2014	Mexican free-tailed bat	133	12	Incidental Find	Year-long	Intact
4/21/2014	mourning dove	92	69	Incidental Find	Year-long	Dismemberd
4/26/2014	warbling vireo	113	82	Scheduled Carcass Search	Year-long	Intact
4/26/2014	Swainson's thrush	113	60	Scheduled Carcass Search	Year-long	Intact
4/28/2014	yellow warbler	75	83	Scheduled Carcass Search	Year-long	Dismemberd
4/29/2014	unidentified bird (small)	93	35	Scheduled Carcass Search	Year-long	Dismemberd
5/6/2014	Townsend's warbler	149	17	Scheduled Carcass Search	Year-long	Scavenged
5/6/2014	Wilson's warbler	149	85	Scheduled Carcass Search	Year-long	Intact
5/23/2014	unidentified large bird	113	66	Scheduled Carcass Search	Year-long	Dismemberd
5/28/2014	white-throated swift	130	46	Scheduled Carcass Search	Year-long	Intact
8/12/2014	unidentified lasiurus bat	44	1	Incidental Find	Year-long	Intact
8/22/2014	Mexican free-tailed bat	148	17	Scheduled Carcass Search	Year-long	Intact
9/5/2014	Mexican free-tailed bat	148	5	Scheduled Carcass Search	Year-long	Intact
9/6/2014	Mexican free-tailed bat	133	23	Scheduled Carcass Search	Year-long	Intact
9/13/2014	white-throated swift	76	22	Scheduled Carcass Search	Year-long	Intact

Appendix B. Complete fatality listing for the Ocotillo Wind Energy Facility.

Date	Common Name	Location	Distance from Turbine	Type of Find	Survey Type	Condition
9/13/2014	Mexican free-tailed bat	28	63	Scheduled Carcass Search	Year-long	Intact
9/18/2014	Mexican free-tailed bat	25	15	Incidental Find	Year-long	Intact
9/18/2014	Mexican free-tailed bat	25	17	Incidental Find	Year-long	Intact

Appendix B. Complete Bird and Bat Fatality Table for the Ocotillo Express Wind Energy Facility for Studies Conducted from October 4, 2013 – September 29, 2014

Appendix B. Correction factors and bird and bat fatality rates by season and turbine type for studies conducted within the Ocotillo Express Wind Energy Facility from October 4, 2013 – September 29, 2014.

	Winter (33 turbines searched)		Spring/Summer/Fall (33 turbines searched)	
Parameter	**Mean**	**90% CI**	**Mean**	**90% CI**
Search Area Adjustment				
A (small birds)	1.00	-	1.00	-
A (large birds)	1.00	-	1.00	-
A (bats)	1.00	-	1.00	-
Observer Detection Rate				
p (small birds)	0.73	0.67-0.80	0.73	0.67-0.80
p (large birds)	0.94	0.89-0.98	0.94	0.89-0.98
p (bats)	0.73	0.67-0.80	0.73	0.67-0.80
Mean Carcass Removal Time (Days)				
$\bar{t}$ (small birds)	5.51	4.12-6.91	3.45	2.52-4.57
$\bar{t}$ (large birds)	8.80	6.19-11.98	8.80	6.19-11.98
$\bar{t}$ (bats)	5.51	4.12-6.91	3.45	2.52-4.57
Observed Fatality Rates (Fatalities/Turbine/Season(s))				
small birds	0.06	0.00-0.15	0.21	0.09-0.36
large birds	0.12	0.03-0.21	0.09	0.03-0.18
bats	0	-	0.33	0.18-0.48
Average Probability of Carcass Availability and Detected				
small birds	0.25	0.19-0.31	0.17	0.12-0.22
large birds	0.45	0.35-0.55	0.45	0.35-0.55
bats	0.25	0.19-0.31	0.17	0.12-0.22
Adjusted Fatality Rates (Fatalities/Turbine/Seasons(s))				
small birds	0.24	0.00-0.56	1.31	0.50-2.32
large birds	0.27	0.08-0.50	0.20	0.05-0.41
bats	0	-	2.06	1.09-3.37
Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)				
	Mean		**90% CI**	
small birds	1.55		0.69-2.61	
large birds	0.47		0.21-0.80	
all birds	2.02		1.11-3.13	
bats	2.06		1.09-3.37	

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Appendix C. Summary of Individuals and Group Observations by Bird Type and Species for Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014

Appendix C. Summary of individuals and group observations by bird type and species for fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility[a] from August 26, 2013 – September 29, 2014.

		Fall		Winter		Spring		Summer		Total	
Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Diurnal Raptors		**8**	**8**	**14**	**16**	**11**	**11**	**5**	**5**	**38**	**40**
Buteos		*8*	*8*	*11*	*12*	*6*	*6*	*5*	*5*	*30*	*31*
red-tailed hawk	*Buteo jamaicensis*	8	8	11	12	6	6	5	5	30	31
Falcons		*0*	*0*	*1*	*1*	*0*	*0*	*0*	*0*	*1*	*1*
American kestrel	*Falco sparverius*	0	0	1	1	0	0	0	0	1	1
Other Raptors		*0*	*0*	*2*	*3*	*5*	*5*	*0*	*0*	*7*	*8*
unidentified raptor		0	0	2	3	5	5	0	0	7	8
Vultures		**2**	**2**	**1**	**1**	**8**	**8**	**4**	**4**	**15**	**15**
turkey vulture	*Cathartes aura*	2	2	1	1	8	8	4	4	15	15
Doves/Pigeons		**0**	**0**	**0**	**0**	**2**	**3**	**5**	**13**	**7**	**16**
Eurasian collared-dove	*Streptopelia decaocto*	0	0	0	0	0	0	2	10	2	10
mourning dove	*Zenaida macroura*	0	0	0	0	2	3	3	3	5	6
Large Corvids		**23**	**30**	**27**	**39**	**35**	**48**	**1**	**1**	**86**	**118**
common raven	*Corvus corax*	23	30	27	39	35	48	1	1	86	118
Cuckoos		**2**	**2**	**1**	**1**	**0**	**0**	**1**	**1**	**4**	**4**
greater roadrunner	*Geococcyx californianus*	2	2	1	1	0	0	1	1	4	4
Passerines		**120**	**142**	**146**	**189**	**108**	**128**	**61**	**75**	**435**	**534**
barn swallow	*Hirundo rustica*	0	0	0	0	1	2	0	0	1	2
black-tailed gnatcatcher	*Polioptila melanura*	8	10	7	8	4	5	3	3	22	26
black-throated gray warbler	*Setophaga nigrescens*	0	0	0	0	1	1	0	0	1	1
black-throated sparrow	*Amphispiza bilineata*	23	30	12	13	27	30	29	40	91	113
black phoebe	*Sayornis nigricans*	5	5	0	0	0	0	0	0	5	5
cactus wren	*Campylorhynchus brunneicapillus*	22	25	12	13	19	19	19	20	72	77
house finch	*Haemorhous mexicanus*	0	0	53	87	9	15	1	1	63	103
Le Conte's thrasher	*Toxostoma lecontei*	2	3	0	0	2	2	1	2	5	7
loggerhead shrike	*Lanius ludovicianus*	7	8	11	11	7	7	4	4	29	30
orange-crowned warbler	*Oreothlypis celata*	1	2	0	0	0	0	0	0	1	2
rock wren	*Salpinctes obsoletus*	25	30	27	31	0	0	0	0	52	61
Say's phoebe	*Sayornis saya*	3	3	3	4	5	6	0	0	11	13
Townsend's warbler	*Setophaga townsendi*	0	0	0	0	1	1	0	0	1	1
unidentified passerine		15	17	11	11	19	21	2	3	47	52
unidentified sparrow		0	0	0	0	2	3	0	0	2	3
unidentified thrush		3	3	0	0	0	0	0	0	3	3

Appendix C. Summary of individuals and group observations by bird type and species for fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility [a] from August 26, 2013 – September 29, 2014.

		Fall		Winter		Spring		Summer		Total	
Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
unidentified warbler		0	0	0	0	4	5	0	0	4	5
verdin	*Auriparus flaviceps*	1	1	1	1	0	0	2	2	4	4
western kingbird	*Tyrannus verticalis*	5	5	4	4	1	1	0	0	10	10
yellow-rumped warbler	*Setophaga coronate*	0	0	5	6	6	10	0	0	11	16
Swifts/Hummingbirds		**3**	**3**	**23**	**28**	**12**	**13**	**2**	**2**	**40**	**46**
Anna's hummingbird	*Calypte anna*	2	2	7	7	0	0	0	0	9	9
calliope hummingbird	*Selasphorus calliope*	0	0	0	0	0	0	1	1	1	1
Costa's hummingbird	*Calypte costae*	0	0	7	8	0	0	0	0	7	8
unidentified hummingbird		1	1	8	8	10	10	1	1	20	20
white-throated swift	*Aeronautes saxatalis*	0	0	1	5	2	3	0	0	3	8
Woodpeckers		**0**	**0**	**4**	**4**	**0**	**0**	**0**	**0**	**4**	**4**
ladder-backed woodpecker	*Picoides scalaris*	0	0	4	4	0	0	0	0	4	4
Overall		**158**	**187**	**216**	**278**	**176**	**211**	**79**	**101**	**629**	**777**

[a] Regardless of distance from observer.

Appendix D. Mean Use, Percent of Use, and Frequency of Occurrence for Large and Small Birds Observed during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September, 2014

Appendix D1. Mean bird use (number of birds/plot[a]/30-min survey), percent of use (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014.

	Mean Use				% of Use				% Frequency			
Type / Species	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**
Diurnal Raptors	**0.05**	**0.08**	**0.09**	**0.05**	**21.6**	**26.0**	**13.8**	**22.7**	**4.8**	**6.5**	**8.6**	**4.8**
Buteos	*0.05*	*0.07*	*0.05*	*0.05*	*21.6*	*24.0*	*7.7*	*22.7*	*4.8*	*6.0*	*4.8*	*4.8*
red-tailed hawk	0.05	0.07	0.05	0.05	21.6	24.0	7.7	22.7	4.8	6.0	4.8	4.8
Falcons	*0*	*<0.01*	*0*	*0*	*0*	*2.0*	*0*	*0*	*0*	*0.6*	*0*	*0*
American kestrel	0	<0.01	0	0	0	2.0	0	0	0	0.6	0	0
Other Raptors	*0*	*0*	*0.04*	*0*	*0*	*0*	*6.2*	*0*	*0*	*0*	*3.8*	*0*
unidentified raptor	0	0	0.04	0	0	0	6.2	0	0	0	3.8	0
Vultures	**0.01**	**0**	**0.07**	**0.03**	**5.4**	**0**	**10.8**	**13.6**	**1.2**	**0**	**5.7**	**2.9**
turkey vulture	0.01	0	0.07	0.03	5.4	0	10.8	13.6	1.2	0	5.7	2.9
Doves/Pigeons	**0**	**0**	**0.03**	**0.12**	**0**	**0**	**4.6**	**59.1**	**0**	**0**	**1.9**	**3.8**
Eurasian collared-dove	0	0	0	0.10	0	0	0	45.5	0	0	0	1.0
mourning dove	0	0	0.03	0.03	0	0	4.6	13.6	0	0	1.9	2.9
Large Corvids	**0.16**	**0.22**	**0.44**	**<0.01**	**73.0**	**74.0**	**70.8**	**4.5**	**11.3**	**11.3**	**25.7**	**1.0**
common raven	0.16	0.22	0.44	<0.01	73.0	74.0	70.8	4.5	11.3	11.3	25.7	1.0
Overall Large Birds	**0.22**	**0.30**	**0.62**	**0.21**	**100**	**100**	**100**	**100**				

[a.] 800-meter (m) radius plot for large birds

Appendix D2. Mean bird use (number of birds/plot[a]/30-min survey), percent of use (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014.

	Mean Use				% of Use				% Frequency			
Type / Species	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**
Cuckoos	**0.01**	**<0.01**	**0**	**0**	**1.6**	**0.5**	**0**	**0**	**1.2**	**0.6**	**0**	**0**
greater roadrunner	0.01	<0.01	0	0	1.6	0.5	0	0	1.2	0.6	0	0
Passerines	**0.74**	**1.02**	**1.10**	**0.56**	**96.1**	**83.8**	**90.6**	**96.7**	**34.5**	**48.2**	**44.8**	**22.9**
barn swallow	0	0	0.02	0	0	0	1.6	0	0	0	1.0	0
black-tailed gnatcatcher	0.06	0.05	0.05	0.03	7.8	3.9	3.9	4.9	3.6	4.2	2.9	2.9
black-throated gray warbler	0	0	<0.01	0	0	0	0.8	0	0	0	1.0	0
black-throated sparrow	0.16	0.07	0.29	0.32	20.9	5.9	23.6	55.7	10.1	6.0	17.1	14.3
black phoebe	0.02	0	0	0	2.3	0	0	0	1.8	0	0	0
cactus wren	0.13	0.07	0.13	0.12	17.1	5.9	11.0	21.3	10.1	6	10.5	9.5
house finch	0	0.50	0.13	<0.01	0	41.2	11.0	1.6	0	22.0	4.8	1.0
Le Conte's thrasher	0.02	0	0.02	0.02	2.3	0	1.6	3.3	1.2	0	1.9	1.0
loggerhead shrike	0.04	0.05	0.06	0.04	4.7	4.4	4.7	6.6	3.0	4.8	5.7	2.9
orange-crowned warbler	0.01	0	0	0	1.6	0	0	0	0.6	0	0	0
rock wren	0.14	0.12	0	0	18.6	10.3	0	0	7.7	9.5	0	0
Say's phoebe	0.01	0.02	0.06	0	1.6	2.0	4.7	0	1.2	1.2	4.8	0
Townsend's warbler	0	0	<0.01	0	0	0	0.8	0	0	0	1.0	0
unidentified passerine	0.10	0.06	0.15	0	13.2	4.9	12.6	0	7.7	4.8	10.5	0
unidentified sparrow	0	0	0.03	0	0	0	2.4	0	0	0	1.9	0
unidentified thrush	0.01	0	0	0	1.6	0	0	0	1.2	0	0	0
unidentified warbler	0	0	0.05	0	0	0	3.9	0	0	0	3.8	0
verdin	<0.01	<0.01	0	0.02	0.8	0.5	0	3.3	0.6	0.6	0	1.9
western kingbird	0.03	0.02	<0.01	0	3.9	2.0	0.8	0	2.4	2.4	1.0	0
yellow-rumped warbler	0	0.04	0.09	0	0	2.9	7.1	0	0	3.0	4.8	0
Swifts/Hummingbirds	**0.02**	**0.17**	**0.11**	**0.02**	**2.3**	**13.7**	**9.4**	**3.3**	**1.8**	**11.9**	**8.6**	**1.9**
Anna's hummingbird	0.01	0.04	0	0	1.6	3.4	0	0	1.2	4.2	0	0
calliope hummingbird	0	0	0	<0.01	0	0	0	1.6	0	0	0	1.0
Costa's hummingbird	0	0.05	0	0	0	3.9	0	0	0	4.2	0	0
unidentified hummingbird	<0.01	0.05	0.09	<0.01	0.8	3.9	7.1	1.6	0.6	4.8	6.7	1.0
white-throated swift	0	0.03	0.03	0	0	2.5	2.4	0	0	0.6	1.9	0
Woodpeckers	**0**	**0.02**	**0**	**0**	**0**	**2.0**	**0**	**0**	**0**	**2.4**	**0**	**0**
ladder-backed woodpecker	0	0.02	0	0	0	2.0	0	0	0	2.4	0	0
Overall Small Birds	**0.77**	**1.21**	**1.21**	**0.58**	**100**	**100**	**100**	**100**				

[a] 100-meter (m) radius plot for small birds.

Appendix E. Species Exposure Indices for Large Birds and Small Birds during Fixed-Point Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014

Appendix E1. Relative exposure index and flight characteristics by large bird species during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
common raven	38	0.21	52.3	82.8	0.09	87.9
red-tailed hawk	15	0.05	50.0	80.0	0.02	93.3
turkey vulture	12	0.03	100	66.7	0.02	75.0
unidentified raptor	3	<0.01	75.0	100	<0.01	100
mourning dove	3	0.01	50.0	33.3	<0.01	33.3
American kestrel	1	<0.01	100	100	<0.01	100
Eurasian collared-dove	1	0.02	90.0	0	0	0

RSH: The likely “rotor swept heights” for potential collision with a turbine blade, or 25-150 m (82-492 ft) above ground level (AGL).

Appendix E2. Relative exposure index and flight characteristics for small birds during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
black-throated sparrow	23	0.21	28.2	6.9	<0.01	6.9
white-throated swift	3	0.02	100	25.0	<0.01	25.0
house finch	16	0.18	37.4	5.4	<0.01	13.5
cactus wren	8	0.11	18.0	0	0	0
unidentified passerine	7	0.08	20.9	0	0	0
rock wren	9	0.07	35.6	0	0	0
loggerhead shrike	12	0.05	48.0	0	0	0
black-tailed gnatcatcher	11	0.05	50.0	0	0	0
unidentified hummingbird	13	0.04	68.4	0	0	0
yellow-rumped warbler	6	0.03	60.0	0	0	0
Say's phoebe	1	0.02	16.7	0	0	0
western kingbird	4	0.02	40.0	0	0	0
Anna's hummingbird	3	0.01	33.3	0	0	0
Costa's hummingbird	1	0.01	12.5	0	0	0
Le Conte's thrasher	2	0.01	42.9	0	0	0
unidentified warbler	3	0.01	80.0	0	0	0
verdin	1	<0.01	25.0	0	0	0
unidentified sparrow	1	<0.01	66.7	0	0	0
ladder-backed woodpecker	2	<0.01	50.0	0	0	0
barn swallow	1	<0.01	100	0	0	0
greater roadrunner	1	<0.01	33.3	0	0	0
black phoebe	1	<0.01	33.3	0	0	0
unidentified thrush	1	<0.01	50.0	0	0	0
orange-crowned warbler	0	<0.01	0	0	0	0
Townsend's warbler	1	<0.01	100	0	0	0
calliope hummingbird	1	<0.01	100	0	0	0
black-throated gray warbler	0	<0.01	0	0	0	0

RSH: The likely “rotor swept heights” for potential collision with a turbine blade, or 25-150 m (82-492 ft) above ground level (AGL).

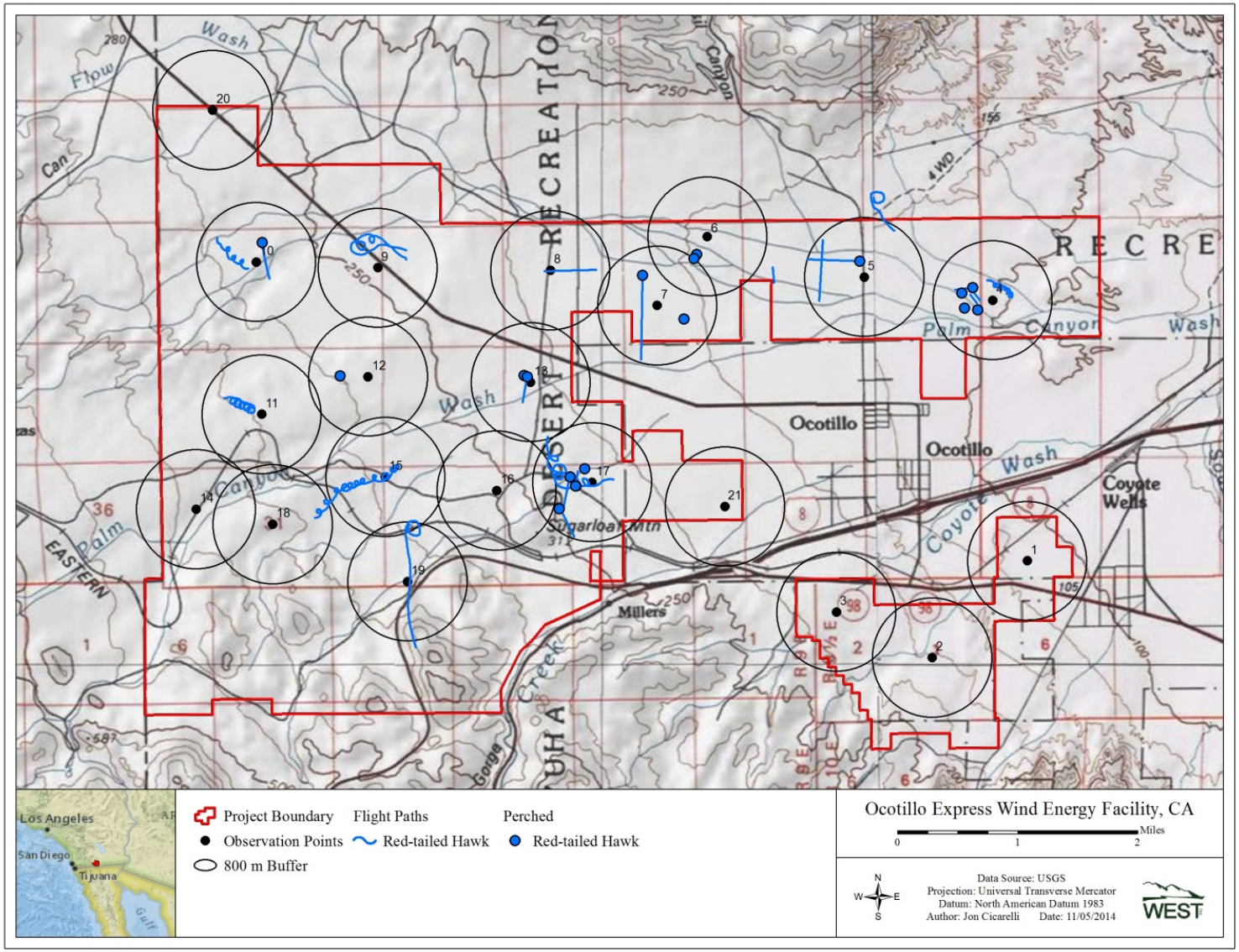
Appendix F. Mean Use by Point for All Birds, Major Bird Types, and Diurnal Raptor Subtypes during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014

Appendix F. Mean use (number of birds/30-minute survey) by point for all birds[a], major bird types, and diurnal raptor subtypes observed at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2013 to September 29, 2014.

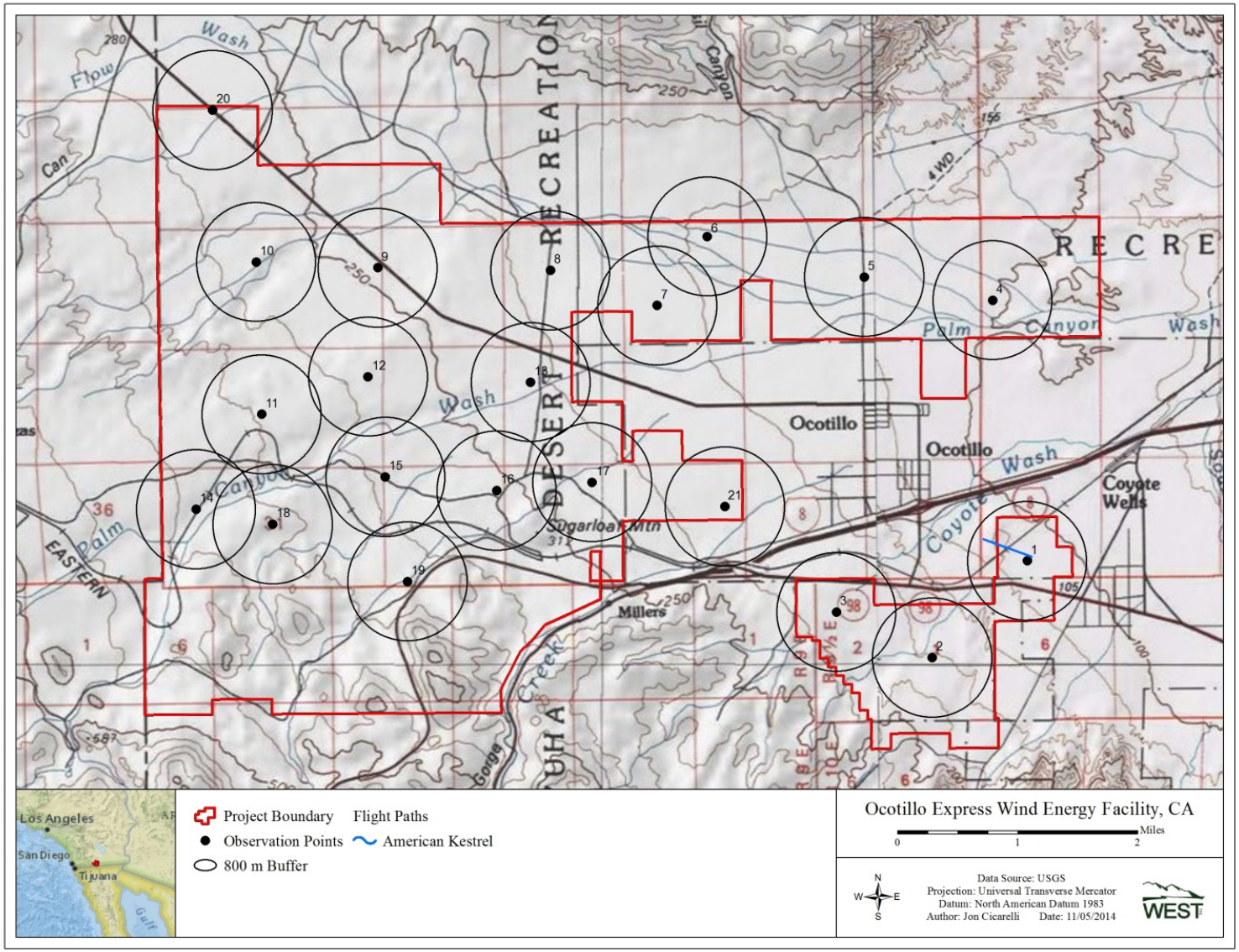
	Survey Point																				
Bird Type	**0**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Diurnal Raptor	0.04	0	0	0.23	0.15	0.12	0.08	0.04	0.04	0.08	0.08	0.08	0.08	0	0.04	0	0.27	0	0.04	0	0
Buteo	*0*	*0*	*0*	*0.23*	*0.12*	*0.08*	*0.08*	*0.04*	*0.04*	*0.08*	*0.04*	*0.04*	*0.08*	*0*	*0.04*	*0*	*0.27*	*0*	*0.04*	*0*	*0*
Falcon	*0.04*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Other Raptor	*0*	*0*	*0*	*0*	*0.04*	*0.04*	*0*	*0*	*0*	*0*	*0.04*	*0.04*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Vulture	0.12	0.12	0.08	0	0	0	0	0	0.08	0	0.08	0	0	0	0	0	0	0	0	0	0
Dove/Pigeon	0.15	0	0	0	0	0	0	0	0	0	0	0	0.38	0	0	0	0	0.04	0	0.04	0
Large Corvid	0.08	0.12	0.08	0.27	0.42	0.42	0.54	0.12	0.12	0.08	0.19	0.04	0.08	0	0.12	0.08	0.58	0.08	0.12	0.27	0.50
All Large Birds	**0.38**	**0.23**	**0.15**	**0.50**	**0.58**	**0.54**	**0.62**	**0.15**	**0.23**	**0.15**	**0.35**	**0.12**	**0.54**	**0**	**0.15**	**0.08**	**0.85**	**0.12**	**0.15**	**0.31**	**0.50**
Passerine	0.5	0.73	0.38	0.50	0.54	0.35	0.23	0.27	0.50	1.27	1.54	0.96	0.46	1.73	1.38	0.46	2.35	1.42	0.54	1.23	0.69
Cuckoo	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0.04	0	0	0	0	0	0.04
Swifts/ Hummingbird	0	0.08	0	0	0.08	0.15	0	0.27	0	0.15	0.12	0.08	0.08	0.12	0.04	0	0.19	0.23	0.04	0.08	0.04
Woodpecker	0	0	0	0	0	0	0	0.04	0	0.04	0	0	0.04	0	0	0	0	0.04	0	0	0
All Small Birds	**0.5**	**0.81**	**0.38**	**0.5**	**0.62**	**0.50**	**0.23**	**0.58**	**0.50**	**1.50**	**1.65**	**1.04**	**0.58**	**1.85**	**1.46**	**0.46**	**2.54**	**1.69**	**0.58**	**1.31**	**0.77**

[a.] 800-meter (m) radius plot for large birds, 100-m for small birds.

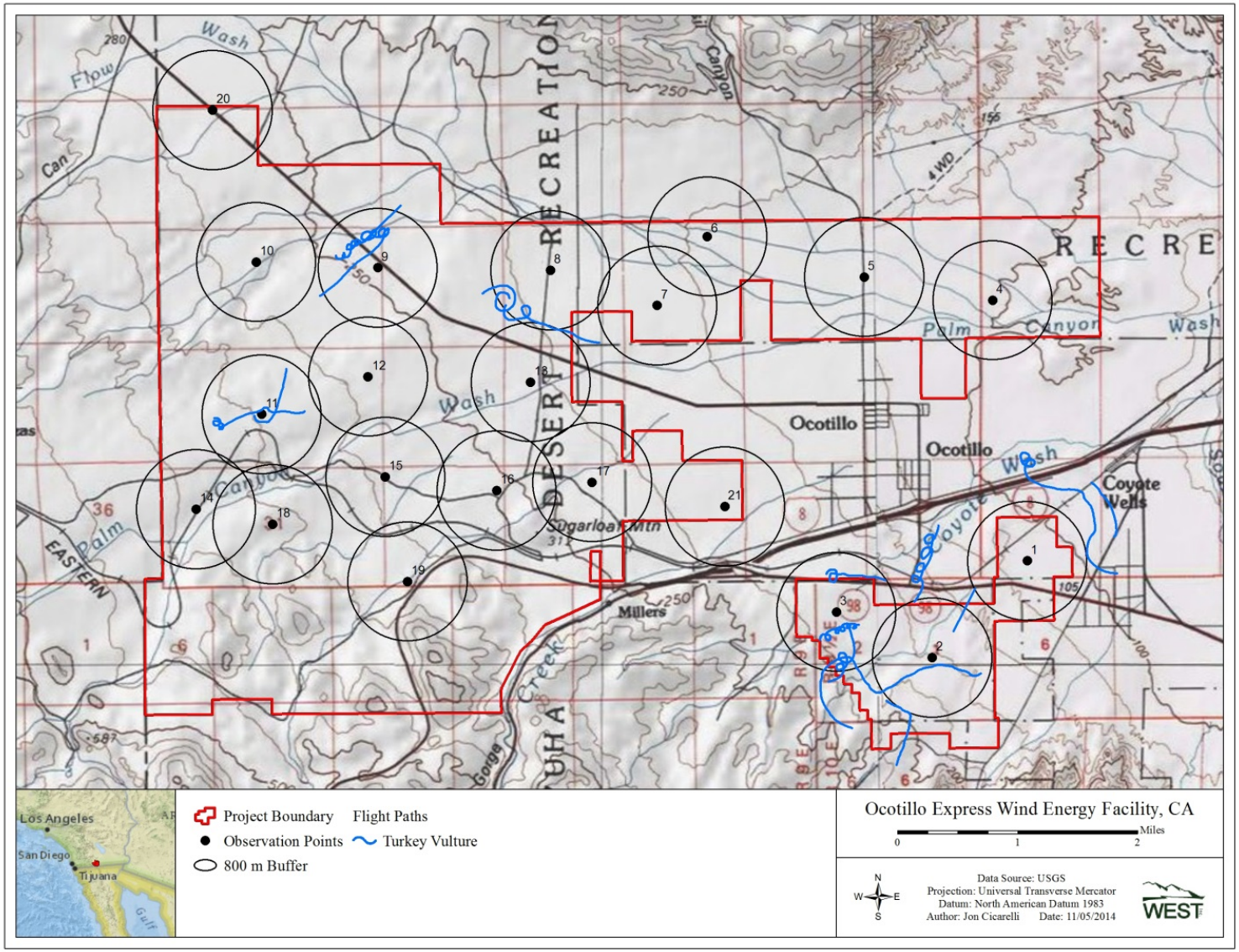
Appendix G. Large Bird Flight Paths Recorded during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from August 26, 2013 – September 29, 2014



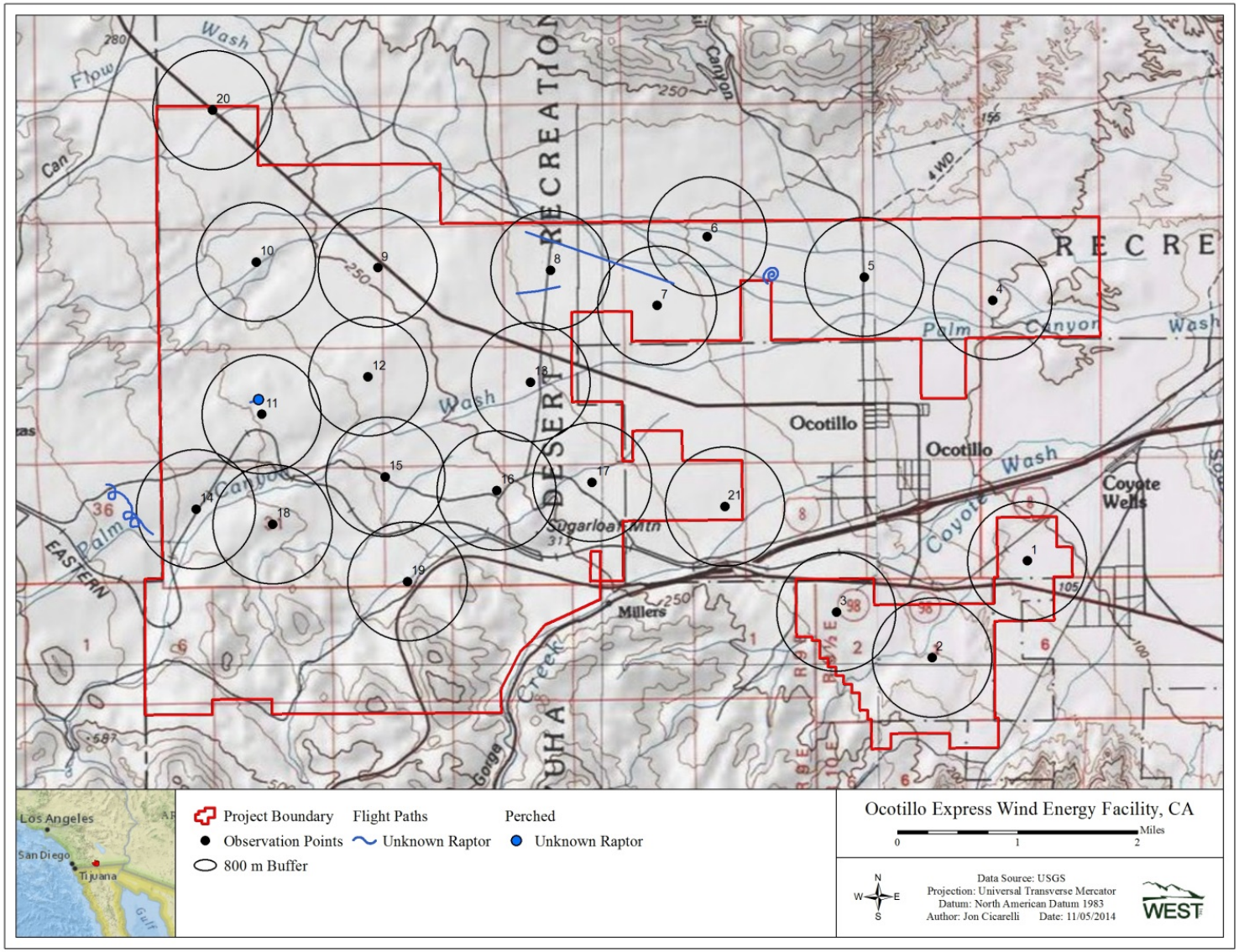
Appendix G. Buteo flight paths recorded at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2012 – September 29, 2014.



Appendix G (*continued*). Falcon flight paths recorded at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2012 – September 29, 2014.



Appendix G (*continued*). Turkey vulture flight paths recorded at Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2012 – September 29, 2014.



Appendix G (*continued*). Unidentified raptor flight paths recorded at Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from August 26, 2012 – September 29, 2014.

Appendix H. North American Fatality Summary Tables

Appendix H1. Wind energy facilities in North America with publicly-available and comparable fatality data for all bird species, by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
Ocotillo, CA	**0.88**	**112**	**315**
California			
Pine Tree, CA (2009-2010)	8.30	90	135
Alta Wind I, CA (2011-2012)	7.07	100	150
Shiloh I, CA (2006-2009)	6.96	100	150
Dillon, CA (2008-2009)	4.71	45	45
Diablo Winds, CA (2005-2007)	4.29	31	20.46
Alta Wind II-V, CA (2011-2012)	1.66	190	570
High Winds, CA (2003-2004)	1.62	90	162
Shiloh II, CA (2009-2010)	1.51	75	150
High Winds, CA (2004-2005)	1.10	90	162
Alite, CA (2009-2010)	0.55	8	24
Southwest			
Dry Lake I, AZ (2009-2010)	2.02	30	63
Dry Lake II, AZ (2011-2012)	1.57	31	65
Pacific Northwest			
Windy Flats, WA (2010-2011)	8.45	114	262.2
Leaning Juniper, OR (2006-2008)	6.66	67	100.5
Linden Ranch, WA (2010-2011)	6.65	25	50
Biglow Canyon, OR (Phase II; 2009-2010)	5.53	65	150
White Creek, WA (2007-2011)	4.05	89	204.7
Tuolumne (Windy Point I), WA (2009-2010)	3.20	62	136.6
Stateline, OR/WA (2001-2002)	3.17	454	299
Klondike II, OR (2005-2006)	3.14	50	75
Klondike III (Phase I), OR (2007-2009)	3.02	125	223.6
Hopkins Ridge, WA (2008)	2.99	87	156.6
Harvest Wind, WA (2010-2012)	2.94	43	98.9
Nine Canyon, WA (2002-2003)	2.76	37	48.1
Biglow Canyon, OR (Phase II; 2010-2011)	2.68	65	150
Stateline, OR/WA (2003)	2.68	454	299
Klondike IIIa (Phase II), OR (2008-2010)	2.61	51	76.5
Combine Hills, OR (Phase I; 2004-2005)	2.56	41	41
Big Horn, WA (2006-2007)	2.54	133	199.5
Biglow Canyon, OR (Phase I; 2009)	2.47	76	125.4
Combine Hills, OR (2011)	2.33	104	104
Biglow Canyon, OR (Phase III; 2010-2011)	2.28	76	174.8
Hay Canyon, OR (2009-2010)	2.21	48	100.8
Elkhorn, OR (2010)	1.95	61	101
Pebble Springs, OR (2009-2010)	1.93	47	98.7
Biglow Canyon, OR (Phase I; 2008)	1.76	76	125.4
Wild Horse, WA (2007)	1.55	127	229
Goodnoe, WA (2009-2010)	1.40	47	94
Vantage, WA (2010-2011)	1.27	60	90
Hopkins Ridge, WA (2006)	1.23	83	150
Stateline, OR/WA (2006)	1.23	454	299
Kittitas Valley, WA (2011-2012)	1.06	48	100.8
Klondike, OR (2002-2003)	0.95	16	24
Vansycle, OR (1999)	0.95	38	24.9
Elkhorn, OR (2008)	0.64	61	101
Marengo I, WA (2009-2010)	0.27	78	140.4
Marengo II, WA (2009-2010)	0.16	39	70.2

Appendix H1. Wind energy facilities in North America with publicly-available and comparable fatality data for all bird species, by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
Rocky Mountains			
Foote Creek Rim, WY (Phase I; 1999)	3.40	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.42	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)	1.93	69	41.4
Summerview, Alb (2005-2006)	1.06	39	70.2
Northeast			
Criterion, MD (2011)	6.40	28	70
Mount Storm, WV (2011)	4.24	132	264
Mount Storm, WV (2009)	3.85	132	264
Lempster, NH (2009)	3.38	12	24
Casselman, PA (2009)	2.88	23	34.5
Mountaineer, WV (2003)	2.69	44	66
Stetson Mountain I, ME (2009)	2.68	38	57
Noble Ellenburg, NY (2009)	2.66	54	80
Lempster, NH (2010)	2.64	12	24
Mount Storm, WV (2010)	2.60	132	264
Maple Ridge, NY (2007)	2.34	195	321.75
Noble Bliss, NY (2009)	2.28	67	100
Criterion, MD (2012)	2.14	28	70
Maple Ridge, NY (2007-2008)	2.07	195	321.75
Noble Altona, NY (2010)	1.84	65	97.5
Mars Hill, ME (2008)	1.76	28	42
High Sheldon, NY (2010)	1.76	75	112.5
Noble Wethersfield, NY (2010)	1.70	84	126
Mars Hill, ME (2007)	1.67	28	42
Noble Chateaugay, NY (2010)	1.66	71	106.5
Noble Clinton, NY (2008)	1.59	67	100
High Sheldon, NY (2011)	1.57	75	112.5
Casselman, PA (2008)	1.51	23	34.5
Munnsville, NY (2008)	1.48	23	34.5
Stetson Mountain II, ME (2010)	1.42	17	25.5
Cohocton/Dutch Hill, NY (2009)	1.39	50	125
Cohocton/Dutch Hills, NY (2010)	1.32	50	125
Noble Bliss, NY (2008)	1.30	67	100
Beech Ridge, WV (2012)	1.19	67	100.5
Stetson Mountain I, ME (2011)	1.18	38	57
Noble Clinton, NY (2009)	1.11	67	100
Locust Ridge, PA (Phase II; 2009)	0.84	51	102
Noble Ellenburg, NY (2008)	0.83	54	80
Locust Ridge, PA (Phase II; 2010)	0.76	51	102
Midwest			
Wessington Springs, SD (2009)	8.25	34	51
Blue Sky Green Field, WI (2008; 2009)	7.17	88	145
Cedar Ridge, WI (2009)	6.55	41	67.6
Buffalo Ridge, MN (Phase III; 1999)	5.93	138	103.5
Moraine II, MN (2009)	5.59	33	49.5
Barton I & II, IA (2010-2011)	5.50	80	160
Buffalo Ridge I, SD (2009-2010)	5.06	24	50.4
Buffalo Ridge, MN (Phase I; 1996)	4.14	73	25
Winnebago, IA (2009-2010)	3.88	10	20
Rugby, ND (2010-2011)	3.82	71	149

Appendix H1. Wind energy facilities in North America with publicly-available and comparable fatality data for all bird species, by geographic region.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
Cedar Ridge, WI (2010)	3.72	41	68
Elm Creek II, MN (2011-2012)	3.64	62	148.8
Buffalo Ridge, MN (Phase II; 1999)	3.57	143	107.25
Buffalo Ridge, MN (Phase I; 1998)	3.14	73	25
Ripley, Ont (2008)	3.09	38	76
Fowler I, IN (2009)	2.83	162	301
Buffalo Ridge, MN (Phase I; 1997)	2.51	73	25
Buffalo Ridge, MN (Phase II; 1998)	2.47	143	107.25
PrairieWinds SD1, SD (2012-2013)	2.01	108	162
Buffalo Ridge II, SD (2011-2012)	1.99	105	210
Kewaunee County, WI (1999-2001)	1.95	31	20.46
NPPD Ainsworth, NE (2006)	1.63	36	20.5
PrairieWinds ND1 (Minot), ND (2011)	1.56	80	115.5
Elm Creek, MN (2009-2010)	1.55	67	100
PrairieWinds ND1 (Minot), ND (2010)	1.48	80	115.5
Buffalo Ridge, MN (Phase I; 1999)	1.43	73	25
PrairieWinds SD1, SD (2011-2012)	1.41	108	162
Wessington Springs, SD (2010)	0.89	34	51
Top of Iowa, IA (2004)	0.81	89	80
Grand Ridge I, IL (2009-2010)	0.48	66	99
Top of Iowa, IA (2003)	0.42	89	80
Pioneer Prairie I, IA (Phase II; 2011-2012)	0.27	62	102.3
Southeast			
Buffalo Mountain, TN (2000-2003)	11.02	3	1.98
Buffalo Mountain, TN (2005)	1.10	18	28.98
Southern Plains			
Buffalo Gap I, TX (2006)	1.32	67	134
Barton Chapel, TX (2009-2010)	1.15	60	120
Buffalo Gap II, TX (2007-2008)	0.15	155	233
Big Smile, OK (2012-2013)	0.09	66	132
Red Hills, OK (2012-2013)	0.08	82	123

A=number of bird fatalities/MW/year

Appendix H1 (*continued*). Wind energy facilities in North America with fatality data for all bird species, by geographic region.

Data from the following sources:

Wind Energy Facility	Fatality Estimate	Wind Energy Facility	Fatality Estimate
Ocotillo, CA	This study.		
Alite, CA (09-10)	Chatfield et al. 2010b	Klondike II, OR (05-06)	NWC and WEST 2007
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Klondike III, OR (Phase I; 07-09)	Gritski et al. 2010
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Klondike IIIa, OR (Phase II; 08-10)	Gritski et al. 2011
Barton I & II, IA (10-11)	Derby et al. 2011a	Leaning Juniper, OR (06-08)	Gritski et al. 2008
Barton Chapel, TX (09-10)	WEST 2011	Lempster, NH (09)	Tidhar et al. 2010
Beech Ridge, WV (12)	Tidhar et al. 2013	Lempster, NH (10)	Tidhar et al. 2011
Big Horn, WA (06-07)	Kronner et al. 2008	Linden Ranch, WA (10-11)	Enz and Bay 2011
Big Smile, OK (12-13)	Derby et al. 2013b	Locust Ridge, PA (Phase II; 09)	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Locust Ridge, PA (Phase II; 10)	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Maple Ridge, NY (07)	Jain et al. 2009a
Biglow Canyon, OR (Phase II; 09-10)	Enk et al. 2011a	Maple Ridge, NY (07-08)	Jain et al. 2009d
Biglow Canyon, OR (Phase II; 10-11)	Enk et al. 2012b	Marengo I, WA (09-10)	URS Corporation 2010b
Biglow Canyon, OR (Phase III; 10-11)	Enk et al. 2012a	Marengo II, WA (09-10)	URS Corporation 2010c
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009	Mars Hill, ME (07)	Stantec 2008
Buffalo Gap I, TX (06)	Tierney 2007	Mars Hill, ME (08)	Stantec 2009a
Buffalo Gap II, TX (07-08)	Tierney 2009	Moraine II, MN (09)	Derby et al. 2010d
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Mount Storm, WV (09)	Young et al. 2009a, 2010b
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Mount Storm, WV (10)	Young et al. 2010a, 2011b
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a	Mount Storm, WV (11)	Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a	Mountaineer, WV (03)	Kerns and Kerlinger 2004
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a	Munnsville, NY (08)	Stantec 2009b
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a	Nine Canyon, WA (02-03)	Erickson et al. 2003b
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a	Noble Altona, NY (10)	Jain et al. 2011b
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a	Noble Bliss, NY (08)	Jain et al. 2009e
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a	Noble Bliss, NY (09)	Jain et al. 2010a
Buffalo Ridge I, SD (09-10)	Derby et al. 2010b	Noble Chateaugay, NY (10)	Jain et al. 2011c
Buffalo Ridge II, SD (11-12)	Derby et al. 2012a	Noble Clinton, NY (08)	Jain et al. 2009c
Casselman, PA (08)	Arnett et al. 2009a	Noble Clinton, NY (09)	Jain et al. 2010b
Casselman, PA (09)	Arnett et al. 2010	Noble Ellenburg, NY (08)	Jain et al. 2009b
Cedar Ridge, WI (09)	BHE Environmental 2010	Noble Ellenburg, NY (09)	Jain et al. 2010c
Cedar Ridge, WI (10)	BHE Environmental 2011	Noble Wethersfield, NY (10)	Jain et al. 2011a
Cohocton/Dutch Hill, NY (09)	Stantec 2010	NPPD Ainsworth, NE (06)	Derby et al. 2007
Cohocton/Dutch Hill, NY (10)	Stantec 2011	Pebble Springs, OR (09-10)	Gritski and Kronner 2010b
Combine Hills, OR (Ph. I; 04-05)	Young et al. 2006	Pine Tree, CA (09-10)	BioResource Consultants 2010
Combine Hills, OR (11)	Enz et al. 2012	Pioneer Prairie I, IA (Phase II; 11-12)	Chodachek et al. 2012
Criterion, MD (11)	Young et al. 2012a	PrairieWinds ND1 (Minot), ND (10)	Derby et al. 2011c
Criterion, MD (12)	Young et al. 2013	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012c
Diablo Winds, CA (05-07)	WEST 2006, 2008	PrairieWinds SD1 (Crow Lake), SD (11-12)	Derby et al. 2012d
Dillon, CA (08-09)	Chatfield et al. 2009	PrairieWinds SD1 (Crow Lake), SD (12-13)	Derby et al. 2013a
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Red Hills, OK (12-13)	Derby et al. 2013c
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Ripley, Ont (08)	Jacques Whitford 2009
Elkhorn, OR (08)	Jeffrey et al. 2009b	Rugby, ND (10-11)	Derby et al. 2011b
Elkhorn, OR (10)	Enk et al. 2011b	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Elm Creek, MN (09-10)	Derby et al. 2010c	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Elm Creek II, MN (11-12)	Derby et al. 2012b	Stateline, OR/WA (01-02)	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003b	Stateline, OR/WA (03)	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003b	Stateline, OR/WA (06)	Erickson et al. 2007
Foote Creek Rim, WY (Ph. I; 01-02)	Young et al. 2003b	Stetson Mountain I, ME (09)	Stantec 2009c
Fowler I, IN (09)	Johnson et al. 2010a	Stetson Mountain I, ME (11)	Normandeau Associates 2011
Goodnoe, WA (09-10)	URS Corporation 2010a	Stetson Mountain II, ME (10)	Normandeau Associates 2010
Grand Ridge, IL (09-10)	Derby et al. 2010g	Summerview, Alb (05-06)	Brown and Hamilton 2006b
Harvest Wind, WA (10-12)	Downes and Gritski 2012a	Top of Iowa, IA (03)	Jain 2005
Hay Canyon, OR (09-10)	Gritski and Kronner 2010a	Top of Iowa, IA (04)	Jain 2005
High Sheldon, NY (10)	Tidhar et al. 2012a	Tuolumne (Windy Point I), WA (09-10)	Enz and Bay 2010
High Sheldon, NY (11)	Tidhar et al. 2012b	Vansycle, OR (99)	Erickson et al. 2000b
High Winds, CA (03-04)	Kerlinger et al. 2006	Vantage, WA (10-11)	Ventus 2012
High Winds, CA (04-05)	Kerlinger et al. 2006	Wessington Springs, SD (09)	Derby et al. 2010f
Hopkins Ridge, WA (06)	Young et al. 2007a	Wessington Springs, SD (10)	Derby et al. 2011d
Hopkins Ridge, WA (08)	Young et al. 2009c	White Creek, WA (07-11)	Downes and Gritski 2012b
Kewaunee County, WI (99-01)	Howe et al. 2002	Wild Horse, WA (07)	Erickson et al. 2008
Kittitas Valley, WA (11-12)	Stantec 2012	Windy Flats, WA (10-11)	Enz et al. 2011
Klondike, OR (02-03)	Johnson et al. 2003b	Winnebago, IA (09-10)	Derby et al. 2010e

Appendix H2. Wind energy facilities in North America with publicly-available and comparable use and fatality data for raptors, by geographic region.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Ocotillo, CA	**0.05**	**NA**	**112**	**315**
California				
High Winds, CA (2003-2004)	2.337	0.5	90	162
Shiloh I, CA (2006-2009)	NA	0.42	100	150
Diablo Winds, CA (2005-2007)	2.161	0.4	31	20.46
High Winds, CA (2004-2005)	2.337	0.28	90	162
Alta Wind I, CA (2011-2012)	0.19	0.27	100	150
Pine Tree, CA (2009-2010)	NA	0.133	90	135
Alite, CA (2009-2010)	NA	0.12	8	24
Shiloh II, CA (2009-2010)	NA	0.12	75	150
Alta Wind II-V, CA (2011-2012)	0.04	0.05	190	570
Dillon, CA (2008-2009)	NA	0	45	45
Southwest				
Dry Lake I, AZ (2009-2010)	0.13	0.13	0.13	0.13
Dry Lake II, AZ (2011-2012)	NA	NA	NA	NA
Pacific Northwest				
White Creek, WA (2007-2011)	NA	0.47	89	204.7
Vantage, WA (2010-2011)	NA	0.29	60	90
Tuolumne (Windy Point I), WA (2009-2010)	0.77	0.29	62	136.6
Linden Ranch, WA (2010-2011)	NA	0.27	25	50
Harvest Wind, WA (2010-2012)	NA	0.23	43	98.9
Goodnoe, WA (2009-2010)	NA	0.17	47	94
Leaning Juniper, OR (2006-2008)	0.522	0.16	67	100.5
Klondike III (Phase I), OR (2007-2009)	NA	0.15	125	223.6
Hopkins Ridge, WA (2006)	0.698	0.14	83	150
Biglow Canyon, OR (Phase II; 2009-2010)	0.318	0.14	65	150
Big Horn, WA (2006-2007)	0.511	0.11	133	199.5
Stateline, OR/WA (2006)	0.478	0.11	454	299
Kittitas Valley, WA (2011-2012)	NA	0.09	48	100.8
Wild Horse, WA (2007)	0.291	0.09	127	229
Stateline, OR/WA (2001-2002)	0.478	0.09	454	299
Stateline, OR/WA (2003)	0.478	0.09	454	299
Elkhorn, OR (2010)	1.07	0.08	61	101
Hopkins Ridge, WA (2008)	0.698	0.07	87	156.6
Klondike II, OR (2005-2006)	0.504	0.06	50	75
Klondike IIIa (Phase II), OR (2008-2010)	NA	0.06	51	76.5
Elkhorn, OR (2008)	1.07	0.06	61	101
Marengo II, WA (2009-2010)	NA	0.05	39	70.2
Combine Hills, OR (2011)	0.746	0.05	104	104
Biglow Canyon, OR (Phase III; 2010-2011)	0.318	0.05	76	174.8
Pebble Springs, OR (2009-2010)	NA	0.04	47	98.7
Windy Flats, WA (2010-2011)	NA	0.04	114	262.2
Nine Canyon, WA (2002-2003)	0.35	0.03	37	48.1
Biglow Canyon, OR (Phase I; 2008)	0.318	0.03	76	125.4
Biglow Canyon, OR (Phase II; 2010-2011)	0.318	0.03	65	150
Klondike, OR (2002-2003)	0.504	0	16	24
Vansycle, OR (1999)	0.66	0	38	24.9
Combine Hills, OR (Phase I; 2004-2005)	0.746	0	41	41
Hay Canyon, OR (2009-2010)	NA	0	48	100.8
Biglow Canyon, OR (Phase I; 2009)	0.318	0	76	125.4
Marengo I, WA (2009-2010)	NA	0	78	140.4

Appendix H2. Wind energy facilities in North America with publicly-available and comparable use and fatality data for raptors, by geographic region.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Rocky Mountains				
Summerview, Alb (2005-2006)	NA	0.11	39	70.2
Foote Creek Rim, WY (Phase I; 1999)	0.554	0.08	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	0.554	0.05	69	41.4
Foote Creek Rim, WY (Phase I; 2001-2002)	0.554	0	69	41.4
Midwest				
Buffalo Ridge, MN (Phase I; 1999)	NA	0.47	73	25
Moraine II, MN (2009)	NA	0.37	33	49.5
Winnebago, IA (2009-2010)	NA	0.27	10	20
Buffalo Ridge I, SD (2009-2010)	NA	0.2	24	50.4
Cedar Ridge, WI (2009)	NA	0.18	41	67.6
Top of Iowa, IA (2004)	NA	0.17	89	80
Cedar Ridge, WI (2010)	NA	0.13	41	68
Ripley, Ont (2008)	NA	0.1	38	76
Wessington Springs, SD (2010)	0.232	0.07	34	51
NPPD Ainsworth, NE (2006)	NA	0.06	36	20.5
Wessington Springs, SD (2009)	0.232	0.06	34	51
Rugby, ND (2010-2011)	NA	0.06	71	149
PrairieWinds ND1 (Minot), ND (2011)	NA	0.05	80	115.5
PrairieWinds ND1 (Minot), ND (2010)	NA	0.05	80	115.5
PrairieWinds SD1, SD (2012-2013)	NA	0.03	108	162
Kewaunee County, WI (1999-2001)	NA	0	31	20.46
Buffalo Ridge, MN (Phase I; 1996)	NA	0	73	25
Buffalo Ridge, MN (Phase I; 1997)	NA	0	73	25
Buffalo Ridge, MN (Phase I; 1998)	NA	0	73	25
Top of Iowa, IA (2003)	NA	0	89	80
Grand Ridge I, IL (2009-2010)	0.195	0	66	99
Elm Creek, MN (2009-2010)	NA	0	67	100
Pioneer Prairie I, IA (Phase II; 2011-2012)	NA	0	62	102.3
Buffalo Ridge, MN (Phase III; 1999)	NA	0	138	103.5
Buffalo Ridge, MN (Phase II; 1998)	NA	0	143	107.25
Buffalo Ridge, MN (Phase II; 1999)	NA	0	143	107.25
Blue Sky Green Field, WI (2008; 2009)	NA	0	88	145
Elm Creek II, MN (2011-2012)	NA	0	62	148.8
Barton I & II, IA (2010-2011)	NA	0	80	160
PrairieWinds SD1, SD (2011-2012)	NA	0	108	162
Buffalo Ridge II, SD (2011-2012)	NA	0	105	210
Fowler I, IN (2009)	NA	0	162	301
Northeast				
Munnsville, NY (2008)	NA	0.59	23	34.5
Noble Ellenburg, NY (2009)	NA	0.25	54	80
Noble Clinton, NY (2009)	NA	0.16	67	100
Noble Wethersfield, NY (2010)	NA	0.13	84	126
Noble Bliss, NY (2009)	NA	0.12	67	100
Noble Ellenburg, NY (2008)	NA	0.11	54	80
Noble Bliss, NY (2008)	NA	0.1	67	100
Noble Clinton, NY (2008)	NA	0.1	67	100
Mount Storm, WV (2010)	NA	0.1	132	264
Noble Chateaugay, NY (2010)	NA	0.08	71	106.5
Cohocton/Dutch Hills, NY (2010)	NA	0.08	50	125

Appendix H2. Wind energy facilities in North America with publicly-available and comparable use and fatality data for raptors, by geographic region.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Mountaineer, WV (2003)	NA	0.07	44	66
High Sheldon, NY (2010)	NA	0.06	75	112.5
Mount Storm, WV (2011)	NA	0.03	132	264
Maple Ridge, NY (2007-2008)	NA	0.03	195	321.75
Criterion, MD (2011)	NA	0.02	28	70
Beech Ridge, WV (2012)	NA	0.01	67	100.5
Lempster, NH (2009)	NA	0	12	24
Lempster, NH (2010)	NA	0	12	24
Stetson Mountain II, ME (2010)	NA	0	17	25.5
Casselman, PA (2009)	NA	0	23	34.5
Casselman, PA (2008)	NA	0	23	34.5
Mars Hill, ME (2007)	NA	0	28	42
Mars Hill, ME (2008)	NA	0	28	42
Stetson Mountain I, ME (2011)	NA	0	38	57
Stetson Mountain I, ME (2009)	NA	0	38	57
Noble Altona, NY (2010)	NA	0	65	97.5
Locust Ridge, PA (Phase II; 2009)	NA	0	51	102
Locust Ridge, PA (Phase II; 2010)	NA	0	51	102
High Sheldon, NY (2011)	NA	0	75	112.5
Cohocton/Dutch Hill, NY (2009)	NA	0	50	125
Mount Storm, WV (2009)	NA	0	132	264
Southeast				
Buffalo Mountain, TN (2000-2003)	NA	0	3	1.98
Buffalo Mountain, TN (2005)	NA	0	18	28.98
Southern Plains				
Barton Chapel, TX (2009-2010)	NA	0.25	60	120
Buffalo Gap I, TX (2006)	NA	0.1	67	134
Red Hills, OK (2012-2013)	NA	0.04	82	123
Big Smile, OK (2012-2013)	NA	0	66	132
Buffalo Gap II, TX (2007-2008)	NA	0	155	233

A=number of raptors/plot/20min survey
B=number of fatalities/MW/year

Appendix H2 (*continued*). Wind energy facilities in North America with publicly-available and comparable use and fatality data for raptors, by geographic region.

Data from the following sources:

Facility	Use Estimate	Fatality Estimate	Facility	Use Estimate	Fatality Estimate
Ocotillo, CA	This study	NA			
Alite, CA (09-10)	NA	Chatfield et al. 2010b	Klondike II, OR (05-06)	Johnson et al. 2002	NWC and WEST 2007
Alta Wind I, CA (11-12)	Erickson and Chatfield 2009	Chatfield et al. 2012	Klondike III (Phase I), OR (07-09)	NA	Gritski et al. 2010
Alta Wind II-V, CA (11-12)	Erickson and Chatfield 2009	Chatfield et al. 2012	Klondike IIIa (Phase II), OR (08-10)	NA	Gritski et al. 2011
Barton I & II, IA (10-11)	NA	Derby et al. 2011a	Leaning Juniper, OR (06-08)	Kronner et al. 2005	Gritski et al. 2008
Barton Chapel, TX (09-10)	NA	WEST 2011	Lempster, NH (09)	NA	Tidhar et al. 2010
Beech Ridge, WV (12)	NA	Tidhar et al. 2013	Lempster, NH (10)	NA	Tidhar et al. 2011
Big Horn, WA (06-07)	Johnson and Erickson 2004	Kronner et al. 2008	Linden Ranch, WA (10-11)	NA	Enz and Bay 2011
Big Smile, OK (12-13)	NA	Derby et al. 2013b	Locust Ridge, PA (Phase II; 09)	NA	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 08)	WEST 2005b	Jeffrey et al. 2009a	Locust Ridge, PA (Phase II; 10)	NA	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 09)	WEST 2005b	Enk et al. 2010	Maple Ridge, NY (07-08)	NA	Jain et al. 2009d
Biglow Canyon, OR (Phase II; 09-10)	WEST 2005b	Enk et al. 2011a	Marengo I, WA (09-10)	NA	URS Corporation 2010b
Biglow Canyon, OR (Phase II; 10-11)	WEST 2005b	Enk et al. 2012b	Marengo II, WA (09-10)	NA	URS Corporation 2010c
Biglow Canyon, OR (Phase III; 10-11)	WEST 2005b	Enk et al. 2012a	Mars Hill, ME (07)	NA	Stantec 2008
Blue Sky Green Field, WI (08; 09)	NA	Gruver et al. 2009	Mars Hill, ME (08)	NA	Stantec 2009a
Buffalo Gap I, TX (06)	NA	Tierney 2007	Moraine II, MN (09)	NA	Derby et al. 2010d
Buffalo Gap II, TX (07-08)	NA	Tierney 2009	Mount Storm, WV (09)	NA	Young et al. 2009a, 2010b
Buffalo Mountain, TN (00-03)	NA	Nicholson et al. 2005	Mount Storm, WV (10)	NA	Young et al. 2010a, 2011b
Buffalo Mountain, TN (05)	NA	Fiedler et al. 2007	Mount Storm, WV (11)	NA	Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase I; 96)	NA	Johnson et al. 2000a	Mountaineer, WV (03)	NA	Kerns and Kerlinger 2004
Buffalo Ridge, MN (Phase I; 97)	NA	Johnson et al. 2000a	Munnsville, NY (08)	NA	Stantec 2009b
Buffalo Ridge, MN (Phase I; 98)	NA	Johnson et al. 2000a	Nine Canyon, WA (02-03)	Erickson et al. 2001	Erickson et al. 2003b
Buffalo Ridge, MN (Phase I; 99)	NA	Johnson et al. 2000a	Noble Altona, NY (10)	NA	Jain et al. 2011b
Buffalo Ridge, MN (Phase II; 98)	NA	Johnson et al. 2000a	Noble Bliss, NY (08)	NA	Jain et al. 2009e
Buffalo Ridge, MN (Phase II; 99)	NA	Johnson et al. 2000a	Noble Bliss, NY (09)	NA	Jain et al. 2010a
Buffalo Ridge, MN (Phase III; 99)	NA	Johnson et al. 2000a	Noble Chateaugay, NY (10)	NA	Jain et al. 2011c
Buffalo Ridge I, SD (09-10)	NA	Derby et al. 2010b	Noble Clinton, NY (08)	NA	Jain et al. 2009c
Buffalo Ridge II, SD (11-12)	NA	Derby et al. 2012a	Noble Clinton, NY (09)	NA	Jain et al. 2010b
Casselman, PA (08)	NA	Arnett et al. 2009a	Noble Ellenburg, NY (08)	NA	Jain et al. 2009b
Casselman, PA (09)	NA	Arnett et al. 2010	Noble Ellenburg, NY (09)	NA	Jain et al. 2010c
Cedar Ridge, WI (09)	NA	BHE Environmental 2010	Noble Wethersfield, NY (10)	NA	Jain et al. 2011a
Cedar Ridge, WI (10)	NA	BHE Environmental 2011	NPPD Ainsworth, NE (06)	NA	Derby et al. 2007
Cohocton/Dutch Hill, NY (09)	NA	Stantec 2010	Pebble Springs, OR (09-10)	NA	Gritski and Kronner 2010b
Cohocton/Dutch Hills, NY (10)	NA	Stantec 2011	Pine Tree, CA (09-10)	NA	BioResource Consultants 2010
Combine Hills, OR (Phase I; 04-05)	Young et al. 2003c	Young et al. 2006	Pioneer Prairie I, IA (Phase II; 11-12)	NA	Chodachek et al. 2012
Combine Hills, OR (11)	Young et al. 2003c	Enz et al. 2012	PrairieWinds ND1 (Minot), ND (10)	NA	Derby et al. 2011c
Criterion, MD (11)	NA	Young et al. 2012a	PrairieWinds ND1 (Minot), ND (11)	NA	Derby et al. 2012c
Diablo Winds, CA (05-07)	WEST 2006, 2008	WEST 2006, 2008	PrairieWinds SD1 (Crow Lake), SD (11-12)	NA	Derby et al. 2012d
Dillon, CA (08-09)	NA	Chatfield et al. 2009	PrairieWinds SD1 (Crow Lake), SD (12-13)	NA	Derby et al. 2013a

Appendix H2 (*continued*). Wind energy facilities in North America with publicly-available and comparable use and fatality data for raptors, by geographic region.

Data from the following sources:

Facility	Use Estimate	Fatality Estimate	Facility	Use Estimate	Fatality Estimate
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Thompson et al. 2011	Red Hills, OK (12-13)	NA	Derby et al. 2013c
Dry Lake II, AZ (11-12)	NA	Thompson and Bay 2012	Ripley, Ont (08)	NA	Jacques Whitford 2009
Elkhorn, OR (08)	WEST 2005a	Jeffrey et al. 2009b	Rugby, ND (10-11)	NA	Derby et al. 2011b
Elkhorn, OR (10)	WEST 2005a	Enk et al. 2011b	Shiloh I, CA (06-09)	NA	Kerlinger et al. 2009
Elm Creek, MN (09-10)	NA	Derby et al. 2010c	Shiloh II, CA (09-10)	NA	Kerlinger et al. 2010b
Elm Creek II, MN (11-12)	NA	Derby et al. 2012b	Stateline, OR/WA (01-02)	Erickson et al. 2003a	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 99)	Johnson et al. 2000b	Young et al. 2003b	Stateline, OR/WA (03)	NA	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 00)	Johnson et al. 2000b	Young et al. 2003b	Stateline, OR/WA (06)	NA	Erickson et al. 2007
Foote Creek Rim, WY (Phase I; 01-02)	Johnson et al. 2000b	Young et al. 2003b	Stetson Mountain I, ME (09)	NA	Stantec 2009c
Fowler I, IN (09)	NA	Johnson et al. 2010a	Stetson Mountain I, ME (11)	NA	Normandeau Associates 2011
Goodnoe, WA (09-10)	NA	URS Corporation 2010a	Stetson Mountain II, ME (10)	NA	Normandeau Associates 2010
Grand Ridge I, IL (09-10)	Derby et al. 2009	Derby et al. 2010g	Summerview, Alb (05-06)	NA	Brown and Hamilton 2006b
Harvest Wind, WA (10-12)	NA	Downes and Gritski 2012a	Top of Iowa, IA (03)	NA	Jain 2005
Hay Canyon, OR (09-10)	NA	Gritski and Kronner 2010a	Top of Iowa, IA (04)	NA	Jain 2005
High Sheldon, NY (10)	NA	Tidhar et al. 2012a	Tuolumne (Windy Point I), WA (09-10)	Johnson et al. 2006	Enz and Bay 2010
High Sheldon, NY (11)	NA	Tidhar et al. 2012b	Vansycle, OR (99)	WCIA and WEST 1997	Erickson et al. 2000b
High Winds, CA (03-04)	Kerlinger et al. 2005	Kerlinger et al. 2006	Vantage, WA (10-11)	NA	Ventus 2012
High Winds, CA (04-05)	Kerlinger et al. 2005	Kerlinger et al. 2006	Wessington Springs, SD (09)	Derby et al. 2008	Derby et al. 2010f
Hopkins Ridge, WA (06)	Young et al. 2003a	Young et al. 2007a	Wessington Springs, SD (10)	Derby et al. 2008	Derby et al. 2011d
Hopkins Ridge, WA (08)	NA	Young et al. 2009c	White Creek, WA (07-11)	NA	Downes and Gritski 2012b
Kewaunee County, WI (99-01)	NA	Howe et al. 2002	Wild Horse, WA (07)	Erickson et al. 2003c	Erickson et al. 2008
Kittitas Valley, WA (11-12)	NA	Stantec 2012	Windy Flats, WA (10-11)	NA	Enz et al. 2011
Klondike, OR (02-03)	Johnson et al. 2002	Johnson et al. 2003b	Winnebago, IA (09-10)	NA	Derby et al. 2010e

Appendix H3. Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats, by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Ocotillo, CA	**NA**	**NA**	**0.90**	**112**	**315**
		California			
Shiloh I, CA (2006-2009)	NA	NA	3.92	100	150
Shiloh II, CA (2009-2010)	NA	NA	2.72	75	150
High Winds, CA (2003-2004)	NA	NA	2.51	90	162
Dillon, CA (2008-2009)	NA	NA	2.17	45	45
High Winds, CA (2004-2005)	NA	NA	1.52	90	162
Alta Wind I, CA (2011-2012)	4.42[C]	6/26/2009 - 10/31/2009	1.28	100	150
Diablo Winds, CA (2005-2007)	NA	NA	0.82	31	20.46
Alite, CA (2009-2010)	NA	NA	0.24	8	24
Alta Wind II-V, CA (2011-2012)	0.78	6/26/2009 - 10/31/2009	0.08	190	570
		Southwest			
Dry Lake I, AZ (2009-2010)	8.8	4/29/10-11/10/10	3.43	30	63
Dry Lake II, AZ (2011-2012)	11.5	5/11/11-10/26/11	1.66	31	65
Biglow Canyon, OR (Phase II; 2009-2010)	NA	NA	2.71	65	150
Nine Canyon, WA (2002-2003)	NA	NA	2.47	37	48.1
Stateline, OR/WA (2003)	NA	NA	2.29	454	299
Elkhorn, OR (2010)	NA	NA	2.14	61	101
White Creek, WA (2007-2011)	NA	NA	2.04	89	204.7
Biglow Canyon, OR (Phase I; 2008)	NA	NA	1.99	76	125.4
Leaning Juniper, OR (2006-2008)	NA	NA	1.98	67	100.5
Big Horn, WA (2006-2007)	NA	NA	1.9	133	199.5
Combine Hills, OR (Phase I; 2004-2005)	NA	NA	1.88	41	41
Linden Ranch, WA (2010-2011)	NA	NA	1.68	25	50
Pebble Springs, OR (2009-2010)	NA	NA	1.55	47	98.7
Hopkins Ridge, WA (2008)	NA	NA	1.39	87	156.6
Harvest Wind, WA (2010-2012)	NA	NA	1.27	43	98.9
Elkhorn, OR (2008)	NA	NA	1.26	61	101
Vansycle, OR (1999)	NA	NA	1.12	38	24.9
Klondike III (Phase I), OR (2007-2009)	NA	NA	1.11	125	223.6
Stateline, OR/WA (2001-2002)	NA	NA	1.09	454	299
Stateline, OR/WA (2006)	NA	NA	0.95	454	299
Tuolumne (Windy Point I), WA (2009-2010)	NA	NA	0.94	62	136.6
Klondike, OR (2002-2003)	NA	NA	0.77	16	24
Combine Hills, OR (2011)	NA	NA	0.73	104	104
Hopkins Ridge, WA (2006)	NA	NA	0.63	83	150
Biglow Canyon, OR (Phase I; 2009)	NA	NA	0.58	76	125.4
Biglow Canyon, OR (Phase II; 2010-2011)	NA	NA	0.57	65	150
Hay Canyon, OR (2009-2010)	NA	NA	0.53	48	100.8
Klondike II, OR (2005-2006)	NA	NA	0.41	50	75
Windy Flats, WA (2010-2011)	NA	NA	0.41	114	262.2
Vantage, WA (2010-2011)	NA	NA	0.4	60	90

Appendix H3. Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats, by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Wild Horse, WA (2007)	NA	NA	0.39	127	229
Goodnoe, WA (2009-2010)	NA	NA	0.34	47	94
Marengo II, WA (2009-2010)	NA	NA	0.27	39	70.2
Biglow Canyon, OR (Phase III; 2010-2011)	NA	NA	0.22	76	174.8
Marengo I, WA (2009-2010)	NA	NA	0.17	78	140.4
Klondike IIIa (Phase II), OR (2008-2010)	NA	NA	0.14	51	76.5
Kittitas Valley, WA (2011-2012)	NA	NA	0.12	48	100.8
Rocky Mountains					
Summerview, Alb (2006; 2007)	7.65[D]	07/15/06-07-09/30/06-07	11.42	39	70.2
Summerview, Alb (2005-2006)	NA	NA	10.27	39	70.2
Judith Gap, MT (2006-2007)	NA	NA	8.93	90	135
Foote Creek Rim, WY (Phase I; 1999)	NA	NA	3.97	69	41.4
Judith Gap, MT (2009)	NA	NA	3.2	90	135
Foote Creek Rim, WY (Phase I; 2001-2002)	2.2[D,E]	6/15/01-9/1/01	1.57	69	41.4
Foote Creek Rim, WY (Phase I; 2000)	2.2[D,E]	6/15/00-9/1/00	1.05	69	41.4
Northeast					
Mountaineer, WV (2003)	NA	NA	31.69	44	66
Mount Storm, WV (2009)	30.09	7/15/09-10/7/09	17.53	132	264
Noble Wethersfield, NY (2010)	NA	NA	16.3	84	126
Criterion, MD (2011)	NA	NA	15.61	28	70
Mount Storm, WV (2010)	36.67[F]	4/18/10-10/15/10	15.18	132	264
Locust Ridge, PA (Phase II; 2010)	NA	NA	14.38	51	102
Locust Ridge, PA (Phase II; 2009)	NA	NA	14.11	51	102
Casselman, PA (2008)	NA	NA	12.61	23	34.5
Maple Ridge, NY (2006)	NA	NA	11.21	120	198
Cohocton/Dutch Hills, NY (2010)	NA	NA	10.32	50	125
Wolfe Island, Ont (July-December 2010)	NA	NA	9.5	86	197.8
Cohocton/Dutch Hill, NY (2009)	NA	NA	8.62	50	125
Casselman, PA (2009)	NA	NA	8.6	23	34.5
Noble Bliss, NY (2008)	NA	NA	7.8	67	100
Criterion, MD (2012)	NA	NA	7.62	28	70
Mount Storm, WV (2011)	NA	NA	7.43	132	264
Mount Storm, WV (Fall 2008)	35.2	7/20/08-10/12/08	6.62	82	164
Maple Ridge, NY (2007)	NA	NA	6.49	195	321.75
Wolfe Island, Ont (July-December 2009)	NA	NA	6.42	86	197.8
Maple Ridge, NY (2007-2008)	NA	NA	4.96	195	321.75
Noble Clinton, NY (2009)	1.9[G]	8/1/09-09/31/09	4.5	67	100
Casselman Curtailment, PA (2008)	NA	NA	4.4	23	35.4
Noble Altona, NY (2010)	NA	NA	4.34	65	97.5
Noble Ellenburg, NY (2009)	16.1[G]	8/16/09-09/15/09	3.91	54	80
Noble Bliss, NY (2009)	NA	NA	3.85	67	100
Lempster, NH (2010)	NA	NA	3.57	12	24

Appendix H3. Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats, by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Noble Ellenburg, NY (2008)	NA	NA	3.46	54	80
Noble Clinton, NY (2008)	2.1[G]	8/8/08-09/31/08	3.14	67	100
Lempster, NH (2009)	NA	NA	3.11	12	24
Mars Hill, ME (2007)	NA	NA	2.91	28	42
Wolfe Island, Ont (July-December 2011)	NA	NA	2.49	86	197.8
Noble Chateaugay, NY (2010)	NA	NA	2.44	71	106.5
High Sheldon, NY (2010)	NA	NA	2.33	75	112.5
Beech Ridge, WV (2012)	NA	NA	2.03	67	100.5
Munnsville, NY (2008)	NA	NA	1.93	23	34.5
High Sheldon, NY (2011)	NA	NA	1.78	75	112.5
Stetson Mountain II, ME (2010)	NA	NA	1.65	17	25.5
Stetson Mountain I, ME (2009)	28.5; 0.3[H]	7/10/09-10/15/09	1.4	38	57
Mars Hill, ME (2008)	NA	NA	0.45	28	42
Stetson Mountain I, ME (2011)	NA	NA	0.28	38	57
Kibby, ME (2011)	NA	NA	0.12	44	132
Midwest					
Cedar Ridge, WI (2009)	9.97[D,E,G]	7/16/07-9/30/07	30.61	41	67.6
Blue Sky Green Field, WI (2008; 2009)	7.7[I]	7/24/07-10/29/07	24.57	88	145
Cedar Ridge, WI (2010)	9.97[D,E,G]	7/16/07-9/30/07	24.12	41	68
Fowler I, II, III, IN (2011)	NA	NA	20.19	355	600
Fowler I, II, III, IN (2010)	NA	NA	18.96	355	600
Forward Energy Center, WI (2008-2010)	6.97	8/5/08-11/08/08	18.17	86	129
Harrow, Ont (2010)	NA	NA	11.13	24 (four 6-turb facilities)	39.6
Top of Iowa, IA (2004)	35.7	5/26/04-9/24/04	10.27	89	80
Pioneer Prairie I, IA (Phase II; 2011-2012)	NA	NA	10.06	62	102.3
Fowler I, IN (2009)	NA	NA	8.09	162	301
Crystal Lake II, IA (2009)	NA	NA	7.42	80	200
Top of Iowa, IA (2003)	NA	NA	7.16	89	80
Kewaunee County, WI (1999-2001)	NA	NA	6.45	31	20.46
Ripley, Ont (2008)	NA	NA	4.67	38	76
Winnebago, IA (2009-2010)	NA	NA	4.54	10	20
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	2.2[D]	6/15/01-9/15/01	4.35	143	107.25
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	2.2[D]	6/15/01-9/15/01	3.71	138	103.5
Crescent Ridge, IL (2005-2006)	NA	NA	3.27	33	49.5
Fowler I, II, III, IN (2012)	NA	NA	2.96	355	600
Elm Creek II, MN (2011-2012)	NA	NA	2.81	62	148.8
Buffalo Ridge II, SD (2011-2012)	NA	NA	2.81	105	210
Buffalo Ridge, MN (Phase III; 1999)	NA	NA	2.72	138	103.5
Buffalo Ridge, MN (Phase II; 1999)	NA	NA	2.59	143	107.25
Moraine II, MN (2009)	NA	NA	2.42	33	49.5
Buffalo Ridge, MN (Phase II; 1998)	NA	NA	2.16	143	107.25

Appendix H3. Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats, by geographic region.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
PrairieWinds ND1 (Minot), ND (2010)	NA	NA	2.13	80	115.5
Grand Ridge I, IL (2009-2010)	NA	NA	2.1	66	99
Barton I & II, IA (2010-2011)	NA	NA	1.85	80	160
Fowler III, IN (2009)	NA	NA	1.84	60	99
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	1.9[D]	6/15/02-9/15/02	1.81	138	103.5
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	1.9[D]	6/15/02-9/15/02	1.64	143	107.25
Rugby, ND (2010-2011)	NA	NA	1.6	71	149
Elm Creek, MN (2009-2010)	NA	NA	1.49	67	100
Wessington Springs, SD (2009)	NA	NA	1.48	34	51
PrairieWinds ND1 (Minot), ND (2011)	NA	NA	1.39	80	115.5
PrairieWinds SD1, SD (2011-2012)	NA	NA	1.23	108	162
NPPD Ainsworth, NE (2006)	NA	NA	1.16	36	20.5
PrairieWinds SD1, SD (2012-2013)	NA	NA	1.05	108	162
Buffalo Ridge, MN (Phase I; 1999)	NA	NA	0.74	73	25
Wessington Springs, SD (2010)	NA	NA	0.41	34	51
Buffalo Ridge I, SD (2009-2010)	NA	NA	0.16	24	50.4
Southeast					
Buffalo Mountain, TN (2005)	NA	NA	39.7	18	28.98
Buffalo Mountain, TN (2000-2003)	23.7[E]	NA	31.54	3	1.98
Southern Plains					
Barton Chapel, TX (2009-2010)	NA	NA	3.06	60	120
Big Smile, OK (2012-2013)	NA	NA	2.9	66	132
Buffalo Gap II, TX (2007-2008)	NA	NA	0.14	155	233
Red Hills, OK (2012-2013)	NA	NA	0.11	82	123
Buffalo Gap I, TX (2006)	NA	NA	0.1	67	134

A = Bat passes per detector-night
B = Number of fatalities per megawatt per year
C = Average of ground-based detectors at CPC Proper (Phase I) for late summer/fall period only
D = Activity rate was averaged across phases and/or years
E = Activity rate calculated by WEST from data presented in referenced report
F = Activity rate based on data collected from ground-based units excluding reference stations during the spring, summer and fall seasons
G = Activity rate based on data collected at various heights all other activity rates are from ground-based units only
H = The overall activity rate of 28.5 is from reference stations located along forest edges which may be attractive to bats; the activity rate of 0.3 is from one unit placed on a nacelle
I = Activity rate based on pre-construction monitoring; data for all other activity and fatality rates were collected concurrently

Appendix H3 (*continued*). Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats.

