Final Environmental Impact Statement for Eagle Take Permits for the Chokecherry and Sierra Madre Phase I Wind Energy Project

Volume 4 — Attachments B–E

U.S. Fish and Wildlife Service
Mountain-Prairie Region

November 2016

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Attachment B

Phase I Bird and Bat Conservation Strategy

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VIA Electronic Mail

July 6, 2016

Casey Stemler, Division Chief
Mountain-Prairie Region
U.S. Fish and Wildlife Service
134 Union Blvd.
Lakewood, CO 80228

Re: Amendment 1 to the Phase I Bird and Bat Conservation Strategy for the Phase I Chokecherry and Sierra Madre Wind Energy Project

Dear Mr. Stemler:

Thank you for your review of Power Company of Wyoming LLC's (PCW's) May 20, 2016, Phase I Bird and Bat Conservation Strategy (Phase I BBCS). PCW is pleased to submit the enclosed Amendment 1 to the Phase I BBCS in response to your feedback. As detailed in the attached document, Amendment 1 addresses three main items that you brought to our attention. In particular, Amendment 1:

1. clarifies a conclusion on page 4-75 regarding the risk of impacts to sagebrush obligate species from Phase I;

2. documents that the results of active nest monitoring will be reported with the annual reports required in Section 8.3; and

3. revises Table 5.1 to more specifically identify benefits to bats from the Phase I ECP avoidance and minimization measures.

The attached Amendment 1 to the Phase I BBCS revises the May 20, 2016 Phase I BBCS filed in support of PCW's June 15, 2015 Phase I Eagle Conservation Plan. We appreciate the assistance and guidance provided by your agency in developing the Phase I BBCS. If you have any questions concerning the Phase I BBCS, please contact me to discuss by telephone or to arrange an in-person meeting. Thank you.

Sincerely,

Garry L. Miller
Vice President, Land and Environmental Affairs

Encl. as referenced

cc: Clint Riley, USFWS

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Amendment No. 1 to
May 20, 2016 Chokecherry and Sierra Madre Wind Energy Project
Phase I Bird and Bat Conservation Strategy

1. Page 4-75, first full paragraph, fifth sentence is changed to read:

   "Finally, sagebrush habitats are available throughout southern Wyoming and the abundance of these habitats throughout that area make it unlikely that the risk of adverse impacts resulting from the construction and operation of Phase I would result in population level declines in obligate species."

2. Page 5-26, first paragraph under the Nest Management sub-heading, the following sentences are added immediately prior to the last sentence of the paragraph:

   "When active nest monitoring is required (*See Figure 5.10*), the qualified biological monitor will document the final nest status (active, abandoned, failed, or fledged) following the completion of the construction, operations, or maintenance activities. This information will be reported in accordance with Section 8.3 and will be used as appropriate to inform adaptive management. *See Section 8.4*."

3. Table 5.1 on pages 5-28 and 5-29 is replaced in its entirety with the following table:

Table 5.1. Phase I ECP Avoidance and Minimization Measure Benefits to Migratory Birds and Bats

Measure or Type of Measure	Description of Measure	Benefits to Migratory Birds and Bats
Eagle Nest-specific Measures	Measures include seasonal curtailment strategies and identification of nest buffers in which no turbines would be constructed that are specific to individual eagle nests or territories.	Benefits avian species using areas surrounding the specific eagle nests for which site-specific avoidance and minimization measures have been identified. Specific benefits are expected for non-eagle raptors and other avian species that nest, roost, or forage along cliff bands associated with eagle nests and territories. Benefits to crevice-roosting and cliff-roosting bats would also be likely in areas surrounding eagle nests built on cliff bands.
Occupied Nest Measures	Measures include seasonal curtailment strategies used when nest-specific or territory-specific measures have not been identified.	Benefits avian species using areas surrounding occupied eagle nests. Specific benefits are expected for non-eagle raptors and other avian species that nest, roost, or forage along cliff bands associated with eagle nests and territories.

Measure or Type of Measure	Description of Measure	Benefits to Migratory Birds and Bats
Unoccupied Nest Measures	Measures include seasonal curtailment strategies used when nest-specific or territory-specific measures have not been identified.	Benefits avian species using areas surrounding unoccupied eagle nests. Specific benefits are expected for non-eagle raptors and other avian species that nest, roost, or forage along cliff bands associated with eagle nests and territories.
Prey Resource Areas	Twenty-eight turbines were removed from a portion of Phase I Sierra Madre where eagle foraging activities or opportunities were identified.	Benefits avian species using identified areas as prey resources. The habitats contained within the prey resource areas primarily consist of sagebrush steppe, upland grasslands, barren slopes, and salt desert shrub. Removal of turbines from this area will benefit foraging raptors that utilize the same prey resources as well as other avian species (including sagebrush obligates, mountain plover, loggerhead shrike, and other species of interest) that use these habitats for foraging, breeding and migratory purposes.
Miller Hill Rim Activity Area	Turbines were set back from the rim of Miller Hill to reduce collision potential for avian species utilizing the habitats along the rim as well as the movement corridor provided by the Miller Hill Rim Turbine No-Build Area	Benefits avian species using habitats along the rim and immediately under the rim of Miller Hill in Phase I. Habitats in this area include upland grasslands, barren slopes, aspen mixed-conifer woodlands, sagebrush steppe, and mountain shrub communities. Species utilizing these habitats and specifically benefiting from this measure include, but are not limited to, raptors, sagebrush obligates, and forest and montane ecosystem specialists. Benefits to tree-roosting bats and foraging bats would also be likely because turbines will be set back from forested habitats used for roosting and mesic areas on the slopes of Miller Hill that may provide foraging habitat.

Measure or Type of Measure	Description of Measure	Benefits to Migratory Birds and Bats
McKinney Creek Activity Area	Four turbines were removed immediately south of the Miller Hill Road in the headwaters of McKinney Creek to provide a movement corridor between undeveloped portions of Miller Hill, the Miller Hill Turbine No-Build Area, and greater sage-grouse Core Areas	Benefits avian species using the Miller Hill Road as a movement corridor, sagebrush steppe habitats on Miller Hill, and habitats along the rim and immediately under the rim of Miller Hill in Phase I. Habitats in this area include upland grasslands, barren slopes, aspen mixed-conifer woodlands, sagebrush steppe, and mountain shrub communities. Species utilizing these habitats and specifically benefiting from this measure include, but are not limited to, raptors, sagebrush obligates, and forest and montane ecosystem specialists. Benefits to tree-roosting bats and foraging bats would also be likely because it provides a movement corridor between forested habitats on the slopes of Miller Hill and suitable lowland mesic foraging habitats on top of Miller Hill.
Lower Miller Hill	Fourteen turbines were removed from areas identified as having eagle and raptor soaring and kiting activities along slopes in the Lower Miller Hill portion of Phase I.	Benefits are primarily to raptors and other avian species that use the same features for soaring and kiting activities. Also benefits other avian species using the habitats within the area for breeding, foraging, or migratory activities.
Eagle Activity Area	Seventeen turbines were removed from an area north of Miller Hill in Phase I where eagle activity was observed during pre-construction survey efforts.	Area is adjacent to the Miller Hill Rim Turbine-No Build area and will benefit all avian species using the corridor provided by that area. Also benefits avian species using the area for foraging, nesting, or migration activities. Habitats in this area include upland grasslands, barren slopes, aspen mixed-conifer woodlands, sagebrush steppe, and mountain shrub communities. Species utilizing these habitats and specifically benefiting from this measure include, but are not limited to, raptors, sagebrush obligates, and forest and montane ecosystem specialists. Benefits to tree-roosting bats and foraging bats would also be likely because turbines have been removed from areas containing forested and mesic habitats that provide suitable roosting and foraging habitats.

Measure or Type of Measure	Description of Measure	Benefits to Migratory Birds and Bats
Infrastructure Avoidance and Minimization Measures	Avoidance and minimization measures were developed for the North Platte River Water Extraction Facility, the Road Rock Quarry, and the Phase I Haul Road and Transmission Lines where these facilities are proximate to certain eagle nests.	Benefits avian species using areas surrounding the specific eagle nests included in the measure. Specific benefits are expected for non-eagle raptors and other avian species that nest, roost, or forage along cliff bands associated with eagle nests and territories.

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VIA Federal Express and E-Mail

May 20, 2016

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134 Union Blvd.
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Re: Phase I Bird and Bat Conservation Strategy
for the Phase I Chokecherry and Sierra Madre Wind Energy Project

Dear Mr. Riley:

Power Company of Wyoming LLC (PCW) is pleased to submit the enclosed Phase I Bird and Bat Conservation Strategy (Phase I BBCS) for Phase I of the Chokecherry and Sierra Madre Wind Energy Project. This Phase I BBCS is filed in support of the separate Phase I Eagle Conservation Plan that PCW filed with the USFWS on June 15, 2015, and completely replaces the Phase I BBCS filed by PCW on August 3, 2015.

This Phase I BBCS addresses the comments received from the U.S. Fish and Wildlife Service on April 15, 2016 concerning the August 2015 Phase I BBCS. For reference, a comment response table and a redline electronic version of the BBCS comparing the May 2016 document to the August 2015 document are available through a file share site. The link to the file share site will be provided by e-mail.

We appreciate the assistance and guidance provided by your agency in developing the Phase I BBCS. If you have any questions concerning the Phase I BBCS, please contact me to discuss by telephone or to arrange an in-person meeting. Thank you.

Sincerely,

Garry L. Miller
Vice President, Land and Environmental Affairs

Encl. as referenced

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Phase I Bird and Bat Conservation Strategy

Chokecherry and Sierra Madre Wind Energy Project

May 2016

Power Company of Wyoming LLC

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ACRONYMS AND ABBREVIATIONS

ACM	applicant-committed measure
APLIC	Avian Power Line Interaction Committee
APP	Avian Protection Plan
BBCS	Bird and Bat Conservation Strategy
BGEPA	Bald and Golden Eagle Protection Act
BLM	Bureau of Land Management
BMP	best management practice
BO	Biological Opinion
BPP	Bat Protection Plan
CCSM Project	Chokecherry and Sierra Madre Wind Energy Project
C.F.R.	Code of Federal Regulations
CUP	Conditional Use Permit
DEIS	Draft Environmental Impact Statement
EA	Environmental Assessment
ECP	Eagle Conservation Plan
EIS	Environmental Impact Statement
ESA	Endangered Species Act
ETP	Eagle Take Permit
FAA	Federal Aviation Administration
FEIS	Final Environmental Impact Statement
GPS	global positioning system
HSR	horizontal scanning radar
ISC	Industrial Siting Council
IM	Instruction Memorandum

MBTA	Migratory Bird Treaty Act
MCP	minimum convex polygon
MW	megawatt
NEPA	National Environmental Policy Act
NREL	National Renewable Energy Laboratory
NTP	notice to proceed
PCW	Power Company of Wyoming LLC
Phase I ECP	Phase I Eagle Conservation Plan
POD	plan of development
Ranch	The Overland Trail Ranch
RFO	Rawlins Field Office
RMP	Resource Management Plan
ROD	Record of Decision
ROW	right-of-way
RSZ	rotor swept zone
SGCN	Species of Greatest Conservation Need
SWAP	State Wildlife Action Plan
TOTCO	The Overland Trail Cattle Company LLC
U.S.C.	United States Code
USFWS	U.S. Fish and Wildlife Service
USFWS Region 6	U.S. Fish and Wildlife Service Mountain-Prairie Region Office, Lakewood, Colorado
USFWS Region 6 Outline	U.S. Fish and Wildlife Service Region 6 Outline for a Bird and Bat Conservation Strategy: Wind Energy Projects
USFWS Wind Energy Guidelines	U.S. Fish and Wildlife Service Land-based Wind Energy Guidelines

VSR	vertical scanning radar
WDA	wind development area
WGFC	Wyoming Game and Fish Commission
WGFC Wind Energy Recommendations	Wyoming Game and Fish Commission Wildlife Protection Recommendations for Wind Energy Development in Wyoming
WGFD	Wyoming Game and Fish Department
WHMA	wildlife habitat management area

1.0 Introduction and Purpose

This Bird and Bat Conservation Strategy (BBCS) applies to Phase I of Power Company of Wyoming LLC's (PCW) Chokecherry and Sierra Madre Wind Energy Project (CCSM Project). Phase I of the CCSM Project (Phase I) is located in the western portions of two Wind Development Areas referred to as "Chokecherry" and "Sierra Madre." *See Figure 1.1*. Phase I will consist of 500 wind turbines generating approximately 1,500 megawatts (MW) of renewable energy.

PCW has developed this BBCS for Phase I of the CCSM Project to avoid and minimize impacts to migratory birds and bats in accordance with USFWS Wind Energy Guidelines, WGFC Wind Energy Recommendations, and BLM requirements:

- The U.S. Fish and Wildlife Service (USFWS) issued Land-Based Wind Energy Guidelines (USFWS Wind Energy Guidelines) in March 2012. They recommend that wind energy projects use an iterative tiered approach to characterize migratory bird and bat use of the project area and to evaluate the potential risks of the project to migratory bird and bat species. This information can then be used when making decisions regarding siting, construction, and operation to avoid and minimize impacts to migratory birds and bats. *See Section 2.4. See USFWS 2012a.*
- The Wyoming Game and Fish Commission (WGFC) issued Wildlife Protection Recommendations for Wind Energy Development in Wyoming (WGFC Wind Energy Recommendations). They suggest early and ongoing coordination with the Wyoming Game and Fish Department (WGFD) to develop appropriate site-specific monitoring and best management practices to avoid potential conflicts with wildlife, including migratory birds and bats. *See Section 2.5. See WGFC 2010.*
- The Bureau of Land Management (BLM) in its Record of Decision (ROD) for the CCSM Project requires PCW to develop an Avian Protection Plan (APP) and Bat Protection Plan (BPP) for Phase I of the CCSM Project prior to the BLM's issuance of a right-of way (ROW) grant or notice to proceed (NTP).[1] *See Section 1.3.2.*

PCW has worked with USFWS personnel from the Mountain-Prairie Region Office, Lakewood, Colorado (USFWS Region 6), and the Wyoming Ecological Services Office, Cheyenne, Wyoming, since 2010 regarding the potential for the CCSM Project to affect migratory birds and bats. USFWS, as documented in its April 2011 letter to BLM regarding the CCSM Project, determined that "developing an APP is an appropriate option to avoid and minimize the potential take of eagles (based on BLM's IM 2010-156) and migratory birds and bats…" provided that PCW incorporate appropriate conservation measures into

[1] The terms Avian Protection Plan (APP), Bat Protection Plan (BPP), and Avian and Bat Protection Plan are used in the BLM ROD and BLM IM-2010-156. *See BLM 2010; BLM 2012a.* USFWS, however, in its Wind Energy Guidelines and other related documents has indicated it prefers the term Bird and Bat Conservation Strategy (BBCS) in the context of wind energy facilities.

the CCSM Project. *See Appendix A.* PCW has prepared this Phase I BBCS, as well as its Phase I Eagle Conservation Plan (Phase I ECP), in compliance with USFWS's determination.1 *See PCW 2015a.*

PCW has worked cooperatively with WGFD since 2009 to avoid and minimize impacts to wildlife, including migratory birds and bats. As recommended by the WGFC Wind Energy Recommendations, PCW has incorporated site-specific best management practices into Phase I of the CCSM Project. PCW has also entered into a Landowner Agreement with The Overland Trail Cattle Company LLC (TOTCO) that sets forth management goals and actions to implement the WGFD recommendations. WGFD reviewed and approved the Landowner Agreement, acknowledging that the Landowner Agreement satisfies the applicable requirements of the WGFC Wind Energy Recommendations. This BBCS further describes PCW's commitments for Phase I and addresses the WGFC monitoring and best management practice recommendations specific to migratory birds and bats.

PCW has worked in close coordination with BLM, WGFD and USFWS using the extensive CCSM Project and Phase I data to avoid and minimize impacts to migratory birds and bats. This Phase I BBCS documents PCW's: (a) extensive site characterization efforts; (b) scientifically rigorous field studies to document the presence or absence of migratory birds and bats and their habitat; and (c) the comprehensive best management practices and conservation measures that have been and will be implemented to avoid and minimize potential adverse impacts to migratory birds and bats. As documented in this Phase I BBCS, development of Phase I is consistent with the USFWS Wind Energy Guidelines, the WGFC Wind Energy Recommendations, and the requirements of BLM's ROD.

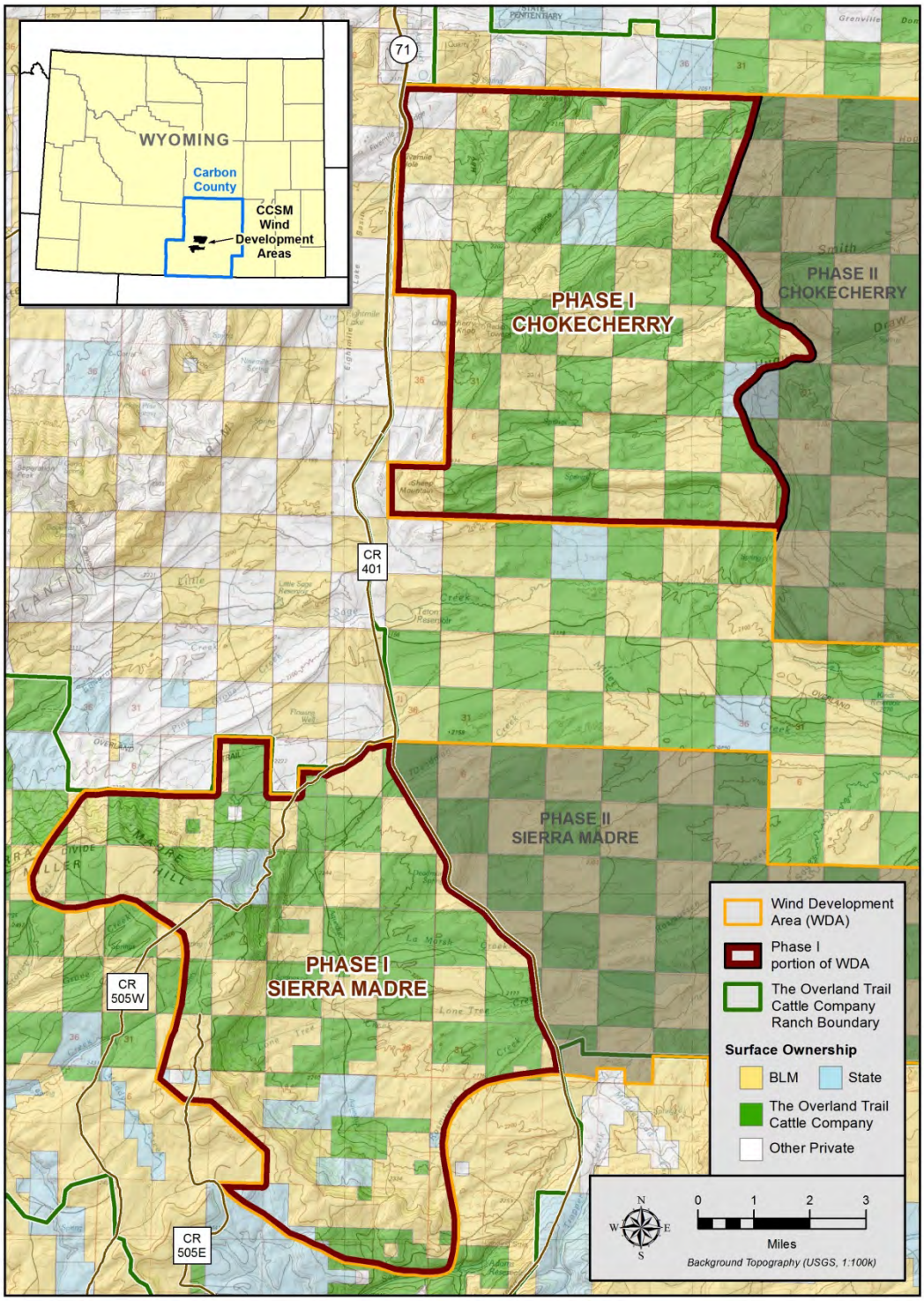

Figure 1.1. Phase I of the Chokecherry and Sierra Madre Wind Energy Project.

1.1 Purpose of the Phase I Bird and Bat Conservation Strategy

This Phase I BBCS documents PCW's strategies and commitments to avoid and minimize impacts to migratory birds and bats during construction, operation, maintenance, and decommissioning of Phase I of the CCSM Project. This Phase I BBCS also details PCW's identification of potential risks to migratory birds and bats and its reduction of those risks through implementation of avoidance and minimization measures, best management practices, and conservation measures. This Phase I BBCS describes Phase I and the surface disturbance[2] associated with the development of Phase I, as well as the alternate sites, configurations, construction methods, and operational practices evaluated by PCW during the project design and avoidance and minimization process. This Phase I BBCS is not intended to provide the full impacts analysis and disclosures required of federal agencies under the National Environmental Policy Act (NEPA). As describe in section 1.3.2, both the USFWS and BLM have prepared NEPA documentation to analyze the impacts of Phase I to migratory birds and bats and their habitats. This Phase I BBCS references these impact analyses where appropriate to evaluate risks to migratory birds and bats from Phase I.

PCW prepared this Phase I BBCS in accordance with the USFWS Wind Energy Guidelines, WGFC Wind Energy Recommendations, USFWS Region 6 *Outline for a Bird and Bat Conservation Strategy: Wind Energy Projects* (USFWS Region 6 Outline) and the requirements included in BLM's ROD. Consistent with these guidelines and recommendations, PCW initiated discussions with USFWS and WGFD regarding potential impacts to migratory bird and bat species early in the development of the CCSM Project and maintained communication with USFWS, WGFD, BLM, and other stakeholders throughout the development process. As a result, PCW substantially redesigned the CCSM Project, removing wind turbines from hundreds of acres of the original proposed site and relocating, removing, and agreeing to curtail certain wind turbines within the areas of the site that remain slated for wind development. Collectively, the measures identified in this Phase I BBCS will avoid and minimize risks to migratory bird and bat species to the extent practicable. *See Chapter 4.0*.

1.2 Scope of the Phase I Bird and Bat Conservation Strategy

This BBCS is limited in scope to Phase I of the CCSM Project. Phase II of the CCSM Project will have a separate BBCS; however, some sections of this Phase I BBCS describe the CCSM Project as a whole to provide context.

The USFWS Wind Energy Guidelines broadly define species of concern as "any species which 1) is either a) listed as an endangered, threatened or candidate species under the Endangered Species Act, subject to the Migratory Bird Treaty Act or Bald and Golden Eagle Protection Act; b) is designated by law, regulation, or other formal process for protection and/or management by the relevant agency or other authority; or c) has been shown to be significantly adversely affected by wind energy development, and

[2] Surface disturbance is used to define project areas and is not intended to represent the full range of direct and indirect impacts to migratory birds and bats.

2) is determined to be possibly affected by the project." *See USFWS 2012a at p.63.* Consistent with the USFWS Wind Energy Guidelines, this Phase I BBCS adopts this broad definition of species of concern. However, in recognition of agency management priorities, this Phase I BBCS is primarily focused on special status species that have been identified by federal and state agencies.

This Phase I BBCS addresses migratory birds managed under the Migratory Bird Treaty Act (MBTA) and bats managed as non-game mammal species by WGFD. However, this Phase I BBCS does not apply to greater sage-grouse (*Centrocercus urophasianus*) or bald and golden eagles (*Haliaeetus leucocephalus* and *Aquila chrysaetos*, respectively). Detailed information on PCW's commitments to avoid, minimize, and mitigate impacts to bald and golden eagles under the provisions of the Bald and Golden Eagle Protection Act (BGEPA) is included in the Phase I Eagle Conservation Plan (ECP) submitted to USFWS on June 15, 2015. *See PCW 2015a.* Information specific to PCW's commitments to avoid, minimize, and mitigate impacts to greater sage-grouse is included in the CCSM Project ROD and PCW's Sage-grouse Conservation Plan. *See BLM 2012b, App. B at App. N.*

In addition, this Phase I BBCS does not apply to any species listed under the Endangered Species Act (ESA). BLM determined that federally threatened or endangered migratory bird or bat species are unlikely to occur on the CCSM Project Site, including Phase I. *See BLM 2012b at pp.3.15-1:3.15-4.* However, if a threatened or endangered migratory bird or bat species is identified in Phase I, PCW will implement the applicable provisions of the ESA in addition to the measures included in this Phase I BBCS.

USFWS maintains a list of all species protected by the MBTA. *See 50 C.F.R. § 10.13*. This list includes over 1,000 species of migratory birds, including raptors, waterfowl, shorebirds, seabirds, wading birds, and passerines. The MBTA does not protect introduced species such as the house (English) sparrow (*Passer domesticus*), European starling (*Sturnus vulgaris*), rock dove (pigeon) (*Columba livia*), Eurasian collared-dove (*Streptopelia decaocto*), and non-migratory upland game birds (Greater sage-grouse, dusky grouse [*Dendragapus obscurus*], etc.). USFWS also maintains a list of introduced species not protected by the MBTA. *See 70 Fed. Reg. 12,710 (2005)*.

PCW has identified 117 species of migratory birds within the CCSM Project Site, including Phase I. *See Appendix B.* Of these, 22 species are identified as USFWS Birds of Conservation Concern, BLM Sensitive Species, or WGFD Species of Greatest Conservation Need (SGCN). *See Table 1.1*. In addition, this Phase I BBCS addresses the multiple bat species that have been observed, acoustically detected, or documented in the vicinity of the CCSM Project. *See Orabona et al. 2012; BLM 2012b.* Table 1.2 lists the bat species that may be present on the CCSM Project Site, including Phase I.

Table 1.1. Phase I Special Status Migratory Bird Species.

Species Group	Common Name	Scientific Name	Conservation Status
Passerines	Brewer's Sparrow	*Spizella breweri*	USFWS-CC, BLM-S, WGFD-SGCN
	Lark Bunting	*Calamospiza melanocorys*	WGFD-SGCN
	Loggerhead Shrike	*Lanius ludovicianus*	USFWS-CC, BLM-S
	Sagebrush Sparrow	*Artemisiospiza nevadensis*	USFWS-CC, BLM-S, WGFD-SGCN
	Sage Thrasher	*Oreoscoptes montanus*	USFWS-CC, BLM-S, WGFD-SGCN
Raptors	Burrowing Owl	*Athene cunicularia*	USFWS-CC, BLM-S, WGFD-SGCN
	Ferruginous Hawk	*Buteo regalis*	USFWS-CC, BLM-S, WGFD-SGCN
	Merlin	*Falco columbarius*	WGFD-SGCN
	Northern Goshawk	*Accipiter gentilis*	BLM-S, WGFD-SGCN
	Peregrine Falcon	*Falco peregrinus*	USFWS-CC, BLM-S, WGFD-SGCN
	Prairie Falcon	*Falco mexicanus*	USFWS-CC
	Swainson's Hawk	*Buteo swainsoni*	USFWS-CC, WGFD-SGCN
Waterbirds/ Waterfowl	Black-crowned Night-heron	*Nycticorax nycticorax*	WGFD-SGCN
	Canvasback	*Aythya valisineria*	WGFD-SGCN
	Clark's Grebe	*Aechmophorus clarkii*	WGFD-SGCN
	Lesser Scaup	*Aythya affinis*	WGFD-SGCN
	Long-billed Curlew	*Numenius americanus*	USFWS-CC, BLM-S, WGFD-SGCN
	Mountain Plover	*Charadrius montanus*	USFWS-CC, BLM-S, WGFD-SGCN
	Northern Pintail	*Anas acuta*	WGFD-SGCN
	Redhead	*Aythya americana*	WGFD-SGCN
	Sandhill Crane	*Grus canadensis*	WGFD-SGCN
	White-faced Ibis	*Plegadis chihi*	BLM-S, WGFD-SGCN

Notes:
USFWS-CC = USFWS Birds of Conservation Concern
BLM-S = BLM Rawlins Field Office Sensitive Species
WGFD-SGCN = WGFD SGCN listed species

Table 1.2. Phase I Bat Species.