Project, Location	Activity Reference	Fatality Reference	Project, Location	Activity Reference	Fatality Reference
Ocotillo, CA	**NA**	**This study**			
Alite, CA (09-10)	NA	Chatfield et al. 2010b	Kewaunee County, WI (99-01)	NA	Howe et al. 2002
Alta Wind I, CA (11-12)	Solick et al. 2010b	Chatfield et al. 2012	Kibby, ME (11)	NA	Stantec 2012
Alta Wind II-V, CA (11-12)	Solick et al. 2010b	Chatfield et al. 2012	Kittitas Valley, WA (11-12)	NA	Stantec Consulting Services 2012
Barton I & II, IA (10-11)	NA	Derby et al. 2011a	Klondike, OR (02-03)	NA	Johnson et al. 2003a
Barton Chapel, TX (09-10)	NA	WEST 2011	Klondike II, OR (05-06)	NA	NWC and WEST 2007
Beech Ridge, WV (12)	NA	Tidhar et al. 2013	Klondike III (Phase I), OR (07-09)	NA	Gritski et al. 2010
Big Horn, WA (06-07)	NA	Kronner et al. 2008	Klondike IIIa (Phase II), OR (08-10)	NA	Gritski et al. 2011
Big Smile, OK (12-13)	NA	Derby et al. 2013b	Leaning Juniper, OR (06-08)	NA	Gritski et al. 2008
Biglow Canyon, OR (Phase I; 08)	NA	Jeffrey et al. 2009a	Lempster, NH (09)	NA	Tidhar et al. 2010
Biglow Canyon, OR (Phase I; 09)	NA	Enk et al. 2010	Lempster, NH (10)	NA	Tidhar et al. 2011
Biglow Canyon, OR (Phase II; 09-10)	NA	Enk et al. 2011a	Linden Ranch, WA (10-11)	NA	Enz and Bay 2011
Biglow Canyon, OR (Phase II; 10-11)	NA	Enk et al. 2012b	Locust Ridge, PA (Phase II; 09)	NA	Arnett et al. 2011
Biglow Canyon, OR (Phase III; 10-11)	NA	Enk et al. 2012a	Locust Ridge, PA (Phase II; 10)	NA	Arnett et al. 2011
Blue Sky Green Field, WI (08; 09)	Gruver 2008	Gruver et al. 2009	Maple Ridge, NY (06)	NA	Jain et al. 2007
Buffalo Gap I, TX (06)	NA	Tierney 2007	Maple Ridge, NY (07)	NA	Jain et al. 2009a
Buffalo Gap II, TX (07-08)	NA	Tierney 2009	Maple Ridge, NY (07-08)	NA	Jain et al. 2009d
Buffalo Mountain, TN (00-03)	Fiedler 2004	Nicholson et al. 2005	Marengo I, WA (09-10)	NA	URS Corporation 2010b
Buffalo Mountain, TN (05)	NA	Fiedler et al. 2007	Marengo II, WA (09-10)	NA	URS Corporation 2010c
Buffalo Ridge, MN (Phase I; 99)	NA	Johnson et al. 2000a	Mars Hill, ME (07)	NA	Stantec 2008
Buffalo Ridge, MN (Phase II; 98)	NA	Johnson et al. 2000a	Mars Hill, ME (08)	NA	Stantec 2009a
Buffalo Ridge, MN (Phase II; 99)	NA	Johnson et al. 2000a	Moraine II, MN (09)	NA	Derby et al. 2010d
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (Fall 08)	Young et al. 2009b	Young et al. 2009b
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (09)	Young et al. 2009a, 2010b	Young et al. 2009a, 2010b
Buffalo Ridge, MN (Phase III; 99)	NA	Johnson et al. 2000a	Mount Storm, WV (10)	Young et al. 2010a, 2011b	Young et al. 2010a, 2011b
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Mount Storm, WV (11)	NA	Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	Johnson et al. 2004	Mountaineer, WV (03)	NA	Kerns and Kerlinger 2004
Buffalo Ridge I, SD (09-10)	NA	Derby et al. 2010b	Munnsville, NY (08)	NA	Stantec 2009b
Buffalo Ridge II, SD (11-12)	NA	Derby et al. 2012a	Nine Canyon, WA (02-03)	NA	Erickson et al. 2003b
Casselman, PA (08)	NA	Arnett et al. 2009a	Noble Altona, NY (10)	NA	Jain et al. 2011b
Casselman, PA (09)	NA	Arnett et al. 2010	Noble Bliss, NY (08)	NA	Jain et al.2009e
Casselman Curtailment, PA (08)	NA	Arnett et al. 2009b	Noble Bliss, NY (09)	NA	Jain et al. 2010a
Cedar Ridge, WI (09)	BHE Environmental 2008	BHE Environmental 2010	Noble Chateaugay, NY (10)	NA	Jain et al. 2011c
Cedar Ridge, WI (10)	BHE Environmental 2008	BHE Environmental 2011	Noble Clinton, NY (08)	Reynolds 2010a	Jain et al. 2009c
Cohocton/Dutch Hill, NY (09)	NA	Stantec 2010	Noble Clinton, NY (09)	Reynolds 2010a	Jain et al. 2010b
Cohocton/Dutch Hills, NY (10)	NA	Stantec 2011	Noble Ellenburg, NY (08)	NA	Jain et al. 2009b
Combine Hills, OR (Phase I; 04-05)	NA	Young et al. 2006	Noble Ellenburg, NY (09)	Reynolds 2010b	Jain et al. 2010c
Combine Hills, OR (11)	NA	Enz et al. 2012	Noble Wethersfield, NY (10)	NA	Jain et al. 2011a
Crescent Ridge, IL (05-06)	NA	Kerlinger et al. 2007	NPPD Ainsworth, NE (06)	NA	Derby et al. 2007
Criterion, MD (11)	NA	Young et al. 2012a	Pebble Springs, OR (09-10)	NA	Gritski and Kronner 2010b
Criterion, MD (12)	NA	Young et al. 2013	Pioneer Prairie I, IA (Phase II; 11-12)	NA	Chodachek et al. 2012
Crystal Lake II, IA (09)	NA	Derby et al. 2010a	PrairieWinds ND1 (Minot), ND (10)	NA	Derby et al. 2011c
Diablo Winds, CA (05-07)	NA	WEST 2006, 2008	PrairieWinds ND1 (Minot), ND (11)	NA	Derby et al. 2012c
Dillon, CA (08-09)	NA	Chatfield et al. 2009	PrairieWinds SD1 (Crow	NA	Derby et al. 2012d

Appendix H3 (*continued*). Wind energy facilities in North America with publicly-available comparable activity and fatality data for bats.

Project, Location	Activity Reference	Fatality Reference	Project, Location	Activity Reference	Fatality Reference
			Lake), SD (11-12)		
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Thompson et al. 2011	PrairieWinds SD1 (Crow Lake), SD (12-13)	NA	Derby et al. 2013a
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Thompson and Bay 2012	Red Hills, OK (12-13)	NA	Derby et al. 2013c
Elkhorn, OR (08)	NA	Jeffrey et a. 2009b	Ripley, Ont (08)	NA	Jacques Whitford 2009
Elkhorn, OR (10)	NA	Enk et al. 2011b	Rugby, ND (10-11)	NA	Derby et al. 2011b
Elm Creek II, MN (11-12)	NA	Derby et al. 2010c	Shiloh I, CA (06-09)	NA	Kerlinger et al. 2009
Elm Creek, MN (09-10)	NA	Derby et al. 2012b	Shiloh II, CA (09-10)	NA	Kerlinger et al. 2010b
Foote Creek Rim, WY (Phase I; 99)	NA	Young et al. 2003b	Stateline, OR/WA (01-02)	NA	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 00)	Gruver 2002	Young et al. 2003b, 2003d	Stateline, OR/WA (03)	NA	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 01-02)	Gruver 2002	Young et al. 2003b, 2003d	Stateline, OR/WA (06)	NA	Erickson et al. 2007
Forward Energy Center, WI (08-10)	Watt and Drake 2011	Grodsky and Drake 2011	Stetson Mountain I, ME (09)	Stantec 2009c	Stantec 2009c
Fowler I, IN (09)	NA	Johnson et al. 2010a	Stetson Mountain I, ME (11)	NA	Normandeau Associates 2011
Fowler III, IN (09)	NA	Johnson et al. 2010b	Stetson Mountain II, ME (10)	NA	Normandeau Associates 2010
Fowler I, II, III, IN (10)	NA	Good et al. 2011	Summerview, Alb (05-06)	NA	Brown and Hamilton 2006b
Fowler I, II, III, IN (11)	NA	Good et al. 2012	Summerview, Alb (06; 07)	Baerwald 2008	Baerwald 2008
Fowler I, II, III, IN (12)	NA	Good et al. 2013	Top of Iowa, IA (03)	NA	Jain 2005
Goodnoe, WA (09-10)	NA	URS Corporation 2010a	Top of Iowa, IA (04)	Jain 2005	Jain 2005
Grand Ridge I, IL (09-10)	NA	Derby et al. 2010g	Tuolumne (Windy Point I), WA (09-10)	NA	Enz and Bay 2010
Harrow, Ont (10)	NA	NRSI 2011	Vansycle, OR (99)	NA	Erickson et al. 2000a
Harvest Wind, WA (10-12)	NA	Downes and Gritski 2012a	Vantage, WA (10-11)	NA	Ventus 2012
Hay Canyon, OR (09-10)	NA	Gritski and Kronner 2010a	Wessington Springs, SD (09)	NA	Derby et al. 2010f
High Sheldon, NY (10)	NA	Tidhar et al. 2012a	Wessington Springs, SD (10)	NA	Derby et al. 2011d
High Sheldon, NY (11)	NA	Tidhar et al. 2012b	White Creek, WA (07-11)	NA	Downes and Gritski 2012b
High Winds, CA (03-04)	NA	Kerlinger et al. 2006	Wild Horse, WA (07)	NA	Erickson et al. 2008
High Winds, CA (04-05)	NA	Kerlinger et al. 2006	Windy Flats, WA (10-11)	NA	Enz et al. 2011
Hopkins Ridge, WA (06)	NA	Young et al. 2007a	Winnebago, IA (09-10)	NA	Derby et al. 2010e
Hopkins Ridge, WA (08)	NA	Young et al. 2009c	Wolfe Island, Ont (July-December 09)	NA	Stantec Ltd. 2010b
Judith Gap, MT (06-07)	NA	TRC 2008	Wolfe Island, Ont (July-December 10)	NA	Stantec Ltd. 2011b
Judith Gap, MT (09)	NA	Poulton and Erickson 2010	Wolfe Island, Ont (July-December 11)	NA	Stantec Ltd. 2012

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Alite, CA (2009-2010)	0.55	0.12	0.24	Shrub/scrub & grassland	Chatfield et al. 2010b
Alta Wind I, CA (2011-2012)	7.07	0.27	1.28	Woodland, grassland, shrubland	Chatfield et al. 2012
Alta Wind II-V, CA (2011-2012)	1.66	0.05	0.08	Desert scrub	Chatfield et al. 2012
Barton I & II, IA (2010-2011)	5.5	0	1.85	Agriculture	Derby et al. 2011a
Barton Chapel, TX (2009-2010)	1.15	0.25	3.06	Agriculture/forest	WEST 2011
Beech Ridge, WV (2012)	1.19	0.01	2.03	Forest	Tidhar et al. 2013
Big Horn, WA (2006-2007)	2.54	0.11	1.9	Agriculture/grassland	Kronner et al. 2008
Big Smile, OK (2012-2013)	0.09	0	2.9	Grassland, agriculture	Derby et al. 2013b
Biglow Canyon, OR (Phase I; 2008)	1.76	0.03	1.99	Agriculture/grassland	Jeffrey et al. 2009a
Biglow Canyon, OR (Phase I; 2009)	2.47	0	0.58	Agriculture/grassland	Enk et al. 2010
Biglow Canyon, OR (Phase II; 2009-2010)	5.53	0.14	2.71	Agriculture	Enk et al. 2011a
Biglow Canyon, OR (Phase II; 2010-2011)	2.68	0.03	0.57	Grassland/shrub-steppe, agriculture	Enk et al. 2012b
Biglow Canyon, OR (Phase III; 2010-2011)	2.28	0.05	0.22	Grassland/shrub-steppe, agriculture	Enk et al. 2012a
Blue Sky Green Field, WI (2008; 2009)	7.17	0	24.57	Agriculture	Gruver et al. 2009
Buffalo Gap I, TX (2006)	1.32	0.1	0.1	Grassland	Tierney 2007
Buffalo Gap II, TX (2007-2008)	0.15	0	0.14	Forest	Tierney 2009
Buffalo Mountain, TN (2000-2003)	11.02	0	31.54	Forest	Nicholson et al. 2005
Buffalo Mountain, TN (2005)	1.1	0	39.7	Forest	Fiedler et al. 2007
Buffalo Ridge, MN (Phase I; 1996)	4.14	0	NA	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1997)	2.51	0	NA	Agriculture	Johnson et al. 2000a

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Buffalo Ridge, MN (Phase I; 1998)	3.14	0	NA	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1999)	1.43	0.47	0.74	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1998)	2.47	0	2.16	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1999)	3.57	0	2.59	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	NA	NA	4.35	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	NA	NA	1.64	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 1999)	5.93	0	2.72	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	NA	NA	3.71	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	NA	NA	1.81	Agriculture	Johnson et al. 2004
Buffalo Ridge I, SD (2009-2010)	5.06	0.2	0.16	Agriculture/grassland	Derby et al. 2010b
Buffalo Ridge II, SD (2011-2012)	1.99	0	2.81	Agriculture, grassland	Derby et al. 2012a
Casselman Curtailment, PA (2008)	NA	NA	4.4	Forest	Arnett et al. 2009b
Casselman, PA (2008)	1.51	0	12.61	Forest	Arnett et al. 2009a
Casselman, PA (2009)	2.88	0	8.6	Forest, pasture, grassland	Arnett et al. 2010
Cedar Ridge, WI (2009)	6.55	0.18	30.61	Agriculture	BHE Environmental 2010
Cedar Ridge, WI (2010)	3.72	0.13	24.12	Agriculture	BHE Environmental 2011
Cohocton/Dutch Hill, NY (2009)	1.39	0	8.62	Agriculture/forest	Stantec 2010
Cohocton/Dutch Hills, NY (2010)	1.32	0.08	10.32	Agriculture, forest	Stantec 2011
Combine Hills, OR (Phase I; 2004-2005)	2.56	0	1.88	Agriculture/grassland	Young et al. 2006
Combine Hills, OR (2011)	2.33	0.05	0.73	Grassland/shrub-steppe, agriculture	Young et al. 2006
Crescent Ridge, IL (2005-2006)	NA	NA	3.27	Agriculture	Kerlinger et al. 2007

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Criterion, MD (2011)	6.4	0.02	15.61	Forest, agriculture	Young et al. 2012a
Criterion, MD (2012)	2.14	NA	7.62	Forest, agriculture	Young et al. 2013
Crystal Lake II, IA (2009)	NA	NA	7.42	Agriculture	Derby et al. 2010a
Diablo Winds, CA (2005-2007)	4.29	0.4	0.82	NA	WEST 2006, 2008
Dillon, CA (2008-2009)	4.71	0	2.17	Desert	Chatfield et al. 2009
Dry Lake I, AZ (2009-2010)	2.02	0	3.43	Desert grassland/forested	Thompson et al. 2011
Dry Lake II, AZ (2011-2012)	1.57	0	1.66	Desert grassland/forested	Thompson and Bay 2012
Elkhorn, OR (2008)	0.64	0.06	1.26	Shrub/scrub & agriculture	Jeffrey et al. 2009b
Elkhorn, OR (2010)	1.95	0.08	2.14	Shrub/scrub & agriculture	Enk et al. 2011b
Elm Creek, MN (2009-2010)	1.55	0	1.49	Agriculture	Derby et al. 2010c
Elm Creek II, MN (2011-2012)	3.64	0	2.81	Agriculture, grassland	Derby et al. 2012b
Foote Creek Rim, WY (Phase I; 1999)	3.4	0.08	3.97	Grassland	Young et al. 2003b
Foote Creek Rim, WY (Phase I; 2000)	2.42	0.05	1.05	Grassland	Young et al. 2003b
Foote Creek Rim, WY (Phase I; 2001-2002)	1.93	0	1.57	Grassland	Young et al. 2003b
Forward Energy Center, WI (2008-2010)	NA	NA	18.17	Agriculture	Grodsky and Drake 2011
Fowler I, II, III, IN (2010)	NA	NA	18.96	Agriculture	Good et al. 2011
Fowler I, II, III, IN (2011)	NA	NA	20.19	Agriculture	Good et al. 2012
Fowler I, II, III, IN (2012)	NA	NA	2.96	Agriculture	Good et al. 2013
Fowler I, IN (2009)	2.83	0	8.09	Agriculture	Johnson et al. 2010a
Fowler III, IN (2009)	NA	NA	1.84	Agriculture	Johnson et al. 2010b

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Goodnoe, WA (2009-2010)	1.4	0.17	0.34	Grassland and shrub-steppe	URS Corporation 2010a
Grand Ridge I, IL (2009-2010)	0.48	0	2.1	Agriculture	Derby et al. 2010g
Harrow, Ont (2010)	NA	NA	11.13	Agriculture	Natural Resource Solutions Inc. (NRSI) 2011
Harvest Wind, WA (2010-2012)	2.94	0.23	1.27	Grassland/shrub-steppe	Downes and Gritski 2012a
Hay Canyon, OR (2009-2010)	2.21	0	0.53	Agriculture	Gritski and Kronner 2010a
High Sheldon, NY (2010)	1.76	0.06	2.33	Agriculture	Tidhar et al. 2012a
High Sheldon, NY (2011)	1.57	0	1.78	Agriculture	Tidhar et al. 2012b
High Winds, CA (2003-2004)	1.62	0.5	2.51	Agriculture/grassland	Kerlinger et al. 2006
High Winds, CA (2004-2005)	1.1	0.28	1.52	Agriculture/grassland	Kerlinger et al. 2006
Hopkins Ridge, WA (2006)	1.23	0.14	0.63	Agriculture/grassland	Young et al. 2007a
Hopkins Ridge, WA (2008)	2.99	0.07	1.39	Agriculture/grassland	Young et al. 2009c
Judith Gap, MT (2006-2007)	NA	NA	8.93	Agriculture/grassland	TRC 2008
Judith Gap, MT (2009)	NA	NA	3.2	Agriculture/grassland	Poulton and Erickson 2010
Kewaunee County, WI (1999-2001)	1.95	0	6.45	Agriculture	Howe et al. 2002
Kibby, ME (2011)	NA	NA	0.12	Forest; commercial forest	Stantec 2012
Kittitas Valley, WA (2011-2012)	1.06	0.09	0.12	Sagebrush-steppe, grassland	Stantec Consulting Services 2012
Klondike, OR (2002-2003)	0.95	0	0.77	Agriculture/grassland	Johnson et al. 2003a
Klondike II, OR (2005-2006)	3.14	0.06	0.41	Agriculture/grassland	NWC and WEST 2007
Klondike III (Phase I), OR (2007-2009)	3.02	0.15	1.11	Agriculture/grassland	Gritski et al. 2010
Klondike IIIa (Phase II), OR (2008-2010)	2.61	0.06	0.14	Grassland/shrub-steppe and agriculture	Gritski et al. 2011
Leaning Juniper, OR (2006-2008)	6.66	0.16	1.98	Agriculture	Gritski et al. 2008

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Lempster, NH (2009)	3.38	0	3.11	Grasslands/forest/rocky embankments	Tidhar et al. 2010
Lempster, NH (2010)	2.64	0	3.57	Grasslands/forest/rocky embankments	Tidhar et al. 2011
Linden Ranch, WA (2010-2011)	6.65	0.27	1.68	Grassland/shrub-steppe, agriculture	Enz and Bay 2011
Locust Ridge, PA (Phase II; 2009)	0.84	0	14.11	Grassland	Arnett et al. 2011
Locust Ridge, PA (Phase II; 2010)	0.76	0	14.38	Grassland	Arnett et al. 2011
Maple Ridge, NY (2006)	NA	NA	11.21	Agriculture/forested	Jain et al. 2007
Maple Ridge, NY (2007-2008)	2.07	0.03	4.96	Agriculture/forested	Jain et al. 2009a
Maple Ridge, NY (2007)	2.34	NA	6.49	Agriculture/forested	Jain et al. 2009d
Marengo I, WA (2009-2010)	0.27	0	0.17	Agriculture	URS Corporation 2010b
Marengo II, WA (2009-2010)	0.16	0.05	0.27	Agriculture	URS Corporation2010c
Mars Hill, ME (2007)	1.67	0	2.91	Forest	Stantec 2008
Mars Hill, ME (2008)	1.76	0	0.45	Forest	Stantec 2009a
Moraine II, MN (2009)	5.59	0.37	2.42	Agriculture/grassland	Derby et al. 2010d
Mount Storm, WV (Fall 2008)	NA	NA	6.62	Forest	Young et al. 2009b
Mount Storm, WV (2009)	3.85	0	17.53	Forest	Young et al. 2009a, 2010b
Mount Storm, WV (2010)	2.6	0.1	15.18	Forest	Young et al. 2010a, 2011b
Mount Storm, WV (2011)	4.24	0.03	7.43	Forest	Young et al. 2011a, 2012b
Mountaineer, WV (2003)	2.69	0.07	31.69	Forest	Kerns and Kerlinger 2004
Munnsville, NY (2008)	1.48	0.59	1.93	Agriculture/forest	Stantec 2009b
Nine Canyon, WA (2002-2003)	2.76	0.03	2.47	Agriculture/grassland	Erickson et al. 2003b
Noble Altona, NY (2010)	1.84	0	4.34	Forest	Jain et al. 2011b
Noble Bliss, NY (2008)	1.3	0.1	7.8	Agriculture/forest	Jain et al. 2009e
Noble Bliss, NY (2009)	2.28	0.12	3.85	Agriculture/forest	Jain et al. 2010a
Noble Chateaugay, NY (2010)	1.66	0.08	2.44	Agriculture	Jain et al. 2011c
Noble Clinton, NY (2008)	1.59	0.1	3.14	Agriculture/forest	Jain et al. 2009c
Noble Clinton, NY (2009)	1.11	0.16	4.5	Agriculture/forest	Jain et al. 2010b

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Noble Ellenburg, NY (2008)	0.83	0.11	3.46	Agriculture/forest	Jain et al. 2009b
Noble Ellenburg, NY (2009)	2.66	0.25	3.91	Agriculture/forest	Jain et al. 2010c
Noble Wethersfield, NY (2010)	1.7	0.13	16.3	Agriculture	Jain et al. 2011a
NPPD Ainsworth, NE (2006)	1.63	0.06	1.16	Agriculture/grassland	Derby et al. 2007
Pebble Springs, OR (2009-2010)	1.93	0.04	1.55	Grassland	Gritski and Kronner 2010b
Pine Tree, CA (2009-2010)	8.3	0.133	NA	Grassland	BioResource Consultants 2010
Pioneer Prairie I, IA (Phase II; 2011-2012)	0.27	0	10.06	Agriculture, grassland	Chodachek et al. 2012
PrairieWinds ND1 (Minot), ND (2010)	1.48	0.05	2.13	Agriculture	Derby et al. 2011c
PrairieWinds ND1 (Minot), ND (2011)	1.56	0.05	1.39	Agriculture, grassland	Derby et al. 2012c
PrairieWinds SD1, SD (2011-2012)	1.41	0	1.23	Grassland	Derby et al. 2012d
PrairieWinds SD1, SD (2012-2013)	2.01	0.03	1.05	Grassland	Derby et al. 2013a
Red Hills, OK (2012-2013)	0.08	0.04	0.11	Grassland	Derby et al. 2013c
Ripley, Ont (2008)	3.09	0.1	4.67	Agriculture	Jacques Whitford 2009
Rugby, ND (2010-2011)	3.82	0.06	1.6	Agriculture	Derby et al. 2011b
Shiloh I, CA (2006-2009)	6.96	0.42	3.92	Agriculture/grassland	Kerlinger et al. 2010a
Shiloh II, CA (2009-2010)	1.51	0.12	2.72	Agriculture	Kerlinger et al. 2010b
Stateline, OR/WA (2001-2002)	3.17	0.09	1.09	Agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2003)	2.68	0.09	2.29	Agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2006)	1.23	0.11	0.95	Agriculture/grassland	Erickson et al. 2007
Stetson Mountain I, ME (2009)	2.68	0	1.4	Forest	Stantec 2009c
Stetson Mountain I, ME (2011)	1.18	0	0.28	Forested	Normandeau Associates 2011
Stetson Mountain II, ME (2010)	1.42	0	1.65	Forested	Normandeau Associates 2010
Summerview, Alb (2005-2006)	1.06	0.11	10.27	Agriculture	Brown and Hamilton 2006b
Summerview, Alb (2006; 2007)	NA	NA	11.42	Agriculture/grassland	Baerwald 2008
Top of Iowa, IA (2003)	0.42	0	7.16	Agriculture	Jain 2005
Top of Iowa, IA (2004)	0.81	0.17	10.27	Agriculture	Jain 2005

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/MW/ year)	Raptor Fatalities (raptors/MW/ year)	Bat Fatalities (bats/MW/ year)	Predominant Habitat Type	Citation
Tuolumne (Windy Point I), WA (2009-2010)	3.2	0.29	0.94	Grassland/shrub-steppe, agriculture and forest	Enz and Bay 2010
Vansycle, OR (1999)	0.95	0	1.12	Agriculture/grassland	Erickson et al. 2000a
Vantage, WA (2010-2011)	1.27	0.29	0.4	Shrub-steppe, grassland	Ventus Environmental Solutions 2012
Wessington Springs, SD (2009)	8.25	0.06	1.48	Grassland	Derby et al. 2010f
Wessington Springs, SD (2010)	0.89	0.07	0.41	Grassland	Derby et al. 2011d
White Creek, WA (2007-2011)	4.05	0.47	2.04	Grassland/shrub-steppe, agriculture	Downes and Gritski 2012b
Wild Horse, WA (2007)	1.55	0.09	0.39	Grassland	Erickson et al. 2008
Windy Flats, WA (2010-2011)	8.45	0.04	0.41	Grassland/shrub-steppe, agriculture	Enz et al. 2011
Winnebago, IA (2009-2010)	3.88	0.27	4.54	Agriculture/grassland	Derby et al. 2010e
Wolfe Island, Ont (July-December 2009)	NA	NA	6.42	Grassland	Stantec Ltd. 2010b
Wolfe Island, Ont (July-December 2010)	NA	NA	9.5	Grassland	Stantec Ltd. 2011b
Wolfe Island, Ont (July-December 2011)	NA	NA	2.49	Grassland	Stantec Ltd. 2012

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Alite, CA (2009-2010)	8	24	80	8	200 m x 200 m	1 year	Weekly (spring, fall), bi-monthly (summer, winter)
Alta Wind I, CA (2011-2012)	100	150	80	25	120-m radius circle	12.5 months	Every two weeks
Alta Wind II-V, CA (2011-2012)	190	570	NA	41	120-m radius circle	14.5 months	Every two weeks
Barton Chapel, TX (2009-2010)	60	120	78	30	200 m x 200 m	1 year	10 turbines weekly, 20 monthly
Barton I & II, IA (2010-2011)	80	160	100	35 (9 turbines were dropped in June 2010 due to landowner issues) 26 turbines were searched for the remainder of the study	200 m x 200 m	1 year	Weekly (spring, fall; migratory turbines), monthly (summer, winter; non-migratory turbines)
Beech Ridge, WV (2012)	67	100.5	80	67	40 m radius	7 months	Every two days
Big Horn, WA (2006-2007)	133	199.5	80	133	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Big Smile, OK (2012-2013)	66	132	NA	17 (plus one met tower)	100 x 100	1 year	Weekly (spring, summer, fall), monthly (winter)
Biglow Canyon, OR (Phase I; 2008)	76	125.4	80	50	110 m x 110 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase I; 2009)	76	125.4	80	50	110 m x 110 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase II; 2009-2010)	65	150	80	50	250 m x 250 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase II; 2010-2011)	65	150	NA	50	252 m x 252 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Biglow Canyon, OR (Phase III; 2010-2011)	76	174.8	NA	50	252 m x 252 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Blue Sky Green Field, WI (2008; 2009)	88	145	80	30	160 m x 160 m	Fall, spring	Daily(10 turbines), weekly (20 turbines)
Buena Vista, CA (2008-2009)	38	38	45-55	38	75-m radius	1 year	Monthly to bi-monthly starting in September 2008
Buffalo Gap I, TX (2006)	67	134	NA	21	215 m x 215 m	10 months	Every 3 weeks
Buffalo Gap II, TX (2007-2008)	155	233	80	36	215 m x 215 m	14 months	Every 21 days
Buffalo Mountain, TN (2000-2003)	3	1.98	65	3	50-m radius	3 years	Bi-weekly, weekly, bi-monthly
Buffalo Mountain, TN (2005)	18	28.98	V47 = 65; V80 = 78	18	50-m radius	1 year	Bi-weekly, weekly, bi-monthly, and 2 to 5 day intervals
Buffalo Ridge, MN (1994-1995)	73	25	37	1994:10 plots (3 turbines/plot), 20 addition plots in Sept & Oct 1994, 1995: 30 turbines search every other week (Jan-Mar), 60 searched weekly (Apr, July, Aug) 73 searched weekly (May-June and Sept-Oct), 30 searched weekly (Nov-Dec)	100 x 100m	20 months	Varies. See number turbines searched or page 44 of report
Buffalo Ridge, MN (Phase I; 1996)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1997)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Buffalo Ridge, MN (Phase I; 1998)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1999)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1998)	143	107.25	50	40	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1999)	143	107.25	50	40	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	143	107.25	50	83	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	143	107.25	50	103	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase III; 1999)	138	103.5	50	30	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	138	103.5	50	83	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	138	103.5	50	103	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge I, SD (2009-2010)	24	50.4	79	24	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Buffalo Ridge II, SD (2011-2012)	105	210	78	65 (60 road and pad, 5 turbine plots)	100 x 100m	1 year	Weekly (spring, summer, fall), monthly (winter)
Casselman, PA (2008)	23	34.5	80	10	126 m x 120 m	7 months	Daily
Casselman, PA (2009)	23	34.5	80	10	126 m x 120 m	7.5 months	Daily searches
Casselman Curtailment, PA (2008)	23	35.4	80	12 experimental; 10 control	126 m x 120 m	2.5 months	Daily
Castle River, Alb (2001-2002)	60	39.6	50	60	50-m radius	2 years	Weekly, bi-weekly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Castle River, Alb (2001-2002)	60	39.6	50	60	50-m radius	2 years	Weekly, bi-weekly
Cedar Ridge, WI (2009)	41	67.6	80	20	160 m x 160 m	Spring, summer, fall	Daily, every 4 days; late fall searched every 3 days
Cedar Ridge, WI (2010)	41	68	80	20	160 m x 160 m	1 year	Five turbines were surveyed daily, 15 turbines surveyed every 4 days in rotating groups each day. All 20 surveyed every three days during late fall
Cohocton/Dutch Hill, NY (2009)	50	125	80	17	130 m x 130 m	Spring, summer, fall	Daily (5 turbines), weekly (12 turbines)
Cohocton/Dutch Hills, NY (2010)	50	125	80	17	120 m x 120 m	Spring, summer, fall	Daily, weekly
Combine Hills, OR (Phase I; 2004-2005)	41	41	53	41	90-m radius	1 year	Monthly
Combine Hills, OR (2011)	104	104	53	52 (plus 1 MET tower)	180 m x 180 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Condon, OR	84	NA	NA	NA	NA	NA	NA
Crescent Ridge, IL (2005-2006)	33	49.5	80	33	70-m radius	1 year	Weekly (fall, spring)
Criterion, MD (2011)	28	70	80	28	40-50m radius	7.3 months	Daily
Criterion, MD (2012)	28	70	80	14	40-50m radius	7.5 months	Weekly
Crystal Lake II, IA (2009)	80	200	80	16 turbines through week 6, and then 15 for duration of study	100 m x 100 m	Spring, summer, fall	3 times per week for 26 weeks

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Diablo Winds, CA (2005-2007)	31	20.46	50 and 55	31	75 m x 75 m	2 years	Monthly
Dillon, CA (2008-2009)	45	45	69	15	200 m x 200 m	1 year	Weekly, bi-monthly in winter
Dry Lake I, AZ (2009-2010)	30	63	78	15	160 m x 160 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Dry Lake II, AZ (2011-2012)	31	65	78	31: 5 (full plot), 26 (road & pad)	160 m x 160 m	1 year	Twice weekly (spring, summer, fall), weekly (winter)
Elkhorn, OR (2008)	61	101	80	61	220 m x 220 m	1 year	Monthly
Elkhorn, OR (2010)	61	101	80	31	220 m x 220 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Elm Creek, MN (2009-2010)	67	100	80	29	200 m x 200 m	1 year	Weekly, monthly
Elm Creek II, MN (2011-2012)	62	148.8	80	30	200 x 200m (2 random migration search areas 100 x 100m)	1 year	20 searched every 28 days, 10 turbines every 7 days during migration)
Erie Shores, Ont (2006)	66	99	80	66	40-m radius	2 years	Weekly, bi-monthly, 2-3 times weekly (migration)
Foote Creek Rim, WY (Phase I; 1999)	69	41.4	40	69	126 m x 126 m	1 year	Monthly
Foote Creek Rim, WY (Phase I; 2000)	69	41.4	40	69	126 m x 126 m	1 year	Monthly
Foote Creek Rim, WY (Phase I; 2001-2002)	69	41.4	40	69	126 m x 126 m	1 year	Monthly
Forward Energy Center, WI (2008-2010)	86	129	80	29	160 m x 160 m	2 years	11 turbines daily, 9 every 3 days, 9 every 5 days

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Fowler I, IN (2009)	162	301	78 (Vestas), 80 (Clipper)	25	160 m x 160 m	Spring, summer, fall	Weekly, bi-weekly
Fowler I, II, III, IN (2010)	355	600	Vestas = 80, Clipper = 80, GE = 80	36 turbines, 100 road and pads	80 m x 80 m for turbines ; 40-m radius for roads and pads	Spring, fall	Daily, weekly
Fowler I, II, III, IN (2011)	355	600	Vestas = 80, Clipper = 80, GE = 80	177 road and pads (spring), 9 turbines & 168 roads and pads (fall)	Turbines (80 m circular plot), roads and pads (out to 80 m)	Spring, fall	Daily, weekly
Fowler I, II, III, IN (2012)	355	600	Vestas = 80, Clipper = 80, GE = 80	118 roads and pads	Roads and pads (out to 80 m)	2.5 months	Weekly
Fowler III, IN (2009)	60	99	78	12	160 m x 160 m	10 weeks	Weekly, bi-weekly
Goodnoe, WA (2009-2010)	47	94	80	24	180 m x 180 m	1 year	14 days during migration periods, 28 days during non-migration periods
Grand Ridge I, IL (2009-2010)	66	99	80	30	160 m x 160 m	1 year	Weekly, monthly
Harrow, Ont (2010)	24 (four 6-turb facilities)	39.6	NA	12 in July, 24 Aug-Oct	50-m radius from turbine base	4 months	Twice-weekly
Harvest Wind, WA (2010-2012)	43	98.9	80	32	180 m x 180 m & 240 m x 240 m	2 years	Twice a week, weekly and monthly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Hay Canyon, OR (2009-2010)	48	100.8	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
High Sheldon, NY (2010)	75	112.5	80	25	115 m x 115 m	7 months	Daily (8 turbines), weekly (17 turbines)
High Sheldon, NY (2011)	75	112.5	80	25	115 m x 115 m	7 months	Daily (8 turbines), weekly (17 turbines)
High Winds, CA (2003-2004)	90	162	60	90	75-m radius	1 year	Bi-monthly
High Winds, CA (2004-2005)	90	162	60	90	75-m radius	1 year	Bi-monthly
Hopkins Ridge, WA (2006)	83	150	67	41	180 m x 180 m	1 year	Monthly, weekly (subset of 22 turbines spring and fall migration)
Hopkins Ridge, WA (2008)	87	156.6	67	41-43	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Jersey Atlantic, NJ (2008)	5	7.5	80	5	130 m x 120 m	9 months	Weekly
Judith Gap, MT (2006-2007)	90	135	80	20	190 m x 190 m	7 months	Monthly
Judith Gap, MT (2009)	90	135	80	30	100 m x 100 m	5 months	Bi-monthly
Kewaunee County, WI (1999-2001)	31	20.46	65	31	60 m x 60 m	2 years	Bi-weekly (spring, summer), daily (spring, fall migration), weekly (fall, winter)
Kibby, ME (2011)	44	132	124	22 turbines	75-m diameter circular plots	22 weeks	Avg 5-day
Kittitas Valley, WA (2011-2012)	48	100.8	80	48	100 m x 102 m	1 year	Bi weekly from Aug 15 - Oct 31 and March 16 - May 15; every 4 weeks from Nov 1 - March 15 and May 16 - Aug 14
Klondike, OR (2002-2003)	16	24	80	16	140 m x 140 m	1 year	Monthly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Klondike II, OR (2005-2006)	50	75	80	25	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (summer, winter)
Klondike III (Phase I), OR (2007-2009)	125	223.6	GE = 80; Siemens= 80, Mitsubishi = 80	46	240 m x 240 m (1.5MW) 252 m x 252 m (2.3MW)	2 year	Bi-monthly (spring, fall migration), monthly (summer, winter)
Klondike IIIa (Phase II), OR (2008-2010)	51	76.5	GE = 80	34	240 m x 240 m	2 years	Bi-monthly (spring, fall), monthly (summer, winter)
Leaning Juniper, OR (2006-2008)	67	100.5	80	17	240 m x 240 m	2 years	Bi-monthly (spring, fall), monthly (winter, summer)
Lempster, NH (2009)	12	24	78	4	120 m x 130 m	6 months	Daily
Lempster, NH (2010)	12	24	78	12	120 m x 130 m	6 months	Weekly
Linden Ranch, WA (2010-2011)	25	50	80	25	110 m x 110 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Locust Ridge, PA (Phase II; 2009)	51	102	80	15	120m x 126m	6.5 months	Daily
Locust Ridge, PA (Phase II; 2010)	51	102	80	15	120m x 126m	6.5 months	Daily
Madison, NY (2001-2002)	7	11.55	67	7	60-m radius	1 year	Weekly (spring, fall), monthly (summer)
Maple Ridge, NY (2006)	120	198	80	50	130 m x 120 m	5 months	Daily (10 turbines), every 3 days (10 turbines), weekly (30 turbines)
Maple Ridge, NY (2007)	195	321.75	80	64	130 m x 120 m	7 months	Weekly
Maple Ridge, NY (2007-2008)	195	321.75	80	64	130 m x 120 m	7 months	Weekly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Marengo I, WA (2009-2010)	78	140.4	67	39	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Marengo II, WA (2009-2010)	39	70.2	67	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Mars Hill, ME (2007)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	Spring, summer, fall	Daily (2 random turbines), weekly (all turbines): extended plot searched once per season
Mars Hill, ME (2008)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	Spring, summer, fall	Weekly: extended plot searched once per season
McBride, Alb (2004)	114	75	50	114	4 parallel transects 120-m wide	1 year	Weekly, bi-weekly
Melancthon, Ont (Phase I; 2007)	45	NA	NA	45	35m radius	5 months	Weekly, twice weekly
Meyersdale, PA (2004)	20	30	80	20	130 m x 120 m	6 weeks	Daily (half turbines), weekly (half turbines)
Moraine II, MN (2009)	33	49.5	82.5	30	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Mount Storm, WV (2009)	132	264	78	44	Varied	4.5 months	Weekly (28 turbines), daily (16 turbines)
Mount Storm, WV (2010)	132	264	78	24	20 to 60 m from turbine	6 months	Daily
Mount Storm, WV (2011)	132	264	78	24	Varied	6 months	Daily
Mount Storm, WV (Fall 2008)	82	164	78	27	Varied	3 months	Weekly (18 turbines), daily (9 turbines)
Mountaineer, WV (2003)	44	66	80	44	60-m radius	7 months	Weekly, monthly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Mountaineer, WV (2004)	44	66	80	44	130 m x 120 m	6 weeks	Daily, weekly
Munnsville, NY (2008)	23	34.5	69.5	12	120 m x 120 m	Spring, summer, fall	Weekly
Nine Canyon, WA (2002-2003)	37	48.1	60	37	90-m radius	1 year	Bi-monthly (spring, summer, fall), monthly (winter)
Noble Altona, NY (2010)	65	97.5	80	22	120 m x 120 m	Spring, summer, fall	Daily, weekly
Noble Bliss, NY (2008)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Bliss, NY (2009)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Weekly, 8 turbines searched daily from July 1 to August 15
Noble Chateaugay, NY (2010)	71	106.5	80	24	120 m x 120 m	Spring, summer, fall	Weekly
Noble Clinton, NY (2008)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Clinton, NY (2009)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), weekly (15 turbines), all turbines weekly from July 1 to August 15
Noble Ellenburg, NY (2008)	54	80	80	18	120 m x 120 m	Spring, summer, fall	Daily (6 turbines), 3-day (6 turbines), weekly (6 turbines)
Noble Ellenburg, NY (2009)	54	80	80	18	120 m x 120 m	Spring, summer, fall	Daily (6 turbines), weekly (12 turbines), all turbines weekly from July 1 to August 15

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Noble Wethersfield, NY (2010)	84	126	80	28	120 m x 120 m	Spring, summer, fall	Weekly
NPPD Ainsworth, NE (2006)	36	20.5	70	36	220 m x 220 m	Spring, summer, fall	Bi-monthly
Oklahoma Wind Energy Center, OK (2004; 2005)	68	102	70	68	20m radius	3 months (2 years)	Bi-monthly
Pebble Springs, OR (2009-2010)	47	98.7	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Pine Tree, CA (2009-2010)	90	135	65	40	NA	1 year	Bi-weekly
Pioneer Prairie I, IA (Phase II; 2011-2012)	62	102.3	80	62 (57 road/pad) 5 full search plots	80 x 80m	1 year	Weekly (spring and fall), every two weeks (summer), monthly (winter)
PrairieWinds SD1, SD (2012-2013)	108	162	80	50	200m x 200m	1 year	Bi-weekly
PrairieWinds ND1 (Minot), ND (2010)	80	115.5	89	35	Minimum of 100 m x 100 m	3 seasons	Bi-monthly
PrairieWinds ND1 (Minot), ND (2011)	80	115.5	80	35	Minimum 100 x 100m	3 season	Twice monthly
PrairieWinds SD1, SD (2011-2012)	108	162	80	50	200 x 200m	1 year	Twice monthly (spring, summer, fall), monthly (winter)
Prince Wind Farm, Ont (2006)	126	189	80	38	63-m radius	4 months	Daily, weekly
Prince Wind Farm, Ont (2007)	126	189	80	38 turbines from January 1st - July 8th, 126 turbines from July 9th-October 31st	63- to 45-m radius	10 months	Daily, weekly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Prince Wind Farm, Ont (2008)	126	189	80	126	45m radius	6.5 months	Daily, 3x/week, 2x/week
Red Canyon, TX (2006-2007)	56	84	70	28	200 m x 200 m in fall and winter; 160 m x 160 m in spring and summer	1 year	Every 14 days in fall and winter; 7 days in spring, 3 days in summer
Red Hills, OK (2012-2013)	82	123	NA	20 (plus one met tower)	100 x 100	1 year	Weekly (spring, summer, fall), monthly (winter)
Ripley, Ont (2008)	38	76	64	38	80 m x 80 m	Spring, fall	Twice weekly for odd turbines; weekly for even turbines.
Ripley, Ont (2008-2009)	38	76	64	38	80 m x 80 m	6 weeks	Twice weekly for odd turbines; weekly for even turbines.
Rugby, ND (2010-2011)	71	149	78	32	200 m x 200 m	1 year	Weekly (spring, fall; migratory turbines), monthly (non-migratory turbines)
San Gorgonio, CA (1997-1998; 1999-2000)	3000	NA	24.4-42.7	NA	50-m radius	2 years	Quarterly
Searsburg, VT (1997)	11	7	65	11	20- to 55-m radius	Spring, fall	Weekly (fall migration)
Shiloh I, CA (2006-2009)	100	150	65	100	105-m radius	3 years	Weekly
Shiloh II, CA (2009-2010)	75	150	33 turbs = 115; 42 turbs = 125	25	100m radius	1 year	Once/week
SMUD Solano, CA (2004-2005)	22	15	65	22	60-m radius	1 year	Bi-monthly
Stateline, OR/WA (2001-2002)	454	299	50	124	Minimum 126 m x 126 m	17 months	Bi-weekly, monthly
Stateline, OR/WA (2003)	454	299	50	153	Minimum 126 m x 126 m	1 year	Bi-weekly, monthly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Stateline, OR/WA (2006)	454	299	50	39	Variable turbine strings	1 year	Bi-weekly
Stetson Mountain I, ME (2009)	38	57	80	19	76-m diameter	27 weeks (spring, summer, fall)	Weekly
Stetson Mountain I, ME (2011)	38	57	80	19	Varied	6 months	Weekly
Stetson Mountain II, ME (2010)	17	25.5	80	17	Varied	6 months	Weekly (3 turbines twice a week)
Summerview, Alb (2005-2006)	39	70.2	67	39	140 m x 140 m	1 year	Weekly, bi-weekly (May to July, September)
Summerview, Alb (2006; 2007)	39	70.2	65	39	52-m radius; 2 spiral transects 7 m apart	Summer, fall (2 years)	Daily (10 turbines), weekly (29 turbines)
Tehachapi, CA (1996-1998)	3300	NA	14.7 to 57.6	201	50-m radius	20 months	Quarterly
Top of Iowa, IA (2003)	89	80	71.6	26	76 m x 76 m	Spring, summer, fall	Once every 2 to 3 days
Top of Iowa, IA (2004)	89	80	71.6	26	76 m x 76 m	Spring, summer, fall	Once every 2 to 3 days
Tuolumne (Windy Point I), WA (2009-2010)	62	136.6	80	21	180 m x 180 m	1 year	Monthly throughout the year, a sub-set of 10 turbines were also searched weekly during the spring, summer, and fall
Vansycle, OR (1999)	38	24.9	50	38	126 m x 126 m	1 year	Monthly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Vantage, WA (2010-2011)	60	90	80	30	240 m x 240 m	1 year	Monthly, a subset of 10 searched weekly during migration
Wessington Springs, SD (2009)	34	51	80	20	200 m x 200 m	Spring, summer, fall	Bi-monthly
Wessington Springs, SD (2010)	34	51	80	20	200 m x 200 m	8 months	Bi-weekly (spring, summer, fall)
White Creek, WA (2007-2011)	89	204.7	80	89	180 m x 180 m & 240 m x 240 m	4 years	Twice a week, weekly and monthly
Wild Horse, WA (2007)	127	229	67	64	110 m from two turbines in plot	1 year	Monthly, weekly (fall, spring migration at 16 turbines)
Windy Flats, WA (2010-2011)	114	262.2	NA	36 (plus 1 MET tower)	180 m x 180 m (120m at MET tower)	1 year	Monthly (spring, summer, fall, and winter), weekly (spring and fall migration)
Winnebago, IA (2009-2010)	10	20	78	10	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Wolfe Island, Ont (May-June 2009)	86	197.8	80	86	60-m radius	Spring	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2009)	86	197.8	80	86	60-m radius	Summer, fall	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2010)	86	197.8	80	86	60-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2010)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2011)	86	197.8	80	86	50m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2011)	86	197.8	80	86	50m radius	6 months	43 twice weekly, 43 weekly

Appendix H5 (*continued*). All post-construction monitoring studies, project characteristics, and select study methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Alite, CA (09-10)	Chatfield et al. 2010b	Klondike III (Phase I), OR (07-09)	Gritski et al. 2010
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Klondike IIIa (Phase II), OR (08-10)	Gritski et al. 2011
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Leaning Juniper, OR (06-08)	Gritski et al. 2008
Barton I & II, IA (10-11)	Derby et al. 2011a	Lempster, NH (09)	Tidhar et al. 2010
Barton Chapel, TX (09-10)	WEST 2011	Lempster, NH (10)	Tidhar et al. 2011
Beech Ridge, WV (12)	Tidhar et al. 2013	Linden Ranch, WA (10-11)	Enz and Bay 2011
Big Horn, WA (06-07)	Kronner et al. 2008	Locust Ridge, PA (Phase II; 09)	Arnett et al. 2011
Big Smile, OK (12-13)	Derby et al. 2013b	Locust Ridge, PA (Phase II; 10)	Arnett et al. 2011
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Madison, NY (01-02)	Kerlinger 2002b
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Maple Ridge, NY (06)	Jain et al. 2007
Biglow Canyon, OR (Phase II; 09-10)	Enk et al. 2011a	Maple Ridge, NY (07)	Jain et al. 2009a
Biglow Canyon, OR (Phase II; 10-11)	Enk et al. 2012b	Maple Ridge, NY (07-08)	Jain et al. 2009d
Biglow Canyon, OR (Phase III; 10-11)	Enk et al. 2012a	Marengo I, WA (09-10)	URS Corporation 2010b
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009	Marengo II, WA (09-10)	URS Corporation 2010c
Buena Vista, CA (08-09)	Insignia Environmental 2009	Mars Hill, ME (07)	Stantec 2008
Buffalo Gap I, TX (06)	Tierney 2007	Mars Hill, ME (08)	Stantec 2009a
Buffalo Gap II, TX (07-08)	Tierney 2009	McBride, Alb (04)	Brown and Hamilton 2004
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Melancthon, Ont (Phase I; 07)	Stantec Ltd. 2008
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Meyersdale, PA (04)	Arnett et al. 2005
Buffalo Ridge, MN (94-95)	Osborn et al. 1996, 2000	Moraine II, MN (09)	Derby et al. 2010d
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a	Mount Storm, WV (Fall 08)	Young et al. 2009b
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a	Mount Storm, WV (09)	Young et al. 2009a, 2010b
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a	Mount Storm, WV (10)	Young et al. 2010a, 2011b
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a	Mount Storm, WV (11)	Young et al. 2011a, 2012b
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a	Mountaineer, WV (03)	Kerns and Kerlinger 2004
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a	Mountaineer, WV (04)	Arnett et al. 2005
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Munnsville, NY (08)	Stantec 2009b
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Nine Canyon, WA (02-03)	Erickson et al. 2003b
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a	Noble Altona, NY (10)	Jain et al. 2011b
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Noble Bliss, NY (08)	Jain et al.2009e
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	Noble Bliss, NY (09)	Jain et al. 2010a
Buffalo Ridge I, SD (09-10)	Derby et al. 2010b	Noble Chateaugay, NY (10)	Jain et al. 2011c
Buffalo Ridge II, SD (11-12)	Derby et al. 2012a	Noble Clinton, NY (08)	Jain et al. 2009c
Casselman, PA (08)	Arnett et al. 2009a	Noble Clinton, NY (09)	Jain et al. 2010b
Casselman, PA (09)	Arnett et al. 2010	Noble Ellenburg, NY (08)	Jain et al. 2009b
Casselman Curtailment, PA (08)	Arnett et al. 2009b	Noble Ellenburg, NY (09)	Jain et al. 2010c
Castle River, Alb. (01)	Brown and Hamilton 2006a	Noble Wethersfield, NY (10)	Jain et al. 2011a
Castle River, Alb. (02)	Brown and Hamilton 2006a	NPPD Ainsworth, NE (06)	Derby et al. 2007
Cedar Ridge, WI (09)	BHE Environmental 2010	Oklahoma Wind Energy Center, OK (04; 05)	Piorkowski and O'Connell 2010
Cedar Ridge, WI (10)	BHE Environmental 2011	Pebble Springs, OR (09-10)	Gritski and Kronner 2010b
Cohocton/Dutch Hill, NY (09)	Stantec 2010	Pine Tree, CA (09-10)	BioResource Consultants 2010
Cohocton/Dutch Hills, NY (10)	Stantec 2011	Pioneer Prairie I, IA (Phase II; 11-12)	Chodachek et al. 2012
Combine Hills, OR (Phase I; 04-05)	Young et al. 2006	PrairieWinds ND1 (Minot), ND (10)	Derby et al. 2011c
Combine Hills, OR (11)	Enz et al. 2012	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012c
Condon, OR	Fishman Ecological Services 2003	PrairieWinds SD1 (Crow Lake), SD (11-12)	Derby et al. 2012d
Crescent Ridge, IL (05-06)	Kerlinger et al. 2007	PrairieWinds SD1 (Crow Lake), SD (12-13)	Derby et al. 2013a
Criterion, MD (11)	Young et al. 2012a	Prince Wind Farm, Ont (06)	Natural Resource Solutions 2009
Criterion, MD (12)	Young et al. 2013	Prince Wind Farm, Ont (07)	Natural Resource Solutions 2009
Crystal Lake II, IA (09)	Derby et al. 2010a	Prince Wind Farm, Ont (08)	Natural Resource Solutions 2009
Diablo Winds, CA (05-07)	WEST 2006, 2008	Red Canyon, TX (06-07)	Miller 2008
Dillon, CA (08-09)	Chatfield et al. 2009	Red Hills, OK (12-13)	Derby et al. 2013c
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Ripley, Ont (08)	Jacques Whitford 2009
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Ripley, Ont (08-09)	Golder Associates 2010
Elkhorn, OR (08)	Jeffrey et a. 2009b	Rugby, ND (10-11)	Derby et al. 2011b
Elkhorn, OR (10)	Enk et al. 2011b	San Gorgonio, CA (97-98; 99-00)	Anderson et al. 2005
Elm Creek, MN (09-10)	Derby et al. 2010c	Searsburg, VT (97)	Kerlinger 2002a
Elm Creek II, MN (11-12)	Derby et al. 2012b	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Erie Shores, Ont. (06)	James 2008	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003b	SMUD Solano, CA (04-05)	Erickson and Sharp 2005
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003b	Stateline, OR/WA (01-02)	Erickson et al. 2004
Foote Creek Rim, WY (Phase I; 01-02)	Young et al. 2003b	Stateline, OR/WA (03)	Erickson et al. 2004
Forward Energy Center, WI (08-10)	Grodsky and Drake 2011	Stateline, OR/WA (06)	Erickson et al. 2007

Appendix H5 (*continued*). All post-construction monitoring studies, project characteristics, and select study methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Fowler I, IN (09)	Johnson et al. 2010a	Stetson Mountain I, ME (09)	Stantec 2009c
Fowler III, IN (09)	Johnson et al. 2010b	Stetson Mountain I, ME (11)	Normandeau Associates 2011
Fowler I, II, III, IN (10)	Good et al. 2011	Stetson Mountain II, ME (10)	Normandeau Associates 2010
Fowler I, II, III, IN (11)	Good et al. 2012	Summerview, Alb (05-06)	Brown and Hamilton 2006b
Fowler I, II, III, IN (12)	Good et al. 2013	Summerview, Alb (06; 07)	Baerwald 2008
Goodnoe, WA (09-10)	URS Corporation 2010a	Tehachapi, CA (96-98)	Anderson et al. 2004
Grand Ridge I, IL (09-10)	Derby et al. 2010g	Top of Iowa, IA (03)	Jain 2005
Harrow, Ont (10)	Natural Resource Solutions 2011	Top of Iowa, IA (04)	Jain 2005
Harvest Wind, WA (10-12)	Downes and Gritski 2012a	Tuolumne (Windy Point I), WA (09-10)	Enz and Bay 2010
Hay Canyon, OR (09-10)	Gritski and Kronner 2010a	Vansycle, OR (99)	Erickson et al. 2000a
High Sheldon, NY (10)	Tidhar et al. 2012a	Vantage, WA (10-11)	Ventus Environmental Solutions 2012
High Sheldon, NY (11)	Tidhar et al. 2012b	Wessington Springs, SD (09)	Derby et al. 2010f
High Winds, CA (03-04)	Kerlinger et al. 2006	Wessington Springs, SD (10)	Derby et al. 2011d
High Winds, CA (04-05)	Kerlinger et al. 2006	White Creek, WA (07-11)	Downes and Gritski 2012b
Hopkins Ridge, WA (06)	Young et al. 2007a	Wild Horse, WA (07)	Erickson et al. 2008
Hopkins Ridge, WA (08)	Young et al. 2009c	Windy Flats, WA (10-11)	Enz et al. 2011
Jersey Atlantic, NJ (08)	NJAS 2008a, 2008b, 2009	Winnebago, IA (09-10)	Derby et al. 2010e
Judith Gap, MT (06-07)	TRC 2008	Wolfe Island, Ont (May-June 09)	Stantec Ltd. 2010a
Judith Gap, MT (09)	Poulton and Erickson 2010	Wolfe Island, Ont (July-December 09)	Stantec Ltd. 2010b
Kewaunee County, WI (99-01)	Howe et al. 2002	Wolfe Island, Ont (January-June 10)	Stantec Ltd. 2011a
Kibby, ME (11)	Stantec 2012	Wolfe Island, Ont (July-December 10)	Stantec Ltd. 2011b
Kittitas Valley, WA (11-12)	Stantec Consulting 2012	Wolfe Island, Ont (January-June 11)	Stantec Ltd. 2011c
Klondike, OR (02-03)	Johnson et al. 2003a	Wolfe Island, Ont (July-December 11)	Stantec Ltd. 2012
Klondike II, OR (05-06)	NWC and WEST 2007		

Second Annual Report of Post-Construction Wildlife Studies at the Ocotillo Express Wind Energy Facility Imperial County, California

October 3, 2014 – September 25, 2015

Final Report



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EXECUTIVE SUMMARY

Pattern Energy, through Ocotillo Express Wind LLC (OE LLC) owns and operates the Ocotillo Express Wind Energy Facility (OWEF or Project) in Imperial County, California, which consists of 112 Siemens 2.3-megawatt (MW) wind turbines. An Environmental Impact Statement (EIS) / Environmental Impact Report (EIR) was prepared for the Project. The Final EIS/EIR was released in February of 2012 and in May of 2012. The Bureau of Land Management (BLM) released a Record of Decision approving the development of the OWEF. The OWEF was constructed in 2012 and 2013, with the Project becoming fully operational in the fall of 2013.

In accordance with BLM Instruction Memorandum No. 2010-156, an Avian and Bat Protection Plan (ABPP) and an Eagle Conservation Plan (ECP) were developed for the Project in consultation with the appropriate agencies and identified measures that OWEF would implement to avoid, minimize, and mitigate Project-related impacts to birds and bats.

The Final EIS/EIR and associated ABPP and ECP identified post-construction monitoring studies and associated protocols for the OWEF. The ABPP required multi-year, formal year-long mortality monitoring studies, raptor nest surveys, and avian use monitoring surveys. This report includes the results of the second full year of post-construction wildlife monitoring studies for the OWEF, including the second standardized year-long fatality monitoring study and avian use studies as well as comparisons of the second-year fatality rates to both the first-year rates and reported fatality rates at wind energy facilities for which publicly available data exist. Separate stand-alone raptor and eagle nest monitoring reports have been prepared and will also be provided to the Technical Advisory Committee. In addition, additional carcass discoveries that occurred during the separate interim/large bird searches are not presented herein, but a comprehensive list of all carcass discoveries at the facility are provided to the agencies on a monthly basis.

The OWEF consists primarily of BLM land and a small portion of private land consisting of approximately 12,565 acres (5,085 hectares), and is located approximately five miles (eight kilometers) west of Ocotillo, California. Topography within the OWEF is generally considered flat, although there are several desert washes that cut throughout the site and there is more abrupt topography outside of the Project to the west and north. Land cover generally consists of a variety of desert scrub habitat types.

The second year of standardized year-long fatality monitoring began at the OWEF in October, 2014. Standardized carcass searches were conducted at 33 of the 112 turbines twice a month for a full year (October 2014 - September 2015). Two different plot sizes were searched during the study, including 160 X 160-meter (m; 525 X 525-foot [ft]) plots at 28 turbines and 270 X 270-m (886 X 886-ft) plots at five turbines. Searcher efficiency trials were conducted to develop estimates of the proportion of casualties which were not detected by searchers (searcher detection bias). Searcher efficiency trials were conducted throughout the year to encompass variable field conditions that may affect surveyor carcass detection. Carcass removal trials were

conducted to estimate the average length of time a carcass remained in the search plots and was available for detection by searchers. Carcass removal trials were conducted throughout the year to incorporate the effects of varying field conditions on scavenger densities.

Twenty-four rounds of searches were conducted at the 33 designated search turbines, for a total of 792 turbine searches. In total, 63 fatalities (37 birds and 26 bats) were documented from October 3, 2014, through September 25, 2015, during the second standardized year-long mortality monitoring study or incidentally during the study period. By comparison, 40 fatalities (26 birds and 14 bats) were documented during the first year of the study. Townsend's warbler was the most commonly identified bird fatality (four fatalities), while no more than three fatalities were documented for other identified bird species. Two red-tailed hawks (one discovered incidentally, one discovered during scheduled searches) were the only raptor fatalities identified during the study. Two Birds of Conservation Concern in Bird Conservation Region 33 (yellow warbler and Costa's hummingbird) were identified during the study and no other sensitive bird species were identified. Cumulatively, no more than three bird fatalities were documented at a single turbine during the year of surveys. There was no strong pattern in the spatial distribution of bird fatalities within the project. Bird fatalities were documented throughout much of the year, although there were only a few fatalities identified during the summer period.

A total of 26 bat fatalities were found during the second year of standardized year-long fatality monitoring studies, with 21 bats documented during scheduled turbine searches and five documented incidentally (two of the incidental bat discoveries were within standardized search plots and three were outside of standardized search plots). By comparison, 14 bat fatalities (five of which were incidental discoveries) were found during the first year. Mexican free-tailed bat was the most commonly documented fatality (10 fatalities); followed by western mastiff bat (three fatalities), pocketed free-tailed bat (three fatalities), western yellow bat (two fatalities), big free-tailed bat (one fatality), and long-legged bat (one fatality) were the other bat species identified as fatalities during the study. There were no federally listed bat species identified during the second standardized year-long mortality monitoring study or incidentally during the study period. One species (western mastiff bat) is listed as a BLM sensitive species and as a California Department of Fish and Wildlife species of special conservation. No more than three bat fatalities were identified at any one turbine during the study and there were no strong patterns in the spatial distribution of bat fatalities identified during the study. Temporally, bat fatalities were concentrated in the late spring (March and April), late summer (early to mid-July) and in early fall (mid-August into early October).

Searcher efficiency trials included 119 small bird and 49 large bird trial carcasses. Bat carcasses were not used during searcher efficiency trials due to the small number of bats available from the site, and as such, searcher efficiency trial data for small birds was used for bats. The overall searcher efficiency rate for small birds (and bats) was 79.8%, while the efficiency rate for large birds was 95.8%. Carcass removal trials included 90 large bird and 90 small bird carcasses. Removal rates differed among seasons for small birds and large birds, thus four rates were applied to estimate annual small bird/bat and large bird fatalities. Average removal times for small birds/bats were 11.95 days in winter, 9.18 days in spring, 6.90 days in

summer, and 2.47 days in fall, while the average removal times for large birds were 19.13 days in winter, 19.41 days in spring, 17.32 days in summer, and 16.23 days in fall.

Fatality estimates and 90% confidence intervals were calculated for birds and bats. For small birds and bats, the probability that a carcass would remain in a search plot and be found by a searcher was 0.48 in winter, 0.41 in spring, 0.33 in summer, and 0.13 in fall. For large birds, the probability was 0.68 in winter and spring, 0.65 in summer, and 0.63 in fall. Annual fatality rates for all birds, adjusted for searcher efficiency and carcass removal, was 1.37 fatalities/MW/year, and the annual adjusted fatality rate for bats was 1.45 fatalities/MW/year.

The estimated overall bird fatality rate of 1.37 birds/MW/year was relatively low compared to other wind energy facilities with publicly available data in North America where rates have ranged from 0.06 to 17.44 birds/MW/year as well as in California and the desert southwest where estimates have ranged from 0.55 to 17.44 birds/MW/year. The overall bird fatality rate at the OWEF ranked sixth lowest compared to 23 other studies at facilities in California and the desert southwest. Based on the data, it is unlikely that operation of the OWEF will result in significant impacts to local or regional bird populations.

The estimated overall raptor fatality rate of 0.04 raptors/MW/year was low compared to other wind energy facilities in North America which have ranged from zero to 1.06 raptors/MW/year as well as in California and the desert southwest where estimates have ranged from zero to 1.06 raptors/MW/year. Based upon the small estimate of raptor mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional raptor populations.

The estimated overall bat fatality rate at the OWEF (1.45 bats/MW/year) was considered low relative to other wind energy facilities in North America where rates have ranged from zero to 40.2 bats/MW/year. The overall bat fatality rate is moderate relative to other wind energy facilities in California and the desert southwest with publicly available bat fatality data, where bat fatality rates ranged from zero to 3.92 bats/MW/year. Based on the relatively small estimate of bat mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bat populations.

Twenty-four rounds of fixed-point avian use surveys were conducted at 21 survey stations from October 3, 2014, through September 25, 2015, resulting in 504 fixed-point surveys. Twenty-seven unique bird species were documented, with house finch, common raven, and rock wren accounting for the majority of all observations. Raptor use was low throughout all seasons, and varied from 0.02 raptors per 800-m (2,625-ft) plot per 30-min survey during the fall to 0.14 raptors/800-m plot/30-min survey during the spring. Red-tailed hawk accounted for the majority of observed raptor use. Passerine use varied from a low of 1.32. birds/100-m plot/30-min survey in the summer to a high of 2.58 birds/100-m plot/30-min survey in the spring. Black-throated sparrow, cactus wren, house finch, and rock wren were the most commonly observed small bird/passerine species, collectively accounting for between 44% and 62% of passerine use across all seasons.

During the 2014-2015 avian use study, house finch, common raven, rock wren, and black-throated sparrow, and cactus wren were the most abundant bird species. All of these species were also among the most abundant species observed during the 2013-2014 avian use study and the pre-construction studies. Avian abundance was slightly higher during the 2014-2015 study compared to the 2013-2014 study but is still considered low relative to the results of other publicly available studies with similar methodologies.

The results of the second year of standardized studies have provided additional insights into the effects of the OWEF on wildlife, which are primarily supportive of the low level of predicted risk of the project on wildlife. The first year of studies found that impacts to birds (including raptors) and bats were low and that the operation of the OWEF is unlikely to result in significant impacts to local or regional bird or bat populations. The results of the second year of post-construction monitoring also support this conclusion, suggesting that the first year results (which demonstrated low impacts to birds and bats), were not an anomaly or unusual, but rather representative of the impacts that can be expected at the Project.

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INTRODUCTION

Pattern Energy, through Ocotillo Express LLC (OE LLC) owns and operates the Ocotillo Express Wind Energy Facility (OWEF or Project) in Imperial County, California (Figure 1). An Environmental Impact Statement (EIS) / Environmental Impact Report (EIR) was prepared for the Project. The Final EIS/EIR was released in February of 2012 and in May of 2012 the Bureau of Land Management (BLM) released a Record of Decision (ROD) approving the development of the OWEF (BLM 2012a, 2012b). The OWEF was constructed in 2012 and 2013 with the Project becoming fully operational in the fall of 2013.

In accordance with BLM Instruction Memorandum No. 2010-156 (BLM 2010), an Avian and Bat Protection Plan (ABPP) and an Eagle Conservation Plan (ECP) were developed for the Project and incorporated as appendices to the Final EIS/EIR. The ABPP and ECP were developed in consultation with the appropriate agencies and identify measures that the OWEF will implement to avoid, minimize, and mitigate Project-related impacts to birds and bats.

The ABPP included provisions for a Technical Advisory Committee (TAC) that was formed to monitor OWEF activities, including mortality data, and to evaluate the need for any avoidance/minimization or mitigation measures. The TAC consists of representatives from the BLM, US Fish and Wildlife Service (USFWS), and California Department of Fish and Wildlife (CDFW). The TAC has reviewed and approved the post-construction wildlife monitoring protocols, and has and will continue to review monitoring results, and provide advice and recommendations to the BLM Authorized Officer on developing and implementing effective measures to monitor, avoid, minimize, and mitigate impacts to avian and bat species and their habitats, as related to operations.

The Final EIS/EIR and associated ABPP and ECP identified post-construction monitoring studies and associated protocols for the OWEF. The ABPP required multi-year, formal year-long mortality monitoring studies, raptor nest surveys, and avian use monitoring surveys. This report includes the results of the second full year of post-construction wildlife monitoring studies for the OWEF including the second standardized year-long mortality monitoring study and avian use studies, as well as comparisons of the second-year mortality rates to the first-year mortality rates and reported mortality rates at wind energy facilities for which publicly available data exist. Separate stand-alone raptor and eagle nest monitoring reports have been prepared and have been or will be provided to the TAC. Additional carcass discoveries that occurred during the separate interim/large bird searches are not presented herein, but a comprehensive list of all carcass discoveries at the facility have been provided to the agencies on a monthly basis.

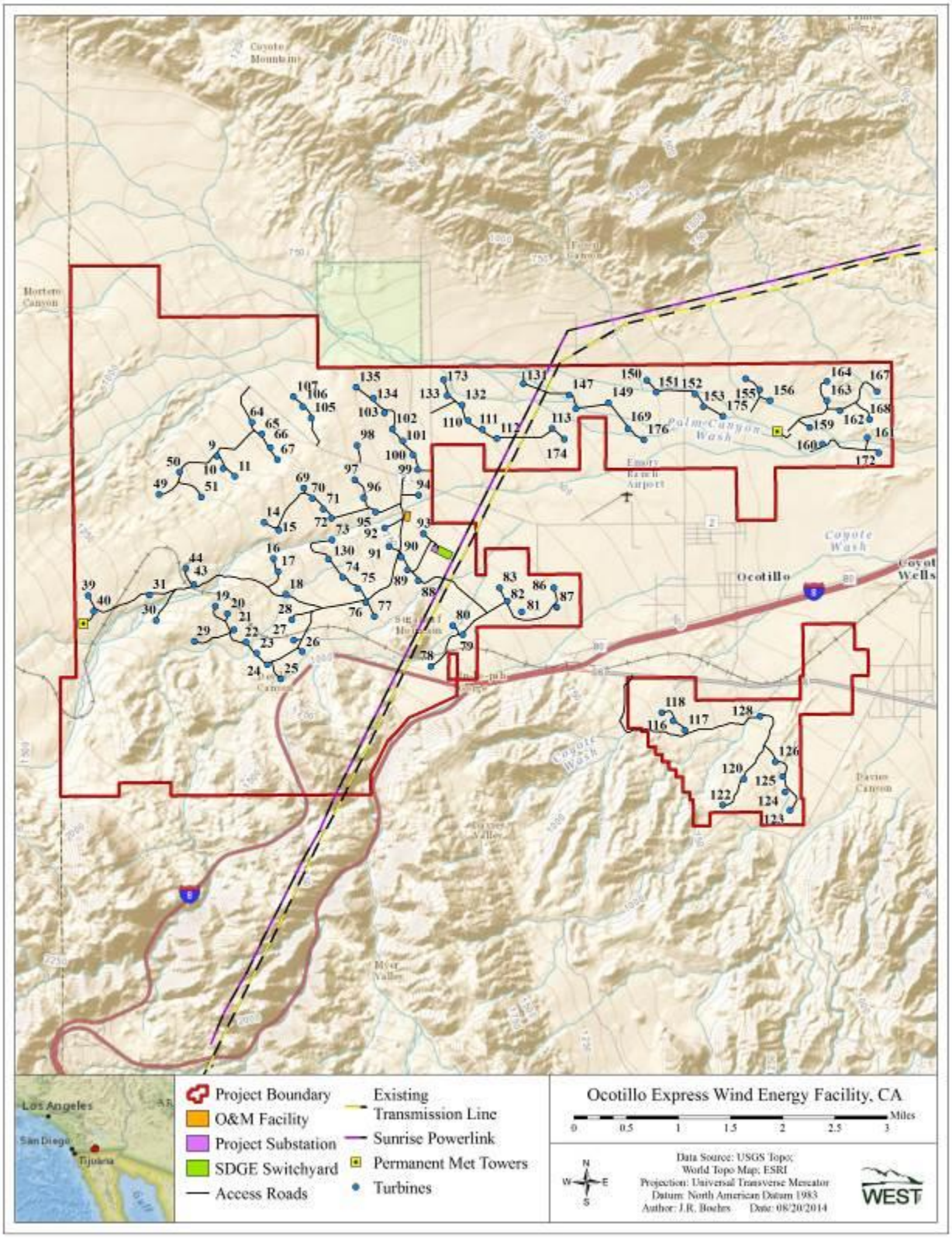


Figure 1. Location of the Ocotillo Express Wind Energy Facility in Imperial County, California.

STUDY AREA

The OWEF is located primarily on BLM land and a small portion of private land consisting of approximately 12,565 acres (5,085 hectares [ha]). The Project includes 112 Siemens SWT – 2.3-108 wind turbines (approximately 315 megawatts [MW]) and associated infrastructure (Figure 1). The diameter of the circle swept by the blades is 354 feet (ft; 108 meters [m]) and turbines are 440 ft (134 m) tall in height from the base of the tower to the fully extended blade tip. In addition to the 112 wind turbines, other above-ground infrastructure includes an Operations and Management (O&M) building, two permanent meteorological (met) towers, an electrical substation, and the Sunrise Powerlink transmission line.

The project site is located within four US Geological Survey (USGS) 7.5-minute quadrangle maps; Carrizo Mountain, Coyote Wells, In-Ko-Pah Gorge, and Painted Gorge. The northern portion of the site is generally situated north of Interstate 8 (I-8), with the western edge along the Imperial/San Diego County border to approximately 1.5 miles (2.4 kilometers [km]) northeast of the town of Ocotillo on its eastern edge. The northern area includes several distinct features, including a portion of the I-8 Island (an undeveloped rocky and hilly terrain between the eastbound and westbound lanes of I-8), Sugarloaf Mountain, and a portion of the San Diego and Arizona Eastern railroad tracks. County Route (CR) S2 bisects the northern project area, and I-8 passes through the southern portion of the northern Project area. The southern area is considerably smaller than the northern area and the majority of the southern area is south of State Route (SR) 98.

Vegetation on site consists of a variety of desert scrub habitat types (USGS National Land Cover Database [NLCD] 2001; Figure 2). Several dry desert washes cut through the site, generally from west to east: Palm Canyon Wash cuts through the center of the northern Project area, Myer Creek Wash cuts through the southern portion of the northern Project area, a portion of Coyote Wash cuts through the northwest portion of the southern Project area, and several additional unnamed washes also cut through the site.