Common Name	Scientific Name	Conservation Status
California Myotis	*Myotis californicus*	---
Fringed Myotis	*Myotis thysanodes*	BLM-S, WGFD-SGCN
Little Brown Myotis	*Myotis lucifugus*	WGFD-SGCN
Long-eared Myotis	*Myotis evotis*	BLM-S, WGFD-SGCN
Long-legged Myotis	*Myotis volans*	WGFD-SGCN
Western Small-footed Myotis	*Myotis ciliolabrum*	WGFD-SGCN
Yuma Myotis	*Myotis yumanensis*	---
Big Brown Bat	*Eptesicus fuscus*	WGFD-SGCN
Eastern Red Bat	*Lasiurus borealis*	WGFD-SGCN
Hoary Bat	*Lasiurus cinereus*	---
Pallid Bat	*Antrozous pallidus*	WGFD-SGCN
Silver-haired Bat	*Lasionycteris noctivagans*	---
Townsend's Big-eared Bat	*Corynorhinus townsendii*	BLM-S, WGFD-SGCN

Notes:
USFWS-CC = USFWS Birds of Conservation Concern
BLM-S = BLM Rawlins Field Office Sensitive Species
WGFD-SGCN = WGFD SGCN listed species

1.3 Relationship with Other Documents and Processes

PCW's commitments set out in this Phase I BBCS, in combination with the various applicant-committed conservation measures and conservation plans included within the Phase I site-specific plans of development (site-specific PODs), along with the requirements outlined in BLM's ROD, promote the conservation of migratory birds and bats as well as many other wildlife and fish species within or near Phase I. *See PCW 2015b; BLM 2012a; BLM 2012b.* The following sections describe the other documents and permitting processes that relate to this Phase I BBCS.

1.3.1 CCSM Project Background [3]

This BBCS is limited in scope to Phase I of the CCSM Project. Phase II of the CCSM Project will have a separate BBCS; however, this section describes the CCSM Project as a whole to provide context for the discussion that follows on permitting.

The CCSM Project is located in Carbon County, Wyoming, south of the City of Rawlins and Town of Sinclair. The project is sited on the Overland Trail Ranch (Ranch), which is owned and operated by PCW's affiliate TOTCO. The Ranch is a 320,000-acre agricultural operation, consisting primarily of cattle ranching and hay production. The Ranch is located in "checkerboard" country, in which land section ownership alternates between private land, mostly owned by TOTCO, and federal land managed by BLM along with a small portion of Wyoming State Land Board and WGFD-managed land. This pattern of land ownership dates back to the land grants made to the railroad under the Union Pacific Railway Act of 1862. The Ranch has some of the nation's best onshore wind energy resources, Class 6 and 7, with annual average winds above 8.8 meters per second (20 miles per hour) as mapped by AWS Truepower for the U.S. Department of Energy's National Renewable Energy Laboratory (NREL).

The CCSM Project will consist of 1,000 wind turbines capable of generating up to 3,000 MW of clean, renewable wind energy. Phase I includes 500 wind turbines and associated infrastructure including the Road Rock Quarry, West Sinclair Rail Facility and Phase I Haul Road and Facilities. The CCSM Project is partially located on federal land administered by BLM's Rawlins Field Office. This federal nexus triggered environmental reviews under NEPA. BLM prepared a Final Environmental Impact Statement (FEIS) and issued a ROD on the CCSM Project. BLM is also preparing two Environmental Assessments (EA) for Phase I. The EA for the Phase I Infrastructure Components is complete; on December 23, 2014, BLM issued a Decision Record approving the Phase I Infrastructure Components. *See BLM 2014a; BLM 2014b.* The EA for the remainder of Phase I, the Phase I Wind Turbine Development, is currently underway, and a Decision Record is anticipated in the fall of 2015. BLM's process to comply with NEPA and the status of its environmental review of the CCSM Project are described in more detail below.

[3] A more detailed description of the CCSM Project is included in chapter 3.0; however, some background is necessary to provide context for the discussion of the related documents and permitting processes.

1.3.2 Federal Environmental Review

BLM's Compliance with NEPA

Development of the CCSM Project began in November 2006 when applications for two right-of-way (ROW) grants for wind energy site testing and monitoring (Type-II Wind Energy Project Area Grants) were filed with BLM. The applications covered two areas of the Ranch, identified as Chokecherry and Sierra Madre. BLM granted the Chokecherry Wind Energy Project Area Grant on June 11, 2007, and the Sierra Madre Wind Energy Project Area Grant on June 15, 2007. By the end of June 2007, the first two meteorological towers were collecting data from the Chokecherry Project Area. Since the Type-II Wind Energy Project Area Grants were issued, PCW has erected over 30 meteorological towers, some located on private land and some located on federal land, collecting wind speed and weather data from diverse areas within Chokecherry and Sierra Madre. PCW has an easement from TOTCO for wind development on the privately owned sections, but a ROW grant for development of a wind energy project (Type-III Wind Energy Development Grant) from BLM is needed in order to use the adjoining federal land for the CCSM Project. Therefore, in January 2008, PCW submitted an application and plan of development (POD) for a Type-III Wind Energy Development Grant to BLM, which would authorize PCW to construct, operate, maintain and decommission the CCSM Project on BLM-administered land. Subsequently, BLM, in compliance with NEPA and in coordination with other state and local governmental agencies, commenced the preparation of an EIS, the most comprehensive form of environmental analysis.

<u>BLM's Environmental Impact Statement</u>

BLM published a Notice of Intent to prepare an EIS and conducted public scoping in August 2008. *See 73 Fed. Reg. 43,469 (July 25, 2008).* The agency action evaluated in the BLM's EIS was "to decide whether the area identified in PCW's proposal would be acceptable for development of a wind farm and identify the appropriate development strategy." *See BLM 2012b at p. ES-1.* On July 22, 2011, BLM segregated approximately 107,175 acres of federal land within the proposed project area and released the Draft EIS for public comment. On July 3, 2012, BLM published the Notice of Availability for the FEIS on the CCSM Project and the segregation of an additional 2,560 acres of federal land in the Federal Register. The BLM FEIS summarized the components of the CCSM Project as follows:

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

See BLM 2012b at p. ES-1. In addition, PCW applied to BLM for a new road to allow PCW to reopen an on-site quarry that will supply aggregate for CCSM Project roads.

BLM prepared a project-wide EIS based on a conceptual POD prepared by PCW. *See BLM 2012b, App. B.* BLM used the conceptual wind turbine and facility sites and conceptual construction schedule in preparing its overall impacts analysis which assumed the "greatest potential for [surface] disturbance" so that impacts identified at the time of micrositing the various project components would most likely not exceed those impacts described in the FEIS. *See BLM 2012a at p. 3-1.* The BLM FEIS recognizes that because BLM's estimates of project-wide impacts are based on conceptual siting and analysis of "the largest possible area of [surface] disturbance," additional NEPA analysis may be necessary for site-specific PODs to examine any impacts that may exceed those analyzed in the project-wide level FEIS. *See BLM 2012b, App. B at pp. 1& 2.* It therefore provides for further NEPA analysis of site-specific PODs to be tiered to the BLM FEIS. *See BLM 2012b, App. B at p. 1.*

The potential impacts to migratory birds and bats at the CCSM Project were analyzed in the BLM FEIS. The BLM FEIS identifies the potential impacts including direct impacts consisting of fatalities and loss of habitat, as well as indirect impacts associated with habitat loss, modification, and displacement. *See BLM 2012b at pp.4.14-15 & 4.14-18.* BLM recognizes that "[t]he magnitude of these impacts depends upon the number of wind turbines and other infrastructure constructed for each alternative and the amount of direct and indirect habitat lost due to construction and operation of the project." *See BLM 2012b at p. 4.14-18.*

The BLM FEIS evaluates the impacts of granting the requested ROWs based on available data as of June 2012, for a 1,000 wind turbine, 3,000 MW project without the benefit of the avoidance, minimization, and conservation measures included in this Phase I BBCS. Without these measures in place, BLM recognizes that significant impacts to certain migratory bird and bat species may occur. *See BLM 2012b at p. 4.14-26 & 4.14-51.* The BLM FEIS requires development of an APP and BPP to avoid and minimize impacts to migratory birds and bats. Further, the BLM FEIS states that "Any project constraints and mitigation measures identified through the development of the [BBCS] will be approved prior to issuance of any Notice to Proceed for the project and, in turn, associated stipulations would be incorporated into the ROW grants."[4] *See BLM 2012b at p. 4.14-16 & 4.14-22.*

BLM's Record of Decision

On October 9, 2012, the U.S. Secretary of the Interior Ken Salazar signed the ROD approving wind energy development in the Chokecherry and Sierra Madre Wind Development Areas. In the ROD BLM determined that portions of the areas for which PCW seeks ROWs "are suitable for wind energy development and associated facilities . . . as described under the Preferred Alternative in the CCSM project Final EIS." *See BLM 2012a at p. ES-1.* BLM's Selected Alternative provides for "development of a

[4] The procedure for issuing ROW grants and NTP was detailed further in the Decision Record for EA1. *See "BLM's Supplemental Tiered NEPA Analysis."*

2,000- to 3,000- megawatt (MW) project consisting of up to 1,000 wind turbines and ancillary facilities in the two sites, the 109,086-acre Chokecherry site and 110,161-acre Sierra Madre site, and off-site access on 460 acres." *See BLM 2012a at p. ES-1.* The Sierra Madre Wind Development Area consists of two distinct areas located both east and west of Highway 71 - with the majority of the wind development acreage located west of Highway 71. *See BLM 2012a at Figure 3-1.* The portion of Sierra Madre located west of Highway 71 is referred to as Miller Hill, and the portion of Sierra Madre located east of Highway 71 is referred to as Sage Creek Basin. *See BLM 2012a, App. B at pp. 4-25 & 4-26. See Figure 4-10.* The Chokecherry Wind Development Area is located east of Highway 71, and is divided into Western and Eastern Chokecherry based on topography. *See BLM 2012a, App. B at p. 4-26, Figure 4-10.*

The BLM FEIS and ROD outline a detailed procedure under which PCW will submit site-specific PODs to BLM for subsequent NEPA analysis tiered "to the analysis and site-specific terms and conditions described in the ROD associated with the project-wide EIS." *See BLM 2012a at p. C-1.* The BLM ROD provides that "BLM will closely evaluate the site-specific [PODs] to determine whether the impacts exceed the [surface] disturbance estimates from the conceptual layouts that served as the basis for determining significance of impacts in the project-wide level EIS." *See BLM 2012a at p. 3-1.* The BLM ROD therefore provides that future site-specific development plans "will be screened against the analysis conducted in this EIS, and then the appropriate level of subsequent, tiered NEPA analysis will be conducted prior to BLM issuing a decision on ROW applications." *See BLM 2012a at p.3-3; BLM 2012a, App. C.* Thus, the ROD anticipated additional environmental review would be conducted by BLM.

The BLM ROD also recognizes that USFWS has jurisdiction with respect to migratory birds; therefore, the BLM ROD requires action by USFWS before BLM will issue a NTP for construction of the CCSM Project. *See BLM 2012a at pp. 3-1 & 3-4.* As explained in the BLM ROD, PCW is to provide an APP (now Eagle Conservation Plan [ECP] and BBCS) that incorporate "additional data collection activities, avoidance and minimization measures, offsite mitigation strategies that could be implemented, and monitoring to determine effectiveness of mitigation measures." *See BLM 2012a at p. 1-2.* The ROD indicates that once PCW develops an ECP and BBCS, BLM will incorporate the measures "into subsequent NEPA analyses and ROW grants." *See BLM 2012a at pp. ES-2 & 1-2.*

In sum, the BLM FEIS and ROD contemplated that "conceptual" construction plans would be refined and become "final" plans or site-specific PODs that would be evaluated as part of BLM's tiered NEPA process for the CCSM Project. The ROD also requires action by USFWS with respect to PCW's ECP and BBCS. The process set out in the ROD identifies that PCW should work with USFWS in submitting refined wind turbine layouts in the applicable site-specific PODs that implement further avoidance and minimization measures. The ROD further provides that "BLM will not issue ROW grants to PCW [ ] until USFWS issues letters of concurrence for the [BBCS] and ECPs." *See BLM 2012a at p. 3-1.*

BLM's Supplemental Tiered NEPA Analysis

PCW's 2012 POD provided that its approach to construction of the CCSM Project would be finalized and detailed in the site-specific PODs submitted to BLM. *See BLM 2012a, App. B at p. 4-1.* PCW's POD also recognized that the "[p]roject design will continue to be updated and refined to utilize the best data and information available." *See BLM 2012a, App. B at p. 4-1.*

PCW submitted four site-specific PODs covering Phase I to BLM for review. In accordance with the ROD, BLM is preparing two EAs evaluating PCW's Phase I site-specific PODs. These EAs are tiered to the BLM FEIS. EA1 is complete and addresses PCW's site-specific PODs for: (1) Phase I Haul Road and Facilities; (2) West Sinclair Rail Facility; and (3) Road Rock Quarry. A Decision Record for EA1 was issued on December 23, 2014. *See BLM 2014a.* EA2 addresses PCW's site-specific POD for the Phase I Wind Turbine Development, including 500 wind turbines and approximately 1,500 MW. BLM issued a draft of EA2 for public review and comment on March 9, 2016. USFWS and WGFD are acting as cooperating agencies on both of the EAs being prepared by BLM.

BLM held four public scoping meetings in September and December 2013 to provide the public with opportunities to provide input on each EA. BLM made a draft of EA1 available to the public for review and comment on August 11, 2014, including a draft Decision Record finding that "no new or significant impacts were identified beyond those already disclosed in the EIS." BLM issued the final Decision Record for EA1 on December 23, 2014, approving the Phase I Infrastructure Components. *See BLM 2014a.* The Decision Record clarifies BLM's intent regarding the ROD's requirements for coordination with USFWS and issuance of Notices to Proceed for the CCSM Project. According to the Decision Record, "[t]he Notice to Proceed (NTP) for individual [site-specific PODs] would be issued as permitting requirements are completed." *See BLM 2014a.* Specific to this Phase I BBCS, the Decision Record states that, "[t]he USFWS concurrence is dependent on PCW submitting a complete application for an eagle take permit, including an ECP and [BBCS] that has all the USFWS required components and is adequate for review of the application." *See BLM 2014a at p. 4.*

USFWS Compliance with NEPA

PCW has submitted applications to USFWS for BGEPA non-purposeful take permits covering activities at Phase I of the CCSM Project. On June 15, 2015, PCW filed its application for a 30-year programmatic take permit for Phase I of the CCSM Project, as well as a standard take permit for potential disturbance take that may occur during construction of Phase I. PCW's applications for eagle take permits (ETPs) incorporate its detailed ECP for Phase I. The Phase I ECP documents PCW's: (a) identification of important eagle use areas; (b) comprehensive actions it has already taken and those it has committed to implement in the future to avoid and minimize adverse effects to eagles, including its commitment to compensatory mitigation; and (c) procedures it will employ to monitor for impacts to eagles during construction and operation of Phase I. Based on its commitments in the Phase I ECP, PCW believes Phase I meets the standards in 50 C.F.R. §22.26 for issuance of ETPs for incidental take.

USFWS's consideration of PCW's applications for ETPs is a discretionary federal action that is subject to NEPA. USFWS has determined that preparation of an EIS is appropriate to comply with NEPA. PCW notified USFWS of its intent to pursue ETPs for the CCSM Project in 2012. USFWS began preparation of its EIS on December 4, 2013, with the publication of a Notice of Intent in the Federal Register. *See 78 Fed. Reg. 72,926 (December 4, 2013).* As set forth in the Notice of Intent, USFWS's purpose and need is to respond to PCW's applications and consider whether or not to issue ETPs to PCW. In responding to PCW's applications for ETPs, USFWS must ensure compliance with BGEPA and its regulations as well as USFWS's goal to maintain stable or increasing breeding populations of bald and golden eagles. While the purpose and need for USFWS's EIS is to respond to PCW's applications for ETPs, the USFWS EIS will also consider the measures included in this Phase I BBCS.

USFWS is preparing its EIS to analyze impacts to eagles, raptors, migratory birds, bats and their habitats from Phase I, to evaluate potential issuance of ETPs for Phase I in parallel with BLM's preparation of the Phase I EAs. USFWS held public scoping meetings for its EIS in Rawlins and Saratoga, Wyoming, on December 16 and 17, 2013, respectively. The USFWS Draft Environmental Impact Statement (DEIS) was issued for public review and comment on April 29, 2016. *See 81 Fed. Reg. 25,688 (April 29, 2016).* The USFWS EIS will analyze the measures described in PCW's Phase I ECP and this Phase I BBCS as well as consider and incorporate where appropriate other relevant information sources, including BLM's NEPA documentation and PCW's site-specific PODs. USFWS is a cooperating agency on the two EAs being prepared by BLM. *See "BLM's Supplemental Tiered NEPA Analysis."*

Section 7 Consultation

The ESA directs all federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the Act. Section 7 of the ESA, called "Interagency Cooperation," is the mechanism by which federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species. Under section 7, federal agencies must consult with USFWS when any action the agency carries out, funds, or authorizes (such as through a permit) *may affect* a listed endangered or threatened species or designated critical habitat.

For the CCSM Project, BLM formally consulted with USFWS resulting in the issuance of a Biological Opinion (BO). *See BLM 2012a, App. F.* All reasonable and prudent measures and terms and conditions for threatened and endangered species listed in the BO will be included by BLM as requirements of any ROW grants BLM issues for the CCSM Project. *See BLM 2012a at p. 4-2; 50 C.F.R. § 402.* In addition, the BO incorporates PCW's applicant-committed measures (ACMs) from the BLM FEIS and ROD; therefore, the ACMs are mandatory requirements of the BO. *See BLM 2012a at p. 4-2.* However, implementation of the conservation measures for proposed and candidate species identified in the BO to reduce potential adverse impacts are discretionary, unless already included in PCW's ACMs. *See BLM 2012a at p. 4-2.*

The migratory birds and bats that are the subject of this Phase I BBCS are not threatened or endangered species and are therefore not protected under the ESA and are not included in the section 7 consultation process. However, when considering PCW's applications for ETPs, USFWS may conduct "intra-Service consultation" regarding threatened and endangered species, as well as proposed species, and candidate species. If necessary, this process would be completed in conjunction with USFWS's NEPA process. *See "USFWS Compliance with NEPA."*

1.3.3 State and County Permitting

In addition to complying with the requirements of BLM and USFWS, the CCSM Project is subject to state and county permitting. PCW has already obtained the principal state and county permits for the CCSM Project. The fact these permits have been issued will not negatively impact the ability of USFWS and BLM to require future modifications to the CCSM Project based on additional environmental analysis, or to enforce such modifications. Although the state and county permitting processes each have their own requirements, they complement and further the goals of BLM and USFWS to avoid, minimize and mitigate the environmental impacts of the CCSM Project. Moreover, they both require that PCW comply with all applicable federal and state laws, regulations, and standards, as well as any requirements of the federal permitting processes.

Wyoming State Permitting Process

Pursuant to Wyo. Stat. Ann. §35-12-101 *et seq.*, PCW is required to have a permit from the Wyoming Industrial Siting Council (ISC) to construct and operate the CCSM Project. On May 12, 2014, PCW filed its permit application with the Department of Environmental Quality, Industrial Siting Division. On July 18, 2014, the Division determined that PCW's application was complete pursuant to Wyo. Stat. Ann. § 35-12-109. The ISC held a two-day administrative hearing beginning on August 5, 2014, in Saratoga, Wyoming. At the end of the hearing, the ISC deliberated in public and unanimously voted to grant PCW a permit for the CCSM Project. The permit issued by ISC on September 12, 2014 requires PCW to comply with all applicable federal permits. Moreover, should BLM or USFWS require modifications to the CCSM Project, enforcement mechanisms are two-fold: (1) if PCW does not make the required modifications, BLM will not issue the ROW grants and the NTPs; and (2) PCW would be in violation of its Wyoming state permit for not meeting the applicable federal permit requirements.

Carbon County Permitting Process

PCW has obtained a Conditional Use Permit (CUP) for the CCSM Project from the Carbon County Board of Commissioners. On September 17, 2012, a public meeting of the Carbon County Planning and Zoning Commission was held, pursuant to section 5.11 of the Carbon County Zoning Resolution of 2003, as amended, in order to provide the opportunity for public comment on PCW's application for a CUP. After considering the Staff Recommendation from the Office of Planning and Development and both written and verbal public comments, the Planning and Zoning Commission voted to recommend approval of the CUP with conditions.

On October 2, 2012, the Carbon County Board of Commissioners (pursuant to section 5.11 of the Carbon County Zoning Regulations of 2003, as amended, and W.S. §18-5-501 *et seq.*) held a public meeting and convened a public hearing for purposes of allowing members of the public to comment on the CCSM Project. Following the hearing and the entry of specific findings into the record, the Board voted unanimously to approve PCW's application for a CUP.

On October 18, 2012, at a regularly scheduled meeting, the Board presented, read and adopted the Opinion of Board of County Commissioners Carbon County, Wyoming Regarding the Decision to Approve the CUP – Commercial Wind Energy Facility (C.U.W. Case File #2012-01) Rendered on October 2, 2012, (the Opinion). The Opinion reflects that the Board made specific and detailed findings of fact that: (1) according to the Carbon County Planning and Zoning Commission, the CCSM Project will comply with standards required by W.S. §18-5-504 and with all applicable zoning and county land use regulations; (2) the application for the CCSM Project meets all standards and requirements of W.S. §18-5-501 *et seq.* and all applicable zoning and county land use regulations; and (3) the CCSM Project is in general conformance with the Carbon County Comprehensive Land Use Plan, as amended, and otherwise promotes the health, safety and general welfare of the residents of Carbon County.

The CUP contains the following conditions of approval:

- Nothing in this permit's conditions is intended to preempt other applicable State and Federal laws or regulations. All WECS[5] Project facilities shall be constructed to meet and be maintained in compliance with all Federal, State, and County requirements, including all Wyoming Industrial Siting Council requirements.

- This Permit is subject to final approval and issuance of a permit by the Industrial Siting Council and a ROW grant by the Bureau of Land Management. The Applicant(s) shall submit a copy of all subsequent Federal and State approvals, including all required studies, reports and certifications prior to the issuance of any building permits.

These permit conditions ensure that any requirements imposed by BLM or USFWS subsequent to Carbon County's issuance of the CUP will be enforced. On July 15, 2014, the Carbon County Board of County Commissioners approved a one-year extension of the Conditional Use Permit's requirement to commence construction within two years of the original date of issuance. On July 2, 2015, PCW applied to the Carbon County Board of County Commissioners for an additional two-year extension of the Conditional Use Permit's requirement to commence construction within two years of the original date of issuance. If approved, the extension would require commencement of construction by October 2, 2017.

[5] WECS means Wind Energy Conversion System. *See Carbon County §5.11 Wind Energy Overlay-District Regulations, Approved April 5, 2011 at 5.11(c)(1).*

1.4 PCW's Objectives and Environmental Commitment

PCW is a limited liability company organized in Delaware and authorized to do business in Wyoming. The company is indirectly wholly-owned by The Anschutz Corporation (Anschutz), an energy and natural resource company based in Denver, Colorado. Anschutz is a diversified company with worldwide investments in energy exploration, ranching and agriculture, lodging, transportation, telecommunications, and entertainment including music, sports and film production. PCW was formed to develop the CCSM Project.

1.4.1 Objectives

PCW's objectives for the CCSM Project are detailed in its POD submitted to BLM in conjunction with BLM's preparation of the FEIS and are also detailed in BLM's ROD. *See BLM 2012a at §3.6.2.* Generally, PCW's objectives for the CCSM Project are to help satisfy the projected future market for power from renewable energy sources by extracting the maximum potential wind energy from the site and developing a 3,000 MW wind energy project consisting of up to 1,000 wind turbines. As reflected in the ROD, "[t]hrough a confidential economic analysis reviewed by the National Renewable Energy laboratory, the applicant has determined that a project size of up to 1,000 wind turbines for the Application Area would provide the greatest return on investment using the highest capacity wind turbines commercially available at the time of development." *See BLM 2012a.* Originally, PCW determined that the Application Area could host up to 2,387 wind turbines. However, 397 wind turbines were removed from greater sage-grouse cores areas designated in Wyoming Executive Order 2011-5, Attachment A, Sage-Grouse Core Breeding Areas Version 3 (Core Areas), 52 wind turbines were removed from below-acceptable wind resource areas, and spacing between wind turbines was increased to avoid significant wake losses further decreasing the potential project size. *See BLM 2012a.* The resulting CCSM Project size of 1,000 wind turbines was considered in the economic analysis reviewed by NREL.

PCW's objectives for Phase I are tied closely to PCW's objectives for the CCSM Project as a whole. As described in the site-specific POD for the Phase I Wind Turbine Development, PCW has determined that developing the CCSM Project in two phases of 500 wind turbines (1,500 MW) each will achieve its purpose and need for the CCSM Project. S*ee PCW 2015b.* This overall size and phased approach is supported by the current market for renewable energy in the Desert Southwest and independent studies by both the NREL and the Western Electricity Coordinating Council (WECC). *See PCW 2015b.* PCW's objectives for Phase I are detailed in its site-specific POD for the Phase I Wind Turbine Development. However, generally, PCW's objectives for Phase I are to permit and build an economically viable project and to extract the maximum potential wind energy from the site by developing the first phase of the CCSM Project consisting of 500 wind turbines with an installed capacity of 1,500 MW.

1.4.2 Environmental Commitment

PCW's approach to development of the CCSM Project is novel because during the process, PCW maintained the flexibility that allowed it to significantly redesign the project from what was originally proposed. PCW has adjusted wind turbine layouts multiple times when finalizing the site-specific POD for the Phase I Wind Turbine Development as more information became available regarding the applicable environmental and site constraints and wildlife considerations. Through iterative application of the tiers identified in the USFWS Wind Energy Guidelines, PCW has substantially revised the CCSM Project from the original Wind Energy Application Area and its original Proposed Action to address potential environmental risks to species of concern, including migratory birds and bats. *See Section 5.1.*

Further, PCW is in the unique position of being able to partner with an affiliate to use the approximately 320,000-acre Ranch for the development of the CCSM Project. Since the 1990s, PCW affiliate TOTCO has owned and operated one of the largest cattle ranching operations in the West. TOTCO has been a part of the Carbon County community and a steward of the land and wildlife resources on the Ranch for over 15 years. PCW has a wind easement, access easement, transmission easement and other non-exclusive rights with respect to TOTCO's privately-owned land on the Ranch. The CCSM Project will result in long-term surface disturbance of less than 2,000 acres of the 320,000-acre Ranch, and ranching operations will continue without material change during construction and operation of the project.[6]

In sum, PCW has demonstrated its commitment to building and operating the CCSM Project in an environmentally responsible manner. Responsible development includes taking measures, such as those documented in this Phase I BBCS to avoid, minimize, and mitigate the CCSM Project's impact to wildlife populations, including migratory birds and bats, within the CCSM Project Site. The evolution of the CCSM Project illustrates: (1) PCW's attention to the early determination of potential environmental risks at the landscape scale; (2) PCW's adjustment of the CCSM Project siting and design based on species of concern and their habitat; (3) PCW's evaluation of potential environmental risks on the adjusted CCSM Project Site based on site-specific data; and (4) PCW's adjustment/limitation of the areas of potential wind turbine development on the CCSM Project Site to avoid, minimize, and mitigate the impacts to migratory birds, bats, and non-avian species.

[6] Surface disturbance is used to define project areas and is not intended to represent the full range of direct and indirect impacts to migratory birds and bats. *See Section 1.1*.

2.0 Regulatory Framework

There is a comprehensive and complex existing legal framework designed to protect migratory birds and bats. This framework includes statutes in the United States Code (U.S.C.), federal regulations, state statutes, state regulations, the USFWS Wind Energy Guidelines, the WGFD State Wildlife Action Plan (SWAP), and the WGFC Wind Energy Recommendations. Brief summaries of the major components of this legal framework are set out below. While not all of the legal authorities summarized in this section apply to this Phase I BBCS, which is limited in scope to migratory birds and bats, they are included to provide context.

2.1 Migratory Bird Treaty Act[7]

The Migratory Bird Treaty Act (MBTA) is the cornerstone of migratory bird conservation and protection in the United States. The MBTA implements four treaties that provide for international protection of migratory birds. It has been described as a strict liability statute, meaning that proof of intent, knowledge, or negligence is not an element of an MBTA violation. Under the statute, actions resulting in a "taking" or possession (permanent or temporary) of a protected species, in the absence of an USFWS permit or regulatory authorization, are a violation of the MBTA.

The MBTA provides, "[u]nless 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 MBTA] 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." *See 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." *See 50 C.F.R. § 10.12.*

The MBTA provides criminal penalties for persons who commit any of the acts prohibited by the statute in section 703 on any of the species protected by the statute. *See 16 U.S.C. § 707.*

USFWS maintains a list of all species protected by the MBTA at 50 C.F.R. § 10.13. This list includes over 1,000 species of migratory birds, including eagles and other raptors, waterfowl, shorebirds, seabirds, wading birds, and passerines. The MBTA does not protect introduced species such as the house (English) sparrow, European starling, rock dove (pigeon), Eurasian collared-dove, and non-migratory upland game birds. USFWS maintains a list of introduced species not protected by the Act. *See 70 Fed. Reg. 12,710 (2005)*.

[7]Drawn from USFWS 2012a at p. 2.

2.2 Bald and Golden Eagle Protection Act[8]

This Phase I BBCS addresses migratory birds and bats other than bald and golden eagles. PCW has developed an ECP for Phase I and has applied for eagle take permits as described in section 1.3.2. Therefore, a brief summary of the Bald and Golden Eagle Protection Act (BGEPA) is provided for reference. Detailed information on the regulatory framework surrounding bald and golden eagles and PCW's commitments to avoid and minimize impacts to bald and golden eagles is included in the Phase I ECP. *See PCW 2015a.*

Under the authority of 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." *See 16 U.S.C. § 668.* BGEPA also defines take 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. *See 16 U.S.C. § 668.* USFWS has further defined the term "disturb" as agitating or bothering an eagle to a degree that causes, or is likely to cause, injury, or either a decrease in productivity or nest abandonment by substantially interfering with normal breeding, feeding, or sheltering behavior. *See 50 C.F.R. § 22.3*. Through its authority for implementation of BGEPA USFWS may permit the take of eagles for certain purposes and under certain circumstances, including scientific or exhibition purposes, religious purposes of Indian tribes, and the protection of wildlife, agricultural, or other interests, so long as that take is compatible with the preservation of eagles. *See generally, 16 U.S.C. § 668(a).*

2.3 Endangered Species Act[9]

This BBCS addresses migratory birds and bats within Phase I of the CCSM Project. No migratory birds or bats that are listed, proposed, or candidate endangered and threatened species occur within Phase I of the CCSM Project. Nevertheless, while the provisions of the Endangered Species Act (ESA) do not apply to the species addressed in this Phase I BBCS, a summary of the ESA is provided for reference.

The purpose of the ESA is to protect and recover imperiled species and the ecosystems upon which they depend. USFWS administers the ESA for terrestrial and freshwater organisms. Under the ESA, species may be listed as either endangered or threatened. "Endangered" means a species is in danger of extinction throughout all or a significant portion of its range. "Threatened" means a species is likely to become endangered within the foreseeable future. For the United States, all native species of plants and animals, except pest insects, are eligible for listing under ESA as endangered or threatened. The ESA directs USFWS to identify and protect endangered and threatened species and their critical habitat, and to provide a means to conserve their ecosystems.

8Drawn from USFWS 2012a at pp. 2 & 3.
9Drawn from USFWS 2013a at p. 2 and USFWS 2013c.

Section 7 of the ESA requires federal agencies to use their legal authorities to promote the conservation purposes of the ESA and to consult with USFWS, as appropriate, to ensure that effects of actions they authorize, fund, or carry out are not likely to jeopardize the continued existence of listed species. During consultation the "action" agency receives a "biological opinion" or concurrence letter addressing the proposed action. BLM consulted with USFWS under section 7 of the ESA for the CCSM Project. The biological opinion for the CCSM Project is included in BLM's ROD. *See BLM 2012a at App. F.* As noted in section 1.3.2, "[t]he USFWS concurrence [for Phase I] is dependent on PCW submitting a complete application for an eagle take permit, including an ECP and [BBCS] that has all the USFWS required components and is adequate for review of the application." *See BLM 2014a at p. 4.*

Section 9 of the ESA prohibits take of federally-listed species. Take is defined as "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct." *See 16 U.S.C. §1532.* The term "harm" is defined as "an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering." *See 50 C.F.R. §17.3.* The ESA imposes civil and criminal penalties for violations of the statute or its regulations.

2.4 U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines[10]

To reduce impacts to migratory birds, bats, and their habitats from wind energy facilities, USFWS advises wind energy project developers to follow the voluntary USFWS Land-Based Wind Energy Guidelines (USFWS Wind Energy Guidelines). *See USFWS 2012a*. The Wind Energy Guidelines were developed by USFWS working with the Department of the Interior Wind Turbine Guidelines Advisory Committee, a federal advisory committee consisting of representatives of the wind energy industry, conservation groups, state wildlife agencies, and USFWS. They replace interim voluntary guidance issued by USFWS in 2003.

The final voluntary USFWS Wind Energy Guidelines provide a structured, scientific process for addressing wildlife conservation concerns at all stages of land-based wind energy development. They also promote effective communication among wind energy developers and federal, state, and local conservation agencies and tribes. When used in concert with appropriate regulatory tools, the USFWS Wind Energy Guidelines form the best practical approach for conserving species of concern. The USFWS Wind Energy Guidelines discuss various risks to "species of concern" from wind energy projects, including collisions with wind turbines and associated infrastructure; loss and degradation of habitat from wind turbines and infrastructure; fragmentation of large habitat blocks into smaller segments that may not support sensitive species; displacement and behavioral changes; and indirect effects such as increased predator populations or introduction of invasive plants. *See USFWS 2012a at p. 7.* The USFWS Wind Energy Guidelines assist developers in identifying species of concern that may potentially be affected by their proposed project, including migratory birds; bats; bald and golden eagles and other

[10]Drawn from USFWS2012a at vi and vii.

birds of prey; prairie grouse and sage-grouse; and listed, proposed, or candidate endangered and threatened species. *See USFWS 2012a at p. 7.*

The USFWS Wind Energy Guidelines recommend a "tiered approach" for assessing potential adverse effects to species of concern and their habitats. The tiered approach is an iterative decision-making process for collecting information in increasing detail; quantifying the possible risks of proposed wind energy projects to species of concern and their habitats; and evaluating those risks to make siting, construction, and operation decisions. During pre-construction tiers (Tiers 1, 2, and 3), developers work to identify, avoid and minimize risks to species of concern. During post-construction tiers (Tiers 4 and 5), developers assess whether actions taken in earlier tiers to avoid and minimize impacts are successfully achieving the goals and, when necessary, take additional steps to compensate for impacts. Subsequent tiers refine and build upon issues raised and efforts undertaken in previous tiers. Each tier offers a set of questions to help developers evaluate the potential risk associated with developing a project at the given location.

The tiered approach provides the opportunity for evaluation and decision-making at each stage, enabling a developer to abandon or proceed with project development, or to collect additional information if required. This approach does not require that every tier, or every element within each tier, be implemented for every project. Instead, the tiered approach allows efficient use of developer and agency resources with increasing levels of effort. The USFWS Wind Energy Guidelines also provide Best Management Practices (BMPs) for site development, construction, retrofitting, repowering, and decommissioning.

The USFWS Wind Energy Guidelines include a Communications Protocol that provides guidance to both developers and USFWS personnel regarding appropriate communication and documentation. Adherence to the USFWS Wind Energy Guidelines is voluntary and does not relieve any individual, company, or agency of the responsibility to comply with laws and regulations. However, USFWS recommends that a BBCS be prepared in accordance with the USFWS Wind Energy Guidelines. USFWS has informed PCW that this Phase I BBCS should be prepared for Phase I in accordance with its Wind Energy Guidelines and that both the Phase I BBCS and Phase I ECP should be stand-alone documents. *Region 6, USFWS, personal communication, 2013*.

2.5 Wyoming Game and Fish Department State Wildlife Action Plan[11]

State Wildlife Action Plans (SWAPs) are comprehensive wildlife conservation strategies to maintain the health and diversity of wildlife within a state, including species with low and declining populations. *See WGFD 2010 at p. I-1-1.* They contain broad-based strategies to meet this goal, including conservation strategies aimed at preventing the need for listing additional species under the ESA. Special emphasis is given in the Wyoming SWAP to addressing wildlife species that have historically received less conservation attention, including those that are not hunted or fished. *See WGFD 2010 at p. I-2-1.*

[11] Drawn from WGFD 2010.

According to the Wyoming SWAP, conserving Wyoming's wildlife species is heavily dependent upon the future quantity and quality of available habitat, both terrestrial and aquatic. *See WGFD 2010 at p. I-2-2.* In turn, the amount and condition of available wildlife habitat is influenced by the success in developing strategies to address the issues which are having the greatest impact on wildlife and habitat resources. Accordingly, to develop conservation strategies, the Wyoming SWAP identifies: (1) the five leading conservation challenges in the state; (2) the terrestrial habitats and aquatic basins within the state; and (3) the wildlife species of greatest conservation need. The Wyoming SWAP then recommends appropriate conservation actions and strategies for these habitats and species.

The Wyoming SWAP addresses many of the migratory bird and bat species that are the subject of this Phase I BBCS. Further, the Wyoming SWAP specifically designates energy development, including wind energy, as one of five leading wildlife conservation challenges in Wyoming. *See WGFD 2010 at p. II-i-1.* To proactively address the wildlife conservation challenges identified in the Wyoming SWAP while balancing the interest in and opportunity to develop Wyoming's wind energy, the WGFC developed recommendations for wind energy development that incorporate many of the conservation actions included in the 2010 SWAP. *See WGFC 2010.*

2.6 Wyoming Game and Fish Commission Wildlife Protection Recommendations for Wind Energy Development in Wyoming

The WGFC serves as the policy-making board of the WGFD and through the WGFD, the WGFC provides a system of control, propagation, management, protection, and regulation for all wildlife in Wyoming. *See W.S. § 23-1-301:303 & W.S. § 23-1-401.* The WGFC Wind Energy Recommendations are "the result of a decision by the WGFC to address the need to protect wildlife resources while wind energy is developed in the state." *See WGFC 2010 at p. i.* The recommendations are a proactive step toward balancing Wyoming's desire to develop its wind energy resources "while affording adequate protection of the state's wildlife resources from activities associated with development of a wind industry." *See WGFC 2010 at p. i.*

The WGFC Wind Energy Recommendations provide recommendations for: (1) collecting baseline data prior to wind turbine siting to avoid potential conflicts with wildlife; (2) construction and operation monitoring; and (3) mitigating impacts to affected wildlife. *See WGFC 2010 at p. ii.* The WGFC Wind Energy Recommendations recognize that not all of the recommendations in the document are applicable to all wind energy projects and states that the recommendations are intended to be applied based on site-specific project characteristics. Therefore, the WGFC Wind Energy Recommendations advise early consultation with WGFD to determine applicability and develop site-specific recommendations. *See WGFC 2010 at p. 31.* As noted in the WGFC Wind Energy Recommendations, the recommendations contained in the document are voluntary and the role of WGFC and WGFD is consultative. *See WGFC 2010 at p. i.* This Phase I BBCS documents PCW's coordination with WGFD on the CCSM Project and its adoption of the applicable provisions of the WGFC Wind Energy Recommendations consistent with the site-specific characteristics of Phase I.

2.7 Avian Power Line Interaction Committee (APLIC) Guidance

The Avian Power Line Interaction Committee (APLIC) leads the electric utility industry in protecting avian resources while ensuring reliable electric energy delivery. Since its inception in 1989, APLIC has addressed a variety of avian interactions with electric facilities including electrocutions, collisions, nests, and avian impacts associated with construction activities. At present, APLIC membership includes over 50 electric utilities, the Edison Electric Institute, USFWS, National Rural Electric Cooperative Association, and Rural Utilities Service.

APLIC provides electric utilities, wildlife agencies, and other stakeholders with suggested practices, guidance, and recommendations for reducing bird electrocutions and collisions with electric power lines based on the most current information. APLIC has issued guidance designed to reduce operational and avian risks by identifying minimization methods for avian electrocutions and collisions, including its Suggested Practices for Avian Protection of Power Lines: State of the Art in 2006 (2006 Suggested Practices) and Mitigating Bird Collisions with Power Lines: The State of the Art in 2012 (Collision Manual). *See APLIC 2006; APLIC 2012.* In addition, APLIC released national APP Guidelines in conjunction with USFWS in 2005. *See APLIC 2005.* The measures outlined in the APP Guidelines, the 2006 Suggested Practices, and the Collision Manual are designed to avoid and minimize risk to migratory birds.

3.0 Project Description and Environmental Setting

This BBCS is limited in scope to Phase I of the CCSM Project. Phase II of the CCSM Project will have a separate BBCS; however, portions of this chapter describe the CCSM Project as a whole to provide context.

The CCSM Project, as described in this chapter, represents the culmination of more than eight years of data collection, planning, and design, considering the environmental analysis completed by BLM, and collaboration and communication with USFWS, various non-governmental organizations, and state and local agencies, such as WGFD.

3.1 Phase I Description

PCW is developing the CCSM Project in two phases. *See Figure 3.1.* The proposed CCSM Project consists of 1,000 wind turbines capable of generating up to 3,000 MW of clean, renewable wind energy. Phase I consists of 500 wind turbines located in the western portions of two Wind Development Areas (WDAs) referred to as "Chokecherry" and "Sierra Madre" and associated infrastructure including the Road Rock Quarry, West Sinclair Rail Facility and Phase I Haul Road and Facilities. Phase I consists of 849 acres of long-term surface disturbance within the 74,066 acre Phase I Development Area.[12] *See Section 3.2.* Phase II will include 500 wind turbines and associated infrastructure located in the eastern portions of the Chokecherry and Sierra Madre WDAs. The significance of the WDAs is that these are the only areas in which PCW will install wind turbines.

[12] Surface disturbance is used to define project areas and is not intended to represent the full range of direct and indirect impacts to migratory birds and bats. *See Section 1.1*.

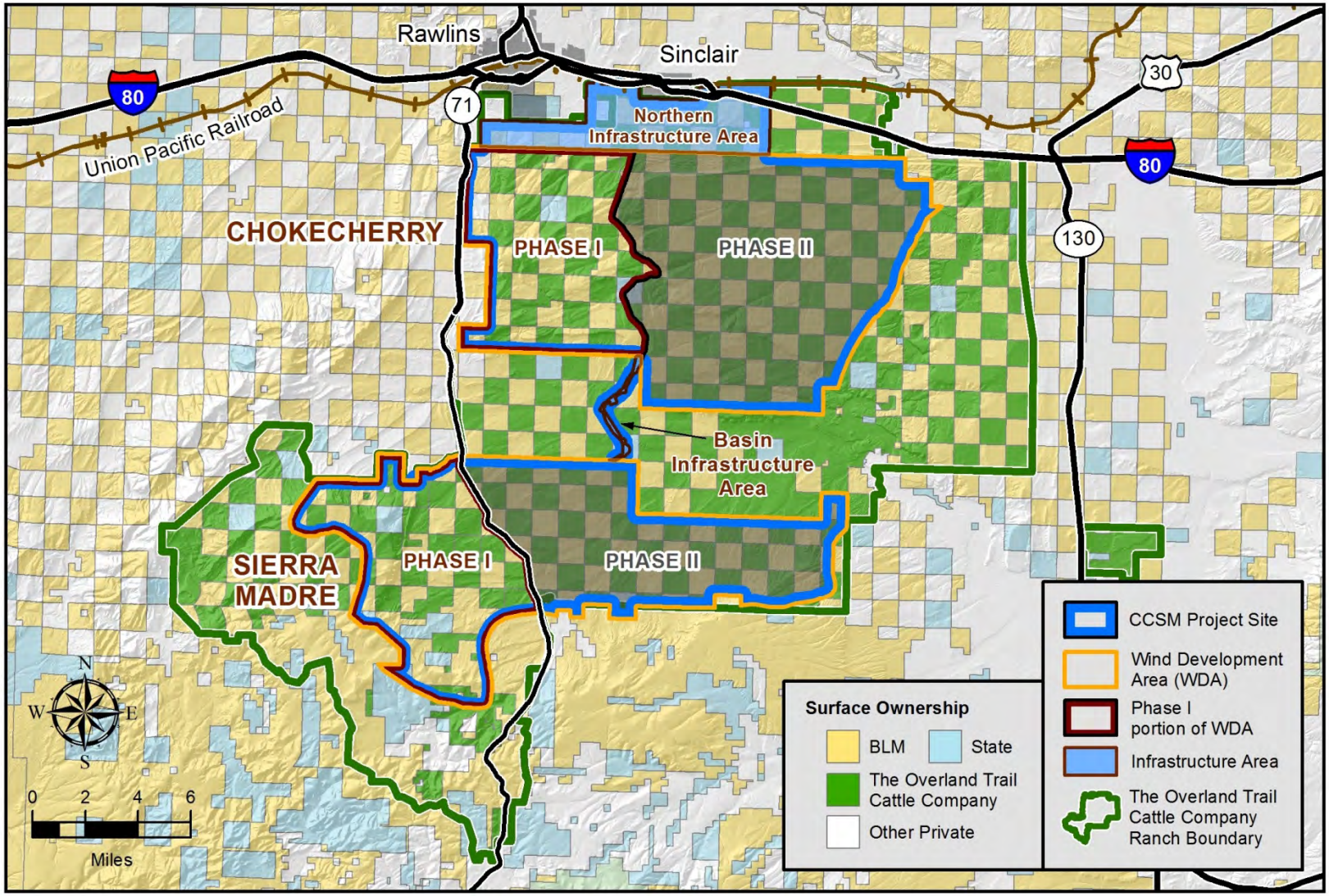

Figure 3.1. CCSM Project Overview.

As shown on Figure 3.2, Phase I within the Chokecherry WDA primarily includes the area west of the Haul Road. Within the Sierra Madre WDA, Phase I includes the area west of Highway 71/County Road 401. PCW submitted site-specific PODs to BLM for each component of Phase I. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*. As described in section 1.3.2, BLM issued its final Decision Record approving the Phase I Infrastructure Components (Phase I Haul Road and Facilities, West Sinclair Rail Facility, and Road Rock Quarry) on December 23, 2014, and is currently analyzing the Phase I Wind Turbine Development. The Phase I components included in each site-specific POD are summarized below and shown on Figure 3.2.

- **Phase I Haul Road and Facilities.** The Phase I Haul Road and Facilities include the Haul Road, certain arterial and facility access roads, water facilities, and laydown yards. *See PCW 2014c.* The Haul Road begins at the northern entrance to the CCSM Project where it connects to County Road [CR] 407. The Haul Road then travels west connecting to the West Sinclair Rail Facility and then south through the center of the Chokecherry WDA and finally through the Sierra Madre WDA.
- **West Sinclair Rail Facility (Rail Facility).** The West Sinclair Rail Facility consists of a rail connection to the Union Pacific Railroad main line between Rawlins and Sinclair and an associated laydown yard to receive, temporarily stage, and deliver components and construction-related materials. *See PCW 2014d.* The Rail Facility connects with the CCSM Project and is designed to minimize impacts on public roadways, provide more cost-effective transportation, and promote efficient project construction activities. The approximately 23 kilometers (14 miles) of track feature a wye, a lead track, a running track, a loop track, and several unloading areas. Vehicle access to the Rail Facility is from Interstate 80 (I-80), Exit 221 via the Haul Road.
- **Road Rock Quarry (Quarry).** Situated on private land within the CCSM Project Site at the location of an existing quarry approximately 3 kilometers (2 miles) south of Rawlins, the Road Rock Quarry will provide road construction material for the CCSM Project. *See PCW 2014b.* The Quarry will improve the efficiency of the CCSM Project by decreasing the number of train and truck trips from offsite quarries to the CCSM Project necessary for road base aggregate. The Quarry will be accessed via the Haul Road. Activities at the Quarry will involve surface rock mining and processing of sandstone and shale. The Quarry includes the excavation area, material processing area, materials storage piles, and the quarry access road (approximately 8 kilometers [5 miles] long).
- **Phase I Wind Turbine Development.** The Phase I Wind Turbine Development includes 500 wind turbines and associated elements for the CCSM Project such as roads, electrical lines, substations, operation and maintenance buildings, meteorological towers, utilities, and temporary construction features. *See PCW 2015b.* The Phase I Wind Turbine Development includes 202 wind turbines in the Chokecherry WDA and 298 wind turbines in the Sierra Madre WDA. The areas within the Phase I portions of the WDAs in which wind turbines will be constructed are referred to as Turbine Build Areas.

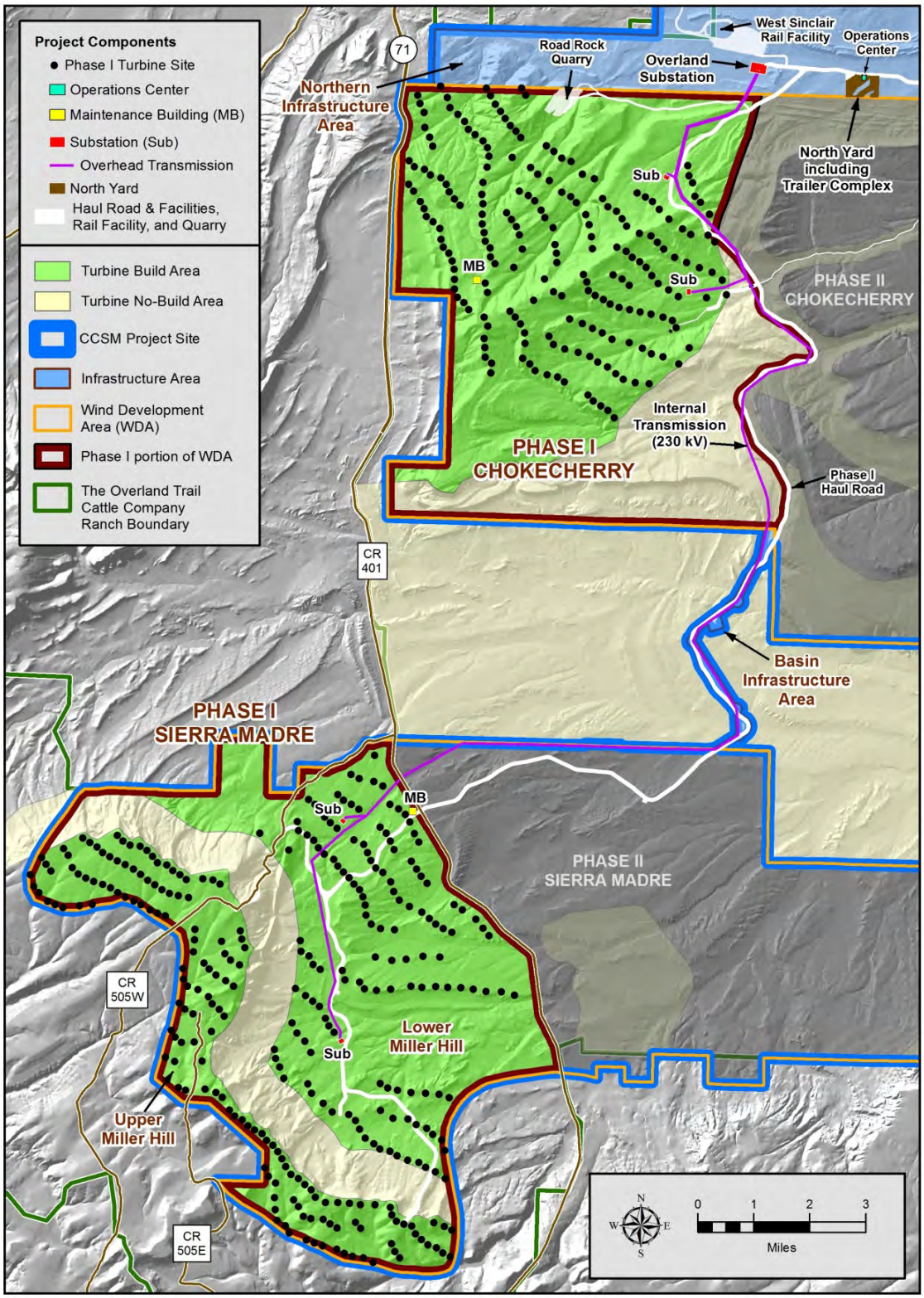

Figure 3.2. Phase I Layout.

3.1.1 Design

The Phase I Wind Turbine Development layout was developed in coordination with BLM, USFWS and WGFD using detailed site-specific information. The layout was designed to meet PCW's goals and objectives for the CCSM Project and Phase I while complying with BLM's ROD and guidance from USFWS and WGFD to avoid and minimize environmental impacts. The ROD considered and adopted numerous environmental constraints, applicant-committed measures, and mitigation measures to avoid or minimize environmental impacts. *See BLM 2012a at p. 3-13*. In addition, the USFWS Wind Energy Guidelines and the WGFC Wind Energy Recommendations recommend extensive measures including collecting site-specific survey data and the application of avoidance and minimization measures. *See USFWS 2012a; WGFC 2010.* In compliance with the ROD and the USFWS and WGFC guidance, PCW collected site-specific data and used a rigorous micrositing process to design the Phase I Wind Turbine Development.

As an initial matter, PCW's ability to site wind turbines was constrained to the WDAs as designated by BLM in the ROD. Within these designated WDAs, PCW used a four-step process to microsite the wind turbines for the Phase I Wind Turbine Development layout:

1. Gather technical data;
2. Complete field review;
3. Gather resource data; and
4. Incorporate agency input.

The Phase I wind turbine layout and infrastructure design went through numerous iterations. This process is described in more detail in chapter 4.0 of this Phase I BBCS. Figure 3.2 shows the Phase I wind turbine layout resulting from the design process, including PCW's consultation with USFWS and WGFD as described in this Phase I BBCS.

3.1.2 Wind Turbines

Wind turbines are designed according to industry standards to meet a range of wind and site conditions. For utility-scale wind turbines such as those required for the CCSM Project, vendors will review the Project's wind data and offer a model(s) that meets the requirements of the observed and predicted wind conditions. PCW is still evaluating wind turbine options for Phase I; however, all wind turbine models under consideration have the same general configuration, i.e. single-rotor, three-bladed upwind horizontal-axis design on a tubular tower. PCW will select wind turbine model(s) to maximize wind energy development potential while meeting the specifications identified as part of BLM's site-specific NEPA analyses and the specifications identified in this Phase I BBCS.

As analyzed in the BLM FEIS, all wind turbine models under consideration for the CCSM Project have a maximum tower height of 100 meters (328 feet) from ground level to the wind turbine hub and a maximum rotor diameter of 120 meters (394 feet). *See Figure 3.3 & Table 3.1.* While these dimensions represent the largest wind turbine dimensions under consideration, wind turbines that are presently being evaluated by PCW range in height from 80 meters (262 feet) to 85 meters (279 feet) with rotor diameters of 101 meters (331 feet) to 112 meters (367 feet). The area between the top of the rotor plane and the bottom of the rotor plane is referred to as the rotor swept zone (RSZ). Any wind turbine model selected by PCW will be painted the standard manufacturer color (approximately 5% grey) unless otherwise specified by BLM and approved by the Federal Aviation Administration (FAA).