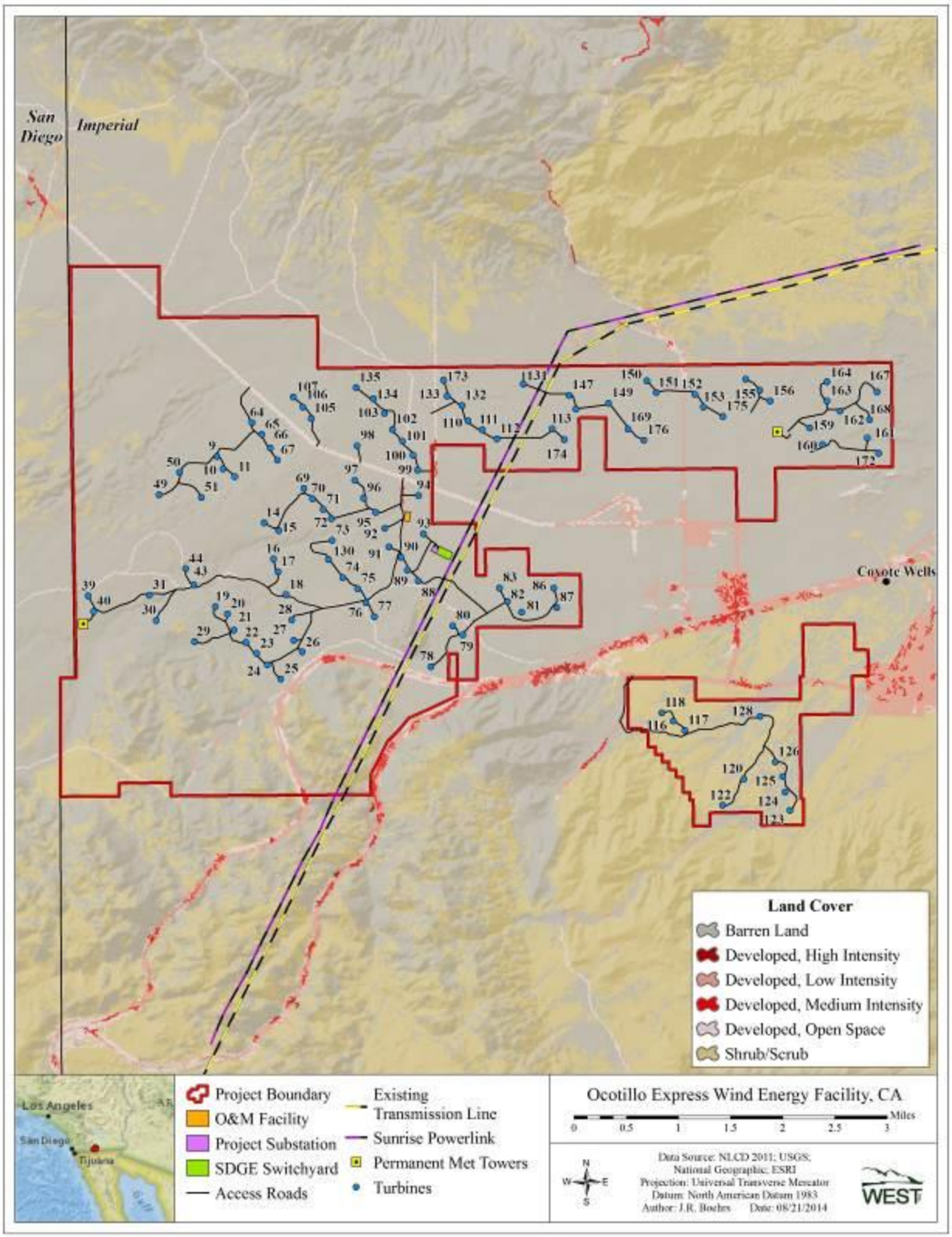


Figure 2. Landuse/landcover information for the Ocotillo Express Wind Energy Facility (USGS NLCD 2001).

METHODS

Year-Long Mortality Monitoring

The primary objective of the standardized mortality monitoring study is to estimate annual levels of avian and bat mortality at the OWEF.

Study Design

The four primary components of the standardized mortality monitoring study are: 1) standardized carcass searches, 2) searcher efficiency trials, 3) scavenger removal trials, and 4) data analyses and reporting.

Standardized Carcass Searches

Mortality surveys consisted of standardized carcass searches at 33 of the turbines (about 30% of 112 total turbines at least twice per month throughout the year (Table 1). A systematic sample with a random start was used to select the 33 search turbines out of the turbines that were determined to be available for searching (i.e., those turbines for which it was determined there were not cultural concerns).

Table 1. Turbines selected for Year 2 mortality surveys at the Ocotillo Express Wind Energy Facility.

Search Turbine Number		
22	86	147
24	87	148
27	89	149
28	93	151
31	111	152
43	112	153
44	113	156
71	118	169
75	124	173
76	130	174
82	133	176

Standardized carcass searches were conducted within 160 X 160 m (525 X 525-ft) plots centered on the turbine for 28 of the 33 turbines and 270 X 270 m (886 X 886-ft) plots centered on the turbine for the remaining five turbines (Turbines 24, 82, 93, 133, and 149; Figure 3). Trained field technicians systematically searched each plot for avian and bat fatalities by walking parallel transects spaced approximately six m (about 20 ft) apart and scanning both sides of the transect for carcasses. For the purposes of the mortality surveys, the condition of carcasses found by searchers was classified according to the following criteria:

- **Intact** - a carcass that is completely intact, is not badly decomposed, and shows no sign of being fed upon by a predator or scavenger;

- **Scavenged** – an entire carcass that shows signs of scavenging or is heavily infested by insects, or portion(s) of a carcass in one location (e.g., wings);
- **Feather Spot** - 10 or more feathers (or two or more primary feathers) at one location indicating predation or scavenging.

Handling of bird and bat carcasses was conducted under the appropriate agency permits. All bird and bat carcasses found during the standardized searches were labeled with a unique number, bagged, and stored in a freezer at the OWEF O&M building. A data sheet was completed for each carcass to record species, sex and age (when possible), date and time collected, location (Global Positioning System [GPS] coordinates), carcass condition, habitat type, suspected cause of death, and any comments. All casualties were photographed in the field and the location was plotted on a map that showed the location of the carcass in relation to the nearest turbine and other facilities (e.g., overhead power lines).

There are three scenarios under which casualties may have been found at the OWEF: 1) within search plots during the standardized carcass searches; 2) within search plots while searchers are on site but not conducting a standardized search; and 3) by project personnel during other activities, such as turbine maintenance. All casualties found by study personnel were recorded in accordance with the methods described above. It is assumed that casualties found incidentally within search plots (by searchers or project personnel) would have been found by searchers and these casualties have been included in mortality estimates. Casualties found incidentally by searchers or project personnel outside the formal search plot have been reported as incidental discoveries and are not included in mortality estimates.

Experimental Bias Trials

Experimental bias trials were conducted to develop estimates of the proportion of casualties which were not detected by searchers. As a result of these estimates, correction factors have been applied to observed carcass discoveries to provide an annual estimate of mortality per turbine and per MW. Two types of experimental bias trials were conducted: 1) searcher efficiency trials, and 2) carcass removal trials.

Searcher Efficiency Trials

Searcher efficiency trials were conducted to develop estimates of the proportion of casualties which were detected by searchers (searcher detection bias). Searcher efficiency trials were conducted throughout the year to encompass variable field conditions that may have affected surveyor carcass detection. A minimum of two searcher efficiency trials were conducted in each of the four seasons, for a total of eight trials annually.

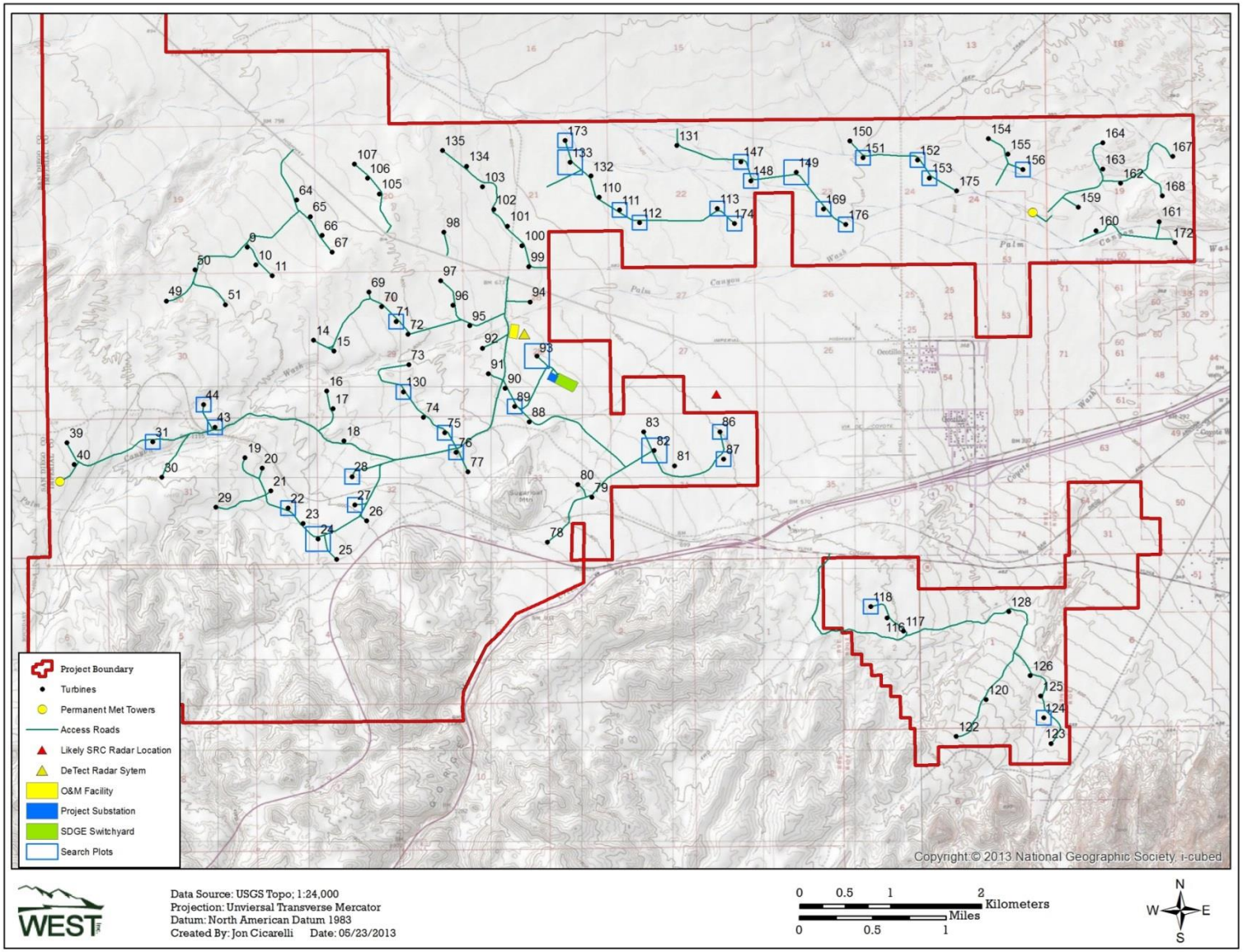


Figure 3. Turbines selected for the Year 2 mortality monitoring study at the Ocotillo Express Wind Energy Facility.

Each trial consisted of placing approximately 20 carcasses divided among two size classes (small and large) in search plots. Carcasses utilized for searcher efficiency trials consisted of birds and bats found during standardized carcass searches at OWEF and/or non-native or commercially-available species. Large birds were represented by species, such as mallard (*Anas platyrhynchos*) or ring-necked pheasant (*Phasianus colchicus*), while small birds included species such as house sparrow (*Passer domesticus*) and rock pigeon (*Columba livia*). Small brown birds (e.g., house sparrows) were used in lieu of bat carcasses, if necessary.

Searcher efficiency trials were conducted simultaneously with mortality searches. Trial carcasses were randomly placed within turbine search plots by a field supervisor immediately prior to a scheduled carcass search. Searchers were not told when or where trials were being conducted to minimize potential bias. Each trial carcass was discreetly marked to distinguish it from an actual mortality. Carcasses were dropped from waist height and allowed to land in a variety of postures. Searchers recorded the location of each trial carcass found during standardized carcass searches. Immediately following completion of the search, the field supervisor retrieved all carcasses not found by searchers to determine the number of carcasses that remained available for detection but were not found. Searcher efficiency trial data were analyzed to develop estimates of detection bias to adjust annual estimates of bird and bat mortality rates.

Carcass Removal Trials

The objective of the carcass removal trials was to estimate the average length of time a carcass remained in the search plot (was not removed by scavengers) and was available for detection by searchers. Carcass removal trials were initiated when carcass search studies began, and were conducted throughout the year to incorporate the effects of varying field conditions and scavenger densities. Carcasses were placed on a minimum of two dates during each season for a minimum total of eight trial initiation dates. For each trial, carcasses were discreetly marked and placed in the field. Small brown birds (e.g., house sparrows) were used in lieu of bat carcasses, if necessary. All trial carcasses were handled with disposable gloves to minimize human scent on the carcasses.

Observers conducting carcass searches monitored the trial birds over a minimum of a 30-day period according to the following schedule as closely as possible. Carcasses were checked every day for the first four days, and then on days seven, 10, 14, 18, 24, and 30. This schedule varied slightly due to logistical constraints. At each visit, the observer noted the condition of the carcass (e.g., intact, scavenged, feather spot [i.e., more than 10 feathers], or absent [less than 10 feathers]). Removal trial carcasses were left at the location until the end of the trial or until the carcass was removed entirely by scavengers. After the trial, any remaining evidence of the carcasses was removed. Carcass removal trial data were analyzed to develop separate removal estimates for large birds, small birds, and bats, and the results were used to adjust annual estimates of bird and bat mortality rates.

Statistical Methods for Calculating Mortality Estimates

Adjusted annual mortality estimates were developed for all birds, all bats, small birds, large birds, and raptors. Estimates of facility-related mortalities are based on:

1) Observed number of carcasses found during standardized searches during the monitoring year for which the cause of death is either unknown or is probably facility-related;
2) Non-removal rates, expressed as the estimated average probability a carcass is expected to remain in the study area and be available for detection by the searchers during removal trials; and
3) Searcher efficiency, expressed as the proportion of placed carcasses found by observers during the searcher efficiency trials.

Mortality estimates were provided for a minimum of five categories: 1) all birds, 2) small birds, 3) large birds, 4) raptors, and 5) bats. The number of avian and bat mortalities attributable to operation of the facility, based on the number of avian and bat mortalities found at the facility, were reported. All carcasses located within areas surveyed or incidentally, regardless of species, were recorded. If the cause of death was not apparent, a "worst case" estimate was made by attributing the mortality to facility operation. The total number of avian and bat carcasses attributable to the facility was estimated by adjusting for removal and searcher efficiency biases.

Definition of Variables

The following variables are used in the equations below:

c_i the number of carcasses detected at plot *i* for the study period of interest (e.g., one monitoring year) for which the cause of death is either unknown or is attributed to the facility

n the number of search plots

k the number of turbines searched (including the turbines centered within each search plot)

$\bar{c}$ the average number of carcasses observed per turbine per monitoring year

s the number of carcasses used in removal trials

s_c the number of carcasses in removal trials that remain in the study area after 30 days

se standard error (square of the sample variance of the mean)

t_i the time (in days) a carcass remains in the study area before it is removed, as determined by the removal trials

$\bar{t}$ the average time (in days) a carcass remains in the study area before it is removed, as determined by the removal trials

d the total number of carcasses placed in searcher efficiency trials

p the estimated proportion of detectable carcasses found by searchers, as determined by the searcher efficiency trials

I the average interval between standardized carcass searches, in days

A proportion of the search area of a turbine actually searched

$\hat{\pi}$ the estimated probability that a carcass is both available to be found during a search and is found, as determined by the removal trials and the searcher efficiency trials

m the estimated annual average number of fatalities per turbine per year, adjusted for removal and searcher efficiency biases.

Observed Number of Carcasses

The estimated average number of carcasses ($\bar{c}$) observed per turbine per monitoring year is:

$$\bar{c} = \frac{\sum_{i=1}^{n} c_i}{k \cdot A} \quad (1)$$

Estimation of Carcass Non-Removal Rates

Estimates of carcass non-removal rates are used to adjust carcass counts for removal bias. Mean carcass removal time ($\bar{t}$) is the average length of time a carcass remains in the study area before it is removed:

$$\bar{t} = \frac{\sum_{i=1}^{s} t_i}{s - s_c} \quad (2)$$

Estimation of Searcher Efficiency Rates

Searcher efficiency rates are expressed as *p,* the proportion of trial carcasses that are detected by searchers in the searcher efficiency trials. These rates will be estimated by carcass size and season.

Estimation of Facility-Related Mortality Rates

The estimated per turbine annual mortality rate (*m*) is calculated by:

$$m = \frac{\bar{c}}{\hat{\pi}} \qquad (3)$$

where $\hat{\pi}$ includes adjustments for both carcass removal (from scavenging and other means) and searcher efficiency bias. Data for carcass removal and searcher efficiency biases will be pooled across the study to estimate $\hat{\pi}$.

The final reported estimates of *m* and associated standard errors and 90% confidence intervals for the OWEF were calculated using bootstrapping (see Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics. For each bootstrap sample, $\bar{c}$, $\bar{t}$, *p*, $\hat{\pi}$, and m are calculated. A total of 1,000 bootstrap samples were used. The reported estimates are the mathematical means of the 1,000 bootstrap estimates that were sampled and the standard deviation of the bootstrap estimates is the estimated standard error. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates are estimates of the lower limit and upper limit of 90% confidence intervals for the reported estimates that will be reported.

Avian Monitoring

The ABPP requires that avian monitoring be conducted twice each month during the first two years of operation using the same methods as pre-construction studies. The ABPP states that "general use point-count data will be collected to provide an accurate comparison between pre- and post-construction use to inform our understanding of avian exposure and probability of mortality as well as behavioral responses to the facility". The avian monitoring was initiated at the same time as the year-long standardized mortality monitoring.

Fixed-Point Avian Use Surveys

Fixed-point avian use surveys were conducted at the 21 pre-construction avian point count locations located within and adjacent to the OWEF (Figure 4). The 21 avian use points were selected during the OWEF pre-construction phase to survey representative habitats and topography, while also providing relatively even coverage of the OWEF. Fixed-point circular plots were used for both passerine and raptor surveys following the field methods described by Reynolds et al. (1980).

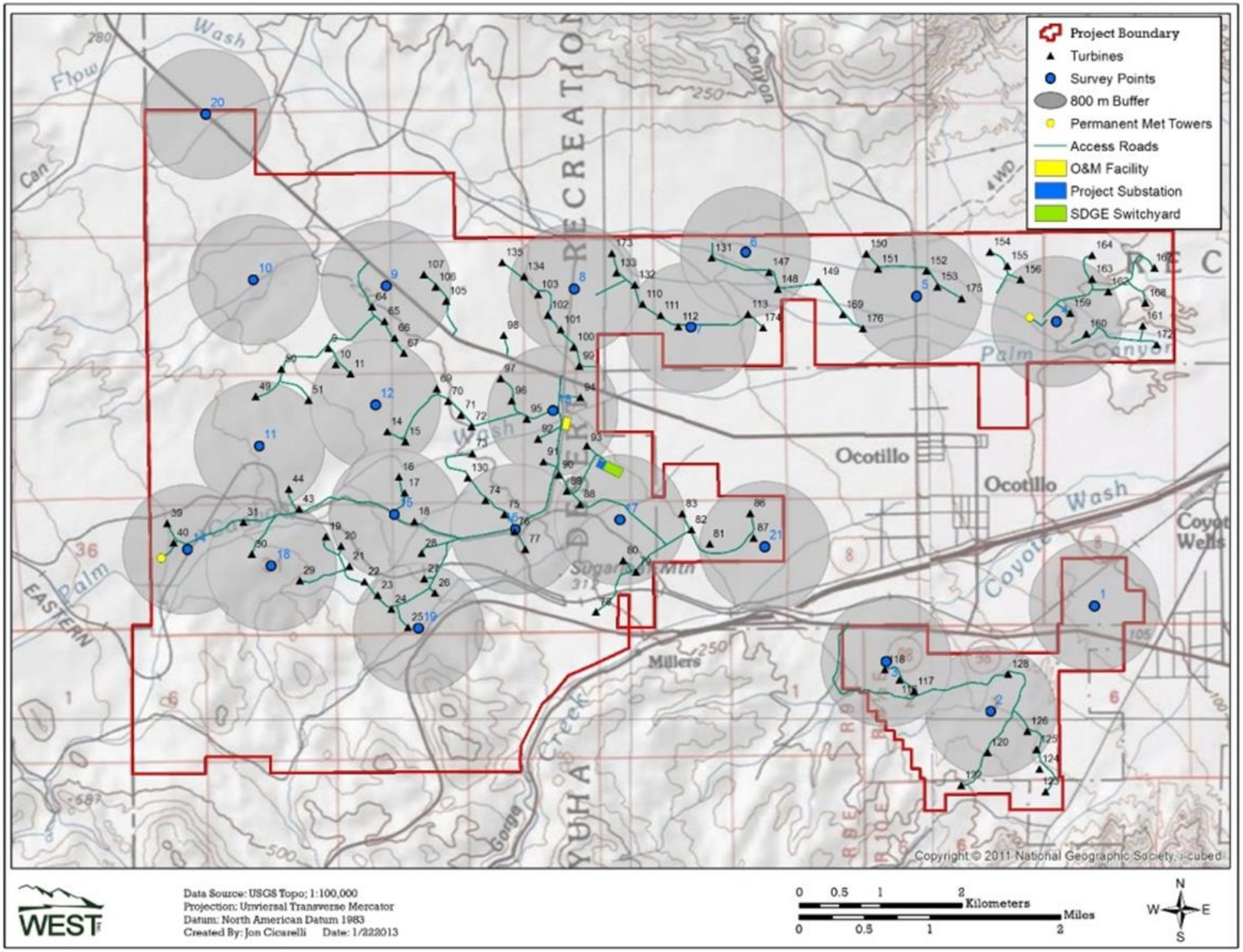


Figure 4. Fixed point locations for avian use surveys at the Ocotillo Express Wind Energy Facility.

Each observation point was surveyed for 30 minutes (min) twice a month. The survey view-sheds included an 800-m (2,625-ft) radius plot for large birds and 100-m (328-ft) radius plot for small birds. All birds observed during each fixed-point survey were recorded regardless of distance from observer. Due to potential for classification error, observations of large birds beyond 800 m and small birds beyond 100 m of the point were recorded but excluded from statistical analyses (e.g., not used for calculating standardized use estimates per plot). Flight paths of all raptors were recorded on paper maps and later digitized with a Geographic Information System (GIS). For this study, large birds included waterbirds, waterfowl, rails/coots, shorebirds, raptors, owls, vultures, upland game birds, doves/pigeons, and large corvids. Small birds included passerines (excluding large corvids), swifts/hummingbirds, woodpeckers, and cuckoos.

For analysis purposes, a visit was defined as the required length of time, in days, needed to survey all of the plots once within the study area. Visits were assigned according to the following criteria: 1) a single visit had to be completed in a single season; and 2) a visit could be spread across multiple dates, but a single date could not contain surveys from multiple visits.

Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) measures were implemented at all stages of the study, including in the field, during data entry and analysis, and report writing. Following field surveys, observers were responsible for inspecting data forms for completeness, accuracy, and legibility. Potentially erroneous data was identified using a series of database queries. Irregular codes or data suspected as questionable were discussed with the observer and/or project manager. Errors, omissions, or problems identified in later stages of analysis were traced back to the raw data forms, and appropriate changes in all steps were made.

Data Compilation and Storage

A Microsoft® ACCESS database was developed to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined protocol to facilitate subsequent QA/QC and data analysis. All data forms and electronic data files were retained for reference.

Bird Diversity and Species Richness

Bird diversity was illustrated by the total number of unique species observed. Species lists (with the number of observations and the number of groups) were generated by season and included all observations of birds detected, regardless of their distance from the observer. In some cases, the tally of observations may represent repeated sightings of the same individual. Species richness by season was calculated by first averaging the total number of species observed within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. Overall species richness was calculated as a weighted average of seasonal values by the number of days in each season. Species diversity and richness were compared among seasons for fixed-point bird use surveys.

Bird Use, Percent of Use, and Frequency of Occurrence

For the standardized fixed-point bird use estimates, large birds detected within the 800-m radius plot at any time were used in the analysis; small birds recorded within a 100-m radius at any time were included. The metric used to measure mean bird use was number of birds per plot per 30-min survey. These standardized estimates of mean bird use were used to compare differences between bird types, seasons, survey points, and other studies where similar methods were used. Mean use by season was calculated by first averaging the total number of birds seen within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season. Overall mean use was calculated as a weighted average of seasonal values by the number of days in each season. To make comparisons to other studies, the use value was further standardized by only including those observations that occurred during the first 20 minutes of the survey, since most of the studies available for comparison used 20-minute survey durations.

Exposure to facility infrastructure is affected by how much a species utilizes an area (percent of use), as well as how often use occurs (frequency of occurrence). Frequency of occurrence and percent of use provide relative measures of species exposure to the proposed facility. Percent of use was calculated as the proportion of large or small bird mean use that was attributable to a particular bird type or species. Frequency of occurrence was calculated as the percent of surveys in which a particular bird type or species was observed. For example, flocks of waterfowl, waterbirds, and shorebirds can be comprised of several hundred, thousand, or tens of thousands of individual birds, which would result in a very high percentage of use. However, examining the percent of use alone would not account for the acute exposure to the facility associated with a small number of very large flocks (low frequency of occurrence). A high percent of use may indicate that a species has higher exposure relative to other species, but when the exposure is acute, the species may be less likely to be affected. Conversely, a species that has a low percentage of use and a high frequency of occurrence would have long-term exposure to the facility, increasing the likelihood that this species may be affected by the facility. Exposure to facility infrastructure is more accurately assessed by evaluating both percent of use and frequency of occurrence.

Bird Flight Height and Behavior

Bird flight heights are important metrics to assess potential exposure. Flight height information was used to calculate the percentage of birds observed flying within the rotor-swept height (RSH; 25-150 m [82-492 ft] above ground level) for turbines likely to be used at the expansion area. The flight height recorded during the initial observation was used to calculate the percentage of birds flying within the RSH and mean flight height. The percentage of birds flying within the RSH at any time was calculated using the lowest and highest flight heights recorded.

Bird Exposure Index

The bird exposure index is used as a relative measure of how often birds fly at heights similar to blades of modern wind turbines. A relative index of bird exposure (R) was calculated for bird species observed during the fixed-point bird use surveys using the following formula:

$$R = A*P_f*P_t$$

where A equals mean relative use for species *i* (large bird observations within 800 m of the observer or 100 m for small birds) averaged across all surveys, P_f equals the proportion of all observations of species *i* where activity was recorded as flying (an index to the approximate percentage of time species *i* spends flying during the daylight period), and P_t equals the proportion of all initial flight height observations of species *i* within the likely RSH.

Spatial Use

Large bird flight paths were qualitatively compared to study area characteristics (e.g., topographic features). The objective of mapping observed large bird locations and flight paths was to identify areas of concentrated use by diurnal raptors and other large birds and/or consistent flight patterns within the study area.

RESULTS

Year-Long Mortality Monitoring

Turbine searches for the year-long mortality monitoring began on October 3, 2014, and continued through September 25, 2015. Twenty-four complete rounds of searches were conducted at the 33 designated search turbines during this period, for a total of 792 turbine searches. Data in the following results includes carcasses discovered during the standardized year-long mortality monitoring study and incidental discoveries from the same study period. Carcasses discovered during interim large bird searches and/or incidental discoveries outside of the study period are not included in the results presented herein. In total, 63 fatalities (37 birds and 26 bats) were documented during the second year mortality monitoring studies from October 3, 2014, through September 25, 2015 (Table 2). A complete listing of all carcasses identified during the second standardized year-long fatality study or incidentally during the study period is provided in Appendix A. Fifty-four of the carcasses were documented during scheduled searches, while nine carcasses were documented incidentally (Table 2). Two of the incidental bat carcass discoveries and four of the incidental bird carcass discoveries were located on search plots; therefore, these carcasses were included in analyses used to estimate annual mortality rates. All other incidental discoveries were located off search plots and were not included in the analyses used to estimate annual mortality rates.

Table 2. Numbers and composition of bird and bat carcasses discovered at the Ocotillo Express Wind Energy Facility during the year-long standardized searches and incidentally from October 3, 2014 – September 25, 2015.

	Fatalities during Scheduled Searches		Incidentals (on search plots)		Incidentals (off search plots)[1]		Total	
Species	**Total**	**Total**	**Total**	**%Comp.**	**Total**	**%Comp.**	**Total**	**%Comp.**
Birds								
unidentified bird (small)[2]	10	30.3	0	0	0	0	10	27.0
Townsend's warbler	3	9.1	1	25.0	0	0	4	10.8
black-throated gray warbler	3	9.1	0	0	0	0	3	8.1
unidentified sparrow	3	9.1	0	0	0	0	3	8.1
mourning dove	2	6.1	1	25.0	0	0	3	8.1
white-throated swift	2	6.1	0	0	0	0	2	5.4
red-tailed hawk	1	3.0	1	25.0	0	0	2	5.4
common poorwill	1	3.0	0	0	0	0	1	2.7
Costa's hummingbird	1	3.0	0	0	0	0	1	2.7
Eurasian collared-dove	1	3.0	0	0	0	0	1	2.7
horned lark	1	3.0	0	0	0	0	1	2.7
house finch	1	3.0	0	0	0	0	1	2.7
unidentified large bird	1	3.0	0	0	0	0	1	2.7
unidentified warbler	1	3.0	0	0	0	0	1	2.7
Wilson's warbler	1	3.0	0	0	0	0	1	2.7
yellow warbler	1	3.0	0	0	0	0	1	2.7
western tanager	0	0	1	25.0	0	0	1	2.7
Overall Birds	**33**	**100**	**4**	**100**	**0**	**0**	**37**	**100**
Bats								
Mexican free-tailed bat	10	47.6	0	0	0	0	10	38.5
unidentified free-tailed bat[1]	2	9.5	1	50.0	1	33.3	4	15.4
western mastiff bat	2	9.5	1	50.0	0	0	3	11.5
pocketed free-tailed bat[1]	2	9.5	0	0	1	33.3	3	11.5
unidentified bat	2	9.5	0	0	0	0	2	7.7
western yellow bat[1]	1	4.8	0	0	1	33.3	2	7.7
big free-tailed bat	1	4.8	0	0	0	0	1	3.8
long-legged bat	1	4.8	0	0	0	0	1	3.8
Overall Bats	**21**	**100**	**2**	**100**	**3**	**100**	**26**	**100**

[1] Incidental discoveries found off search plots were excluded from the annual mortality estimates.
[2] One unidentified small bird was found outside of the 160 X 160-m plot, but was within the larger 270 X 270-m plot.

Bird Mortalities

During the study, 33 birds comprising 14 identifiable species were found during scheduled searches or incidentally (Table 2). Fifteen of the bird carcasses were not identifiable to species as they consisted primarily of bones, bone fragments, or non-distinct feathers. The bird species most commonly found during the study, either during scheduled searches or incidentally was Townsend's warbler (*Setophaga townsendi*; four carcasses). Mortalities of all other species consisted of either one, two or three individuals (Table 2). One raptor species (red-tailed hawk; *Buteo jamaicensis*) was discovered during the study (two carcasses). None of the avian species identified during the second standardized year-long fatality or incidentally during the study period are federal or state listed species. One Costa's hummingbird (*Calypte costae*) and one yellow warbler (*S. petechia*), both listed as Birds of Conservation Concern (BCC) in Bird

Conservation Region (BCR) 33 [see USFWS 2008]) were the only sensitive avian species carcasses identified during the second year-long mortality monitoring study.

The greatest number of bird mortalities found at any one search plot was three mortalities found at five turbines (Turbines T124, T133, T152, T156, and T76); two bird mortalities were found at six of the turbines, and single mortalities were found at 10 other search turbines (Figure 5 and Figure 6a). The lack of strong patterns in the spatial distribution of bird mortalities suggests no large differences in bird mortality by location within the Project. Of the bird fatalities, about half (54%) were found within 60 m (197 ft) of the turbine and nine were found beyond 90 m (295 ft) from a turbine (Table 3). One of the 19 bird carcasses discovered during scheduled searches was located outside of the 160 X 160-m plot, but was within the larger 270 X 270-m plot. Bird mortalities occurred throughout the year, peaking between March and May (Figure 6b).

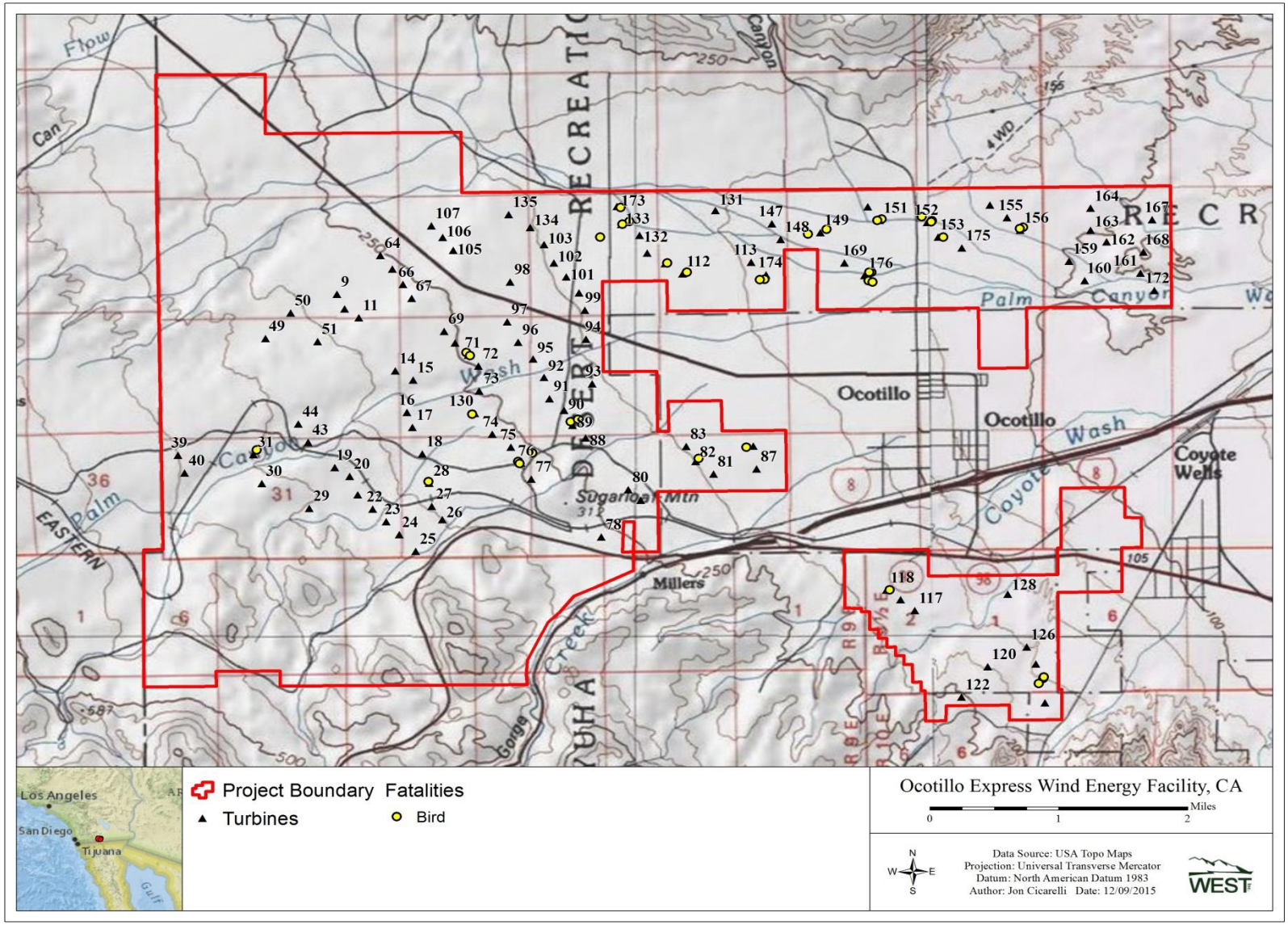


Figure 5. Location of all bird carcasses found during the second standardized year-long mortality study or incidentally during the study period at the Ocotillo Express Wind Energy Facility.

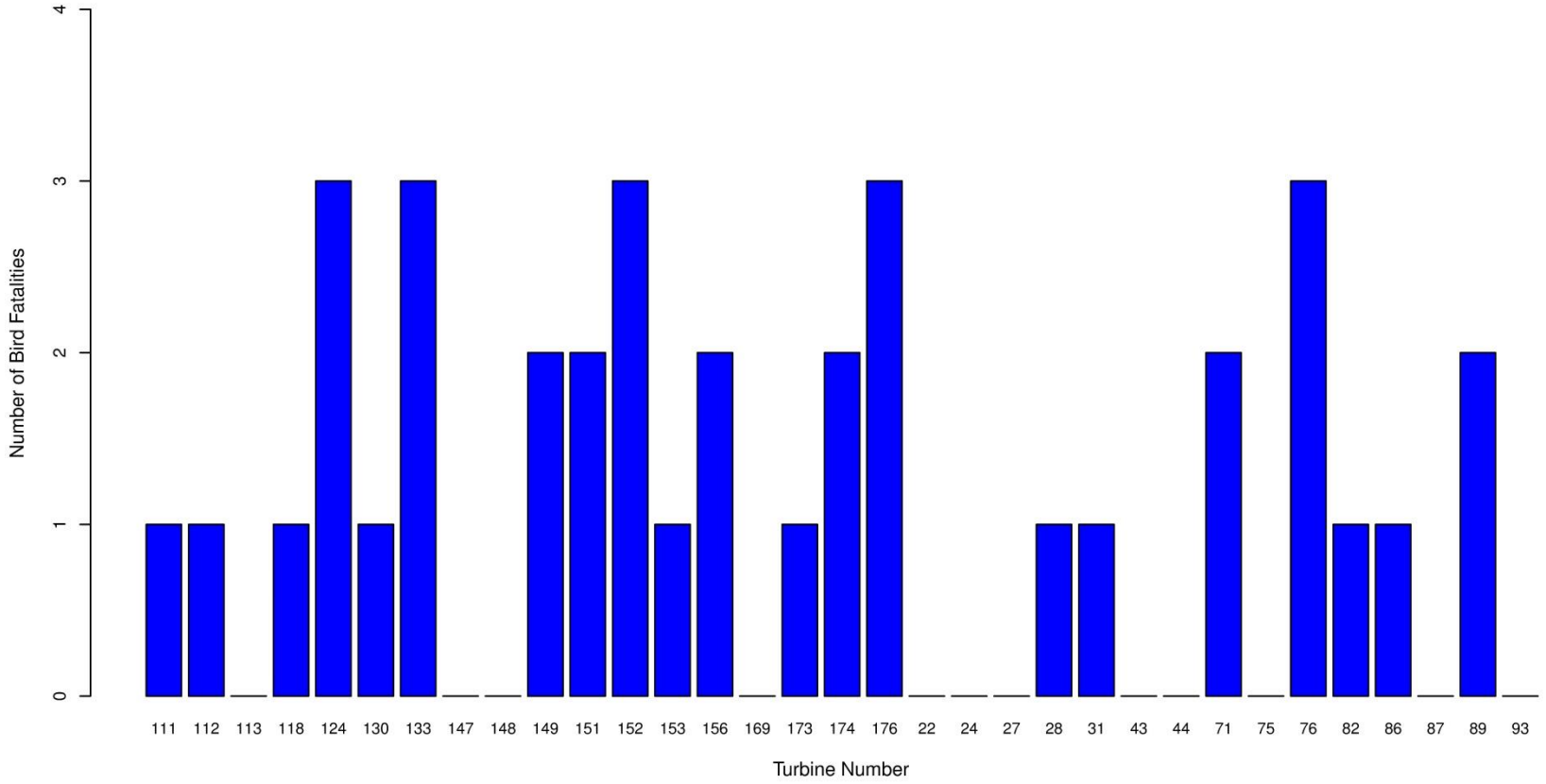


Figure 6a. Number of bird carcasses by turbine found during year-long standardized searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

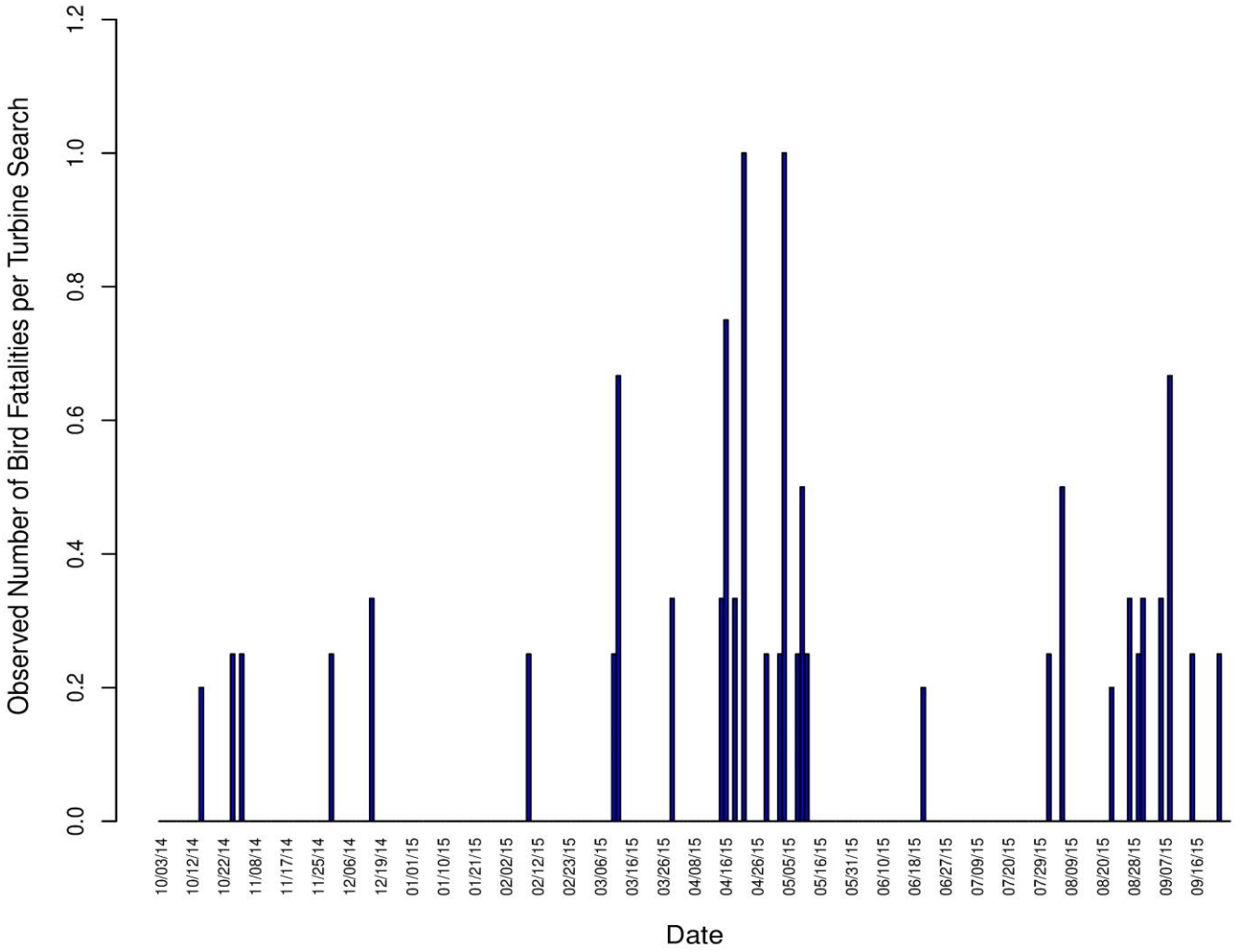


Figure 6b. Timing of bird mortalities found during scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

Table 3. Distribution of distances from turbines of bird and bat casualties found during year-long standardized searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

Distance to Turbine (m)	Number of Bird Casualties	% Bird Casualties	Number of Bat Casualties	% Bat Casualties
0 to 10	0	0	4	17.4
10 to 20	2	5.4	3	13.0
20 to 30	5	13.5	6	26.1
30 to 40	3	8.1	2	8.7
40 to 50	5	13.5	2	8.7
50 to 60	5	13.5	3	13.0
60 to 70	2	5.4	2	8.7
70 to 80	3	8.1	1	4.3
80 to 90	3	8.1	0	0
>90	9	24.3	0	0

Bat Mortalities

A total of 26 bat mortalities were found during the second standardized year-long mortality monitoring study or incidentally during the study period, with twenty-one documented during scheduled turbine searches and five documented incidentally (two inside and three outside of search plots; Table 2). The bat species most commonly found during the study, either during scheduled searches or incidentally, was Mexican free-tailed bat (*Tadarida brasiliensis*; 10 carcasses). Western mastiff bat (*Eumops perotis*; three carcasses), pocketed free-tailed bat (*Nyctinomops femorosaccus*; three carcasses), western yellow bat (*Lasiurus xanthinus*; two carcasses), big free-tailed bat (*N. macrotis*; one carcass), and long-legged bat (*Macrophyllum macrophyllum*; one carcass) were the other bat species identified. The remaining six bat carcasses could not be identified to species. None of the bat species identified during the second standardized year-long fatality or incidentally during the study period are federal or state listed species. The western mastiff bat (*Eumops perotis californicus*) is listed as a species of special concern by CDFW and is also listed as a BLM sensitive species.

Three bat carcasses were found at turbine 149; two bat carcasses were found at each of five turbines (Turbine T148, T173, T174, T31, and T93), and single carcasses were found at 10 other search turbines (Figure 7 and Figure 8a). The lack of strong patterns in the spatial distribution of bat carcasses suggests no large differences in bat mortality by location within the Project. Of the bat mortalities, 73.9% were found within 50 m (164 ft) of the turbine, and no bat mortalities were found greater than 75 m (230 ft) from a turbine (Table 3). Temporally, bat fatalities were concentrated in the late spring (March and April), late summer (early to mid-July), and in early fall (mid-August into early October; Figure 8b).

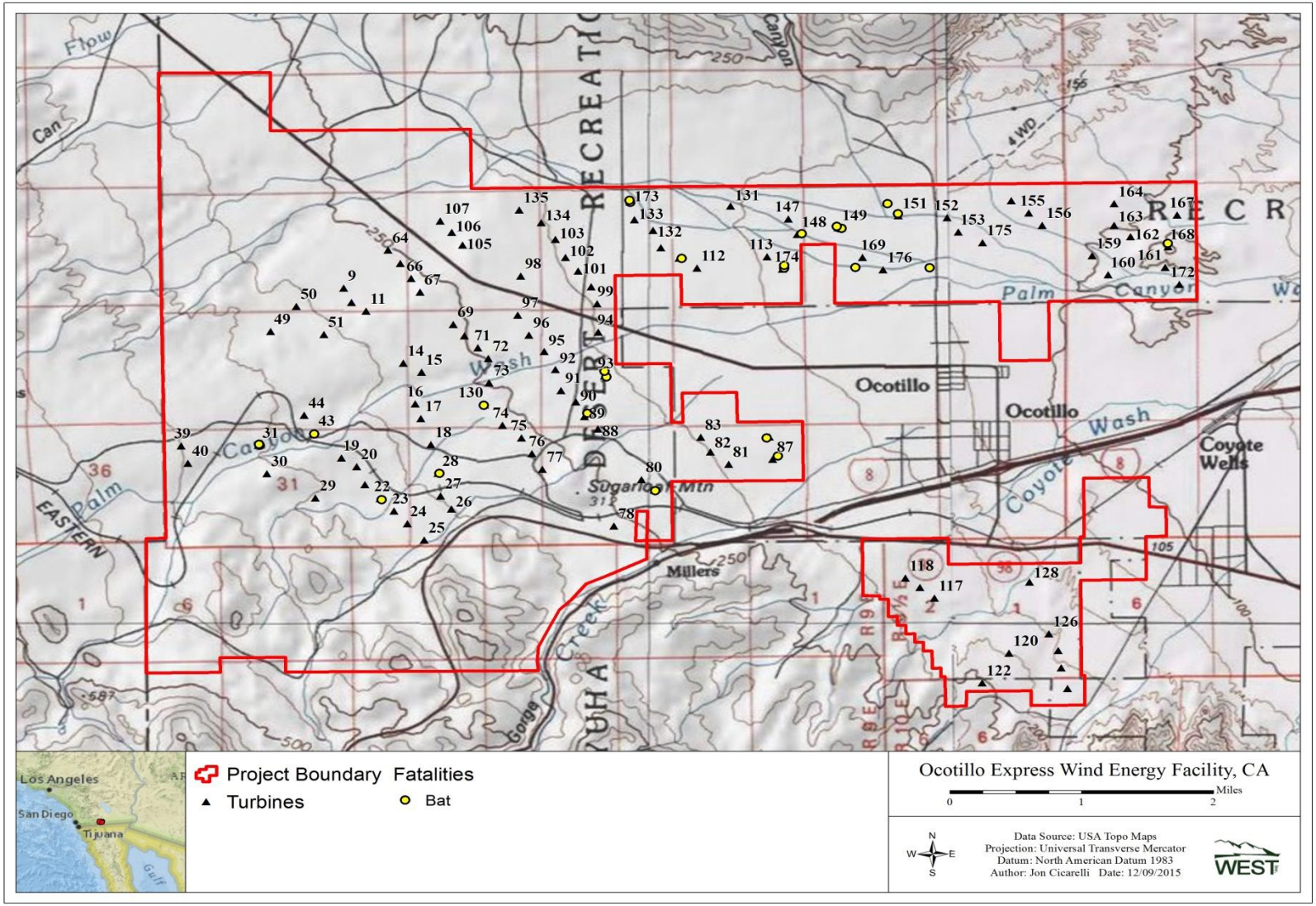


Figure 7. Location of all bat carcasses found during the second standardized year-long fatality study or incidentally during the study period at the Ocotillo Express Wind Energy Facility.

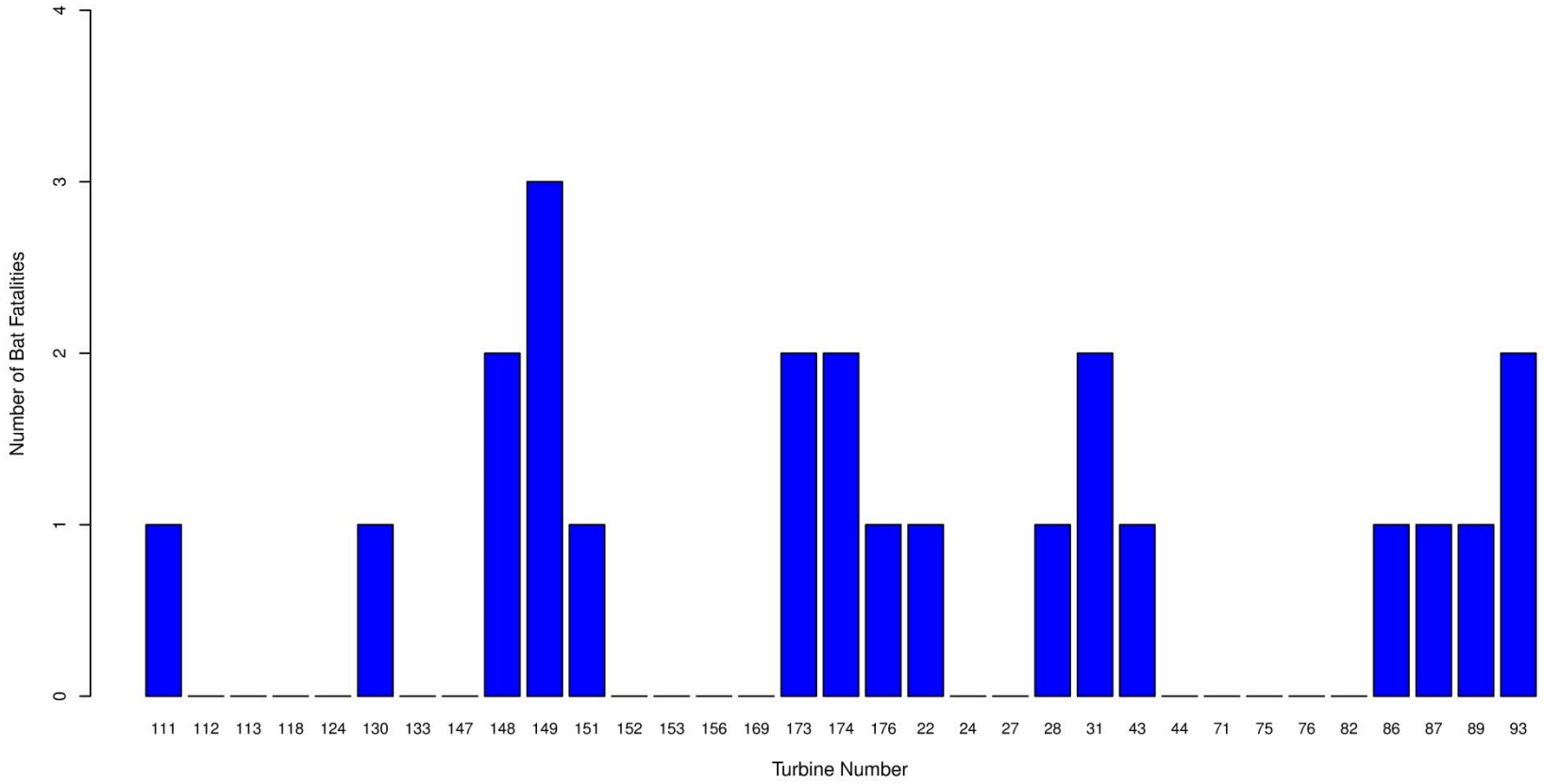


Figure 8a. Number of bat mortalities by turbine found during year-long scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

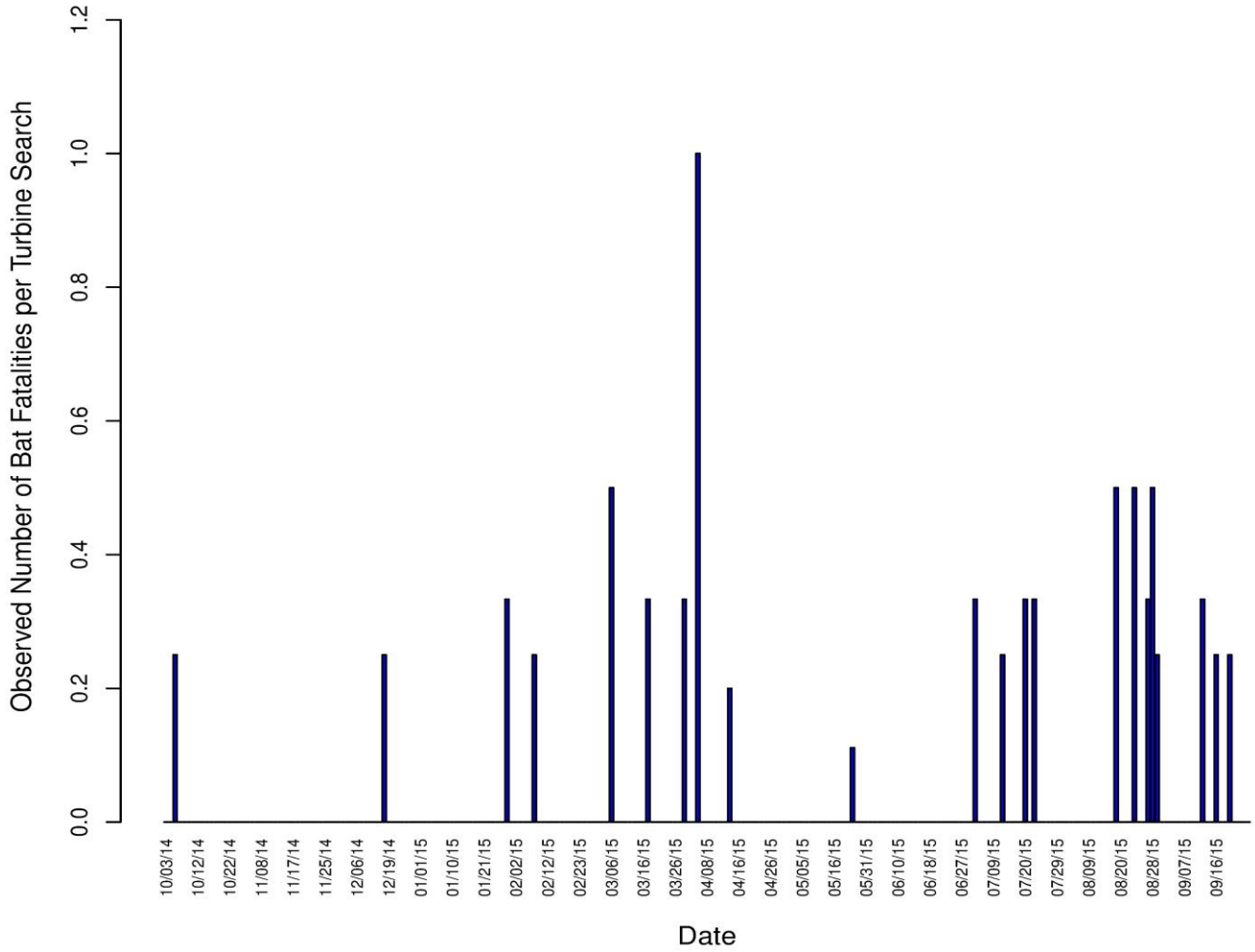


Figure 8b. Timing of bat mortalities found during scheduled searches or incidentally on turbine search plots at the Ocotillo Express Wind Energy Facility.

Searcher Efficiency Trials

Searcher efficiency trials were conducted throughout the year-long study period and included 119 small bird and 49 large bird trial carcasses. As bats were not used during searcher efficiency trials due to sample sizes and the small number of bats available from the site, efficiency trial data for small birds was used for bats (Table 4). The overall searcher efficiency rate for small birds (and bats) was 79.8%, while the efficiency rate for large birds was 95.8%, which is similar to the rates observed during the first year of study (73.4% for small birds and 94.3% for large birds). Efficiency rates did not differ significantly across seasons; therefore data were pooled and a single rate was used for each size class (small birds/bats and large birds).

Table 4. Searcher efficiency results at the Ocotillo Express Wind Energy Facility by date and carcass size.

Size	Date	# Placed	# Available	# Found	% Found
Small Birds	9/27/2014	15	15	13	86.7
	11/8/2014	19	19	15	78.9
	12/13/2014	15	15	10	66.7
	1/31/2015	14	13	13	100
	4/25/2015	17	13	8	61.5
	5/28/2015	19	19	19	100
	6/18/2015	10	10	7	70.0
	7/27/2015	10	10	6	60.0
Total		**119**	**114**	**91**	**79.8**
Large Birds	9/27/2014	4	4	4	100
	11/8/2014	5	5	5	100
	12/13/2014	4	4	4	100
	1/31/2015	5	5	5	100
	4/25/2015	6	5	4	80.0
	5/28/2015	5	5	4	80.0
	6/18/2015	10	10	10	100
	7/27/2015	10	10	10	100
Total		**49**	**48**	**46**	**95.8**

Carcass Removal Trials

Nine carcass removal trials were conducted throughout the study period. In total, 90 large bird and 90 small bird carcasses were placed (Table 5). No bat carcasses were used during removal trials. Trials were distributed throughout the seasons. Removal rates differed among the four seasons for small birds and large birds, thus four rates were applied to estimate annual small bird/bat and large bird mortality rates. Average removal times for small birds/bats were 11.95 days in winter, 9.18 days in spring, 6.90 days in summer, and 2.47 days in fall, while the average removal time for large birds were 19.13 days in winter, 19.41 days in spring, 17.32 days in summer, and 16.23 days in fall (Figure 9 and Appendix B).

Table 5. Carcass removal trials conducted at the Ocotillo Express Wind Energy Facility, August 19, 2014 – August 17, 2015.

Start Date	# Large Birds Placed	# Small Birds Placed	# Bats Placed
8/19/2014	10	10	0
9/18/2014	10	10	0
11/13/2014	10	10	0
1/14/2015	10	10	0
3/30/2015	10	10	0
4/20/2015	10	10	0
6/8/2015	10	10	0
7/6/2015	10	10	0
8/17/2015	10	10	0
	90	**90**	**0**

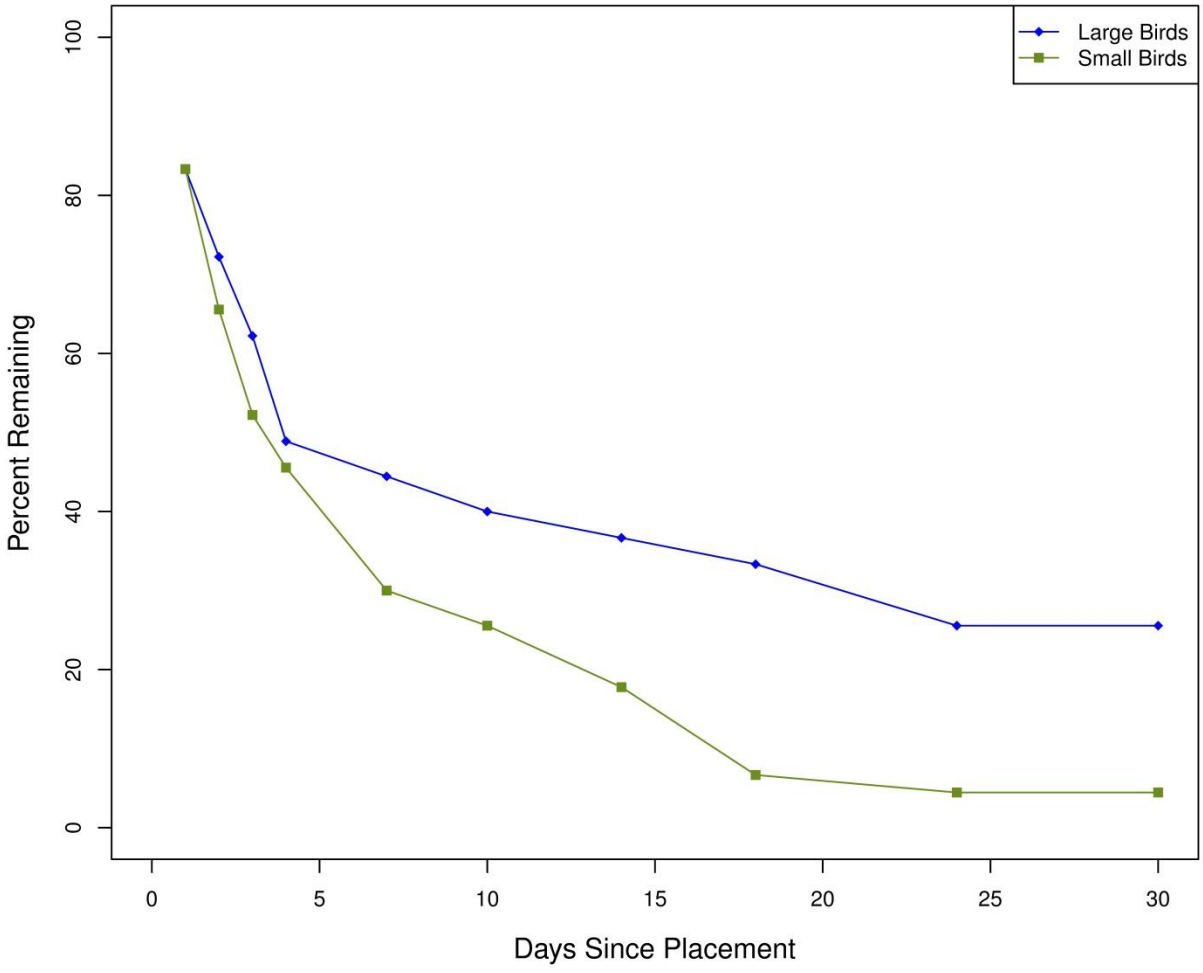


Figure 9. Carcass removal rates at the Ocotillo Express Wind Energy Facility.

Adjusted Fatality Estimates

Fatality estimates and 90% confidence intervals were calculated for birds and bats (Table 6, Appendix B). The fatality estimates were adjusted based on the corrections for carcass removal and observer detection bias (Appendix B). Searcher efficiency rates were consistent throughout the entire study period and therefore the same rates were applied across all seasons. However, since removal rates differed among seasons for small birds and large birds, four rates were applied to estimate annual small bird/bat and large bird mortalities. For small birds and bats, the probability that a carcass would remain in a search plot and be found by a searcher was 0.48 in winter, 0.41 in spring, 0.33 in summer, and 0.13 in fall. For large birds, the probability was 0.68 in winter and spring, 0.65 in summer, and 0.63 in fall (Appendix B).

Since the study consisted of two different plot sizes, we estimated two different sets of annual fatality rates (one using data from 33 160 X 160-m plots and one using data from only the five 270 X 270-m plots). The resulting annual fatality estimates from the larger plots were close to, and in some cases lower, than the annual fatality estimates for the smaller plots across all categories (small birds, large birds, and bats). In order to facilitate comparison with other studies, the results presented here include only the annual fatality estimates resulting from the 33 160 X 160-m plots (Table 6). However, additional details of the two different plot sizes are provided in the discussion section below.

Table 6. Adjusted bird and bat mortality estimates for the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015.

	Corrected Mortality Estimates[1]	
Species Category	**# mortalities/turbine/study period**	**90% Confidence Intervals**
Small birds	2.87	(1.97, 4.18)
Large birds	0.28	(0.11, 0.51)
Raptors	0.09	-[2]
All birds	3.15	(2.02, 4.23)
Bats	3.33	(2.06, 4.97)
Species Category	**# mortalities/MW/study period**	**90% Confidence Intervals**
Small birds	1.25	(0.85, 1.82)
Large birds	0.12	(0.05, 0.22)
Raptors	0.04	-[2]
All birds	1.37	(0.88, 1.84)
Bats	1.45	(0.90, 2.16)

[1]For details concerning correction factors and confidence intervals for both bird and bat mortality estimates, refer to Appendix B.
[2]Confidence intervals are not reported for categories with five or fewer mortalities

Small Birds

The estimated annual mortality rate for small birds was 2.87 mortalities/turbine/year or 1.25 mortalities/MW/year (Table 6). A detailed breakdown of mortality rates and the associated correction factors is presented in Appendix B.

Large Birds

The estimated annual mortality rate for large birds was 0.28 mortalities/turbine/year or 0.12 mortalities/MW/year (Table 6). A detailed breakdown of mortality rates and the associated correction factors is presented in Appendix B.

All Birds

The estimated annual mortality rate for all birds was 3.15 mortalities/turbine/year or 1.37 mortalities/MW/year (Table 6). A detailed breakdown of mortality rates and the associated correction factors is presented in Appendix B.

Raptors

Two red-tailed hawks were discovered (one incidentally; one during scheduled searches) during the study period. The estimated annual mortality rate for raptors was 0.09 mortalities/turbine/year or 0.04 mortalities/MW/year (Table 6). A detailed breakdown of mortality rates for raptors and the associated correction factors is presented in Appendix B.

Bats

The estimated annual mortality rate for all bats was 3.33 mortalities/turbine/year or 1.45 mortalities/MW/year (Table 6). A detailed breakdown of bat mortality rates and the associated correction factors is presented in Appendix B.

Avian Monitoring

Fixed-Point Avian Use Surveys

Twenty-four rounds of fixed-point avian use surveys were conducted at 21 survey stations from October 3, 2014, through September 25, 2015, resulting in 504 fixed-point surveys (Table 7). Two viewsheds were utilized for all calculations: 800 m for large birds and 100 m for small birds.

Table 7. Species richness (species/plot[a]/30-min survey), and sample size by season and overall during the fixed-point bird use surveys at the Ocotillo Express Wind Resource Area from October 3, 2014 – September 25, 2015.

Season	Number of Visits	# Surveys Conducted	# Unique Species	Species Richness	
				Large Birds	Small Birds
Fall	5	105	16	0.22	1.26
Winter	7	147	18	0.26	1.69
Spring	6	126	19	0.42	1.87
Summer	6	126	19	0.38	1.05
Overall	**24**	**504**	**27**	**0.32**	**1.49**

[a] 800-m radius for large birds and 100-m radius for small birds.

Bird Diversity and Species Richness

Twenty-seven unique bird species were observed during fixed-point surveys (Table 7). The most abundant species observed were house finch (*Haemorhous mexicanus*; 301 observations; 18.1% of all observations), common raven (*Corvus corax*; 177 observations; 10.7% of all observations), and rock wren (*Salpinctes obsoletus*; 152 observations; 9.2% of all observations;

Appendix C). Species richness (i.e., the number of species observed per plot per survey) was lowest in the summer for small birds, and lowest in the fall for large birds, whereas species richness was highest in the spring for both large and small bird types (Table 7).

Bird Use

Diurnal raptor use varied from 0.02 raptors/800-m plot/30-min survey during the fall to 0.14 raptors/800-m plot/30-min survey during the spring (Appendix D1). Diurnal raptor use was greatest during the spring, with red-tailed hawk accounting for all of the raptor use observed during the spring season. Red-tailed hawk accounted for 100% of raptor use during fall, winter, and spring (Appendix D1), and almost 100% of raptor use during summer (Appendix D1). American kestrel (*Falco sparverius*) and unidentified raptors accounted for the remainder of raptor use in the summer season (Appendix D1).

Passerine use ranged from 1.32 birds/100-m plot/30-min survey in the summer to 2.58 birds/100-m plot/30-min survey in the spring (Appendix D2). Passerine use was dominated by black-throated sparrows (*Amphispiza bilineata*), cactus wrens (*Campylorhynchus brunneicapillus*), house finches, and rock wrens. House finch accounted for 27.1% of passerine use in fall, 28.0% in spring, and 28.3% in summer (Appendix D2). Black-throated sparrow accounted for 18.4% of passerine use in fall and 21.3% in summer. Cactus wren accounted for 19.0% of passerine use in summer, and rock wren accounted for 21.3% of passerine use in fall and 16.9% in winter (Appendix D2).

Bird Exposure Index

A relative exposure index based on initial flight height observations and relative abundance (defined as the use estimate) was calculated for each bird species. Those species that had exposure to the RSH are listed in Appendices E1 and E2. All other species observed had exposure indices of zero, as none were observed flying within the RSH at the point of initial observation. The exposure index does not account for other possible collision risk factors, such as foraging or courtship behavior, nor does it account for avoidance behaviors. For example, although common raven had the highest exposure index of any species (0.11; Appendix E1) during the study, no common ravens were found as mortalities. Red-tailed hawk, turkey vulture (*Cathartes aura*), and great-tailed grackle (*Quiscalus mexicanus*) were the only other identified large bird species with exposure indices greater than zero (ranging from 0.01 for great-tailed grackle to 0.03 for red-tailed hawk and turkey vulture; Appendix E1). Small birds with an exposure index greater than zero included house finch (0.04) and yellow-rumped warbler (less than 0.01; Appendix E2).

Spatial Use

For all large bird species combined, use was highest at Point 18 (3.04 birds/plot/30-min survey); Appendix F). Large bird use at other points ranged from 0.08 to 1.46 birds/30-min survey (Appendix F). The mean use estimate for Point 18 was largely due to relatively high dove/pigeon use (2.71 birds/plot/30-min survey; Appendix F). Similar to the 2013-2014 avian use study, diurnal raptor use was highest at Point 17 (0.54 birds/plot/30-min survey; Appendix F). Point 17 was located in close proximity to transmission towers with an active red-tailed hawk

nest and it is likely that the relatively higher use was due to the proximity to the active nest. Point 7, with corvid use of 1.21 birds/plot/30-min survey (Appendix F), was located in close proximity to a transmission tower with an active common raven nest. Small bird use, dominated by passerines, was greatest at Point 17 (4.79 birds/plot/30-min survey) compared to other points, where it ranged from 0.62 to 4.29 birds/plot/30-min survey (Appendix F).

Flight paths of diurnal raptors and vultures were digitized and mapped (Appendix G). Based on the fixed-point survey data, no obvious flyways or concentration areas were observed for any raptor species, which suggests that no particular portion of the OWEF seems to be of greater risk to flying raptors than other areas within the OWEF.

DISCUSSION

Year-Long Mortality Monitoring

The approach used for calculating adjusted fatality estimates is consistent with the approach outlined by Shoenfeld (2004) and Erickson (2006), and accounted for search interval, searcher efficiency rates, and carcass removal rates. It is hypothesized that scavenging could change through time at a given site and must be accounted for when attempting to estimate fatality rates. We accounted for this by conducting scavenging trials throughout the year. We also estimated searcher efficiency rates throughout the study period to account for potential biases associated with changes in conditions that could have influenced searcher efficiency.

There are numerous factors that could contribute to both positive and negative biases in estimating fatality rates (Erickson 2006) and the overall design of this study incorporates several assumptions or factors that affect the results of the mortality estimates. First, all bird casualties found within the standardized search plots, either during a scheduled search or incidentally, were included in the analysis. Second, it was assumed that all carcasses found during the study on search plots were a result of collision with wind turbines; the true cause of death is unknown for most of the mortalities. It is possible that some of the bird mortalities were caused by predators and that some of the mortalities included in the data were potentially due to natural causes (background mortality), however, to be conservative, all mortalities were included in the estimates. It is less likely that bat fatalities were due to factors unrelated to interactions with wind turbines.

There are some other potential negative biases. For example, no adjustments were made for mortalities possibly occurring outside of the plot boundaries. While this could potentially lead to an underestimate of mortality, to help address this issue, two different plot sizes were searched during the study (160 X 160-m and 270 X 270-m plots). The estimates of annual mortality using the data from the larger plots were comparable or lower than the estimates from the smaller plot sizes (2.00 small birds/turbine/year compared to 2.87 small birds/turbine/year, 0.32 large birds/turbine/year compared to 0.28 large birds/turbine year, 2.31 all birds/turbine year compared to 3.15 all birds/turbine/year, and 3.65 bats/turbine/year compared to 3.33 bats/turbine/year).

Regardless of plot size, a total of 60 carcasses were found within standardized search plots (37 bird and 23 bats). During the first study year, 30 carcasses (19 birds and 11 bats) were found within standardized search plots. At the five turbines for which larger plots were searched, a total of 10 carcasses were found (five birds and five bats) and of those, one bird carcass was found in the portion of the plot that did not overlap with the smaller 160 X 160-m plot. During the first year of the study, nine carcasses (seven birds and two bats) were found at the five turbines for which larger plots were searched and of those carcasses, three bird carcasses were found in the portion of the plot that did not overlap with a smaller 160 X 160-m plot. No bat carcasses were found beyond 75 m from a turbine during the study. If we assume that on average the distribution of bird carcasses by distance is similar across the Project, we would expect to have found approximately six additional bird carcasses during the second year of study if we would have searched all 33 turbines at 270 X 270-m plots. However, estimates from 270 X 270-m plots are not necessarily comparable to the vast majority of publicly available fatality studies as smaller plots are typically searched during fatality monitoring studies.

While there are a number of factors that could be influencing the observed results (e.g. sample sizes, specific search plots, one year of data), given the level of estimated annual mortality and taking into account mortalities that might be expected to fall outside of the smaller 160 X 160-m plots, searching the larger plots does not change the overall assessment that estimated annual mortality rates at the OWEF are considered low relative to other comparable studies (see the discussion of comparisons to other mortality rates below).

Other potential biases are associated with the experimental carcasses used in searcher efficiency and carcass removal trials and whether or not they are representative of actual carcasses. This may occur for example, if the types of birds used are larger or smaller than the carcasses of mortalities or more or less cryptic in color than the actual mortalities. Rock pigeons, mallards, Coturnix quail (*Coturnix japonica*), and house sparrows were used to represent the range of bird mortalities expected. It is believed that this variety of species approximates the range of sizes and other characteristics of actual mortalities and should be a reasonable representation of scavenging rates for birds as a group. For the study, we are assuming that small birds are representative of bats, which may or may not be correct; however, small birds are used as surrogates for bats in many of the other mortality studies at wind energy projects.

Concern has also been raised regarding how the number of carcasses placed in the field for carcass removal trials on a given day could lead to biased estimates of scavenging rates. Hypothetically, this would lead to underestimating true scavenging rates if the scavenger densities are low enough such that scavenging rates for placed carcasses are lower than for actual fatalities (Smallwood 2007, Smallwood et al. 2010). The logic is that if the trials are based on too many carcasses being placed on a given day, scavengers are unable to access all trial carcasses, whereas they could access all wind turbine collision fatalities. If this is the case, and the trial carcass density is much greater than actual turbine fatality density, the trials would underestimate scavenging rates compared to rates on actual fatalities. Carcass removal trials

were conducted throughout the year with limited numbers of carcasses of each size class placed in the field during each trial. No more than 10 small bird and 10 large bird carcasses were placed in the field during an individual trial. Carcasses were placed throughout the Project to maintain dispersion and eliminate attraction of scavengers and/or overwhelming the local scavenger population.

Bird Fatalities

A total of 37 bird mortalities were found during the second standardized year-long mortality monitoring study, with 33 of those found during scheduled searches (the remaining four were found incidentally, but were within search plots, and as such, were included in the mortality estimates). With the exception of Townsend's warbler (four individuals found), a maximum of three individuals were found for each of the other 12 species identified. No state- or federal-listed threatened or endangered bird species were documented as mortalities. Two BCC species in BCR 33 (yellow warbler and Costa's hummingbird) were documented as mortalities during the study.

The estimated overall bird mortality rate of 1.37 birds/MW/year was relatively low compared to other wind energy facilities in North America (where estimates have ranged from 0.06 to 17.44 birds/MW/year and the California and the desert southwest where estimates have ranged from 0.55 to 17.44 birds/MW/year (Figures 10 and 11, Appendix H1). The overall bird mortality rate at the OWEF ranked sixth lowest compared to 23 other studies at facilities in California and the desert southwest (Figure 10). Based on the relatively low estimate of avian mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bird populations.

Raptor Mortalities

Two raptor mortalities (red-tailed hawk) were documented within the OWEF, one incidentally and one during scheduled searches. During the first standardized year-long mortality monitoring study, one raptor mortality (red-tailed hawk) was documented incidentally within the OWEF. While red-tailed hawks are protected under the Migratory Bird Treaty Act (MBTA), the red-tailed hawk is not considered a sensitive species in California. The estimated overall raptor mortality rate of 0.04 raptors/MW/year was relatively low compared to other wind energy facilities in North America (where estimates have ranged from zero to 1.06 raptors/MW/year) as well as in California and the desert southwest where estimates have ranged from zero to 1.06 raptors/MW/year (Figures 12 and 13, Appendix H2). The overall raptor mortality rate at the OWEF ranked fifth lowest compared to 19 other studies at facilities in California and the desert southwest (Figure 11). Based on the relatively small estimate of raptor mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional raptor populations.