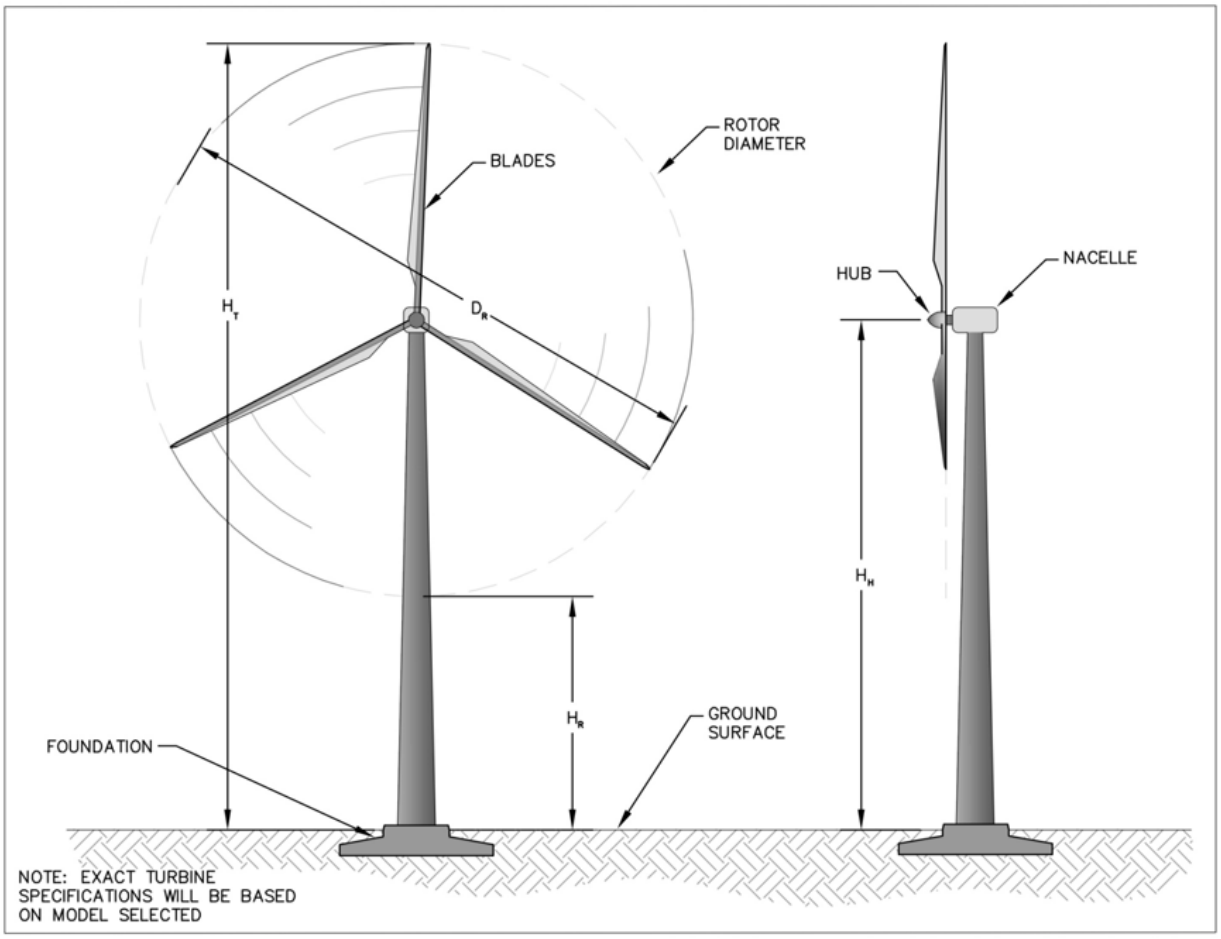

Figure 3.3. Wind Turbine Schematic.

Table 3.1. Phase I Wind Turbine Attributes.

Turbine Attribute	Expected Range
Rated Power	1.5 – 3.0 MW
Rotor Diameter (D_R)	253 – 394 ft. (77 – 120 m)
Tower Height (H_H)	256 – 328 ft. (78 – 100 m)
Top of Rotor Plane (H_T)	383 – 525 ft. (117 – 160 m)
Bottom of Rotor Plane (H_R)	130 – 197 ft. (40 –60 m)
Tower Type	Tubular Steel
Turbine Color	RAL 7035 (roughly 5% gray) or similar
Cut-In Wind Speed	7 – 9 mph (3 – 4 m/s)
Nominal Wind Speed	27 – 34 mph (12 – 15 m/s)
Cut-Out Wind Speed	48 – 56 mph (20 – 25 m/s)
Rotor Speed	4 – 20 RPM

3.1.3 Overhead Electrical System

The Phase I wind turbines are electrically connected via a 34.5kV electric collection system. The electric collection system transmits electricity from the individual wind turbines via overhead power lines to four collection substations. The Phase I 230 kV overhead transmission lines then connect to the collection substations and transfer the electrical generation from the collection substations to the interconnection substation where the electricity enters the regional electric grid. Detailed information on the Phase I electric collection and transmission system design is included in the Phase I Wind Turbine Development site-specific POD. *See PCW 2015b.*

The major equipment of the Phase I electric substations includes power transformers, aluminum and steel buswork and structures, circuit breakers and other protective devices, relaying and control instrumentation, area lighting, and a control house. The electric collection and transmission systems connect to the substations and wind turbines using a combination of underground cables and overhead lines. The design of the Phase I electric systems, including overhead electric line structure types and where underground and overhead lines are used, is based on the wind turbine and substation locations as well as a wide range of technical, environmental, and economic factors. Drawings of the Phase I overhead electric line structures and an example of a collection substation layout are included in Appendix C.

3.1.4 Surface Disturbance

This section discusses the types and extent of the Phase I surface disturbance. Surface disturbance is used to define project areas and is not intended to represent the full range of direct and indirect impacts to migratory birds and bats. Therefore, this discussion is not intended to provide the impacts analysis and disclosures required of federal agencies under the National Environmental Policy Act (NEPA). As describe in section 1.3.2, both the USFWS and BLM have prepared NEPA documentation to analyze the impacts of Phase I to migratory birds and bats and their habitats. This Phase I BBCS references these impact analyses where appropriate to evaluate risks to migratory birds and bats from Phase I.

Phase I surface disturbance includes initial surface disturbance, long-term surface disturbance, and activity areas. Initial surface disturbance is the total area that will be disturbed for construction of Phase I. Initial surface disturbance is inclusive of long-term surface disturbance, which consists of areas that will remain disturbed during operation of Phase I. Finally, activity areas are defined areas where activities may occur that do not require surface disturbance (would not be cleared or graded), e.g. locations for personnel to walk holding taglines that stabilize wind turbine component during lifts. Thick vegetation higher than one foot in activity areas may be trimmed to allow for safe vehicle access and minimize fire potential. Table 3.2 shows the estimated initial and long-term surface disturbance, as well as activity areas for Phase I by site-specific POD and cumulatively.

Table 3.2. Phase I Surface Disturbance and Activity Area Estimates.

Site-specific Plan of Development	Initial Surface Disturbance (acres)	Long-Term Surface Disturbance (acres)	Activity Area (acres)
Phase I Haul Road and Facilities	875	225	0
West Sinclair Rail Facility	370	121	0
Road Rock Quarry	184	18	0
Phase I Wind Turbine Development	3,035	485	440
Total Surface Disturbance	**4,464**	**849**	**N/A**

3.1.5 Schedule

Phase I construction is anticipated to begin in 2016 and be complete by 2020 as shown in Table 3.3. The Phase I schedule is designed to first open the site to road and rail access, then establish the on-site quarry, and finally proceed with wind turbine construction. In accordance with PCW's objective to develop the highest wind energy potential areas first, the Phase I portion of the Sierra Madre WDA will be constructed first followed by the Phase I portion of the Chokecherry WDA. PCW anticipates the installation of 229 wind turbines in 2019 and another 271 wind turbines in 2020. Following construction, Phase I has a proposed life of 30 years after which, subject to market conditions, it may be repowered as necessary to continue its operations.

Table 3.3. Phase I Construction Schedule.

Facility	2016	2017	2018	2019	2020[1]
Phase I Haul Road and Facilities					
Roads	Construct	Construct			
Laydown yards	Construct	Construct	Operate	Operate	Operate
Water facilities	Construct	Construct	Operate	Operate	Operate
West Sinclair Rail Facility					
Rail Facility		Construct	Construct	Operate	Operate
Access road	Construct				
Laydown yards		Construct	Construct	Operate	Operate
Road Rock Quarry					
Quarry	Construct	Mobilize & Operate	Operate	Operate	Operate
Access road	Construct				
Phase I Wind Turbine Development					
Roads			Construct	Construct	Construct
Wind turbine sites			Construct	Construct	Construct
Wind turbines				Construct/Operate[2]	Construct/Operate[2]
Substations and Transmission				Construct	Construct
Facilities		Construct	Construct	Construct	Construct

Notes:

1. Reclamation activities associated with Phase I construction will begin concurrent with construction in 2016 and may extend beyond 2020.
2. Wind turbines will be brought online as they are constructed. For purposes of this Phase I BBCS, commencement of commercial operation is considered to be the date that all 500 Phase I wind turbines are brought online and are available for dispatch. This is anticipated to occur at the end of the 2020 construction season.

3.2 Land Ownership

Phase I is located in Carbon County, Wyoming, within the bounds of the Ranch and the CCSM Project Site. The Ranch and CCSM Project Site boundaries are discussed below because they provide context for the environmental setting of Phase I and the conservation measures that will be discussed in subsequent chapters. As previously described, Phase I consists of 4,464 acres of initial surface disturbance, 849 acres of long-term surface disturbance, and 440 acres of activity areas over the approximately 74,066-acre Phase I Development Area.[13] *See Sections 3.2.3 & 3.2.4.*

3.2.1 Overland Trail Ranch

Since the 1990s, PCW affiliate TOTCO has owned and operated the Ranch, one of the largest cattle ranching operations in the West. Located south of the City of Rawlins and Town of Sinclair in Carbon County, Wyoming, the Ranch encompasses approximately 320,000 acres or 500 square miles. *See Figure 3.1.* As described in chapter 1.0, the Ranch is located in Wyoming's "checkerboard" country. The checkerboard consists of alternating square miles of private land, largely owned by TOTCO, and federal land managed by BLM and leased to TOTCO for grazing, along with a small portion of Wyoming State Land Board and WGFD-managed land.

3.2.2 CCSM Project Site

The CCSM Project Site is located within the Ranch boundary but excludes the western most portions of the Ranch on top of Miller Hill and areas east of the North Platte River. *See Figure 3.1.* The CCSM Project Site expressly excludes any part of: (1) designated greater sage-grouse Core Areas identified by the State of Wyoming under the Governor's Executive Order 2011-5 (EO 2011-5 Version 3 map); and (2) the Red Rim-Grizzly Wildlife Habitat Management Area (WHMA) identified by BLM in the FEIS.

3.2.3 Phase I Development Area

The Phase I Development Area consists of the Phase I portions of the Chokecherry and Sierra Madre WDAs and two infrastructure areas, the Northern and Basin Infrastructure Areas. *See Figure 3.2.* The Phase I portion of each WDA is further divided into Turbine Build Areas and Turbine No-build Areas as designated in chapter 4.0 and shown in Figure 3.2. Table 3.4 shows the total acreage and land ownership within the Phase I Development Area.

[13] Surface disturbance is used to define project areas and is not intended to represent the full range of direct and indirect impacts to migratory birds and bats. *See Sections 1.1 and 3.1.4*.

Table 3.4. Phase I Development Area Land Ownership.

	Private Land (acres)	Federal Land (acres)	State Land (acres)	Total (acres)
Turbine Build Area	23,401	21,558	1,968	46,927
Turbine No-Build Area	6,665	7,020	1,475	15,160
Infrastructure Components	5,955	4,612	1,412	11,979
Phase I Development Area	**36,021**	**33,190**	**4,855**	**74,066**

3.2.4 Phase I

Phase I is defined as the initial surface disturbance, long-term surface disturbance and activity areas contained within the Phase I Development Area.[14] *See Section 3.1.3.* Phase I surface disturbance and activity area estimates are shown in Table 3.2 and are further broken down by land ownership in Table 3.5.

Table 3.5. Phase I Land Ownership.

	Private Land (acres)	Federal Land (acres)	State Land (acres)	Total (acres)
Initial Surface Disturbance	1,568	1,346	121	**3,035**
Long-term Surface Disturbance	256	211	18	**485**
Activity Areas	264	153	23	**440**

3.3 Environmental Setting

The environmental setting of Phase I is described in the context of either the Ranch or the CCSM Project Site to provide perspective on the siting decisions and avoidance and minimization measures described in chapter 4.0. This section focuses on those elements of the environmental setting most relevant to migratory birds and bats. The environmental setting for other resources, such as air quality, soils, noxious and invasive weeds, range resources, cultural resources, paleontological resources, visual resources and socioeconomics for the CCSM Project are described in detail in BLM's FEIS and tiered EAs.

[14] Surface disturbance is used to define project areas and is not intended to represent the full range of direct and indirect impacts to migratory birds and bats. *See Sections 1.1 and 3.1.4*.

3.3.1 Land Use

Land use and land management affects migratory birds and bats. Current land use in Phase I and across the Ranch consists of agricultural operations, including cattle grazing and hay production. The Ranch includes the entire Pine Grove/Bolten grazing allotment as well as portions of 11 other grazing allotments. TOTCO manages the Ranch and each allotment to provide periodic growing season rest from grazing by decreasing stocking density and shortening the grazing period. *See BLM 2008a*. There are two areas of summer and winter range on the Ranch, and multiple potential grazing rotations across the Ranch. The grazing rotations allow rest for upland communities in spring and early summer, and late summer rest for riparian communities. Stocking rates and movement between various pastures within the allotments fluctuate yearly based on forage availability and resource conditions. According to BLM, since TOTCO has owned and operated the Ranch, the grazing management in the Bolten Ranch/Pine Grove allotment has been greatly improved; further, BLM has recognized that TOTCO's grazing management plan provides for a well-managed grazing program. *See BLM 2008a*.

In 2014, the BLM Rawlins Field Office once again recognized TOTCO for its environmental stewardship and range management initiatives across three of the BLM grazing allotments that TOTCO manages in Carbon County. Citing TOTCO's significant investments in range and water improvements on the Ranch, BLM found that all three allotments meet all six Rangeland Health Standards, including those that benefit wildlife such as migratory birds and bats. According to BLM, TOTCO's planned grazing rotations ensure all pastures receive growing season rest every other year, which has improved vegetation composition, condition and vigor while reducing bare ground. BLM cited improved grazing management as resulting in narrowed stream channels, increased woody plant composition and reduced sedimentation in streams. BLM also recognized TOTCO for its cooperative grazing management of the Grizzly allotment in conjunction with its three allotments, broadening benefits for wildlife habitat "on an even larger landscape level." *See BLM 2014c.*

3.3.2 Physiographic Setting

The Ranch, including the CCSM Project Site, is dominated by three topographic features, Chokecherry Plateau, Miller Hill, and Sage Creek Rim, separated by the Sage Creek Basin. As previously described, the CCSM Project Site is divided into two WDAs, Chokecherry to the north and Sierra Madre to the south. Each WDA is further divided into Phase I and Phase II. *See Figure 3.4.*

To the north, Chokecherry Plateau consists of ridges and rolling hills that generally slope northeasterly down toward the North Platte River. Approximately 40 kilometers (25 miles) of the North Platte River flow along the eastern edge of Chokecherry, with the vast majority occurring outside of the Chokecherry WDA. Most of the northern portion of Chokecherry is defined by a small, east/west ridge commonly known as a hogback, which is approximately 16 kilometers (10 miles) long, and the southern portion is defined by a cliff edge commonly referred to as the Bolten Rim, which is approximately 32 kilometers (20 miles) long. In addition, a prominent north/south ridge known as the Interior Chokecherry Rim bisects Chokecherry for approximately 19 kilometers (12 miles), and is cut by three ephemeral

drainages, Smith Draw, Hugus Draw, and Iron Springs Draw. Phase I is located entirely west of the Interior Chokecherry Rim.

The southwestern portion of the Ranch is dominated by a steep-sloped mesa commonly known as Miller Hill. This predominant feature slopes gently toward the south and southwest, with relatively level terrain near the edge of the rim and becoming increasingly undulated towards the southwest. Phase I includes Upper Miller Hill and Lower Miller Hill within the Sierra Madre WDA. *See Figure 3.4.*

The southeastern portion of the Ranch includes Sage Creek Rim, which has similar characteristics to Miller Hill, although this feature is not as large or high. Development areas on the Sage Creek Rim are included in Phase II of the CCSM Project.

The area between the Chokecherry and Sierra Madre WDAs is a high desert basin transected by Sage Creek and several smaller ephemeral tributaries. The majority of this basin is outside the WDAs; however, the Haul Road and internal transmission lines included in Phase I will traverse the Sage Creek Basin and connect the WDAs. Larger waterbodies, which include the Teton, Kindt, Rasmussen, and Sage Creek Reservoirs, are interspersed throughout this arid landscape outside of Phase I.

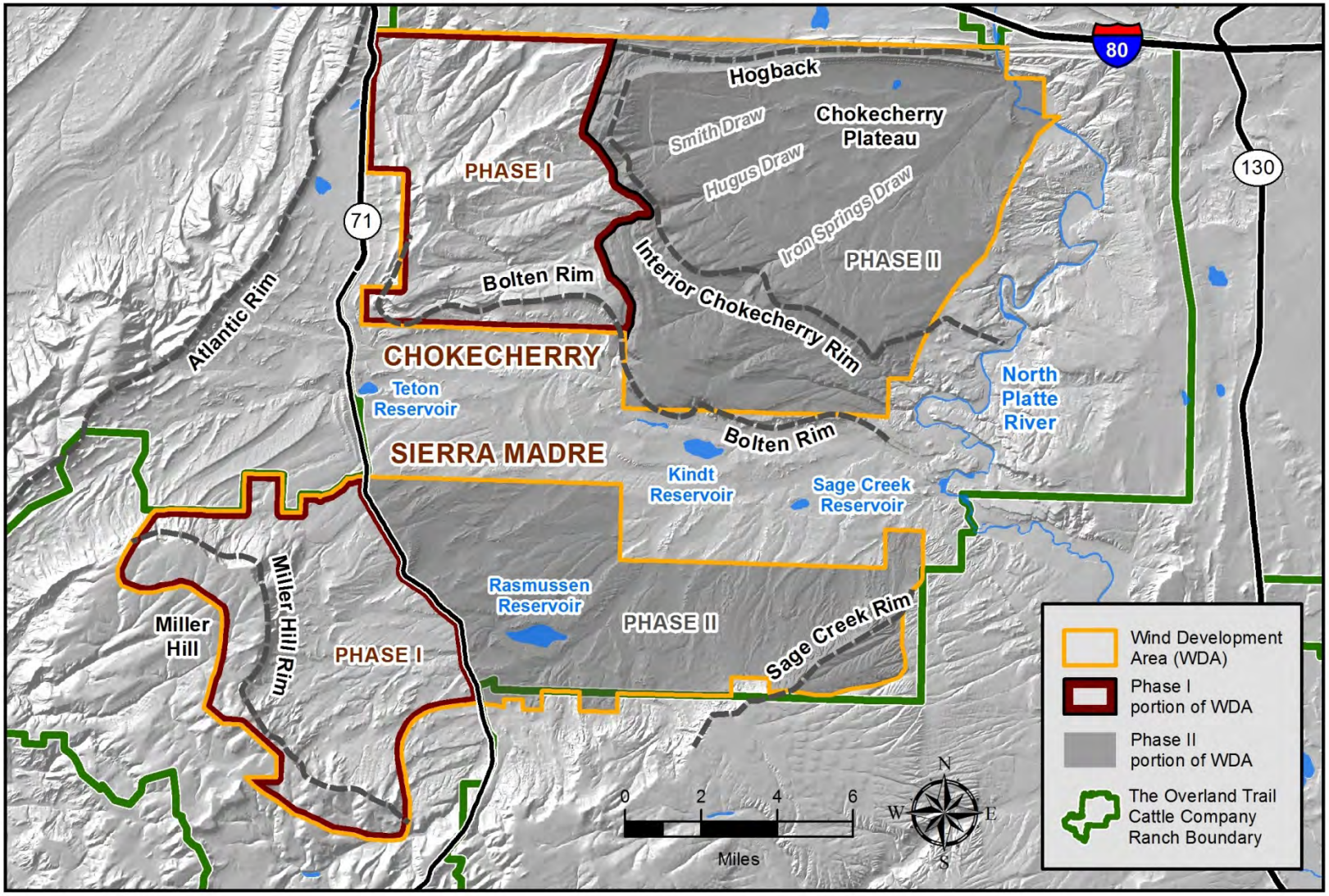

Figure 3.4. CCSM Project Physiographic Features.

3.3.3 Vegetation

Vegetation cover within the CCSM Project Site is typical of Wyoming Basin and Southern Rockies ecoregions, defined by rolling sagebrush steppe, salt-desert shrub basins, and foothill shrublands (Chapman *et al.* 2004). Rolling sagebrush steppe communities are dominated by various densities of Wyoming big sagebrush (*Artemisia tridentata ssp. wyomingensis*) and mountain big sagebrush (*Artemisia tridentata ssp. vaseyana*) at higher elevations, with areas of silver sagebrush (*Artemisia cana*) in the lowlands and black sagebrush (*Artemisia nova*) and low sagebrush (*Artemisia arbuscula*) in exposed, rocky soils. *See Figure 3.5 & Figure 3.6.*

Sagebrush steppe communities are interspersed with bunchgrass/rhizomatous grass communities and allied shrubs, and generally have relatively low forb cover. Salt-desert shrub basins are characterized by sparse vegetation cover of cushion plant communities with dominant shrub cover of Gardner's saltbush (*Atriplex gardneri*), shadscale (*Atriplex confertifolia*), and black greasewood (*Sarcobatus vermiculatum*). Perennial streams throughout salt-desert shrub basins are typically surrounded by basin big sagebrush (*Artemisia tridentata ssp. tridentata*) and riparian communities dominated by willows (*Salix spp*.), sedges (*Carex spp.*), and rushes (*Juncus spp.*). Foothill shrubland communities are dominated by montane deciduous shrubland consisting of mountain big sagebrush, snowberry (*Symphoricarpos spp.*), serviceberry (*Amelanchier spp.*), and mountain mahogany (*Cercocarpus spp.*), surrounded by extended groves of quaking aspen (*Populus tremuloides*), low-growing common juniper (*Juniperus communis*), and patches of limber pine (*Pinus flexilis*). *See Section 4.3.1.*

Table 3.6 summarizes the vegetation community distribution within the Phase I surface disturbance and activity areas. Additional detail on vegetation communities within Phase I can be found in the site-specific PODs for Phase I of the CCSM Project. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

Table 3.6. Phase I Vegetation Communities.

Vegetation Community[1,2]	Total Acreage within Phase I Development Area	Initial Surface Disturbance (acres)	Long-term Surface Disturbance (acres)	Activity Areas (acres)
Agriculture/Pasture	408	18	4	11
Aspen-Mixed Conifer Woodland	2,564	19	3	2
Barren/Developed	1,052	211	55	7
Lowland Mesic Zone	1,413	42	6	4
Mixed Conifer Woodland	6	0	0	0
Montane Shrubland	2,593	45	5	9
Open Water	37	0	0	0
Sagebrush Steppe	36,888	2,355	403	255
Sagebrush Steppe - Dense	9,133	335	60	41
Salt-Desert Shrub	9,681	822	200	52
Sparsely Vegetated	2,653	114	30	11
Upland Grassland	7,638	503	83	48
Total	**74,066**	**4,464**	**849**	**440**

Notes:
1. As defined in the site-specific PODs for Phase I. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.
2. See Section 4.3.1 for vegetation community descriptions

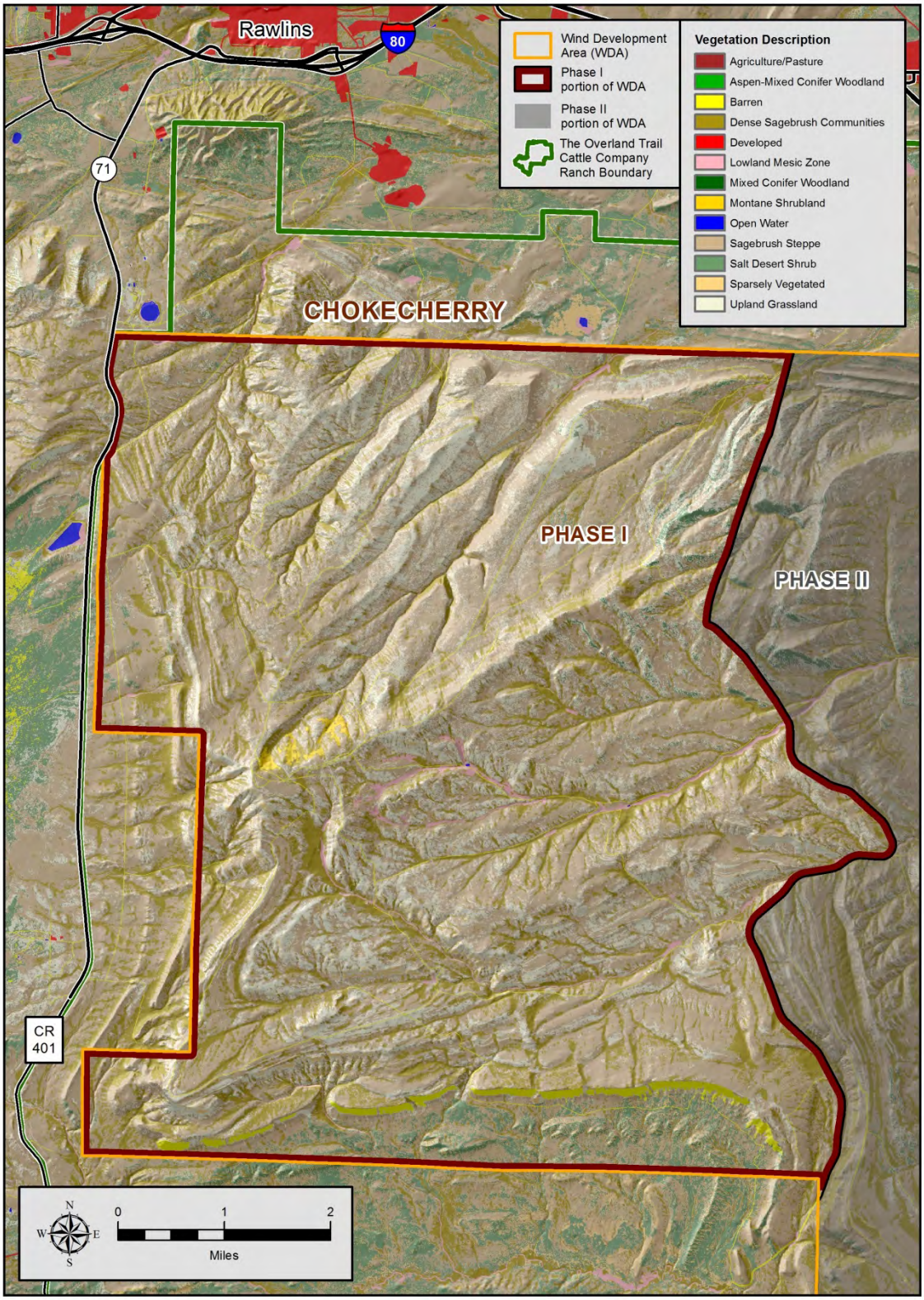

Figure 3.5. Phase I Chokecherry WDA Vegetation Cover.

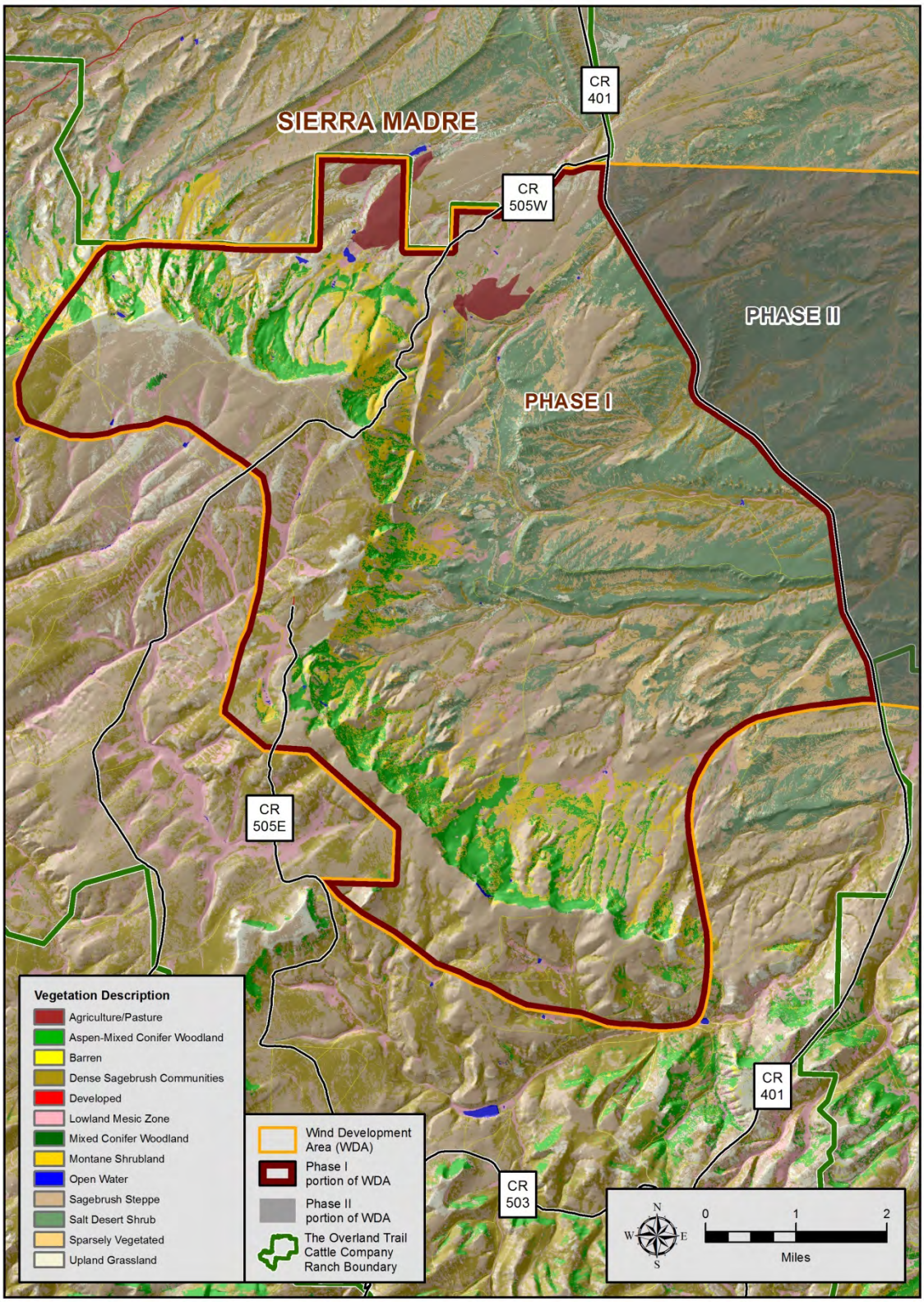

Figure 3.6. Phase I Sierra Madre WDA Vegetation Cover.

3.3.4 Water Resources

The surface water resources on the Ranch include the North Platte River, as well as several streams including Sage Creek, Miller Creek, and Rasmussen Creek in the North Platte River Basin and McKinney Creek, Grove Creek, and Stony Creek in the Yampa-White River Basin. *See Figure 3.7 & Figure 3.8.* In addition, several small ephemeral streams and a few isolated springs are located throughout the Ranch. There are also numerous stock ponds and some larger reservoirs in the vicinity including Teton, Kindt, Rasmussen, and Sage Creek Reservoirs. During the spring, summer, and fall seasons these irrigation reservoirs support use by waterfowl, primarily ducks and geese, with infrequent use by small groups of shorebirds and pelicans.

Water resources within Phase I include several named and unnamed ephemeral and perennial drainages. Within the Chokecherry WDA, the headwaters of Smith Draw and Hugus Draw flow east toward the North Platte River, and multiple other unnamed drainages cross through the area. In the Upper Miller Hill area, the headwaters of Grove Creek and McKinney Creek trend southwest from the Miller Hill Rim. In Lower Miller Hill, Deadman Creek, Lone Tree Creek, Rasmussen Creek, and several unnamed drainages flow east toward the Sage Creek Basin. No large waterbodies or reservoirs occur within Phase I.

Additional detail on water resources within Phase I can be found in the site-specific plans of development for Phase I of the CCSM Project. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

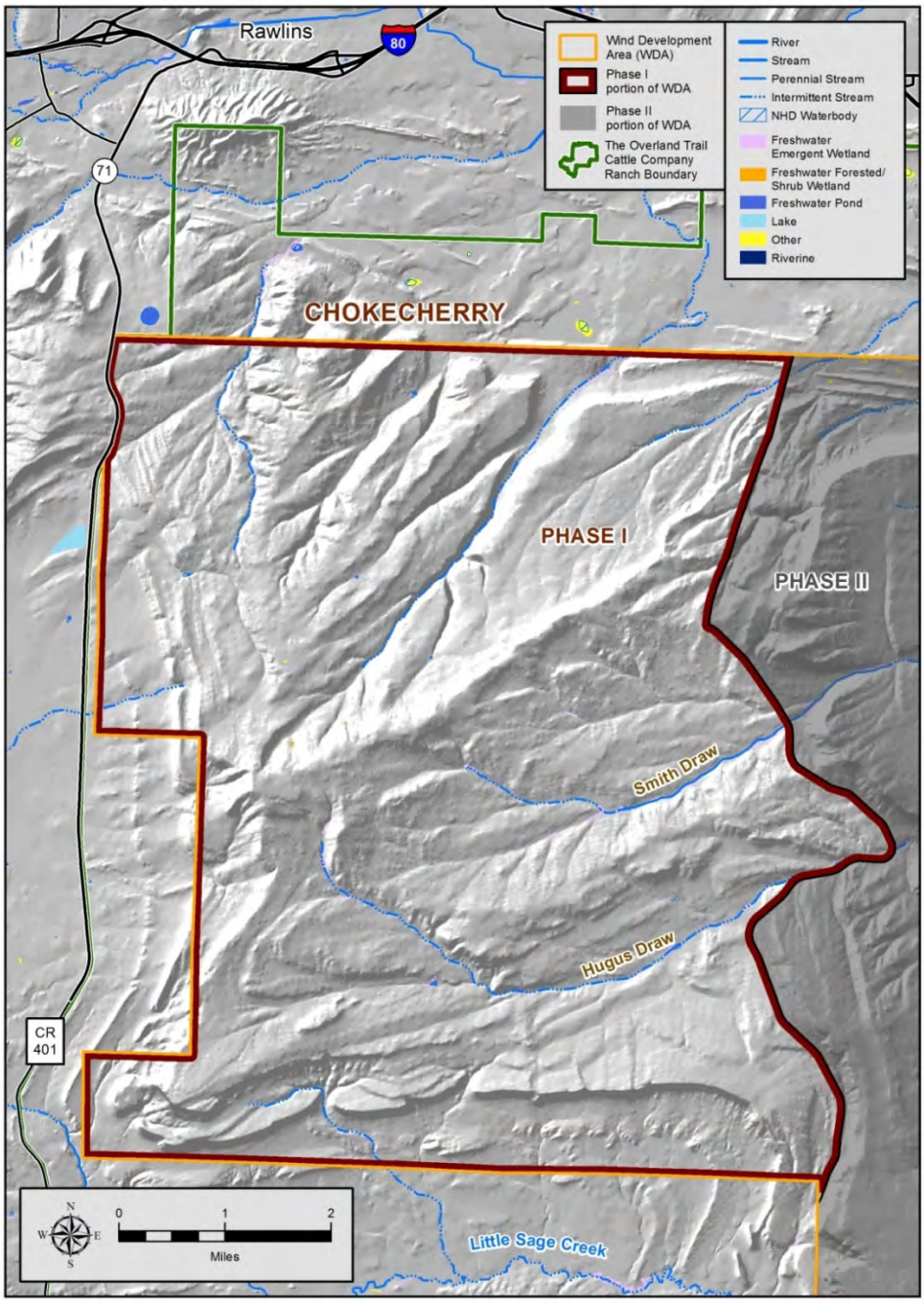

Figure 3.7. Phase I Chokecherry WDA Water Features. [15]

[15] The wetlands indicated on this figure are those mapped by the USFWS National Wetlands Inventory. A wetland delineation was completed by PCW to refine the NWI data that ultimately determined that a number of these areas are not in fact wetlands; however the delineation is limited to Phase I. The NWI data is presented in this figure to provide an overview of the wetlands that may be present within the Phase I Development Area as a whole.

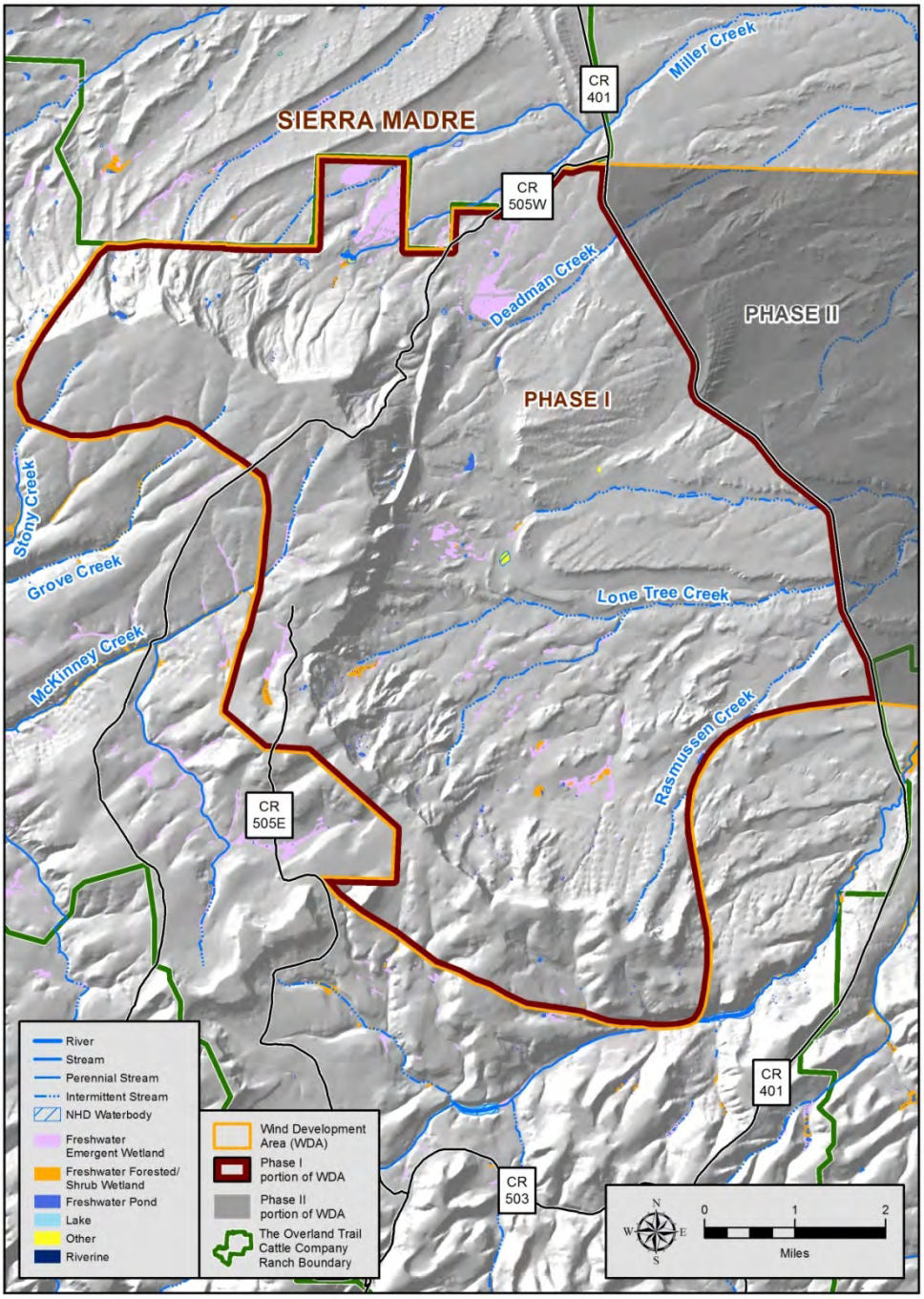

Figure 3.8. Phase I Sierra Madre WDA Water Features. [16]

[16] The wetlands indicated on this figure are those mapped by the USFWS National Wetlands Inventory. A wetland delineation was completed by PCW to refine the NWI data that ultimately determined that a number of these areas are not in fact wetlands; however the delineation is limited to Phase I. The NWI data is presented in this figure to provide an overview of the wetlands that may be present within the Phase I Development Area as a whole.

4.0 Pre-construction Migratory Bird and Bat Risk Assessment (USFWS Wind Energy Guidelines – Tiers 1 through 3; WGFC Wind Energy Recommendations – Tiers 1 and 2)

This BBCS is limited in scope to Phase I of the CCSM Project. Phase II of the CCSM Project will have a separate BBCS; however, portions of this chapter describe the monitoring and risk assessment process for the CCSM Project as a whole to provide context.

The WGFC Wind Energy Recommendations and USFWS Wind Energy Guidelines both recommend a tiered approach for assessing risks to migratory birds and bats. *See Section 2.4.* The tiered approach sets out an iterative decision-making process for collecting information in increasing detail; quantifying the possible risks of proposed wind energy projects to species of concern and their habitats; and evaluating those risks to make siting, construction, and operation decisions. *See USFWS 2012a at p. vi.* Each subsequent tier refines and builds upon the issues raised and efforts undertaken in previous tiers. Each tier also offers a set of questions to help evaluate the potential risk to migratory birds and bats associated with developing a wind energy project at a given location. *See USFWS 2012a at p vi.*

The pre-construction tiers, Tiers 1 through 3 of the USFWS Wind Energy Guidelines and Tiers 1 and 2 of the WGFC Wind Energy Recommendations, are designed to identify, avoid, and minimize risks to migratory bird and bat species of concern from proposed wind energy projects. PCW selected the original CCSM Project Site for wind energy development in 2006, approximately six years prior to the 2012 release of the USFWS Wind Energy Guidelines and four years prior to the release of the WGFC Wind Energy Recommendations. According to the USFWS Wind Energy Guidelines, "[p]rojects that are already under development or are in operation are not expected to start over or return to the beginning of a specific tier." *See USFWS 2012a at p. 4.* Instead, the guidelines instruct a developer to consider where it is in the planning process relative to the appropriate tier. When the USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations were published, the BLM FEIS was already published and PCW was conducting migratory bird and bat studies for the CCSM Project consistent with Tier 3 of the USFWS Wind Energy Guidelines and Tier 2 of the WGFC Wind Energy Recommendations.

While the USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations were not available, i.e. had not been published, at the time of site selection for the CCSM Project, PCW coordinated extensively with BLM, USFWS, and WGFD throughout the development of the project, including Phase I. PCW has collected detailed data for migratory birds and bats and has followed a robust avoidance and minimization process that complies with the tiered approach recommended in the USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations. PCW's pre-construction risk identification and avoidance and minimization process for Phase I is documented below. PCW evaluated the CCSM Project and answered the questions posed by the USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations as it would have if the guidance had been place throughout the CCSM Project development.

4.1 Summary of Risks to Migratory Birds and Bats

Understanding the risks to migratory birds and bats from wind energy projects provides context for the risk evaluation and avoidance and minimization process documented in the remainder of this Phase I BBCS. A summary of the risks to migratory bird and bats from wind energy projects is provided below based on: (1) the USFWS Wind Energy Guidelines; (2) the WGFC Wind Energy Recommendations; and (3) the APLIC Recommendations for Power Pole Configurations at Wind Energy Projects. *See APLIC 2015.* The information provided below is not specific to the CCSM Project or Phase I; instead this is a generalized overview of risks wind energy projects may pose to migratory birds and bats.

The USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations discuss various risks to migratory birds and bats from wind energy projects, generally including: (1) collisions with wind turbines and associated infrastructure; (2) habitat loss and degradation; (3) fragmentation of large habitat blocks into smaller segments that may not support sensitive species; (4) displacement and behavioral changes; and (5) indirect effects such as increased predator populations or introduction of invasive plants. *See USFWS 2012a at p. 25-26.* In addition, APLIC recognizes additional risks to migratory birds and bats from the electrical system, including electrocutions and nest vulnerability. *See APLIC 2006.* The pre-construction risk evaluation described in this chapter evaluates the risks to migratory birds and bats from Phase I for the purposes of avoiding and minimizing the identified risks to the extent practicable, and developing appropriate conservation measures and post construction monitoring. *See Chapters 5.0 & 6.0.* The types of risks to migratory birds and bats from wind energy projects are described in additional detail below.

4.1.1 Collision

Direct mortality or injury to migratory birds and bats occurs at wind energy projects due to collisions with wind turbines, electric power lines, meteorological towers, and vehicles on project roads.[17] According to USFWS, "[c]ollision likelihood for individual birds and bats at a particular wind energy facility may be the result of complex interactions among species distribution, "relative abundance," behavior, visibility, weather conditions, and site characteristics." *See USFWS 2012a at p. 25.* The likelihood of collision for individual migratory bird and bat species is affected by abundance, ecology, and behavior.

Electric facilities located between feeding and roosting areas of flocking birds may also present an increased collision risk. This is especially true for power lines near rivers, lakes, or wetlands where fog may be common, making lines less visible. Human activity near lines may flush birds, with startled birds potentially colliding with power lines. Heavy-bodied, less agile birds or those within flocks may lack the ability to quickly negotiate obstacles, making them more vulnerable to power line collisions. Collisions

[17] Direct mortality to bats, and potentially some small migratory bird species, may also be caused by barotrauma rather than collision with turbines.

with electric lines occur most often with the overhead static wire, which may be less visible than energized conductors due to its smaller diameter. *See APLIC 2012*.

A detailed description of the current understanding of collision risk to specific types of migratory birds and bats is included in the WGFC Wind Energy Recommendations. *See WGFC 2010 at pp. 2:6,10:12.*

4.1.2 Electrocution

As described in section 2.7, APLIC provides electric utilities, wildlife agencies, and other stakeholders with suggested practices, guidance, and recommendations for managing avian interactions with electric facilities. As part of its guidelines and recommendations, APLIC has identified the primary risks to migratory birds from electric facilities, including those associated with wind energy projects. These risks include electrocution. Bird electrocutions from wind energy project electric facilities may occur due to a combination of biological, environmental, and electrical design factors. Biological and environmental factors include:

- Habitat
- Bird species
- Body size
- Behavior
- Distribution
- Abundance
- Prey availability

The key electrical design factor is the physical separation between energized and or grounded portions of electrical facilities. If the distance between energized conductors or between an energized conductor and grounded hardware is less than that of the head-to-foot or wrist-to-wrist distance of a bird (the wrist is the joint toward the middle of the leading edge of a bird's wing), the bird is at risk of electrocution. Because a bird's feathers provide insulation when dry, contact must typically be made with fleshy parts, such as the skin, feet, or bill, for electrocution to occur.[18]

The majority of electrocutions are associated with low-voltage electric power lines or transformers, rather than high-voltage electric power lines. *See Lehman 2001; Lehman et al. 2007.* Most avian electrocutions occur on low-voltage electric power lines of 35 kV or less. Electric power lines of 69 kV and above pose a very low electrocution because the lines are designed with sufficient spacing between conductors (electric wires or lines) such that phase to phase or phase to ground contact is not generally possible. *See APLIC 2006.* Low-voltage electric power lines have closer conductor spacing, which presents a greater electrocution hazard to avian species. *See APLIC 2006.* Consequently, most electrocutions are of large birds, such as eagles, hawks, and ravens. *See APLIC 2006.*

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[18] APLIC does recognize that "wet weather can increase electrocution risk, as wet feathers are electrically more conductive than dry feathers." *See APLIC 2006*.

4.1.3 Habitat Loss and Degradation

Wind energy projects result in direct habitat loss and habitat modification. *See USFWS 2012a at p. 25.* USFWS acknowledges that "many of North America's native landscapes are greatly diminished or degraded from multiple causes unrelated to wind energy." *See USFWS 2012a at p. 25.* However, species that depend on these landscapes may still be susceptible to further loss and/or degradation of their habitat from wind energy projects. USFWS also states that "while habitat lost due to footprints of turbines, roads, and other infrastructure is obvious, less obvious is the potential reduction of habitat quality." *See USFWS 2012a at p. 25.* Migratory bird and bat species that may be susceptible to habitat loss and modification are also identified in the WGFC Wind Energy Recommendations. *See WGFC 2010 at pp.2:6, 10:12.*

4.1.4 Habitat Fragmentation

Both USFWS and WGFC identify habitat fragmentation as a concern for some migratory bird and bat species. Wind energy projects can cause habitat fragmentation. "Habitat fragmentation separates blocks of habitat for some species into segments, such that the individuals in the remaining habitat segments may suffer from effects such as decreased survival, reproduction, distribution, or use of the area." *See USFWS 2012a at p. 25.* Surface disturbance may displace some species or fragment continuous habitat areas into smaller, isolated tracts. Sensitivity to fragmentation effects varies among migratory bird and bat species, as described in the WGFC Wind Energy Recommendations. *See WGFC 2010 at pp.2:6,10:12.*

4.1.5 Displacement and Behavioral Changes

According to USFWS, "[e]stimating displacement risk requires an understanding of animal behavior in response to a project and its infrastructure and activities, and a pre-construction estimate of presence/absence of species whose behavior would cause them to avoid or seek areas in proximity to turbines, roads, and other components of the project." *See USFWS 2012a at p. 26.* While the science regarding displacement effects continues to evolve, it is generally recognized that each species and individual respond differently. The WGFC Wind Energy Recommendations identify species that occur in Wyoming that are likely to be sensitive to displacement from wind energy projects, including associated infrastructure such as roads and electric facilities. *See WGFC 2010 at pp.2:6,10:12. I*n some cases, displacement and behavioral changes, including potential avoidance of wind energy infrastructure, could create barrier effects that would result in increased energetic losses associated with increased flight times or lengths between foraging, roosting, or nesting locations. Restriction of movement between these locations could create barrier effects that would have localized impacts on resident and non-resident migratory birds and bats.

4.1.6 Indirect Effects

"Indirect effects include reduced nesting and breeding densities and the social ramifications of those reductions; loss or modification of foraging habitat; loss of population vigor and overall population density; increased isolation between habitat patches, loss of habitat refugia; attraction to modified habitats; effects on behavior, physiological disturbance, and habitat unsuitability." *See USFWS 2012a at p. 26*. Indirect effects from wind energy projects, including associated infrastructure such as roads and electric facilities, may be due to a number of factors including the introduction and establishment of invasive plants that affect habitat suitability and quality or changes in the natural fire regime.

4.1.7 Nesting

Raptors and other migratory bird species can benefit from the presence of utility structures, such as power poles, by using them for nesting. Most species that nest on power lines or similar structures inhabit open, arid areas, e.g. red-tailed hawks, great-horned owls, rough-legged hawks and prairie falcons. *See APLIC 2006.* One notable exception is the osprey, which uses utility structures for nesting more than any other North American raptor. Osprey typically select structures that are located near or over waters where fish are abundant.[19] *See APLIC 2006*. A number of non-raptor migratory bird species also nest on utility structures. Latticework power line structures can provide suitable nesting substrate for ravens, herons, cormorants and other large birds. Power poles are also used by smaller birds that build their nests on support brackets, transformers, or capacitors. *See APLIC 2006.*

Utility structures can provide nesting substrates in habitats where natural sites are scarce. Power line structures can facilitate range expansion, increase local density, and offer some protection from the elements. In addition, some avian species have increased their nest success and productivity on power line structures. *See APLIC 2006.* However, some avian species that nest or perch on power poles can experience the following: increased risk of electrocution and collision; susceptibility to nest damage from wind, weather, and fire; disturbance from maintenance or construction, and vulnerability to shooting. Raptors, corvids, and other avian species nesting on power line structures may also impact some prey species and other avian species and can reduce power reliability by contaminating equipment with excrement or nesting material. *See APLIC 2006.*

The activity and noise that occurs during power-line construction and operation can disturb raptors and other migratory bird species. Maintenance operations also temporarily disrupt normal bird nesting, hunting and roosting behavior. *See APLIC 2006.* While electrocution of birds that nest on power line structures during operation is infrequent, the nests themselves can cause operational problems and reduce power reliability creating the need for nest management. For example, nesting material or prey debris can cause interruptions and outages. *See APLIC 2006.*

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[19] Although ospreys are known to use areas adjacent to the North Platte River, there is no suitable osprey nesting habitat within Phase I and no ospreys were observed during Phase I surveys. *See Sections 4.3 & 4.4*.

4.2 Preliminary Site Evaluation (USFWS Wind Energy Guidelines – Tier 1; WGFC Wind Energy Recommendations – Tier 1)

The USFWS Wind Energy Guidelines call for a preliminary site evaluation using a landscape-level assessment of habitat for species of concern based on existing information and literature. *See USFWS 2012a at p. vi.* The preliminary site evaluation (Tier 1 of the USFWS Wind Energy Guidelines) corresponds to the Tier 1 site selection process outlined in the WGFC Wind Energy Recommendations. *See WGFC 2010 at pp. 37:38.* During the preliminary site evaluation and site selection process, the project proponent gathers existing information and literature and then uses this information to select and refine potential project sites by balancing suitability for development with potential risk to protected wildlife and their habitats, in this case migratory birds and bats.

For the CCSM Project, site selection occurred in 2006. In 2006, PCW's potential wind development site included the entire 320,000-acre Ranch owned and operated by PCW's affiliate, TOTCO. PCW did not possess the required property rights to consider or evaluate land located outside of the Ranch boundary for wind energy development. However, within the boundaries of the Ranch, PCW evaluated a number of project designs using different land and development scenarios. This is consistent with the USFWS Wind Energy Guidelines which indicate that the preliminary site evaluation (Tier 1) can be used to: (1) "screen" a landscape to avoid areas with the highest habitat values; or (2) begin to determine if a single potential site poses serious risk to species of concern or their habitats. *See USFWS 2012a at p. 12.*

4.2.1 Site Evaluation Data

In 2006, there was limited data available on migratory birds and bats specific to the Ranch. However, PCW reviewed and evaluated available data including the BLM Rawlins Field Office (RFO) Resource Management Plans (RMP), the BLM nest database, available data from WGFD, and existing vegetation and habitat maps. *See BLM 1990; BLM 2004; WGFD 2005.*

4.2.2 Site Evaluation Questions

Both the USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations pose a series of questions to guide the site evaluation and site selection process. The site evaluation and site selection questions are intended to help determine potential environmental risks and potential or known conflicts with wildlife resources at the landscape scale. As contemplated in the USFWS Wind Energy Guidelines, the questions are most useful to "screen" the Ranch to identify sites with the highest habitat values and to determine if any areas pose a serious risk to migratory birds and bats or their habitats. *See USFWS 2012a at p. 12.* PCW's response to the site evaluation questions and its risk assessment are based on the information available in 2006 at the time of site selection for the CCSM Project.

USFWS Wind Energy Guidelines[20]

1. *Are there species of concern present on the potential site(s), or is habitat (including designated critical habitat) present for these species?*

   In 2006, PCW evaluated the Ranch for the presence of species of concern or their habitat using existing data, including publically available data from USFWS, WGFD and BLM. In 2006, no federally-listed migratory bird or bat species were known to occur on the Ranch.[21] However, the 1990 RFO RMP, 2004 RFO draft RMP, and the 2005 WGFD list of species of greatest conservation need (SGCN) identified migratory bird and bat species of concern that may occur on the Ranch. *See BLM 1990; BLM 2004; WGFD 2005.* The BLM and WGFD migratory bird and bat species of concern that were identified in 2006 are included in Table 1.1 and Table 1.2 of this Phase I BBCS.