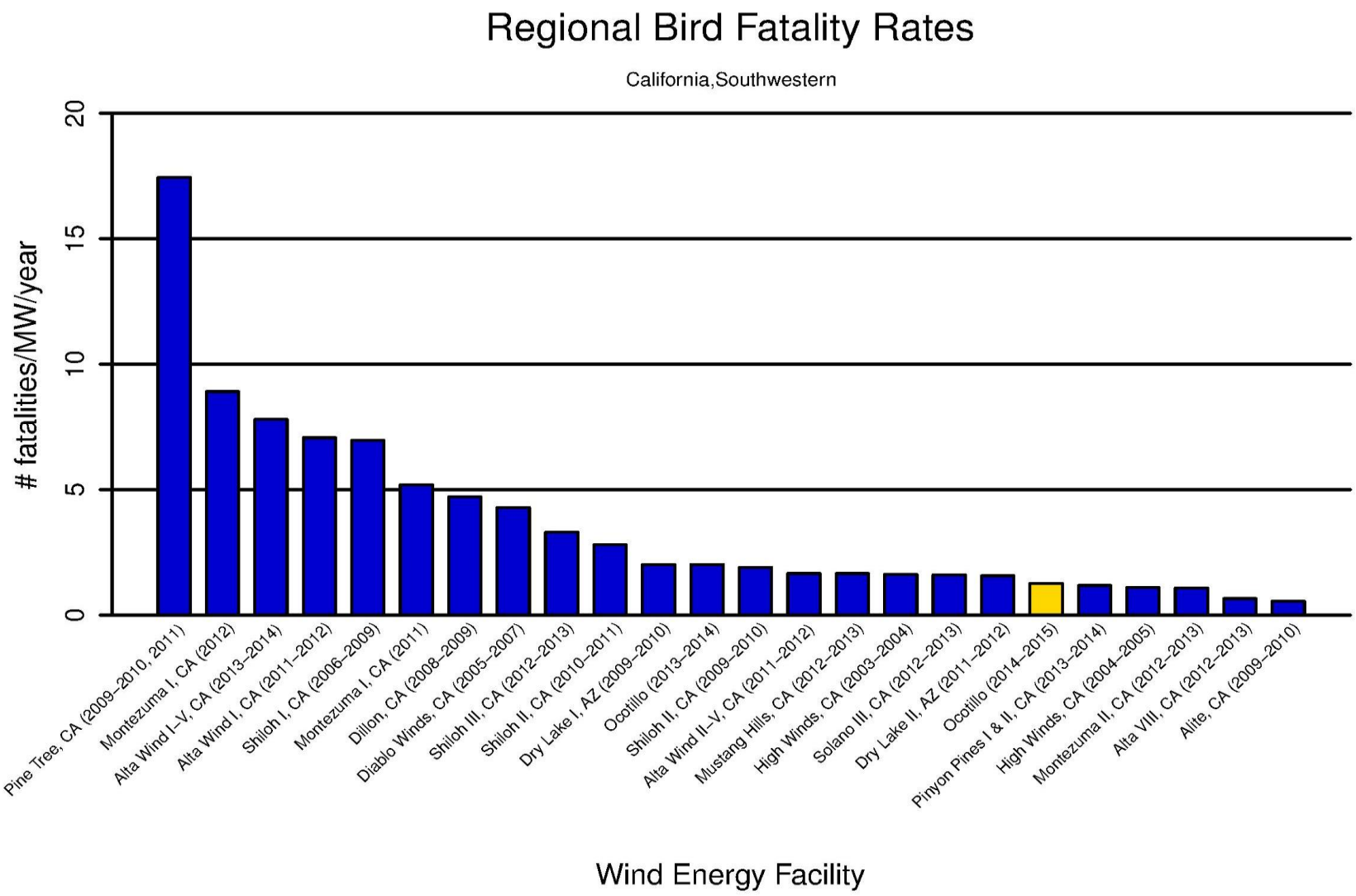


Figure 10. Fatality rates for all birds (number of birds per MW per year) from publicly-available studies of wind energy facilities In California and the desert southwest.

Figure 10 (*Continued*). Fatality rates for all birds (number of birds per MW per year) from publicly-available studies of wind energy facilities in California and the desert southwest.

Data From The Following Sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Ocotillo, CA (13-14)	This Study.				
Pine Tree, CA (09-10, 11)	Bioresource Consultants 2012	Shiloh III, CA (12-13)	Kerlinger Et Al. 2013b	Solano III, CA (12-13)	AECOM 2013
Montezuma I, CA (12)	ICF International 2012	Shiloh II, CA (10-11)	Kerlinger Et Al. 2013a	Dry Lake II, AZ (11-12)	Thompson And Bay 2012
Alta Wind I-V, CA (13-14)	Chatfield Et Al. 2014	Dry Lake I, AZ (09-10)	Thompson Et Al. 2011	Pinyon Pines I & II, CA (13-14)	Chatfield And Russo 2014
Alta Wind I, CA (11-12)	Chatfield Et Al. 2012	Ocotillo, CA (12-13)	WEST 2015	High Winds, CA (04-05)	Kerlinger Et Al. 2006
Shiloh I, CA (06-09)	Kerlinger Et Al. 2009	Shiloh II, CA (09-10)	Kerlinger Et Al. 2010b	Montezuma II, CA (12-13)	Harvey & Associates 2013
Montezuma I, CA (11)	ICF International 2012	Alta Wind II-V, CA (11-12)	Chatfield Et Al. 2012	Alta VIII, CA (12-13)	Chatfield And Bay 2014
Dillon, CA (08-09)	Chatfield Et Al. 2009	Mustang Hills, CA (12-13)	Chatfield And Bay 2014	Alite, CA (09-10)	Chatfield Et Al. 2010b
Diablo Winds, CA (05-07)	WEST 2006, 2008	High Winds, CA (03-04)	Kerlinger Et Al. 2006		

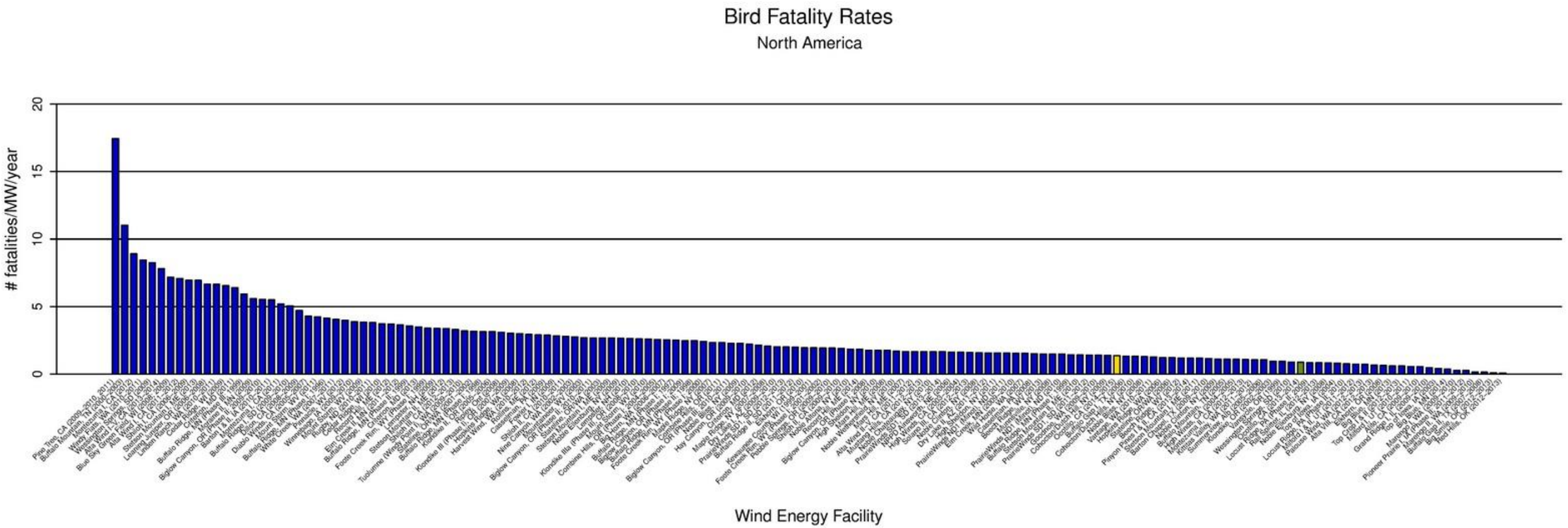


Figure 11. Fatality rates for all birds (number of birds per MW per year) from publicly-available studies in North America. Ocotillo Express Wind Energy Facility Year 1 data is in olive green, Ocotillo Year 2 data is in yellow. Data sources may be found in Appendix H.

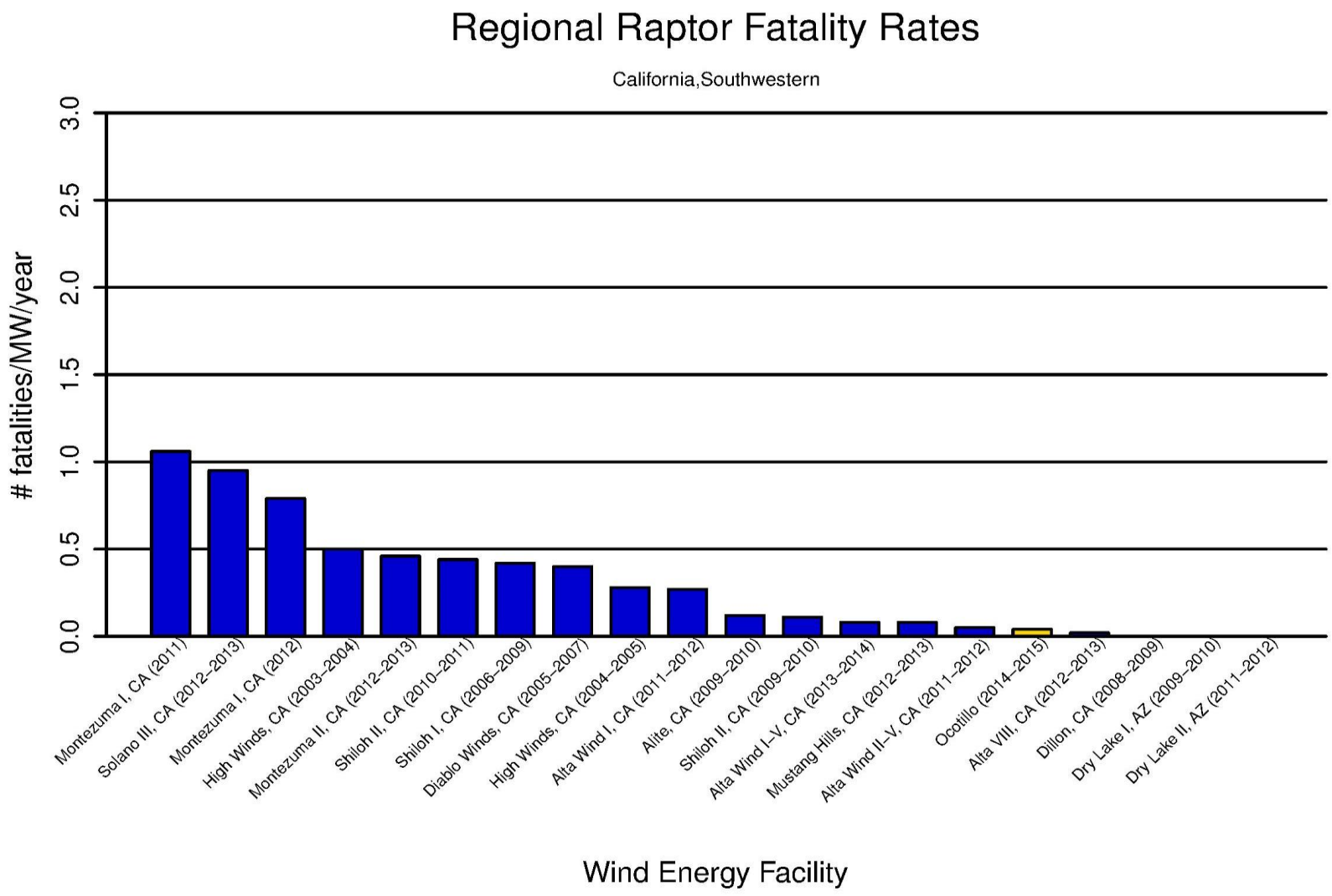


Figure 12. Fatality rates for raptors (number of raptors per MW per year) from publicly-available studies at wind energy facilities in California and the desert southwest.

Figure 12 (*continued*). Fatality rates for raptors (number of raptors per MW per year) from publicly-available studies of wind energy facilities in California and the desert southwest.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Ocotillo, CA (14-15)	This study.				
Montezuma I, CA (11)	ICF International 2012	Diablo Winds, CA (05-07)	WEST 2006, 2008	Alta Wind II-V, CA (11-12)	Chatfield et al. 2012
Solano III, CA (12-13)	AECOM 2013	High Winds, CA (04-05)	Kerlinger et al. 2006	Alta VIII, CA (12-13)	Chatfield and Bay 2014
Montezuma I, CA (12)	ICF International 2012	Alta Wind I, CA (11-12)	Chatfield et al. 2012	Dillon, CA (08-09)	Chatfield et al. 2009
High Winds, CA (03-04)	Kerlinger et al. 2006	Alite, CA (09-10)	Chatfield et al. 2010b	Dry Lake I, AZ (09-10)	Thompson et al. 2011
Montezuma II, CA (12-13)	Harvey & Associates 2013	Shiloh II, CA (09-10)	Kerlinger et al. 2010b	Dry Lake II, AZ (11-12)	Thompson and Bay 2012
Shiloh II, CA (10-11)	Kerlinger et al. 2013a	Alta Wind I-V, CA (13-14)	Chatfield et al. 2014		
Shiloh I, CA (06-09)	Kerlinger et al. 2009	Mustang Hills, CA (12-13)	Chatfield and Bay 2014		

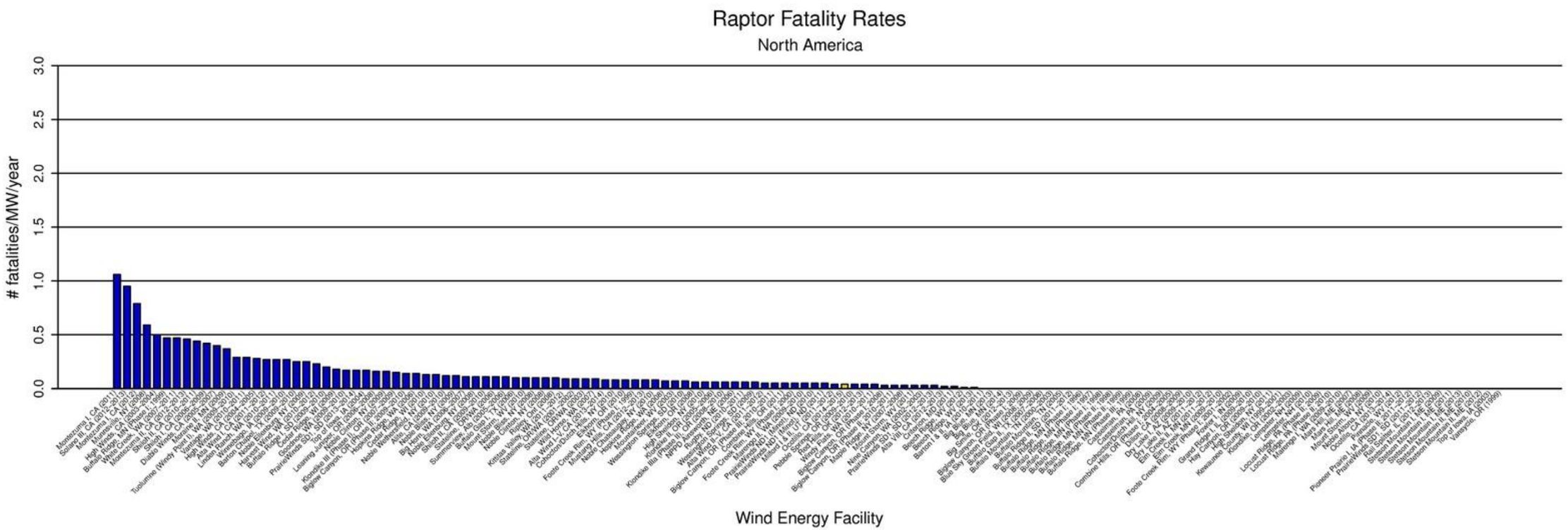


Figure 13. Fatality rates for raptors (number of raptors per MW per year) from publicly-available studies in North America. Ocotillo Express Wind Energy Facility Year 2 data is in yellow. Data sources may be found in Appendix H.

Bat Mortalities

A total of 26 bats (including 21 found during standardized searches, two incidentals on search plots, and three incidentals off plots) were discovered during the second year-long mortality monitoring study. Mexican free-tailed bats accounted for 38.5% of all documented bat mortalities, while unidentified free-tailed bats accounted for 15.4%, western mastiff bat and pocketed free-tailed bats each accounted for 11.5%, western yellow and unidentified bats each accounted for 7.7%, and big free-tailed and long-legged bats each accounted for 3.9%. None of the bat species identified during the first year-long fatality study are federally listed species, although one species (western mastiff) is designated as a species of special concern by the CDFW and is also listed as a BLM sensitive species. The estimated overall bat mortality rate at the OWEF (1.45 bats/MW/year) was considered moderate relative to other wind energy facilities in California and the desert southwest with publicly available bat fatality data (Figure 14, Appendix H3). Bat mortality rates at these other facilities in California and the desert southwest ranged from zero to 3.92 bats/MW/year (Appendix H3). However, the estimated mortality rate at the OWEF, is considered low relative to publicly available bat mortality rates across North America where reported bat mortality rates have ranged from zero to 40.2 bats/MW year and averaged approximately 5 bats/MW/year (Figure 15; Appendix H4). Based on the estimate of bat mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bat populations.

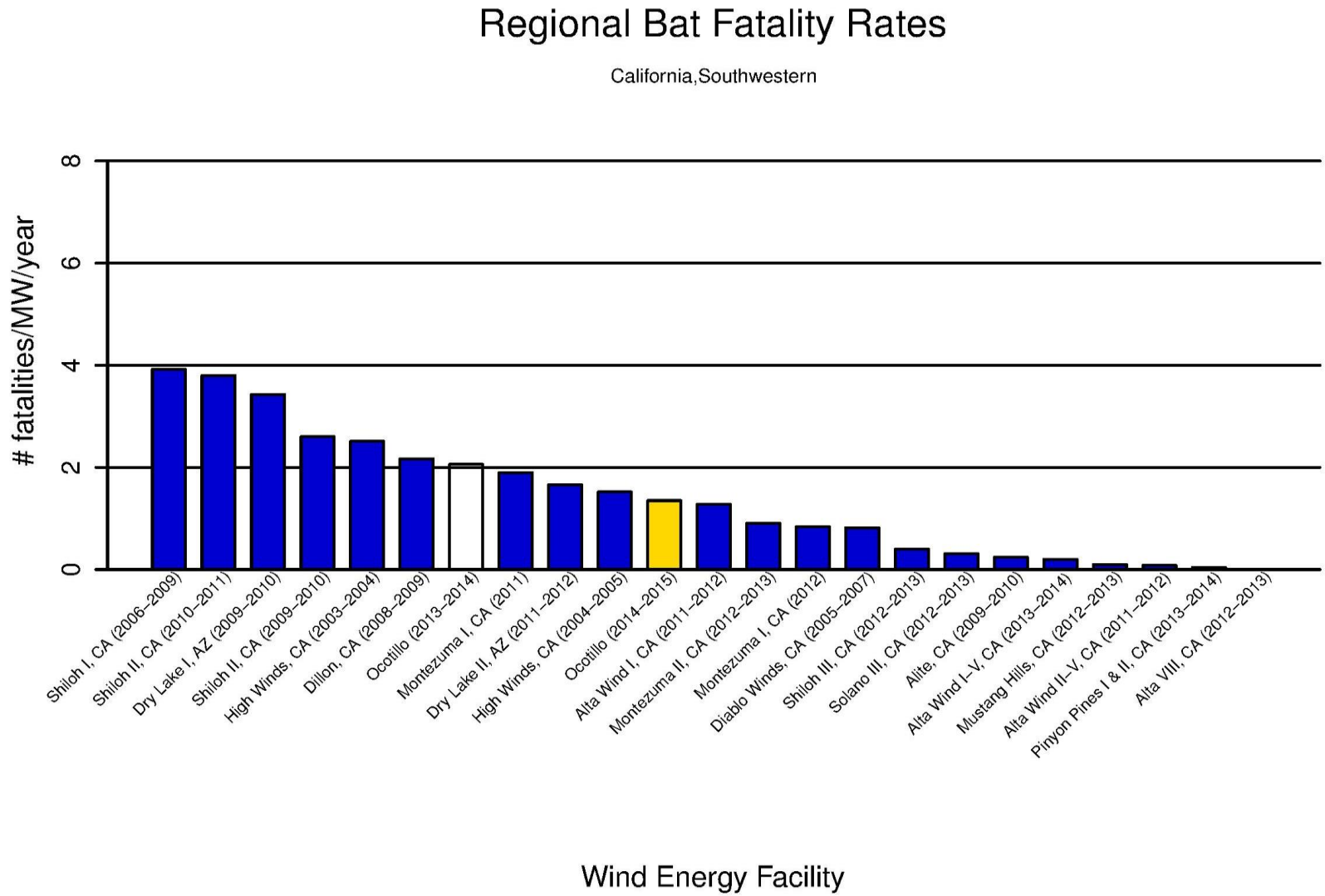


Figure 14. Fatality rates for bats (number of bats per MW per year) from publicly-available studies at wind energy facilities in California and the desert southwest.

Figure 14 (*continued*). Fatality rates for bats (number of bats per MW per year) from publicly-available studies of wind energy facilities in California and the desert southwest.

Data from the following sources:

Wind Energy Facility	Reference	Wind Energy Facility	Reference	Wind Energy Facility	Reference
Ocotillo, CA (13-14)	This study.				
Shiloh I, CA (06-09)	Kerlinger et al. 2009	Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Alite, CA (09-10)	Chatfield et al. 2010b
Shiloh II, CA (10-11)	Kerlinger et al. 2013a	High Winds, CA (04-05)	Kerlinger et al. 2006	Alta Wind I-V, CA (13-14)	Chatfield et al. 2014
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Alta Wind I, CA (11-12)	Chatfield et al. 2012	Mustang Hills, CA (12-13)	Chatfield and Bay 2014
Shiloh II, CA (09-10)	Kerlinger et al. 2010b	Montezuma II, CA (12-13)	Harvey & Associates 2013	Alta Wind II-V, CA (11-12)	Chatfield et al. 2012
High Winds, CA (03-04)	Kerlinger et al. 2006	Montezuma I, CA (12)	ICF International 2013	Pinyon Pines I&II, CA (13-14)	Chatfield and Bay 2014
Dillon, CA (08-09)	Chatfield et al. 2009	Diablo Winds, CA (05-07)	WEST 2006, 2008	Alta VIII, CA (12-13)	Chatfield and Bay 2014
Ocotillo, CA (12-13)	WEST 2015	Shiloh III, CA (12-13)	Kerlinger et al. 2013b		
Montezuma I, CA (11)	ICF International 2012	Solano III, CA (12-13)	AECOM 2013		

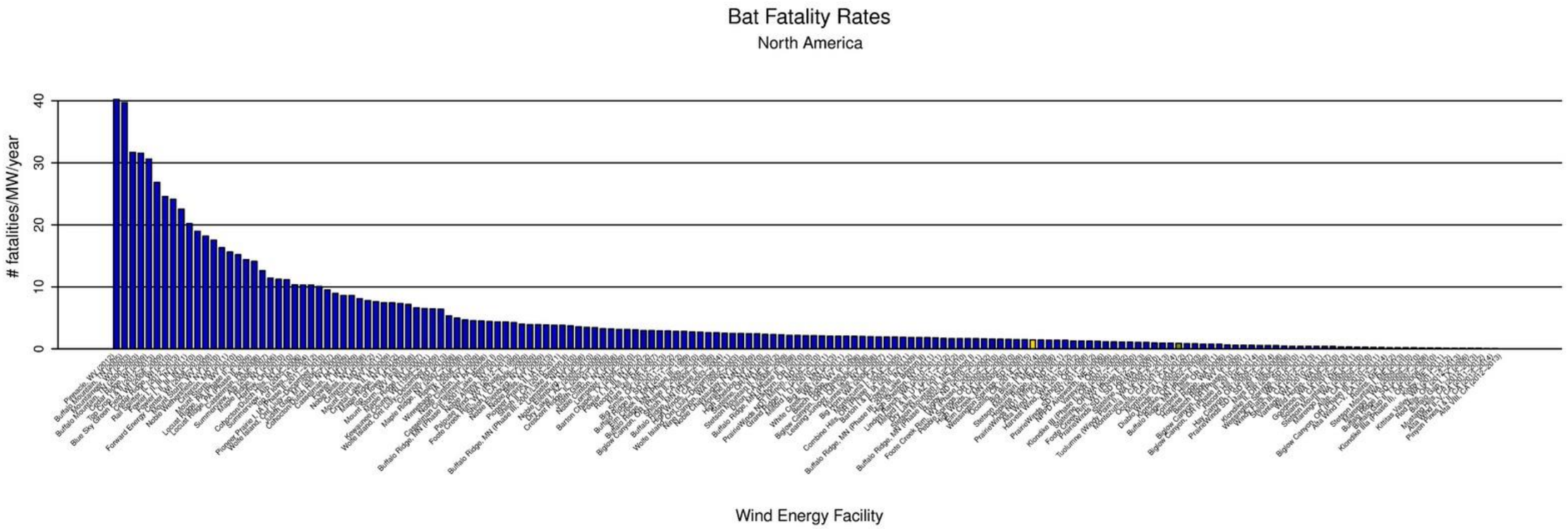


Figure 15. Fatality rates for bats (number of bats per MW per year) from publicly-available studies in North America. Ocotillo Express Wind Energy Facility Year 1 data is in olive green, Ocotillo Year 2 data is in yellow. Data sources may be found in Appendix H.

Avian Monitoring

Fixed-Point Avian Use Surveys

Based on the 2014-2015 avian use data, raptor use was highest in the spring (0.14 raptors/800-m plot/30-min survey) relative to the remaining seasons. Raptor use was highest in the spring (0.09 raptors/800-m plot/30-min survey) during the 2013-2014 study as well. The relatively higher raptor use measured in spring was primarily due to use by red-tailed hawk in both years. Red-tailed hawk had the highest exposure index of any raptor species. The only other raptors observed during the 2014-2015 avian use study were American kestrel and unidentified raptor. Overall, raptor use was relatively low compared to other projects where similar data have been collected (Figure 16). The relatively low raptor use observed at the Project is consistent with the low overall raptor mortality that has been observed during the first and second year of the standardized mortality monitoring study.

Similar to the first year of study, small bird use was greatest in the spring (2.89 birds/100-m plot/30-min survey) and winter (2.53 birds/100-m plot/30-min survey), and lower in the fall (1.79) and summer (1.38). This pattern of use by small birds is generally consistent with the observed bird mortalities, with more carcasses discovered in the spring, winter, and fall seasons, and fewer carcasses discovered during the summer.

During both the first and second year of the avian use study, common raven, black-throated sparrow, house finch, cactus wren, and rock wren were the most abundant bird species. All of these species were also among the most abundant species observed during the pre-construction studies. Avian abundance was slightly higher during the 2014-2015 study compared to the 2013-2014 study but is still considered low relative to the results of other publicly available studies with similar methodologies.

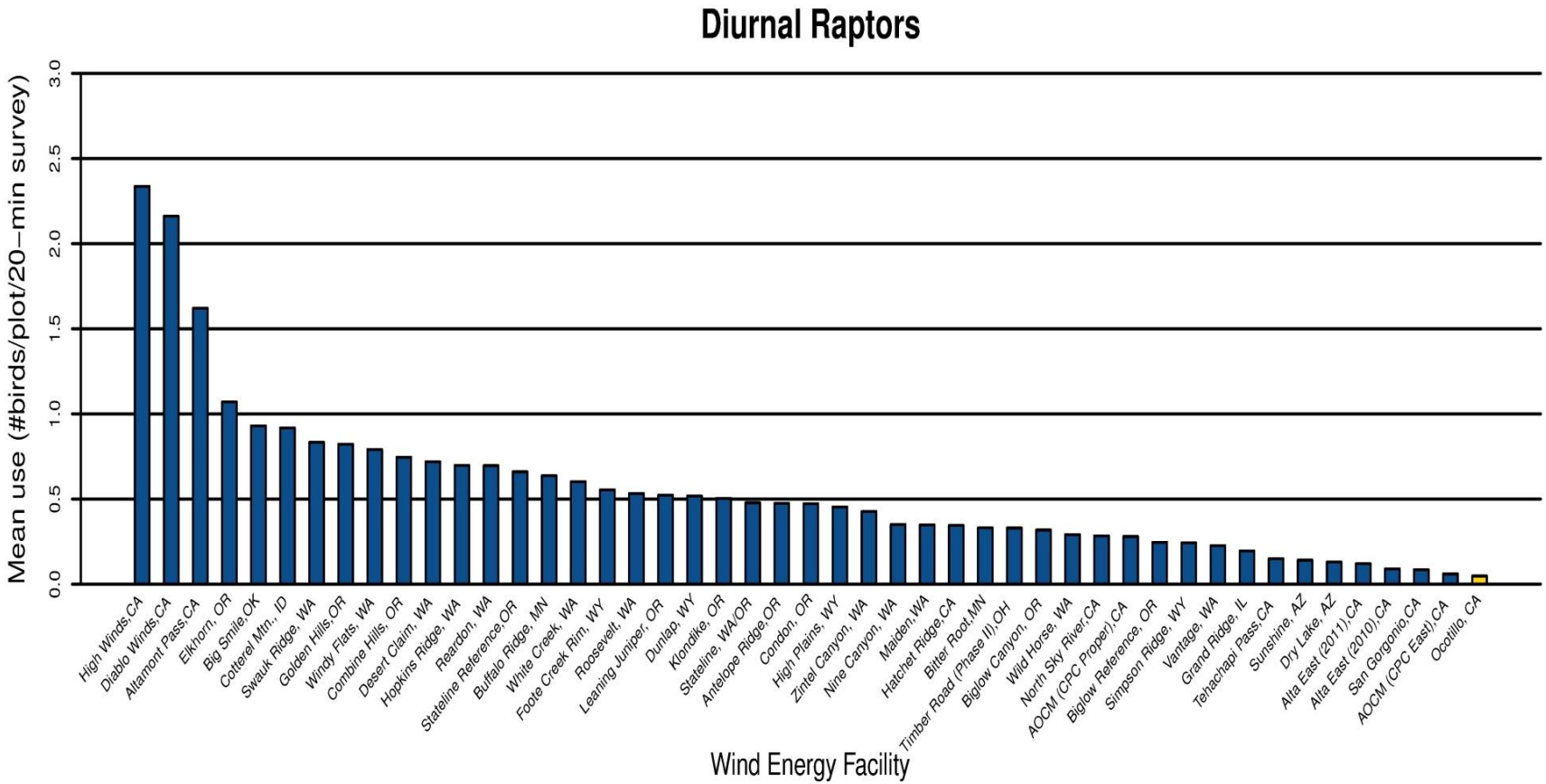


Figure 16. Comparison of estimated annual diurnal raptor use (raptors/800-m plot/20-min survey) during fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015, and diurnal raptor use at other wind resource areas with three or four other seasons of raptor use data.

Figure 16 (*continued*). Comparison of estimated annual diurnal raptor use (raptors/800-m plot/20-min survey) during fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015, and diurnal raptor use at other wind resource areas with three or four other seasons of raptor use data.

Data from the following sources:

Study and Location	Reference	Study and Location	Reference	Study and Location	Reference
Ocotillo, CA	This study				
High Winds, CA	Kerlinger et al. 2005	Foote Creek Rim, WY	Johnson et al. 2000b	Wild Horse, WA	Erickson et al. 2003d
Diablo Winds, CA	WEST 2006	Roosevelt, WA	NWC and WEST 2004	North Sky River, CA	Erickson et al. 2011
Altamont Pass, CA	Orloff and Flannery 1992	Leaning Juniper, OR	Kronner et al. 2005	AOCM (CPC Proper), CA	Chatfield et al. 2010a
Elkhorn, OR	WEST 2005a	Dunlap, WY	Johnson et al. 2009a	Biglow Reference, OR	WEST 2005c
Big Smile (Dempsey), OK	Derby et al. 2010a	Klondike, OR	Johnson et al. 2002	Simpson Ridge, WY	Johnson et al. 2000b
Cotterel Mtn., ID	BLM 2006	Stateline, WA/OR	Erickson et al. 2003a	Vantage, WA	Jeffrey et al. 2007
Swauk Ridge, WA	Erickson et al. 2003b	Antelope Ridge, OR	WEST 2009	Grand Ridge, IL	Derby et al. 2009
Golden Hills, OR	Jeffrey et al. 2008	Condon, OR	Erickson et al. 2002b	Tehachapi Pass, CA	Anderson et al. 2000, Erickson et al. 2002b
Windy Flats, WA	Johnson et al. 2007	High Plains, WY	Johnson et al. 2009b	Sunshine, AZ	WEST and the CPRS 2006
Combine Hills, OR	Young et al. 2003d	Zintel Canyon, WA	Erickson et al. 2002a, 2003c	Dry Lake, AZ	Young et al. 2007c
Desert Claim, WA	Young et al. 2003b	Nine Canyon, WA	Erickson et al. 2001	Alta East (2011), CA	Chatfield et al. 2011
Hopkins Ridge, WA	Young et al. 2003a	Maiden, WA	Young et al. 2002	Alta East (2010), CA	Chatfield et al. 2011
Reardon, WA	WEST 2005b	Hatchet Ridge, CA	Young et al. 2007b	San Gorgonio, CA	Anderson et al. 2000, Erickson et al. 2002b
Stateline Reference, OR	URS et al. 2001	Bitter Root. MN	Derby and Dahl 2009	AOCM (CPC East), CA	Chatfield et al. 2010a
Buffalo Ridge, MN	Johnson et al. 2000a	Timber Road (Phase II), OH	Good et al. 2010		
White Creek, WA	NWC and WEST 2005	Biglow Canyon, OR	WEST 2005c		

CONCLUSIONS

The second standardized year-long mortality monitoring study and avian use study at the OWEF were completed in the fall of 2015, with the conclusion of the 12 months of mortality surveys. This report presents the results of the second full year of standardized mortality surveys and avian use surveys. Additional carcass discoveries that occurred during the separate interim/large bird searches are not presented herein, but a comprehensive list of all carcasses discoveries at the facility are provided to the agencies on a monthly basis. The results of the second year of standardized studies have provided additional insights into the effects of the OWEF on wildlife, which are primarily supportive of the low level of predicted risk of the Project on wildlife. The first year of studies found that impacts to birds (including raptors) and bats were low compared to other wind energy projects in North America. The second year of the study also supported this conclusion, suggesting that the first year results, (which demonstrate low impacts to birds and bats), were not an anomaly or unusual, but rather representative of the impacts that can be expected at the OWEF. No federal- or state-listed species were identified during the first or second year-long standardized mortality monitoring studies. Two BCC species in BCR 33 (yellow warbler and Costa's hummingbird) and one CDFW species of special concern and BLM sensitive species (western mastiff bat) were discovered during the second year-long mortality monitoring study. Based on the relatively small estimates of avian and bat mortality at the OWEF, it is unlikely that operation of this facility will result in significant impacts to local or regional bird or bat populations.

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Appendix A. Complete Mortality Listing for Carcasses Discovered during the Second Year of Standardized Year-Long Fatality Monitoring and Incidentally at the Ocotillo Express Wind Energy Facility, October 3, 2014 – September 25, 2015

Appendix A. Complete mortality listing for the Ocotillo Wind Energy Facility.

Date	Common Name	Location	Distance from Turbine	Type of Find	Survey Type	Condition
9/1/2015	mourning dove	133	313	incidental find	Twice Monthly	Intact
8/23/2015	mourning dove	112	58	carcass search	Twice Monthly	Feather Spot
8/17/2015	western mastiff bat	151	27	incidental find	Twice Monthly	Intact
9/8/2015	Eurasian collared-dove	82	58	carcass search	Twice Monthly	Dismembered
9/8/2015	unidentified bird (small)	86	87	carcass search	Twice Monthly	Feather Spot
8/27/2015	long-legged bat	130	7	carcass search	Twice Monthly	Intact
8/28/2015	Mexican free-tailed bat	86	37	carcass search	Twice Monthly	Intact
8/27/2015	unidentified bird (small)	130	31	carcass search	Twice Monthly	Feather Spot
8/24/2015	Mexican free-tailed bat	174	54	carcass search	Twice Monthly	Intact
10/16/2014	unidentified bird (small)	174	62	carcass search	Twice Monthly	Feather Spot
8/31/2015	mourning dove	76	41	carcass search	Twice Monthly	Intact
9/20/2015	Mexican free-tailed bat	22	22	carcass search	Twice Monthly	Intact
9/22/2015	white-throated swift	76	17	carcass search	Twice Monthly	Feather Spot
9/15/2015	unidentified warbler	152	47	carcass search	Twice Monthly	Feather Spot
10/5/2014	Mexican free-tailed bat	174	25	carcass search	Twice Monthly	Intact
9/16/2015	Mexican free-tailed bat	148	57	carcass search	Twice Monthly	Intact
8/30/2015	unidentified large bird	31	74	carcass search	Twice Monthly	Feather Spot
9/13/2015	Mexican free-tailed bat	31	15	carcass search	Twice Monthly	Intact
8/28/2015	unidentified bat	87	75	carcass search	Twice Monthly	Intact
8/30/2015	unidentified free-tailed bat	93	64	carcass search	Twice Monthly	Intact
4/3/2015	big free-tailed bat	176	46	carcass search	Twice Monthly	Intact
4/23/2015	black-throated gray warbler	111	31	carcass search	Twice Monthly	Intact
4/15/2015	black-throated gray warbler	124	91	carcass search	Twice Monthly	Intact
4/16/2015	black-throated gray warbler	153	68	carcass search	Twice Monthly	Intact
4/14/2015	Mexican free-tailed bat	43	10	carcass search	Twice Monthly	Scavenged
4/28/2015	common poorwill	71	23	carcass search	Twice Monthly	Feather Spot
3/29/2015	pocketed free-tailed bat	93	29	carcass search	Twice Monthly	Intact
3/19/2015	unidentified free-tailed bat	79	17	incidental find	Twice Monthly	Intact
3/17/2015	unidentified free-tailed bat	148	60	carcass search	Twice Monthly	Intact
4/29/2015	western yellow bat	150	25	incidental find	Twice Monthly	Intact
5/6/2015	western tanager	76	197	incidental find	Twice Monthly	Intact
4/21/2015	Townsend's warbler	176	100	carcass search	Twice Monthly	Intact
3/23/2015	pocketed free-tailed bat	168	35	incidental find	Twice Monthly	Intact
4/23/2015	red-tailed hawk	156	25	incidental find	Twice Monthly	Dismembered
5/7/2015	Townsend's warbler	89	107	carcass search	Twice Monthly	Intact
4/16/2015	unidentified sparrow	156	56	carcass search	Twice Monthly	Dismembered
4/26/2015	Townsend's warbler	176	79	incidental find	Twice Monthly	Scavenged
4/16/2015	Townsend's warbler	152	60	carcass search	Twice Monthly	Intact

Appendix A. Complete mortality listing for the Ocotillo Wind Energy Facility.

Date	Common Name	Location	Distance from Turbine	Type of Find	Survey Type	Condition
3/29/2015	unidentified sparrow	118	44	carcass search	Twice Monthly	Intact
5/4/2015	Wilson's warbler	149	90	carcass search	Twice Monthly	Scavenged
5/4/2015	unidentified bird (small)	176	85	carcass search	Twice Monthly	Feather Spot
5/8/2015	yellow warbler	133	108	carcass search	Twice Monthly	Intact
6/20/2015	horned lark	28	23	carcass search	Twice Monthly	Intact
7/22/2015	Mexican free-tailed bat	173	20	carcass search	Twice Monthly	Intact
5/28/2015	Mexican free-tailed bat	173	9	carcass search	Twice Monthly	Intact
8/7/2015	unidentified bird (small)	173	49	carcass search	Twice Monthly	Feather Spot
7/20/2015	western mastiff bat	149	25	carcass search	Twice Monthly	Intact
8/7/2015	unidentified bird (small)	133	16	carcass search	Twice Monthly	Feather Spot
7/2/2015	unidentified bat	149	44	carcass search	Twice Monthly	Intact
7/12/2015	western yellow bat	89	61	carcass search	Twice Monthly	Intact
8/1/2015	unidentified bird (small)	151	27	carcass search	Twice Monthly	Feather Spot
12/2/2014	unidentified bird (small)	149	161	carcass search	Twice Monthly	Feather Spot
2/10/2015	house finch	89	57	carcass search	Twice Monthly	Intact
12/15/2014	unidentified free-tailed bat	149	5	incidental find	Twice Monthly	Intact
3/11/2015	white-throated swift	124	21	carcass search	Twice Monthly	Intact
12/15/2014	unidentified bird (small)	151	34	carcass search	Twice Monthly	Feather Spot
1/30/2015	Mexican free-tailed bat	31	14	carcass search	Twice Monthly	Intact
11/1/2014	red-tailed hawk	152	103	carcass search	Twice Monthly	Feather Spot
3/11/2015	unidentified sparrow	124	72	carcass search	Twice Monthly	Scavenged
3/10/2015	Costa's hummingbird	71	41	carcass search	Twice Monthly	Intact
11/3/2014	unidentified bird (small)	174	101	carcass search	Twice Monthly	Feather Spot
2/9/2015	western mastiff bat	28	21	carcass search	Twice Monthly	Intact
3/6/2015	pocketed free-tailed bat	111	31	carcass search	Twice Monthly	Intact

Appendix B. Complete Bird and Bat Fatality Table for the Ocotillo Express Wind Energy Facility for Studies Conducted from October 3, 2014 – September 25, 2015

Appendix B. Correction factors and bird and bat fatality rates by season and turbine type for studies conducted within the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015.

Parameter	Winter (33 turbines searched) Mean	Winter (33 turbines searched) 90% CI	Spring (33 turbines searched) Mean	Spring (33 turbines searched) 90% CI
Search Area Adjustment				
A (small birds)	1.00	-	1.00	-
A (large birds)	1.00	-	1.00	-
A (bats)	1.00	-	1.00	-
Observer Detection Rate				
p (small birds)	0.80	0.74-0.86	0.80	0.74-0.86
p (large birds)	0.96	0.92-1.00	0.96	0.92-1.00
p (bats)	0.80	0.74-0.86	0.80	0.74-0.86
Mean Carcass Removal Time (Days)				
$\bar{t}$ (small birds)	11.95	7.17-17.59	9.18	6.55-12.18
$\bar{t}$ (large birds)	19.13	9.94-34.38	19.41	12.18-28.87
$\bar{t}$ (bats)	11.95	7.17-17.59	9.18	6.55-12.18
Observed Fatality Rates (Fatalities/Turbine/Season(s))				
small birds	0.18	0.09-0.36	0.39	0.21-0.61
large birds	0.03	-	0.03	-
bats	0.12	0.03-0.21	0.12	-
Average Probability of Carcass Availability and Detected				
small birds	0.48	0.34-0.59	0.41	0.31-0.49
large birds	0.68	-	0.68	-
bats	0.48	0.34-0.59	0.41	-
Adjusted Fatality Rates (Fatalities/Turbine/Seasons(s))				
small birds	0.39	0.18-0.83	0.97	0.53-1.60
large birds	0.04	-	0.04	-
bats	0.25	0.06-0.48	0.30	-

*90% confidence levels not provided for categories including five or fewer fatalities

Appendix B (continued). Correction factors and bird and bat fatality rates by season and turbine type for studies conducted within the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015.

	Summer (33 turbines searched)		Fall (33 turbines searched)	
Parameter	**Mean**	**90% CI**	**Mean**	**90% CI**
Search Area Adjustment				
A (small birds)	1.00	-	1.00	-
A (large birds)	1.00	-	1.00	-
A (bats)	1.00	-	1.00	-
Observer Detection Rate				
p (small birds)	0.80	0.74-0.86	0.80	0.74-0.86
p (large birds)	0.96	0.92-1.00	0.96	0.92-1.00
p (bats)	0.80	0.74-0.86	0.80	0.74-0.86
Mean Carcass Removal Time (Days)				
$\bar{t}$ (small birds)	6.9	4.42-9.57	2.47	1.90-3.00
$\bar{t}$ (large birds)	17.32	16.93-9.37	16.23	8.38-28.23
$\bar{t}$ (bats)	6.9	4.42-9.57	2.47	1.90-3.00
Observed Fatality Rates (Fatalities/Turbine/Season(s))				
small birds	0.12	-	0.15	0.06-0.24
large birds	0	-	0.12	-
bats	0.15	0.03-0.30	0.30	0.15-0.45
Average Probability of Carcass Availability and Detected				
small birds	0.33	-	0.13	0.10-0.16
large birds	0.65	-	0.63	-
bats	0.33	0.23-0.43	0.13	0.10-0.16
Adjusted Fatality Rates (Fatalities/Turbine/Seasons(s))				
small birds	0.37	-	1.16	0.47-2.08
large birds	0	-	0.19	-
bats	0.46	0.08-0.95	2.32	1.20-3.79

Overall Adjusted Fatality Rates (Fatalities/Turbine/Study Period)		
	Mean	**90% CI**
small birds	2.87	(1.97, 4.18)
large birds	0.28	(0.11, 0.51)
all birds	3.15	(2.02, 4.23)
bats	3.33	(2.06, 4.97)

*90% confidence levels not provided for categories including five or fewer fatalities

Appendix C. Summary of Individual and Group Observations by Bird Type and Species for Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015

Appendix C. Summary of individual and group observations by bird type and species for fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility [a] from October 3, 2014 – September 25, 2015.

		Fall		Winter		Spring		Summer		Total	
Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Diurnal Raptors		**4**	**5**	**8**	**9**	**20**	**27**	**10**	**12**	**42**	**53**
Buteos		3	4	8	9	16	21	5	5	32	39
red-tailed hawk	*Buteo jamaicensis*	3	4	8	9	16	21	5	5	32	39
Falcons		0	0	0	0	0	0	1	2	1	2
American kestrel	*Falco sparverius*	0	0	0	0	0	0	1	2	1	2
Other Raptors		1	1	0	0	4	6	4	5	9	12
unidentified raptor	*NA*	1	1	0	0	4	6	4	5	9	12
Vultures		**3**	**5**	**1**	**1**	**2**	**2**	**12**	**18**	**18**	**26**
turkey vulture	*Cathartes aura*	3	5	1	1	2	2	12	18	18	26
Doves/Pigeons		**5**	**69**	**1**	**2**	**8**	**8**	**23**	**34**	**37**	**113**
Eurasian collared-dove	*Streptopelia decaocto*	0	0	0	0	5	5	13	19	18	24
mourning dove	*Zenaida macroura*	4	67	1	2	2	2	4	4	11	75
unidentified dove	*NA*	1	2	0	0	1	1	6	11	8	14
Large Corvids		**16**	**17**	**38**	**60**	**50**	**74**	**16**	**26**	**120**	**177**
common raven	*Corvus corax*	16	17	38	60	50	74	16	26	120	177
Cuckoos		**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
greater roadrunner	*Geococcyx californianus*	0	0	0	0	0	0	1	1	1	1
Passerines		**175**	**221**	**280**	**372**	**248**	**371**	**143**	**177**	**846**	**1,141**
black-tailed gnatcatcher	*Polioptila melanura*	9	10	20	23	12	14	2	3	43	50
black-throated sparrow	*Amphispiza bilineata*	7	11	18	27	40	69	22	37	87	144
black phoebe	*Sayornis nigricans*	0	0	0	0	3	4	0	0	3	4
cactus wren	*Campylorhynchus brunneicapillus*	13	18	40	52	29	35	30	36	112	141
great-tailed grackle	*Quiscalus mexicanus*	0	0	0	0	0	0	1	5	1	5
horned lark	*Eremophila alpestris*	0	0	2	3	14	22	1	1	17	26
house finch	*Haemorhous mexicanus*	47	70	70	107	61	120	4	4	182	301
Le Conte's thrasher	*Toxostoma lecontei*	7	7	1	1	7	8	20	22	35	38
loggerhead shrike	*Lanius ludovicianus*	13	14	18	18	24	26	46	52	101	110
rock wren	*Salpinctes obsoletus*	45	54	51	70	20	25	3	3	119	152
Say's phoebe	*Sayornis saya*	10	10	9	10	4	4	2	2	25	26
Scott's oriole	*Icterus parisorum*	0	0	0	0	1	2	0	0	1	2
unidentified passerine	*NA*	22	25	46	54	33	42	10	10	111	131
unidentified thrasher	*NA*	0	0	0	0	0	0	1	1	1	1
unidentified warbler	*NA*	1	1	0	0	0	0	0	0	1	1
western kingbird	*Tyrannus verticalis*	0	0	0	0	0	0	1	1	1	1
western meadowlark	*Sturnella neglecta*	1	1	0	0	0	0	0	0	1	1
yellow-rumped warbler	*Setophaga coronata*	0	0	5	7	0	0	0	0	5	7

Appendix C. Summary of individual and group observations by bird type and species for fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility [a] from October 3, 2014 – September 25, 2015.

		Fall		Winter		Spring		Summer		Total	
Type / Species	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Swifts/Hummingbirds		**17**	**18**	**36**	**41**	**31**	**31**	**3**	**3**	**87**	**93**
Anna's hummingbird	*Calypte anna*	0	0	5	5	8	8	2	2	15	15
calliope hummingbird	*Selasphorus calliope*	0	0	1	1	0	0	0	0	1	1
Costa's hummingbird	*Calypte costae*	0	0	9	12	9	9	0	0	18	21
unidentified hummingbird	*NA*	17	18	21	23	12	12	1	1	51	54
white-throated swift	*Aeronautes saxatalis*	0	0	0	0	2	2	0	0	2	2
Woodpeckers		**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**2**	**2**
ladder-backed woodpecker	*Picoides scalaris*	1	1	1	1	0	0	0	0	2	2
Unidentified Birds		**6**	**10**	**0**	**0**	**11**	**13**	**7**	**33**	**24**	**56**
unidentified bird (small)	*NA*	6	10	0	0	10	11	6	32	22	53
unidentified large bird	*NA*	0	0	0	0	1	2	1	1	2	3
Overall		**227**	**346**	**365**	**486**	**370**	**526**	**215**	**304**	**1,177**	**1,662**

[a] Regardless of distance from observer.

Appendix D. Mean Use, Percent of Use, and Frequency of Occurrence for Large and Small Birds Observed during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015

Appendix D1. Mean bird use (number of birds/plot[a]/30-min survey), percent of use (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015.

	Mean Use				% of Use				% Frequency			
Type / Species	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**
Diurnal Raptors	**0.02**	**0.06**	**0.14**	**0.07**	**2.2**	**14.5**	**19.6**	**11.2**	**1.9**	**4.8**	**8.7**	**5.6**
Buteos	0.02	0.06	0.14	0.04	2.2	14.5	19.6	6.2	1.9	4.8	8.7	4.0
red-tailed hawk	0.02	0.06	0.14	0.04	2.2	14.5	19.6	6.2	1.9	4.8	8.7	4.0
Falcons	0	0	0	0.02	0	0	0	2.5	0	0	0	0.8
American kestrel	0	0	0	0.02	0	0	0	2.5	0	0	0	0.8
Other Raptors	0	0	0	0.02	0	0	0	2.5	0	0	0	1.6
unidentified raptor	0	0	0	0.02	0	0	0	2.5	0	0	0	1.6
Vultures	**0.02**	**<0.01**	**0.02**	**0.09**	**2.2**	**1.6**	**2.2**	**13.8**	**1.9**	**0.7**	**1.6**	**6.3**
turkey vulture	0.02	<0.01	0.02	0.09	2.2	1.6	2.2	13.8	1.9	0.7	1.6	6.3
Doves/Pigeons	**0.66**	**0.01**	**0.06**	**0.27**	**76.7**	**3.2**	**8.7**	**42.5**	**3.8**	**0.7**	**6.3**	**14.3**
Eurasian collared-dove	0	0	0.04	0.15	0	0	5.4	23.8	0.0	0	4.0	7.9
mourning dove	0.64	0.01	0.02	0.03	74.4	3.2	2.2	5.0	2.9	0.7	1.6	3.2
unidentified dove	0.02	0	<0.01	0.09	2.2	0	1.1	13.8	1.0	0	0.8	4.0
Large Corvids	**0.16**	**0.34**	**0.51**	**0.21**	**18.9**	**80.6**	**69.6**	**32.5**	**14.3**	**19.7**	**25.4**	**10.3**
common raven	0.16	0.34	0.51	0.21	18.9	80.6	69.6	32.5	14.3	19.7	25.4	10.3
Overall Large Birds	**0.86**	**0.42**	**0.73**	**0.63**	**100**	**100**	**100**	**100**				

[a] 800-meter (m) radius plot for large birds

Appendix D2. Mean bird use (number of birds/plot[a]/30-min survey), percent of use (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015.

	Mean Use				% of Use				% Frequency			
Type / Species	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**
Cuckoos	**0**	**0**	**0**	**<0.01**	**0**	**0**	**0**	**0.6**	**0**	**0**	**0**	**0.8**
greater roadrunner	0	0	0	<0.01	0	0	0	0.6	0	0	0	0.8
Passerines	**1.58**	**2.24**	**2.58**	**1.32**	**88.3**	**88.7**	**89.3**	**95.4**	**59.0**	**71.4**	**69.8**	**57.1**
black-tailed gnatcatcher	0.1	0.16	0.11	0.02	5.3	6.2	3.8	1.7	7.6	12.9	8.7	1.6
black-throated sparrow	0.1	0.18	0.53	0.29	5.3	7.0	18.4	21.3	5.7	11.6	27.0	15.1
black phoebe	0	0	0.02	0	0	0	0.5	0	0	0	1.6	0
cactus wren	0.14	0.26	0.17	0.26	8.0	10.2	6.0	19.0	8.6	16.3	14.3	19.0
great-tailed grackle	0	0	0	0.04	0	0	0	2.9	0	0	0	0.8
horned lark	0	0.02	0.17	<0.01	0	0.8	6.0	0.6	0	1.4	10.3	0.8
house finch	0.49	0.71	0.82	0.03	27.1	28.0	28.3	2.3	29.5	38.1	37.3	3.2
Le Conte's thrasher	0.07	<0.01	0.06	0.17	3.7	0.3	2.2	12.6	6.7	0.7	5.6	15.9
loggerhead shrike	0.09	0.09	0.18	0.37	4.8	3.5	6.3	26.4	6.7	7.5	15.9	30.2
rock wren	0.38	0.43	0.19	0.02	21.3	16.9	6.6	1.7	26.7	24.5	13.5	2.4
Say's phoebe	0.05	0.06	0.02	<0.01	2.7	2.4	0.8	0.6	4.8	5.4	1.6	0.8
Scott's oriole	0	0	0.02	0	0	0	0.5	0	0	0	0.8	0
unidentified passerine	0.16	0.29	0.28	0.07	9.0	11.6	9.6	5.2	13.3	23.1	21.4	7.1
unidentified thrasher	0	0	0	<0.01	0	0	0	0.6	0	0	0	0.8
unidentified warbler	<0.01	0	0	0	0.5	0	0	0	1.0	0	0	0
western kingbird	0	0	0	<0.01	0	0	0	0.6	0	0	0	0.8
western meadowlark	<0.01	0	0	0	0.5	0	0	0	1.0	0	0	0
yellow-rumped warbler	0	0.05	0	0	0	1.9	0	0	0	3.4	0	0
Swifts/Hummingbirds	**0.17**	**0.28**	**0.25**	**0.02**	**9.6**	**11.0**	**8.5**	**1.7**	**11.4**	**21.1**	**24.6**	**2.4**
Anna's hummingbird	0	0.03	0.06	0.02	0	1.3	2.2	1.1	0	3.4	6.3	1.6
calliope hummingbird	0	<0.01	0	0	0	0.3	0	0	0	0.7	0	0
Costa's hummingbird	0	0.08	0.07	0	0	3.2	2.5	0	0	6.1	7.1	0
unidentified hummingbird	0.17	0.16	0.1	<0.01	9.6	6.2	3.3	0.6	11.4	13.6	9.5	0.8
white-throated swift	0	0	0.02	0	0	0	0.5	0	0	0	1.6	0
Woodpeckers	**<0.01**	**<0.01**	**0**	**0**	**0.5**	**0.3**	**0**	**0**	**1.0**	**0.7**	**0**	**0**
ladder-backed woodpecker	<0.01	<0.01	0	0	0.5	0.3	0	0	1.0	0.7	0	0
Unidentified Birds	**0.03**	**0**	**0.06**	**0.03**	**1.6**	**0**	**2.2**	**2.3**	**1.9**	**0**	**4.8**	**3.2**
unidentified bird (small)	0.03	0	0.05	0.02	1.6	0	1.6	1.7	1.9	0	4.0	2.4
unidentified large bird	0	0	0.02	<0.01	0	0	0.5	0.6	0	0	0.8	0.8
Overall Small Birds	**1.79**	**2.53**	**2.89**	**1.38**	**100**	**100**	**100**	**100**				

[a] 100-meter (m) radius plot for small birds.

Appendix E. Species Exposure Indices for Large Birds and Small Birds during Fixed-Point Surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015

Appendix E1. Relative exposure index and flight characteristics by large bird species during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
common raven	74	0.31	72.0	50.4	0.11	79.6
red-tailed hawk	21	0.07	70.6	66.7	0.03	70.8
turkey vulture	14	0.03	100	81.2	0.03	100
unidentified dove	8	0.03	100	14.3	<0.01	28.6
unidentified raptor	2	<0.01	100	50.0	<0.01	50.0
mourning dove	6	0.15	93.3	0	0	92.9
Eurasian collared-dove	15	0.05	87.5	0	0	0.0
American kestrel	1	<0.01	100	0	0	100

RSH: The likely “rotor swept heights” for potential collision with a turbine blade, or 25-150 m (82-492 ft) above ground level (AGL).

Appendix E2. Relative exposure index and flight characteristics for small birds during the fixed-point bird use surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within RSH based on initial obs	Exposure Index	% Within RSH at anytime
house finch	66	0.52	51.5	14.8	0.04	18.5
great-tailed grackle	1	0.01	100	100	0.01	100
unidentified passerine	25	0.21	31.7	15.2	<0.01	27.3
yellow-rumped warbler	2	0.01	57.1	75.0	<0.01	75.0
black-throated sparrow	48	0.28	63.6	0	0	0
rock wren	9	0.26	11.5	0	0	0
cactus wren	11	0.21	14.8	0	0	0
loggerhead shrike	35	0.18	44.0	0	0	5.0
unidentified hummingbird	40	0.11	79.6	0	0	11.6
black-tailed gnatcatcher	15	0.1	40.0	0	0	0
Le Conte's thrasher	8	0.08	26.3	0	0	0
horned lark	8	0.05	57.7	0	0	0
Costa's hummingbird	9	0.04	57.1	0	0	0
Say's phoebe	5	0.04	27.8	0	0	0
Anna's hummingbird	8	0.03	53.3	0	0	0
unidentified bird (small)	7	0.02	75.0	0	0	0
unidentified large bird	2	<0.01	100	0	0	0
white-throated swift	2	<0.01	100	0	0	0
Scott's oriole	1	<0.01	100	0	0	0
black phoebe	2	<0.01	100	0	0	0
ladder-backed woodpecker	1	<0.01	50.0	0	0	0
western kingbird	1	<0.01	100	0	0	0
unidentified thrasher	0	<0.01	0	0	0	0
greater roadrunner	0	<0.01	0	0	0	0
calliope hummingbird	1	<0.01	100	0	0	0
western meadowlark	0	<0.01	0	0	0	0
unidentified warbler	1	<0.01	100	0	0	0

RSH: The likely “rotor swept heights” for potential collision with a turbine blade, or 25-150 m (82-492 ft) above ground level (AGL).

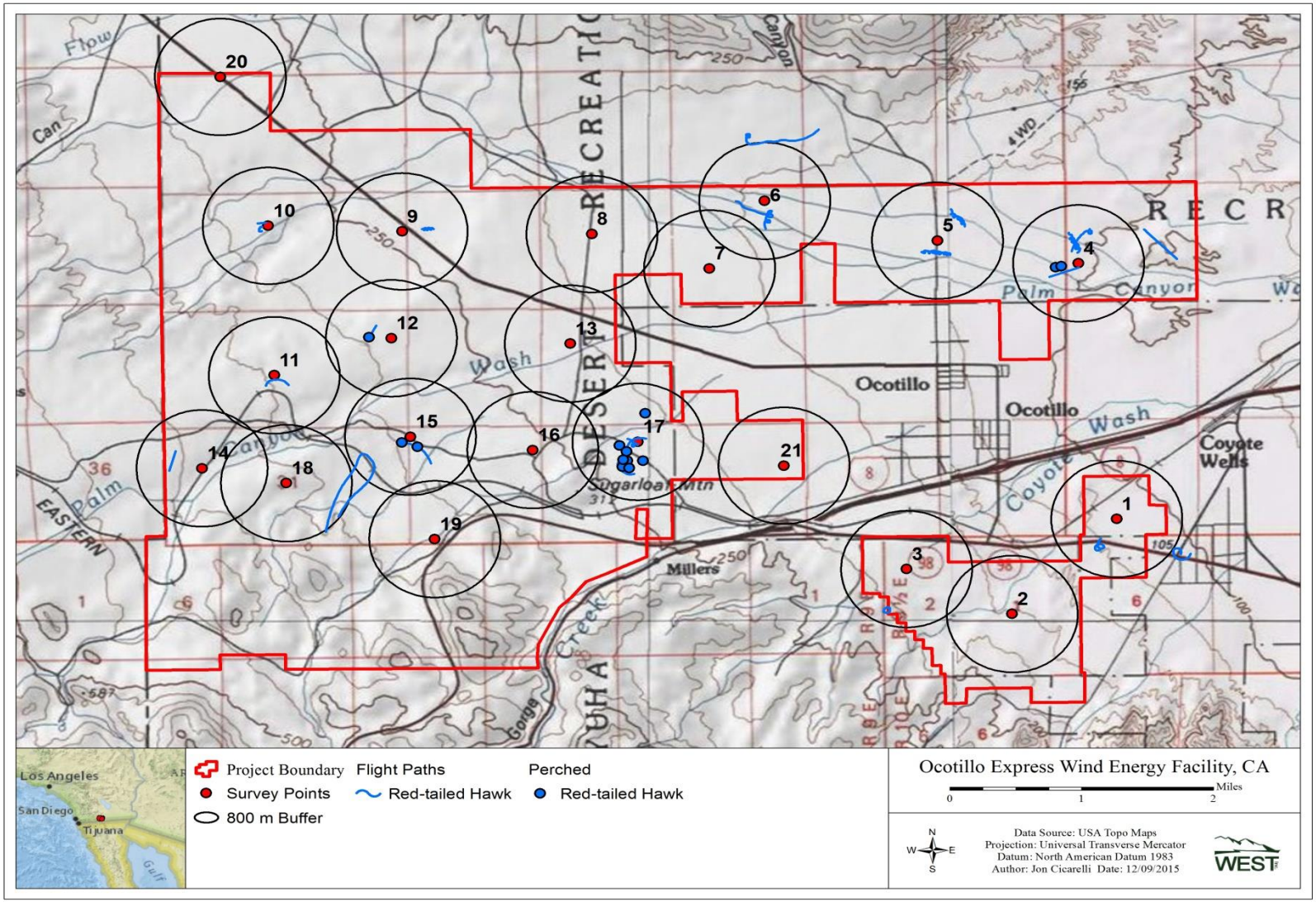
Appendix F. Mean Use by Point for All Birds, Major Bird Types, and Diurnal Raptor Subtypes during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015

Appendix F. Mean use (number of birds/30-minute survey) by point for all birds[a], major bird types, and diurnal raptor subtypes observed at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from October 3, 2014 to September 25, 2015.

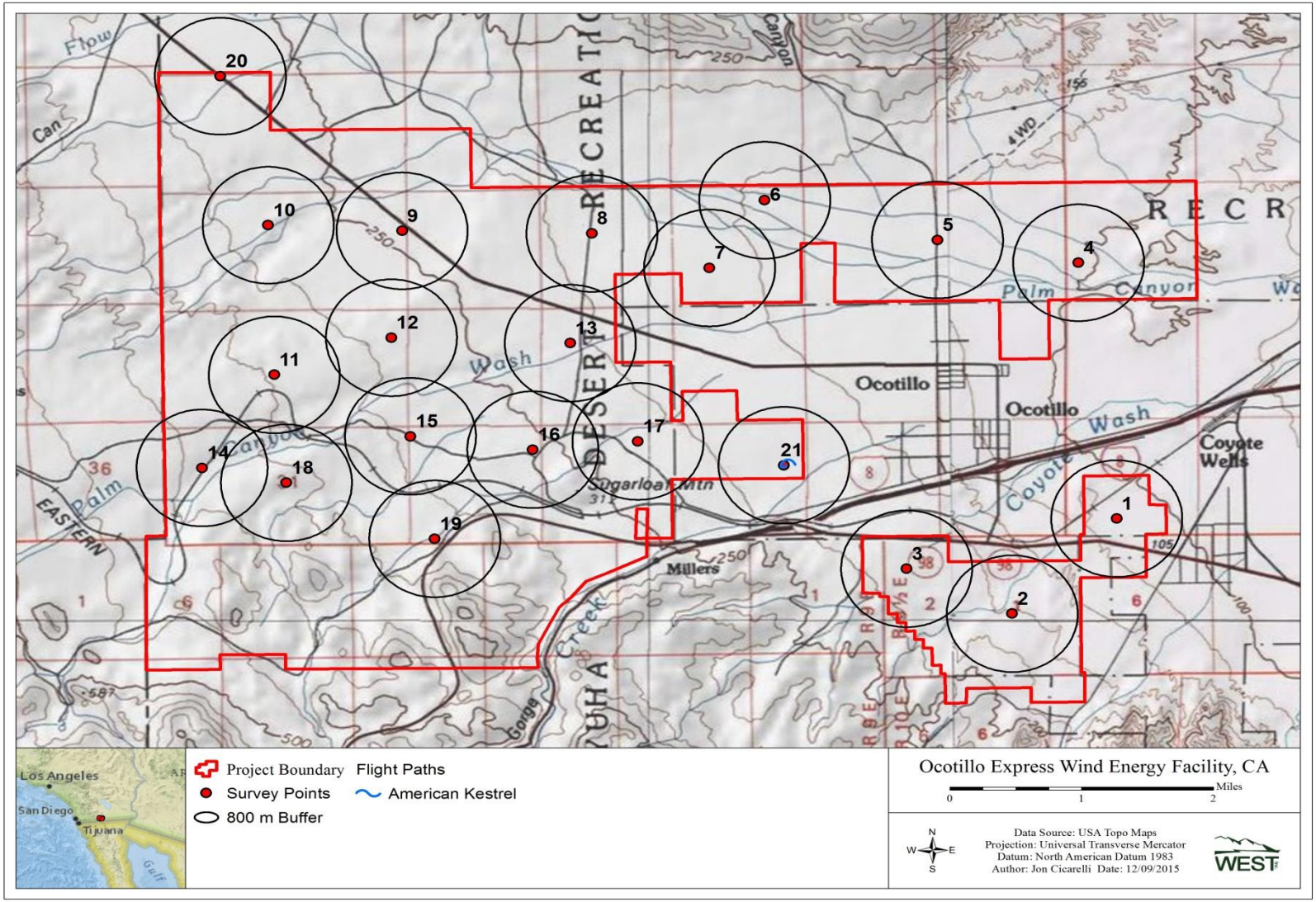
	Survey Point																				
Bird Type	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**
Diurnal Raptors	0.12	0	0.08	0.25	0.08	0.08	0	0	0	0.08	0.04	0.04	0	0.04	0.04	0	0.54	0.04	0	0.04	0.08
Buteos	0.12	0	0.04	0.25	0.08	0.08	0	0	0	0.08	0.04	0.04	0	0.04	0.04	0	0.54	0.04	0	0	0
Falcons	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.08
Other Raptors	0	0	0.04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0
Vultures	0.12	0.08	0	0.17	0.08	0	0.04	0	0.08	0	0	0	0	0	0	0	0	0	0	0.08	0
Doves/Pigeons	0.38	0.21	0.04	0	0	0	0.04	0.08	0	0.25	0.04	0.04	0.12	0	0	0	0.12	2.71	0.17	0.04	0.46
Large Corvids	0.29	0.12	0.21	0.12	0.58	0.33	1.21	0.17	0.08	0.25	0.29	0.08	0.21	0.12	0.04	0.25	0.25	0.29	0.58	0.12	0.92
All Large Birds	**0.92**	**0.42**	**0.33**	**0.54**	**0.75**	**0.42**	**1.29**	**0.25**	**0.17**	**0.58**	**0.38**	**0.17**	**0.33**	**0.17**	**0.08**	**0.25**	**0.92**	**3.04**	**0.75**	**0.29**	**1.46**
Passerines	1.42	0.62	0.88	0.62	1	1.04	0.67	1.21	1.46	3.67	3.08	3.92	2	3.12	2.67	1.21	4.33	2.96	1.5	2.04	1.71
Cuckoos	0	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0	0	0	0	0	0
Swifts/ Hummingbirds	0.04	0.17	0.04	0	0.08	0.08	0.08	0.17	0.25	0.5	0.29	0.21	0.04	0.33	0.17	0.08	0.46	0.29	0.08	0.38	0.12
Woodpeckers	0	0	0	0	0	0	0	0	0	0	0	0	0	0.04	0	0	0	0	0.04	0	0
Unidentified Birds	0	0	0	0	0	0	0.04	0	0.08	0.12	0.08	0	0.04	0.04	0.04	0	0	0	0.08	0	0.08
All Small Birds	**1.46**	**0.79**	**0.92**	**0.62**	**1.08**	**1.12**	**0.79**	**1.38**	**1.79**	**4.29**	**3.5**	**4.12**	**2.08**	**3.54**	**2.88**	**1.29**	**4.79**	**3.25**	**1.71**	**2.42**	**1.92**

[a] 800-meter (m) radius plot for large birds, 100-m for small birds.

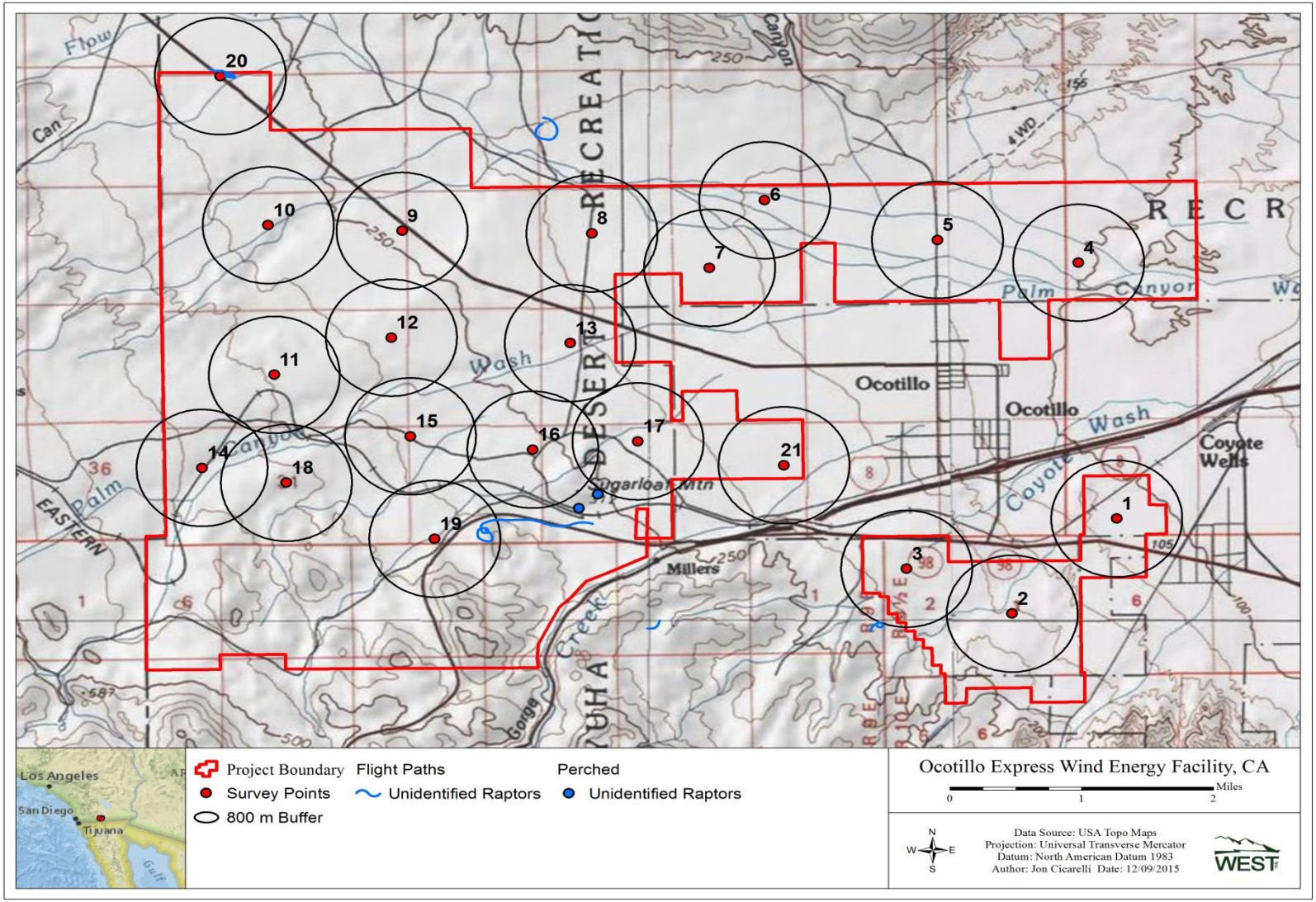
Appendix G. Large Bird Flight Paths Recorded during Fixed-Point Bird Use Surveys at the Ocotillo Express Wind Energy Facility from October 3, 2014 – September 25, 2015



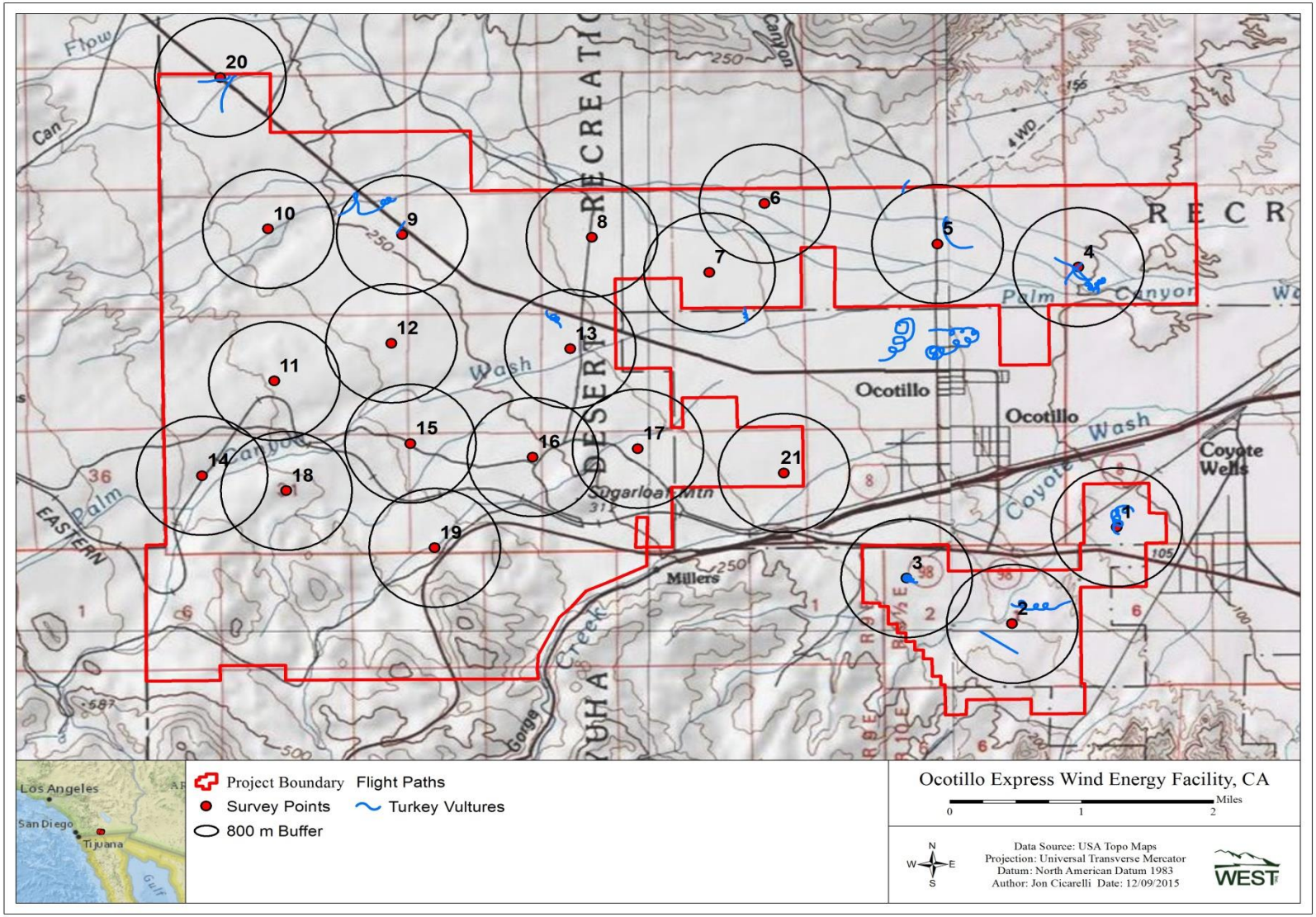
Appendix G. Buteo flight paths recorded at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from October 3, 2014 – September 25, 2015.



Appendix G (*continued*). Falcon flight paths recorded at the Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from October 3, 2014 – September 25, 2015.



Appendix G (*continued*). Unidentified raptor flight paths recorded at Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from October 3, 2014 – September 25, 2015.



Appendix G (*continued*). Turkey vulture flight paths recorded at Ocotillo Express Wind Energy Facility during fixed-point bird use surveys from October 3, 2014 – September 25, 2015.

Appendix H. North American Fatality Summary Tables

Appendix H1. Wind energy facilities in California and the Southwest with publicly-available and comparable fatality data for all bird species.