2. *Does the landscape contain areas where development is precluded by law or areas designated as sensitive according to scientifically credible information?*

   The Ranch does not include areas where development is precluded by law. However, portions of the Ranch are within WGFD's Red Rim-Grizzly WHMA. The Red Rim-Grizzly WHMA is managed by WGFD for the co-existence of wildlife and livestock. *See WGFD 2013.* According to WGFD, the Red Rim-Grizzly WHMA also provides habitat for migratory birds such as ferruginous hawk, red-tailed hawk (*Buteo jamaicensis*), and passerines. *See WGFD 2013.*

3. *Are there known critical areas of wildlife congregation, including, but not limited to: maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, leks, or other areas of seasonal importance?*

   No critical areas of wildlife congregation for migratory bird or bat species were known in 2006. WGFD identified big game winter range and greater sage-grouse leks on the Ranch; however, these features are not related to the migratory bird and bat species that are the subject of this Phase I BBCS. *See Section 1.2.*

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[20] *See USFWS 2012a at p. 13.*

[21] In 2006 bald eagles were listed as threatened under the ESA; however, bald eagles are no longer listed under the ESA. Further, potential impacts to bald eagles from Phase I are addressed in PCW's Phase I ECP. Therefore, potential impacts to bald eagles are not discussed in this Phase I BBCS. *See Section 1.2.*

4. *Are there large areas of intact habitat with the potential for fragmentation, with respect to species of habitat fragmentation concern needing large contiguous blocks of habitat?*

   In 2006, species of habitat fragmentation concern were not designated. In addition, there was no detailed habitat information available on the Ranch. Therefore, there was not adequate information in 2006 to evaluate the suitability of the existing habitat and the potential for fragmentation.

WGFC Wind Energy Recommendations[22]

1. *Are there species or habitat(s) of concern present on the site?*

   In 2006, PCW identified migratory bird and bat species designated by WGFD as SGCN that may occur on the Ranch. These species are listed in Table 1.1 and Table 1.2 of this Phase I BBCS. See response to question 1 above under USFWS Wind Energy Guidelines.

2. *Does the landscape contain areas where development is precluded by law, regulation or policy?*

   The Ranch does not include areas where development is precluded by law. However, portions of the Ranch are within WGFD's Red Rim-Grizzly WHMA. See response to question 2 above under USFWS Wind Energy Guidelines.

3. *Are there known crucial areas for wildlife such as hibernacula, winter ranges, migration corridors, or other vital/sensitive habitats?*

   No crucial areas for wildlife congregation for migratory bird or bat species were known in 2006. See response to question 3 above under USFWS Wind Energy Guidelines.

4. *Are there large areas of intact habitat with species where habitat impacts are a concern?*

   There was no detailed habitat information available for the Ranch in 2006. Therefore, there was not adequate information in 2006 to evaluate potential impacts to existing habitat. See response to question 4 above under USFWS Wind Energy Guidelines.

[22] *See WGFC 2012 at pp. 37:38*

5. *Using best available scientific information, has the potential presence of important species or crucial/vital habitat been documented?*

   In 2006, PCW identified migratory bird and bat species designated by WGFD as SGCN that may occur on the Ranch. These species are included in Table 1.1 and Table 1.2 of this Phase I BBCS. See response to question 1 above under USFWS Wind Energy Guidelines.

6. *Which SGCN or interest is likely to use the proposed site based upon known data?*

   The migratory bird and bat SGCN most likely to use the Ranch are listed in Table 1.1 and Table 1.2 of this Phase I BBCS.

4.2.3 Site Evaluation Risk Assessment

As reflected in the responses to the site evaluation questions, there was insufficient information in 2006 to adequately assess risk to migratory birds and bats. Therefore, as recommended in the USFWS Wind Energy Guidelines and in coordination with BLM, USFWS, and WGFD, PCW proceeded to Site Characterization (Tier 2) with a specific emphasis on collecting the additional data necessary to characterize the site and further assess potential impacts to wildlife. *See USFWS 2012a at p. 9.*

4.3 Site Characterization (USFWS Wind Energy Guidelines – Tier 2)

The site characterization process in the USFWS Wind Energy Guidelines (Tier 2) is intended to characterize a potential site in terms of the risk that wind energy development may pose to species of concern and their habitats. According to the USFWS Wind Energy Guidelines, site characterization generally involves one or more visits by a qualified biologist to assess the potential site. Site characterization is an intermediary step in the USFWS Wind Energy Guidelines that has no direct counterpart in the WGFC Wind Energy Recommendations. However, the USFWS Wind Energy Guidelines call for the involvement of state wildlife agencies such as WGFD throughout the site characterization process.

According to the USFWS Wind Energy Guidelines, site characterization should be based on a combination of: (1) existing information; (2) input from federal, state, and local agencies or organizations that have relevant scientific information; and (3) reconnaissance-level site visits by a wildlife biologist. The data collection and agency coordination conducted for the CCSM Project EIS meets the recommendations for the USFWS Tier 2 site characterization process. *See Section 4.3.1.* Therefore, the site characterization and risk assessment process described in this section is based on the information compiled for and contained in the BLM FEIS. *See BLM 2012b.* Data collection for the CCSM Project site characterization process was completed in 2008 and 2009; these data were then incorporated into the 2012 FEIS.

4.3.1 Site Characterization Data

The site characterization and Tier 2 risk assessment for the CCSM Project, including Phase I, is based on the information collected to support the BLM EIS. As described in section 1.3.2, BLM began preparation of its EIS in 2008. In support of the EIS, both PCW and BLM collected existing information on the CCSM Project Site. In addition, PCW collected additional site-specific wildlife data for the original proposed action, including data on migratory birds and bats. Through public outreach and cooperating agency involvement, BLM coordinated with interested parties to insure that local, state, and federal agencies, the public, and non-governmental organizations had an opportunity to provide relevant information and to comment on the EIS analysis. The data and information collected in 2008 and 2009 by PCW and BLM in support of BLM's EIS is consistent with the site characterization data called for in Tier 2 of the USFWS Wind Energy Guidelines.

Vegetation Surveys

PCW completed extensive field mapping and vegetation classification of the Ranch in 2009. Vegetation was sampled at 500 randomly selected 50-meter transects. Dominant vegetation classes and associated plant communities were characterized, and detailed measurements of vegetation structure (e.g., canopy cover, canopy height, understory height) were collected. Using the field survey data, aerial imagery, and remote sensing, a detailed 4-meter resolution vegetation classification was developed for the Ranch and a 3-mile buffer around the Ranch. Thirteen vegetation classes were created to capture the diversity of the landscape. To characterize potential habitat use by bird species, PCW evaluated the potential for migratory bird and bat species to use each of the vegetation communities and habitat types identified. Raptors and other large species such as ravens (*Corvus corax*), American crow (*Corvus brachyrhynchos*), and black-billed magpie (*Pica hudsonia*) can be found in any of the vegetation communities occurring in the Ranch. Many small bird species including vesper sparrow (*Pooecetes gramineus*) and horned lark (*Eremophila alpestris*) and bats can also be found across multiple vegetation assemblages.

Characterizations of the major vegetation types and habitats on the Ranch are below along with descriptions of the migratory bird and bat species most likely to use each habitat.

<u>Sagebrush Steppe Communities</u>

Sagebrush steppe is the most common vegetation type on the Ranch occurring across approximately 63% of the Ranch. Sagebrush habitats within the Ranch consist of a mosaic of sagebrush, allied shrubs and forbs, and grasses and are dominated or co-dominated by one or more *Artemisia* species, such as Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) and basin big sagebrush (*Artemisia tridentata* ssp. *tridentata*). In higher elevations, mountain big sagebrush (*Artemisia tridentata* ssp. *vaseyana*) is present. Sagebrush communities occur across approximately 60% of the Ranch. Migratory bird species found in sagebrush steppe include sagebrush obligates such as sagebrush sparrow, Brewer's sparrow, and sage thrasher. Other species commonly found within sagebrush communities on the Ranch include horned lark and vesper sparrow.

Salt-desert Shrub Communities

Salt-desert shrub communities are the second most common vegetation and occur across approximately 20% of the Ranch. Salt-desert shrub communities are characterized by salt-tolerant plants with a dominant shrub component of one or more *Atriplex* species such as Gardner's saltbush (*Atriplex gardneri*) or shadscale (*Atriplex confertifolia*) and are often co-dominant with birdsfoot sagebrush (*Artemisia pedatifida*), black greasewood (*Sarcobatus vermiculatus*), or other allied shrub and herbaceous species. These communities primarily occur within the northern flats north of the Chokecherry WDA, the Sage Creek Basin, and saline soils in the Lower Miller Hill area. Salt-desert shrub communities also occur in the eastern portions of the Chokecherry WDA. Horned lark is the most commonly observed species within salt-desert shrub communities. Other species characteristic of salt-desert shrub communities include vesper sparrow, killdeer (*Charadrius vociferous*), and rock wren (*Salpinctes obsoletus*).

Sparsely Vegetated and Barren Communities

Sparsely vegetated and barren vegetation communities are scattered and occur across 4-5% of the Ranch. These communities primarily occur in association with salt-desert shrub communities although sparsely vegetated areas also occur in association with sagebrush communities, especially in windswept areas or areas with shallow soils. Vegetation in these areas is generally characterized by a patchy distribution of upland sedges, cushion plants, and mat-forming forbs. Various buckwheat species (*Eriogonum* spp.) and pricklypear (*Opuntia* spp.) often co-dominate these barren landscapes, but cover is minimal. Horned lark are often found within sparsely vegetated communities. Additionally, killdeer may nest in barren locations.

Aspen Mixed-conifer Woodlands and Riparian Communities

Aspen mixed-conifer woodlands and riparian communities occur at elevations greater than 7,500 feet within the southwestern portions of the Ranch below the rim of Miller Hill. These communities occupy less than 2% of the Ranch. The predominant overstory vegetation is an open-canopy of quaking aspen (*Populus tremuloides*) interspersed with a variety of conifers and willows. The dense understory consists of forbs, grasses, and montane shrubs. Migratory bird species associated with this habitat include American robin (*Turdus migratorius*), black-capped chickadee (*Poecile atricapillus*), dark-eyed junco (*Junco hyemalis*), green-tailed towhee (*Pipilo chlorurus*), northern flicker (*Colaptes auratus*), and American goldfinch (*Spinus tristis*).

Mixed Mountain Shrub/ Montane Shrubland Communities

Mixed mountain shrub/ montane shrubland communities cover approximately 1% of the Ranch, predominantly located in the southern and southwestern portions at elevations ranging between 7,200 to 8,100 feet. These systems are typically associated with dry, exposed sites and are often in the uplands adjacent to aspen communities. Inclusions of sagebrush steppe or grassland often occur, but the vegetation is typically dominated by a variety of shrubs including serviceberry (*Amelanchier* spp.), mountain mahogany (*Cercocarpus montanus*), antelope bitterbrush (*Purshia tridentata*), and skunkbush sumac (*Rhus trilobata*). Migratory bird species associated with this habitat type are similar to those found in aspen mixed-conifer woodlands and may also include mountain bluebird (*Sialia currucoides*) and rock wren.

Upland Grassland Communities

Upland grassland communities occur throughout the Ranch, although the Chokecherry WDA has a greater occurrence of contiguous grassland cover. These communities typically occur between 6,500 to 8,400 feet in elevation and occur across approximately 7% of the Ranch. The vegetation is characterized as mixed-grass prairie on gentle to moderate slopes (0–20%), growing on drainage terraces, draws, alluvial flats and plains, escarpments, gulches, hillslopes, knobs, knolls, bluffs, and plateaus. Upland grasslands form a matrix with the surrounding sagebrush steppe, creating a mosaic landscape of rolling grasslands interspersed throughout sagebrush communities.

Generally, upland grassland communities in Phase I are dominated by native bunchgrass and rhizomatous species. Occurrences of this community have multiple plant associations that are dominated by patchy to dense populations of western wheatgrass (*Pascopyrum smithii*), bluebunch wheatgrass (*Pseudoroegneria spicata*), and needle and thread (*Hesperostipa comata*). Other grasses may include Indian ricegrass (*Achnatherum hymenoides*), bottlebrush squirreltail (*Elymus elymoides*), thickspike wheatgrass (*Elymus lanceolatus*), Kentucky bluegrass (*Poa pratense*), Sandberg bluegrass (*Poa secunda*), prairie dropseed (*Sporobolus heterolepis*), and alkali sacaton (*Sporobolus airoides*). Various buckwheat species (*Eriogonum* spp.), phloxes (*Phlox* spp.), stemless mock goldenweed (*Stenotus acaulis*), broom snakeweed (*Gutierrezia sarothrae*), and hairy false goldenaster (*Heterotheca villosa*) are often interspersed throughout the grass cover. Open-canopied shrubs occur sporadically and include big basin sagebrush (*Artemisia tridentata* ssp. *tridentata*), Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*), yellow rabbitbrush (*Chrysothamnus viscidiflorus*), rubber rabbitbrush (*Ericameria nauseosa*), Gardner's saltbush (*Atriplex gardneri*), shadscale (*Atriplex confertifolia*), spiny hopsage (*Grayia spinosa*), and black greasewood (*Sarcobatus vermiculatus*). While most species occurring within the upland grass community are native, non-native species including cheatgrass (*Bromus tectorum*) and crested wheatgrass (*Agropyron cristatum*) may be present in previously disturbed areas.

Migratory bird species associated with this habitat type include western meadowlark, horned lark, vesper sparrow, mourning dove (*Zenaida macroura*), mountain bluebird, and long-billed curlew (*Numenius americanus*).

Avian Use Surveys

PCW completed baseline wildlife surveys, including surveys for raptors and other avian species in 2008 and 2009 for the purposes of characterizing the site. *See Appendix D & E*. The 2008-2009 survey area was based upon the CCSM Project as originally proposed in PCW's POD submitted to BLM in 2008. *See Chapter 5.0.*

The pre-construction avian use surveys were initiated in June 2008 and concluded in June 2009. Nineteen points for fixed-point avian use surveys were selected in habitats and topography representative of the original CCSM Project configuration. *See Figure 4.1*. *See BLM 2011b; BLM 2012b.* While some of these survey points occur outside of Phase I, they were conducted in the same habitat types and similar topographic conditions; therefore, these data can still be used to characterize avian use in Phase I. The fixed-point avian use surveys (variable circular plots) were conducted using methods described by Reynolds *et al.* (1980). Surveys at each 800-meter radius plot consisted of a 20-minute point count conducted approximately bi-weekly during the summer and winter (June 15 to August 31 and November 16 to December 31, respectively) and weekly during the fall and spring (September 1 to October 15 and March 16 to May 31, respectively). All raptors and large bird observations were recorded out to a distance of 800 meters from the point center. Small bird observations were restricted to those within 100 meters. Data were collected for each observation, including species, number of individuals, distance from point center, and altitude above ground, among other variables. Sampling intensity was designed to document bird use and behavior by vegetation community and season.

The 2008-2009 year-long avian use survey data characterize seasonal, spatial, and temporal migratory bird use within the boundaries of the Original Proposed Action (also referred to by BLM as the Study Area), which included portions of Phase I. *See Figure 4.1. See Section 5.1.2*. These data inform site characterization completed as part of Tier 2 of the USFWS Wind Energy Guidelines.

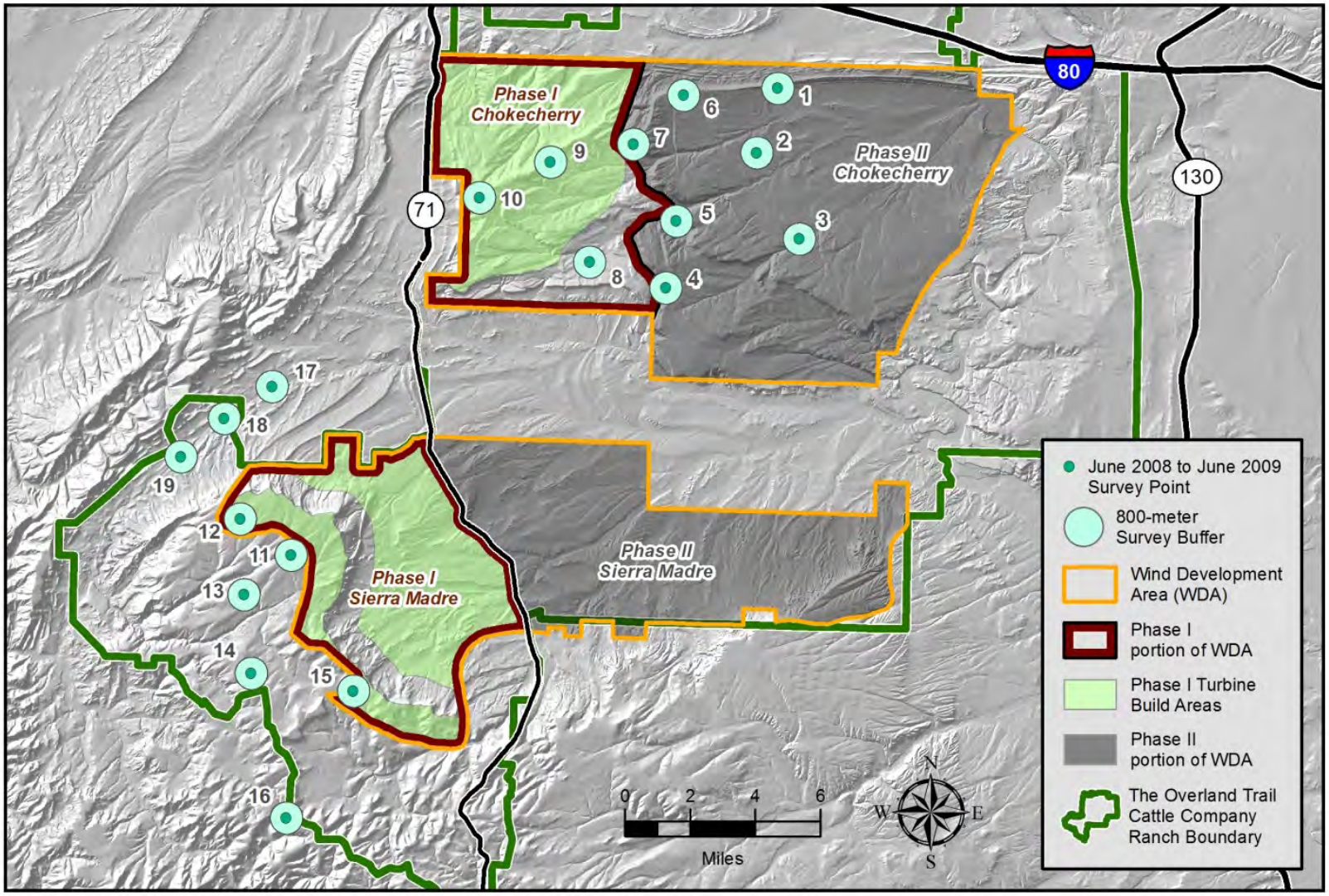

Figure 4.1. Avian Use Survey Locations, June 2008 to June 2009.

During the June 2008 to June 2009 avian use surveys, 1,903 migratory birds representing over 50 species were recorded. *See Table 4.1.* Detailed data from the 2008-2009 avian use surveys is included in Appendix E. In summary, small birds (i.e., those within 100 meters) were detected more frequently than raptors accounting for 1,484 individuals or 78% of all individuals. Horned lark accounted for 805 individuals or 42% of all detections followed by common raven (175 detections; 9%) and vesper sparrow (121 detections; 6%). The most frequently observed non-eagle raptors were American kestrel (*Falco sparverius*), northern harrier (*Circus cyaneus*), and red-tailed hawk representing approximately 6% of all detections (115 individuals). Avian use was greatest in spring, summer, and fall when migratory bird species were present. Approximately 99% of all individuals (1,883 individuals) were observed during these three seasons. During the winter season, most species migrate south away from Wyoming and the CCSM Project. Only 20 individuals or 1% of all individuals were observed during winter surveys.

When considering only small birds (i.e., those within 100 meters), horned lark accounted for 54% of the 1,484 small birds detected. Other small birds, in order of prevalence, were vesper sparrow (8%; 121 individuals), Brewer's sparrow (5%; 80 individuals), western meadowlark (5%; 69 individuals), and sage thrasher (4%; 65 individuals). The total number of small bird detections was similar in spring (593 individuals) and summer (632 individuals), but more than 50% lower in fall (255 individuals) and almost non-existent in winter (4 individuals). The only small bird identified during winter surveys was a single horned lark. The remaining individuals were unidentified.

The predominance of the five small bird species listed above (horned lark, vesper sparrow, Brewer's sparrow, western meadowlark, and sage thrasher) is primarily due to high numbers of each recorded during the spring and summer season. Dominant species composition varied during the spring and fall seasons, with Brewer's blackbird (*Euphagus cyanocephalus*) (spring), mountain bluebird (spring and fall), and sagebrush sparrow (spring) among the species contributing higher numbers during those seasons.

The most frequently observed non-eagle raptors during the 2008-2009 avian use surveys were American kestrel (43 individuals), northern harrier (42 individuals), and red-tailed hawk (30 individuals). The total number of non-eagle raptors was similar for summer (86 individuals) and fall (88 individuals), but more than 38% lower during the spring (53 individuals) and almost nonexistent in the winter (1 individual). The only non-eagle raptor recorded during winter surveys was one ferruginous hawk.

Table 4.1. Migratory Bird Observations, 2008-2009 Avian Use Surveys.

Species/Species Group	Spring	Summer	Fall	Winter	Total
Corvids					
American crow	16	49	---	---	**65**
common raven	44	16	102	13	**175**
Other Corvids	---	1	3	2	**6**
Passerines					
Brewer's blackbird	26	9	---	---	**35**
Brewer's sparrow	18	57	5	---	**80**
horned lark	368	264	172	1	**805**
mountain bluebird	14	4	16	---	**34**
sagebrush sparrow	52	7	---	---	**59**
sage thrasher	8	55	2	---	**65**
vesper sparrow	38	79	4	---	**121**
western meadowlark	28	34	7	---	**69**
Other Passerines	36	90	49	3	**178**
Non-eagle Raptors, Owls, and Allies					
American kestrel	16	25	2	---	**43**
ferruginous hawk	1	1	2	1	**5**
northern harrier	5	15	22	---	**42**
prairie falcon	4	1	1	---	**6**
red-tailed hawk	8	16	6	---	**30**
rough-legged hawk (*Buteo lagopus*)	2	---	9	---	**11**
Swainson's hawk	1	8	---	---	**9**
Other Non-Eagle Raptors, Owls, and Allies	3	1	8	---	**12**
Waterfowl, Waterbirds, and Wading Birds					
American white pelican (*Pelecanus erythrorhynchos*)	14	---	---	---	**14**
Other Waterfowl, Waterbirds, and Wading Birds	3	---	---	---	**3**

Species/Species Group	Spring	Summer	Fall	Winter	Total
Other Birds					
common nighthawk (*Chordeiles minor*)	---	6	---	---	**6**
mourning dove	---	10	---	---	**10**
northern flicker	1	1	---	---	**2**
unidentified hummingbird	---	2	---	---	**2**
white-throated swift (*Aeronautes saxatalis*)	3	13	---	---	**16**
Totals	**709**	**764**	**410**	**20**	**1903**

Raptor Nest Surveys

Understanding the use of raptor nests and identifying appropriate measures to avoid and minimize impacts to those nests requires an evaluation of the occupancy of the nest as well as the type of activity that is occurring at the nest location. *See Chapter 5.0.* For purposes of determining nest status during raptor nest surveys, PCW used the following definitions that are consistent with those used in PCW's Phase I ECP[23]:

- **Occupied Nest.** An occupied nest is a nest used for breeding in the current year by a pair of raptors. Presence of an adult, eggs, or young, freshly molted feathers or plucked down, or current year's mutes (whitewash) suggest site occupancy. In years when food resources are scarce, it is not uncommon for a pair of raptors to occupy a nest yet never lay eggs; such nests are considered occupied. *See PCW 2015a; USFWS 2013b*.
- **Unoccupied Nest.** Unoccupied nests are "those nests not selected by raptors for use in the current nesting season." *See PCW 2015a; USFWS 2013b*.

BLM has collected information on raptor nests within the CCSM Project Site since 1980 (a 33-year period). Prior to 1996, BLM mapped raptor nest locations opportunistically. Since 1996, both aerial and ground-based surveys have been conducted to map raptor nests within the RFO. BLM's records have been supplemented with raptor nests located as part of the permitting process for other development activities such as pipelines and oil and gas development. *See BLM 2012b*. In addition, PCW conducted helicopter-based aerial nest surveys between May 14 and 30, 2008. These aerial surveys for raptor

[23] The definitions of occupied and unoccupied nests are consistent between the Phase I ECP and Phase I BBCS for purposes of determining nest occupancy during raptor nest surveys. However, the avoidance and minimization measures for occupied and unoccupied nests developed in the Phase I ECP are specific to eagle nests and are not intended to be applied to the non-eagle raptor nests described in this Phase I BBCS. Further, the MBTA uses the term "active" to describe nest status. Consistent with the MBTA, the avoidance and minimization measures in this Phase I BBCS were developed to address "active" nests. The term "active" is defined in section 5.2.1 of this Phase I BBCS.

nests were completed within a 1600-meter (1-mile) buffer of the Original Proposed Action, surveying a total of approximately 270 square miles. *See Johnson et al. 2008. See Appendix F.* The surveys documented nest species and occupancy to the extent it could be determined. Surveys were conducted by flying over suitable nesting habitat (e.g., cliff bands, rocky areas, and stands of trees) and recording a geospatial location and noting the status for all known or potential raptor nests. The 2008 surveys also documented nests located incidental to other surveys and project activities. These aerial surveys for raptor nests identify species composition and relative abundance and are appropriate for site characterization purposes.

As described above, BLM has collected information on nests within the CCSM Project Site since 1980 (a 33-year period) and helicopter-based aerial nest surveys were completed for the CCSM Project, including Phase I in 2008. For the CCSM Project Site, red-tailed hawk, prairie falcon, and ferruginous hawk were the most commonly recorded species in the BLM nest database. Nest occupancy was not always recorded and there is a large variance in the current condition of the historic raptor nests in BLM's database. Many of the historic nests recorded by BLM are in poor condition as observed and documented during aerial flights conducted by PCW. Nests in poor condition are less likely to be used for nesting because they require an extensive rebuild in order to be used for future nesting activities and because nearby alternate nests in good condition are often available.

During the 2008 nest surveys, a total of 21 occupied non-eagle raptor nests (11 red-tailed hawk, 5 prairie falcon, and 5 great horned owl [*Bubo virginianus*]) were located within the survey area, of which only 7 were located within the Phase I Development Area. *See Figure 4.2 and Figure 4.3*. The majority of the nests detected in 2008 were red-tailed hawk nests located outside of the CCSM Project Site. Within the Phase I portion of the Sierra Madre WDA there were 2 red-tailed hawk nests and 2 great horned owl nests. Within the Phase I portion of the Chokecherry WDA there were 2 prairie falcon nests and 1 red-tailed hawk nest.[24]

[24] The red-tailed hawk nest is not visible on Figure 4.2 due to scale. The nest is located on the Bolten Rim in the Chokecherry WDA in close proximity to the prairie falcon nest; therefore, only the prairie falcon nest point is visible.