Wind Energy Facility	Fatality Estimate[A]	No. of Turbines	Total MW
Ocotillo, CA	**1.37**	**112**	**315**
California			
Pine Tree, CA (2009-2010, 2011)	17.44	90	135
Montezuma I, CA (2012)	8.91	16	36.8
Alta Wind I-V, CA (2013-2014)	7.8	290	720 (150 GE, 570 vestas)
Alta Wind I, CA (2011-2012)	7.07	100	150
Shiloh I, CA (2006-2009)	6.96	100	150
Montezuma I, CA (2011)	5.19	16	36.8
Dillon, CA (2008-2009)	4.71	45	45
Diablo Winds, CA (2005-2007)	4.29	31	20.46
Shiloh III, CA (2012-2013)	3.3	50	102.5
Shiloh II, CA (2010-2011)	2.8	75	150
Shiloh II, CA (2009-2010)	1.9	75	150
Mustang Hills, CA (2012-2013)	1.66	50	150
Alta Wind II-V, CA (2011-2012)	1.66	190	570
High Winds, CA (2003-2004)	1.62	90	162
Solano III, CA (2012-2013)	1.6	55	128
Pinyon Pines I & II, CA (2013-2014)	1.18	100	NA
High Winds, CA (2004-2005)	1.1	90	162
Montezuma II, CA (2012-2013)	1.08	34	78.2
Alta VIII, CA (2012-2013)	0.66	50	150
Alite, CA (2009-2010)	0.55	8	24
Southwest			
Dry Lake I, AZ (2009-2010)	2.02	30	63
Dry Lake II, AZ (2011-2012)	1.57	31	65

A=number of bird fatalities/MW/year

Data from the following sources:

Wind Energy Facility	Estimate Reference	Wind Energy Facility	Estimate Reference
Ocotillo, CA	This study.		
Alite, CA (09-10)	Chatfield et al. 2010b	Montezuma I, CA (11)	ICF International 2012
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Montezuma I, CA (12)	ICF International 2012
Alta Wind I-V, CA (13-14)	Chatfield et al. 2014	Montezuma II, CA (12-13)	Harvey & Associates 2013
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Mustang Hills, CA (12-13)	Chatfield and Bay 2014
Alta VIII, CA (12-13)	Chatfield and Bay 2014	Pine Tree, CA (09-10, 11)	BioResource Consultants 2012
Diablo Winds, CA (05-07)	WEST 2006, 2008	Pinyon Pines I & II, CA (13-14)	Chatfield and Russo 2014
Dillon, CA (08-09)	Chatfield et al. 2009	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Shiloh II, CA (10-11)	Kerlinger et al. 2013a
High Winds, CA (03-04)	Kerlinger et al. 2006	Shiloh III, CA (12-13)	Kerlinger et al. 2013b
High Winds, CA (04-05)	Kerlinger et al. 2006	Solano III, CA (12-13)	AECOM 2013

Appendix H2. Wind energy facilities in California and the Southwestwith publicly-available and comparable use and fatality data for raptors.

Wind Energy Facility	Use Estimate[A]	Raptor Fatality Estimate[B]	No. of Turbines	Total MW
Ocotillo, CA	**NA**	**0.04**	112	315
	California			
Montezuma I, CA (2011)	NA	1.06	16	36.8
Solano III, CA (2012-2013)	NA	0.95	55	128
Montezuma I, CA (2012)	NA	0.79	16	36.8
High Winds, CA (2003-2004)	2.337	0.5	90	162
Montezuma II, CA (2012-2013)	NA	0.46	34	78.2
Shiloh II, CA (2010-2011)	NA	0.44	75	150
Shiloh I, CA (2006-2009)	NA	0.42	100	150
Diablo Winds, CA (2005-2007)	2.161	0.4	31	20.46
High Winds, CA (2004-2005)	2.337	0.28	90	162
Alta Wind I, CA (2011-2012)	0.19	0.27	100	150
Alite, CA (2009-2010)	NA	0.12	8	24
Shiloh II, CA (2009-2010)	NA	0.11	75	150
Mustang Hills, CA (2012-2013)	NA	0.08	50	150
Alta Wind I-V, CA (2013-2014)	NA	0.08	290	720 (150 GE, 570 vestas)
Alta Wind II-V, CA (2011-2012)	0.04	0.05	190	570
Alta VIII, CA (2012-2013)	NA	0.02	50	150
Dillon, CA (2008-2009)	NA	0	45	45
	Southwest			
Dry Lake I, AZ (2009-2010)	0.13	0	30	63
Dry Lake II, AZ (2011-2012)	NA	0	31	65

A=number of raptors/plot/20-min survey
B=number of fatalities/MW/year
Data from the following sources:

Wind Energy Facility	Estimate Reference	Wind Energy Facility	Estimate Reference
Ocotillo, CA	This study.		
Alite, CA (09-10)	Chatfield et al. 2010b	Montezuma I, CA (11)	ICF International 2012
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Montezuma I, CA (12)	ICF International 2013
Alta Wind I-V, CA (13-14)	Chatfield et al. 2014	Montezuma II, CA (12-13)	Harvey & Associates 2013
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Mustang Hills, CA (12-13)	Chatfield and Bay 2014
Alta VIII, CA (12-13)	Chatfield and Bay 2014	Pine Tree, CA (09-10, 11)	BRC 2012
Diablo Winds, CA (05-07)	WEST 2006, 2008	Pinyon Pines I & II, CA (13-14)	Chatfield and Russo 2014
Dillon, CA (08-09)	Chatfield et al. 2009	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Shiloh II, CA (10-11)	Kerlinger et al. 2013a
High Winds, CA (03-04)	Kerlinger et al. 2006	Shiloh III, CA (12-13)	Kerlinger et al. 2013b
High Winds, CA (04-05)	Kerlinger et al. 2006	Solano III, CA (12-13)	Kerlinger et al. 2010b

Appendix H3. Wind energy facilities in California and the Southwest with publicly-available comparable activity and fatality data for bats.

Wind Energy Facility	Bat Activity Estimate[A]	Bat Activity Dates	Fatality Estimate[B]	No. of Turbines	Total MW
Ocotillo, CA	**NA**	**NA**	**1.45**	**112**	**315**
California					
Shiloh I, CA (2006-2009)	NA	NA	3.92	100	150
Shiloh II, CA (2010-2011)	NA	NA	3.8	75	150
Shiloh II, CA (2009-2010)	NA	NA	2.6	75	150
High Winds, CA (2003-2004)	NA	NA	2.51	90	162
Dillon, CA (2008-2009)	NA	NA	2.17	45	45
Montezuma I, CA (2011)	NA	NA	1.9	16	36.8
High Winds, CA (2004-2005)	NA	NA	1.52	90	162
Alta Wind I, CA (2011-2012)	4.42[C]	6/26/09-10/31/09	1.28	100	150
Montezuma II, CA (2012-2013)	NA	NA	0.91	34	78.2
Montezuma I, CA (2012)	NA	NA	0.84	16	36.8
Diablo Winds, CA (2005-2007)	NA	NA	0.82	31	20.46
Shiloh III, CA (2012-2013)	NA	NA	0.4	50	102.5
Solano III, CA (2012-2013)	NA	NA	0.31	55	128
Alite, CA (2009-2010)	NA	NA	0.24	8	24
Alta Wind I-V, CA (2013-2014)	NA	NA	0.2	290	720 (150 GE, 570 vestas)
Mustang Hills, CA (2012-2013)	NA	NA	0.1	50	150
Alta Wind II-V, CA (2011-2012)	0.78	6/26/09-10/31/09	0.08	190	570
Pinyon Pines I & II, CA (2013-2014)	NA	NA	0.04	100	NA
Alta VIII, CA (2012-2013)	NA	NA	0	50	150
Southwest					
Dry Lake I, AZ (2009-2010)	8.8	4/29/10-11/10/10	3.43	30	63
Dry Lake II, AZ (2011-2012)	11.5	5/11/11-10/26/11	1.66	31	65

A = Bat passes per detector-night
B = Number of fatalities per megawatt per year
C = Average of ground-based detectors at CPC Proper (Phase I) for late summer/fall period only
Data from the following sources:

Facility	Activity Estimate	Fatality Estimate	Facility	Activity Estimate	Fatality Estimate
Ocotillo, CA	**NA**	**This study**			
Alite, CA (09-10)		Chatfield et al. 2010b	Montezuma I, CA (11)		ICF International 2012
Alta Wind I, CA (11-12)	Solick et al. 2010b	Chatfield et al. 2012	Montezuma I, CA (12)		ICF International 2013
Alta Wind I-V, CA (13-14)		Chatfield et al. 2014	Montezuma II, CA (12-13)		Harvey & Associates 2013
Alta Wind II-V, CA (11-12)	Solick et al. 2010b	Chatfield et al. 2012	Mustang Hills, CA (12-13)		Chatfield and Bay 2014
Alta VIII, CA (12-13)		Chatfield and Bay 2014	Pinyon Pines I&II, CA (13-14)		Chatfield and Bay 2014
Diablo Winds, CA (05-07)		WEST 2006, 2008	Shiloh I, CA (06-09)		Kerlinger et al. 2009
Dillon, CA (08-09)		Chatfield et al. 2009	Shiloh II, CA (09-10)		Kerlinger et al. 2010b
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Thompson et al. 2011	Shiloh II, CA (10-11)		Kerlinger et al. 2013a
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Thompson and Bay 2012	Shiloh III, CA (12-13)		Kerlinger et al. 2013b
High Winds, CA (03-04)		Kerlinger et al. 2006	Solano III, CA (12-13)		AECOM 2013
High Winds, CA (04-05)		Kerlinger et al. 2006			

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/ MW/year)	Raptor Fatalities (raptors/ MW/year)	Bat Fatalities (bats/ MW/year)	Predominant Habitat Type	Citation
Alite, CA (2009-2010)	0.55	0.12	0.24	Shrub/scrub & grassland	Chatfield et al. 2010b
Alta Wind I, CA (2011-2012)	7.07	0.27	1.28	Woodland, grassland, shrubland	Chatfield et al. 2012
Alta Wind I-V, CA (2013-2014)	7.8	0.08	0.2	Na	Chatfield et al. 2014
Alta Wind II-V, CA (2011-2012)	1.66	0.05	0.08	Desert scrub	Chatfield et al. 2012
Alta VIII, CA (2012-2013)	0.66	0.02	0	Grassland and riparian	Chatfield and Bay 2014
Barton I & II, IA (2010-2011)	5.5	0	1.85	Agriculture	Derby et al. 2011a
Barton Chapel, TX (2009-2010)	1.15	0.25	3.06	Agriculture/forest	WEST 2011
Beech Ridge, WV (2012)	1.19	0.01	2.03	Forest	Tidhar et al. 2013b
Beech Ridge, WV (2013)	1.48	0.01	0.58	Forest	Young et al. 2014a
Big Blue, MN (2013)	0.6	0	2.04	Agriculture	Fagen Engineering 2014
Big Blue, MN (2014)	0.37	0	1.43	Agriculture	Fagen Engineering 2015
Big Horn, WA (2006-2007)	2.54	0.11	1.9	Agriculture/grassland	Kronner et al. 2008
Big Smile, OK (2012-2013)	0.09	0	2.9	Grassland, agriculture	Derby et al. 2013b
Biglow Canyon, OR (Phase I; 2008)	1.76	0.03	1.99	Agriculture/grassland	Jeffrey et al. 2009a
Biglow Canyon, OR (Phase I; 2009)	2.47	0	0.58	Agriculture/grassland	Enk et al. 2010
Biglow Canyon, OR (Phase II; 2009-2010)	5.53	0.14	2.71	Agriculture	Enk et al. 2011a
Biglow Canyon, OR (Phase II; 2010-2011)	2.68	0.03	0.57	Grassland/shrub-steppe, agriculture	Enk et al. 2012b
Biglow Canyon, OR (Phase III; 2010-2011)	2.28	0.05	0.22	Grassland/shrub-steppe, agriculture	Enk et al. 2012a
Blue Sky Green Field, WI (2008; 2009)	7.17	0	24.57	Agriculture	Gruver et al. 2009
Buffalo Gap I, TX (2006)	1.32	0.1	0.1	Grassland	Tierney 2007
Buffalo Gap II, TX (2007-2008)	0.15	0	0.14	Forest	Tierney 2009
Buffalo Mountain, TN (2000-2003)	11.02	0	31.54	Forest	Nicholson et al. 2005
Buffalo Mountain, TN (2005)	1.1	0	39.7	Forest	Fiedler et al. 2007
Buffalo Ridge, MN (Phase I; 1996)	4.14	0	NA	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1997)	2.51	0	NA	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1998)	3.14	0	NA	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase I; 1999)	1.43	0.47	0.74	Agriculture	Johnson et al. 2000a

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/ MW/year)	Raptor Fatalities (raptors/ MW/year)	Bat Fatalities (bats/ MW/year)	Predominant Habitat Type	Citation
Buffalo Ridge, MN (Phase II; 1998)	2.47	0	2.16	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 1999)	3.57	0	2.59	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	NA	NA	4.35	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	NA	NA	1.64	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 1999)	5.93	0	2.72	Agriculture	Johnson et al. 2000a
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	NA	NA	3.71	Agriculture	Johnson et al. 2004
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	NA	NA	1.81	Agriculture	Johnson et al. 2004
Buffalo Ridge I, SD (2009-2010)	5.06	0.2	0.16	Agriculture/grassland	Derby et al. 2010c
Buffalo Ridge II, SD (2011-2012)	1.99	0	2.81	Agriculture, grassland	Derby et al. 2012a
Casselman, PA (2008)	1.51	0	12.61	Forest	Arnett et al. 2009a
Casselman, PA (2009)	2.88	0	8.6	Forest, pasture, grassland	Arnett et al. 2010
Casselman Curtailment, PA (2008)	NA	NA	4.4	Forest	Arnett et al. 2009b
Cedar Ridge, WI (2009)	6.55	0.18	30.61	Agriculture	BHE Environmental 2010
Cedar Ridge, WI (2010)	3.72	0.13	24.12	Agriculture	BHE Environmental 2011
Cohocton/Dutch Hill, NY (2009)	1.39	0	8.62	Agriculture/forest	Stantec 2010
Cohocton/Dutch Hills, NY (2010)	1.32	0.08	10.32	Agriculture, forest	Stantec 2011
Combine Hills, OR (Phase I; 2004-2005)	2.56	0	1.88	Agriculture/grassland	Young et al. 2006
Combine Hills, OR (2011)	2.33	0.05	0.73	Grassland/shrub-steppe, agriculture	Enz et al. 2012
Crescent Ridge, IL (2005-2006)	NA	NA	3.27	Agriculture	Kerlinger et al. 2007
Criterion, MD (2011)	6.4	0.02	15.61	Forest, agriculture	Young et al. 2012a
Criterion, MD (2012)	2.14	NA	7.62	Forest, agriculture	Young et al. 2013
Criterion, MD (2013)	3.49	NA	5.32	Forest, agriculture	Young et al. 2014b
Crystal Lake II, IA (2009)	NA	NA	7.42	Agriculture	Derby et al. 2010b
Diablo Winds, CA (2005-2007)	4.29	0.4	0.82		WEST 2006, 2008
Dillon, CA (2008-2009)	4.71	0	2.17	Desert	Chatfield et al. 2009
Dry Lake I, AZ (2009-2010)	2.02	0	3.43	Desert grassland/forested	Thompson et al. 2011
Dry Lake II, AZ (2011-2012)	1.57	0	1.66	Desert grassland/forested	Thompson and Bay 2012

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/ MW/year)	Raptor Fatalities (raptors/ MW/year)	Bat Fatalities (bats/ MW/year)	Predominant Habitat Type	Citation
Elkhorn, OR (2008)	0.64	0.06	1.26	Shrub/scrub & agriculture	Jeffrey et al. 2009b
Elkhorn, OR (2010)	1.95	0.08	2.14	Shrub/scrub & agriculture	Enk et al. 2011b
Elm Creek, MN (2009-2010)	1.55	0	1.49	Agriculture	Derby et al. 2010d
Elm Creek II, MN (2011-2012)	3.64	0	2.81	Agriculture, grassland	Derby et al. 2012b
Foote Creek Rim, WY (Phase I; 1999)	3.4	0.08	3.97	Grassland	Young et al. 2003c
Foote Creek Rim, WY (Phase I; 2000)	2.42	0.05	1.05	Grassland	Young et al. 2003c
Foote Creek Rim, WY (Phase I; 2001-2002)	1.93	0	1.57	Grassland	Young et al. 2003c
Forward Energy Center, WI (2008-2010)	NA	NA	18.17	Agriculture	Grodsky and Drake 2011
Fowler I, IN (2009)	2.83	0	8.09	Agriculture	Johnson et al. 2010a
Fowler I, II, III, IN (2010)	NA	NA	18.96	Agriculture	Good et al. 2011
Fowler I, II, III, IN (2011)	NA	NA	20.19	Agriculture	Good et al. 2012
Fowler I, II, III, IN (2012)	NA	NA	2.96	Agriculture	Good et al. 2013c
Fowler III, IN (2009)	NA	NA	1.84	Agriculture	Johnson et al. 2010b
Goodnoe, WA (2009-2010)	1.4	0.17	0.34	Grassland and shrub-steppe	URS Corporation 2010a
Grand Ridge I, IL (2009-2010)	0.48	0	2.1	Agriculture	Derby et al. 2010h
Harrow, Ont (2010)	NA	NA	11.13	Agriculture	Natural Resource Solutions Inc. (NRSI) 2011
Harvest Wind, WA (2010-2012)	2.94	0.23	1.27	Grassland/shrub-steppe	Downes and Gritski 2012a
Hay Canyon, OR (2009-2010)	2.21	0	0.53	Agriculture	Gritski and Kronner 2010a
High Sheldon, NY (2010)	1.76	0.06	2.33	Agriculture	Tidhar et al. 2012a
High Sheldon, NY (2011)	1.57	0	1.78	Agriculture	Tidhar et al. 2012b
High Winds, CA (2003-2004)	1.62	0.5	2.51	Agriculture/grassland	Kerlinger et al. 2006
High Winds, CA (2004-2005)	1.1	0.28	1.52	Agriculture/grassland	Kerlinger et al. 2006
Hopkins Ridge, WA (2006)	1.23	0.14	0.63	Agriculture/grassland	Young et al. 2007a
Hopkins Ridge, WA (2008)	2.99	0.07	1.39	Agriculture/grassland	Young et al. 2009c
Judith Gap, MT (2006-2007)	NA	NA	8.93	Agriculture/grassland	TRC 2008
Judith Gap, MT (2009)	NA	NA	3.2	Agriculture/grassland	Poulton and Erickson 2010
Kewaunee County, WI (1999-2001)	1.95	0	6.45	Agriculture	Howe et al. 2002
Kibby, ME (2011)	NA	NA	0.12	Forest; commercial forest	Stantec 2012

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/ MW/year)	Raptor Fatalities (raptors/ MW/year)	Bat Fatalities (bats/ MW/year)	Predominant Habitat Type	Citation
Kittitas Valley, WA (2011-2012)	1.06	0.09	0.12	Sagebrush-steppe, grassland	Stantec Consulting Services 2012a
Klondike, OR (2002-2003)	0.95	0	0.77	Agriculture/grassland	Johnson et al. 2003
Klondike II, OR (2005-2006)	3.14	0.06	0.41	Agriculture/grassland	NWC and WEST 2007
Klondike III (Phase I), OR (2007-2009)	3.02	0.15	1.11	Agriculture/grassland	Gritski et al. 2010
Klondike IIIa (Phase II), OR (2008-2010)	2.61	0.06	0.14	Grassland/shrub-steppe and agriculture	Gritski et al. 2011
Leaning Juniper, OR (2006-2008)	6.66	0.16	1.98	Agriculture	Gritski et al. 2008
Lempster, NH (2009)	3.38	0	3.11	Grasslands/forest/rocky embankments	Tidhar et al. 2010
Lempster, NH (2010)	2.64	0	3.57	Grasslands/forest/rocky embankments	Tidhar et al. 2011
Linden Ranch, WA (2010-2011)	6.65	0.27	1.68	Grassland/shrub-steppe, agriculture	Enz and Bay 2011
Locust Ridge, PA (Phase II; 2009)	0.84	0	14.11	Grassland	Arnett et al. 2011
Locust Ridge, PA (Phase II; 2010)	0.76	0	14.38	Grassland	Arnett et al. 2011
Maple Ridge, NY (2006)	NA	NA	11.21	Agriculture/forested	Jain et al. 2007
Maple Ridge, NY (2007)	2.34	NA	6.49	Agriculture/forested	Jain et al. 2009a
Maple Ridge, NY (2007-2008)	2.07	0.03	4.96	Agriculture/forested	Jain et al. 2009d
Maple Ridge, NY (2012)	NA	NA	7.3	Agriculture/forested	Jain et al. 2009d
Marengo I, WA (2009-2010)	0.27	0	0.17	Agriculture	URS Corporation 2010b
Marengo II, WA (2009-2010)	0.16	0.05	0.27	Agriculture	URS Corporation 2010c
Mars Hill, ME (2007)	1.67	0	2.91	Forest	Stantec 2008
Mars Hill, ME (2008)	1.76	0	0.45	Forest	Stantec 2009a
Milford I, UT (2010-2011)	0.56	NA	2.05	Desert shrub	Stantec 2011
Milford I & II, UT (2011-2012)	0.73	0.04	1.67	Desert shrub	Stantec 2012b
Montezuma I, CA (2011)	5.19	1.06	1.9	Agriculture and grasslands	ICF International 2012
Montezuma I, CA (2012)	8.91	0.79	0.84	Agriculture and grasslands	ICF International 2013
Montezuma II, CA (2012-2013)	1.08	0.46	0.91	Agriculture	Harvey & Associates 2013
Moraine II, MN (2009)	5.59	0.37	2.42	Agriculture/grassland	Derby et al. 2010e
Mount Storm, WV (Fall 2008)	NA	NA	6.62	Forest	Young et al. 2009b
Mount Storm, WV (2009)	3.85	0	17.53	Forest	Young et al. 2009a, 2010b
Mount Storm, WV (2010)	2.6	0.1	15.18	Forest	Young et al. 2010a, 2011b
Mount Storm, WV (2011)	4.24	0.03	7.43	Forest	Young et al. 2011a, 2012b

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/ MW/year)	Raptor Fatalities (raptors/ MW/year)	Bat Fatalities (bats/ MW/year)	Predominant Habitat Type	Citation
Mountaineer, WV (2003)	2.69	0.07	31.69	Forest	Kerns and Kerlinger 2004
Munnsville, NY (2008)	1.48	0.59	1.93	Agriculture/forest	Stantec 2009b
Mustang Hills, CA (2012-2013)	1.66	0.08	0.1	Grasslands and riparian	Chatfield and Bay 2014
Nine Canyon, WA (2002-2003)	2.76	0.03	2.47	Agriculture/grassland	Erickson et al. 2003c
Noble Altona, NY (2010)	1.84	0	4.34	Forest	Jain et al. 2011b
Noble Bliss, NY (2008)	1.3	0.1	7.8	Agriculture/forest	Jain et al. 2009e
Noble Bliss, NY (2009)	2.28	0.12	3.85	Agriculture/forest	Jain et al. 2010a
Noble Chateaugay, NY (2010)	1.66	0.08	2.44	Agriculture	Jain et al. 2011c
Noble Clinton, NY (2008)	1.59	0.1	3.14	Agriculture/forest	Jain et al. 2009c
Noble Clinton, NY (2009)	1.11	0.16	4.5	Agriculture/forest	Jain et al. 2010b
Noble Ellenburg, NY (2008)	0.83	0.11	3.46	Agriculture/forest	Jain et al. 2009b
Noble Ellenburg, NY (2009)	2.66	0.25	3.91	Agriculture/forest	Jain et al. 2010c
Noble Wethersfield, NY (2010)	1.7	0.13	16.3	Agriculture	Jain et al. 2011a
NPPD Ainsworth, NE (2006)	1.63	0.06	1.16	Agriculture/grassland	Derby et al. 2007
Ocotillo (2014-2015)	1.27	0.04	1.35	NA	This study
Palouse Wind, WA (2012-2013)	0.72	NA	4.23	Agriculture and grasslands	Stantec 2013a
Pebble Springs, OR (2009-2010)	1.93	0.04	1.55	Grassland	Gritski and Kronner 2010b
Pine Tree, CA (2009-2010, 2011)	17.44	NA	NA	Grassland	BioResource Consultants 2012
Pinnacle, WV (2012)	3.99	0	40.2	Forest	Hein et al. 2013a
Pinyon Pines I & II, CA (2013-2014)	1.18	NA	0.04	Na	Chatfield and Russo 2014
Pioneer Prairie I, IA (Phase II; 2011-2012)	0.27	0	10.06	Agriculture, grassland	Chodachek et al. 2012
Pioneer Prairie II, IA (2013)	NA	NA	3.83	Agriculture	Chodachek et al. 2014
PrairieWinds ND1 (Minot), ND (2010)	1.48	0.05	2.13	Agriculture	Derby et al. 2011c
PrairieWinds ND1 (Minot), ND (2011)	1.56	0.05	1.39	Agriculture, grassland	Derby et al. 2012c
PrairieWinds SD1, SD (2011-2012)	1.41	0	1.23	Grassland	Derby et al. 2012d
PrairieWinds SD1, SD (2012-2013)	2.01	0.03	1.05	Grassland	Derby et al. 2013a
PrairieWinds SD1, SD (2013-2014)	1.66	0.17	0.52	Grassland	Derby et al. 2014
Rail Splitter, IL (2012-2013)	0.84	0	22.53	Agriculture	Good et al. 2013b
Record Hill, ME (2012)	3.7	NA	2.96	Forest	Stantec 2013b
Record Hill, ME (2014)	1.84	NA	0.55	Forest	Stantec 2015
Red Hills, OK (2012-2013)	0.08	0.04	0.11	Grassland	Derby et al. 2013c

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/ MW/year)	Raptor Fatalities (raptors/ MW/year)	Bat Fatalities (bats/ MW/year)	Predominant Habitat Type	Citation
Ripley, Ont (2008)	3.09	0.1	4.67	Agriculture	Jacques Whitford 2009
Rollins, ME (2012)	2.9	NA	0.18	Forest	Stantec 2013c
Rugby, ND (2010-2011)	3.82	0.06	1.6	Agriculture	Derby et al. 2011b
Shiloh I, CA (2006-2009)	6.96	0.42	3.92	Agriculture/grassland	Kerlinger et al. 2010a
Shiloh II, CA (2009-2010)	1.9	0.11	2.6	Agriculture	Kerlinger et al. 2010a, 2013a
Shiloh II, CA (2010-2011)	2.8	0.44	3.8	Agriculture	Kerlinger et al. 2013a
Shiloh III, CA (2012-2013)	3.3	NA	0.4	Na	Kerlinger et al. 2013b
Solano III, CA (2012-2013)	1.6	0.95	0.31	Na	AECOM 2013
Stateline, OR/WA (2001-2002)	3.17	0.09	1.09	Agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2003)	2.68	0.09	2.29	Agriculture/grassland	Erickson et al. 2004
Stateline, OR/WA (2006)	1.23	0.11	0.95	Agriculture/grassland	Erickson et al. 2007
Stetson Mountain I, ME (2009)	2.68	0	1.4	Forest	Stantec 2009c
Stetson Mountain I, ME (2011)	1.18	0	0.28	Forest	Normandeau Associates 2011
Stetson Mountain I, ME (2013)	6.95	0	0.18	Forest	Stantec 2014
Stetson Mountain II, ME (2010)	1.42	0	1.65	Forest	Normandeau Associates 2010
Stetson Mountain II, ME (2012)	3.37	0	2.27	Forest	Stantec 2013e
Summerview, Alb (2005-2006)	1.06	0.11	10.27	Agriculture	Brown and Hamilton 2006b
Summerview, Alb (2006; 2007)	NA	NA	11.42	Agriculture/grassland	Baerwald 2008
Top Crop I & II (2012-2013)	0.6	NA	26.85	Agriculture	Good et al. 2013a
Top of Iowa, IA (2003)	0.42	0	7.16	Agriculture	Jain 2005
Top of Iowa, IA (2004)	0.81	0.17	10.27	Agriculture	Jain 2005
Tuolumne (Windy Point I), WA (2009-2010)	3.2	0.29	0.94	Grassland/shrub-steppe, agriculture and forest	Enz and Bay 2010
Vansycle, OR (1999)	0.95	0	1.12	Agriculture/grassland	Erickson et al. 2000
Vantage, WA (2010-2011)	1.27	0.29	0.4	Shrub-steppe, grassland	Ventus Environmental Solutions 2012
Wessington Springs, SD (2009)	8.25	0.06	1.48	Grassland	Derby et al. 2010g
Wessington Springs, SD (2010)	0.89	0.07	0.41	Grassland	Derby et al. 2011d
White Creek, WA (2007-2011)	4.05	0.47	2.04	Grassland/shrub-steppe, agriculture	Downes and Gritski 2012b
Wild Horse, WA (2007)	1.55	0.09	0.39	Grassland	Erickson et al. 2008
Windy Flats, WA (2010-2011)	8.45	0.04	0.41	Grassland/shrub-steppe, agriculture	Enz et al. 2011

Appendix H4. Fatality estimates for North American wind-energy facilities.

Project	Bird Fatalities (birds/ MW/year)	Raptor Fatalities (raptors/ MW/year)	Bat Fatalities (bats/ MW/year)	Predominant Habitat Type	Citation
Winnebago, IA (2009-2010)	3.88	0.27	4.54	Agriculture/grassland	Derby et al. 2010f
Wolfe Island, Ont (July-December 2009)	NA	NA	6.42	Grassland	Stantec Ltd. 2010b
Wolfe Island, Ont (July-December 2010)	NA	NA	9.5	Grassland	Stantec Ltd. 2011b
Wolfe Island, Ont (July-December 2011)	NA	NA	2.49	Grassland	Stantec Ltd. 2012

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Alite, CA (2009-2010)	8	24	80	8	200 m x 200 m	1 year	Weekly (spring, fall), bi-monthly (summer, winter)
Alta Wind I, CA (2011-2012)	100	150	80	25	120-m radius circle	12.5 months	Every two weeks
Alta Wind I-V, CA (2013-2014)	290	720 (150 GE, 570 vestas)	80	55 (25 at Alta I, 30 at Alta II-V)	120 m radius circles	NA	Monthly or bi-weekly
Alta Wind II-V, CA (2011-2012)	190	570	80	41	120-m radius circle	14.5 months	Every two weeks
Alta VIII, CA (2012-2013)	50	150	90	12 plots (equivalent to 15 turbines)	240 x 240 m	1 year	Bi-weekly
Barton I & II, IA (2010-2011)	80	160	100	35 (9 turbines were dropped in June 2010 due to landowner issues) 26 turbines were searched for the remainder of the study	200 m x 200 m	1 year	Weekly (spring, fall; migratory turbines), monthly (summer, winter; non-migratory turbines)
Barton Chapel, TX (2009-2010)	60	120	78	30	200 m x 200 m	1 year	10 turbines weekly, 20 monthly
Beech Ridge, WV (2012)	67	100.5	80	67	40 m radius	7 months	Every two days
Beech Ridge, WV (2013)	67	100.5	80	67	40 m radius	7.5 months	Every two days
Big Blue, MN (2013)	18	36	78 or 90 (according to Gamesa website)	18	200m diameter	NA	Weekly, monthly (Nov and Dec)
Big Blue, MN (2014)	18	36	78 or 90 (according to Gamesa website)	18	200m diameter	NA	Weekly, monthly (Nov and Dec)

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Big Horn, WA (2006-2007)	133	199.5	80	133	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Big Smile, OK (2012-2013)	66	132	78	17 (plus one met tower)	100 x 100	1 year	Weekly (spring, summer, fall), monthly (winter)
Biglow Canyon, OR (Phase I; 2008)	76	125.4	80	50	110 m x 110 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase I; 2009)	76	125.4	80	50	110 m x 110 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase II; 2009-2010)	65	150	80	50	250 m x 250 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Biglow Canyon, OR (Phase II; 2010-2011)	65	150	80	50	252 m x 252 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Biglow Canyon, OR (Phase III; 2010-2011)	76	174.8	80	50	252 m x 252 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Blue Sky Green Field, WI (2008; 2009)	88	145	80	30	160 m x 160 m	Fall, spring	Daily(10 turbines), weekly (20 turbines)
Buena Vista, CA (2008-2009)	38	38	45-55	38	75-m radius	1 year	Monthly to bi-monthly starting in September 2008
Buffalo Gap I, TX (2006)	67	134	78	21	215 m x 215 m	10 months	Every 3 weeks
Buffalo Gap II, TX (2007-2008)	155	233	80	36	215 m x 215 m	14 months	Every 21 days
Buffalo Mountain, TN (2000-2003)	3	1.98	65	3	50-m radius	3 years	Bi-weekly, weekly, bi-monthly
Buffalo Mountain, TN (2005)	18	28.98	V47 = 65; V80 = 78	18	50-m radius	1 year	Bi-weekly, weekly, bi-monthly, and 2 to 5 day intervals

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Buffalo Ridge, MN (1994-1995)	73	25	37	1994:10 plots (3 turbines/plot), 20 addition plots in Sept & Oct 1994, 1995: 30 turbines search every other week (Jan-Mar), 60 searched weekly (Apr, July, Aug) 73 searched weekly (May-June and Sept-Oct), 30 searched weekly (Nov-Dec)	100 x 100m	20 months	Varies. See number turbines searched or page 44 of report
Buffalo Ridge, MN (Phase I; 1996)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1997)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1998)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase I; 1999)	73	25	36	21	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1998)	143	107.25	50	40	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 1999)	143	107.25	50	40	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase II; 2001/Lake Benton I)	143	107.25	50	83	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase II; 2002/Lake Benton I)	143	107.25	50	103	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase III; 1999)	138	103.5	50	30	126 m x 126 m	1 year	Bi-monthly (spring, summer, and fall)
Buffalo Ridge, MN (Phase III; 2001/Lake Benton II)	138	103.5	50	83	60 m x 60 m	Summer, fall	Bi-monthly
Buffalo Ridge, MN (Phase III; 2002/Lake Benton II)	138	103.5	50	103	60 m x 60 m	Summer, fall	Bi-monthly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Buffalo Ridge I, SD (2009-2010)	24	50.4	79	24	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Buffalo Ridge II, SD (2011-2012)	105	210	78	65 (60 road and pad, 5 turbine plots)	100 x 100m	1 year	Weekly (spring, summer, fall), monthly (winter)
Casselman, PA (2008)	23	34.5	80	10	126 m x 120 m	7 months	Daily
Casselman, PA (2009)	23	34.5	80	10	126 m x 120 m	7.5 months	Daily searches
Casselman Curtailment, PA (2008)	23	35.4	80	12 experimental; 10 control	126 m x 120 m	2.5 months	Daily
Castle River, Alb (2001)	60	39.6	50	60	50-m radius	2 years	Weekly, bi-weekly
Castle River, Alb (2002)	60	39.6	50	60	50-m radius	2 years	Weekly, bi-weekly
Cedar Ridge, WI (2009)	41	67.6	80	20	160 m x 160 m	Spring, summer, fall	Daily, every 4 days; late fall searched every 3 days
Cedar Ridge, WI (2010)	41	68	80	20	160 m x 160 m	1 year	Five turbines were surveyed daily, 15 turbines surveyed every 4 days in rotating groups each day. All 20 surveyed every three days during late fall
Cohocton/Dutch Hill, NY (2009)	50	125	80	17	130 m x 130 m	Spring, summer, fall	Daily (5 turbines), weekly (12 turbines)
Cohocton/Dutch Hills, NY (2010)	50	125	80	17	120 m x 120 m	Spring, summer, fall	Daily, weekly
Combine Hills, OR (Phase I; 2004-2005)	41	41	53	41	90-m radius	1 year	Monthly
Combine Hills, OR (2011)	104	104	53	52 (plus 1 MET tower)	180 m x 180 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Condon, OR	84	n/a	n/a	n/a	n/a	NA	NA
Crescent Ridge, IL (2005-2006)	33	49.5	80	33	70-m radius	1 year	Weekly (fall, spring)
Criterion, MD (2011)	28	70	80	28	40-50m radius	7.3 months	Daily

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Criterion, MD (2012)	28	70	80	14	40-50m radius	7.5 months	Weekly
Criterion, MD (2013)	28	70	80	14	40-50m radius	7.5 months	Weekly
Crystal Lake II, IA (2009)	80	200	80	16 turbines through week 6, and then 15 for duration of study	100 m x 100 m	Spring, summer, fall	3 times per week for 26 weeks
Diablo Winds, CA (2005-2007)	31	20.46	50 and 55	31	75 m x 75 m	2 years	Monthly
Dillon, CA (2008-2009)	45	45	69	15	200 m x 200 m	1 year	Weekly, bi-monthly in winter
Dry Lake I, AZ (2009-2010)	30	63	78	15	160 m x 160 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Dry Lake II, AZ (2011-2012)	31	65	78	31: 5 (full plot), 26 (road & pad)	160 m x 160 m	1 year	Twice weekly (spring, summer, fall), weekly (winter)
Elkhorn, OR (2008)	61	101	80	61	220 m x 220 m	1 year	Monthly
Elkhorn, OR (2010)	61	101	80	31	220 m x 220 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Elm Creek, MN (2009-2010)	67	100	80	29	200 m x 200 m	1 year	Weekly, monthly
Elm Creek II, MN (2011-2012)	62	148.8	80	30	200 x 200m (2 random migration search areas 100 x 100m)	1 year	20 searched every 28 days, 10 turbines every 7 days during migration)
Erie Shores, Ont (2006)	66	99	80	66	40-m radius	2 years	Weekly, bi-monthly, 2-3 times weekly (migration)
Foote Creek Rim, WY (Phase I; 1999)	69	41.4	40	69	126 m x 126 m	1 year	Monthly
Foote Creek Rim, WY (Phase I; 2000)	69	41.4	40	69	126 m x 126 m	1 year	Monthly
Foote Creek Rim, WY (Phase I; 2001-2002)	69	41.4	40	69	126 m x 126 m	1 year	Monthly
Forward Energy Center, WI (2008-2010)	86	129	80	29	160 m x 160 m	2 years	11 turbines daily, 9 every 3 days, 9 every 5 days

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Fowler I, IN (2009)	162	301	78 (Vestas), 80 (Clipper)	25	160 m x 160 m	Spring, summer, fall	Weekly, bi-weekly
Fowler I, II, III, IN (2010)	355	600	Vestas = 80, Clipper = 80, GE = 80	36 turbines, 100 road and pads	80 m x 80 m for turbines ; 40-m radius for roads and pads	Spring, fall	Daily, weekly
Fowler I, II, III, IN (2011)	355	600	Vestas = 80, Clipper = 80, GE = 80	177 road and pads (spring), 9 turbines & 168 roads and pads (fall)	turbines (80 m circular plot), roads and pads (out to 80 m)	Spring, fall	Daily, weekly
Fowler I, II, III, IN (2012)	355	600	Vestas = 80, Clipper = 80, GE = 80	118 roads and pads	roads and pads (out to 80 m)	2.5 months	Weekly
Fowler III, IN (2009)	60	99	78	12	160 m x 160 m	10 weeks	Weekly, bi-weekly
Goodnoe, WA (2009-2010)	47	94	80	24	180 m x 180 m	1 year	14 days during migration periods, 28 days during non-migration periods
Grand Ridge I, IL (2009-2010)	66	99	80	30	160 m x 160 m	1 year	Weekly, monthly
Harrow, Ont (2010)	24 (four 6-turb facilities)	39.6	NA	12 in July, 24 Aug-Oct	50-m radius from turbine base	4 months	Twice-weekly
Harvest Wind, WA (2010-2012)	43	98.9	80	32	180 m x 180 m & 240 m x 240 m	2 years	Twice a week, weekly and monthly
Hay Canyon, OR (2009-2010)	48	100.8	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Heritage Garden I, MI (2012-2014)	14	28	90	14	120 x 120 m except one plot that was 280 x 280 m	2 years	Weekly (spring, summer, and fall) and bi-weekly (winter)

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
High Sheldon, NY (2010)	75	112.5	80	25	115 m x 115 m	7 months	Daily (8 turbines), weekly (17 turbines)
High Sheldon, NY (2011)	75	112.5	80	25	115 m x 115 m	7 months	Daily (8 turbines), weekly (17 turbines)
High Winds, CA (2003-2004)	90	162	60	90	75-m radius	1 year	Bi-monthly
High Winds, CA (2004-2005)	90	162	60	90	75-m radius	1 year	Bi-monthly
Hopkins Ridge, WA (2006)	83	150	67	41	180 m x 180 m	1 year	Monthly, weekly (subset of 22 turbines spring and fall migration)
Hopkins Ridge, WA (2008)	87	156.6	67	41-43	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Jersey Atlantic, NJ (2008)	5	7.5	80	5	130 m x 120 m	9 months	Weekly
Judith Gap, MT (2006-2007)	90	135	80	20	190 m x 190 m	7 months	Monthly
Judith Gap, MT (2009)	90	135	80	30	100 m x 100 m	5 months	Bi-monthly
Kewaunee County, WI (1999-2001)	31	20.46	65	31	60 m x 60 m	2 years	Bi-weekly (spring, summer), daily (spring, fall migration), weekly (fall, winter)
Kibby, ME (2011)	44	132	124	22 turbines	75-m diameter circular plots	22 weeks	Avg 5-day
Kittitas Valley, WA (2011-2012)	48	100.8	80	48	100 m x 102 m	1 year	Bi-weekly from Aug 15 - Oct 31 and March 16 - May 15; every 4 weeks from Nov 1 - March 15 and May 16 - Aug 14
Klondike, OR (2002-2003)	16	24	80	16	140 m x 140 m	1 year	Monthly
Klondike II, OR (2005-2006)	50	75	80	25	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (summer, winter)
Klondike III (Phase I), OR (2007-2009)	125	223.6	GE = 80; Siemens= 80, Mitsubishi = 80	46	240 m x 240 m (1.5MW) 252 m x 252 m (2.3MW)	2 year	Bi-monthly (spring, fall migration), monthly (summer, winter)

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Klondike IIIa (Phase II), OR (2008-2010)	51	76.5	GE = 80	34	240 m x 240 m	2 years	Bi-monthly (spring, fall), monthly (summer, winter)
Lakefield Wind, MN (2012)	137	205.5	80	26	100 m x 100 m	7.5 months	3 times per week
Leaning Juniper, OR (2006-2008)	67	100.5	80	17	240 m x 240 m	2 years	Bi-monthly (spring, fall), monthly (winter, summer)
Lempster, NH (2009)	12	24	78	4	120 m x 130 m	6 months	Daily
Lempster, NH (2010)	12	24	78	12	120 m x 130 m	6 months	Weekly
Linden Ranch, WA (2010-2011)	25	50	80	25	110 m x 110 m	1 year	Bi-weekly(spring, fall), monthly (summer, winter)
Locust Ridge, PA (Phase II; 2009)	51	102	80	15	120m x 126m	6.5 months	Daily
Locust Ridge, PA (Phase II; 2010)	51	102	80	15	120m x 126m	6.5 months	Daily
Madison, NY (2001-2002)	7	11.55	67	7	60-m radius	1 year	Weekly (spring, fall), monthly (summer)
Maple Ridge, NY (2006)	120	198	80	50	130 m x 120 m	5 months	Daily (10 turbines), every 3 days (10 turbines), weekly (30 turbines)
Maple Ridge, NY (2007)	195	321.75	80	64	130 m x 120 m	7 months	Weekly
Maple Ridge, NY (2007-2008)	195	321.75	80	64	130 m x 120 m	7 months	Weekly
Maple Ridge, NY (2012)	195	321.75	80	105 (5 turbines, 100 roads/pads)	100 m x 100 m	3 months	Weekly
Marengo I, WA (2009-2010)	78	140.4	67	39	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Marengo II, WA (2009-2010)	39	70.2	67	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Mars Hill, ME (2007)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	Spring, summer, fall	Daily (2 random turbines), weekly (all turbines): extended plot searched once per season

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Mars Hill, ME (2008)	28	42	80.5	28	76-m diameter, extended plot 238-m diameter	Spring, summer, fall	Weekly: extended plot searched once per season
McBride, Alb (2004)	114	75	50	114	4 parallel transects 120-m wide	1 year	Weekly, bi-weekly
Melancthon, Ont (Phase I; 2007)	45	NA	NA	45	35m radius	5 months	Weekly, twice weekly
Meyersdale, PA (2004)	20	30	80	20	130 m x 120 m	6 weeks	Daily (half turbines), weekly (half turbines)
Milford I, UT (2010-2011)	58	145	80	24	120x120	NA	Weekly
Milford I & II, UT (2011-2012)	107	160.5 (58.5 I, 102 II)	80	43	120x120	NA	Every 10.5 days
Montezuma I, CA (2011)	16	36.8	80	16	105 m radius	1 year	Weekly and bi-Weekly
Montezuma I, CA (2012)	16	36.8	80	16	105 m radius	1 year	Weekly and bi-Weekly
Montezuma II, CA (2012-2013)	34	78.2	80	17	105 m radius	1 year	Weekly
Moraine II, MN (2009)	33	49.5	82.5	30	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Mount Storm, WV (Fall 2008)	82	164	78	27	varied	3 months	Weekly (18 turbines), daily (9 turbines)
Mount Storm, WV (2009)	132	264	78	44	varied	4.5 months	Weekly (28 turbines), daily (16 turbines)
Mount Storm, WV (2010)	132	264	78	24	20 to 60 m from turbine	6 months	Daily
Mount Storm, WV (2011)	132	264	78	24	varied	6 months	Daily
Mountaineer, WV (2003)	44	66	80	44	60-m radius	7 months	Weekly, monthly
Mountaineer, WV (2004)	44	66	80	44	130 m x 120 m	6 weeks	Daily, weekly
Munnsville, NY (2008)	23	34.5	69.5	12	120 m x 120 m	Spring, summer, fall	Weekly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Mustang Hills, CA (2012-2013)	50	150	90	13 plots (equivalent to 15 turbines)	240 x 240 m	1 year	Bi-weekly
Nine Canyon, WA (2002-2003)	37	48.1	60	37	90-m radius	1 year	Bi-monthly (spring, summer, fall), monthly (winter)
Nine Canyon II, WA (2004)	12	15.6	60	12	90 m x 90 m	3 months	Once every two weeks
Noble Altona, NY (2010)	65	97.5	80	22	120 m x 120 m	Spring, summer, fall	Daily, weekly
Noble Altona, NY (2011)	65	97.5	80	22	120m x 120m	2 months	Daily
Noble Bliss, NY (2008)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Bliss, NY (2009)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Weekly, 8 turbines searched daily from July 1 to August 15
Noble Bliss/Wethersfield, NY (2011)	151	226	80	48 (24 from each site:12 ag, 12 forest)	road & pad 70 m out from turbine	2 months	Daily
Noble Chateaugay, NY (2010)	71	106.5	80	24	120 m x 120 m	Spring, summer, fall	Weekly
Noble Clinton, NY (2008)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), 3-day (8 turbines), weekly (7 turbines)
Noble Clinton, NY (2009)	67	100	80	23	120 m x 120 m	Spring, summer, fall	Daily (8 turbines), weekly (15 turbines), all turbines weekly from July 1 to August 15
Noble Ellenburg, NY (2008)	54	80	80	18	120 m x 120 m	Spring, summer, fall	Daily (6 turbines), 3-day (6 turbines), weekly (6 turbines)
Noble Ellenburg, NY (2009)	54	80	80	18	120 m x 120 m	Spring, summer, fall	Daily (6 turbines), weekly (12 turbines), all turbines weekly from July 1 to August 15
Noble Wethersfield, NY (2010)	84	126	80	28	120 m x 120 m	Spring, summer, fall	Weekly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
NPPD Ainsworth, NE (2006)	36	20.5	70	36	220 m x 220 m	Spring, summer, fall	Bi-monthly
Oklahoma Wind Energy Center, OK (2004; 2005)	68	102	70	68	20m radius	3 months (2 years)	Bi-monthly
Pacific, CA (2012-2013)	70	140	78.5	20	126 m radius	NA	Twice weekly (fall), and biweekly
Palouse Wind, WA (2012-2013)	58	104.4	80, 90, or 105 M (according to the Vestas website)	19	120m x 120m	1 year	Monthly (Winter) and Weekly (Spring-Fall)
Pebble Springs, OR (2009-2010)	47	98.7	79	20	180 m x 180 m	1 year	Bi-monthly (spring, fall), monthly (winter, summer)
Pine Tree, CA (2009-2010, 2011)	90	135	65	40	100 m radius	1.5 year	Bi-weekly, weekly
Pinnacle, WV (2012)	23	55.2	80	11	126 m x 120m	9 months	Weekly
Pinnacle Operational Mitigation Study (2012)	23	55.2	80	12	126m x 120m	2.5 months	Daily
Pinyon Pines I & II, CA (2013-2014)	100	NA	90	25 plots (aprox 31 turbines)	240x240 m	NA	Bi-weekly
Pioneer Prairie I, IA (Phase II; 2011-2012)	62	102.3	80	62 (57 road/pad) 5 full search plots	80 x 80m	1 year	Weekly (spring and fall), every two weeks (summer), monthly (winter)
Pioneer Prairie II, IA (2013)	62	102.3	80	62	80x80 m (5 turbines), road and pad within 100 m of turbine (57 turbines)	NA	Weekly
Pioneer Trail, IL (2012-2013)	94	150.5	NA	50	80x80m	Fall, spring	Weekly
Prairie Rose, MN (2014)	119	200	80	10	100x100m	6 months	Weekly
PrairieWinds ND1 (Minot), ND (2010)	80	115.5	89	35	minimum of 100 m x 100 m	3 seasons	Bi-monthly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
PrairieWinds ND1 (Minot), ND (2011)	80	115.5	80	35	minimum 100 x 100m	3 season	Twice monthly
PrairieWinds SD1, SD (2012-2013)	108	162	80	50	200 x 200m	1 year	Bi-weekly
PrairieWinds SD1, SD (2013-2014)	108	162	80	45	200 x 200m	1 year	Twice monthly (spring, summer, fall), monthly (winter)
PrairieWinds SD1, SD (2011-2012)	108	162	80	50	200 x 200m	1 year	Twice monthly (spring, summer, fall), monthly (winter)
Rail Splitter, IL (2012-2013)	67	100.5	80	34	60 m radius	1 year	Weekly (spring, summer, and fall) and bi-weekly (winter)
Record Hill, ME (2012)	22	50.6	80	22	126.5 x1 26.5 m	5 months	Three times every two weeks
Record Hill, ME (2014)	22	50.6	80	10	varied due to steep terrain and heavily vegetated areas	4.5 months	Daily for 5 days a week
Red Canyon, TX (2006-2007)	56	84	70	28	200 m x 200 m in fall and winter; 160 m x 160 m in spring and summer	1 year	Every 14 days in fall and winter; 7 days in spring, 3 days in summer
Red Hills, OK (2012-2013)	82	123	80	20 (plus one met tower)	100 x 100	1 year	Weekly (spring, summer, fall), monthly (winter)
Ripley, Ont (2008)	38	76	64	38	80 m x 80 m	Spring, fall	Twice weekly for odd turbines; weekly for even turbines.
Ripley, Ont (2008-2009)	38	76	64	38	80 m x 80 m	6 weeks	Twice weekly for odd turbines; weekly for even turbines.
Rollins, ME (2012)	40	60	80	20	varied; turbine laydown area and gravel access roads out to 60m	6 months	Weekly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Rugby, ND (2010-2011)	71	149	78	32	200 m x 200 m	1 year	Weekly (spring, fall; migratory turbines), monthly (non-migratory turbines)
San Gorgonio, CA (1997-1998; 1999-2000)	3000	n/a	24.4-42.7		50-m radius	2 years	Quarterly
Searsburg, VT (1997)	11	7	65	11	20- to 55-m radius	Spring, fall	Weekly (fall migration)
Sheffield, VT (2012)	16	40	80	8	126m x 120m	3 months	Daily
Sheffield Operational Mitigation Study (2012)	16	40	80	16	126m x 120m	4 months	Daily
Shiloh I, CA (2006-2009)	100	150	65	100	105-m radius	3 years	Weekly
Shiloh II, CA (2009-2010)	75	150	80	25	100m radius	1 year	Weekly
Shiloh II, CA (2010-2011)	75	150	80	25	100 m radius	1 year	Weekly
Shiloh III, CA (2012-2013)	50	102.5	78.5	25	100 m radius	NA	Weekly
SMUD Solano, CA (2004-2005)	22	15	65	22	60-m radius	1 year	Bi-monthly
Solano III, CA (2012-2013)	55	128	80	19	100 m radius	NA	Bi-Weekly
Spruce Mountain, ME (2012)	10	20	78	10	100 m x 100 m	7 months	Weekly
Stateline, OR/WA (2001-2002)	454	299	50	124	minimum 126 m x 126 m	17 months	Bi-weekly, monthly
Stateline, OR/WA (2003)	454	299	50	153	minimum 126 m x 126 m	1 year	Bi-weekly, monthly
Stateline, OR/WA (2006)	454	299	50	39	variable turbine strings	1 year	Bi-weekly
Steel Winds I & II, NY (2012)	14	35	80	8 (1 was just gravel pad)	120m x 120m	6 months	Weekly, bi-weekly (November only)
Steel Winds I, NY (2007)	8	20	80	8	176m x 176m	6.5 months	Every 10 days (spring, fall) every 21 days (summer)
Stetson Mountain I, ME (2009)	38	57	80	19	76-m diameter	27 weeks (spring, summer, fall)	Weekly
Stetson Mountain I, ME (2011)	38	57	80	19	79.45x79.45m	6 months	Weekly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Stetson Mountain I, ME (2013)	38	57	80	19	76 m diameter	6 months	Weekly
Stetson Mountain II, ME (2010)	17	25.5	80	17	74.5x74.5m	6 months	Weekly (3 turbines twice a week)
Stetson Mountain II, ME (2012)	17	25.5	80	17	laydown area and road up to 60m	6 months	Weekly
Summerview, Alb (2005-2006)	39	70.2	67	39	140 m x 140 m	1 year	Weekly, bi-weekly (May to July, September)
Summerview, Alb (2006; 2007)	39	70.2	65	39	52-m radius; 2 spiral transects 7 m apart	Summer, fall (2 years)	Daily (10 turbines), weekly (29 turbines)
Tehachapi, CA (1996-1998)	3300	n/a	14.7 to 57.6	201	50-m radius	20 months	Quarterly
Top Crop I & II (2012-2013)	68 (phase I) 132 (phase (II)	300 (102 (phase I) 198 (phase II))	65 (phase I) 80 (phase II)	100	61 m radius	1 year	Weekly (spring, summer, and fall) and bi-weekly (winter)
Top of Iowa, IA (2003)	89	80	71.6	26	76 m x 76 m	Spring, summer, fall	Once every 2 to 3 days
Top of Iowa, IA (2004)	89	80	71.6	26	76 m x 76 m	Spring, summer, fall	Once every 2 to 3 days
Tuolumne (Windy Point I), WA (2009-2010)	62	136.6	80	21	180 m x 180 m	1 year	Monthly throughout the year, a sub-set of 10 turbines were also searched weekly during the spring, summer, and fall
Vansycle, OR (1999)	38	24.9	50	38	126 m x 126 m	1 year	Monthly
Vantage, WA (2010-2011)	60	90	80	30	240 m x 240 m	1 year	Monthly, a subset of 10 searched weekly during migration
Vasco, CA (2012-2013)	34	78.2	80	34	105 m radius	1 year	Weekly, monthly

Appendix H5. All post-construction monitoring studies, project characteristics, and select study methodology.

Project Name	Total # of Turbines	Total MW	Tower Size (m)	Number Turbines Searched	Plot Size	Length of Study	Survey Frequency
Wessington Springs, SD (2009)	34	51	80	20	200 m x 200 m	Spring, summer, fall	Bi-monthly
Wessington Springs, SD (2010)	34	51	80	20	200 m x 200 m	8 months	Bi-weekly (spring, summer, fall)
White Creek, WA (2007-2011)	89	204.7	80	89	180 m x 180 m & 240 m x 240 m	4 years	Twice a week, weekly and monthly
Wild Horse, WA (2007)	127	229	67	64	110 m from two turbines in plot	1 year	Monthly, weekly (fall, spring migration at 16 turbines)
Windy Flats, WA (2010-2011)	114	262.2	80	36 (plus 1 MET tower)	180 m x 180 m (120m at MET tower)	1 year	Monthly (spring, summer, fall, and winter), weekly (spring and fall migration)
Winnebago, IA (2009-2010)	10	20	78	10	200 m x 200 m	1 year	Weekly (migratory), monthly (non-migratory)
Wolfe Island, Ont (May-June 2009)	86	197.8	80	86	60-m radius	Spring	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2009)	86	197.8	80	86	60-m radius	Summer, fall	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2010)	86	197.8	80	86	60-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2010)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2011)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (July-December 2011)	86	197.8	80	86	50-m radius	6 months	43 twice weekly, 43 weekly
Wolfe Island, Ont (January-June 2012)	86	197.8	NA	86	50-m radius	NA	1/2 searched twice weekly, 1/2 searched weekly

Appendix H5 (*continued*). All post-construction monitoring studies, project characteristics, and select study methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Alite, CA (09-10)	Chatfield et al. 2010b	Locust Ridge, PA (Phase II; 10)	Arnett et al. 2011
Alta Wind I, CA (11-12)	Chatfield et al. 2012	Madison, NY (01-02)	Kerlinger 2002b
Alta Wind I-V, CA (13-14)	Chatfield et al. 2014	Maple Ridge, NY (06)	Jain et al. 2007
Alta Wind II-V, CA (11-12)	Chatfield et al. 2012	Maple Ridge, NY (07)	Jain et al. 2009a
Alta VIII, CA (12-13)	Chatfield and Bay 2014	Maple Ridge, NY (07-08)	Jain et al. 2009d
Barton I & II, IA (10-11)	Derby et al. 2011a	Maple Ridge, NY (12)	Tidhar et al. 2013a
Barton Chapel, TX (09-10)	WEST 2011	Marengo I, WA (09-10)	URS Corporation 2010b
Beech Ridge, WV (12)	Tidhar et al. 2013b	Marengo II, WA (09-10)	URS Corporation 2010c
Beech Ridge, WV (13)	Kagan et al. 2014	Mars Hill, ME (07)	Stantec 2008
Big Blue, MN (13)	Fagen Engineering 2014	Mars Hill, ME (08)	Stantec 2009a
Big Blue, MN (14)	Fagen Engineering 2015	McBride, Alb (04)	Brown and Hamilton 2004
Big Horn, WA (06-07)	Kronner et al. 2008	Melancthon, Ont (Phase I; 07)	Stantec Ltd. 2008
Big Smile, OK (12-13)	Derby et al. 2013b	Meyersdale, PA (04)	Arnett et al. 2005
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Moraine II, MN (09)	Derby et al. 2010e
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Mount Storm, WV (Fall 08)	Young et al. 2009b
Biglow Canyon, OR (Phase II; 09-10)	Enk et al. 2011a	Mount Storm, WV (09)	Young et al. 2009a, 2010b
Biglow Canyon, OR (Phase II; 10-11)	Enk et al. 2012b	Mount Storm, WV (10)	Young et al. 2010a, 2011b
Biglow Canyon, OR (Phase III; 10-11)	Enk et al. 2012a	Mount Storm, WV (11)	Young et al. 2011a, 2012b
Blue Sky Green Field, WI (08; 09)	Gruver et al. 2009	Mountaineer, WV (03)	Kerns and Kerlinger 2004
Buena Vista, CA (08-09)	Insignia Environmental 2009	Mountaineer, WV (04)	Arnett et al. 2005
Buffalo Gap I, TX (06)	Tierney 2007	Munnsville, NY (08)	Stantec 2009b
Buffalo Gap II, TX (07-08)	Tierney 2009	Mustang Hills, CA (12-13)	Chatfield and Bay 2014
Buffalo Mountain, TN (00-03)	Nicholson et al. 2005	Nine Canyon, WA (02-03)	Erickson et al. 2003c
Buffalo Mountain, TN (05)	Fiedler et al. 2007	Nine Canyon II, WA (04)	Erickson et al. 2005
Buffalo Ridge, MN (94-95)	Osborn et al. 1996, 2000	Noble Altona, NY (10)	Jain et al. 2011b
Buffalo Ridge, MN (Phase I; 96)	Johnson et al. 2000a	Noble Altona, NY (11)	Kerlinger et al. 2011b
Buffalo Ridge, MN (Phase I; 97)	Johnson et al. 2000a	Noble Bliss, NY (08)	Jain et al.2009e
Buffalo Ridge, MN (Phase I; 98)	Johnson et al. 2000a	Noble Bliss, NY (09)	Jain et al. 2010a
Buffalo Ridge, MN (Phase I; 99)	Johnson et al. 2000a	Noble Bliss/Wethersfield, NY (11)	Kerlinger et al. 2011a
Buffalo Ridge, MN (Phase II; 98)	Johnson et al. 2000a	Noble Chateaugay, NY (10)	Jain et al. 2011c
Buffalo Ridge, MN (Phase II; 99)	Johnson et al. 2000a	Noble Clinton, NY (08)	Jain et al. 2009c
Buffalo Ridge, MN (Phase II; 01/Lake Benton I)	Johnson et al. 2004	Noble Clinton, NY (09)	Jain et al. 2010b
Buffalo Ridge, MN (Phase II; 02/Lake Benton I)	Johnson et al. 2004	Noble Ellenburg, NY (08)	Jain et al. 2009b
Buffalo Ridge, MN (Phase III; 99)	Johnson et al. 2000a	Noble Ellenburg, NY (09)	Jain et al. 2010c
Buffalo Ridge, MN (Phase III; 01/Lake Benton II)	Johnson et al. 2004	Noble Wethersfield, NY (10)	Jain et al. 2011a
Buffalo Ridge, MN (Phase III; 02/Lake Benton II)	Johnson et al. 2004	NPPD Ainsworth, NE (06)	Derby et al. 2007
Buffalo Ridge I, SD (09-10)	Derby et al. 2010c	Oklahoma Wind Energy Center, OK (04; 05)	Piorkowski and O'Connell 2010
Buffalo Ridge II, SD (11-12)	Derby et al. 2012a	Pacific, CA (12-13)	Sapphos 2014
Casselman, PA (08)	Arnett et al. 2009a	Palouse Wind, WA (12-13)	Stantec 2013a
Casselman, PA (09)	Arnett et al. 2010	Pebble Springs, OR (09-10)	Gritski and Kronner 2010b
Casselman Curtailment, PA (08)	Arnett et al. 2009b	Pine Tree, CA (09-10, 11)	BioResource Consultants 2012
Castle River, Alb. (01)	Brown and Hamilton 2006a	Pinnacle, WV (12)	Hein et al. 2013a
Castle River, Alb. (02)	Brown and Hamilton 2006a	Pinnacle Operational Mitigation Study (12)	Hein et al. 2013b
Cedar Ridge, WI (09)	BHE Environmental 2010	Pinyon Pines I&II, CA (13-14)	Chatfield and Russo 2014
Cedar Ridge, WI (10)	BHE Environmental 2011	Pioneer Prairie I, IA (Phase II; 11-12)	Chodachek et al. 2012
Cohocton/Dutch Hill, NY (09)	Stantec 2010	Pioneer Prairie II, IA (13)	Chodachek et al. 2014
Cohocton/Dutch Hills, NY (10)	Stantec 2011	Pioneer Trail, IL (12-13)	ARCADIS U.S. 2014
Combine Hills, OR (Phase I; 04-05)	Young et al. 2006	Prairie Rose, MN (14)	ARCADIS U.S. 2014
Combine Hills, OR (11)	Enz et al. 2012	PrairieWinds ND1 (Minot), ND (10)	Derby et al. 2011c
Condon, OR	Fishman Ecological Services 2003	PrairieWinds ND1 (Minot), ND (11)	Derby et al. 2012c
Crescent Ridge, IL (05-06)	Kerlinger et al. 2007	PrairieWinds SD1 (Crow Lake), SD (11-12)	Derby et al. 2012d
Criterion, MD (11)	Young et al. 2012a	PrairieWinds SD1 (Crow Lake), SD (12-13)	Derby et al. 2013a
Criterion, MD (12)	Young et al. 2013	PrairieWinds SD1 (Crow Lake), SD (13-14)	Bay et al. 2015
Criterion, MD (13)	Young et al. 2014b	Rail Splitter, IL (12-13)	Good et al. 2013b
Crystal Lake II, IA (09)	Derby et al. 2010b	Record Hill, ME (12)	Stantec 2013b
Diablo Winds, CA (05-07)	WEST 2006, 2008	Record Hill, ME (14)	Stantec 2015
Dillon, CA (08-09)	Chatfield et al. 2009	Red Canyon, TX (06-07)	Miller 2008
Dry Lake I, AZ (09-10)	Thompson et al. 2011	Red Hills, OK (12-13)	Derby et al. 2013c
Dry Lake II, AZ (11-12)	Thompson and Bay 2012	Ripley, Ont (08)	Jacques Whitford 2009
Elkhorn, OR (08)	Jeffrey et a. 2009b	Ripley, Ont (08-09)	Golder Associates 2010
Elkhorn, OR (10)	Enk et al. 2011b	Rollins, ME (12)	Stantec 2013c
Elm Creek, MN (09-10)	Derby et al. 2010d	Rugby, ND (10-11)	Derby et al. 2011b
Elm Creek II, MN (11-12)	Derby et al. 2012b	San Gorgonio, CA (97-98; 99-00)	Anderson et al. 2005

Appendix H5 (*continued*). All post-construction monitoring studies, project characteristics, and select study methodology.

Data from the following sources:

Project, Location	Reference	Project, Location	Reference
Erie Shores, Ont. (06)	James 2008	Searsburg, VT (97)	Kerlinger 2002a
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003c	Sheffield, VT (12)	Martin et al. 2013
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003c	Sheffield Operational Mitigation Study (12)	Martin et al. 2013
Foote Creek Rim, WY (Phase I; 01-02)	Young et al. 2003c	Shiloh I, CA (06-09)	Kerlinger et al. 2009
Forward Energy Center, WI (08-10)	Grodsky and Drake 2011	Shiloh II, CA (09-10)	Kerlinger et al. 2010b
Fowler I, IN (09)	Johnson et al. 2010a	Shiloh II, CA (10-11)	Kerlinger et al. 2013a
Fowler I, II, III, IN (10)	Good et al. 2011	Shiloh III, CA (12-13)	Kerlinger et al. 2013b
Fowler I, II, III, IN (11)	Good et al. 2012	SMUD Solano, CA (04-05)	Erickson and Sharp 2005
Fowler I, II, III, IN (12)	Good et al. 2013c	Solano III, CA (12-13)	AECOM 2013
Fowler III, IN (09)	Johnson et al. 2010b	Spruce Mountain, ME (12)	Tetra Tech 2013
Goodnoe, WA (09-10)	URS Corporation 2010a	Stateline, OR/WA (01-02)	Erickson et al. 2004
Grand Ridge I, IL (09-10)	Derby et al. 2010h	Stateline, OR/WA (03)	Erickson et al. 2004
Harrow, Ont (10)	Natural Resource Solutions 2011	Stateline, OR/WA (06)	Erickson et al. 2007
Harvest Wind, WA (10-12)	Downes and Gritski 2012a	Steel Winds I, NY (07)	Grehan 2008
Hay Canyon, OR (09-10)	Gritski and Kronner 2010a	Steel Winds I & II, NY (12)	Stantec 2013d
Heritage Garden I, MI (12-14)	Heritage Garden I, MI (12-14)	Stetson Mountain I, ME (09)	Stantec 2009c
High Sheldon, NY (10)	Tidhar et al. 2012a	Stetson Mountain I, ME (11)	Normandeau Associates 2011
High Sheldon, NY (11)	Tidhar et al. 2012b	Stetson Mountain I, ME (13)	Stantec 2014
High Winds, CA (03-04)	Kerlinger et al. 2006	Stetson Mountain II, ME (10)	Normandeau Associates 2010
High Winds, CA (04-05)	Kerlinger et al. 2006	Stetson Mountain II, ME (12)	Stantec 2013e
Hopkins Ridge, WA (06)	Young et al. 2007a	Summerview, Alb (05-06)	Brown and Hamilton 2006b
Hopkins Ridge, WA (08)	Young et al. 2009c	Summerview, Alb (06; 07)	Baerwald 2008
Jersey Atlantic, NJ (08)	NJAS 2008a, 2008b, 2009	Tehachapi, CA (96-98)	Anderson et al. 2004
Judith Gap, MT (06-07)	TRC 2008	Top Crop I & II, IL (12-13)	Good et al. 2013a
Judith Gap, MT (09)	Poulton and Erickson 2010	Top of Iowa, IA (03)	Jain 2005
Kewaunee County, WI (99-01)	Howe et al. 2002	Top of Iowa, IA (04)	Jain 2005
Kibby, ME (11)	Stantec 2012	Tuolumne (Windy Point I), WA (09-10)	Enz and Bay 2010
Kittitas Valley, WA (11-12)	Stantec Consulting 2012a	Vansycle, OR (99)	Erickson et al. 2000
Klondike, OR (02-03)	Johnson et al. 2003	Vantage, WA (10-11)	Ventus Environmental Solutions 2012
Klondike II, OR (05-06)	NWC and WEST 2007	Vasco, CA (12-13)	Brown et al. 2013
Klondike III (Phase I), OR (07-09)	Gritski et al. 2010	Wessington Springs, SD (09)	Derby et al. 2010g
Klondike IIIa (Phase II), OR (08-10)	Gritski et al. 2011	Wessington Springs, SD (10)	Derby et al. 2011d
Lakefield Wind, MN (12)	MPUC 2012	White Creek, WA (07-11)	Downes and Gritski 2012b
Leaning Juniper, OR (06-08)	Gritski et al. 2008	Wild Horse, WA (07)	Erickson et al. 2008
Milford I, UT (10-11)	Stantec 2011	Windy Flats, WA (10-11)	Enz et al. 2011
Milford I & II, UT (11-12)	Stantec 2012b	Winnebago, IA (09-10)	Derby et al. 2010f
Montezuma I, CA (11)	ICF International 2012	Wolfe Island, Ont (May-June 09)	Stantec Ltd. 2010a
Montezuma I, CA (12)	ICF International 2013	Wolfe Island, Ont (July-December 09)	Stantec Ltd. 2010b
Montezuma II, CA (12-13)	Harvey & Associates 2013	Wolfe Island, Ont (January-June 10)	Stantec Ltd. 2011a
Lempster, NH (09)	Tidhar et al. 2010	Wolfe Island, Ont (July-December 10)	Stantec Ltd. 2011b
Lempster, NH (10)	Tidhar et al. 2011	Wolfe Island, Ont (January-June 11)	Stantec Ltd. 2011c
Linden Ranch, WA (10-11)	Enz and Bay 2011	Wolfe Island, Ont (July-December 11)	Stantec Ltd. 2012
Locust Ridge, PA (Phase II; 09)	Arnett et al. 2011	Wolfe Island, Ont (January-June 12)	Stantec Ltd. 2014

Appendix D: US Fish and Wildlife Service Risk Assessment for the Ocotillo Wind Energy Facility

Appendix D Service Analysis of Golden Eagle Fatality Predictions from the Ocotillo ECP

D.1 Background

The Service uses explicit models in a Bayesian statistical inference framework to estimate eagle fatalities at a wind facility while accounting for uncertainty. The analysis presented below follows the Service's Eagle Conservation Plan Guidance version 2 (ECP Guidance, USFWS 2013); a more detailed background on the Service's model and modeling framework are presented in Appendix D of the Technical Appendices of the ECP Guidance. The basic Service fatality prediction model is based on the assumption that there is a predictable relationship between pre-construction eagle exposure (λ) and subsequent annual fatalities resulting from collisions with wind turbines (F), such that:

$$F = \varepsilon\lambda C$$

Where C is the probability of a collision given a minute of eagle flight within the hazardous area (see Service definition in ECP Guidance Technical Appendices), and ε is the expansion factor, a constant that describes the total area and time within a project footprint that is potentially hazardous to eagles; this is used to expand the estimated fatality rate into the annual number of predicted fatalities. One advantage of using a Bayesian modeling framework is the ability to incorporate known information directly into the model fitting by defining an appropriate prior probability distribution (or simply "prior"). The Service has defined prior distributions for both eagle exposure and collision probability based on the best available data. The exposure prior is updated with the pre-construction eagle use data collected at the site (which will overwhelm any influence of the prior with adequate sampling) and the collision probability will be updated with post-construction fatality if the project becomes operational. The expansion term represents the hazardous area (dependent on turbine number and size).

All of the model scenarios have the same inputs except for the number of hours of observation. We modeled different scenarios based on different hours of observations because there was concern that the all bird avian point counts were not an effective survey method for raptors. Consequently, we calculated eagle risk at Ocotillo Express under two modeling scenarios. This only affected the observation time because no eagles were observed during the all bird avian point counts. It should be noted that all scenarios assume that the observers detected 100% of eagle flight minutes below 200-m within an 800-m radius plot for each count.

- Model Scenario 1 was calculated using 2745.6 hours of observation. This scenario includes raptor migration data and no avian point count data.

- Model Scenario 2 was calculated using 3270.1 hours of observation. This scenario includes both raptor migration survey and avian point count data.

Avian point count surveys are described in Helix 2010a and based on CEC 2007. Raptor migration surveys are described in Helix 2010b.

D.1.2 EXPOSURE

The Service defines a prior for eagle exposure (Gamma (0.97, 2.76)) based on the exposure rates across a range of sites (USFWS 2012). The prior is then updated with the eagle flight minutes observed and the total area and time covered by observation surveys to get the posterior distribution for exposure that is then used in the fatality model (USFWS 2013). In this case,

$$\textbf{\textit{Posterior}}\ \lambda \sim \textbf{\textit{Gamma}}\textbf{(0.97 + 0.3056, 2.76 + 0.1588),}$$
$$\textbf{therefore}$$

$$\textbf{\textit{Posterior}}\ \lambda \sim \textbf{\textit{Gamma}}\textbf{(1.2756, 2.9188)}$$

Eagle minutes were calculated from eagle tracks recorded during observation surveys (see Figures 6, 7, 8, and 9 in ECP). Eagle minutes were calculated for each observation by multiplying the number of eagles observed by the total time of the observation by the fraction of the total distance that occurred within 800 m of an observation point, rounded up to the nearest minute (see Tables 2, 4 and 5 in ECP). This resulted in a total of 47 eagle minutes over either 2745.6 and 3270.1 hours of observations (this value varied depending on which survey effort was included). No eagles were observed below 200-m and within 800-m of an observation point during avian point counts, so the eagle minutes are the same for both scenarios. Note, unless strata are specified, exposure rate is assumed to be uniform across the space and time of the project footprint. In this case the observation data were not collected in such a way that allow for spatial or temporal stratification, therefore the model is assuming the data represent the range of exposure throughout a typical year.

D.1.3 COLLISION

The Service defines the collision probability as *Beta* (2.31, 396.69) based on information from projects presented in Whitfield (2009).

$$\textbf{\textit{Prior}}\ C \sim \textbf{\textit{Beta}}\textbf{(2.31, 396.69)}$$

D.1.4 EXPANSION

This is the product of the total hazardous area ($A = \pi r^2$), where r is the turbine rotor radius and A is summed across all turbines) and daylight hours.

For the Ocotillo Express modeling scenarios, ε is

$$\varepsilon = (51 \times (\pi \times 0.0515^2)) \times 4448.48 = 1890.37$$

The units for ε are hr·km2.

D.1.5 ESTIMATING FATALITIES

Table D-1. Site Data for all model scenarios*

Input		
Location	Latitude 32.750182	Longitude -116.054643
	Value	Notes
Number of Turbines*	112	2.3 MW
Turbine Rotor Radius (km)	0.054	108-m diameter
Eagle Minutes	47	
Survey Effort (hours)	2745.6 (Scenario 1) 3270.1 (Scenario 2)	
Count Area (km2)	8.05 (Helix 2010b)	800-m circular plot

*All inputs were the same for all model scenarios except for the number of observation minutes; 2745.6, and 3270.1 for Model Scenarios 1 and 2, respectively. FatalityCMR software was used to estimate prior updates (Peron and Hines 2014).

D.1.6 UPDATING BAYESIAN PRIORS

The Bayesian risk model developed by USFWS (2013) and New et al. (2015) utilize a Bayesian prior based off the post-construction golden eagle mortality data of four wind projects. We were able to utilize this Bayesian risk model to assess how including post-construction mortality monitoring to update the prior can influence the eagle risk estimate. We used the Fatality Capture Mark Recapture (FCMR) approach as provided by Peron and Hines (2014) and divided by the number of years of post-construction mortality monitoring. We provide take estimates with and without updating the risk priors.

Table D-2. Site Data for updating of Bayesian risk model prior

Input		
Sample Sizes	Used	Not Included
Carcass Persistence (CP)	159 mallard, 2 years	6 rock pigeons and 1 RTHA not included due to species difference
Searcher Efficiency (SE)	66 mallards placed, 63 found, 2 years	39 chukar and rock pigeons not included due to species difference
Estimates	Mean	SD
CP	0.6148	0.0289
SE	0.9504	0.0215

	Mean	SD
Exposure Prior - 2 years of study	0.3056	0.159
Exposure Prior - divided by 2 years of study	0.1528	0.159
Exposure Posterior	0.200	0.130

So the fatality estimate is a product of

$$\textit{Fatalities} = \textit{Posterior } \lambda \times \textit{Prior } C \times \varepsilon$$

We calculate predicted fatalities using simulation runs that draw from the exposure and collision distributions and insert the drawn values into the model. This results in a distribution of predicted fatalities:

Model Scenario 1a: Analysis with preconstruction use data only - 2745.6 observation hours

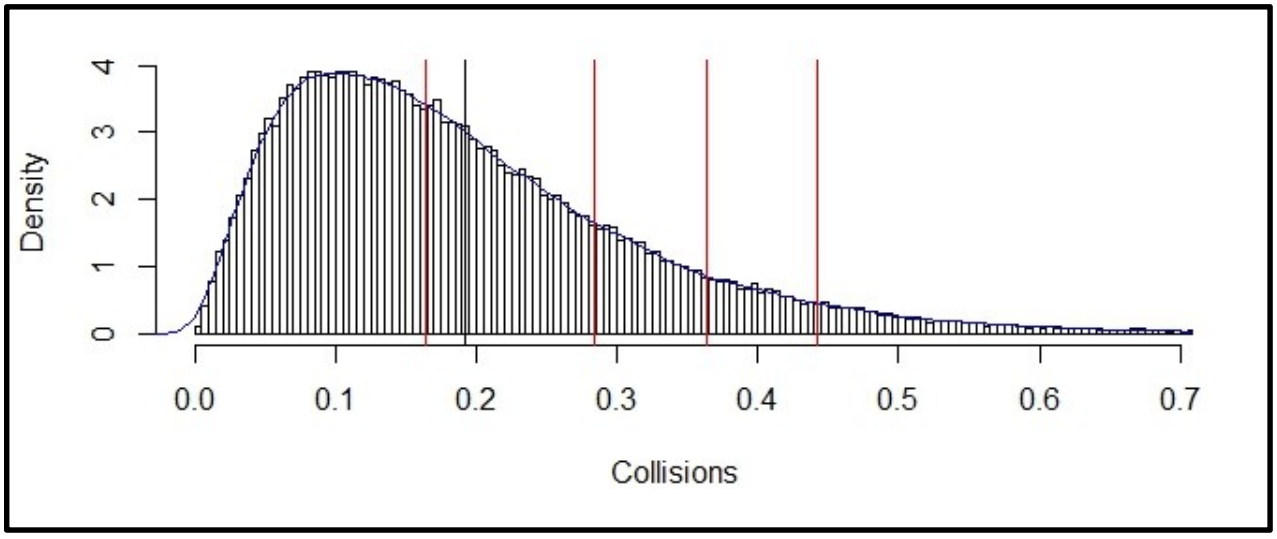


Figure D-1. Annual predicted fatalities for Ocotillo Model Scenario 1a (2745.6 hours of observations) without updating the prior with post-construction mortality data. The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.19 and a standard deviation of 0.13. Moving from left to right, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for annual predicted golden eagle collision rates.

Table D-2. Annual Predicted Fatalities for Model Scenario 1a

	Mean	SD	CI50	CI80	CI90	CI95
2745.6 hours	0.19	0.13	0.16	0.28	0.36	0.44

Model Scenario 1b: Analysis with both preconstruction use and postconstruction mortality data - 2745.6 observation hours

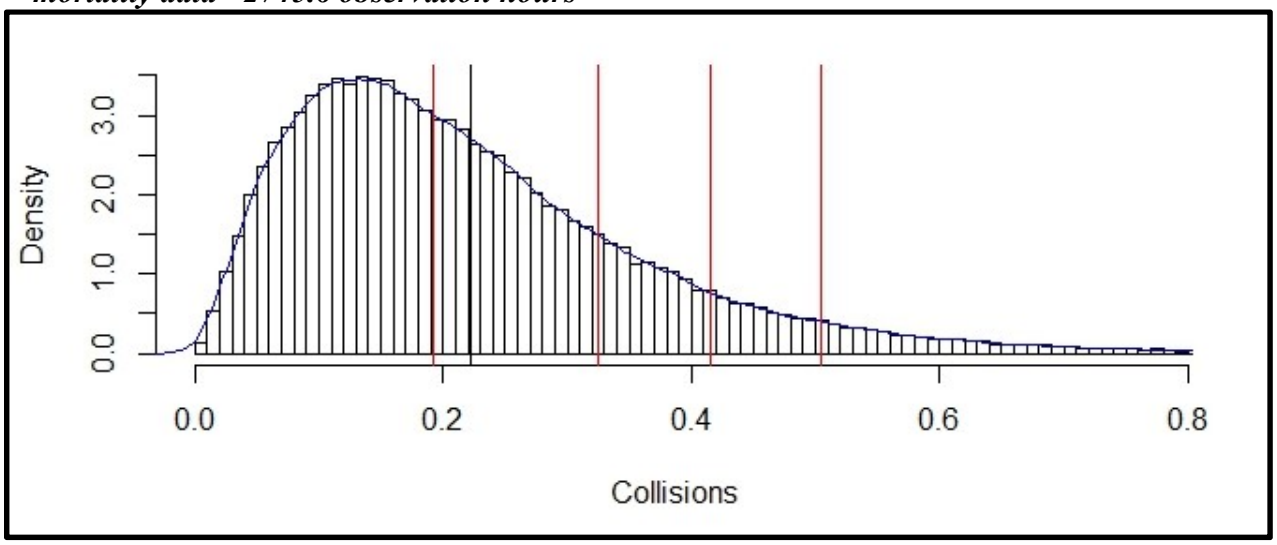


Figure D-2. Annual predicted fatalities for Ocotillo Model Scenario 1b (2745.6 hours of observations). The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.22 and a standard deviation of 0.15. Moving from left to right, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for annual predicted golden eagle collision rates.

Table D-2. Annual Predicted Fatalities for Model Scenario 1b

	Mean	SD	CI50	CI80	CI90	CI95
2745.6 hours	0.22	0.15	0.19	0.32	0.41	0.50

Model Scenario 2a: Analysis with preconstruction use data only - 3270.1 observation hours

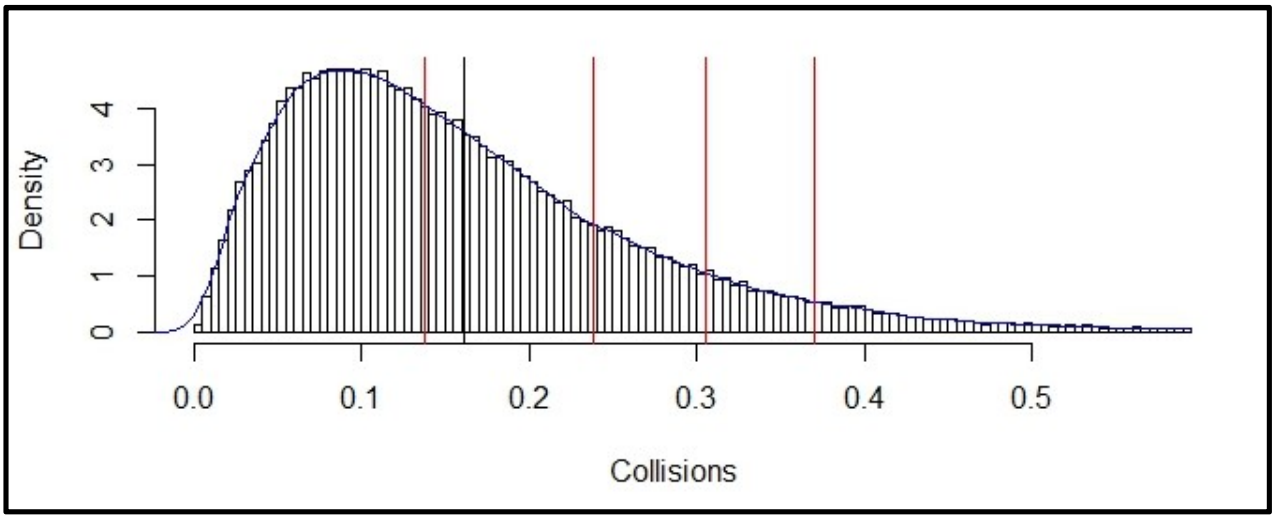


Figure D-3. Annual predicted fatalities for Ocotillo Model Scenario 2a (3270.1 hours of

observations). The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.16 and a standard deviation of 0.11. Moving from left to right, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for annual predicted golden eagle collision rates.

Table D-3. Annual Predicted Fatalities for Model Scenario 2a

	Mean	SD	CI50	CI80	CI90	CI95
3270.1 hours	0.16	0.11	0.14	0.24	0.31	0.37

Model Scenario 2b: Analysis with both preconstruction use and postconstruction mortality data - 3270.1 observation hours

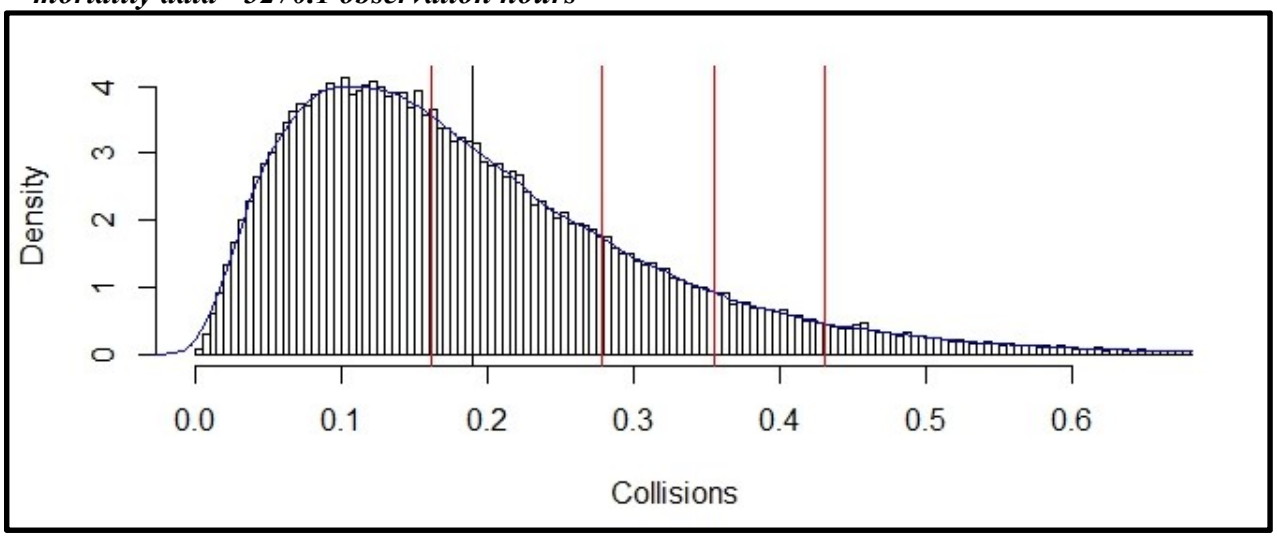


Figure D-4. Annual predicted fatalities for Ocotillo Model Scenario 2a (3270.1 hours of observations). The probability distribution of the collision probability prior, a Beta distribution with a mean of 0.19 and a standard deviation of 0.12. Moving from left to right, the red lines indicate the 50th, 80th, 90th and 95th confidence intervals for annual predicted golden eagle collision rates.

Table D-4. Annual Predicted Fatalities for Model Scenario 2b

	Mean	SD	CI50	CI80	CI90	CI95
3270.1 hours	0.19	0.12	0.16	0.28	0.36	0.43

D.2 Discussion

We modeled different scenarios based on different hours of observations because there was concern that the all bird point counts were not an effective survey method for raptors. Our results indicate that there is a negligible decrease in predicted collision rate at the 80th confidence interval from 2745.6 to 3270.1 hours. Consequently, the more conservative scenario (2745.6 hours of observations) will be used for the risk assessment.

D.3 Literature Cited

California Energy Commission (CEC). 2007. California Guidelines for Reducing Impacts to Birds and Bats From Wind Energy Development (Final Report). October 2007.

HELIX Environmental Planning, Inc. 2010a. Avian Point Count Report for the Ocotillo Wind Energy Project. AEG-09. December 10, 2010.

HELIX Environmental Planning, Inc. 2010b. Raptor Migration Report for the Ocotillo Wind Energy Project. AEG-09. December 10, 2010.

New, L., E. Bjerre, B. Millsap, M. C. Otto, and M. C. Runge. 2015. A collision risk model to predict avian fatalities at wind facilities: an example using golden eagles, Aquila chrysaetos. PLoS ONE 10:e0130978.

Péron, Guillaume, and Hines, J.E., 2014, fatalityCMR—Capture-recapture software to correct raw counts of wildlife fatalities using trial experiments for carcass detection probability and persistence time: U.S. Geological Survey Techniques and Methods 7–C11, 14 p., http://dx.doi.org/10.3133/tm7C11.

U.S. Fish and Wildlife Service. 2013. Eagle conservation plan guidance. Module 1—land-based wind energy. Version 2. https://www.fws.gov/migratorybirds/pdf/management/eagleconservationplanguidance.pdf. Accessed 5 Feb 2016.

R Code with Data Inputs for Bayesian Eagle Risk Analysis Including update of the prior:

```
source("C:/Eagle risk model/DayLen.R")
### Ocotillo Project - Model Inputs###
SeasonType<-"Annual"
LatLng<-c(lat= 32.750182, -116.054643  )
### run the next 4 lines of code
DayLtHr<-DayLen(LatLng[2],LatLng[1],Type=SeasonType)
colnames(DayLtHr)[1]<-"Season"
DayLtHr$AveDayLen<-with(DayLtHr,DayLtHr/Days)
print(DayLtHr)
cProject<-"Octotillo Express" #project ID to track model outputs

nTurbine<-c(112)  #number of turbines

HazRadKm<-c(54/1000) #rotor radius (in kilometers)

HzKM2<-sum(nTurbine*pi*HazRadKm^2) #calculates the total hazardous area

## (note: this version of the code assumes that eagle suverys for the survey plot size
## indicated were made up to 200-m; if not, we must use a version of the code/model priors
## that account for volume; here the assumption is that observation height and hazardous area
## height cancel out)

CntHr<-c(3270.1)  # count duration (in hours)
## the data provided only included total count hours so they are all included here and
## nCnt in the ExpSvy dataframe is set to 1.
## a separate evaluation of temporal and  geographic representativeness should be made,
## as well as consideration of seasonal or other strata, if appropriate.

## Create the "ExpSvy" data frame:
# this includes the Eagle Minutes observed, number of counts conducted,
# and the area observed at each observation point
ExpSvy<-data.frame(row.names=c("SVW"),
                   #EMin=c(45.49),
                   EMin=c(47),
                   nCnt=c(1),
                   CntKM2=c(pi*(800/1000)^2),
                   DayLtHr=c(DayLtHr$DayLtHr)
)

AddTot<-TRUE #Add strata for total (TRUE) or not (FALSE)

###' Added for inclusion of post-constructon estimate to update the collision prior
EOutMin <- 0.1528
##' Note: The code beyond the point generally will not need to be modified
##' ------------------------------------------------------------------------------
```

```
##' -------------------------------------------------------------------------------
##' -------------------------------------------------------------------------------
##' -------------------------------------------------------------------------------
##' Source FatalFcns.R
##'
##' Note: much of this code may be extraneous. Generally there will be no need to modify.

### Fatality Functions - 23 Apr 2013 ###

simFatal<-function(EMin,SmpHrKM2,ExpFac,
                   aPriExp=0.9776543,bPriExp=2.777427,aPriCPr=2.31,bPriCPr=396.69){

  require(rv)

  # Update the exposure prior
  aPostExp<-aPriExp+EMin
  bPostExp<-bPriExp+SmpHrKM2
  print(c(aPostExp=aPostExp,bPostExp=bPostExp,aPriCPr=aPriCPr,bPriCPr=bPriCPr))

  Exp<-rvgamma(n=1,aPostExp,bPostExp)
  CPr<-if(bPriCPr==0){
    aPriCPr
  } else {
    rvbeta(n=1,aPriCPr,bPriCPr)
  }
  Fatalities<-ExpFac*Exp*CPr
  attr(Fatalities,"Exp")<-cbind(Mean=rvmean(Exp),SD=rvsd(Exp))
  return(Fatalities)
}

simFatalCPr <- function(EMin, EOutMin, SmpHrKM2, ExpFac, aPriExp=0.97,
                        bPriExp=2.76,aPriCPr=2.31, bPriCPr=396.69){

  # EMin: observed number of eagle minutes
  # EOutMin: annual eagle fatalities on an operational wind facility
  # SmpHrKM2:total hr km2 surveyed for eagle minutes
  # ExpFac:expansion factor
  # aPriExp: alpha parameter for the prior on lambda
  # bPriExp: beta parameter for the prior on lambda
  # aPriCPr: alpha parameter for the prior on C
  # bPriCPr: beta parameter for the prior on C

  # Entering a negative value for EMin or EOutMin indicates that no data
  # were collected for those model inputs

  require(rv)

  # Update the exposure prior
```

```
  if(EMin>=0){
    aPostExp <- aPriExp + EMin
    bPostExp <- bPriExp + SmpHrKM2
  }else{
    aPostExp <- aPriExp
    bPostExp <- bPriExp}

  Exp <- rvgamma(n=1, aPostExp, bPostExp)

  # Update the collisions prior
  if(EOutMin>=0){
    aPostCPr <- aPriCPr + EOutMin
    bPostCPr <- ((rvmean(Exp) * ExpFac) - EOutMin) + bPriCPr
  }else{
    aPostCPr <- aPriCPr
    bPostCPr <- bPriCPr}

  CPr <- rvbeta(n=1, aPostCPr, bPostCPr)

  Fatalities            <- ExpFac * Exp * CPr
  attr(Fatalities,"Exp") <- c(Mean=rvmean(Exp), SD=rvsd(Exp))
  attr(Fatalities,"CPr") <- c(Mean=rvmean(CPr), SD=rvsd(CPr))

  return(Fatalities)}


plotFatal<-function(Fatalities,probs=0.8,PlotHist=TRUE,
                    xlim=NULL,xlab="Collisions",ylab="Density",# bty="o",
                    col="red",add=FALSE,...){
  require(rv)

  Names<-if(is.null(names(Fatalities))) 1:length(Fatalities) else
    names(Fatalities)
  Smry<-RVSmry(Names,Fatalities,probs=probs)
  ColIdx<-grepl("CI",colnames(Smry))
  CIs<-Smry[,ColIdx]

  if(!add){
    if(is.null(xlim)) xlim<-c(0,1.1*rvquantile(Fatalities,probs=0.99))
    rvhist(Fatalities,xlab=xlab,ylab=ylab,
           xlim=xlim,freq=FALSE,# bty=bty,
           ...
    )
  }

  lines(density(as.numeric(Fatalities[[1]],bw="sj")),col=if(add) col else "blue")
  abline(v=Smry$Mean,col=if(add) col else "black")
  abline(v=CIs,col=col)
```

```
  invisible(NULL)
}

##' ------------------------------------------------------------------------------
##' Source FatalFcns.R
##'
##' Note: much of this code may be extraneous. Generally there will be no need to modify.

### Summary Function ###

RVSmry<-function(Names,Series,probs=c(0.5,0.05,0.95)){
  Smry<-data.frame(
    Mean=as.vector(rvmean(Series)),SD=as.vector(rvsd(Series)),
    #   rvquantile(Series,probs=probs),
    matrix(rvquantile(Series,probs=probs),ncol=length(probs)),
    row.names=rownames(Names)
  )
  colnames(Smry)[2+1:length(probs)]<-paste("CI",format(100*probs),sep="")
  return(data.frame(Names,Smry))
}
##' ------------------------------------------------------------------------------
### Draft USFWS Collision Fatality Model Code version 4.1 (23 Apr 2013)          ###
### This code is a working version only. It is not intended for general distribution. ###
### Check back often for updates to the model/code                               ###

## Please review Model Code v4.1 README for general instructions
## requires the rv and maptools package for R

## Analysis Inputs ##

UCI<-c(0.5,0.8,0.9,0.95)

require(maptools)
require(rv)
nSim<-100000
setnsims(nSim)

### Survey Inputs ###

nSvy<-nrow(ExpSvy)
cSvy<-(rownames(ExpSvy))

SmpHrKM2<-with(ExpSvy,nCnt*CntHr*CntKM2)
ExpFac<-ExpSvy$DayLtHr*HzKM2

# Calculate the fatalities and store as a temporary object.
tmp<-
with(ExpSvy,mapply(simFatal,EMin=EMin,SmpHrKM2=SmpHrKM2,ExpFac=ExpFac,
```

```
                    SIMPLIFY=FALSE
))

# R code to get the survey specific simulations in an rv vector.
Fatalities<-rvnorm(nSvy)
Exp<-data.frame(Mean=rep(NA,nSvy),SD=NA,row.names=cSvy)
for(i in 1:nSvy){
  Fatalities[i]<-tmp[[i]]
  Exp[i,]<-attr(tmp[[i]],"Exp")
}
rm(tmp)
names(Fatalities)<-cSvy

# Summarize the results, including a total if needed.
nSvy<-length(Fatalities)
if(is.null(nSvy))nSvy<-1
FatalStats<-RVSmry(cSvy,Fatalities,probs=UCI)
if(AddTot){
  FatalStats<-rbind(
    FatalStats,
    RVSmry("Total",sum(Fatalities),probs=UCI)
  )
}

# Look at the results
cat(cProject,"\n")
#cat(paste(Name,", ",date(),"\n",sep=""))
#Number of Turbines
print(nTurbine)
#Hazardous Area Per Turbine (km^2)
#print(HzKM2PT)
print(ExpSvy)
#Exposure rate
print(Exp,digits=3)
#Annual Collision Fatalities
print(FatalStats,digits=2)

# Plots
nPlot<-nSvy+as.integer(AddTot)
nCol<-floor(sqrt(nPlot))
nRow<-ceiling(nPlot/nCol)
xlim<-range(rvrange(Fatalities))

par(mfrow=c(nRow,nCol))
for(iPlot in 1:nSvy){
  plotFatal(Fatalities[iPlot],probs=UCI,
          #  xlim=xlim,add=FALSE,  # uncomment this line to put the graphs for all of the strata
on the same scale
```

```
        main=cSvy[iPlot])
}
if(AddTot)plotFatal(sum(Fatalities),main="Total")

##' ------------------------------------------------------------------------------
## Modify to allow post-construction estiamte update of collision probabilty

## Analysis Inputs ##

UCI<-c(0.5,0.8,0.9,0.95)

require(maptools)
require(rv)
nSim<-100000
setnsims(nSim)

### Survey Inputs ###

nSvy<-nrow(ExpSvy)
cSvy<-(rownames(ExpSvy))

SmpHrKM2<-with(ExpSvy,nCnt*CntHr*CntKM2)
ExpFac<-ExpSvy$DayLtHr*HzKM2

# Calculate the fatalities and store as a temporary object.
tmp<-
with(ExpSvy,mapply(simFatalCPr,EMin=EMin,EOutMin=EOutMin,SmpHrKM2=SmpHrK
M2,ExpFac=ExpFac,
                   SIMPLIFY=FALSE
))

# R code to get the survey specific simulations in an rv vector.
Fatalities<-rvnorm(nSvy)
Exp<-data.frame(Mean=rep(NA,nSvy),SD=NA,row.names=cSvy)
for(i in 1:nSvy){
  Fatalities[i]<-tmp[[i]]
  Exp[i,]<-attr(tmp[[i]],"Exp")
}
rm(tmp)
names(Fatalities)<-cSvy

# Summarize the results, including a total if needed.
nSvy<-length(Fatalities)
if(is.null(nSvy))nSvy<-1
FatalStats<-RVSmry(cSvy,Fatalities,probs=UCI)
if(AddTot){
  FatalStats<-rbind(
    FatalStats,
```

```
   RVSmry("Total",sum(Fatalities),probs=UCI)
  )
}

# Look at the results
cat(cProject,"\n")
#cat(paste(Name,", ",date(),"\n",sep=""))
#Number of Turbines
print(nTurbine)
#Hazardous Area Per Turbine (km^2)
#print(HzKM2PT)
print(ExpSvy)
#Exposure rate
print(Exp,digits=3)
#Annual Collision Fatalities
print(FatalStats,digits=2)

# Plots
nPlot<-nSvy+as.integer(AddTot)
nCol<-floor(sqrt(nPlot))
nRow<-ceiling(nPlot/nCol)
xlim<-range(rvrange(Fatalities))

par(mfrow=c(nRow,nCol))
for(iPlot in 1:nSvy){
  plotFatal(Fatalities[iPlot],probs=UCI,
          #  xlim=xlim,add=FALSE,  # uncomment this line to put the graphs for all of the strata
on the same scale
          main=cSvy[iPlot])
}
if(AddTot)plotFatal(sum(Fatalities),main="Total")
```

Appendix B
Avian and Bat Protection Plan

Avian and Bat Protection Plan for the Ocotillo Wind Energy Facility

Ocotillo Express LLC
1600 Smith Street, Suite 4025
Houston, Texas 77002

February 2012

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1.0 INTRODUCTION

1.1 Purpose

The primary purposes of this Avian and Bat Protection Plan (ABPP) are to summarize the baseline avian and bat studies conducted within the proposed Ocotillo Express Wind Energy Facility (OWEF), identify measures to avoid and minimize risks through site planning, best management practices (BMP's), advanced conservation practices (ACP's), and describe the adaptive management, monitoring, and reporting requirements for the proposed project. This plan describes the measures that would be implemented prior to, during, and following construction to protect migratory and resident birds and bats and allow for the proposed wind energy facility in an environmentally responsible and practicable manner. This ABPP was prepared in accordance with the Interim Guidelines for the Development of a Project Specific Avian and Bat Protection Plan for Wind Energy Facilities (US Fish and Wildlife Service [USFWS] 2010a) and with the California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development (California Energy Commission [CEC] 2007).

1.2 Background

In order to address the growing interest in developing wind energy resources and National Energy Policy recommendations to increase renewable energy production capability, the Bureau of Land Management (BLM) began evaluating wind energy potential on public lands and developing a wind energy policy. In October 2003, the BLM started preparation of a *Wind Energy Development Programmatic Environmental Impact Statement* (PEIS) to analyze the potential impacts of wind energy development on public lands and to minimize those impacts to natural, cultural, and socioeconomic resources. The PEIS was published in June 2005, and in December 2005 the Record of Decision was signed to implement a comprehensive Wind Energy Development program on BLM-administered lands in the western United States (BLM 2005). The program has established policies and BMPs to address the administration of wind energy development actions on BLM lands and has identified mitigation measures. The programmatic policies and BMPs of the Wind Energy Development Program allow project-specific analysis to focus on the site-specific issues and concerns of individual projects. On August 24, 2006, the BLM Washington Office issued Instruction Memorandum (IM) 2006-216, Right-of-Way Management, Wind Energy Land Use Plan Amendments, Wind Energy that provided guidance on issuing rights-of-way (ROWs) for wind energy testing, monitoring, and development (BLM 2006). Until then, the BLM had an interim wind energy policy, issued in 2002 (BLM 2003).

In August 2009, Pattern Energy, through Ocotillo Express LLC (OE LLC), applied for a testing and monitoring ROW near Ocotillo, California. Since then, it has maintained anemometers to determine the suitability of the project for wind energy development. In October 2009, OE LLC applied for a wind energy development ROW grant from BLM. The ROW grant would be for the construction, operation, and maintenance of the 112-turbine, approximately 300-megawatt (MW)

OWEF and associated facilities. The OWEF would be located on approximately 12,565 acres in the project area and consist of up to112 turbines, including 6 potential alternate turbine locations and associated infrastructure.

In December 2008, a new IM, 2009-043, was issued to update policy and give further guidance on processing Wind Energy Facilities (WEFs) on BLM-administered lands (BLM 2009). OE LLC's Plan of Development (POD) complies with the 2008 guidance. The POD was tentatively finalized in February 2011 but may change in response to comments on the preliminary Environmental Impact Report/Environmental Impact Assessment (EIR/EIS).

On July 9, 2010, IM 2010-156 was issued to provide direction for complying with the Bald and Golden Eagle Protection Act (Eagle Act), including its implementing regulations (i.e., September 11, 2009, Eagle Rule [Rule] 50 CFR parts 13 and 22) for golden eagles, and to identify steps that may be necessary within the habitat of golden eagles to ensure environmentally responsible authorization and development of renewable energy resources. OE LLC has developed an Eagle Conservation Plan as a separate document, but in support of this Avian and Bat Protection Plan.

1.3 Facility Description

The principal components of the OWEF would consist of wind turbine generators (WTGs), an underground electrical collection system for collecting the power generated by each WTG, electrical substation and switchyard, access roads, Operation and Maintenance (O&M) building, temporary laydown and storage areas, concrete batch plant, sand and gravel source, fiber-optic communications, four permanent meteorological (MET) towers, and one radar unit. The maximum temporary and permanent disturbance areas are described in Table 1 below. The OWEF totals approximately 12,565 acres, all of which are on BLM land covered by the requested ROW except for 26 acres of private land. This is to allow for the necessary set back distances and spacing between individual WTGs and linear arrays. The total area estimated for use by the wind energy facility (including both short- and long-term disturbance) is approximately 491.6 acres, or approximately 4.0 % of the total ROW.

Table 1. Ocotillo Express Wind Facility Components; Maximum Disturbance Summary Table, Based on Construction of 112 Turbines.

Facility Component	Temporary Disturbance (Acres)	Permanent Disturbance (Acres)
Turbine Foundations	157.8	11.3
Access Roads Lines/Crane Walk/Crane Pads	96.9	75.7
Collector Lines	88.3	0
Substation / Switchyard	0.7	31.7
O&M Facility	0	3.3
Batching Plant & Laydown/Parking Area	29.4	0
Meteorological Towers	2.0	0.01
Total	**375.1**	**122.1**

Since wind turbine technology is continually improving and the cost and availability of specific types of WTGs vary from year to year, a representative range of turbine types that are most likely to be used for the project are listed in Table 2. One-hundred and twelve WTG sites have been identified that provide not only the highest wind speeds but also the most consistent wind resource, which provides the highest overall energy output and reliability.

Table 2. Wind Turbine Specifications.

Turbine	Hub Height (m)	Rotor Diameter (m)	Total Height (m)	Rated Capacity Wind Speed (rpm)	Rotor Speed (rpm)	Tower Base Diameter (m)
2.3/3.0 MW Siemens	80	101/108/113	136.5	13	6-16	4.5
1.6/2.75 MW GE	80	100/107	130	13.5	14.8	4.3

Notes: m = meters; rpm = rotations per minute.

Wind turbines consist of three main components: the turbine tower, the nacelle, and the rotor consisting of the hub and the blades. The nacelle is the portion of the wind turbine mounted at the top of the tower, which houses the gearbox and electrical generator. Turbine hub heights and rotor diameters (RD) for the potential turbines may have slight variations, but for purposes of analysis will not exceed 113 m max rotor diameter. The towers will be a tapered tubular steel structure manufactured in three or four sections depending on the tower height, and approximately 15 feet (4.5 meters) in diameter at the base. The towers will be painted white per Federal Aviation Administration (FAA) requirements. A service platform at the top of each

section will allow for access to the tower's connecting bolts for routine inspection. A ladder inside the structure will ascend to the nacelle to provide access for turbine maintenance. The tower will be equipped with interior lighting and a safety glide cable alongside the ladder. The towers will be fabricated and erected in sections.

The nacelle houses the main mechanical components of the WTG, the drive train, gearbox, and generator. The nacelle will be equipped with an anemometer and a wind vane that signals wind speed and direction information to an electronic controller. A mechanism will use electric or hydraulic motors to rotate (yaw) the nacelle and rotor to keep the turbine pointed into the wind to maximize energy capture. An enclosed steel-reinforced fiberglass shell houses the nacelle to protect internal machinery from the elements.

Modern wind turbines have three-bladed rotors. The diameter of the circle swept by the blades will be no more than 371 feet (113 meters). Generally, larger wind turbine generators have slower rotating blades, but the specific rotations per minute (RPM) values depend on aerodynamic design and vary across machines. Based on the turbines considered, the blades will turn at no more than 16 RPM.

The proposed facility will connect to the new SDG&E Sunrise Powerlink 500-kilovolt (kV) transmission line scheduled for completion in June 2012 across the middle of the project site. The Point of Interconnection will be adjacent to the project substation. A new substation, electrical collection system, padmount transformer vaults (if used), and above ground junction boxes will be installed. Furthermore, a 500-kV above ground stub line will connect the new substation to the new SDG&E Sunrise Powerlink 500-kV line. In addition to the turbines, the project will include the construction of twenty-three 34.5-kV electrical collection system circuits connecting into a new high voltage (HV) main transformer located at the substation. The new substation will be located within the project area, near the new SDG&E 500kV line. The collection lines connecting one turbine to the next and to the project substation will be buried underground generally adjacent to the interior turbine access roads as noted above. Above ground components of the collection system will include pad mounted transformers alongside each turbine, junction boxes throughout the project site, the main substation/switchyard (which will be fenced), and the overhead 500-kV stub line connecting the switchyard to the new 500-kV transmission line. SDG&E intends to construct and operate the switchyard independently from OE LLC and as such the measures identified in the ABPP for the OWEF do not apply to the SDG&E facilities. SDG&E switchyard and facilities will meet APLIC standards for electrical equipment design.

1.4 Key Avian and Bat Laws, Regulations, Authorizations

The project is subject to all relevant federal, state, and local statutes, regulations, and plans as described in the EIS/EIR. The key federal, state, and local agency approvals, reviews, and permitting requirements for avian and bat species that are anticipated to be needed are presented in Table 3.

Table 3. Key Avian and Bat Laws, Regulations, and Authorizations.

Authorization	Agency Authority	Statutory Reference
Federal		
National Environmental Policy Act (NEPA) Compliance to Grant Right-of-Way	Bureau of Land Management (BLM)	NEPA (Public Law [PL] 91-190, 42 United States Code [USC] 4321−4347, January 1, 1970, as amended by PL 94-52, July 3, 1975, PL 94-83, August 9, 1975, and PL 97-258, §4[b], Sept. 13, 1982)
Endangered Species Act Compliance	U.S. Fish and Wildlife Service (USFWS)	Endangered Species Act (PL 93-205, as amended by PL 100-478 [16 USC 1531 *et seq*.]); 50 Code of Federal Regulations (CFR) 402
Migratory Bird Treaty Act	USFWS	16 USC 703–711; 50 CFR 21 Subchapter B
Bald and Golden Eagle Protection Act	USFWS	16 USC 668−668(d)
State		
Section 2081 Incidental Take Permit	California Department of Fish and Game (CDFG)	California Endangered Species Act (CESA) of 1984, Fish and Game Code §§ 2050-2098

The regulatory framework for protecting birds includes the Endangered Species Act of 1973, as amended (ESA 1973), the Migratory Bird Treaty Act (MBTA 1918), the Bald and Golden Eagle Protection Act (BGEPA) of 1940, and Executive Order (EO) 13186. The MBTA prohibits the take of migratory birds and does not include provisions for allowing unauthorized take. This project affords substantial design measures to avoid and minimize the likelihood of take, but if take occurs, it will be reported to the US Fish and Wildlife Service (USFWS) for further action. Additionally, this ABPP has been developed to meet BLM and USFWS requirements for addressing the ESA, MBTA, and BGEPA. Both the BGEPA and the MBTA prohibit take as defined as pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, destroy, molest, disturb, or otherwise harm eagles, their nests, or their eggs. Under the BGEPA, "disturb" means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on

the best scientific information available: 1) injury to an eagle; 2) decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior. However, on September 11, 2009 (*Federal Register,* 50 Code of Federal Regulations [CFR] 13 and 22), the USFWS set in place rules establishing two new permit types: 1) take of bald and golden eagles that is associated with, but not the purpose of, the activity; and 2) purposeful take of eagle nests that pose a threat to human or eagle safety. The USFWS recommends that project proponents prepare an ABPP to avoid, minimize, and mitigate project-related impacts to birds and bats and specifically golden eagles to ensure no-net-loss to the golden eagle population. Pursuant to BLM IM 2010-156, the BLM will request "concurrence" from the USFWS that the ABPP meets specific requirements.

1.5 Policy and Commitment to Environmental Protection

Pattern is an independent, fully integrated energy company that develops, constructs, owns, and operates wind power projects across North America and parts of Latin America. Pattern commenced operations in June 2009 as one of the most experienced and best capitalized renewable energy companies in the United States. OE LLC, through Pattern, is dedicated to delivering the highest values for their partners and the communities where they work, while exhibiting a strong commitment to promoting environmental stewardship and corporate responsibility. The OE LLC team has a proven track record of using science and ground-breaking technology to build wind projects that successfully coexist with wildlife and protect the environment. OE LLC is committed to building environmentally responsible renewable energy projects and continues to work closely with environmental agencies to develop appropriate mitigation measures to reduce impacts to wildlife.

1.6 Public Outreach

OWEF will coordinate with key interest groups within the community to determine how capital contributions from the project can go towards worthwhile community projects. In addition, a project fact sheet describing the project and measures that have been put in place to address avian and bat issues will be prepared and made available at the local BLM El Centro District Office.

2.0 EXISTING CONDITIONS

2.1 Environmental Setting

The project site is located within four US Geological Survey (USFS) 7.5-minute quadrangle maps; Carrizo Mountain, Coyote Wells, In-Ko-Pah Gorge, and Painted Gorge. The northern portion of the site is generally situated north of Interstate 8 (I-8), from the Imperial/San Diego County border on its western edge to approximately 1.5 miles northeast of the town of Ocotillo on its eastern edge. The northern area includes several distinct features, including a portion of the

I-8 Island, which is undeveloped rocky and hilly terrain between the eastbound and westbound lanes of I-8, Sugarloaf Mountain, and a portion of the San Diego and Arizona Eastern railroad tracks. County Route (CR) S2 bisects the northern project area, and I-8 passes through the southern portion of the northern project area. The southern area is much smaller than the northern area and the majority is south of State Route (SR) 98.

Vegetation on site consists of a variety of desert scrub habitat types. Several dry desert washes cut through the site, generally from west to east: Palm Canyon Wash cuts through the center of the northern project area, Myer Creek Wash cuts through the southern portion of the northern project area, a portion of Coyote Wash cuts through the northwest portion of the southern project area, and several additional unnamed washes cut through the site.

Elevations on site range from approximately 300 feet above mean sea level (amsl) in the northeast portion of the site to approximately 1,490 feet amsl in the southwest portion of the site. The site generally slopes downward from the west to the east, with the Coyote Mountains to the north of the site, and the Jacumba Mountains to the west and south of the site.

2.1.1 Sensitive Species

California utilizes several levels of protection and/or designations for sensitive wildlife species, with the top tier being an official listing or proposed listing under the federal or California ESA, followed by state or federal candidate species for possible listing. The California Department of Fish and Game (CDFG) also maintain a list of sensitive species that includes several designations. A CDFG listed fully protected species is the most restrictive designation in terms of "take"; however, the CDFG code sections dealing with fully protective species were amended in 2003 to allow the department to authorize some take in specific circumstances (CDFG Code §3511). CDFG species of special concern are species that are vulnerable to extinction or extirpation due to declining population levels, limited ranges, and/or continuing threats. CDFG watch list species are those that are not on the current special species list, but were included in previous iterations or have been delisted from the federal ESA or CESA. Neither CDFG species of special concern nor watch list species are specifically protected under the CDFG code. In addition to the California hierarchy of sensitive species, the BLM maintains a list of sensitive species, and the USFWS maintains a list of Birds of Conservation Concern (BCC). A list of federally listed species, CA state-listed species, BLM sensitive species, and USFWS BCC species with at least some potential to occur within Imperial County, CA is provided in Appendix A.

No federally listed avian and bat species are known to occur within the OWEF. One California state threatened species (Swainson's hawk; *Buteo swainsoni*) has been observed within the OWEF. One BLM sensitive avian species (burrowing owl; *Athene cunicularia*) as well as one BLM sensitive bat species (western mastiff*; Eumops perotis*) are known to occur within the

OWEF. In addition, four USFWS BCC species (Costa's hummingbird [*Calypte costae*], peregrine falcon [*Falco peregrines*], prairie falcon [*Falco mexicanus*], and yellow warbler [*Sonovana spp*.]) have been observed within the OWEF. The majority of federal or CESA listed species, BLM sensitive species, and UFSWS BCC species are unlikely to occur within the OWEF due to lack of suitable habitats.

2.2 Monitoring and Surveying to Date

In response to concerns about impacts to wildlife resulting from the development of the OWEF, a variety of field studies and literature reviews were initiated. Field studies consisted of avian and bat surveys, which are summarized below in Table 4. The field studies were conducted by HELIX Environmental Planning, Inc. (HELIX) biologists and subconsultants to HELIX.

Table 4. Monitoring and Surveying Efforts.

Study	Taxa	Survey Dates
Raptor Migration Count Surveys (Helix 2010a, Helix 2011)	Raptors, Vultures	September – November 2009,March – May 2010, August – November 2010, March – May 2011
Avian Point Count Surveys (Helix 2010b)	All Birds	September 2009-August 2010
Eagle Nest Surveys (WRI 2011)	Eagles	March – April 2010
Bat Surveys (Rahn 2011)	Bats	January – November 2010
AnaBat Acoustic Surveys (Rahn 2011)	Bats	April – November 2010
Burrowing Owl Surveys (Helix 2010c)	Owls	Jan 2010 ,March-April, 2010,June-July 2010, July-August 2010
Merlin Radar passive data collection (DeTect 2011)	Birds and Bats	July 2010 – present

2.2.1 Raptor Migration Count Surveys

2.2.1.1 Methods

The purpose of the raptor migration counts study was to document the diurnal raptor activity within the OWEF project area in order to provide a risk assessment for these species. HELIX conducted migration counts over an eight calendar-week period during the 2009 fall migration period (September 24 to November 10, 2009), over a 10-week calendar-week period during the 2010 spring migration period (March 22-May 28, 2010), over a 15 calendar-week period during the fall 2010 migration period (August 23 to November 12, 2010), and over a 10 calendar-week period during the spring 2011 migration period (March 21 to May 27, 2011). HELIX stationed four surveyors throughout the site to scan the sky and record bird migration data. The four migration count locations (Locations A through D; Figure 1) were spaced approximately two miles apart generally along a southwest-northeast axis across the site. Migration count locations

were located to maximize the likelihood of detecting potential north-south and east-west migration through the site. Migration counts were conducted in accordance with the OWEF survey protocols approved by BLM and generally in accordance with the methods described in the CEC's Guidelines for Reducing Bird Impacts from Wind Development (CEC 2007).

Migration counts were focused on the time of day when raptors were observed to be most active over the site (late morning to late afternoon). The raptor counts were staggered to either begin shortly after sunrise or to conclude before sundown to cover the bimodal activity of diurnal bird migrants. During fall 2009 and spring 2010, migration counts were conducted approximately eight hours per day; during fall 2010 and spring 2011, migration counts were conducted approximately 5.5 hours per day (typically from mid morning to late afternoon). The total number of observation hours during each study included 763 observation hours in fall 2009, 952 observation hours in spring 2010, 577.5 observation hours in fall 2010, and 489.5 observation hours in spring 2011. Surveyors methodologically scanned the sky and recorded all bird species, number of individuals, direction of movement, estimated distance from the surveyor, and estimated height above the ground. Surveyors documented activity on standardized datasheets for each date. Weather conditions (e.g., temperature, wind speed, wind direction, cloud cover, etc.) at the start and end of each day were also recorded. Surveyor positions were rotated each day.

HELIX biologists Kimberly Davis, Erica Harris, Rob Hogenauer, Jason Kurnow, Erik LaCoste, Debbie Leonard, Eric Piehl, and Dale Ritenour, along with John Konecny (Konecny Biological Services), conducted the migration counts. Independent contractor Marie Bennett assisted on one date.

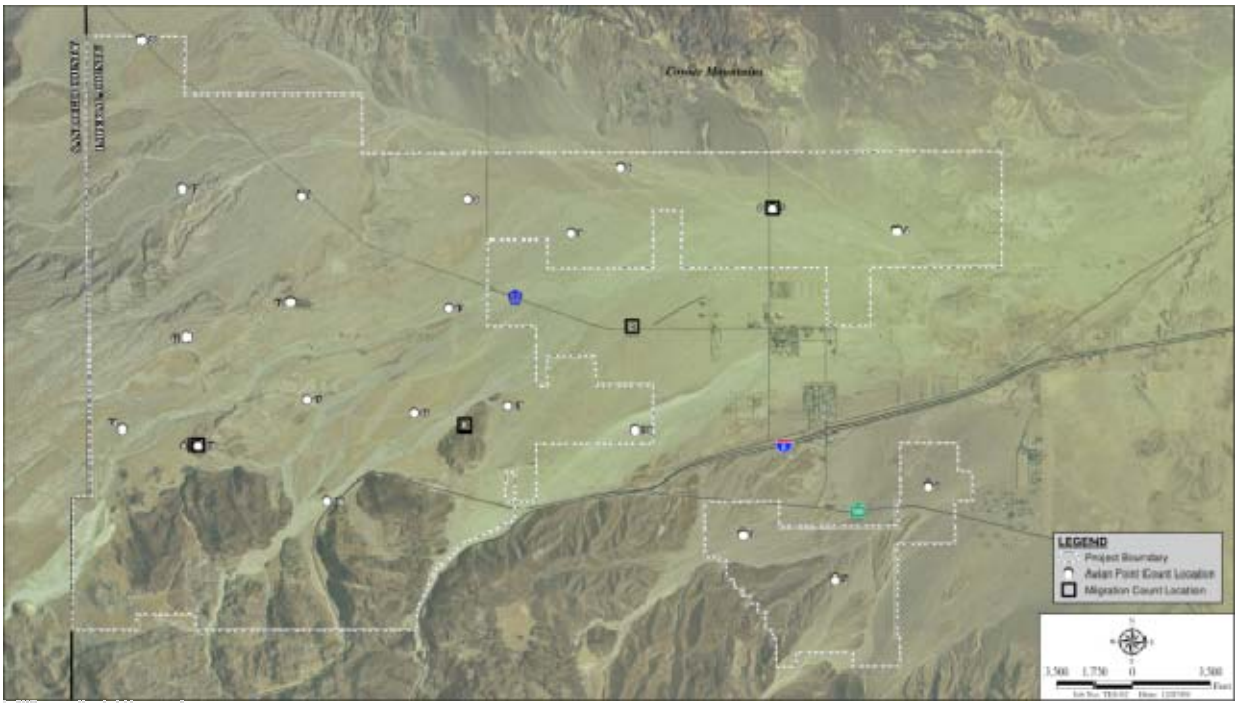


Figure 1. Raptor Migration Count and Avian Point Count Locations.

2.2.1.2 Results

A total of 2, 073 raptors/large birds were recorded on site or directly adjacent to the site during the four seasons of raptor migration surveys (165 raptors/large birds during the fall of 2009, 522 during spring 2010, 451 during fall 2010, and 935 during spring of 2011). The number of raptors and turkey vultures observed during the spring migration counts were greater compared to fall.

HELIX calculated raptor use estimates and relative abundance using the fall 2009, spring 2010, fall 2010, and spring 2011 migration count data (Table 5). Raptor use was calculated by dividing the number of raptor observations in each respective survey period by the number of observation hours in each of those survey periods. Relative abundance was calculated by dividing the number of observations of each raptor species by 2,073, which is the total number of raptor observations during the four seasons. Less than one raptor observation per hour of observation was recorded during the fall and spring migration periods at the proposed OWEF site (excluding turkey vultures). Raptor use (including turkey vultures) of the site in spring 2010 (0.548 observations/hour [hr]) was more than double the raptor use of the site during fall 2009 (0.216 observations/hr), but was less than the raptor use in the fall 2010 (0.781 observations/hr) and spring of 2010 (1.910 observations/hr; Table 5).

During the fall 2009 raptor migration counts, the species with the highest use of the site were the red-tailed hawk, American kestrel (*Falco sparverius*), prairie falcon (*Falco mexicanus*), and turkey vulture. During the fall of 2010, red-tailed hawk, turkey vulture, American kestrel, and

Swainson's hawk had the highest use of the site. During the spring 2010 migration counts, the species with the highest use of the site were the turkey vulture, red-tailed hawk, prairie falcon, and American kestrel. During the spring of 2011, turkey vulture, red-tailed hawk, Swainson's hawk, and prairie falcon had the highest use.

The turkey vulture accounted for 42% of the total observations during the study period and red-tailed hawk constituted 34% of the total observations. Prairie falcon and American kestrel each accounted for four percent of the observations, and Swainson's hawk accounted for three percent of total observations. There were 169 raptor sightings that could not be definitively identified, which accounted for approximately eight percent of observations (Table 5).

Table 5. Raptor use and relative abundance from Raptor Migration Count Surveys.

Species	Fall 2009		Spring 2010		Fall 2010		Spring 2011		Total		Relative Abundance
	No.	No./hr	No.	No./hr	No.	No./hr	No.	No./hr	No.	No./hr	
American kestrel	17	0.022	16	0.017	43	0.074	18	0.037	94	0.034	0.045
Cooper's hawk	2	0.003	1	0.001	3	0.005	3	0.006	9	0.003	0.004
ferruginous hawk	4	0.005	0	0	0	0	0	0	4	0.001	0.002
golden eagle	9	0.012	0	0	11	0.019	11	0.022	31	0.011	0.015
merlin	1	0.001	0	0	2	0.003	0	0	3	0.001	0.001
northern harrier	8	0.010	2	0.002	2	0.003	0	0	12	0.004	0.006
osprey	1	0.001	5	0.005	1	0.002	3	0.006	10	0.004	0.005
prairie falcon	15	0.020	22	0.023	9	0.016	37	0.076	83	0.030	0.040
red-tailed hawk	68	0.089	121	0.127	249	0.431	274	0.560	712	0.256	0.343
sharp-shinned hawk	1	0.001	0	0	3	0.005	1	0.002	5	0.002	0.002
Swainson's hawk	1	0.001	2	0.002	17	0.029	51	0.104	71	0.026	0.034
turkey vulture	15	0.020	316	0.332	83	0.144	456	0.932	870	0.313	0.420
unidentified raptor	23	0.030	37	0.039	28	0.048	81	0.165	169	0.061	0.082
Total Observations	**165**	**0.216**	**522**	**0.548**	**451**	**0.781**	**935**	**1.910**	**2,073**	**0.745**	
Total Identified Species	**12**		**8**		**11**		**9**		**12**		
Observation Hours	**763**		**952**		**577.5**		**489.5**		**2,782**		

HELIX noted raptor nests during the migration counts and during the other biological studies for the project. An active raven nest was observed on another lattice tower in the spring just south of Sugarloaf Mountain. A prairie falcon was observed on multiple occasions flying with nesting material to an area in the rocky hills south of Sugarloaf Mountain; however, a nest was not definitively located. Other large bird nests were documented on site during other biological surveys. A barn owl (*Tyto alba*) nest was documented in the western portion of the project site.

2.2.1.3 Conclusions

The majority of the project site supports desert scrub vegetation and dry desert washes. The site does not contain the appropriate topography to funnel migrating birds through the site. With the exception of Sugarloaf Mountain and the rocky terrain in the southwest portion of the site, the project is generally flat and is located east of the Jacumba Mountains and south of the Coyote Mountains. The site lacks a major ridgeline, water bodies, and large stands of mature trees. The closest major water body is the Salton Sea, which is 30 miles to the northeast of the site, and the irrigated agriculture fields near El Centro are approximately 15 miles to the east of Ocotillo. The results of HELIX's migration counts indicate that the OWEF site is not part of a major migratory pathway for diurnally migrating raptor species, although there was an increase in turkey vulture observations during spring seasons which may suggest increased turkey vulture migration during the spring season.

An average of approximately 0.745 raptor observations/hr (including turkey vultures) were made during the four seasons of migration counts, which is considered low raptor use when compared to similar studies conducted for other wind projects. Springtime raptor use estimates from other wind energy facilities in California range from approximately 0.25 birds/hr at Tehachapi Pass to approximately five birds/hr at Altamont Pass (WEST 2009); fall raptor use estimates from other wind energy facilities in California range from approximately 0.25 birds/hr at San Gorgonio to approximately 9.5 birds/hr at Diablo Winds (Erickson et al. 2009). The closest project site to the OWEF site where raptor use counts have been conducted is at the proposed Tule Wind Farm project site in McCain Valley where 1.16 birds/hour were counted from 2005-2006 and 1.96 birds/hour were counted from 2007-2008 (Tetra Tech EC, Inc. 2008, 2009 as cited in Dudek 2010).

Red-tailed hawk and turkey vulture accounted for approximately 76% of the observations made during the four seasons of raptor counts at the proposed OWEF site (see Table 5). Many of the red-tailed hawk observations made were likely repeat observations of the same individual or individuals. These two species were also commonly observed within the proposed rotor-swept area (RSA; see risk assessment section below) and are two of the most common raptor/vulture species in North America. Based solely on use, red-tailed hawk and turkey vulture would have the greatest risk of collision.

Resident raptor species (red-tailed hawk, prairie falcon, and American kestrel) use the site regularly for foraging and perching but do not occur in high densities. Migratory raptor species observed on site include turkey vulture, osprey (*Pandion haliaetus*), Cooper's hawk (*Accipiter cooperii*), sharp-shinned hawk (*A. striatus*), merlin (*Falco columbarius*), ferruginous hawk (*Buteo regalis*), and Swainson's hawk. With the exception of turkey vultures, migratory raptor species were uncommon during the fall and spring. The migratory raptor species listed above (excluding turkey vultures) were observed infrequently during the study period; 10 or fewer observations were made of each of the following species during the four seasons of raptor counts: osprey, Cooper's hawk, sharp shinned hawk, merlin, and ferruginous hawk. Based solely on behavioral use of the site, resident raptor species would be at greater risk to collision than migratory raptor species because they were more frequently observed foraging over the site, including in the proposed RSA.

2.2.2 Avian Point Count Surveys

2.2.2.1 Methods

The purpose of the avian point count surveys (Point Counts) was to determine what avian species are present on the project site and how the project site is used by those species. This was accomplished by recording bird species, abundance, behavior, and flight characteristics at selected sampling locations over 30-minute period.

HELIX conducted Point Counts approximately weekly over a one-year period (September 1, 2009, to August 31, 2010). A total of 50 weeks of Point Counts were conducted over the one-year period (Point Counts were not conducted the week of November 29-December 5, 2009 or the week of January 17-23, 2010). Each Point Count location was visited once per week (the one exception is that Location 13 was not surveyed the week of February 21-27, 2010). The Point Counts were conducted in accordance with the OWEF survey protocols approved by BLM and generally in accordance with the bird use count methods described in the CEC's Guidelines for Reducing Bird Impacts from Wind Development (CEC 2007). The yearlong Point Counts study was conducted in what was considered a typical year for the Colorado Desert. The 2009-2010 time period was considered an average rainfall year for the region, and the region did not experience abnormally long hot, cold, wet, or dry periods during this timeframe. As such, the results of the point counts would be considered typical for this area. In addition, the results of the raptor migration surveys (encompassing two years of fall and spring seasons) provide further support for the results identified during the yearlong Point Counts study. The timing of migration, resident and migratory species composition and abundance, and bird behavior is expected to vary during years when conditions are abnormally wet, dry, hot, or cold.

Twenty-one Point Count locations were established approximately one mile apart throughout the approximately 15,000-acre site (Locations 1-21; Figure 1). The Point Count locations cover a wide range of elevation, from approximately 340 feet AMSL (Location 4) to approximately

1,250 ft amsl (Location 18). The Point Count locations were strategically located to sample different microhabitats. Although each of the locations occurred in desert scrub habitat, several of the locations were within and adjacent to dry desert washes (e.g., Locations 6, 10, 13, 14, and 21), while others were located on or adjacent to hilly topography (e.g., Locations 2, 12, 18, and 19).

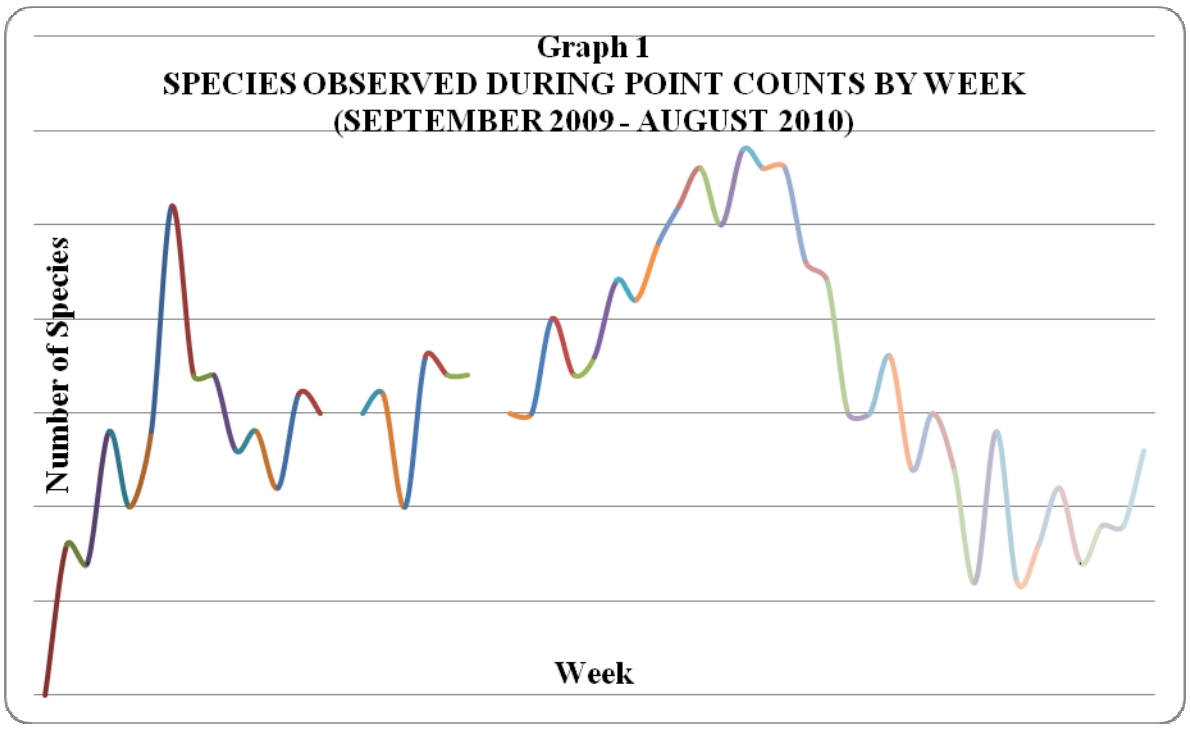
At each Point Count location, the species, number of individuals, flight height, flight direction, distance from observer, and behavior (e.g., directional flight, perched, flapping flight, soaring, etc.) was recorded over a 30-minute period. Weather conditions (e.g., temperature, wind speed and direction, and cloud cover) were recorded at the start and end of the 30-minute interval using a hand-held Kestrel anemometer. Species were detected visually with the aid of binoculars and by identifying songs and call notes. All observations were recorded on standardized data sheets. Efforts were made to sequence observation times so that locations were surveyed both in the morning and in the afternoon under varying weather conditions, in accordance with the CEC's Guidelines (2007).

2.2.2.2. Results

Resident species observed on site include black-throated sparrow (*Amphispiza bilineata*), rock wren (*Salpinctes obsoletus*), house finch (*Carpodacus mexicanus*), loggerhead shrike (*Lanius ludovicianus*), cactus wren (*Campylorhynchus brunneicapillus*), Costa's hummingbird (*Calypte costae*), verdin (*Auriparus flaviceps*), common raven (*Corvus corax*), and red-tailed hawk. Wintering species observed include white-crowned sparrow (*Zonotrichia leucophrys*), Brewer's sparrow (*Spizella breweri*), yellow-rumped warbler (*Dendroica coronata*), sage sparrow (*Amphispiza belli*), sage thrasher (*Oreoscoptes montanus*), and blue-gray gnatcatcher (*Polioptila caerulea*). Fall migratory species include various swallow species (of the genus *Tachycineta*, *Hirundo,* and *Petrochelidon*), black-throated gray warbler (*Dendroica nigrescens*), and chipping sparrow (*Spizella passerina*). Spring migratory species include various warblers (of the genus *Dendroica* and *Vermivora*), swallows, hooded oriole (*Icterus cucullatus*), western kingbird (*Tyrannus verticalis*), Swainson's hawk, and lazuli bunting (*Passerina amoena*).

Forty-seven of the 77 species detected during Point Counts are considered migratory. Thirty-eight of the migratory species passed through the site, while nine of the species migrated to the site. Species that migrated to the site either arrived in the fall and wintered at the site, or arrived in the spring and summered at the site. Approximately one-third of the species that migrated through the site were warblers and swallows. The remaining two-thirds consisted of an assortment of species that included lazuli bunting, western tanager (*Piranga ludoviciana*), Pacific-slope flycatcher (*Empidonax difficilis*), black-headed grosbeak (*Pheucticus melanocephalus*), and warbling vireo (*Vireo gilvus*). Raptors accounted for nine of the 77 species observed.

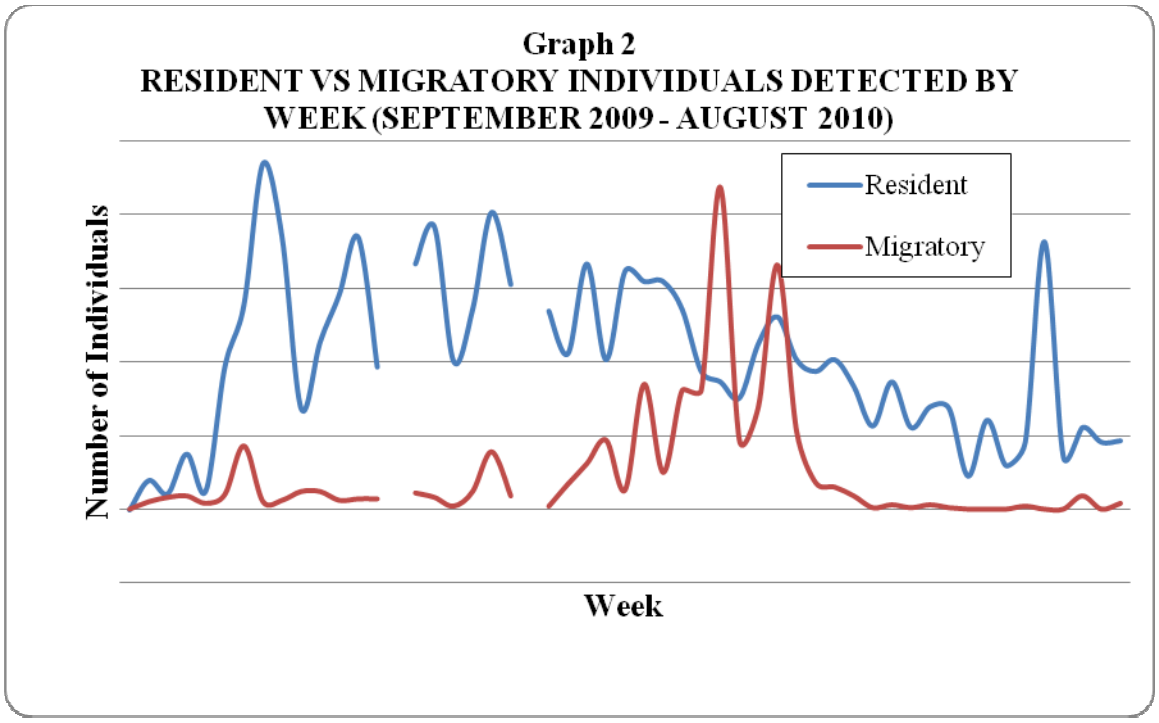
Seventy-seven species were recorded over the 52-week survey period. The number of species detected during Point Counts varied weekly (Graph 1). Species richness substantially increased between March and May of 2010, corresponding to the peak in spring migration. Species richness was lowest (less than 10 species per week) during weeks 1, 2, 44, 46, 47, and 49-51, which corresponded with very hot daytime temperatures occurring during times of the year when migratory activity was either low or absent. Conversely, species richness was highest (25 or more species per week) during weeks 6 and 30-35, which were weeks when migratory species composed approximately 50% of the species recorded. The two peaks in species richness shown in Graph 1 (i.e., weeks 6-8 and weeks 30-35) correspond with the fall 2009 and spring 2010 migratory periods.



A total of 6,387 individual observations were recorded over the 52-week survey period. Of the 6,387 individual observations 5,169 were considered resident species and 1,218 were considered migratory species. House finches, black-throated sparrows, and horned larks were the most abundant species observed during the study. Combined, they make up 51% of total individual observations.

Migratory species occurred in low numbers throughout the survey period, with the exception of several weeks in April (Graph 2). During the first seven weeks, swallows were the most abundant species migrating through the site. During Week 6, there was a peak in species

migrating through the site, a majority of which were Vaux's swifts (*Chaetura vauxi*). Beginning in March, spring migratory species were observed on site. The number of migratory individuals peaked during the first week in April (Week 31), which was the result of numerous observations of western kingbirds and Bullock's orioles (*Icterus bullockii*). In addition, low numbers of northern rough-winged swallows (*Stelgidopteryx serripennis*), warblers, and other migratory species were observed. A high number of migratory individuals were also detected during the end of April (Week 34). During this week, Brewer's sparrows, northern rough-winged swallows, and Vaux's swifts accounted for the majority of the species observations. Observations of migratory species were minimal after April.



Raptors were observed throughout the survey period. A total of 227 raptor observations (3.6% of the total species) were detected during the survey period. Raptor observations varied weekly from a low of zero in Weeks 46, 47, 49 and 51 to a high of 21 in Week 33. The most frequently observed raptors were red-tailed hawk and turkey vulture. The greatest number of raptor observations occurred in the spring (Weeks 28, 32-34, and 36-37). The American kestrel, Cooper's hawk, northern harrier (*Circus cyaneus*), prairie falcon, ferruginous hawk, Swainson's hawk, golden eagle (*Aquila chrysaetos*), and unidentified raptors made up the remaining 41 observations. HELIX conducted a Raptor Migration Study (HELIX 2010a), which is discussed in Section 2.2.1.

2.2.2.3 Conclusions

The OWEF site does not support a large population of resident species. Many of the resident species observations, including raptor observations, were likely repeat observations of the same individual. The site does not appear to be part of a major migration corridor for sensitive and non-sensitive species. Sensitive species observed were Swainson's hawk (ST), ferruginous hawk (CA watch list species), northern harrier (State Species of Special Concern; SSC), loggerhead shrike (SSC), yellow warbler (*Dendroica petechia*; SSC), Vaux's swift (SSC nesting), and Le Conte's thrasher (*Toxostoma lecontei*; SSC). All sensitive species were observed in low numbers during APC's, except Loggerhead Shrike which is a resident bird of the region.

A total of 77 species and 6,387 individual observations were documented during the yearlong Point Count study. All bird use across the yearlong Point Counts study was 6.1 birds per 30-minute survey. Species abundance was variable throughout the year, with the biggest fluctuation occurring between seasons. The weekly surveys began in fall, which had one of the lower seasonal abundance (5.4 individuals per 30-minute period). The lower abundance corresponded with very high daytime temperatures in September and early October. Species abundance was comparatively greater in the winter and spring compared to the fall. Migratory species were responsible for the increase in observations in spring. Hot temperatures and the absence of migratory species accounted for low abundance in summer.

Raptor observations account for 3.6% of birds recorded during the survey period. The highest number of raptor observations occurred in the spring, which likely correlated to an increase in prey availability. The majority of these sightings were common desert species, including red-tailed hawk, turkey vulture, American kestrel, and prairie falcon. Other raptor observations included a single individual of each of the three species (ferruginous hawk, Cooper's hawk, and northern Harrier), and three separate observations of a single Swainson's hawk flying over the site in spring.

Mean raptor use (number of raptors per hour) from avian Point Count study was determined to be 0.43/hr (including turkey vultures). Mean raptor use (number of raptors per hour) from raptor migration count surveys was determined to be 0.75/hr (including turkey vultures). Combining all surveys to date, mean raptor use (number of raptors per hour) was determined to be 0.70/hr (including turkey vultures).

Migratory species account for 19% of total observations over the yearlong study. Approximately 68% of individuals that were considered migrants occurred during the peak of spring migration (March-April). It is also notable that migratory species abundance surpassed that of resident species twice within this period. This is in contrast to fall migration, where resident species outnumbered migratory species 10:1. The amount of food resources available to migrants in

spring is much greater than in winter, which is likely the primary factor responsible for the disproportionate numbers associated with migratory species richness and abundance.

2.2.3 Eagle Nest Surveys

HELIX contracted with the Wildlife Research Institute (WRI) to conduct surveys of golden eagle (*Aquila chrysaetos*) nest sites in eagle territories that occur within 10 miles of the project site, in accordance with the guidance provided in the USFWS Inventory and Monitoring Protocols (USFWS 2010b). WRI conducted helicopter surveys in 4 known territories (referred to as Coyote Mountains West, Coyote Mountains East, Table Mountain, and Carrizo Gorge) in spring 2010. A handheld Global Positioning System (GPS) was used to record the helicopter flight path and the location of each nest site. Nest-specific information was documented by two eagle biologists in the helicopter, and each nest site was photographed. In addition to helicopter surveys, WRI conducted ground surveys of an additional suspected golden eagle territory (referred to as Mountain Springs) in spring 2010. Helicopter surveys were not allowed by USFWS in the Mountain Springs area because of potential disturbance to Peninsular bighorn sheep (*Ovis canadensis nelsoni*). Results of the golden eagle nest surveys were provided in a survey report (WRI 2011). In addition to this ABPP, a separate Eagle Conservation Plan is being implemented for the OWEF project to address potential impacts to golden eagles.

2.2.4 Bat Surveys

2.2.4.1 Methods

The purpose of the bat surveys was to characterize what species are using the project area and the locations at which those species are observed. In addition, surveys aimed to characterize key areas of bat activity and determine which areas within the proposed wind turbine project area have a high impact risk for bats.

Initial surveys and site assessments were conducted in January 2010 to determine the best routes for active bat monitoring and to evaluate the availability of important bat resources (e.g., roost sites, standing water, and potential foraging areas). The surveys included assessments during the peak of all four seasons, which was dependant on prevailing weather conditions and expected periods of peak bat activity: winter (January/February), spring (May/June), summer (July/August), and fall (October/November).

A minimum of nine nights of active AnaBat surveys were conducted during each season to determine the presence of resident and migratory bat species. Biologists followed established trails and access roads within the project area in three distinct areas, maximizing coverage of the entire study area. Survey routes were stratified across the various vegetation communities and habitat features (e.g., rocky outcrops, cliffs, and desert washes) in order to maximize the detection of bats. The active bat surveys utilized AnaBat™ SDI Bat Detectors that download all recorded echolocation signals into a Compact Flash memory card and can be linked to a GPS

unit. The GPS provides the location of the echolocation calls as they are recorded during an evening. A thermal imaging camera was used to estimate the number of bats present along the survey route (relative abundance) and document the behavior of the bats (commuting, foraging, drinking, etc.). The thermal camera was also used to estimate the height that the bats were flying above ground level and their direction of travel. Ambient environmental conditions were recorded each night, ensuring that data are collected only during those conditions that are optimal for bat activity. Finally, surveys along the areas adjacent to the project area attempted to locate and identify potential roost sites, resources (e.g., water or potential foraging areas), and bat activity areas adjacent to the project area to determine if any bat species were actively using these adjacent areas, and identify any path of emergence.

Long-term echolocation monitoring stations were installed on two met towers to assess the temporal variability of bats in the project area. These stations collected data autonomously from April 18 through November 31. These stations collected data passively by storing bat calls for later analysis. Two stations were installed on the East and West tower at approximately 50 m and 2 m above ground level. Long-term acoustic monitoring collected data on bat presence and activity, as well as seasonal changes in species composition. The data were analyzed using software filters to remove those calls that were the result of wind or insect background noise. Analysis was conducted for all calls recorded during the project period, identifying bat species when possible.

Surveys were conducted by trained and expert bat biologists. Regular staff included Dr. Matt Rahn and Ms. Kelcey Stricker. Dr. Rahn has over 17 years of experience as a bat biologist, extensive experience with habitat assessments, and has been working with the AnaBat system since 1995. Ms. Stricker has been working on bat projects as both a researcher and consultant since 2005. Biologists from HELIX also regularly supported the bat surveys.

2.2.4.2 Results

Ultimately, only five bat species were identified in the project area in 2010: California myotis (*Myotis californicus*), big brown bat (*Eptesicus fuscus*), Mexican free-tailed bat (*Tadarida brasiliensis*), western pipistrelle (*Parastrellus hesperus*), and western mastiff bat. The majority of the bats (approximately 77%) were recorded during the spring (103 calls; May-June) and summer (56 calls; August-September). Bat activity was lower during the winter or fall survey periods (winter = 15 calls; fall = 31 calls). Bat activity was recorded at only seven distinct locations within the project area and from two tower locations within the project area (Figure 2). The remainder of the project area showed no bat activity, either through the echolocation recording or use of the thermal imaging camera.

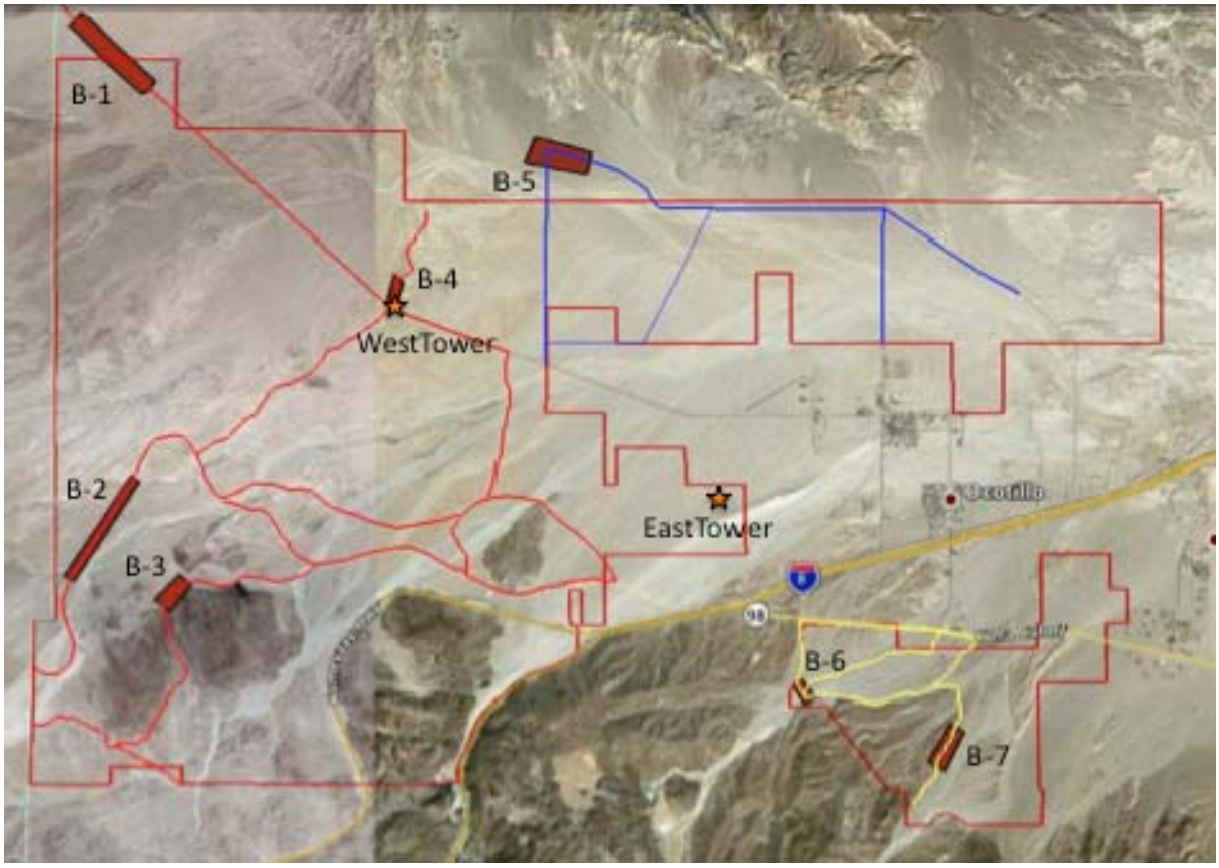


Figure 2. Bat Survey Routes. Long-term AnaBat stations were located on the two towers indicated on the map (designated East and West). Polygons represent areas where bat activity was observed or recorded during surveys (B-1 through B-7).

Most bat activity was located along the western edge of the project area. Other locations identified during the surveys recorded bats only along the perimeter of the area. The thermal imaging camera was used to identify the total number of bats flying when an echolocation signal was recorded. Over 95% of the time, the calls recorded represented only a single individual flying in the vicinity. Bats were infrequently observed in the interior of the site during the survey, and only from a distance using the thermal imaging camera.

The majority of the bats recorded during the driving/walking surveys were found at sites B-1 and B-2 (26% and 28%, respectively). Both B-4 and B-7 had roughly 12% of the bats recorded, with the remaining sites each having less than 10% of the remaining calls recorded (B-3 = 7%; B-5 = 5%; B-6 = 9%). The most abundant species recorded were the big brown bat (43%), the California myotis (26%), and the western pipistrelle (17%). The greater western mastiff bat and the Mexican free-tailed bat were rarely recorded within the project area (6% and 9%,

respectively). Table 6 provides a summary of all bat data collected from both active and passive surveys in 2010.

Table 6. Bat species recorded at each survey location during each survey season in 2010.

Location	California Myotis	Big Brown Bat	Mexican Free-tailed Bat	Western Pipistrelle	Western Mastiff Bat	Unknown
Winter						
B-1	1	3				
B-2	1	4				1
B-3						
B-4						
B-5						
B-6						
B-7						
Spring						
B-1	1	1		1		2
B-2		1		1	1	2
B-3		1				
B-4						
B-5						
B-6						
B-7						
East Tower - 50m						
East Tower - 2m	6	11		7		
West Tower - 50m					3	
West Tower - 2m	23	16		19	7	
Summer						
B-1	1	2			1	
B-2	2					2
B-3	1					
B-4	1	2	1	1		2
B-5			1			
B-6	1	1		1		1
B-7			2		1	
East Tower - 50m		1		1		
East Tower - 2m		3		1		1
West Tower - 50m	2	1	2		2*	
West Tower - 2m	6	5	2	4	2*	3

Table 6. Bat species recorded at each survey location during each survey season in 2010.

Location	California Myotis	Big Brown Bat	Mexican Free-tailed Bat	Western Pipistrelle	Western Mastiff Bat	Unknown
Fall						
B-1		1		1		
B-2	1					
B-3		1		1		
B-4						
B-5	2					
B-6		1				
B-7		2		2		
East Tower - 50m**		1		1		1
East Tower - 2m		2		2		
West Tower - 50m	1	2		1	1	2
West Tower - 2m	1	2		1		1
Abundance/% (Transects)	**12/25.5%**	**20/42.5 %**	**4/8.5%**	**8/17.1%**	**3/6.4%**	**10/NA**
Calls Recorded (Tower)	**39**	**44**	**4**	**37**	**13**	**8**
TOTAL	**51**	**64**	**8**	**45**	**14**	**18**

*Calls were from the same individual at the same time in both upper and lower microphones;
**Strong winds broke the upper mounting bracket in late September.

2.2.4.3 Conclusions

Bat use of the project area was remarkably low. Over 70% of the surveys conducted failed to record a single bat during the night. Bat activity was generally restricted to the perimeter of the project boundary, with infrequent observations of bats. Bats observed during the surveys were commuting through the area (22%), actively foraging (60%), or were both foraging and commuting (18%). Surveys of adjacent land did not identify areas of suitable roosting habitat nor were there any significant opportunities for tree roosting nearby or within the town of Ocotillo. There was a general lack of cave formations, suitable cliff faces, and boulders.

The results of the long-term echolocation monitoring stations suggest that most of the bats in the project area were flying at lower heights. This is likely true for all species except the greater western mastiff bat, which typically flies at higher elevations than many species, particularly when commuting through an area. Observations with the thermal imaging camera showed similar results. Across all species observed, bats were typically seen at elevations between one and 25 m above ground level (below the RSA of the turbines proposed for the OWEF). Again,

the only exception was the greater western mastiff bat, which was typically observed above 25 m.

No significant pattern in the distribution or flight behavior of the bats was observed. It is unlikely that significant numbers of bats occur throughout the project area. All observations and survey results suggest that the majority of the bat population in the local area occurs outside of the Ocotillo Valley area. No significant resources for foraging or water exist, severely limiting the bat abundance and diversity, particularly when compared with adjacent mountain ranges to the west and the Imperial Valley to the east.

2.2.5 Burrowing Owl Surveys

2.2.5.1 Methods

The CDFG requested HELIX to follow The California Burrowing Owl Consortium (CBOC) Guidelines (CBOC 1997) for burrowing owl habitat surveys within the OWEF study area. The CBOC Guidelines include three phases: (1) habitat assessment, (2) focused burrow search, and (3) surveys for owls during the breeding season. HELIX conducted a burrowing owl habitat assessment, a burrow survey, and focused owl surveys in accordance with the CBOC Guidelines and with OWEF's survey protocols that HELIX prepared and the BLM approved. The purpose of the surveys was to determine presence/absence of burrowing owls on site.