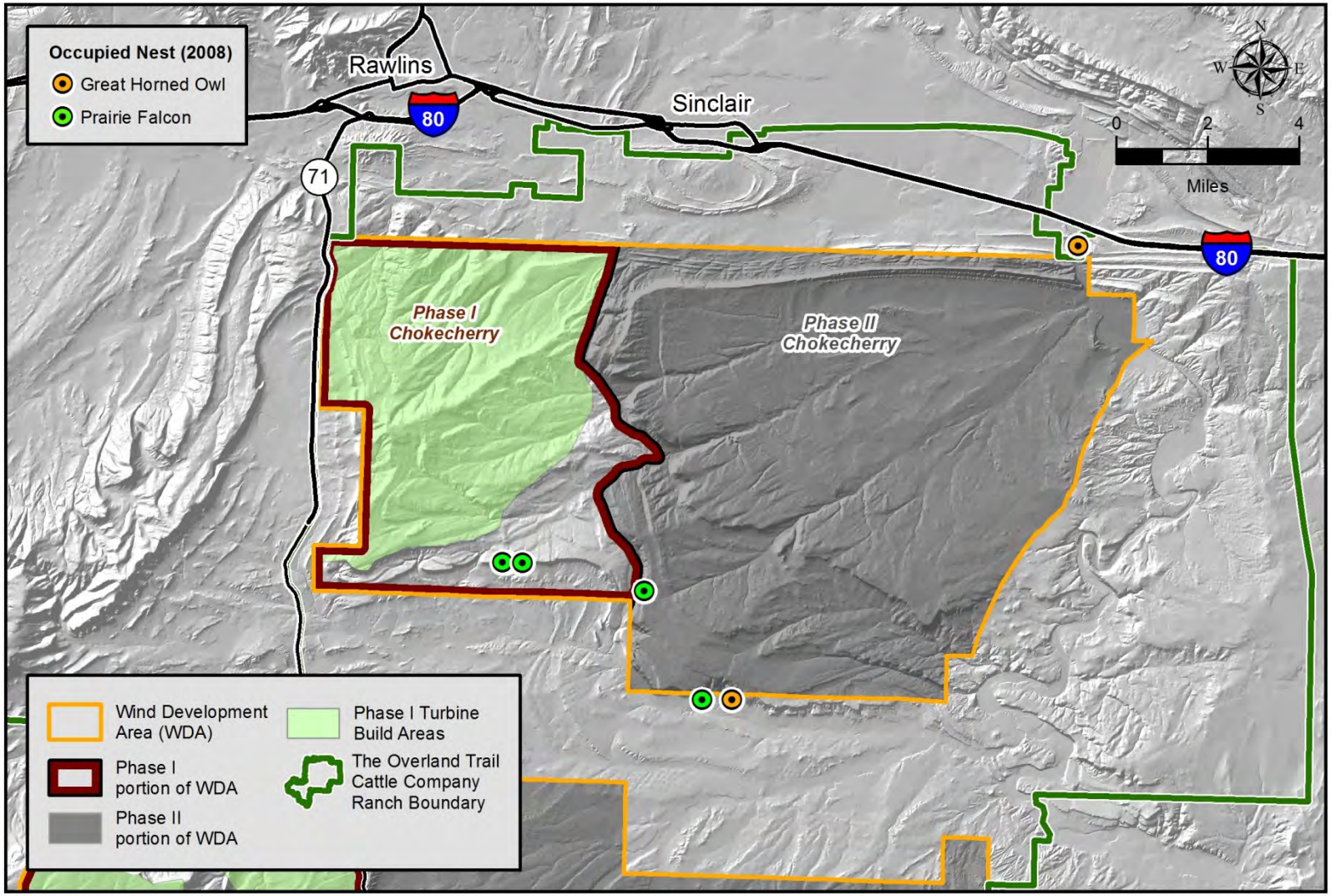

Figure 4.2. Chokecherry WDA Occupied Non-eagle Raptor Nests, 2008.

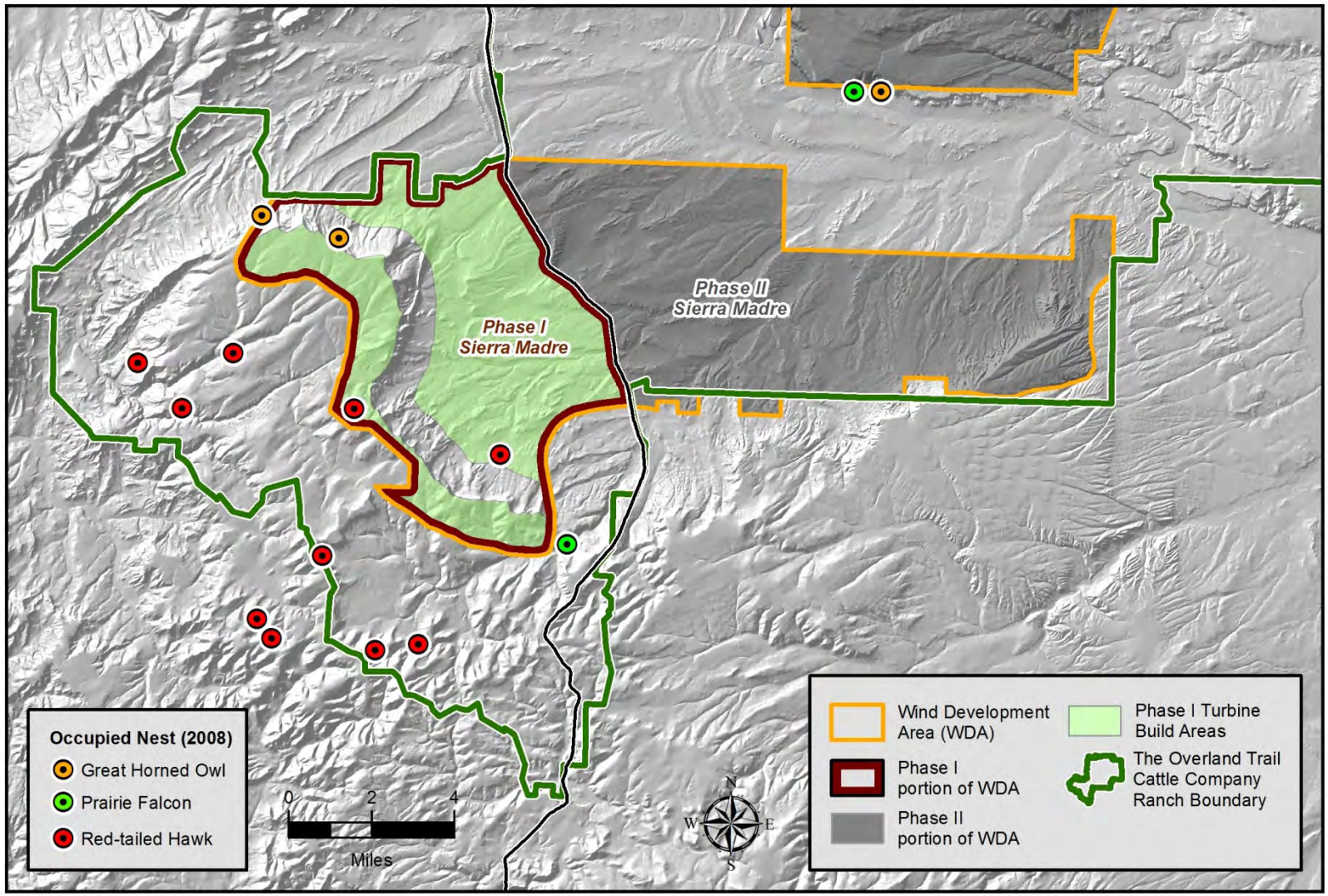

Figure 4.3. Sierra Madre WDA Occupied Non-eagle Raptor Nests, 2008.

Acoustic Bat Surveys

AnaBat detection systems manufactured by Titley Electronics were used for acoustic bat surveys conducted on the CCSM Project Site. Bat species produce echolocation vocalizations based on their ecological niche requirements, which may demand different frequency bandwidth, pulse duration, and other characteristics discernible in sonograms. AnaBat systems are capable of detecting and recording these ultrasonic sounds and producing sonograms, individual pulses on a frequency graph plotted against time. AnaBat sonograms generally have enough information to label a pulse sequence to a group of bats with similar acoustic characteristics (e.g., 25-kilohertz [kHz] bats) and even allow for identification of acoustically distinctive species (e.g., hoary bat). *See Kunz et al. 2007.* In North America, Myotis bat species are generally recognized as being the most difficult to differentiate due to similarities in vocalization characteristics; therefore these pulses are often placed within a frequency group (e.g., 40-kHz Myotis).

For acoustic bat surveys conducted for the CCSM Project in 2008, a standard index of bat activity was generated by counting the number of bat passes per detector-night at each survey location. *See Hayes 1997; Kunz et al. 2007.* A bat pass is defined as a pulse sequence (commonly referred to as a "call") consisting of at least one individual pulse that was separated by more than 1 second from the next pulse. *See White and Gehrt 2001*. Individual bats are not identifiable in an acoustical dataset since pulses may have been produced by the same or different individuals over the course of a single night survey period; therefore, an index of activity is used because the exact number of bats cannot be quantified from acoustic data. *See Hayes 2000; Kunz et al. 2007.*

All bat passes were categorized through assessment of both qualitative (e.g., shape) and quantitative (e.g., characteristic frequency) qualities as demonstrated by Weller and Baldwin (2012). Bat passes were classified as pertaining to low (<35 kilohertz [kHz]) or high (>35 kHz) characteristic frequency groups. Diagnostic call sequences in the datasets were labeled only for hoary bat as that species has a unique call pattern easily distinguished from other bat species.

Passive acoustic bat surveys were conducted from July 13 to October 13, 2008. While some of these survey points were located outside of Phase I, they were conducted in the same habitat types and similar topographic conditions; therefore, these data can be used to characterize bat use in Phase I. *See Solick et al. 2008*. Six sites were surveyed with eight AnaBat units, two of which were placed on meteorological towers approximately 45 meters above the ground, with the remaining six AnaBat units being ground-based. *See Figure 4.4.* The study resulted in 3,021 bat passes across 669 detector-nights for an average of 4.52 bat passes/detector-night. However, this mean value is heavily influenced by site A3 located in Hugus Draw, which comprised 63% of all bat passes recorded during 2008 (average 20.62 passes/detector-night). *See Figure 4.4.* Site A3 is located near a wetland/stock pond outside of the Phase I Turbine Build Area. *See Figure 4.4.* As no impacts to bats will occur at site A3 because of its location, it was removed from the dataset as an outlier. After removal of site A3, the remaining seven AnaBat sites demonstrated more consistent bat use with an average of 1.9 bat passes per detector-night. *See Table 4.2.*

Bat activity in 2008 was highest from July 13 through the end of August, with activity peaks on July 27 and August 22. Very low activity was recorded in September and October. Temporal variation was similar among AnaBat sites across the CCSM Project.

Approximately 63% of all bat passes recorded were of high-frequency bats. Ground-based AnaBat units recorded similar ratios of low- and high-frequency bats, though there was variation between sites and across the survey period. However, elevated units deployed on meteorological towers consistently recorded disproportionately high numbers of low-frequency bat passes than high-frequency, with hoary bat comprising 7% of all bat passes. Trends in activity for hoary bat were consistent with patterns observed for all bat frequency groups, including a peak in activity on August 22.

Table 4.2. 2008 Acoustic Bat Survey Data.

Characteristic	Value
High Frequency Bat Passes	1909
Low Frequency Bat Passes	895
Hoary Bat Passes	217
Total Bat Passes	**3,021**
Total Bat Passes (Excluding Site A3)	1124
Total Detector Nights (Excluding Site A3)	577
Bat Passes per Detector Night Excluding Site A3	**1.9**

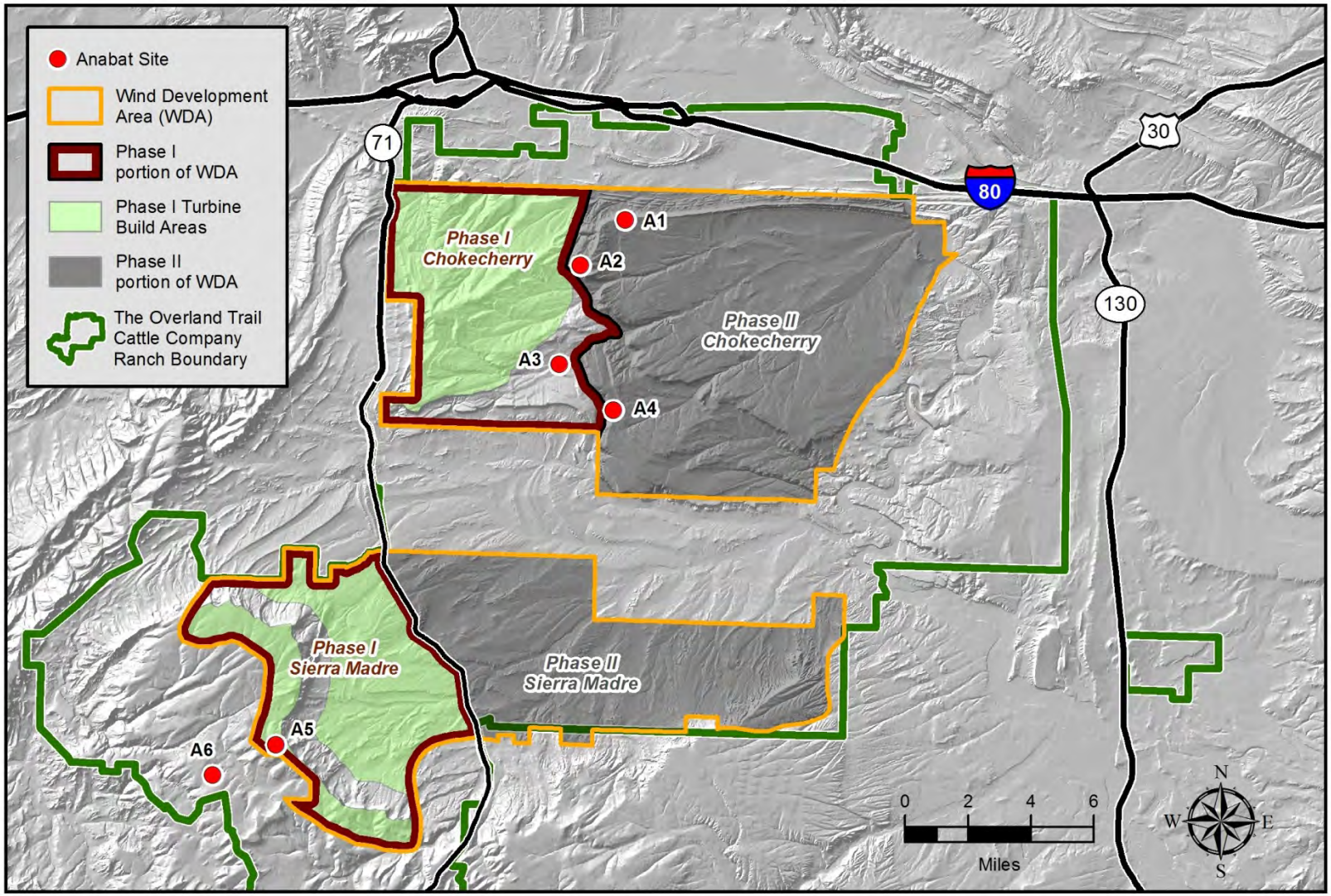

Figure 4.4. 2008 Acoustic Bat Survey Sites.

4.3.2 Site Characterization Questions

As described above, the site characterization and risk assessment process for the CCSM Project, including Phase I, is based on the information compiled for and contained in the BLM FEIS. *See BLM 2012b.* Consistent with the USFWS Wind Energy Guidelines, the BLM FEIS reviewed available data from: (1) existing data sources, such as peer-reviewed literature, agency technical reports, CCSM Project-specific technical reports, Wyoming Geographic Information Science Center datasets, and Wyoming Natural Diversity Database records; (2) other federal, state and local agencies, non-governmental organizations, and the public; and (3) site-specific field data collected by qualified wildlife biologists.

1. *Are there species of concern[25] present on the potential site(s), or is habitat (including designated critical habitat) present for these species?*

   As discussed in section 1.2, PCW has identified 117 species of migratory birds within the CCSM Project Site, including Phase I. *See Appendix B.* In addition, 13 bat species have been observed, acoustically detected, or documented in the vicinity of the CCSM Project. *See Orabona et al. 2012; BLM 2012b.* Of these species, the BLM FEIS identified 11 migratory bird and 3 bat species listed on the BLM Wyoming Sensitive Species Policy and List that have the potential to occur on the CCSM Project Site. *See BLM 2012b at p. 3.15-5. See Appendix B.* In addition, data supporting the analysis in the BLM FEIS identified 21 migratory bird and 8 bat species included in the SWAP as SGCN that have the potential to occur on the CCSM Project Site. *See WGFD 2010. See Appendix B.* Some of the BLM and WGFD species of concern are the same; when this redundancy is removed there are a total of 22 migratory bird and 9 bat species of concern that have the potential to occur on the CCSM Project Site. *See Table 1.1 & Table 1.2.*

2. *Does the landscape contain areas where development is precluded by law or areas designated as sensitive according to scientifically credible information?*

   Consistent with the site evaluation, the Red Rim-Grizzly WHMA is the only avian-related sensitive area in the vicinity of the CCSM Project Site identified in the BLM FEIS. The Grizzly portion of the WHMA is managed for several raptor species. *See WGFD and BLM 1992.* At the time of the CCSM Project Site characterization, development was proposed for a small portion of the Red Rim-Grizzly WHMA. However, as discussed in section 5.1, the CCSM Project was ultimately reconfigured to eliminate development in the Red Rim-Grizzly WHMA. *See BLM 2012a.*

[25] This Phase I BBCS adopts this definition of species of concern from the USFWS Wind Energy Guidelines. However, in recognition of agency management priorities, this Phase I BBCS is primarily focused on special status species that have been identified by federal and state agencies. *See Section 1.2.*

In addition to the Red Rim-Grizzly WHMA, the 2008 BLM RFO RMP designated the Upper Muddy Creek Watershed/Grizzly WHMA on BLM lands adjacent to the Red-Rim Grizzly WHMA. *See BLM 2008a.* However, the Upper Muddy Creek Watershed/Grizzly WHMA was designated for purposes of managing habitat for Colorado River fish species and crucial winter habitat for elk and mule deer. As the Upper Muddy Creek Watershed/Grizzly WHMA is not designated for purposes of managing migratory birds and bats, this WHMA is not discussed further in this Phase I BBCS.

3. *Are there known critical areas of wildlife congregation, including, but not limited to: maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors, leks, or other areas of seasonal importance?*

   Based on the results of migratory bird point count surveys, acoustic bat monitoring, and other wildlife surveys across the CCSM Project Site, the BLM FEIS did not identify any maternity roosts, hibernacula, staging areas, winter ranges, nesting sites, migration stopovers or corridors for migratory birds and bats within the CCSM Project Site or surrounding areas. *See BLM 2012b at pp. 13.14-1 & 13.15-1.* Areas of seasonal importance were identified including nesting sites and several small reservoirs that may provide habitat and stopover sites for waterfowl and wading birds. Some of these areas were originally proposed for development; however, the majority of these areas were eventually eliminated from the CCSM Project, including Phase I, as described in section 5.1. WGFD identified big game winter range and greater sage-grouse leks within the CCSM Project Site, including Phase I. However, these features are not related to the migratory bird and bat species that are the subject of this Phase I BBCS. *See Section 1.2.*

4. *Are there large areas of intact habitat with the potential for fragmentation, with respect to species of habitat fragmentation concern needing large contiguous blocks of habitat?*

   BLM analyzed the impacts of the CCSM Project on sagebrush obligate species (sage thrasher, sagebrush sparrow, Brewer's sparrow). This species group is generally believed to be sensitive to fragmentation of sagebrush ecosystems. *See Rich et al. 2005*. The BLM FEIS also identified large tracts of rangelands and other agricultural use areas across the CCSM Project Site. These habitats are relatively intact but are regularly bisected by state highways, county roads, ranch roads, electrical transmission and distribution lines, oil and gas pipelines, and communications facilities. As described in the BLM FEIS, the CCSM Project would result in increased potential for fragmentation or displacement. *See BLM 2012b at p. 3.14-1*. However, BLM identified that impacts to sagebrush obligate species (sage thrasher, sagebrush sparrow, Brewer's sparrow) would not be significant. In addition, based on the site-specific data, PCW has developed a number of measures to minimize impacts to sagebrush steppe communities and other habitats in Phase I. These measures are described in chapter 5.0.

5. *Using best available scientific information has the developer or relevant federal, state, tribal, and/or local agency identified the potential presence of a population of a species of habitat fragmentation concern?*

   As identified in the vegetation surveys and BLM FEIS, the CCSM Project Site contains several intact patches of sagebrush steppe that support sagebrush-obligate species. As described above, BLM did not identify any significant impacts to sagebrush-obligate species from the CCSM Project in its EIS.

   In addition to sagebrush obligates, the Wyoming SWAP specifically mentions habitat fragmentation as a concern for ferruginous hawk and Swainson's hawk.[26] *See WGFD 2010.* BLM's FEIS considered effects to these species, including direct effects and indirect effects such as habitat fragmentation, displacement, and collision with wind turbines. *See BLM 2012b at p. 4.14-8.* The BLM FEIS concluded that the development and implementation of this Phase I BBCS and the associated adaptive management process would avoid and minimize impacts to all migratory bird and bat species, including those of habitat fragmentation concern. *See BLM 2012b at pp. 4-14-17 & 4.14-24.*

6. *Which species of birds and bats, especially those known to be at risk by wind energy facilities, are likely to use the proposed site based on an assessment of site attributes?*

   Common non-eagle raptor species identified in the avian use surveys include American kestrel, northern harrier, red-tailed hawk, and Swainson's hawk. *See Section 4.3.1.* The most common passerine species within the CCSM Project Site include horned lark, western meadowlark, vesper sparrow, Brewer's sparrow, sagebrush sparrow, and sage thrasher. *See Section 4.3.1.* Given that passerines make up the largest proportion of birds observed in the avian use surveys, the BLM FEIS found that passerine species (e.g., small songbirds) are most likely to be at risk of fatalities from wind energy development. *See BLM 2012b at p. 4.14-24.* Therefore, it is anticipated that horned lark, western meadowlark, vesper sparrow, Brewer's sparrow, sagebrush sparrow, and sage thrasher would be the species most likely to be impacted by the CCSM Project, including Phase I.

   The BLM FEIS found that there was low potential for impacts from the CCSM Project to the three BLM sensitive bat species (long-eared myotis, fringed myotis, and Townsend's big-eared bat) from the CCSM Project. *See BLM 2012b at p.4.14-18.* The BLM FEIS also determined that the species of bats most likely to be impacted by wind energy development in the western United

[26] The USFWS and other federal agencies have yet to designate species of habitat fragmentation concern for Wyoming. It is possible that there are other species of habitat fragmentation concern in Phase I. However, as they have not been identified, they cannot be specifically addressed in this Phase I BBCS. If additional species of habitat fragmentation concern are identified by the agencies, they may be addressed through the adaptive management process described in Section 8, as appropriate.

States are the hoary bat and the silver-haired bats. *See BLM 2012b at p. 4.14-17.* However, hoary bats were detected in just 7% of all bat passes recorded on the CCSM Project Site, or 217 bat passes out of a total of 3,021. *See Section 4.3.1.* The low occurrence of hoary bats on the CCSM Project Site indicates that impacts to this species will be minimal. As described in the FEIS, it is likely that hoary bat and silver-haired bat would have the greatest risk for impacts resulting from the CCSM Project. *See BLM 2012b at p. 4.14-16*. However, the overall risk to bats remains low. *See Appendix D.*

7. *Is there a potential for significant adverse impacts to species of concern based on the answers to the questions above, and considering the design of the proposed project?*

   As identified in the CCSM Project avian use surveys, certain migratory bird and bats species of concern may be present on the CCSM Project Site. *See Section 4.3.1.* The BLM FEIS analyzed potential impacts to these species from the CCSM Project and concluded that no significant impacts would occur to sagebrush obligate bird species or BLM-sensitive bat and WGFD SGCN bat species. *See BLM 2012b at pp. 4.14-17 & 4.14-25*. The FEIS found that, while adverse impacts may occur to some bird species on a localized basis, the avoidance and minimization measure in this Phase I BBCS would likely substantially reduce impacts to migratory bird and bat species. *See BLM 2012b at pp. 4.14-17 & 4.14-24*.

   The migratory bird and bat species and habitats most likely to be impacted by the CCSM Project, including Phase I, are ubiquitous throughout south-central Wyoming and much of the western United States. As such, localized impacts associated with the CCSM Project are not likely to have significant impacts to the availability of habitats or populations of the migratory bird and bat species observed during survey efforts and addressed in this Phase I BBCS. In addition, PCW has developed extensive avoidance, minimization and conservation measures in this Phase I BBCS to avoid and minimize impacts to migratory birds and bats. *See Chapter 5.0.*

4.3.3 Site Characterization Risk Assessment

The site characterization process for the CCSM Project, including Phase I, concluded that there are no threatened or endangered migratory birds or bat species present on the CCSM Project Site. However, PCW determined that migratory bird or bat species of concern may be present. *See Appendix B.* Therefore, consistent with the USFWS Wind Energy Guidelines, PCW identified additional measures to avoid and minimize impacts to migratory bird and bat species. *See USFWS 2012a at p. 49.* The avoidance and minimization measures included a substantial re-design of the entire CCSM Project, and specifically Phase I. The Phase I avoidance and minimization process and the conservation measures and best management practices identified for migratory birds and bats are described in chapter 5.0.

Following completion of the site characterization process and development of the associated avoidance and minimization measures, PCW determined that the answer to one or more of the site characterization (Tier 2) questions was still inconclusive. Therefore, PCW conducted additional in-depth field studies on migratory bird and bat use based on the issues raised during site characterization.

4.4 Field Studies and Impact Prediction (USFWS Wind Energy Guidelines – Tier 3; WGFC Wind Energy Recommendations – Tier 2)

As discussed above, after completion of the CCSM Project site characterization process, PCW determined that additional field studies were appropriate to assess the potential risk to migratory birds and bats from the CCSM Project, including Phase I. The completion of additional field studies, i.e. additional data collection, is consistent with Tier 3 of the USFWS Wind Energy Guidelines and Tier 2 of the WGFC Wind Energy Recommendations.

Tier 2 of the WGFC Wind Energy Recommendations and Tier 3 of the USFWS Wind Energy Guidelines recommend the collection of quantitative data using scientifically rigorous studies. The intent of these studies is to assess the potential risk of a proposed project to migratory bird and bat species and to inform appropriate measures to avoid and minimize that risk. The field studies are also intended to inform the duration and level of effort of post-construction monitoring. *See Chapter 6.0.*

In compliance with Tier 2 of the WGFC Wind Energy Recommendations and Tier 3 of the USFWS Wind Energy Guidelines, PCW conducted additional site-specific, scientifically rigorous migratory bird and bat field studies following completion of the 2008-2009 site characterization surveys. The field studies were designed in coordination with USFWS, WGFD, and BLM based on data collected during the site characterization process. *See Section 4.3.*

4.4.1 Field Study Data

To assess the potential risk to migratory birds and bats from the CCSM Project, including Phase I, PCW conducted numerous field studies and surveys. *See Table 4.3.* These studies and surveys include:

1. Raptor use surveys designed to characterize raptor use and identify important raptor-use areas;
2. Raptor nest surveys designed to characterize local area nesting population;
3. Migratory bird surveys to assess the diversity and abundance of migratory birds;
4. Avian radar surveys to identify patterns of migratory bird and bat use;
5. Breeding bird surveys to document use of habitats during nesting season;
6. Waterbird/ waterfowl surveys to document the diversity and abundance of waterbirds and waterfowl using reservoirs in the vicinity of the CCSM Project; and
7. Acoustic bat surveys to document bat activity at additional locations within the CCSM Project Site.

Table 4.3. CCSM Project Migratory Bird and Bat Surveys.

Survey	Date
Raptor Use Surveys	
Long-watch Raptor Use and Migration Surveys	April 2011 - July 2012
800-meter Raptor Count Surveys	August 2012 - August 2013
Raptor Nest Surveys	
Raptor Nest Surveys	May 2008 May - July 2011 April - July 2012 April - July 2013 April - July 2014
Migratory Bird Use Surveys	
Migratory Bird Surveys	April 2011 - April 2012
Avian Radar Surveys	March 2011 - March 2013
Bats	
Acoustic Bat Surveys	April, August, October 2011
Other	
Breeding Bird Density Surveys	June 2011
Waterbird/ Waterfowl Surveys	April, August, October 2011

Following the site characterization process described in section 4.3, PCW initiated discussions with USFWS, BLM, and WGFD to begin development of a BBCS for the CCSM Project. During this collaborative process, USFWS and BLM reviewed the existing data and determined that additional data would be useful for more detailed risk assessments and siting efforts consistent with Tier 3 of the USFWS Wind Energy Guidelines. Therefore, USFWS and BLM recommended that PCW conduct additional surveys to identify high avian use areas and requested that PCW develop survey protocols to assess site-specific risk within the WDAs. USFWS emphasized the importance of identifying high avian use areas within the WDAs that might be avoided during development of final wind turbine layouts and micrositing of facilities. Specifically, USFWS and BLM identified avian radar technology in combination with long-watch raptor surveys and standard point counts as a desired method to map areas of high avian use.