HELIX conducted a (Phase I) habitat assessment within the proposed project footprint in January 2010. HELIX biologists evaluated the project site to determine if it contained areas that met the basic requirements of owl habitat, which include open expanses of sparsely vegetated areas (less than 30% canopy cover for trees and shrubs), gently rolling or level terrain, small mammal burrows (especially those of antelope ground squirrel [*Ammospermophilus leucurus*]), and/or fence posts, rock, or other low perching locations. Suitable owl habitat was found to be present throughout the study area. As such, additional surveys were required.

HELIX conducted a winter resident burrowing owl survey from January 16 through 29. The CBOC and CDFG define the wintering survey period as December 1 to January 31 (CBOC 1997; CDFG 1995). The winter resident owl survey was conducted to gather data on burrowing owl use of the study area during the non-breeding season. The winter resident burrowing owl surveys were conducted in areas with the highest potential for burrowing owl use (i.e., low hilly regions, deep canyon washes with numerous rodent colony holes, and along both sides of the railroad tracks that cross through the study area). Biologists walked slowly and methodically through each of the survey areas to search for burrowing owls and to evaluate and map potential owl burrows, including those that showed signs of recent owl occupation.

HELIX conducted a (Phase II) focused burrow search in spring 2010 within the project footprint (i.e., proposed project features plus a 150-meter [500-foot] buffer from proposed project

features). The focused burrow search was conducted concurrently with the spring rare plant survey in March and April 2010. Biologists walked transects within the survey area to allow for 100% coverage. All potential burrows, burrowing owl sign, or burrowing owls were recorded with a handheld GPS unit. Burrowing owl sign included pellets/casting (e.g., regurgitated fur, bones, and insect parts), white wash (excrement), and feathers.

HELIX conducted a (Phase III) focused burrowing owl survey between June 14 and July 8, 2010 for each of the potential burrow locations mapped during Phase II burrow search. The breeding season is defined by CDFG (1995) and CBOC (1997) as the period between April 15 and July 15. Surveys consisted of four site visits, each on a separate day, conducted approximately one week apart. Surveys took place from two hours before sunset to one hour after sunset or from one hour before sunrise to two hours after sunrise in accordance with the CBOC Guidelines. Biologists took care to not disturb potentially nesting burrowing owls and used a combination of techniques to determine occupancy and nesting status, including observing the locations from a distance using binoculars and spotting scopes and carefully walking through the habitat.

In addition, HELIX also conducted follow-up breeding season surveys between July 26 and August 3. The purpose of the follow-up breeding season surveys was to search for burrowing owls and owl burrows in areas of the project site that were not extensively surveyed during other surveys conducted by HELIX in spring and summer 2010 (i.e., rare plant surveys, flat tailed horned lizard (FTHL; *Phrynosoma mcallii*) survey, or Point Counts/migration surveys). Burrowing owls also were mapped opportunistically during other surveys, including during the fall 2010 special status plant surveys.

2.2.5.2 Results

The results of the Phase I, II, and III surveys were provided in a survey report (HELIX 2010c). Three burrowing owls and one active burrow were documented during the January 2010 winter resident burrowing owl survey. The three owls were in the north-central and western portions of Site 1 of the study area; the active burrow was in Site 2 of the study area. No burrowing owls were observed during the Phase II burrow search in March/April 2010. Two burrowing owl pairs with active burrows were documented during the Phase III focused survey in June/July 2010 in two of the same locations in Site 1 as in January. The active owl burrow observed in January in Site 2 was re-evaluated during the Phase III owl surveys and was determined to be inactive during the 2010 breeding season. Burrowing owls were repeatedly observed near the westernmost active burrow in Site 1 during the summer survey conducted at the end of July and early August. It is assumed that these repeat observations near the westernmost burrow were the owls associated with the active burrow. In addition, 20 burrowing owls were documented throughout the study area during the fall 2010 special status plant surveys.

2.2.5.3 Conclusions

The burrowing owl is a year-long resident of open, dry grassland and desert habitats. It is also found as a resident in grass, forb, and open shrub stages of pinyon-juniper and ponderosa pine habitats as well as agricultural lands. This small owl is found along the length of the State of California in appropriate habitats. The burrowing owl is migratory over much of its range, even in southern California (Unitt 2004). Burrowing owl observations on the proposed project site during the non‐breeding season is likely a combination of owls that use the Imperial Valley for breeding and owls that migrate through and/or overwinter in the project site from their breeding grounds in Canada and the northern United States.

Burrowing owls were not observed migrating through the site during the 2009 or 2010 migration counts. The increased number of burrowing owls observed on the proposed OWEF site in fall is likely due in part to migrating owls from the northern United States other areas of Imperial County.

2.2.6 Merlin Radar System

2.2.6.1 Methods

A MERLIN Avian Radar System was deployed at the OWEF site by DeTect on September 15, 2010 (DeTect 2011). The radar unit deployed contained both an X-band frequency vertical scanning radar (VSR) sensor and an S-band frequency horizontal surveillance radar (HSR) sensor. The initial radar system was upgraded to reduce ground clutter due to high water content in the dominant shrubs and cacti present within the site. For the study, the HSR settings were optimized for detecting bighorn sheep and the VSR was optimized for detecting birds. The VSR data is used to determine target altitudes, and was the primary dataset used to determine target passage rates through the rotor swept zones for mortality risk assessments. The HSR data is only used to determine directional movement of targets over or through the OWEF site, and does not provide data on target counts or passage rates.

The radar unit was located in open, desert habitat for which turbine locations are proposed. The data range settings for the radar were selected to allow optimal detection of bird-sized targets (for the VSR) as well as sheep sized targets (for the HSR). The MERLIN system collected radar data continuously (24 hours a day, 7 days a week), with the exception of limited periods of system maintenance and upgrade, service downtime, and periods of moderate to heavy precipitation.

The data was displayed in real-time (at the radar unit and remotely via the internet) and all data on targets, tracks, and system parameters were stored on internal databases. The databases were queried and used to develop statistical data from the target movements recorded within the OWEF site. DeTect biologists conducted the initial setups for both systems, after which each system was remotely monitored via the data uplink/internet connections for the remaining data

collection periods. The data was run through the MERLIN Avian Radar processing software to identify and track bird targets within the OWEF site and to suppress noise. Although the criteria for identifying bird targets has been developed to only track targets that are most likely birds, occasional targets such as insects or clutter will be falsely identified and tracked as bird targets. Optimization of the operational settings in the software and application of custom database queries minimized the inclusion of non-bird targets. During review of the dataset, likely insect activity was noted in trackplot images, frequently occurring alongside bird activity. In order to preserve the bird activity in the dataset, some insect activity was not filtered out and is likely included in the data results. Time periods in which insect activity was noted by reviewers were identified and reported. Due to the inability to identify individual birds from radar echos, the radar data does not necessarily reflect a count of individuals, but rather an index of bird activity or exposure level for a given period of time.

The average altitude of each target AGL was generated and used to derive mean and median target heights, as well as to group targets into one of three categories: below rotor swept zone, in rotor swept zone, or above rotor swept zone to a maximum height of ~2,800 AGL. Some migrating birds fly even higher than this altitude, but these were not detected in this radar study. The turbine dimensions used for the altitude analyses included a rotor swept zone ranging from 29.9 to 133.8 m AGL.

The VSR data queries were standardized to a 1-km front per hour, generally the industry standard for most migratory and wind energy avian studies and risk analysis. For this report, target passage rates are further defined as the number of targets detected within 0.5 km to either side of the radar and up to ~ 2,8000 m AGL, for a total frontal width of 1 km, during a one hour period. Passage rates were standardized using the number of minutes with radar data within a given time period (minus any time with rain) and collated for each dawn (30 minutes before sunrise to 30 minutes after sunrise), day (30 minutes after sunrise to 30 minutes before sunset), dusk (30 minutes before sunset to 30 minutes after sunset), and night (30 minutes after sunset to 30 minutes before sunrise the next day) as well as the entire season. The average target passage rates (below, within, and above the rotor swept zone, as well as total), and mean and median target heights, were calculated for dawns, days, dusks, and nights as well as hourly during this survey (DeTect 2011).

2.2.6.2 Results

The MERLIN Avian Radar System operated continuously (24 hours a day) during the fall 2010 season, (September 15 – November 30, 2010), the winter season of 2010-2011 (December 1, 2010 – February 28, 2011), the spring season of 2011 (March 1 – May 31, 2011), and the summer season of 2011 (June 1 – July 9, 2011). A total of 7,151.2 hours were available during the study and 6,347.1 hours (88.8%) of VSR data were collected and 6,601.1 hours (92.3%) of HSR data were collected (DeTect 2011).

Weather can make some of this radar data unusable because precipitation can block the radar wavelength so few if any targets are discernable. This is more prevalent among X-band radars than S-band because the longer wavelength of the S-band radar allows almost all targets to be detected in rain with the help of digital processing.

Therefore, of the 6,347.1 hours of vertical radar data, 477.5 hours were removed because rain prevented the collection of radar data. This left 5,869.6 hours of useable vertical radar data (92.5% of radar time, 82.1% of the study period). A total of 168.8 hours of horizontal radar data were removed because of rain, leaving 6,432.3 hours of useable horizontal radar data (97.4% of radar time, 90.0% of the study period).

Vertical Radar Data (VSR)

Data collected from the vertical scanning radar (VSR) was used to quantify target movements through the project area. Data is presented as total number of targets / 1-km front / hr. This rate is also used when quantifying targets above (up to ~2,800 m AGL), below, and at the height of the rotor swept zone (DeTect 2011).

Target passage rates during the study period were variable throughout the study and among the four biological periods (days, nights, dawns, and dusks). During the fall of 2010, target passage rates averaged the greatest during days, followed by nights, dawns, and then dusks. During the winter season of 2010-2011, target passage rates averaged the greatest during days, followed by nights, dusks, and then dawns. Target passage rates during spring and summer seasons in 2011 season averaged the greatest during days and nights, and the least during dawns and dusks.

Average target passage rates differed hourly throughout the study with a consistent trend that passage rates were greatest during midday hours and another peak in the evening during all seasons except winter. During the fall of 2010, passage rates were greatest midday (hours 10-12, 10am-noon) with another peak around hour 18 (6pm). During the winter 2010-2011 season, passage rates were greatest midday (hours 11-13, 11am-1pm). Passage rates during the spring 2011 season were greatest midday (hours 10-12, 10am-noon) followed by a secondary peak during evening (hours 19-22). During the summer 2011 season passage rates were greatest midday (hours 9-12, 9am-noon) with a secondary peak in the evening (hours 19 and 20). Throughout the study period, target passage rates were greatest above the rotor swept zone compared to within and below the rotor swept zone (DeTect 2011).

Average hourly target heights varied throughout the study ranging from 232.5 m during hour 9 of the winter season to 474.4 during hour 5 of the summer season. Mean target heights detected during the study period were generally above the maximum RSA height of 133.8 m AGL.

Median target heights were consistently lower than means but were still generally above the RSA (DeTect 2011).

Targets were detected up to 2,800 m AGL by the vertical radar throughout the study period. The distribution of targets in 50-meter increments was greatest above the rotor swept zone throughout the study period although targets also occurred within the rotor swept zone during all seasons. When all targets detected within a season were combined together, the majority of targets were consistently recorded above the RSA and the least below the RSA throughout the study period.

Within the RSA, percents of targets recorded during the fall of 2010 were the greatest during days (16.3%) followed by dusks (12.9%), dawns (12.7%) and finally nights (9.4%). Within the RSA, percents of targets recorded during the winter 2010-2011 were the greatest during dawns (36.6%) followed by days (30.4%), nights (17.2%) and finally days (16.4%). Within the RSA, percents of targets recorded during the spring were the greatest during dusks (16.2%) followed by dawns (12.2%), days (10.5%) and finally nights (9.7%). Within the RSA, percents of targets recorded during the summer were the greatest during dusks (19.6%) followed by days (9.8%), nights (6.8%) and finally dawns (6.5%).

Average target passage rates above, within, and below the RSA were the greatest above the RSA during all time periods. When percent targets in the RSA were calculated for each date, dawns averaged the greatest, followed by dusks, days and nights had the lowest average percent of targets in the RSA during both the fall season of 2010 and the winter season of 2010-2011. During the spring and summer seasons of 2011, when percent targets in the RSA were calculated for each date, dusks averaged the greatest, followed by dawns, days and nights had the lowest average percent of targets in the RSA (DeTect 2011).

Horizontal Radar Data (HSR)

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during dawns, days, dusks, and nights throughout all seasons during the study. The average flight direction varied by season as well as biological time period (day, dusks, nights, and dawns; DeTect 2011).

The average flight direction of all targets during the fall 2010 season was 111° (east), and averaged 75° (east) during dawns, 249° (west) during days, 257° (west) during dusks, and 112° (east) during nights. Prominent target movements varied by biological period; dawns had east and northeast movements, dusks had westerly movements, nights had east and southeast movements, and days were fairly dispersed. Target directions were only moderately concentrated, with dawns averaging the greatest angular concentration (average r = 0.51) and days the least (average r = 0.17: DeTect 2011).

The average flight direction of all targets during the winter 2010-11 season was 317° (northwest), and averaged 77° (east) during dawns, 313° (northwest) during days, 279° (west) during dusks, and 314° (northwest) during nights. Target movements were predominantly southwest and west during dawns, southwest and south during days and nights, and east during dusks. Target directions were moderately concentrated, with dusks averaging the greatest angular concentration (average r = 0.50) and day the least (average r = 0.18; DeTect 2011).

The average flight direction of all targets during the spring 2011 season was 201° (south), and averaged 201° (south) during dawns, 198° (south) during days, 188° (south) during dusks, and 205° (southwest) during nights. Target movements were predominantly south and southwest during all time periods. Target directions were moderately concentrated, with dawns averaging the greatest angular concentration (average r = 0.46) and day the least (average r = 0.11; DeTect 2011).

The average flight direction of all targets during the summer 2011 season was 58° (northeast), and averaged 46° (northeast) during dawns, 49° (northeast) during days, 58° (northeast) during dusks, and 136° (southeast) during nights. Target movements were quite varied during the summer 2011 season lacked any prominent directions or concentration of direction. Target directions were poorly concentrated, with dawns averaging the greatest angular concentration (average r = 0.21) and days the least (average r = 0.06: DeTect 2011).

2.2.6.3 Conclusions

Target passage rates varied considerably throughout each season, but also by biological period. Average target passage rates were greatest during the fall 2010 season and lowest during the summer 2011 season. Day time target passage rates averaged the greatest, and were much greater than the other three biological periods during the fall and winter seasons. During the spring and summer seasons, night time target passage rates were similar to day time target passage rates, but dawn and dusk rates stayed relatively low.

Hourly target passages rates support the greater target passage rates observed during days. Daytime target passage rates typically peaked between 10am and 1pm all season. The spring and summer seasons also had secondary target activity peaks during early night, between hours 19 and 22.

Before target passage rates can be compared with those from other proposed wind energy sites, it is important to recognize the variation in radar systems and methods among studies and the possible affects these differences may have on target counts and the related target passage rates. Although some radar study results such as average target directions and temporal magnitudes of nocturnal migration are fairly robust and resistant to differences in radar systems and methods, numerical target counts and related target passage rates are more influenced by these differences. Therefore, great care much be taken when comparing these types of numbers, and a full

understanding of both the radar systems and methods used to derive these numbers are needed before making comparisons.

Due to the difficulty of comparing target passage rates from other radar systems, it is preferable to compare target passage rates at the proposed OWEF site to other studies using DeTect avian radar systems. Comparisons can be made between both the Gulf Wind I windfarm on the southeast coast of Texas, and from the proposed Ripley-Westfield Wind Farm in western New York. Although is it difficult to determine the degree that region and local topography or habitat may have influenced these target passage rates, they do provide target passage rates calculated the same way using data from the same DeTect vertical radars.

The nightly target passage rates observed at the proposed OWEF site during all seasons of year 1 were less than those observed at the other two sites. Daytime target passage rates at the proposed Ocotillo Wind Project site were similar to those from the proposed Ripley-Westfield Wind Farm site, but much lower than Gulf Wind I Wind Farm site, during similar seasons. Dawn and dusk target passage rates were not calculated at the proposed Ripley-Westfield Wind Farm, but the target passage rates calculated at Gulf Wind I during these time periods were greater than at the proposed OWEF site during each respective season.

When targets were combined by season at the proposed OWEF site, the majority passed above the RSA during year 1. At least 80% of targets passed above the RSA during all time periods of each season except for dawns and dusks of winter and dusks of summer, which averaged lower percentages. Mean and median target heights were typically above the RSA, although means, and especially median target heights which averaged lower, occurred more frequently below 133.8 m starting in November 2010 and tapering off during spring 2011.

Target movement patterns also varied by season and by biological period. The fall 2010 season showed most targets moving southeast and east, likely indicative of fall nocturnal migration. Days and dusks during fall were relatively dispersed, but dawns showed an east / northeast movement trend. The winter 2010-11 season had relatively lower targets than the other seasons, both in number and altitude, and had variable movement patterns (east / northeast during dawns, northwest during days, west during dusks, and northwest during nights). During the spring 2011 season, a northerly target movement was expected because of spring nocturnal migration (at least during nights) however, this was not the case as all time periods showed southerly movements. The summer 2011 season had target movements that were relatively dispersed, and lacked a prominent target movement pattern during any of the four time periods.

It is worth noting that the radar settings for the horizontal radar (from which target directional information is derived) were optimized for tracking bighorn sheep during year 1 of this study. Although still capable of also tracking bird targets well, the sheep-optimized settings on the horizontal radar likely captured somewhat different targets and target information than radar

settings that are optimized specifically for small birds. It is also important to note that the sheep-optimized horizontal radar settings would have only affected target direction information, and not target counts or passage rates which are derived only from the vertical radar data. The vertical radar was NOT optimized for tracking sheep, but was rather fully configured for detecting and tracking bird activity. Thus, target counts and passage rates from the radar study were not affected by the study efforts to track bighorn sheep with the horizontal radar.

3.0 ASSESSMENT OF RISK TO BIRDS AND BATS

3.1 Direct Impacts to Birds and Bats

3.1.1 Raptors

3.1.1.1 All Raptors

Three approaches are used to describe and estimate risk to all raptors: 1) a comparison of annual use relative to other facilities in the US, 2) an estimate of fatality rates based on other publicly available studies for which both raptor use and raptor fatality rates are available, and 3) an estimate of risk based on fatality rates estimated for other California wind energy facilities.

Combined mean diurnal raptor use (number of raptor observations from both the Avian Point Count Surveys and Raptor Migration Counts divided by the total observation hours standardized to 20-minutes; excluding turkey vulture) at the OWEF was compared with 44 other wind energy facilities that implemented similar protocols and had data for three or four seasons. The annual mean raptor use at these wind energy facilities ranged from 0.06 to 2.34 raptors/plot/20-min survey (Figure 3). Mean diurnal raptor use at the OWEF excluding turkey vulture (adjusted for 20-min surveys; 0.14 raptors/plot/20-min survey) is considered to be low, ranking 41 compared to the 44 other wind energy facilities (Figure 3).

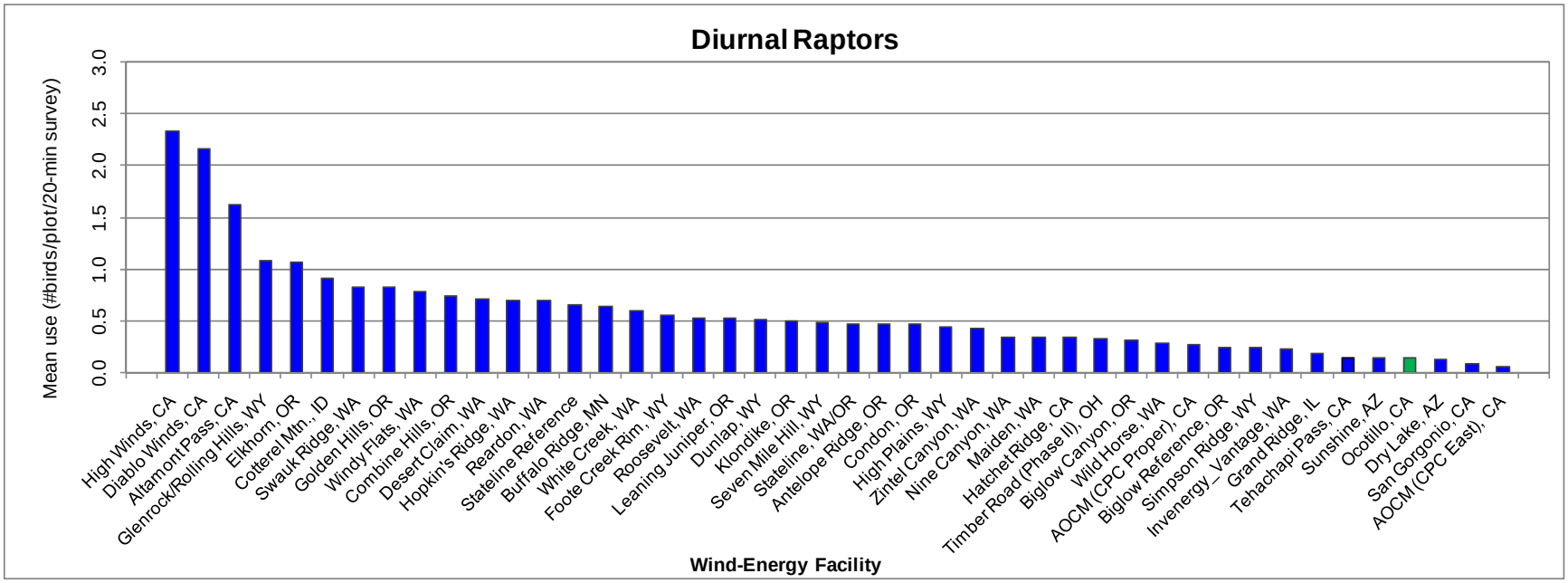


Figure 3. Comparison of annual raptor use between the Ocotillo Wind Energy Facility and other US wind energy facilities.

Data from the following sources:

Ocotillo, CA	This study.				
High Winds, CA	Kerlinger et al. 2005	White Creek, WA	NWC and WEST 2005	Timber Road (Phase II), OH	Good et al. 2010
Diablo Winds, CA	WEST 2006	Foote Creek Rim, WY	Erickson et al. 2002b	Biglow Canyon, OR	WEST 2005c
Altamont Pass, CA	Erickson et al. 2002b	Roosevelt, WA	NWC and WEST 2004	Wild Horse, WA	Erickson et al. 2003a
Glenrock/Rolling Hills, WY	Johnson et al. 2008a	Leaning Juniper, OR	Kronner et al. 2005	AOCM (CPC Proper), CA	Chatfield et al. 2010
Elkhorn, OR	WEST 2005a	Dunlap, WY	Johnson et al. 2009a	Biglow Reference, OR	WEST 2005c
Cotterel Mtn., ID	BLM 2006	Klondike, OR	Johnson et al. 2002	Simpson Ridge, WY	Johnson et al. 2000b
Swauk Ridge, WA	Erickson et al. 2003b	Seven Mile Hill, WY	Johnson et al. 2008b	Invenergy_Vantage, WA	WEST 2007
Golden Hills, OR	Jeffrey et al. 2008	Stateline, WA/OR	Erickson et al. 2002b	Grand Ridge, IL	Derby et al. 2009
Windy Flats, WA	Johnson et al. 2007	Antelope Ridge, OR	WEST 2009	Tehachapi Pass, CA	Erickson et al. 2002b
Combine Hills, OR	Young et al. 2003d	Condon, OR	Erickson et al. 2002b	Sunshine, AZ	WEST and the CPRS 2006
Desert Claim, WA	Young et al. 2003b	High Plains, WY	Johnson et al. 2009b	Dry Lake, AZ	Young et al. 2007c
Hopkin's Ridge, WA	Young et al. 2003a	Zintel Canyon, WA	Erickson et al. 2002a	San Gorgonio, CA	Erickson et al. 2002b
Reardon, WA	WEST 2005b	Nine Canyon, WA	Erickson et al. 2001	AOCM (CPC East), CA	Chatfield et al. 2010
Stateline Reference	URS et al. 2001	Maiden, WA	Erickson et al. 2002b		
Buffalo Ridge, MN	Erickson et al. 2002b	Hatchet Ridge, CA	Young et al. 2007b		

The mean and range of mortality rates for sites considered to have low raptor use is 0.06 raptors/megawatt/year (0 – 0.11 raptors/MW/year; Table 7). Based on raptor use (excluding turkey vulture) at the project (approximately 0.14/20-min survey), the estimated raptor mortality rate might be expected to be within the range of fatality rates observed at existing facilities where low raptor use has been recorded. Based on the relative abundance of red-tailed hawks throughout the year and the flight height information recorded for red-tailed hawks, there is higher potential for red-tailed hawk fatalities compared to other species.

Table 7. Raptor use estimations and estimated raptor mortality for sites considered to have low use estimates (< 0.50 birds per plot per 20-minute survey).

Study and Location	Raptor Use (birds/plot /20-min survey)	Raptor Fatality Rate (fatalities/MW/yr)
Klondike II, OR	0.50	0.11
Stateline, WA/OR	0.48	0.09
Wild Horse, WA	0.29	0.09
Wessington Springs, SD	0.23	0.06
Zintel, WA	0.43	0.05
Klondike, OR	0.50	< 0.01
Grand Ridge, IL	0.20	0

Data From the following sources:

Study and Location	Use Estimate	Fatality Estimate
Klondike II, OR	Johnson 2004	NWC and WEST 2007
Stateline, WA/OR	Erickson et al. 2004	Erickson et al. 2002b
Wild Horse, WA	Erickson et al. 2003a	Erickson et al. 2008
Wessington Springs, SD	Derby et al. 2008	Derby et al. 2010a
Zintel, WA	Erickson et al. 2002a	Erickson et al. 2002b
Klondike, OR	Johnson et al. 2002	Johnson et al. 2003b
Grand Ridge, IL	Derby et al. 2009	Derby et al. 2010b

Estimated raptor fatality rates were available for six wind energy facilities in California. Raptor fatality estimates in California ranged from 0.87 raptor fatalities/MW/study period at the Diablo Winds facility to zero raptor fatalities/MW/study period at the Dillon wind energy facility (Table 8). Raptor use at the higher mortality sites was upwards of an order of magnitude higher than at Ocotillo.

Table 8. All bird, raptor, and bat fatality rates at other wind energy facilities in California.

Project	Bird fatality/ MW/study period	Raptor Use Estimate (raptors/plot/ 20-min survey)	Raptor fatality/ MW/study period	Bat fatality/ MW/study period	Habitat	Use Estimate Reference	Fatality Data Reference
Alite, CA	0.55	NA	0.12	0.24	desert scrub		Chatfield et al, 2010
Buena Vista, CA	NA	NA	0.44	NA	grassland		Insignia 2009
Diablo	4.29	2.16	0.87	NA	grassland	WEST 2006	WEST 2006, 2008
Dillon	4.71	NA	0	2.17	desert		Chatfield et al. 2009
High Winds 2004	1.62	2.34	NA	2.51	agriculture/grassland	Kerlinger et. al. 2005	Kerlinger 2006
High Winds 2005	1.1	2.34	NA	1.52	agriculture/grassland	Kerlinger et. al. 2005	Kerlinger 2006
Pine Tree, CA	8.33	NA	0.133	0	grassland/scrubland		BRC 2010
SMUD Solano	0.99	NA	0.53	0.07	agriculture/grassland		URS, Erickson et al. 2005

3.1.1.2. Specific Raptor Species

Collision risks to individual species were accessed as the likelihood that adverse impacts would occur to individuals or populations of species of concern as a result of wind energy development and operation, in accordance with Wind Turbine Guidelines Advisory Committee's (WTGAC's) recommendations to USFWS for wind projects in general (WTGAC 2010). A weight-of-evidence approach is often used to analyze risk because relatively few methods are available for direct estimation of risk (Anderson et al. 1999 as cited in WTGAC 2010). The WTGAC also indicates that "for most populations, risk cannot easily be reduced to a strict metric, especially in the absence of population viability models for most species. Consequently, estimating the quantitative risk to populations is usually beyond the scope of project studies due to the difficulties in evaluating these metrics, and therefore risk assessment will be qualitative" (WTGAC 2010). Use data for proposed wind sites is often compared to use data of other wind sites to evaluate collision risk. The collision risk analysis presented below incorporates the quantitative data collected during four seasons of raptor migration count studies and a full year of avian point count studies on the OWEF site. Avian use, observed flight heights, and species behaviors were incorporated into the qualitative collision risk assessment below. During analysis, the rotor swept area (i.e., the zone where the blades of the turbine would occur; RSA) was assumed to be between 100 feet to 450 feet above ground level.

Cooper's hawk does not commonly occur within the proposed OWEF site, and the 10 observations (nine during raptor migration counts and one during APC's) likely represent migratory birds passing through the proposed OWEF area. Cooper's hawk was recorded flying within the RSA 52% of the time observed flying during raptor migration observations (Table 9). Although foraging behavior was not observed, it is expected that the species could use the site for foraging during migration periods, which would put it at risk for collision. Wintering and resident Cooper's hawks are typically found in riparian habitats, which are lacking within the proposed OWEF site. Cooper's hawk use of the proposed OWEF site was low (0.003 observations/hour made over the four seasons of raptor migration counts); therefore, overall collision risk for this species is low.

Like the Cooper's hawk, sharp-shinned hawk does not commonly occur within the proposed OWEF site, and the five observations (all during raptor migration counts) likely represent migratory birds passing through the proposed OWEF site. Each observation was a single individual and sharp-shinned hawk was observed flying within the proposed RSA 63% of the time recorded flying based on raptor migration surveys (Table 9). Although foraging behavior was not observed, it is expected that the species could use the site for foraging during migration periods, which would put it at risk for collision. Both wintering and resident sharp-shinned hawk are typically associated with riparian habitats, which are lacking within the proposed OWEF site. Sharp-shinned hawk use of the proposed OWEF site was low (0.002 observations/hour made

over the four seasons of raptor migration counts); therefore, overall collision risk for this species is low.

Ferruginous hawk is an infrequent migrant through the proposed OWEF site and is not a common winter resident. The five observations (four during raptor migration counts and one during APC's) likely represent migratory birds passing through the proposed OWEF site during fall/winter migration. Each observation was a single individual, and ferruginous hawks were observed flying within the proposed RSA 83% of the time recorded as flying during raptor migration surveys (based on four observations; Table 9). Although foraging behavior was not observed, it is expected that the species could use the site for foraging during migration periods, which would put it at risk for collision. Wintering ferruginous hawks are more commonly observed in the agricultural complexes east of the proposed OWEF site where rodent populations are typically higher. Ferruginous hawk use of the proposed OWEF site was low (0.002 observations/hour made over the four seasons of raptor counts); therefore, overall collision risk for this species is low.

A total of 74 Swainson's hawk observations were recorded (71 during raptor migration surveys and three during APC's. Of the 71 observations recorded during raptor migration surveys, Swainson's hawk was observed flying within the proposed RSA during 57% of the time (Table 9). Although foraging behavior was not observed, it is expected that the species could use the site for foraging during migration periods, which would put it at risk for collision. Collision risk for Swainson's hawk is considered low to moderate due to the species' use of the proposed OWEF site during the fall and spring (0.034 observations/hour made over the four seasons of raptor counts).

Northern harrier was not frequently observed on the OWEF site (a total of 13 observations were made over four seasons of raptor counts [12 observations] and during APC's [one observation]). During raptor migration surveys, northern harrier was recorded flying within the proposed RSA 11% of the time (Table 9). The species was observed foraging on site, which would put it at risk for collision. Northern harriers prey on a variety of species, specializing in small- to medium-sized mammals (Johnsgard 1990), which occur throughout the proposed OWEF site. Harriers typically hunt by flying at heights closer to the ground, although they will commonly fly at heights within the RSA. The species' use of the proposed OWEF site was low (0.004 observations/hour made over the four seasons of raptor counts); therefore, overall collision risk for this species is low.

Merlin does not commonly occur on the proposed OWEF site, and the three observations recorded during Raptor Migration Counts likely represent migratory birds passing through the proposed OWEF site. Each observation was a single individual, and merlins were recorded flying within the proposed RSA during 7% of the time (Table 9). Although foraging behavior

was not observed, it is expected that the species could use the site for foraging during migration periods, which would put it at risk for collision. Wintering merlins are not common in southern California. Merlin use of the proposed OWEF site was low (0.001 observations/hour made over the four seasons of raptor counts); therefore, overall collision risk for this species is low.

Osprey was not frequently observed on the OWEF site (a total of nine observations were made over four seasons of raptor counts). Osprey were observed flying within the proposed RSA during 66% of the time (Table 9). This species does not commonly occur in the desert during migration and is not expected to use the proposed OWEF site for hunting due to the lack of water bodies within the proposed OWEF site. The species is commonly observed at the Salton Sea, which is located approximately 30 miles northeast of the proposed OWEF site. Osprey use of the proposed OWEF site is low (0.005 observations/hour made over the four seasons of raptor counts); therefore, the collision risk for this species is low.

The multiple observations (83 during raptor migration counts and nine during APC's) of prairie falcons on the proposed OWEF site suggest that this is a resident species of the Ocotillo area. Based on raptor migration surveys, prairie falcons were recorded as flying in the proposed RSA during 54% of the time (Table 9). The habitat in the southwest portion of the proposed OWEF site and adjacent areas to the north and west of the proposed OWEF site contain suitable nesting habitat for the species. A suspected prairie falcon nest location was noted in the I-8 Island (outside of the project ROW, just south of Site 1), but the location was never definitively documented. The prairie falcons that forage within the proposed OWEF site may be at greater risk of collision as compared to many of the other raptor species because their use of the site was greater (0.030 observations/hour made over the four seasons of raptor counts).

There were 94 observations of American kestrels during the four seasons of raptor counts and 10 observations were recorded during APC surveys suggesting American kestrels are resident species in the Ocotillo area. American kestrels are at a greater risk of collision compared to many raptors due to their use of the site and flight height information; although there were three raptor species (excluding turkey vulture) that had a higher number of exposure minutes within the RSA. They are commonly found as fatalities at existing wind energy facilities. Furthermore, their detection from visual observations is likely less than for larger raptor species, so their true use of the site may be higher than observed.

A single incidental observation of two peregrine falcons (*Falco peregrinus*) on the proposed OWEF site suggests that the species is a very rare visitor to the proposed OWEF site. No peregrine falcons were observed during raptor migration counts or APC surveys and the species is not expected to forage on site; therefore, the collision risk is low.

Excluding turkey vultures, red-tailed hawk was the most commonly observed raptor species and was also the raptor species with the highest number of exposure minutes within the RSA. The site specific baseline data suggest that red-tailed hawk would be the most likely collision risk at the OWEF.

In addition to the qualitative risk assessment provided above, a relative exposure index (minutes within the RSA) for each raptor species was calculated using the four seasons of raptor migration count data (fall 2009, spring 2010, fall 2010, and spring 2011). Table 9 also provides the percentage of time each species was observed flying in the proposed RSA out of the total time recorded as flying for each species. When evaluating relative species risk, it is important to assess relative abundance in addition to the duration within the RSA for a given species.

Table 9. Raptor flight height information and relative exposure based on Raptor Migration Counts at the Ocotillo Wind Energy Facility.

Species	# of Observations	Flight Height (ft above ground)	Cumulative duration of observations (minutes)	Relative Exposure Index (Duration within RSA[2] [minutes])	Percentage of Flight Time within RSA[3]
American kestrel	94	0 – 600	320	64	**0.20**
Cooper's hawk	9	0 - 1,000	21	11	**0.52**
ferruginous hawk	4	100 – 500	6	5	**0.83**
golden eagle	31*	0 – 4,000	384	165	**0.43**
merlin	3	10 – 100	14	1	**0.07**
northern harrier	12	0 – 1,000	53	6	**0.11**
osprey	10	5 – 1,500	32	21	**0.66**
prairie falcon	83	0 – 1,500	267	144	**0.54**
red-tailed hawk	712	0 – 7,500	3,764	1,729	**0.46**
sharp-shinned hawk	5	8 – 1,000	8	5	**0.63**
Swainson's hawk	71	0 – 2,500	512	293	**0.57**
turkey vulture	870	0 – 5,000	5,054	2,677	**0.53**
unidentified raptor	169	0 – 10,000	736	275	**0.37**

1Fall 2009, Spring 2010, Fall 2010 and Spring 2011 data
2Rotor Swept Area (100 ft to 450 ft above ground level)
3Percentage of flight time within RSA = (duration within RSA ÷ cumulative duration of observations)
*Does not include four additional golden eagles incidentally observed during other biological surveys

3.1.2 Non-raptor Bird Species

Estimated bird fatality rates were available for seven wind energy facilities in California. Bird fatality estimates in California ranged from 0.55 fatalities/MW/study period at the Alite facility to 4.71 fatalities/MW/study period at the Dillon wind energy facility. Fatality rates at the OWEF site might be expected to be within the range of fatality rates observed at other California wind energy facilities and based on habitat similarities, fatality rates could be similar to rates observed at the Dillon facility (Table 8).

Ninety-six% of observations of passerines occurred outside the RSA. However, some bias exists for lower flying birds. There is some potential for all recorded species to fly within the RSA. Given that the site is not part of a major migratory movement corridor and the bird abundance is relatively low, overall collision risk for diurnally active avian species is expected to not be unique. Based on data from other fatality studies, both likely nocturnal migrating passerines and resident passerines are the most common fatalities, and are the most common bird groups from surveys. It is possible that nocturnal species such as owls, nightjars, etc., and species that migrate at night (most passerines) may be at a greater risk of collision. Even with the abundance of individuals during spring migration, site use by migratory species should be considered low given the size of the site. Many of the migratory species were detected in relatively low numbers, which indicates this is not a major migratory corridor for passerines.

Some fatalities of nocturnal migrating birds have been observed at wind energy projects within the U.S. (Kerlinger et al. 2010), although the rates of fatalities at individual wind farms appear to be relatively low compared to estimates of the numbers of migrants flying over the sites. Most nocturnal songbird mirgation is believed to occur above 500 feet above ground level (Longcore et al. 2005). There are several records of large mortality events at tall guyed communication towers (Kerlinger 2000, Kemper 1996) and these events are typically associated with bad weather conditions (low ceilings, fog). Unlike communication towers, however, there have been no reported large episodic mortality events (e.g., >50 birds during a single night) recorded within a single U.S. wind farm. Based on a review of collision fatalities at 30 wind energy facilities in North America, fatalities of nocturnal migrants have ranged from <1 fatality/turbine/year to ~7 fatalities/turbine/year with higher rates recorded in eastern North America and lower rates in the west (Kerlinger et al. 2010). Multi-bird mortality events (defined as >3 birds killed in one night at one turbine) were recorded at only four out of approximately 25,000 turbine searches. The largest mortality events reported at U.S. wind energy facilities to date include 14 migrant songbirds found at two turbines during spring migration at Buffalo Ridge, Minnesota (Johnson et al. 2002) and 27 migrants at the Mountaineer facility in West Virginia (Kerns and Kerlinger 2004). The West Virginia mortalities apparently occurred during inclement weather and the fatalities occurred at a turbine near a heavily lit substation. Most migrant songbird casualties recorded during systematic carcass searches at turbines have been a single fatality found during a single search (Erickson et al. 2001).

3.1.3 Bats

Estimated bat fatality rates were available for five wind energy facilities in California, and ranged from 0.07 fatalities/MW/study period at the SMUD Solano facility to 2.57 fatalities/MW/study period at the High Winds facility (2004). Based on estimated fatality rates observed at other California wind energy facilities, fatality rates at the OWEF site might be expected to be within the range of fatality rates observed at other California wind energy facilities (Table 8). However, more uncertainty exists for predicting bat mortality, based on high variation in rates across the country.

The species specific collision risk analysis for bats incorporates the quantitative data collected during four seasons of bat survey data on the OWEF site. Four of the five species observed in the project area are considered to be at low risk and not particularly sensitive species within the local area or the region (California myotis, western pipistrelle, Mexican free-tailed bat, and big brown bat). The greater western mastiff bat is the species considered a high-risk species. This species is severely limited to habitat areas based on its high demand for water (it is the largest bat in North America) and is unable to drink from water sources less than 30 m long (Chebes 2002). Therefore, because there are no water bodies within the project area that could likely support this species, and foraging potential is rather limited, this rare occurrence is probably only moving through the project area infrequently in search of suitable habitat.

3.2 Indirect Impacts to Birds and Bats

Construction and O&M of the OWEF may alter the landscape and habitat conditions so that wildlife use patterns are affected, displacing wildlife away from the project facilities and suitable habitat. Examples of potential indirect effects during construction and O&M include night lighting, construction noise, and degradation of foraging habitat. Construction will be conducted primarily during daylight hours; however, if it becomes necessary to conduct work at night, Best Management Practice's (refer to avoidance and minimization of risk section below) will be implemented to avoid and minimize any potential impacts. Construction and O&M noise could impact breeding behavior or reproductive success.

The introduction or spread of invasive weed species that results in changes in prey abundance or species assemblages would also be considered an indirect impact to bird and bat species. Soil disturbance during construction can encourage invasive weeds to encroach into the habitat from areas outside the site, and weed seed can be introduced to the site if construction vehicles and equipment entering the site are not cleaned properly. Invasive weed species have the potential to out-compete native species and change the overall quality of the habitat.

3.2.1 Raptors

Raptors nesting closer to turbines have the potential to be impacted by disturbance due to construction or operation of the facility. Birds displaced from wind energy facilities might move

to lower quality habitat with fewer disturbances, with an overall effect of reducing breeding success. Most studies on raptor displacement at wind energy facilities, however, indicate effects to be negligible (Howell and Noone 1992; Johnson et al. 2000a, 2003a; Madders and Whitfield 2006). Notable exceptions include a study in Scotland that described territorial golden eagles avoiding the entire wind energy facility area, except when intercepting non-territorial birds (Walker et al. 2005). A study at the Buffalo Ridge wind energy facility in Minnesota found evidence of northern harriers avoiding turbines on both a small scale (less than 100 m from turbines) and a larger scale in the year following construction (Johnson et al. 2000a). Two years following construction, however, no large-scale displacement of northern harriers was detected.
The only published report of avoidance of wind turbines by nesting raptors occurred at the Buffalo Ridge facility in Minnesota, where raptor nest density on 101 mi^2 (262 km^2) of land surrounding the wind energy facility was 5.94 nests/39 mi^2 (101 km^2), yet no nests were present in the 12 mi^2 (31 km^2) facility itself, even though habitat was similar (Usgaard et al. 1997). However, this analysis assumes that raptor nests are uniformly distributed across the landscape (an unlikely event), and only two nests would be expected for an area 12 mi^2 in size if the nests were distributed uniformly. Based on extensive monitoring using helicopter flights and ground observations, raptors continued to nest at a wind energy facility in eastern Washington at approximately the same levels after construction, and several nests were located within a half-mile of turbines (Erickson et al. 2004). At the Foote Creek Rim wind energy facility in southern Wyoming, one pair of red-tailed hawks nested within 0.3 miles (0.5 km) of the turbine strings, and seven red-tailed hawk nests, one great horned owl (*Bubo virginianus*) nest, and one golden eagle nest located within one mile of the wind energy facility successfully fledged young (Johnson et al. 2000b). The golden eagle pair successfully nested a half-mile from the facility for three different years after it became operational. In Oregon, a Swainson's hawk also nested within a quarter-mile (0.4 km) of a turbine string at the Klondike I wind energy facility after the facility was operational (Johnson et al. 2003b). These observations suggest that there will be limited nesting displacement of raptors at the OWEF, although the creation of a buffer surrounding known nests when siting turbines will further reduce any potential disturbance/displacement impact to nesting raptors by reducing human activities in close proximity to raptor nests.

3.2.2 Non-Raptor Bird Species

Wind energy facility construction appears to cause small-scale local displacement of grassland passerines. Construction also reduces habitat effectiveness because of the presence of access roads and large gravel pads surrounding turbines (Leddy 1996; Johnson et al. 2000a). Leddy et al. (1999) surveyed bird densities in Conservation Reserve Program (CRP) grasslands at the Buffalo Ridge wind energy facility in Minnesota, and found mean densities of 10 grassland bird species were four times higher at areas located 180 m (591 ft) from turbines than they were at grasslands nearer turbines. Johnson et al. (2000a) found reduced use of habitat by seven of 22 grassland-breeding birds following construction of the Buffalo Ridge wind energy facility.

Results from the Stateline wind energy facility in Oregon and Washington (Erickson et al. 2004) and the Combine Hills wind energy facility in Oregon (Young et al. 2005) suggest a relatively small impact of wind energy facilities on grassland-nesting passerines. Transect surveys conducted prior to and after construction of the wind energy facilities found that grassland passerine use was significantly reduced within approximately 50 m (164 ft) of turbine strings, but areas further away from turbine strings did not have reduced bird use. Assuming similar displacement impacts occur for passerine species that utilize desert-scrub habitats; there is the potential for small-scale displacement of passerines at the OWEF.

3.2.3 Bats

Due to the lack of any known maternity roosts for bats as well as the lack of wetland/water habitats for foraging, any potential displacement impacts to bats are unlikely at the proposed OWEF.

3.3 Sensitive Species

Burrowing owls, a BLM-listed sensitive species and CDFG designated species of special concern, have been regularly documented during surveys of the OWEF. Burrowing owls have been recorded as fatalities at existing wind energy projects. In a review of 21 monitoring studies, burrowing owls were among the most common raptor fatalities (n=13) based on cumulative fatality data from 21 monitoring studies (Johnson and Stephens 2010). However, all 13 fatalities were recorded at the Diablo Winds Facility and there was a high degree of uncertainty associated with cause of death determinations. In all 13 cases, strong evidence that the fatality was a wind turbine collision was lacking (WEST 2008). More research is needed to understand potential collision risks to burrowing owls however; given the low use of the RTWEP by burrowing owls (one observation during two years of baseline surveys) the risk of collision is considered low. Conservation measures for burrowing owls are included in Section 6.2 below.

Breeding Swainson's hawk are listed as threatened in the CESA, and Swainson's hawks were observed within the OWEF during APCs; however, the habitat at the OWEF suggests breeding Swainson's hawks would be unlikely in the OWEF. Therefore, the proposed facility is unlikely to affect breeding and nesting populations of Swainson's hawks. Collision risks to Swainson's hawks are addressed in Section 3.1.1 above.

The western mastiff bat, a BLM sensitive species and CDFG designated species of special concern, was identified within the OWEF through acoustic bat monitoring. While collisions with turbines have the potential to occur, no western mastiff bat fatalities have been documented in publically available wind energy fatality monitoring studies (Chatfield et al. 2009, Piorkowski and O'Connell 2010).

4.0 AVOIDANCE AND MINIMIZATION OF RISK USING BMP's and ACP's

OE LLC plans to implement a variety of BMP's and ACP's to reduce the risk to avian and bat species from the project. The following BMP's and ACP's have been implemented or are planned for the OWEF during the pre-construction, construction, and operation phase of the project.

4.1 BMP's and ACP's Pre-Construction

OE LLC collected available site-specific information on avian and bat use to guide project siting to avoid and minimize impacts. Other BMP's and ACP's implemented during the pre-construction phase of the OWEF include:

- The area and intensity of disturbances was minimized during pre-construction monitoring and testing activities.
- Existing roads and transmission corridors have been used to the extent possible while developing site plans.
- The Avian Power Line Interaction Committee (APLIC) guidance on power line siting (APLIC 1994) was followed while planning.
- Site plans minimized the extent of the road network needed for the OWEF.
- No lattice or structures that are attractive to birds for perching are including in facility designs other than two SDG&E replacement structures to accommodate the switchyard.
- No guy wires will be included on permanent MET towers.
- The facility was not sited in any areas containing high concentrations of ponds, streams, or wetlands.
- The OWEF site plan includes a 50-foot tall Advanced Biological Observation Command and Control Center (ABOCCC) to allow for early detection of any significant raptor and passerine migration through the site. OE LLC will consult with USFWS on the appropriate perch deterrents for the ABOCCC.

4.2 BMP's during Construction

The following BMP's will be implemented at the OWEF during construction:

- The area and intensity of disturbance will be minimized to the extent possible during construction.
- Existing roads will be used for access during construction to the extent possible.
- Non-operational MET towers will be dismantled during construction.
- Powerlines will be buried to the extent possible to reduce avian collision and electrocution.
- APLIC guidance on power line construction (APLIC 2006) will be followed.

- A transportation plan will be implemented during construction that includes road design, locations and speed limits to minimize habitat fragmentation and wildlife collisions, and minimize noise effects.
- Lighting plans for the facility are the minimum according to requirements.
- All security lighting will be motion or heat activated, instead of being left on throughout the night.
- All security lighting will be down-shield and related to infrastructure lights.
- Night lighting will be minimized to the extent possible.
- Any construction lighting to be used at night will be down-shielded, will be directed toward the interior of the disturbance area, or at the specific location being constructed.
- Clearing of vegetation for construction will avoid the bird breeding season when feasible. Pre-construction bird surveys would be conducted if clearing of vegetation needs to be completed during the bird breeding season. Construction setbacks will be implemented if active nests are found during pre-construction surveys.
- A Designated Biologist/biological monitor will monitor compliance of measures to control the introduction/spread of invasive weed species during construction.
- A worker Education Awareness Program will be implemented to educate employees and contractors on controlling the spread of invasive weed species.
- An Integrated Weed Management Plan will be prepared and implemented.
- Any temporarily disturbed areas will be revegetated.
- A wildlife awareness program will be implemented by OE LLC for its employees and contractors.
- Compliance monitoring by a Designated Biologist will be conducted to ensure construction BMP's are being implemented.

In addition to the construction BMP's identified above, a Nesting Bird Management, Monitoring, and Reporting Plan (NBMMRP) will be implemented for the OWEF. If the project must occur during the avian breeding season (February 1st to August 31st, as early as January 1 for some raptors), OE LLC will work with the CDFG, BLM and the USFWS to prepare a Nesting Bird Management, Monitoring, and Reporting Plan (NBMMRP) to address avoidance of direct impacts to nesting birds.

4.3 BMP's during Operation

In addition to the intensive monitoring and research program, the following BMP's will be implemented during operation of the OWEF:

- Management activities such as seeding forbs or maintaining rock piles that attract potential prey will be avoided.
- Parts and equipment which may be used as cover by prey will not be stored in the vicinity of wind turbines.
- Any carcasses (with the exception carcasses being used for post-construction bias trials) found within the OWEF will be removed immediately assuming the appropriate permits/authorizations have been granted to OE LLC.
- Low level speed limits (< 25 mph) will be maintained on all roads within the OWEF.
- Personnel will be trained to be alert for wildlife at all times, especially during low visibility conditions.
- Personnel, contractors, and visitors will be instructed to avoid disturbing wildlife, especially during the breeding seasons and seasonal periods of stress.
- A wildlife incident reporting system and associated worker awareness training will be implemented for the life of the OWEF (see Section 5.1.6)
- Fire hazards will be reduced from vehicles and human activities (e.g., use spark arrestors on power equipment, avoid driving vehicles off roads, and allow smoking in designated areas only).
- Federal and state measures for handling toxic substances will be followed.
- Effects to wetlands and water resources will be minimized by following provisions of the Clean Water Act (1972).

5.0 MONITORING AND ADAPTIVE MANAGEMENT PROCESS

The process for addressing potential impacts to bird and bat species from implementation of the OWEF is divided into two sections: 1) Post-Construction Monitoring and 2) Adaptive Management based on monitoring results.

Post-construction monitoring is designed to evaluate the project during operation to determine actual impacts. Adaptive management has been designed to use monitoring data to evaluate whether impacts are determined to be significant or unique, and if so, to implement measures to reduce them to acceptable levels or consider some other type of minimization or mitigation.

To help ensure that impacts to avian and bat species can be monitored and mitigated as necessary due to routine operations of the OWEF, a Technical Advisory Committee (TAC) will monitor OWEF activities, including mortality data, to determine the need for project mitigation. The

TAC will consist of one representative from OE LLC, and a single resource specialist (two members may be appropriate if one person specializes in birds and the other in bats) from the BLM, USFWS, and CDFG. In addition, the TAC may invite an avian or bat expert to sit on the committee (e.g. Audubon, Bat Conservation International, etc.). The TAC will provide advice and recommendations to the BLM Authorized Officer on developing and implementing effective measures to monitor, avoid, minimize, and mitigate impacts to avian and bat species and their habitats related to operations. The BLM Authorized Officer will evaluate any recommendations of the TAC, including discussions with the proponent on new measures or measures that are not completely detailed in this ABPP, and make a decision on what measure(s) to require for implementation.

A TAC Lead will be designated for the group whose duties will include disseminating project data, including data on mortality events, setting up and moderating meetings, reviewing mortality data, and documenting mitigation recommendations for the OWEF. Because the OWEF occurs on BLM land and they are the federal decision-maker, BLM will provide a designated TAC Lead for the duration of the project. Because it is the TAC Lead's responsibility to coordinate meetings and involve all team members, the TAC Lead reserves the right to make recommendation decisions under extraordinary circumstances or when all TAC members are unable to meet.

A Memorandum of Agreement (MOA) will be signed by each party to ensure participation in the TAC. Unless there is a failure on the part of any of these representatives to respond or agree to participate, the TAC shall be formed prior to project operations.

The guiding principles, duties, and responsibilities of the TAC include the following.

- Approve TAC charter and sign MOA.
- Make recommendations based on best available science and to address specific issues resulting from this project.
- In the event decisions cannot be made by consensus, decisions of the TAC shall be made by simple majority vote.
- The TAC is only an advisory committee, and final management decisions will be made by the BLM Authorized Officer.
- Provide sufficient flexibility to adapt as more is learned about the project as well as strategies to reduce avian and bat impacts.
- Review initial and any subsequent revised monitoring protocols for mortality monitoring studies.
- Review results of mortality monitoring.
- Recommend appropriate mitigation measure(s) to the BLM Authorized Officer for implementation in the event that a significant or unique event occurs.
- Review annual report on status of compliance with mitigation measures and permit conditions and provide recommendations to the BLM Authorized Officer, as necessary.

- Develop and recommend additional mitigation measures or research to the BLM Authorized Officer if predetermined mitigation is outdated or deemed ineffective or "unexpected fatalities" occur.
- Evaluate effectiveness of implemented mitigation strategies and provide the BLM Authorized Officer with recommendations based on findings.
- If selected as part mitigation, recommend compensatory mitigation funding opportunities for implementation of off-site species or habitat enhancement or protection/conservation measures.
- The TAC will terminate when the BLM Authorized Officer determines that it is no longer a necessary pathway in reducing avian and bat impacts.

The TAC shall hold the first meeting prior to the commencement of operations to develop and approve the charter and requirements of this ABPP. The charter will include an MOA ensuring participation in the TAC and agreeing to how funds provided in this ABPP would be accessed. Thereafter, the TAC shall meet annually, unless data reveal that mortality triggers have been exceeded. Attendance at TAC meetings shall be by invitation of its members only.

5.1 Post-construction Monitoring

Post-construction monitoring for bats and birds is a critical component of this ABPP. The post construction monitoring described in the OWEF ABPP are for the OWEF only and do not apply to the SDG&E switchyard. SDG&E intends to construct and operate the switchyard independently from OE LLC. The observations made during post-construction monitoring will be reported to the TAC, which will respond with appropriate management decisions should mortalities exceed the triggers outlined in the adaptive management section of this ABPP. Post-construction monitoring will be completed for bats and birds concurrently, and detailed methods for these surveys are presented below. Since post-construction monitoring methods are constantly improving as researchers develop new and more accurate methods of survey, the TAC should consider recommendations to adopt new survey techniques and protocols as they become available.

Post-construction surveys will focus on mortality surveys for birds and bats. These surveys will be conducted in accordance with industry standards for post-construction fatality monitoring in the region and will be completed regularly to document the number and species of birds and bats killed as a result of the OWEF. As part of these mortality surveys, the searcher efficiency rate (i.e., the ability of a surveyor to locate a mortality) and carcass removal rate (i.e., the average time that a carcass persists before a scavenger removes it) will be determined for bats and small and large bird size classes. For each mortality located, the appropriate (i.e., bat, small bird, large bird) searcher efficiency and scavenger removal rate will be used to estimate the actual number of bird and bat mortalities. Methods for completing post-construction surveys are described below, and datasheets examples are shown in Appendix B.

OE LLC will also have a state of the art Merlin radar system onsite for the life of the OWEF specifically tiered to collect data to potentially curtail turbines in order to minimize direct

impacts to golden eagles and indirect impacts to bighorn sheep. The Merlin radar system will be mounted on top of a 50-foot tall Advanced Biological Observation Command and Control Center (ABOCCC) that would be constructed in the central portion of the site. The Merlin system incorporates vertical and horizontal radar and the information detected on the radar is linked to a high-resolution camera, which will also be mounted on top of the ABOCCC. A depiction of the ABOCCC is provided as Figure 4. Due to the low level and avian migration and bat use at the site, this system will also be used for data collection purposes for general avian and bat species. The ABOCCC will be manned from sunup to sundown for the first ten years of operations to specifically monitor movements of eagles and other wildlife.

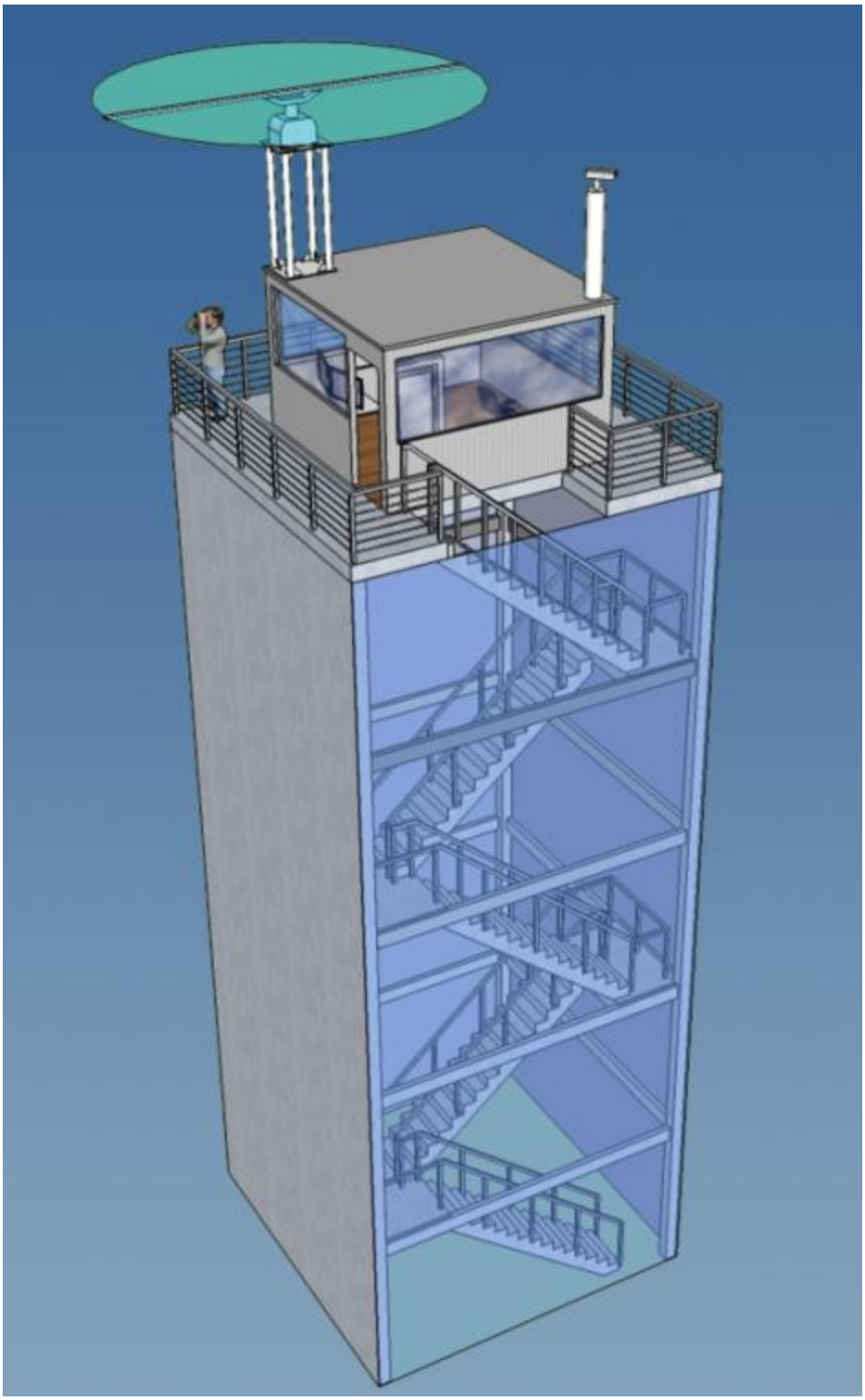


Figure 4. Advanced Biological Command and Control Center (ABOCCC). (Conceptual)

5.1.1 Raptor Nest Surveys

Nest surveys will be conducted prior to the nesting season (approximately March 15 to July 30) and once each month during the nesting season during the first three years of operations. Aerial or ground based raptor nest surveys will be conducted within the entire project area and a one-mile buffer for raptors (BLM 2007), except for golden eagles. The golden eagle nest surveys and associated mitigation are discussed in the OWEF's Eagle Conservation Plan (OE LLC 2012). The raptor nest survey effort will be focused on species that build large nest structures, such as red-tailed hawk (*Buteo jamaicensis*). Other species that nest on the ground or in cavities were recorded if observed, but will not be the focus of surveys. Where appropriate, construction activities will be limited within 500 feet of any active raptor nest site (except golden eagles). Nest locations found within the project area and within buffer will be documented by noting the species, dates of activity, Universal Transverse Mercator (UTM) North American Datum (NAD) 83 coordinates, nest contents (where possible), and behavior. The data will be presented to the TAC to determine whether mitigation should be recommended to reduce impacts to nesting activities. Active raptor nests will be monitored to track the breeding success of resident raptors and evaluate the effectiveness of mitigation measures, if any are applied.

5.1.2 Avian Monitoring

To provide a comparison between pre-construction use and post-construction use at the site, avian point-count surveys will be conducted twice each month during the first two years of operation. Point-count surveys will be completed using the same methods as pre-construction studies. Basic methods will include general use point-counts in the first few hours of the morning, followed by raptor counts during the middle of the day, and several hours of general use point-counts in the late-afternoon/evening. General use point-count data will be collected to provide an accurate comparison between pre- and post-construction use to inform our understanding of avian exposure and probability of mortality as well as behavioral responses to the facility. Raptor count data would be collected to help determine how post-construction use compares to recorded mortality.

5.1.3 Mortality Surveys

Fatality surveys for baseline monitoring will begin with the next survey season (within 4 months) after commercial operation delivery (COD) of the project. Monitoring will consist of a minimum of 3 years of post-construction bird and bat mortality monitoring, in accordance with the California Guidelines for Reducing Impacts to Birds and Bats from Wind Energy Development (CEC 2007) or improved protocols as recommended by the TAC. If the first two years of fatality monitoring do not coincide with a good rain year (i.e. a good rain year is defined as greater than annual rainfall of 10.6 inches in Campo, CA; WRCC-DRI 2009), then OE LLC will conduct the third year of monitoring following a good rain year.

OWEF will implement monitoring of turbines for fatalities pursuant to an enforceable monitoring program established in consultation with the TAC. OWEF shall monitor a subset (30%) of the turbines at least twice per month for the duration of the post-construction monitoring period for fatalities, bird and bat utilization and or behavior, in consultation with the TAC, as appropriate. Data collected for each carcass will include estimated time since death, condition, type of injury, cover type, distance to nearest WTG location, distance to nearest road, and distance to nearest structure. All observed carcasses will be photo-documented and identified. All mortalities that cannot be identified will be recorded as an unidentified bat or bird. Contingent upon approval and permit by CDFG and the USFWS, it is recommended that carcasses be collected for use in searcher efficiency and scavenger removal trials. Post-construction monitoring shall be conducted by a consultant with applicable experience ("Monitor") approved by the TAC.

5.1.3.1 Searcher Efficiency Trials

Searcher efficiency and scavenger rate studies will be used to develop correction factors that will be applied to mortality findings for each surveyed turbine. The corrected data for surveyed turbines will be used to evaluate the mortality per turbine and per MW. Additionally, survey intervals may need to be adjusted based on the findings for these studies in order to ensure precise correction factors, as described by Huso (2009).

Searcher efficiency trials will be conducted throughout the year to correct observed bat and bird mortalities for bias created by the ability of the surveyor to detect bat and bird carcasses. These will be conducted for each searcher to address differences between searchers. Searcher efficiency trials will be completed during each season to account for different field conditions and weather (i.e., springtime when annual vegetation may be dense, summertime when vegetation is dry and temperatures are hot, etc.) that may affect the ability of the surveyor to locate carcasses. Seasons will be defined as described by Erickson et al. (2003): spring migration (March 16–May 15), breeding season (May 16–August 15), fall migration (August 16–October 31), and winter (November 1–March 15). Although seasonal trials will not address fluke events, they will address the overall time period.

Separate searcher efficiency rates will be determined for bats, small birds (passerines), and large birds (raptors). In order to have an adequate sample size (> 50, Huso [2009]), 20 carcasses will be used for each rate. Bat carcasses collected from the OWEF will be used for bat searcher efficiency trials, as available. If an insufficient number of bat carcasses are available, small, drab passerines or brown mice carcasses will be used as substitutes. A minimum of two distinct sizes of bird carcasses will be used to determine searcher efficiency rates for passerines and larger birds. As available, bird carcasses collected from the OWEF will be used in the searcher efficiency trials; however, substitute carcasses may be used as necessary. Substitute small bird carcasses may include species such house sparrows (*Passer domesticus*) and/or brown-headed

cowbirds (*Molothrus ater*). Substitute large bird carcasses may include road-killed birds (fresh carcasses only) and/or carcasses from veterinary colleges or wildlife rehabilitation centers; actual large species will be determined in coordination with the TAC. In all cases, carcasses used will either be non-native, non-protected species provided by an authorized agency, or species collected through permitted take, and carcasses will be free of disease and poison.

Prior to initiating the searcher efficiency trial, carcass locations will be randomly generated, but constrained so that no more than three carcasses will be located at any one turbine at a time. An additional biologist who is not participating in the searcher efficiency trials will plant carcasses in pre-determined locations. Carcasses will be dropped from waist level, so that they land in a random position and location. The position and location will be recorded for later comparison with actual mortalities.

Bat carcasses will be marked by pulling an upper canine tooth as described by Arnett et al. (2009). Similarly, the beaks of trial birds will be notched to avoid using chemically based marking methods, which may influence scavenger removal rates. When surveyors located a marked carcass, they will note the finding and notify the biologist who planted the carcass. The percentage of planted bats and birds located by surveyors will be used to generate a correction factor to estimate the actual number of bats killed, based on the number of actual mortalities observed.

5.1.3.2 Carcass Removal Trials

Carcass removal trials will be completed during each of the four seasons over the three-year post-construction monitoring period. Different seasonal rates for carcass removal are necessary to address the effects of varying weather conditions, scavenger densities, and scavenger assemblages throughout the season, as well as over time, as scavengers adapt to a novel food source. Separate carcass removal rates will be determined for bats, small birds (passerines), and large birds (raptors). All animals used in the carcass removal trials will be handled with disposable nitrile gloves or an inverted plastic bag to avoid leaving a scent on the carcasses and interfering with the scavenger removal trial (Arnett et al. 2009). Carcasses to be used for the carcass removal trials will be obtained from the same sources as described for the Searcher Efficiency Trials, as described in Section 4.4.

5.1.4 Reporting

The Monitor will prepare an interim monitoring/progress report within 3 months of the half way point for each year of monitoring, annual monitoring reports within three months of completing each year of post-construction monitoring, and will prepare a final three-year Monitoring Report within three months of completing three years of post-construction monitoring.

All monitoring reports, including all raw monitoring data upon which the reports are based, will be made available to members of the TAC. All monitoring reports will report adjusted and unadjusted annual fatalities for bats and all other bird species on a per-turbine and per megawatt basis. The fatality numbers will be adjusted to account for searcher efficiency and scavenger rates. The monitoring reports shall also summarize the results of the bird and bat behavior and use studies, the results of the searcher efficiency trials, and the results of the carcass removal trials, for the preceding one or three years, as applicable. The Monitor shall supplement the final three-year Monitoring Report with subsequent monitoring data collected.

5.1.5 Fatality Measures

The TAC, as applicable, shall review the final three-year Monitoring Report for the project to evaluate whether any turbines are causing significantly bird and/or bat fatalities relative to other turbines included within that particular portion of the project. If one or more turbines are causing significantly disproportionate bird or bat fatalities, then the TAC, as applicable, in consultation with the Parties, may recommend to the Planning Director of the BLM additional focused monitoring and/or management measures designed to reduce the fatalities attributable to those turbines; provided, however, that such measures shall not include relocation or permanent shutdown of any turbine. Notwithstanding the foregoing, the Parties acknowledge that fatality reduction or other measures may be required pursuant to applicable law inc1uding but not limited to the federal Endangered Species Act (16 U.S.C §§ 1530 *et seq.),* Bald and Golden Eagle Protection. Act (16 U.S.C. §§ 668-668d), Migratory Bird Treaty Act (16 U.S.C. §§ 703712) or the California Endangered Species Act {California Fish and Game Code, §§ 2050, *et seqJ.*

5.1.6 Wildlife Incident Reporting System

In addition to the three-year post-construction fatality monitoring study described above, OE LLC will implement a Wildlife Incident Reporting System (WIRS) at the start of operations and it will remain active for the life of the OWEF. The purpose of the WIRS is to standardize the actions taken by site personnel in response to wildlife incidents encountered in the OWEF and to fulfill the obligations for reporting wildlife incidents. The WIRS will be utilized by site operations and maintenance personnel who encounter dead or injured birds or bats incidentally while conducting general wind facility or transmission line maintenance activities. The WIRS is designed to provide a means of recording and collecting fatalities in the OWEF to increase the understanding of wind turbine and wildlife interactions. Additionally, any native bird or bat found injured within the OWEF will be taken to the nearest appropriate wildlife rehabilitation facility as directed in the WIRS. Any incident involving a State or Federally listed threatened or endangered species or a bald or golden eagle must be reported to the USFWS and CDFG within 24 hours of identification. OE LLC maintains an ongoing commitment to investigate wildlife incidents involving company facilities and to work cooperatively with federal and state agencies in an effort to prevent and mitigate future bird and wildlife fatalities. It is the responsibility of

OE LLC employees and subcontractors to report all avian incidents to their immediate supervisor.

5.2 Adaptive Management

The adaptive management techniques described in this section have been developed to ensure that potentially significant levels of mortality from operation of the OWEF are effectively mitigated.

This section describes the adaptive management process that will be applied for avian and bat species. Changes in federal, state, and/or BLM status for wildlife species occurring within the project area may result in the addition of, or changes to, adaptive management strategies, as determined by the BLM through TAC recommendations.

5.2.1 Adaptive Management Process

The TAC will meet to discuss mitigation needs if the TAC Lead determines a unique or significant event has occurred. The TAC will evaluate the results of the post-construction monitoring efforts including evaluation of any potential local population impacts. Cumulative impacts due to other developments in the region will be considered. At a minimum, the TAC will meet annually to review data and determine whether mitigation is necessary. If the TAC determines mitigation is necessary, the TAC will be responsible for identifying and recommending suitable mitigation(s). One or more ACP's may be applied for birds or bats if a unique or significant event occurs.

5.2.2 TAC Consultation Triggers

For this ABPP, species for which TAC consultation triggers have been designated are provided protection by federal and/or state ESA regulations (CESA 1984) which protect against unlawful take, BLM sensitive species and USFWS Birds of Conservation Concern (BCC) in Bird Conservation Region (BCR) 33, and all raptors. Changes in federal listing status or state status for avian and bat species occurring within the project area may result in the addition to, removal or reclassification of species for TAC consultation triggers. These triggers do not permit take under any legal protections but have been developed to ensure any potential population impacts to identified species are addressed. If TAC consultation triggers are exceeded, voluntary mitigation will be considered as described in Section 5.2.3 below. TAC consultation triggers for federal or state ESA listed species as well as BLM sensitive bats will not have searcher efficiency or scavenger rate correction factors applied.

The first step taken to identify TAC consultation triggers for BLM sensitive or BCC species and raptors was to estimate the 75th percentile of observed fatality rates at existing in the western US (Figures 4 and 5). References for fatality data from wind energy facilities in the western US is included in Table 10. Using the observed fatality rates in the western US, a probability density

function for regional bird (small and large birds), raptors, and bat fatality rates was generated using kernel density estimation (Parzen 1962). Kernel density estimation is a non-parametric data smoothing process used to interpolate population distributions from finite samples. Regional fatality data were log transformed to provide support across the all real numbers and then fit to a probability density function using R-statistical software (2011). The 75th percentile of the resulting density function was calculated and provides a population level estimate for fatality rates exceeding the upper quartile of observed data. The 75th percentile for small birds was estimated at 3.19 birds/MW/study period, 0.42 birds/MW/study period for large birds, 0.12 birds/MW/study period for raptors, and 2.41 bats/MW/study period for bats.

To calculate TAC consultation triggers for BLM sensitive and BCC species, the proportions of BLM sensitive and BCC species (birds [small and large] and bats) observed as fatalities out of all known fatalities at existing wind energy facilities in the western US were multiplied by the estimated 75th percentile for small birds (3.19 birds/MW/study period), large birds (0.42) or all bat (2.41) fatality rates (Tables 11 and 12). In the event that no BLM sensitive or BCC species were found in the fatality database for a given class (i.e., small birds, large birds, or bats), one observed fatality was assumed.

Table 10. References for fatality data from wind energy facilities in the western U.S.

Project, Location	Reference	Project, Location	Reference
Alite (10), CA	Chatfield et al. 2010	Hopkins Ridge, WA (08)	Young et al. 2009
Big Horn, WA	Kronner et al. 2008	Klondike, OR	Johnson et al. 2003
Biglow Canyon, OR (Phase I; 08)	Jeffrey et al. 2009a	Klondike II, OR	NWC and WEST 2007
Biglow Canyon, OR (Phase I; 09)	Enk et al. 2010	Klondike III, OR	Gritski et al. 2009a
Biglow Canyon, OR (Phase II; 09/10)	Enk et al. 2011	Klondike IIIa (Phase II), OR	Gritski et al. 2009b
Combine Hills, OR	Young et al. 2006	Leaning Juniper, OR	Kronner et al. 2007
Dillon, CA	Chatfield et al. 2009	Marengo I, WA (2009)	URS Corporation 2010b
Dry Lake, AZ	Thompson et al. 2011	Marengo II, WA (2009)	URS Corporation 2010c
Elkhorn, OR (2008)	Jeffrey et al. 2009b	Nine Canyon, WA	Erickson et al. 2003
Foote Creek Rim, WY (Phase I; 99)	Young et al. 2003	Pebble Springs, OR	Gritski and Kronner 2010b
Foote Creek Rim, WY (Phase I; 00)	Young et al. 2003	Pine Tree, CA	BioResource Consultants 2010
Foote Creek Rim, WY (Phase I; 01-02)	Young et al. 2003	Shiloh I, CA	Kerlinger et al. 2010
Goodnoe, WA	URS Corporation 2010a	Stateline, OR/WA (02)	Erickson et al. 2004
Hay Canyon, OR	Gritski and Kronner 2010a	Stateline, OR/WA (03)	Erickson et al. 2004
High Winds, CA (2004)	Kerlinger et al. 2006	Tuolumne (Windy Point I), WA	Enz and Bay 2010
High Winds, CA (2005)	Kerlinger et al. 2006	Vansycle, OR	Erickson et al. 2000
Hopkins Ridge, WA (2006)	Young et al. 2007	Wild Horse, WA	Erickson et al. 2008

Table 11. Three year Average TAC Consultation Triggers for Mortality among Avian Species.

TAC Consultation Trigger Categories	Trigger Value[1,2] Large Birds[3]	Small Birds[4]
Federal or State ESA listed species (refer to Appendix A) Golden eagle has a separate mitigation plan outlined in the Ocotillo ECP.	1	1
BLM sensitive or BCC bird species (e.g. refer to Appendix A).	Exceeds adjusted average of 0.03 per MW per year over 3 year period	Exceeds adjusted average of 0.02 per MW per year over 3 year period
Raptors	Exceeds adjusted average of 0.12 raptors per MW per year over a 3 year period	

[1] The triggers for federal or state ESA listed species are unadjusted.
[2] For BLM sensitive and BCC species triggers (excluding ESA listed species), fatality estimates will be determined by estimating the proportion of observed BLM sensitive or BCC species fatalities out of all observed fatalities and multiplying that proportion by the overall adjusted fatality estimate for the large or small category.
[3]For the purpose of this ABPP, large birds include any ESA listed (federal or state) and BLM sensitive or BCC species in the following bird types: waterbirds, waterfowl, rails and coots, gulls and terns, shorebirds, diurnal raptors, owls, vultures, upland game birds, doves/pigeons, large corvids (e.g., ravens, magpies, and crows), goatsuckers, kingfisher, and large woodpeckers (e.g., flickers).
[4] For the purpose of this ABPP, small birds include any ESA listed (federal or state) and BLM sensitive or BCC species in the following bird types: passerines (excluding large corvids, cuckoo, and woodpeckers), swifts/hummingbirds, some woodpeckers, and most cuckoos are considered small birds.

Table 12. Three year Average TAC Consultation Triggers for Mortality among Bat Species.

TAC Consultation Trigger Species	Trigger Value[1,2]
Species categorized as state or federally listed as threatened or endangered (none currently known to occur; refer to Appendix A)	1
BLM sensitive species (refer to Appendix A)	Greater than 1[1,3]

[1] The TAC consultation trigger for state or federally listed species and BLM sensitive bats are unadjusted.
[2] For the BLM sensitive species triggers, fatality estimates will be determined by estimating the proportion of observed sensitive species fatalities out of all observed fatalities and multiplying that proportion by the overall fatality estimate.
[3] No BLM sensitive bat species with potential for occurrence in Imperial county have been observed as fatalities in the western US and as such the approach used would result in less than one fatality at the OWEF over three years of monitoring. Due to the level of sensitivity associated with BLM sensitive species, the trigger level was modified to be greater than 1 individual during the three years of post construction monitoring.

5.2.3 Voluntary Conservation Measures

The determination of how to implement voluntary conservation measures will be determined in consultation with the TAC. A voluntary conservation measure may be applied each time a TAC

consultation trigger (shown in Table 11 or 12) is exceeded for either a bird or bat species, depending on recommendations from the TAC. Each time a TAC consultation trigger for that group (i.e., birds or bats) is exceeded an additional voluntary conservation measure may be implemented up to a fourth and final measure (e.g., if three voluntary conservation measures have been applied and TAC consultation triggers continue to be exceeded, at the decision of OE LLC, either a final voluntary habitat compensation payout may be made or OE LLC will work with the TAC to determine additional reasonable phases of voluntary conservation). The final voluntary conservation measure would be triggered the fourth time a bird TAC consultation trigger is met, the fourth time a bat TAC consultation trigger is met or a combination of four bird and bat TAC consultation triggers are exceeded. The final voluntary measure will be capped based on models that have been completed to ensure a commercially viable project. Examples of voluntary conservation measures that could be funded through this program include:

- Placement of visual and/or auditory bird flight diverters in critical locations determined based on evaluation of all post-construction monitoring data.
- If fossorial mammals are found burrowing near turbines, burrows may be filled and the turbine pad may be surrounded within gravel at least two inches deep.
- Installing perch guards on overhead electric lines in the vicinity of the OWEF if raptors are shown to regularly use the lines.
- Possibly cut-in speed adjustments during peak migration periods to reduce impacts to bats.
- Other direct, non-operational mitigation as recommended by the TAC.

6.0 CONCLUSION

This document was written to provide guidance for avoiding, minimizing, and monitoring potential impacts to avian and bat species prior to, during, and after construction of the OWEF. The measures described in this document are intended to help protect and reduce impacts to wildlife, as well as to monitor potential impacts to wildlife following implementation of the OWEF. It is anticipated that this ABPP will adaptively manage the OWEF based on findings following construction.

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Appendix A: Sensitive Species with the Potential to Occur in Imperial County, California.

Appendix A. Sensitive species protected under the Federal or California Endangered Species Act, species listed as sensitive by the Bureau of Land Management, and USFWS Birds of Conservation Concern that have potential to occur within Imperial County, California.

Common Name	Scientific Name	Status*	Habitat	Likelihood in Project Area
Birds				
Arizona bell's vireo	*Vireo bellii arizonae*	SE; BLM:S; BCC	Inhabits low, dense riparian growth along water or along dry parts of intermittent streams. Typically associated with willow, cottonwood, baccharis, wild blackberry, or mesquite in desert localities.	Unlikely due to the lack of riparian areas and wetlands
bald eagle	*Haliaeetus leucocephalus*	SE; BLM:S; BCC	Requires large bodies or free flowing rivers with adjacent perches. Roosts in dense, sheltered conifer stands.	Unlikely due to the lack of suitable habitat.
Bendire's thrasher	*Toxostoma bendirei*	BLM:S; BCC	Flat areas of desert shrub and Joshua tree habitats. Primarily occurs in San Bernardino and Kern Counties.	Unlikely to occur in the project area based on range maps.
black-chinned sparrow	*Spizella atrogularis*	BCC	Breeds and forages in open to moderately dense chaparral and similar brushy habitats; often on arid, south-facing slopes with ceanothus, manzanita, sagebrush, chamise.	Possible
black skimmer	*Rynchops niger*	BCC	Requires shallow, calm water for foraging, and sand bars, beaches, or dikes for roosting and nesting.	Unlikely due to the lack of suitable habitat
brown pelican	*Pelecanus occidentalis*	BLM:S	Rare to uncommon on the Salton Sea. Generally found in estuarine, marine subtidal, and marine pelagic waters.	Unlikely due to lack of suitable habitat.
burrowing owl	*Athene cunicularia*	BLM:S; SSC; BCC	Open, dry grassland and desert habitats, and in grass, forb, and open shrub stages of pinyon-juniper and ponderosa pine habitats; uses rodent or other burrow for roosting and nesting cover.	Known to occur in the OWEF.
California black rail	*Laterallus jamaicensis coturniculus*	ST; BLM:S; BCC	Dependent upon upper zones of saline emergent wetlands and brackish fresh emergent wetlands.	Unlikely due to the lack of riparian areas and wetlands
Costa's hummingbird	*Calypte costae*	BCC	Occurs primarily in arid scrub and chaparral habitats and in riparian edge.	Known to occur in the OWEF
elf owl	*Micrathene whitneyi*	SE; BLM:S; BCC	Occupies desert riparian habitat of moderate to open canopy, often with a moderate to sparse shrub understory, and typically bordering desert wash, desert scrub, or grassland habitats. Taller trees with a shrub understory seem to be required	Unlikely due to the lack of riparian areas and wetlands
Gila woodpecker	*Melanerpes uropygialis*	SE; BLM:S; BCC	Groves of riparian trees, planted shade trees, and date palm orchards; Formerly found in farm and ranchyards throughout the Imperial Valley, but most regularly now near Brawley.	Unlikely due to the lack of riparian areas and wetlands

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Common Name	Scientific Name	Status*	Habitat	Likelihood in Project Area
gilded flicker	*Colaptes chrysoides*	SE; BLM:S; BCC	Desert riparian woodlands and giant cactus forests with snags for nest cavities; trees, shrubs, nest, and roost cavities provide cover. Frequents riparian, desert wash, and other habitats with Joshua trees or saguaro cactus.	Occurs in the Colorado River Valley in southeastern California in desert riparian, desert wash, and Joshua tree habitats.
golden eagle**	*Aquila chrysaetos*	BLM:S	Typically utilizes rolling foothills, mountainous areas, sage-juniper flats, and desert habitat. Cliffs with overhanging ledges and large trees used for cover.	Known to occur in the project area
gray vireo	*Vireo vicinior*	BLM:S; BCC	Arid chaparral habitats in the mountains of southern California.	Unlikely to occur in the project area, but occurs in adjacent counties.
greater sandhill crane	*Grus canadensis tabida*	ST; BLM:S	Occurs near wet meadow, shallow lacustrine, and fresh emergent wetlands	Unlikely to occur due to the lack of suitable habitat.
gull-billed tern	*Gelochelidon nilotica*	BCC	Prefers sandy beaches for nesting, and forages over shallow waters, mudflats, grasslands, and croplands	Unlikely to occur due to lack of suitable habitat
Inyo California towhee	*Pipilo crissalis eremophilus*	FT; SE	Foothills and lowlands, as well as open chaparral and coastal scrub, brushland patches in open riparian habitat, hardwood, cropland, and urban. Edge species of densely vegetated habitats.	Unlikely to occur in the OWEF. Occurs only in the Argus Mountains of Inyo County.
Laurence's goldfinch	*Carduelis lawrencei*	BCC	Typical habitats include valley foothill hardwood, valley foothill hardwood-conifer, and, in southern California, desert riparian, palm oasis, pinyon-juniper, and lower montane habitats. Nearby herbaceous habitats often used for feeding.	Unlikely to occur due to lack of suitable habitat
least Bell's vireo	*Vireo bellii pusillus*	FE;SE; BCC	Early successional riparian areas, brushy fields, young forest or woodland, coastal chaparral and mesquite brushlands; often near water in arid regions.	Unlikely due to the lack of riparian areas and wetlands
least bittern	*Ixobrychus exilis*	BCC	Southern California common summer resident at Salton Sea and Colorado River, in dense emergent wetlands near sources of freshwater, and in desert riparian	Unlikely to occur due to lack of suitable habitat
long-billed curlew	*Numenius americanus*	BCC	Upland shortgrass prairies and wet meadows are used for nesting; coastal	Unlikely to occur due

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Common Name	Scientific Name	Status*	Habitat	Likelihood in Project Area
			estuaries, open grasslands, and croplands are used in winter.	to lack of suitable habitat
Lucy's warbler	*Oreothlypis luciae*	BLM:S; SSC; BCC	Frequents open to dense thickets of mesquite and other trees and shrubs in desert wash and desert riparian habitats.	An uncommon to common, summer resident and breeder along the Colorado River, fairly common locally in a few other desert areas, and rare near Salton Sea.
marbled godwit	*Limosa fedoa*	BCC	Estuaries, Common along CA coast, uncommon in interior, except at Salton Sea	Unlikely to occur due to lack of suitable habitat
mountain plover	*Charadrius montanus*	BLM:S; SSC; BCC	Winter resident found in foothill valleys west of San Joaquin Valley and Imperial Valley; frequents open plains with low, herbaceous or scattered shrub vegetation.	Some potential to occur in the project area.
peregrine falcon	*Falco peregrines*	BCC	Frequents bodies of water in open areas with cliffs and canyons nearby for cover and nesting.	Recorded incidentally within the OWEF. Although the OWEF generally lacks suitable habitat
prairie falcon	*Falco mexicanus*	BCC	Uses open terrain for foraging; nests in open terrain with canyons, cliffs, escarpments, and rock outcrops. Distributed from annual grasslands to alpine meadows, but associated primarily with perennial grasslands, savannahs, rangeland, some agricultural fields, and desert scrub areas.	Known to occur within the OWEF.
red knot	*Calidris canutus*	BCC	Coastal Estuaries	Unlikely due to lack of habitat
rufous-winged sparrow	*Peucaea carpalis*	BCC	South-central Arizona	Unlikely due to species range.
San Joaquin Le Conte's thrasher	*Toxostoma lecontei macmillanorum*	BLM:S; SSC; BCC	Frequents desert washes and flats with scattered shrubs and large areas of open, sandy, or alkaline terrain in desert wash, desert scrub, alkali desert scrub, and desert succulent shrub habitats.	Le Conte’s thrasher identified within the OWEF
snowy plover	*Charadrius nivosus*	BCC	Nests, feeds, and takes cover on sandy or gravelly beaches along the coast, on estuarine salt ponds, alkali lakes, and at the Salton Sea.	Unlikely due to the lack of suitable habitat
southwestern	*Empidonax traillii*	FE;SE	Requires dense riparian habitats for	Unlikely due to the

Appendix A. Sensitive species protected under the Federal or California Endangered Species Act, species listed as sensitive by the Bureau of Land Management, and USFWS Birds of Conservation Concern that have potential to occur within Imperial County, California.

Common Name	Scientific Name	Status*	Habitat	Likelihood in Project Area
willow flycatcher	*extimus*		nesting. Saturated soils, standing water, streams, pools required for breeding. Summer breeding in US only.	lack of wetlands in the OWEF
Swainson's hawk	*Buteo Swainsoni*	ST(B); BLM:S	Breeds in stands with few trees in juniper-sage flats, riparian areas, and in oak savannah and forages in adjacent grasslands or suitable grain or alfalfa fields, or livestock pastures. Mostly limited to spring and fall transient in southern California.	Breeding pairs unlikely to occur in the OWEF.
tricolored blackbird	*Agelaius tricolor*	BLMS; SCC	Breeds near fresh water, preferably in emergent wetlands with tall, dense cattail or tules. Feeds in grassland and cropland habitats.	Some potential to occur in the OWEF.
western yellow-billed cuckoo	*Coccyzus americanus occidentalis*	FC;SE; BCC	Inhabits extensive deciduous riparian thickets or forests with dense, low-level or understory foliage, which abut on slow-moving watercourses, backwaters, or seeps. Willow almost always a dominant component of the vegetation.	Unlikely due to the lack of riparian areas and wetlands
whimbrel	*Numenius phaeopus*	BCC	On the coast, forages on rocky intertidal and sandy beach marine habitats, on the intertidal mudflats of estuarine habitats, and on wet meadow and pasture habitats adjacent to the immediate coast. Occasionally forages on lawns or golf courses. Inland, prefers flooded fields, wet meadows, croplands and the margins of riverine and lacustrine habitats	Unlikely due to lack of suitable habitat
white-tailed kite	*Elanus leucurus*	BLM:S; FP	Uses herbaceous lowlands with variable tree growth and dense population of voles; Substantial groves of dense, broad-leafed deciduous trees used for nesting and roosting	Unlikely due to the lack of suitable habitat
yellow warbler	*Sonorana spp*	BCC	Winters in Imperial and Colorado river valleys. Frequents open to medium-density woodlands and forests with a heavy brush understory in breeding season. In migration, found in a variety of sparse to dense woodland and forest habitats.	Known to occur within the OWEF
Yuma clapper rail	*Rallus longirostris yumanensis*	FE;ST	Freshwater marshes dominated by cattail or bulrush that provide both vegetated and shallow open water areas	Unlikely due to the lack of wetland habitat
Bats				
California leaf-nosed bat	*Macrotus californicus*	SSC; BLM:S	Roosts in rocky, rugged terrain with mines and caves. Forages over nearby	Some potential to occur in the project

Appendix A. Sensitive species protected under the Federal or California Endangered Species Act, species listed as sensitive by the Bureau of Land Management, and USFWS Birds of Conservation Concern that have potential to occur within Imperial County, California.

Common Name	Scientific Name	Status*	Habitat	Likelihood in Project Area
			flats and washes; Habitats occupied include desert riparian, desert wash, desert scrub, desert succulent shrub, alkali desert scrub, and palm oasis. Can go extended periods of time (~6wks) without water.	area.
cave myotis	*Myotis velifer*	SSC; BLM:S	Feeds along riparian vegetation, over water, between patches of riparian vegetation, and to a lesser extent over open areas. Habitats occupied in California include desert scrub, desert succulent shrub, desert wash, and desert riparian. Water probably required; A colonial cave-dweller but temporary night roosts used.	Some potential to occur in the project area. However, less likely due to water requirements.
fringed myotis	*Myotis thysanodes*	BLM:S	Wide variety of habitats, with optimally habitat being pinyon-juniper, valley foothill hardwood and hardwood conifer. Roosts in caves, mines, buildings and crevices. Feeds over water, open habitats, and gleans foliage.	Unlikely to occur in the project area based on range maps.
long-eared myotis	*Myotis evotis*	BLM:S	Found in brush, woodland, and forest habitats, but prefers coniferous woodlands and forests. Avoids hot arid regions. Roosts in buildings, crevices, under bard, and in snags. Forages among trees, over water, and over shrubs.	Unlikely to occur in the project area based on range maps.
pallid bat	*Antrozous pallidus*	SSC; BLM:S	A wide variety of habitats, including grasslands, shrublands, woodlands, and forests from sea level up through mixed conifer forests. The species is most common in open, dry habitats with rocky areas for roosting.	Potential to occur in the project area.
spotted bat	*Euderma maculatum*	BLM:S; SSC	Habitats include arid deserts, grasslands and mixed conifer forests; prefers sites with roosting habitat. Feeds over water and along washes. May move from forests to lowlands in autumn.	Some potential to occur in the project area.
Townsend's big-eared bat	*Corynorhinus townsendii*	SSC; BLM:S	Prefers mesic habitats. Gleans from brush or trees or feeds along habitat edges.	Some potential to occur in the project area.

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Common Name	Scientific Name	Status*	Habitat	Likelihood in Project Area
western mastiff bat	*Eumops perotis californicus*	SSC; BLM:S	Most frequently encountered in broad open areas. Generally, this bat is found in a variety of habitats, from dry desert washes, flood plains, chaparral, oak woodland, open ponderosa pine forest, grassland, montane meadows, and agricultural areas.	Known to occur in the project area.
western small-footed myotis	*Myotis ciliolabrum*	BLM:S	Arid, upland habitats. It prefers open stands in forests and woodlands as well as brushy habitats. Streams, ponds, springs, and stock tanks are used for drinking and feeding. This species requires water	Unlikely due to the lack of wetland habitat
Yuma myotis	*Myotis yumanensis*	BLM:S	Distribution is closely tied to bodies of water, which it uses as foraging sites and sources of drinking water. Open forests and woodlands are optimal habitat.	Unlikely due to the lack of wetland habitat

*FE=federally endangered (USFWS 2008);
BLM:S=Bureau of Land Management sensitive species (BLM 2006);
SE=Endangered under the California Endangered Species Act (CDFG 2011);
ST=Threatened under the California Endangered Species Act (CDFG 2011);
ST(B)=Breeding population listed as threatened under the California Endangered Species Act (CDFG 2011);
SSC=California Species of Special Concern species by the California Department of Fish and Game (CDFG 2011).
BCC=USFWS Birds of Conservation Concern in Bird Conservation Region 33 (USFWS 2008)
Source of habitat information: All About Birds website
** discussed in detail in the Eagle Conservation Plan

Appendix B: Mortality Tracking Spreadsheets.

Bird Mortality

Location: _____
Turbine number
should add types of towers (e.g., lattice or tubular)

Date: _____
in a form appropriate for sorting in the database software (i.e., 021496)

Start time: _____
24-hour clock

Weather
Temperature: _____°C

Precipitation: _____
Record as N (none), L (light), M (moderate), H (heavy), F (fog)

Snow cover: _____% ground covered

Observer: _____
initials

Primary data

Species: _____
4-letter code

Sex: M or F; unknown

Age: _____
Adult, immature (be as specific as possible)

Dead: Y or N

Estimated time since death: _____
in days

Description of bird (e.g., broken or missing body parts): _____

Disposition of bird: _____

Distance of carcass from turbine: _____m

Notes on bird: _____
(e.g., condition and location)

MORTALITY/INJURY STUDY 1996
Field Data Sheet with Variables

(CEC 1/10/96)

Check1___ Comp____
Check2___ Map____
Spp. List___

CODE

_____ **Rec.#**: Record Number: sequential number starting with 001.(Will be assigned outside of field.)

_____ **Date**: Date bird discovered: month/day

_____ **Comp.**:Company/Area:
100 = Zond
110 = near Zond/Zond side of Cameron Rd.
120 = between TWS Rd.& Zond - West of Zond
200 = Cannon
210 = near Cannon/Cannon side of Cameron Rd
220 = area between Cannon & Sea West
300 = Sea West
310 = near Sea West
400 = FloWind

_____ **Trans#**: Transect Number or "0" for not applicable.

_____ **Subloc.**: Sublocation Number or "0" for not applicable.

_____ **Obs.**: Observer:
1 = Dick Anderson
2 = Natasha Neumann
3 = Jennifer Noone
4 = Judy Tom
5= Michele Disney
6= John Cleckler

_____ **Spp.**: Species: the 4-letter acronym for the species of bird found dead.

_____ **Age**:
1 = unknown 2 = immature 3 = adult

_____ **Sex**:
1 = unknown 2 = female 3 = male

_____ **Time**: Estimated time since death:
1 = undetermined
2 = fresh kill - < 2 days old
3 = few days - maggots starting to appear
4 = 1 week - maggots over entire body
5 = 2 week - flesh at least half gone
6 = 1 month - no flesh left, just bones and feathers
7 = over 6 months - bones and feathers disassembled
8 = bird alive - not applicable
9 = status unknown - not applicable

_____ **Cause**: Cause of Death or Injury
1 = unknown
2 = collission with turbine
3 = collission with wire
4 = electrocution
5 = other - explain in comments
6 = not applicable (ie.one feather)

* If bird/feather(s) found in association with a predator/scavenger den (ie. coyote, kit fox) or raptor nest, exclude from study. But be sure to include in an incidental observation report. Make sure to document in mort. rec. only if feather is of resident nester.

CODE

_____ **Certain.**: Degree of certainty for cause of death/injury.
1 2 3 4 5
low high
6 = not applicable

_____ **Cond.**: Condition (also describe in detail in comments)
1 = dead
2 = alive
3 = unknown - not applicable

_____ **Injur.**: Injuries (For both dead and alive birds)(Can include more than one code)
1 = no obvious signs
2 = wing sheared off
3 = head sheared off
4 = feet sheared off
5 = body sheared in half
6 = multiple dimemberment
7 = broken wing bone
8 = broken neck bone
9 = broken leg bone
10 = injury to wing
11 = injury to legs
12 = injury to eyes
13 = injury to body
14 = injury to head
15 = feather damage
16 = body and feathers intact
17 = feathers and body disassembled
18 = just feathers
19 = just bones
20 = just feathers and bones
23 = wing only
24 = electric burns on feet
25 = electric burns on wings
26 = internal injuries
27 = impact, then continued on
28 = stunned
29 = entangled in wires
30 = other - describe in comments
100 = unknown status - no indication of injury/mortality (ie.single feather; feather(s)of same species found within 1 sublocation.)
200 = unknown status of bird found outside of sublocation (ie. feather found only)
200 + code = injury of bird found outside of sublocation.

_____ **Collected**: Was the bird collected?
1 = collected
2 = not collected
3 = partially collected (ie.few feathers)

_____ **Mx.Dt.**: Maximum Distance(m)at which bird/bird part/feather could be observed: Refer to feather closest to turbine
1 = <0.5m
2 = 0.5m - 1m
3 = 1.1m - 5m
4 = 5.1m - 10m
5 = >10m

(MORE ON BACK)

RECORD OF DEAD BIRDS - SCAVENGING STUDY # ____ 1996

Date: _____ Obs: _____ [chicken spp. not included in this list] *(CEC 12/12/95)*

Size: 1 = small (ie. sparrow); 2 = medium (ie. dove, kestral); 3 = large (ie.raven, hawk,) Cond(ition): 1 = fresh; 2 = old

Band#	Spp.	Size	Cond.	Band#	Spp.	Size	Cond.	Band#	Spp.	Size	Cond.

____ scavenging study #

SCAVENGING STUDY 1996

Company/Area _____ (c)___ OBS _____ (c)___ pg — of —

check 1 ☐
smp ☐
check 2 ☐

Date																					
Time	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	am	pm	
Temp.																					
Wind																					
Cloud																					
Precip.																					
Fog																					
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OBSERVER BIAS STUDY
1996

DATE:_____ / _____ OSERVER:_____ (c) ____

NCom. Type:_____ (c) _____ SITE #:_____

ORDER: 1st 2nd 3rd

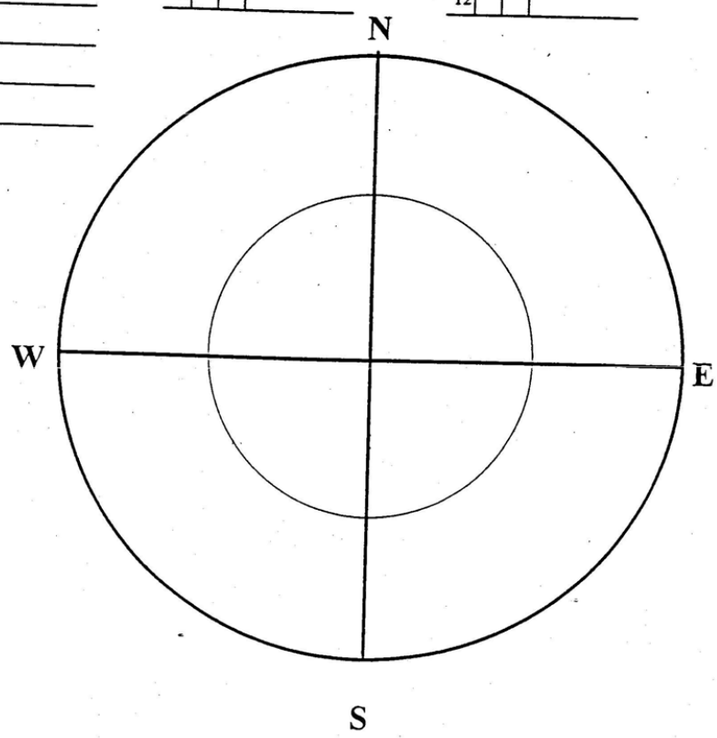
COMPANY:_____ (c) _____ TIME: Start _____ End _____

Bird Mortality Sign Description (small = ≤ 8 in.; large = > 8 in.)
Distance at which sign was first observed

	sm	lg	dist.
1.			
2.			
3.			
4.			
5.			
6.			

	sm	lg	dist.
7.			
8.			
9.			

	sm	lg	dist.
10			
11			
12			



Appendix C
Listed Species and/or Their Critical Habitat Likely to Occur within Oak Woodland Savannah and Mohave Desert Habitats, and Potential Impacts

TABLE C-1

Listed Species and/or Their Critical Habitat Likely to Occur within Oak Woodland Savannah Habitats

Type/Species	Status	Has Critical Habitat	
Amphibians			
California red-legged frog (*Rana draytonii*) Population: Entire	Threatened	species info	Final designated critical habitat
Birds			
California condor (*Gymnogyps californianus*) Population: Entire, except where listed as an experimental population	Endangered	species info	Final designated critical habitat
Least Bell's vireo (*Vireo bellii pusillus*) Population: Entire	Endangered	species info	Final designated critical habitat
Southwestern Willow flycatcher (*Empidonax traillii extimus*) Population: Entire	Endangered	species info	Final designated critical habitat
Flowering Plants			
Purple amole (*Chlorogalum purpureum*)	Threatened	species info	Final designated critical habitat
Mammals			
San Joaquin Kit fox (*Vulpes macrotis mutica*) Population: U.S.A(CA)	Endangered	species info	

TABLE C-2

Listed Species and/or Their Critical Habitat Likely to Occur in Mohave Desert Habitats

Type/Species	Status		Has Critical Habitat
Mammals			
Amargosa Vole (*Microtus californicus scirpensis*) Population: Entire	Endangered	species info	Final designated critical habitat
Peninsular Bighorn Sheep (Ovis candensis nelson) Population: Entire	Endangered	species info	
San Joaquin Kit Fox (*Vulpes macrotis mutica*) Population: Entire	Endangered	species info	
Birds			
California condor (*Gymnogyps californianus*) Population: Entire, except where listed as an experimental population	Endangered	species info	Final designated critical habitat
Inyo California Towhee (*Pipilo crissalis eremophilus*) Population: Entire	Threatened	species info	Final designated critical habitat
Least Bell's vireo (*Vireo bellii pusillus*) Population: Entire	Endangered	species info	Final designated critical habitat
Southwestern Willow flycatcher (*Empidonax traillii extimus*) Population: Entire	Endangered	species info	Final designated critical habitat
Yuma Clapper Rail (*Rallus longirostris yumanensis*) Population: Entire	Endangered	species info	
Reptiles and Amphibians			
Desert Tortoise (*Gopherus agassizii*) Population: Entire	Threatened	species info	Final designated critical habitat
Arroyo (=arroyo Southwestern) Toad (*Anaxyrus californicus*) Population: Entire	Endangered	species info	Final designated critical habitat
Insects			
Casey's June Beetle (*Dinacoma caseyi*) Population: Entire	Endangered	species info	Final designated critical habitat
Flowering Plants			
Amargosa Niterwort (*Nitrophila mohavensis*) Population: Entire	Endangered	species info	Final designated critical habitat

Type/Species	Status		Has Critical Habitat
Ash-grey Paintbrush (*Castilleja cinerea*) Population: Entire	Threatened	species info	Final designated critical habitat
Bakersfield Cactus (*Opuntia treleasei*) Population: Entire	Threatened	species info	
Lane Mountain Milk-vetch (*Astragalus jaegerianus*) Population: Entire	Endangered	species info	Final designated critical habitat
San Joaquin Adobe Sunburst (*Pseudobahia peirsonii*)	Threatened	species info	

TABLE C-3

Potential Impacts of Power Pole Retrofit Work to ESA Listed Species and/or Their Critical Habitat Likely to Occur within the Mojave Desert and Oak Woodland Savannah Habitats.

Type/Species	Habitat	Potential Impacts from Power Pole Retrofit Work
Amphibians		
California red-legged frog (*Rana draytonii*) Threatened	Oak Woodland Savannah	Potential direct impacts from construction vehicles during construction; no impacts anticipated once retrofits complete
Birds		
California condor (*Gymnogyps californianus*) Endangered	Oak Woodland Savannah; Mojave Desert	Potential beneficial impacts by reducing electrocution risk at the retrofit poles
Inyo California Towhee (*Pipilo crissalis eremophilus*) Threatened	Mojave Desert	Potential impacts on productivity success if work is conducted in breeding season; no impacts anticipated once retrofits complete
Least Bell's vireo (*Vireo bellii pusillus*) Endangered	Oak Woodland Savannah; Mojave Desert	Potential impacts on productivity success if work is conducted in breeding season; no impacts anticipated once retrofits complete
Southwestern Willow flycatcher (*Empidonax traillii extimus*) Endangered	Oak Woodland Savannah; Mojave Desert	Potential impacts on productivity success if work is conducted in breeding season; no impacts anticipated once retrofits complete
Yuma Clapper Rail (*Rallus longirostris yumanensis*) Endangered	Mojave Desert	Potential impacts on productivity success if work is conducted in breeding season; no impacts anticipated once retrofits complete
Flowering Plants		
Purple amole (*Chlorogalum purpureum*) Threatened	Oak Woodland Savannah	Potential direct impacts if construction vehicles drive off established roads/trails ; no impacts anticipated once retrofits complete
Insects		
Casey's June Beetle (*Dinacoma caseyi*) Endangered	Mojave Desert	Potential direct impacts from construction vehicles during construction; no impacts anticipated once retrofits complete
Mammals		
Amargosa Vole (*Microtus californicus scirpensis*) Endangered	Mojave Desert	Potential direct impacts from construction vehicles during construction; no impacts anticipated once retrofits complete
Peninsular Bighorn Sheep (Ovis candensis nelson) Endangered	Mojave Desert	Potential impacts on productivity success if work is conducted in breeding season ; no impacts anticipated once retrofits complete
San Joaquin Kit fox (*Vulpes macrotis mutica*) Endangered	Oak Woodland Savannah; Mojave Desert	Potential impacts on productivity success if work is conducted in breeding season ; no impacts anticipated once retrofits complete

Attachment 2
Response to Comments on Draft Environmental Assessment

Comments and Response to Comments Summary

We invited public comment on the Draft Environmental Assessment (DEA). In response, we received four submissions: one from the applicant, two from nongovernmental organizations (NGOs), and one from a Native American tribe. One NGO comment letter combined comments from three different environmental groups: Defenders of Wildlife, the Natural Resources Defense Council, and the San Diego Audubon Society/National Audubon Society. Our responses to the comments on the EA are presented in this attachment (Attachment 2) of the FONSI.

In total, the comment letters contained approximately 30 individual comments. These comments generally fell under one of five main categories: (1) effects (addressing a variety of issues relating to eagles, including number of fatalities, local population effects, cumulative effects, other sources of fatalities, overall population numbers, and effects on raptors); (2) conservation plan (addressing the technical advisory committee, transparency of the process, future technology, and curtailment); (3) mitigation (addressing scientific basis for electric utility retrofits and location of retrofits); (4) monitoring and reporting (addressing project reporting and eagle mortality reporting); and (5) general comments.

Overall, the comments raised issues regarding the opportunities and challenges associated with issuing eagle take permits. We made minor changes to three topic areas of the EA based on these comments. First, we added information on our risk evaluation under the curtailment program. Second, we added more detailed information on the science behind the electric utility pole retrofit process for mitigation and added an explanation for why a range was provided for the number of retrofits needed. Lastly, we added information about depositing funds into our NFWF Eagle Mitigation Account. We made additional minor changes to the EA to improve clarity. After considering the comments, and in light of the record, we determined that neither substantial revisions nor a new analysis are required for the EA.

Detailed responses to specific comments are provided in attached Table 1. Comment letters follow Table 1.

Table 1: Response to Comments

Table 1: Ocotillo Wind Energy Facility Eagle Conservation Plan Environmental Assessment Response to Comments

Organization Type/Commenter Name	Comment #	Summary of Comment	Response
Applicant	**Applicant**		
Ocotillo Express, LLC	1-1	Recommends that footnote in Table 2-2 be revised to be consistent with language on page 2-2 of EA(description of Alternative 2) discussing what would happen if grant holder should not reapply for a permit at end of 5 year term.	Confirmed; footer language in Table 2-2 has been updated to be consistent with the process described on page 2-2.
	1-2	Notes that number of poles to be retrofitted should be "up to 74" consistent with rest of references (p 4-6 in Section 4.6.2 of the EA).	Noted; correction made in the EA.
	1-3	Comment in Section 4.6.2 of EA – commenter states that because only 10 hours of curtailment have happened since December 2012, that data on raptor risk in general collected at the Project should be sufficient to characterize risk to raptors; suggests that this risk should be characterized as low.	At this time, US Fish and Wildlife Service (Service) has no method for estimating risk of raptor mortality or injury from curtailment. Curtailment is a conservation measure to reduce mortality and depends on observer diligence. Observers can either over or under curtail based on their diligence and observer skills. There is a margin for error that would be difficult to quantify. Also, the observer was based in tower with limited or reduced visibility for wind turbines further from the tower. Visibility would vary with weather conditions and time of day, which would also be difficult to quantify. Risk for eagles from the project was estimated in the Eagle Conservation Plan (ECP) in accordance with Service approved methods (EA Appendix A).

Organization Type/Commenter Name	Comment #	Summary of Comment	Response
	1-4	Suggests that Alternative 3 recognize the possibility that the USFWS, BLM and Ocotillo would determine that the Project's risk of eagle take is sufficiently unlikely that continued biomonitoring and curtailment is not necessary to manage eagle risk.	This comment is noted and will be retained in our administrative record. The EA analyzes a range of alternatives and the outcome of an eagle take permit application considered under Alternative 3 was one component of possible reasonable alternatives. As shown in Sections 4.2 and 4.3.1 of the EA, the Service has analyzed potential risk to golden eagles at the facility, and estimates that two golden eagles may be taken within every 5 year period.
	1-5	Suggests that monitoring requirements for Alternative 4 (30-year term) be revised to say something like "1 additional year of eagle specific monitoring during the first 4 years of the permit and periodic monitoring at agreed-to intervals for the remainder of the permit term."	This comment is noted and will be retained in our administrative record.
	1-6	Suggests that additional utilities beyond PG&E and SCE be considered for providing retrofits	Section 2.3.2 of the EA has been updated to state that in accordance with our most recent analysis of golden eagle populations (Service 2016), compensatory mitigation would occur within the appropriate eagle management unit (EMU). For this area, the EMU is the Pacific Flyway. The applicant would be required to either deposit money in our eagle NFWF account or purchase credits from a Service approved in lieu fee mitigation bank within 30 days of permit issuance.
	1-7	Suggests that 10% threshold discussion in cumulative effects analysis should only apply to Alternative 4 (30 year term), and that because the other alternatives are dealing with application under 2009 permit rule, only 5% threshold applies, and that this should be clarified in the EA.	We evaluate all alternatives using the best available information and the latest policy as laid out in the 2016 PEIS. Regardless, analysis indicates that estimated take is under both the 5% and the 10% thresholds for all alternatives, including Alternative 2 (chosen alternative).

Organization Type/Commenter Name	Comment #	Summary of Comment	Response
Nongovernmental Organization	**ORG**		
Center for Biological Diversity	1-1	Unclear why considered permitted take of golden eagles in 5 year period is rounded up instead of more conservative approach of rounding down.	The Service cannot permit the take of partial eagles. In this case, rounding up is the more conservative approach because it requires more mitigation and therefore provides more protection for golden eagles.
	1-2	Because eagle “take” permits are still relatively new, the eagle “take” permits should be given for no longer than 5 years at this point.	Comment noted.
	1-3	Additional avoidance and minimization measures should be included in permit, including: seasonal curtailment during eagle high use periods, and after local nests fledge; acquisition of local eagle nesting/foraging habitat; identification of eagle migration corridors and establishment of turbine free zones to ensure that a "wall" of turbines is not created	Eagle use and migration corridors were assessed for the Project, as summarized in Section 3.3.2 of the EA and in detail in Section 2.3 of the ECP (EA Appendix A). The Ocotillo Wind Energy Facility is not located in a known raptor migration corridor, and the site does not contain the appropriate topography to funnel migrating birds through the site. Golden eagle use at the site has not been high enough to warrant seasonal curtailment of turbines. Designation of turbine-free zones in the general region are beyond the scope of this specific Project/EA. However, it should be noted that the Ocotillo Wind Energy Facility is located east of the Jacumba Mountains and south of the Coyote Mountains, both of which are BLM-designated wilderness areas and are thereby de facto turbine-free zones. The DRECP can be found at: https://www.drecp.org/

Organization Type/Commenter Name	Comment #	Summary of Comment	Response
	1-4	DEA is not clear enough on details on mortality monitoring methodology and frequency	Details on the eagle mortality monitoring methodology and frequency are described in the Ocotillo ECP (EA Appendix A section 5.2). Under the ROW agreement, the first two years of mortality monitoring included 30% of the turbines being searched twice per month. For the third year of mortality monitoring, under the ROW agreement, the same subset of 30% of the turbines will be searched twice monthly. Additionally, eagle-specific searches will be conducted at the remaining 79 turbines; these eagle-specific searches will be conducted once a month by walking transects spaced up to 20 m apart, in search plots 160- m by 160-m in size. This protocol was developed in coordination with the Service to meet our requirements.
	1-5	Unclear if TAC will continue to be part of eagle take permit; CBD recommends extending membership to local golden eagle experts outside of agency staff. TAC meetings should be publicly noticed, open to public and minutes should be provided to public within a month of meetings.	The TAC is a BLM advisory committee only and may invite experts to attend at its discretion. The Service does not have the authority to establish a technical advisory committee and must ensure that the Service's actions do not violate the provisions of the Federal Advisory Committee Act, which specifies the terms under which federal agencies can establish, utilize, and participate in multi-stakeholder groups. Our National Eagle Programmatic Permit Implementation Team (EPPIT) will be involved in permit oversight and decision-making as appropriate. The EPPIT is composed of eagle permit coordinators and raptor biologists from each of our nine Service Regions. This team includes topical experts and scientists from the Service and the USGS as needed. The Service's Pacific Southwest Region will consider recommendations from the EPPIT, although we retain all decision-making authority over this permit and its adaptive management process. Updates will be provided to the public via our Pacific Southwest Region Eagle Page website: http://www.fws.gov/cno/conservation/MigratoryBirds/EaglePermits.html

Organization Type/Commenter Name	Comment #	Summary of Comment	Response
	1-6	EA needs to state where retrofits will take place.	This response is similar to Applicant comment 1-6 above due to similar issues being raised. Compensatory mitigation of retrofitting within the Pacific Flyway is consistent with the chosen alternative outlined in the 2016 PEIS. We consider local area population effects within the species-specific natal dispersal distances, which is 109 miles for golden eagles. Thus, the applicant will work with the Service and with a utility to identify a location within that distance that is considered a high-priority for retrofits due to documented previous fatalities and nearby eagle population densities, and which has the number of poles needed. We believe that the Service and the Applicant will choose a site that best meets these requirements.
	1-7	Recommends that Imperial Irrigation District and SDG&E are closest utilities and therefore should be used for retrofits, to benefit local golden eagle populations	Comment is noted; see responses to Applicant comment 1-6 and ORG comment 1-5 above.
	1-8	EA should more clearly explain where ratio of 1.2:1 comes from for power pole retrofits, and also explain why there is a "range" of potential number of poles	The 2016 PEIS confirmed the Service's assessment of status and population size in 2009 for golden eagles, and established compensatory mitigation requirements for the authorized take of golden eagles. The ratio of 1.2:1 is established in the 2016 PEIS and is consistent with the goal of maintaining stable or increasing breeding populations in all eagle management units, and the persistence of local populations throughout the geographic range of each species. Regarding the range of number poles that is provided in the EA, our REA indicates that a minimum of 32 utility pole retrofits will offset direct impacts to eagles resulting from Project operations, if the retrofits are installed and properly maintained for 30 years. In order to account for possibility that the retrofit materials may not be maintained properly for 30 years, we also calculated how many poles would be required to offset the take assuming the retrofit poles would be maintained for only 10 years; this would require 74 poles (maintained for 10 years) to sufficiently offset direct impacts to eagles. We have added this explanation to Section 2.3.2 of the EA for clarification.

Organization Type/Commenter Name	Comment #	Summary of Comment	Response
	1-9	Additional mitigation should be included, including decommissioning problem turbines, off-site acquisition of habitat/conservation easements, and/or undergrounding transmission lines in areas of eagle mortalities	Comment is noted and will be retained in our administrative record. We will continue to encourage and coordinate needed research on other sources of eagle mortality which could be mitigated to offset take. Other options for compensatory mitigation might include a lead abatement program, a carcass removal program along highways, or funding mitigation banking efforts. However, a resource equivalency analysis would first need to be developed for any alternative compensatory mitigation options, to demonstrate that the amount of anticipated eagle take from the Project would be fully offset by the alternative mitigation measures. Service would not accept any alternative compensatory mitigation options until a credible analysis was completed and accepted. Service is evaluating other forms of compensatory mitigation to combat the lesser known forms of anthropogenic mortality but retrofits are currently the only Service-approved mitigation for eagle take.
Defenders of Wildlife, Natural Resources Defense Council, and Audubon Society	2-1	Concern with overall slow processing of eagle take permit applications, which could discourage proponents from seeking permits	This comment is noted and will be retained in our administrative record.
	2-2	States that potential increased risk to eagles from eliminating the bio-curtailment program is adequately addressed in DEA	This comment is noted and will be retained in our administrative record.
	2-3	Recommend that additional utilities beyond PG&E and SCE be considered for utilities to install retrofits - recommend Imperial Irrigation District be considered	Comment is noted; see responses to Applicant comment 1-6 and ORG comment 1-5 above.

Organization Type/Commenter Name	Comment #	Summary of Comment	Response
	2-4	Recommend that Service along with other agencies, address need to conserve golden eagles within this region through a long-term programmatic eagle conservation and mortality mitigation strategy	This comment is noted; the development of a long-term programmatic eagle conservation and mortality mitigation strategy to conserve golden eagles within this region is beyond the scope of this analysis. However, the Service is charged with protecting eagle populations and we will use our authority to ensure monitoring, mitigation, and adaptive management prescriptions are protective of eagle populations. We will keep the public informed through our Pacific Southwest Region's Eagle Page website: http://www. fws.gov/cno/conservation/MigratoryBirds/EaglePermits.html
	2-5	Support Alternative 2, with additional recommendations for inclusion	This comment is noted and will be retained in our administrative record.
	2-6	Recommend that wind developers like Pattern who implement new technologies should be given credit for eagle mortality successfully avoided in the calculation of take limits and mitigation requirements, and additionally specific language in permit should allow consideration of alternate technologies if they become available	This comment is noted and will be retained in our administrative record. The Adaptive Management approach outlined in Table 15 of the ECP does consider implementation of Advanced Conservation Practices, which could include the use of new technologies if they become available.
	2-7	Recommend validating the monitoring technology fully and provide it as an option for future permits; additionally, recommend standardizing numbers to define what would constitute "relatively few" eagles in comparison to other projects in same region	This comment is noted and will be retained in our administrative record.
	2-8	Final EA should explain how FAA lighting change will affect golden eagles or large raptors	Reducing the occurrence of flashing lights, which would only flash when aircraft are in the vicinity of the Project, is expected to have a generally beneficial effect to visual resources in general, as described in Section 4.4.1 of the EA. Eagles and other large raptors are not typically nocturnal, and therefore will not be affected by the lighting change.

Organization Type/Commenter Name	Comment #	Summary of Comment	Response
	2-9	Recommend that contract or provisions of funds to NFWF will obligate NFWF to contact utility and schedule retrofits within a specified time period	This comment is noted and will be retained in our administrative record. .–As noted in Section2.3.2, we will require that the Applicant deposit the initial mitigation amount in the NFWF Eagle Mitigation Account within 30 days of permit issuance. While the NFWF would start coordinating with the utility(ies) as soon as possible after the funds are received, the overall coordination time for identification of high risk poles, ordering of equipment, installation and other logistics is anticipated to take approximately two years. EA updated, see Section 2.3.1.
	2-10	Recommend Service provide a formula for calculating unreported take in order to more thoroughly account for this unknown	Comment is noted and will be retained in our administrative record. This request is beyond the scope of this EA analysis. The 2016 PEIS evaluation of unreported take discusses a myriad of threats including poaching, lead poisoning, climate change, loss and fragmentation of eagle habitat, powerlines, and disease. Cumulative factors are likely contributing to ongoing declines of golden eagles. Currently, the level of golden eagle take throughout the US due to anthropogenic sources exceeds the sustainable threshold and therefore no additional unmitigated mortality is permitted (81 FR 242). It is difficult, at best, to assess the impacts of cumulative risk factors, particularly when take is unreported. Regardless, for golden eagles compensatory mitigation is required for any permitted take, which supports the conservation of golden eagles.
	2-11	States that data in ABPP is sufficient to determine a baseline risk level to raptors at Project, and are concerned that removal of the radar, video and biologists will increase mortality of large raptors and others protected by MBTA, and that these impacts should be addressed in the EA	Comment is noted and will be retained in our administrative record. Baseline risk level to golden eagle was calculated based on pre-construction surveys and used to estimate take levels for permit issuance as discussed in the ECP in accordance with Service approved methods (EA Appendix A). Risk to eagles and other raptors from the project using the current curtailment system is difficult to calculate as discussed previously.

Organization Type/Commenter Name	Comment #	Summary of Comment	Response
	2-12	Supports providing an eagle take permit given relatively low risk to eagles and adequate adaptive management program; eagle mortality monitoring should continue to support the AM aspect.	This comment is noted and will be retained in our administrative record.
	2-13	Recommend that Service develop a golden eagle conservation plan for San Diego County at the earliest opportunity, in cooperation with CDFW and local agencies	Comment is noted; response is similar to ORG comment 2-4 above. The development of a golden eagle conservation plan for San Diego County is beyond the scope of this analysis. Additionally, the Ocotillo Wind Energy Facility is in Imperial County, CA. However, the Service is charged with protecting eagle populations and we will use our authority to ensure monitoring, mitigation, and adaptive management prescriptions are protective of eagle populations. We will keep the public informed through our Pacific Southwest Region's Eagle Page website: http://www.fws.gov/cno/conservation/MigratoryBirds/EaglePermits.html
Native American Tribe	**Tribe**		
Augustine Band of Cahuilla Indians	1-1	The Augustine Band of Cahuilla Indians is unaware of specific cultural resources that may be affected by the proposed Project, but recommends that tribal monitors be on site during pre-construction and construction phases, and requests the Service notify them immediately should any cultural resources be discovered during the development of the Project.	This comment is noted and will be retained in our administrative record. The federal action reviewed under this EA will not result in any ground disturbing activities; however, cultural resources would be respected during any Project activities. Section 1.8 of the EA provides a detailed description of the Tribal Consultation that has occurred as part of this federal action.

Comment Letters

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November 26, 2018

Heather Beeler
Migratory Bird Program
U.S. Fish and Wildlife Service
Pacific Southwest Region
2800 Cottage Way, W-2605
Sacramento, CA 95825

Re:Ocotillo Wind Energy Facility DEA Comments

Dear Heather:

Thank you for the opportunity to comment on the U.S. Fish and Wildlife Service ("Service") Draft Environmental Assessment ("DEA") of the Ocotillo Wind Energy Facility Eagle Conservation Plan ("ECP"). Pattern Energy Group, Inc., on behalf of Ocotillo Express LLC ("Ocotillo") would also like to thank the Service for its assistance in developing the ECP to support Ocotillo's eagle take permit application. The DEA provides a thorough assessment of the impacts to the human environment that may arise from the Service's issuance of the eagle take permit and the Bureau of Land Management's ("BLM") amendment of the right-of-way in accordance with the National Environmental Policy Act. Ocotillo offers a few clarifying and conforming suggestions for the DEA.

- **Alternative 2 - biomonitoring**. In section 2.2.2, the DEA accurately describes the process that would follow upon expiration of the five-year permit term. On page 2-2, the DEA says that:

  > [a]t the end of the 5-year permit term, the BLM would require coordination between the applicant, the Service, and the BLM to determine if a subsequent eagle take permit process would be initiated. Should the grant holder (holder) not reapply for a permit, BLM would coordinate with the Service and the applicant to consider resuming the requirement for a daytime biological monitoring and curtailment, or to consider if alternate eagle take avoidance and minimization measures and/or additional mortality monitoring would be appropriate.

  Ocotillo agrees this is the appropriate response at the conclusion of the permit term. However, footnote "***" in Table 2-2 on page 2-11 briefly describes Alternative 2 and states: "should the grant holder not reapply for a permit, day time biological monitoring and curtailment would resume." This footnote describes Alternative 2, but is inconsistent with the language quoted above and should be revised to be consistent with the above.

- **Alternative 2 — Number of power poles to be retrofitted**. In section 4.6.2 on page 4-6, it states that up to 62 power poles will be retrofitted. This number should be updated to be 74, consistent with the rest of the references in the DEA.

- **Alternative 2 — Effects on migratory birds**. In section 4.6.2, the DEA describes the effect that Alternative 2 would have on migratory birds. It states:

  > Because the eagle risk minimization system has been in place since operations and during both years of post-construction mortality monitoring that have occurred to date, we do not have the data necessary to determine if the relatively low raptor fatality rates are due to the curtailment system or simply a low level of baseline risk to raptors in the area.

  This statement is inaccurate. Since December of 2012, biomonitoring curtailments have occurred for less than a total of 10 hours. Given that amount of curtailment to date has been extremely low, the curtailment system has not impacted Project data on raptors such that risk could not be assessed based on available data. The DEA should be revised to accurately characterize the risk to raptors as low.

- **Alternative 3 - Biomonitoring**. In section 2.2.3, on page 2-3, the DEA describes a scenario where the Service denies Ocotillo's eagle take permit application, but BLM proceeds with amending the right-of-way. In this scenario, the DEA states that:

  > The wind Project would continue to operate without a take permit being issued. Under this alternative, the BLM would require that unless or until an eagle take permit is obtained, that the applicant would continue full time bio-monitoring and associated curtailment during daylight hours.

  Ocotillo recommends that this alternative recognize the possibility that the Service, BLM, and Ocotillo determine the Project's risk of eagle take is sufficiently unlikely that continued biomonitoring and curtailment is not necessary to manage eagle risk. From early December of 2012 through November 15, 2018, the biological monitors spent approximately 25,850 hours conducting biomonitoring, during that time only 17 eagle curtailments were implemented, for a total of 8.87 hours, out of over 25,000 hours. This means that eagles have been identified in the project area less than 0.0004% of the daylight hours in which they are active. No eagle fatalities have occurred. If the Service incorporates this recommendation, please note that this language appears again in Table 2-2 and in section 4.6.3 on page 4-7 and conforming edits should be made throughout.

- **Alternative 4 — Eagle mortality monitoring**. In table 2-2, the Service describes eagle mortality monitoring for a thirty-year eagle take permit option as: "1 additional year of eagle-specific monitoring during the first 4 years of the permit; 2 years eagle specific monitoring year 6-10 of the permit; 1-2 years of eagle specific monitoring every following 5-year term as determined necessary by the Service." It is possible that an eagle mortality monitoring program for a thirty-year eagle take permit may ultimately end up as

described in Table 2-2. However, because Ocotillo has focused on proposed Alternative 2, it has not had extensive discussions with the Service regarding a thirty-year eagle mortality monitoring program. Ocotillo suggests that this column of table 2-2 be revised to more accurately reflect the nature of conversations to date with the Service such as "1 additional year of eagle specific monitoring during the first 4 years of the permit and periodic monitoring at agreed-to intervals for the remainder of the permit term."

- **Power pole retrofit providers**: Ocotillo, pursuant to its ECP, will commit to providing power pole retrofits as compensatory mitigation for predicted eagle take. The Service, on page 2-7, has identified Southern California Edison ("SCE") and Pacific Gas and Electric (PG&E") as primary candidates for these power pole retrofits. Ocotillo recommends that the Service edit this language on page 2-7 to acknowledge that other electric transmission and distribution providers may also be appropriate for fulfilling Ocotillo's power pole retrofit obligation. Singling out SCE and PG&E is advertently limiting before Ocotillo has finalized the power pole retrofitting details.

- **Local Area Population analysis**. Section 4.3.4 describes the cumulative effects analysis common to all alternatives. In this discussion, the DEA evaluates whether unauthorized take exceeds 10% of the local area population. This 10% analysis should apply to Alternative 4 only. The Eagle Conservation Plan Guidance speaks only to the 5% local area population threshold, and the Service introduced the 10% unauthorized take analysis in the 2016 amendments to the eagle permit rule. Since alternative 2 entails the issuance of an eagle take permit under the 2009 eagle permit rule, the 10% analysis would not apply to that alternative. This should be clarified in the DEA.

Ocotillo appreciates the Service's time and effort spent processing our eagle take permit application. Should the Service have any questions regarding the above suggestions, please do not hesitate to contact me.

Sincerely,

Rene Braud
Director, Environmental Policy & Compliance

CENTER *for* BIOLOGICAL DIVERSITY
Because life is good.

Protecting and restoring natural ecosystems and imperiled species through
Science, education, policy, and environmental law

Via email

November 26, 2018

Heather Beeler, Migratory Bird Program,
U.S. Fish and Wildlife Service,
Pacific Southwest Regional Office,
2800 Cottage Way, W–2605,
Sacramento, CA 95825
fw8_eaglepermits@fws.gov

RE: Ocotillo Wind Energy Facility DEA Comments

Dear Ms. Beehler,

On behalf of the one million staff, members and supporters of the Center for Biological Diversity (Center), we submit the following comments on the Draft Environmental Assessment (DEA) for Ocotillo Wind's Eagle Conservation Plan. The Center strongly supports the development of renewable energy as a critical component of efforts to reduce greenhouse gas emissions, avoid the worst consequences of global warming, and to assist in achieving needed emission reductions. The development of renewable energy production and the generation of electricity from wind power in an important part of those efforts. However, like all projects, wind power projects should be thoughtfully planned and implemented to minimize impacts to the environment. In particular, the Ocotillo wind energy facility should seek to avoid operational impacts to sensitive species such as golden eagles and their habitat. Only by maintaining the highest environmental standards with regard to local impacts, and effects on species including eagles and habitat at the local and regional scale, can wind energy production be truly sustainable.

The Center supports wind projects applying for golden eagle permits as required under the Bald and Golden Eagle Protection Act, because of the overall benefits to eagle conservation that the Act provides, by providing permit conditions that limit mortality, require consistent mortality monitoring, and require application of avoidance measures including adaptive management.

The Center is concerned over the decline in golden eagles in the southwest[1] and the regionally high impact of wind energy on golden eagles in California[2] compared to other regions. From that perspective we offer the following comments

[1] Millsap et al. 2013
[2] Pagel et al. 2013

Ileene Anderson, Senior Scientist
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Current Eagle Mortality

Because the Ocotillo Express Wind project has been in operation since 2012, and monitoring for eagles and other avian species has occurred in the area, some data are available on golden eagle use of the site. The DEA is unclear if any or how many eagles have been impacted by the operation of the wind turbines at Ocotillo Express. Clearly avoidance of injury and mortality to golden eagles needs to be the highest priority of any eagle permit and the EA should provide these very basic data.

Alternatives

If the current system in place for avoidance of eagles is working (i.e. no mortalities), and curtailment of only "8.49 hours of curtailment over the 4.5-year period" (at pg. 2-1), which equates to less than 2 hours of curtailment per year, has provided adequate safeguards for eagles, then the current system is a success and should remain in place as part of the Eagle Conservation Plan and "take" permit. Unfortunately, this successful approach was not included as an alternative in the EA, but it should be. If it is not included, then justification for why this feasible and successful strategy was dismissed needs to be included.

Because eagle "take" permits are still relatively new, the eagle "take" permits should be given for no longer than 5 years at this point. Only Alternative 2 meets this requirement. However, Alternative 2 also allows for "take" of 2 eagles over the five year period "rounded up to two eagles over a 5-year period under Alternative 2" (at pg. 2-5) from the mortality estimates from the Service's modeling of 0.3 golden eagles per year during operations. It is unclear why the number of golden eagles was "rounded up" instead of a more conservative approach to eagle conservation by "rounding down". Rounding down is more consistent with eagle conservation in southern California where golden eagle populations have been noted to decline for decades[3].

In order to provide adequate protection for this local eagle population, in addition to an alternative that keeps the existing avoidance of eagle "take" in place, other avoidance and minimization measures need to be included in the permit that could reduce potential impacts to golden eagles and should be considered as part of the alternatives analysis. These measures include:

- Seasonal curtailment during eagle high use periods and especially after local nests fledge should be considered annually.
- Acquisition of local eagle nesting/foraging habitat for conservation purposes (also see below)
- Identification of eagle migration corridors and the establishment of "turbine free zones" in those areas, via land use planning to ensure that future projects would not create a "wall" of turbines that would be unnavigable to eagles.

Mortality Monitoring

Mortality monitoring needs to be over the life of the project, and certainly must be required over the life of the eagle permit. The DEA is mute on the methodology and frequency to be used for eagle mortality monitoring. This lack of clarity is troubling particularly because mortality monitoring has been inconsistent both in

[3] Bittner and Oakley 1999

timeframes, methodologies and across wind projects, complicating the capacity of the U.S. Fish and Wildlife Service (Service) to estimate eagle mortality and model future mortalities. Consistent monitoring going forward will improve the ability of the Service and the companies to better implement conservation measures in the future.

Technical Advisory Committee

It is unclear if the Technical Advisory Committee (TAC) is proposed to continue to be part of the eagle "take" permit. It is currently made up of representatives of the BLM, the Service, and California Department of Fish and Wildlife (CDFW), (at pg. 1-2). While we support the retention of the established TAC, we believe that extending the membership of the TAC to golden eagle experts, preferably local, outside of the agencies would be beneficial. In addition, the TAC meetings should be publicly noticed, open to the public, and detailed minutes of TAC meetings should be provided to the public within a month of any meeting including any recommendations from the TAC.

Compensatory Mitigation Falls Short

While we support the reduction of avian mortalities from power poles in general, if power poles are causing golden eagle (or other sensitive species) mortality, then it is incumbent on the power pole owner(s) to retrofit the power poles, not this project proponent. Yet, even if power pole retrofits were appropriate mitigation, the EA needs to identify where the retrofits would take place. While the EA states that power pole retrofits would be coordinated with PG&E and/or SCE, the two closest electricity providers to the project (and therefore the potential impact) are Imperial Irrigation District (IID) and San Diego Gas and Electric (SDG&E). In order to offset the impact to the local population of golden eagles, it needs to commit to working with the local utilities to forward conservation of golden eagles in the area.

If power pole retrofits were appropriate mitigation for eagle injury and mortalities from wind tower impact, which they are not, it is unclear how a 1.2:1 mitigation ratio was determined. Frankly, it is unclear what that ratio represents. The EA needs to more clearly identify how the ratio was determined and how it applies to the power poles to be retrofitted (i.e. how was the ratio applied to estimate that "a range of 32 to 74 power poles proposed to be retrofitted under Alternative 2 and for the first five year term of the 30-year permit term under Alternative 4." (at pg. 2-5)). That estimate has quite a large range and the proposed 1.2:1 ratio should not result in a "range".

Additional mitigation for impacts should be included in the permit. For example, decommissioning of problem turbines or groups of turbines needs to be included. The EA should also consider off-site acquisition of habitat or conservation easements specifically in support of golden eagle conservation in perpetuity to offset the impacts from this project. Mitigation acreage should include more than just the rotor swept area acreage, it should include the landscape as a whole, because effectively the whole Ocotillo Wind Project site will continue to pose an ongoing threat to golden eagles as long as turbines of the current technology are present. Mitigation lands should be acquired to secure lands nearby to provide safe movement corridors for eagles and other birds, for example, lands adjacent to Anza Borrego Desert State Park or other open spaces in the region.

Another example of mitigation instead of power pole retrofitting (although it is inappropriate for mitigating eagle mortalities from being hit by a wind tower rotor) is undergrounding transmission lines in areas of eagle mortalities. Not only do transmission lines electrocute eagles, but they continue to be the ignition source for devastating wildfires that affect not only eagle nests, but the prey that the eagles rely on. Undergrounding lines would decrease this ignition source which would benefit many species including eagles.

Conclusion

We appreciate the effort that went into this analysis for this golden eagle take permit for Ocotillo Wind project, and we appreciate the opportunity to comment on the EA. By clarifying the confusing points in the DEA and incorporating a full range of alternatives, avoidance, minimization and mitigation requirements as we have laid out in the comments above, we believe the FWS will be able to craft an adequate permit. Please feel free to contact me with any questions.

Sincerely,



Ileene Anderson
Senior Scientist

Cc via email:
Leslie MacNair, CDFW Leslie.MacNair@wildlife.ca.gov

References:

Bittner, J.D. and J. Oakley 1999. Status of Golden Eagles in southern California. Golden Eagle Symposium, Raptor Research Foundation Annual Meeting, La Paz Mexico.

Millsap, B.A., G.S. Zimmerman, J.R. Sauer, R.M. Nielson, M. Otto, E. Bjerre and R. Murphy 2013. Golden Eagle Population Trends in the Western United States: 1968-2010. Journal of Wildlife Management 77(7): 1436–1448 https://wildlife.onlinelibrary.wiley.com/doi/epdf/10.1002/jwmg.588

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Re: Ocotillo Wind Energy Facility Draft Environmental Assessment (DEA) Comments Dear

Ms. Beeler,

Defenders of Wildlife (Defenders), the Natural Resources Defense Council (NRDC), San Diego Audubon Society and National Audubon Society (Audubon) appreciate the opportunity to provide comments on the U.S. Fish and Wildlife Service (USFWS) proposal to issue an eagle take permit to Pattern Energy for its operating Ocotillo Express Wind Energy Facility (Ocotillo project or Ocotillo Express) located in the southwestern portion of Imperial County, California.

Defenders is a national conservation organization dedicated to protecting all wild animals and plants in their natural communities. To this end, we employ science, public education and participation, media, legislative advocacy, litigation, and proactive on-the-ground solutions in order to impede the accelerating rate of extinction of species, associated loss of biological diversity, and habitat alteration and destruction. Defenders has 1.8 million members and supporters nationally, including 279,000 in California.

NRDC combines the power of more than three million members and online activists with the expertise of some 500 lawyers, scientists and policy advocates across the globe to solve the most pressing environmental issues we face today. NRDC has worked for many years to protect wildlands and natural values on public and private lands and to promote sustainable energy development. NRDC has been a long-time advocate for guided low-conflict renewable energy development, as well as enduring protections for the sensitive species and habitat values present in California.

The mission of the San Diego Audubon Society is to foster the protection and appreciation of birds, other wildlife, and their habitats, through education and study, and advocate for a cleaner, healthier environment. Since 1917, San Diego Audubon Society members have been dedicated to protecting and appreciating our local wildlife and their habitats. From the tidal flats to the sun-parched Borrego badlands, we actively work to preserve San Diego's environment.

For more than a century, Audubon has built a legacy of conservation success by mobilizing the strength of its network of one million members and supporters, 450 chapters, 41 Audubon centers, 23 state offices, and dedicated professional staff to connect people with nature and the power to protect it. Audubon's 2014 Climate science hosted online at www.climate.audubon.org reveals that 314 species of our North American birds are seriously threatened on their breeding and wintering grounds by changes in climate suitability depending on how fast we can reduce our emissions. Transforming our energy sector to emission-free generation by wind, solar and geothermal energy is a key strategy to combat the effects of climate change on our birds while providing jobs and economic benefits to our people, and is a priority for Audubon.

Golden Eagle is projected to lose climate-suitability in 41 percent of its breeding range and 16 percent of its non-breeding range by 2080 depending on how fast we can reduce our emissions, according to Audubon's climate model. Whether the raptor will keep pace with a shrinking breeding range is uncertain, as is how changes in prey abundance will adjust to the shifting climate.[1]

At the national, state and local level in California and elsewhere our groups have supported policies that drive a rapid deployment of renewable energy as well as the adoption of siting guidelines and other policies to avoid, minimize and mitigate effectively for impacts on birds and other wildlife of that energy. This includes comments on each iteration of the Eagle rule and the PEIS that this permit analysis tiers off of.

Our groups also participated in the environmental review and permitting for the Ocotillo project conducted by the Bureau of Land Management (BLM) in 2011 and other nearby wind energy projects, such as the Tule Wind farm project located in McCain Valley. Based on the extensive monitoring data made available, we agree that issuing an eagle permit for this site is compatible with the conservation of the golden eagle, consistent with USFWS' preferred alternative, assuming permit terms comply with USFWS regulations.

Background Information

The BLM issued a right of way (ROW) grant for the construction, operation and decommissioning of the Ocotillo project on 12,565 acres of public land in 2012. It became operational in 2013 and is comprised of 112 wind turbines and related infrastructure, with a generating capacity of 265 MW. The BLM ROW grant required the applicant to complete an Avian and Bat Protection Plan and an Eagle Conservation Plan (ECP), both of which were approved by BLM and the USFWS.

Continuous monitoring of the project for a two-year period to assess avian mortality has occurred since the project became operational and, to date, no injury or mortality to golden eagles has been observed. Monitoring for a third year is now underway. Monitoring utilized a state-of-the-art MERLIN Avian Radar System (DeTect, Inc.) in conjunction with an avian biologist stationed in an observation tower to detect birds within the project area, and who had the ability to curtail operation of individual wind turbines to eliminate or minimize bird collision risk if a bird came within $^1/_2$-mile of an operating turbine. The radar system was also used to detect movements of endangered Peninsular bighorn sheep during the first year of operation of the project. A total of 41 golden eagle observations were recorded from December 2012 through June 2017 (19,687 hours) by biological monitors stationed in the monitoring tower. Wind turbines were curtailed 16 times for a total of 8.49 hours when 35 golden eagles were observed within the $^1/_2$-mile buffer zone surrounding individual turbines. The average turbine curtailment time was approximately 32 minutes. Pattern Energy found the DeTect Merlin radar system regularly displayed "false positives" or non-bird detections such as spinning turbine blades, vehicles, motorcycles, rain, and notified the USFWS that it does not consider the system useful in detecting golden eagles.

Based on the documented low risk to golden eagles from the Ocotillo project, Pattern Energy has applied to the USFWS for an eagle take permit under the Bald and Golden Eagle Protection Act ("Eagle Act") for a five-year period provided it can receive an amended ROW grant from the BLM to discontinue the Advanced Conservation Practices (ACPs) pertaining to golden eagles and to implement an adaptive management program

[1] http://climate.audubon.org/birds/goleag/golden-eagle.

to address unforeseen impacts to golden eagles. The ACPs associated with the project included the DeTect Merlin Radar avian radar system, video tracking system and a full-time biological monitor. As part of its application for an eagle take permit, Pattern Energy prepared and submitted a revised ECP which the USFWS has used in analyzing the effects of issuing an eagle permit for the project. Pattern Energy has requested a permit allowing for the incidental take of up to two golden eagles over a period of five-years. The USFWS must determine if the revised ECP is sufficient to avoid, minimize, and mitigate adverse effects on golden eagles.

Overarching Comment

Overall, we appreciate the efforts of Pattern Energy, BLM and USFWS to address potential impacts to eagles and large raptors at Ocotillo Express with experimental radar detection and on-site biologist stationed in a tower that has avoided take through turbine curtailment. The DEA confirms that this experiment has worked in avoiding take citing Pattern's data. The DEA and ECP appear to be well-reasoned and demonstrate a thoughtful range of alternatives.

We note that the permit application was made in 2013 and the DEA was not issued until 2018. This five-year delay seems unreasonable in light of a permitting program that we hoped would provide for certainty in conservation of eagles as well as certainty for developers and operators of wind energy by encouraging more proponents to seek and obtain permits for activities that would otherwise continue to take eagles without implementing the conservation measures that are critical to eagle conservation nationally, regionally, and locally. The delays in processing permits may actually discourage proponents from seeking permits and may be an obstacle to the rapid growth of wind energy that is needed to combat climate change.

Additional Comments on the DEA

Standards for issuing golden eagle take permit. The USFWS can only issue golden eagle take permits if it finds that in doing so the affected golden eagle breeding population would remain stable or increase as required in the Eagle Act's preservation standard. For purposes of the DEA, the analysis of the effects to the local breeding population of issuing an eagle permit is based on: 1) the project area plus a 10-mile radius, and 2) the local population of golden eagles, defined as a 109-mile radius around the project based on the dispersal distance for young eagles from nests.

Within a 10-mile radius of the project, surveys conducted in 2010 documented five golden eagle nesting territories, three of which were active, with the closest active nest located 4.1 miles from existing wind turbines. No active nests were documented within 10 miles of the operating project during monitoring conducted in 2013, 2014 and 2015. Ongoing drought conditions in Imperial County from 2013 through 2017 is considered a factor in documented inactive nesting. If existing nests become active during the planned 30-year operational life of the project, nesting adults and young eagles produced from these nests will be at risk from injury or mortality due to the operational project.

Within the 109-mile radius of the project are portions of four Bird Conservation Regions (BCRs) in California and Mexico, 1) BCR 32 – Coastal California, 2) BCR 33 – Sonoran and Mohave Deserts, 3) BCR 39 – Sierras de Baja California, and 4) BCR 40 – Desierto de Baja California. The golden eagle breeding

population within 109 miles of the project in California is estimated by the USFWS to be 419. Based on this analysis, the local-area 5% benchmark would be 21 golden eagles annually. Assuming a mortality rate of 0.28 golden eagles per year, this amount of mortality comprises less than 0.1% of the total estimated local area population and less than 2.0% of the local-area 5% benchmark for golden eagle mortality.

Comment: Given that turbine operation was curtailed 16 times for a total of 8.49 hours when golden eagles were observed within the $^1/_2$-mile buffer zone surrounding individual turbines, eliminating turbine curtailment in the Pattern Energy's revised ECP has the potential to increase the probability that golden eagles would experience increased injury or mortality. However, we concur that such increased risk is adequately addressed in the DEA because if authorized take exceeds predicted levels, the observer-curtailment of wind turbines posing a risk to eagles would resume as an adaptive management measure.

Mitigation measures to fully mitigate projected mortality at the Ocotillo project: Power pole retrofitting is proposed as the mitigation measure to fully offset projected mortality, and is proposed to occur within service territories for Pacific Gas and Electric Company (PG&E) and Southern California Edison (SCE). Retrofitting 15 power poles would benefit one golden eagle according to the EA for an eagle permit for the Shiloh wind project[2].

Comment: While we appreciate that two electrical utilities, PG&E and SCE, have established power pole retrofit programs throughout their service territories, we recommend that power pole retrofit projects be located in high quality eagle nesting and foraging habitats as close to the project as practicable and where there are known electrocution problems. The service territory of PG&E is outside the local area population of golden eagles and power pole retrofits. Given the resident nature of the golden eagle population in this area, we recommend that the primary service territory where power pole retrofits should occur is within that for San Diego Gas and Electric Company. The service territory for the Imperial Irrigation District should also be evaluated if there are known electrocution problems within eagle nesting and foraging territories. Maps of the service territories for each of these utility companies are attached to this comment letter.

A total of 30 power pole retrofits would be needed to offset the anticipated take of two eagles from the project over a five-year period; and the USFWS proposes a ratio of 1.2:1 for calculating the number of retrofits (36) needed to achieve a net gain in the overall eagle breeding population. For a 30-year eagle take permit, the number of retrofits required would be 180 to offset anticipated impacts, and 216 needed to achieve a net gain in the breeding population.

Need for a regional golden eagle conservation and mortality mitigation strategy: There are four operational wind farms in southeastern San Diego County (Tule, Jordan, Manzanita and Campo). An additional project, the Torrey Wind Project, is proposed on approximately 2,000 acres of private land in McCain Valley with generating capacity of 126 MW from 30 wind turbines.

Comment: Given that contemporary wind turbines are known sources of avian mortality, including golden eagles, and that there are numerous active eagle nesting and foraging territories in the mountainous regions of San Diego County, we urge the USFWS, in concert with federal, state and local agencies, to address the need to conserve golden eagles within this region through a long-term programmatic eagle conservation and mortality

[2] https://www.fws.gov/cno/pdf/ShilohIV-ECP-DEA.pdf

mitigation strategy that seeks to increase compliance of wind energy facilities and other sources of eagle mortality in the region with the Eagle Act.

We support Alternative 2: Issue a 5 year Permit for Applicant's Revised ECP and issue ROW grant amendment; and make the following additional comments on the DEA and Alternative 2, in particular, for consideration of inclusion:

1. From the DEA: ***The applicant is also requesting an amendment to their BLM right of way (ROW) grant, to allow discontinuation of a system designed to minimize risk to eagles.*** *The golden eagle risk minimization system includes a DeTect Merlin avian radar system, radar-controlled video tracking system, and a full-time golden eagle biological monitor to observe any golden eagles flying within the wind facility and to curtail turbines when eagles are at risk of collision. This eagle risk minimization program was required as part of the ROW grant and associated Record of Decision (ROD) that was signed by the BLM on May 11, 2012.* (DEA, p. 1-1)

Alternative 2: *Under this alternative, the radar system and observer-curtailment system would no longer occur at the Project for the 5-year permit term, unless take exceeds predicted levels, in which case reinstallation of the observer-curtailment measure could be an adaptive management measure.* (DEA, p. 2-2)

Comment: Technology for detection and avoidance of eagles, Condors, and potentially Whooping cranes and other large birds is progressing rapidly, and our groups support funding from DOE and other agencies and the private sector in developing, testing and refining these technologies that emphasize avoidance and minimization before compensatory mitigation.

Pattern, BLM and USFWS should get recognition and credit for collaborating in the creation and operation of a system that was experimental at the time and that has shown results in zero mortality of eagles and low mortality of large raptors.

Wind energy developers, like Pattern, who implement new technologies should be given credit for any eagle mortality successfully avoided in calculation of take limits and compensatory mitigation requirements or other considerations. This will help incentivize avoidance as the most effective step of addressing impacts in the mitigation hierarchy.

Additionally, we expect new technologies for detection and avoidance to come online over the term of the permit and recommend inclusion of specific language in the permit that allows consideration of alternate technologies for detection and avoidance in adaptive management.

2. As documented in Section 5.1 of the ECP, ***the biomonitors have documented relatively few golden eagles at the Project since it became operational.*** *Over 19,867 hours of bio-monitoring conducted from early December 2012 through June 30, 2017, 41 observations of golden eagles have occurred (0.002 golden eagles/hour). Turbines were curtailed as a result of these operations 16 times between December 2012 and the end of June 2017, for a total of 8.49 hours of curtailment over the 4.5-year period.* (DEA, p. 2-1)

Comment: Since this technology was an experiment, USFWS should consider whether it may be appropriate to validate the technology fully and provide the technology as an option for future eagle permits and operations at wind projects.

Additionally, if 41 observations are relatively few golden eagles, we wonder if there could be standardized quantified numbers to define eagle observations in comparison to other projects in the same region.

3. This alternative would involve removal of the DeTect Merlin radar system and installation of an aviation radar system which would turn on the Federal Aviation Administration (FAA) required flashing lights on the turbines when aircraft are in the area.

Comment: Please explain in the final EA how this lighting change affects golden eagles or large raptors.

4. NFWF Eagle Mitigation Account

The DEA states: We established an Eagle Mitigation Account with the National Fish and Wildlife Foundation (NFWF) to facilitate the eagle permit process in our Pacific Southwest Region. Deposits to this account would be used to accomplish specified conservation practices as identified in permits issued under the Eagle Act. Under the action alternatives that involve issuance of an eagle take permit (Alternatives 2 and 4), the applicant would deposit compensatory mitigation funds into the NFWF Eagle Mitigation Account. Within 30 days of permit issuance, the applicant would make the initial deposit into our NFWF Eagle Mitigation Account. Further deposits would be required if the funds run out before the required retrofits are completed. Under Alternative 4, for eagle take permit terms beyond the first 5 years, the Service may consider compensatory mitigation options that do not include use of the NFWF account. (DEA, p. 2-7)

Comment: In order to provide effective and time-efficient mitigation, we recommend that the terms of a contract or deposit of funds to NFWF obligate NFWF to contact the utility and schedule the retrofits within a specified time period.

5. Table 4-1 in the DEA summarizes known unauthorized take within the LAP.

Comment: We recommend that USFWS provides a formula for calculating unreported take to be applied to the Local-Area Population analyses in a standardized way, in order to more thoroughly account for this unknown.

6. In 4.6.2 Alternative 2: Issue a 5-year permit for Applicant's Revised ECP and Issue ROW Grant Amendment, Effects on Migratory Birds, the following is stated:

Because the eagle risk minimization system has been in place since operations and during both years of post-construction mortality monitoring that have occurred to date, we do not have the data necessary to determine if the relatively low raptor fatality rates are due to the curtailment system or simply a low level of baseline risk to raptors in this area.

Yet the Avian Protection Plan (Appendix A) reports that:

A total of 2, 073 raptors/large birds were recorded on site or directly adjacent to the site during the four seasons of raptor migration surveys (165 raptors/large birds during the fall of 2009, 522 during spring 2010, 451 during fall 2010, and 935 during spring of 2011). The number of raptors and turkey vultures observed during the spring migration counts were greater compared to fall.

Comment: Since raptors are at high risk from collision with turbines, it would seem that this data would be sufficient to determine a baseline risk level to raptors in this area. We are concerned that removal of the DeTect radar unit, video program and biologist will increase mortality of large raptors/large birds and recommend that impacts to these birds and other migratory birds that are protected by the Migratory Bird Treaty Act of 1918 and California regulations (see https://oag.ca.gov/news/press-releases/attorney-general-becerra-and-california-department-fish-and-wildlife-issue-legal) be addressed in the FEA.

Conclusion

Defenders, NRDC, San Diego Audubon Society and Audubon thank USFWS, BLM and Pattern Energy for their successful collaboration on this permit and significant efforts to address potential impacts to eagles. We consider it reasonable to offer an eagle take permit for the Ocotillo project given its relatively low risk to golden eagles and an adequate adaptive management program that would effectively address unanticipated take. Accompanied by transparent five-year reviews and revision, a longer duration permit may also be appropriate in the future. Eagle mortality monitoring at the project must continue to be required in support of the adaptive management aspect of the permit.

We strongly urge the USFWS, in cooperation with the California Department of Fish and

Wildlife and local agencies, to develop a golden eagle conservation plan for San Diego County at the earliest opportunity due to the ongoing known and unknown levels of eagle mortality, especially that associated with existing and planned wind energy projects in the eastern portion of the county. Thank you for the opportunity to provide comments on the DEA.

Sincerely,

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ATTACHMENTS: ELECTRIC UTILITY SERVICE AREA MAPS

Energy Service Maps

The IID energy service territory covers 6,471 square miles, including all of Imperial County along with parts of Riverside and San Diego counties. With low electric and water rates, an abundance of natural resources, a capable workforce and a close proximity to the border, this region has turned into a destination for business and industry of all kinds.

To learn more about the IID energy service area, please click on the map below. To find out if a specific home or business is located within the service territory, please enter the address in the search box.





AUGUSTINE BAND OF CAHUILLA INDIANS

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By

November 6, 2018

Thomas Dietsch
United States Department of the Interior
Fish and Wildlife Service
Pacific Southwest Region
2800 Cottage Way, Suite W-2606
Sacramento, CA 95825

Re: **The Bald and Golden Eagle Protection Act**

Dear Mr. Dietsch—

Thank you for the opportunity to offer input concerning the development of the above-identified project. We appreciate your sensitivity to the cultural resources **that** may be impacted by your project, and the importance of these cultural resources to the Native American peoples that have occupied the land surrounding the area of your project for thousands of years. Unfortunately, increased development and lack of sensitivity to cultural resources has resulted in many significant cultural resources being destroyed or substantially altered and impacted. Your invitation to consult on this project is greatly appreciated.

At this time we are unaware of specific cultural resources that may be affected by the proposed project. We encourage you to contact other Native American Tribes and individuals within the immediate vicinity of the project site that may have specific information concerning cultural resources that may be located in the area. We also encourage you to **contract with** a monitor who is qualified in Native American cultural resources identification and who is able to be present on-site full-time during the pre-construction and construction phase of the project. Please notify **us** immediately should you discover any cultural resources during the development of this project.

Very truly yours,

Victoria Martin
Tribal Secretary