In December 2010, PCW circulated draft survey protocols to the USFWS, BLM and WGFD for review and comment. PCW incorporated USFWS, BLM and WGFD recommendations and comments into the final survey protocols in March 2011. *See Appendix D*. PCW provided the March 2011 survey protocols to USFWS and received USFWS's concurrence with and endorsement of the protocols.[27] PCW implemented the March 2011 protocols and completed a full year of surveys from April 2011 to March 2012. These surveys included long-watch raptor surveys, avian radar studies, raptor nest surveys, migratory bird surveys, breeding bird surveys, and waterbird/ waterfowl surveys.

In April 2012, working with the USFWS, PCW identified an additional long-watch raptor survey protocol and new survey locations to: (1) refine important avian use areas; (2) identify additional avian use areas; and (3) inform the implementation of appropriate avoidance and minimization approaches to reduce risks to migratory bird and bat species. *See Appendix D.* Surveys were conducted under the additional protocol between April 2012 and July 2012. During this period, PCW also completed raptor nest surveys and continued avian radar surveys. The 2011 and 2012 protocols were implemented to provide site-specific data to identify important raptor use areas including those related to nesting activity, migration, foraging, and roosting as well as to provide the data necessary to complete a risk assessment for the CCSM Project, including Phase I. The data collected from these comprehensive surveys, were used to redesign the CCSM Project and develop the final wind turbine layout for Phase I. *See Chapter 5.0*.

During implementation of the 2011 and 2012 protocols, PCW worked closely with the USFWS to identify additional data collection and survey needs. During a meeting on July 24, 2012, USFWS recommended that raptor survey protocols be revised again for the CCSM Project to focus on 800-meter radius surveys to collect data that would be compatible with upcoming USFWS guidance. PCW revised its survey protocols as recommended by USFWS, and on August 20, 2012, 800-meter raptor count surveys began at 40 locations across the CCSM Project Site. After further coordination with USFWS, the 800-meter raptor count surveys were expanded again on November 12, 2012, to cover 60 locations within the CCSM Project Site to aid in the further refinement of important raptor use areas and inform avoidance and minimization measures. *See Appendix D*. Surveys continued at the 60 point locations through the end of August 2013.

[27] In a March 3, 2011 email, Mr. Sanderson, a USFWS employee, stated "[a]s we have stated all along, we are 100% behind the monitoring protocols . . . ." On May 5, 2011, Mr. Sanderson reiterated the USFWS's approval of the monitoring protocols and BBCS/ECP development approach in an email stating "[a]s discussed previously, the Service is entirely on-board with the proposed monitoring protocols . . . ."

Long-watch Raptor Surveys

Between April 4, 2011, and July 24, 2012, biweekly long-watch raptor surveys were completed throughout the CCSM Project Site. From April 2011 through March 2012, surveys were completed at 15 locations. From April 2012 through July 2012, surveys were completed at 14 locations. *See Figure 4.5. See Appendix E & F*. The duration and frequency of long-watch raptor surveys varied by season in accordance with the recommendations of the federal and state agencies; however, survey minutes were evenly distributed across all daylight hours and between sites within each season.

Long-watch raptor surveys were conducted for 4–8 hours at each location, with summer and winter surveys having the shortest duration, based on agency recommendations. Data collected for each raptor detected included species, number of individuals, age, sex, distance from observer, bearing to the bird, heading of the bird, height, and flight behavior. Flight paths were also recorded on aerial maps for each raptor detected. Long-watch raptor surveys were conducted in 4,000-meter radius plots strategically distributed across the WDAs to maximize coverage for the purposes of identifying high use areas and potential migratory pathways and other raptor use areas while maintaining observer confidence in species identification. While data were collected on raptor use out to 4,000 meters, for purposes of comparison with other raptor data collected for the CCSM Project, only those raptors observed within 800 meters of each long-watch raptor survey location are reported here. *See Table 4.4*. This is necessary because small raptors such as kestrels have a lower probability of detection beyond 800 meters than large raptors such as ferruginous hawks.

From April 2011 through July 2012, 430 surveys were conducted for a total of 146,876 minutes (2,447.9 hours) or more than 40% of the daylight minutes during this period. The entirety (100%) of the Phase I wind turbine layout was covered during the long-watch raptor surveys between April 2011 and July 2012. The data collected through the long-watch surveys was used to identify areas of high raptor use within the CCSM Project Site for the purposes of micrositing wind turbines and other facilities to avoid and minimize impacts to raptors and other migratory bird and bat species. In addition, the results were used to identify Turbine No-Build Areas in which wind turbines would not be constructed to further avoid impacts to raptors and other migratory bird and bat species using those areas. *See Chapter 5.0*.

A total of 452 hours of survey were completed at the Phase I long-watch raptor survey sites located in the Chokecherry WDA and 661 hours of survey were completed for the Sierra Madre WDA Phase I long-watch raptor survey sites. While portions of some of these 800-meter survey locations overlap with Turbine No-Build Areas, or are outside of the Phase I Turbine Build Area, they were conducted in the same habitat types and similar topographic conditions; therefore, these data can still be used to assess avian use in Phase I.

A total of 303 non-eagle raptor observations were recorded within 800 meters of Phase I long-watch raptor survey locations. Non-eagle raptor use was relatively consistent during spring, summer, and fall survey periods across Phase I. Slightly higher numbers of raptors were observed during spring presumably as a result of increased use during migration. Non-eagle raptors were not observed during winter surveys conducted in 2011-2012. *See Table 4.4*.

During surveys of the Phase I portion of the Chokecherry WDA, American kestrel was the most commonly observed non-eagle raptor within 800 meters of the long-watch raptor survey locations comprising 42 of 76 total non-eagle raptors (55%), followed by red-tailed hawk (9 individuals, 12%), and prairie falcon (9 individuals, 12%).

During surveys of the Phase I portion of the Sierra Madre WDA, red-tailed hawk was the most commonly observed non-eagle raptor within 800 meters of the long-watch raptor survey locations accounting for 80 of the 227 individuals (35%), followed by American kestrel (50 individuals, 22%), northern harrier (28 individuals, 12%), Swainson's hawk (19 individuals, 8%), and prairie falcon (18 individuals, 8%).

Table 4.4. Phase I Non-eagle Raptor Observations, 2011-2012 Long-watch Raptor Surveys.

Species	Spring 2011	Summer 2011	Fall 2011	Winter 2011-2012	Spring 2012	Total
Phase I Chokecherry WDA						
American Kestrel	32	8	---	---	2	**42**
Ferruginous Hawk	1	---	2	---	---	**3**
Merlin (*Falco columbarius*)	---	---	2	---	---	**2**
Northern Harrier	4	---	2	---	---	**6**
Prairie Falcon	9	---	---	---	---	**9**
Red-tailed Hawk	1	4	4	---	---	**9**
Sharp-shinned Hawk (*Accipiter striatus*)	1	---	1	---	1	**3**
Turkey Vulture (*Cathartes aura*)	---	---	---	---	1	**1**
Unknown Buteo	1	---	---	---	---	**1**

Species	Spring 2011	Summer 2011	Fall 2011	Winter 2011-2012	Spring 2012	Total
Phase I Sierra Madre WDA						
American Kestrel	14	16	9	---	11	**50**
Cooper's Hawk	3	---	2	---	1	**6**
Ferruginous Hawk	2	3	---	---	---	**5**
Merlin	---	---	1	---	2	**3**
Northern Goshawk	---	---	---	---	1	**1**
Northern Harrier	18	4	6	---	---	**28**
Peregrine Falcon	---	1	1	---	---	**2**
Prairie Falcon	7	7	3	---	1	**18**
Rough-legged Hawk	---	---	1	---	---	**1**
Red-tailed Hawk	58	5	8	---	9	**80**
Sharp-shinned Hawk	2	---	4	---	---	**6**
Swainson's Hawk	3	10	---	---	6	**19**
Turkey Vulture	---	2	1	---	---	**3**
Unknown Accipiter	1	---	---	---	---	**1**
Unknown Buteo	1	---	1	---	---	**2**
Unknown Raptor	1	---	---	---	1	**2**
Total	**159**	**60**	**48**	**0**	**36**	**303**

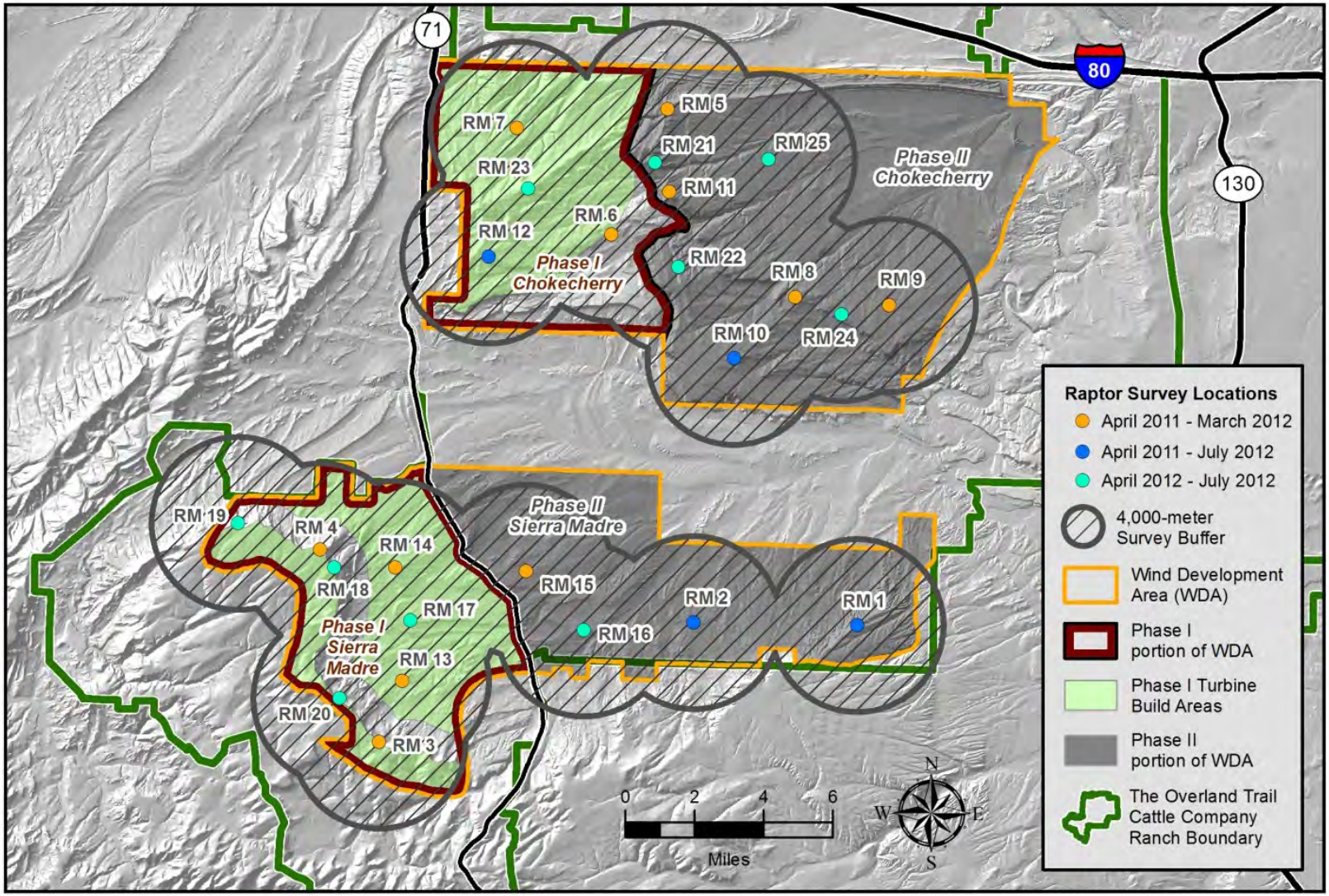

Figure 4.5. Long-watch Raptor Survey Locations, April 2011 to July 2012.

800-meter Raptor Count Surveys

Between August 20, 2012, and November 9, 2012, 1,382 biweekly 800-meter raptor count surveys were conducted at 40 locations within the CCSM Project Site. *See Figure 4.6*. Following discussion with USFWS, the biweekly 800-meter raptor count surveys were increased to 60 sites between November 12, 2012, and August 30, 2013, to achieve additional coverage. *See Figure 4.7. See Appendix E & F*.

PCW's 800-meter raptor count surveys provide more than 30% coverage of the Phase I wind turbine layout. To obtain the desired coverage, minimum convex polygons (MCPs) were placed around potential wind turbine construction areas in the WDAs and were evaluated for differences in habitat characteristics, forage potential, and topography. Using the Geostatistical Analyst tools in ArcGIS, spatially balanced 800-meter raptor count survey locations were sequentially selected to capture the variability in habitat conditions, terrain features, and wind turbine numbers and densities, while ensuring that no overlap occurred between survey locations. The total number of sampling locations per MCP was based on the relative surface area, number of wind turbines, and wind turbine densities in each MCP.

The 800-meter raptor count surveys were generally conducted for 1 hour at each site (on rare occasions weather conditions and visibility truncated the 1 hour survey time), and data collected for each raptor observed during these surveys included species, number of individuals, age, sex, distance from observer, bearing to the bird, heading of the bird, height, flight behavior, and number of flight minutes. Flight paths were also recorded on aerial maps for each raptor detected. The 800-meter raptor count surveys were conducted within 800-meter radius plots in order to maintain high confidence in detection and identification of raptors, and in the recording of their flight paths.

From August 2012 to August 2013, 800-meter raptor count surveys were conducted across the CCSM Project Site for a total of 97,573 minutes (1,626 hours), covering 35.5% of the total daylight minutes during this period. Of these surveys, 51,964 minutes (866 hours) of survey were conducted within the Phase I Development Area. Fifteen survey locations in the Phase I portion of the Chokecherry WDA were surveyed for a total of 21,364 minutes. Eighteen survey locations in the Phase I portion of the Sierra Madre WDA were surveyed for a total of 30,600 minutes. Data from the 800-meter raptor count surveys were used to further identify high raptor use areas for the purpose of micrositing Phase I to avoid and minimize impacts to raptors and other migratory bird and bat species.

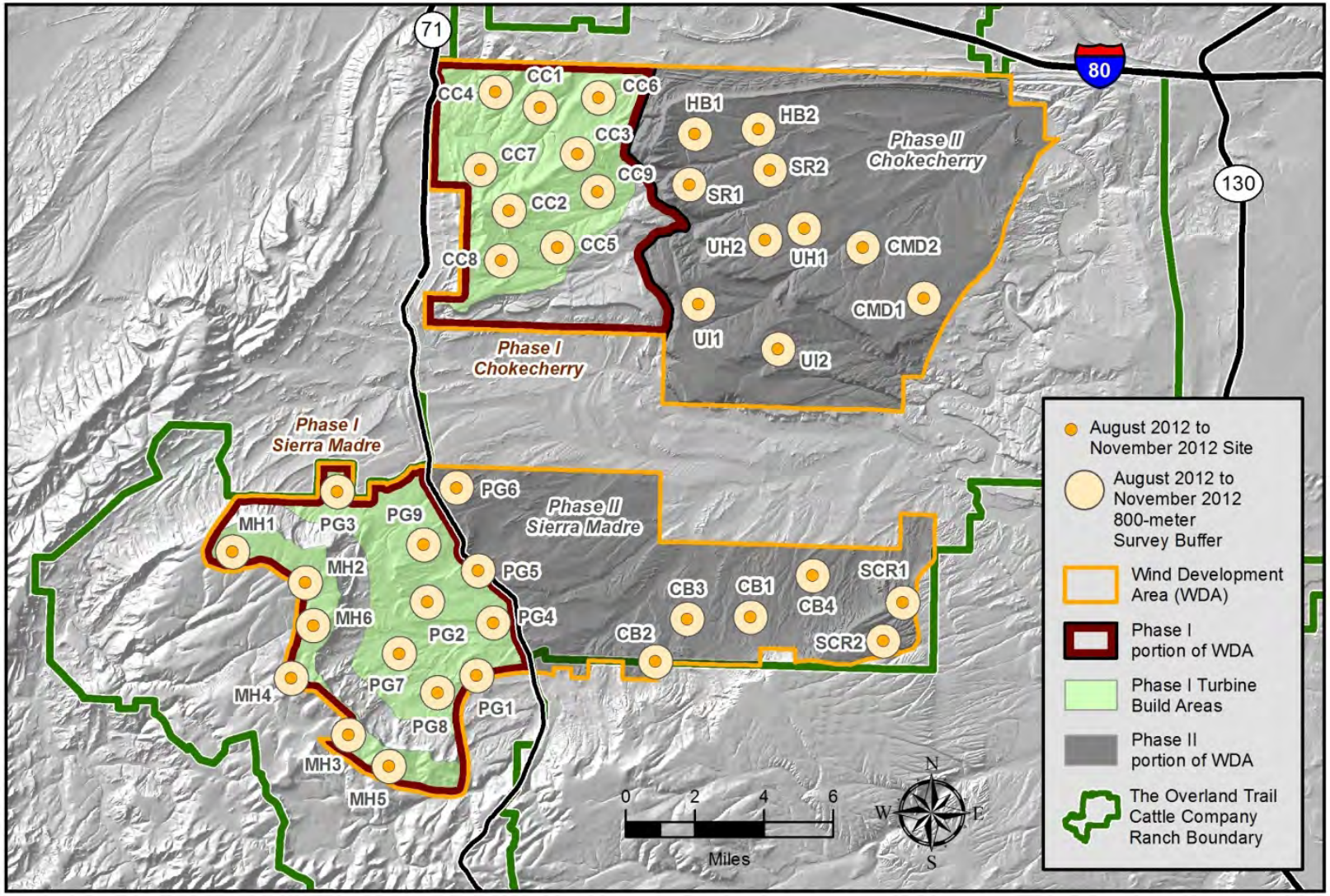

Figure 4.6. 800-meter Raptor Count Locations, August 2012 to November 2012.

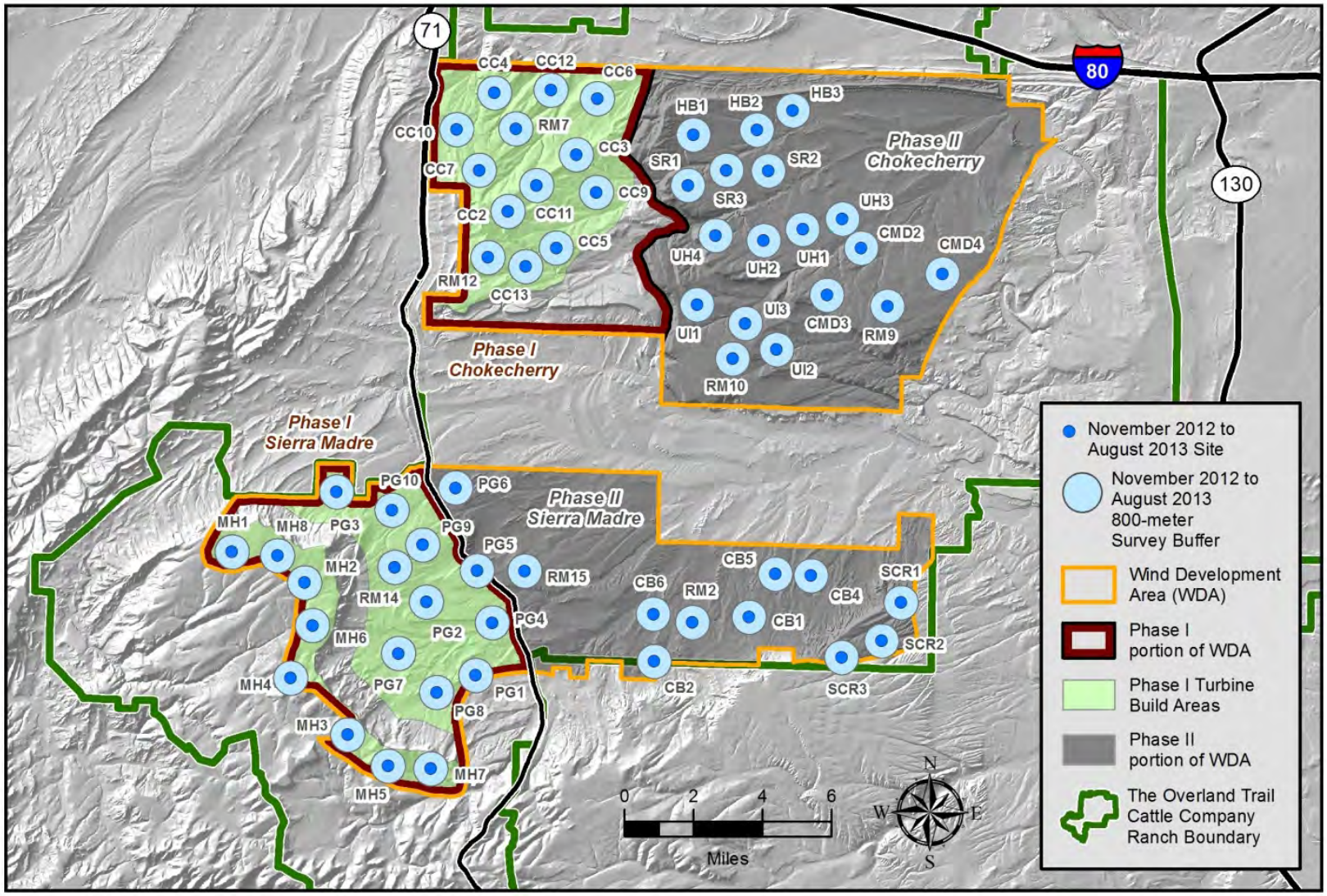

Figure 4.7. 800-meter Raptor Count Locations, November 2012 to August 2013.

A total of 104 non-eagle raptors were observed during the 2012-2013, 800-meter raptor counts. The number of non-eagle raptors observed was highest during the fall of 2012 with slightly fewer individuals observed during the spring and summer months of 2013. Very low use was observed during winter 2012-2013, with only 3 individual non-eagle raptors observed. American kestrel was the most commonly observed species in the Phase I portions of both the Chokecherry and Sierra Madre WDAs and made up 28% (29 of 104 observations) of all non-eagle raptor observations. Other common non-eagle raptor species in order of abundance included Swainson's hawk (24 observations, 23%), northern harrier (15 observations, 14%), and red-tailed hawk (14 observations, 13%). While Swainson's hawk was the second most abundant species based on number of individuals observed, 13 of the 24 individuals (54%) were observed in a single migrating group on September 11, 2012. *See Table 4.5*.

During the fall of 2012 (August 20 to November 9, 2012), over 281.6 hours of survey were completed within the Phase I Development Area. American kestrel, Swainson's hawk, red-tailed hawk, and northern harrier were the most commonly observed non-eagle raptor species in both the Sierra Madre and Chokecherry WDAs. As described above, 13 of the 18 (72%) of the Swainson's hawks observed during fall 2012 were associated with a single migrating group. Ferruginous hawk, merlin, prairie falcon, rough-legged hawk, and sharp-shinned hawk were also observed, primarily in the Sierra Madre WDA, but accounted for a small percentage of total observations and use.

During the winter of 2012-2013 (November 12, 2012, to March 29, 2013), over 267.5 hours of survey were completed within the Phase I Development Area. Use of the Phase I Development Area by raptors was very low during the winter months. Rough-legged hawk was the only non-eagle raptor observed during winter months. A single ferruginous hawk was recorded in late March 2013 (March 21), likely an early spring migrant. During winter months, there was no observed non-eagle raptor use in the Phase I portions of the Sierra Madre WDA. All winter non-eagle raptor use across the Phase I Development Area occurred in the Chokecherry WDA.

During the spring of 2013 (April 1 to June 21, 2013), over 178 hours of survey were completed within the Phase I Development Area. American kestrel, red-tailed hawk, northern harrier, and Swainson's hawk were the most commonly observed species. Additional species observed during this period included prairie falcon, rough-legged hawk, ferruginous hawk, and merlin.

During the summer of 2013 (June 24 to August 30, 2013), over 160 hours of survey were completed within the Phase I Development Area. Species observed included American kestrel, northern harrier, red-tailed hawk, prairie falcon, and Swainson's hawk.

Table 4.5. Phase I Non-eagle Raptor Observations, 2012-2013 800-meter Raptor Count Surveys.

Species	Fall 2012	Winter 2012-2013	Spring 2013	Summer 2013	Total
Phase I Chokecherry WDA					
American Kestrel	2	---	2	1	5
Ferruginous Hawk	---	1	---	---	1
Northern Harrier	1	---	1	---	2
Prairie Falcon	---	---	1	---	1
Rough-legged Hawk	---	2	1	---	3
Red-tailed Hawk	---	---	1	---	1
Swainson's Hawk	1	---	---	---	1
Unknown Buteo	---	---	1	---	1
Phase I Sierra Madre WDA					
American Kestrel	10	---	3	11	24
Ferruginous Hawk	2	---	3	---	5
Merlin	1	---	1	---	2
Northern Harrier	3	---	5	5	13
Prairie Falcon	1	---	1	4	6
Rough-legged Hawk	1	---	---	---	1
Red-tailed Hawk	5	---	4	4	13
Sharp-shinned hawk	1	---	---	---	1
Swainson's Hawk	17	---	4	2	23
Unknown Buteo	---	---	1	---	1
Totals	**45**	**3**	**29**	**27**	**104**

Raptor Nest Surveys

As discussed in section 4.3.1, BLM has collected information on nests within the CCSM Project Site since 1980 (a 33-year period) and in May of 2008 PCW conducted aerial surveys for raptor nests within a 1-mile buffer of the Original Proposed Action. To provide further site-specific data to assess potential impacts to raptors from the CCSM Project, PCW conducted additional aerial raptor nest surveys in May and early-June of 2011, and April and May of 2012, 2013 and 2014. Nest surveys were completed in accordance with the survey recommendations provided by the BLM and USFWS at the time of survey. Generally, protocols required surveys to occur prior to leaf-out to allow most raptors to initiate their nests while maintaining maximum detectability for nests located in trees. While this approach may have prevented the detection of some early season nesting attempts, the data are sufficient to quantify relative abundance of nesting raptors, identify interannual variability in nesting effort, and characterize nesting patterns across Phase I.

PCW's 2011 through 2014 raptor nest surveys were conducted in suitable nesting habitats within the CCSM Project Site and a 8-kilometer (5-mile) buffer surrounding the CCSM Project (approximately 700 square miles), which includes all of Phase I. *See Figure 4.8. See Appendix F.* An 8-kilometer-wide (5-mile-wide) buffer was determined to be appropriate for the CCSM Project in coordination with USFWS and BLM based on calculated golden eagle inter-nest distances in the CCSM Project vicinity. Within the survey area, all previously recorded nest locations identified in BLM's nest database were visited. Additionally, surveys were structured to cover all suitable raptor nesting habitat (e.g., cliff bands, rock outcrops, riparian zones, stands of aspen, etc.) located within the 5-mile buffer to facilitate detection of new nests that were not previously identified in BLM's nest database or as part of 2008 raptor nest surveys. Ground surveys were conducted for all ferruginous hawk nest locations identified in BLM's nest database within the 8-kilometer survey buffer.

Location, nesting substrate, condition, and nesting status were recorded for each observed nest. For occupied nests, species, adult activity, and nestling activity were also recorded. Unoccupied nests were marked as unknown stick nests as it is not possible to determine what species may have built the nest, or what species may use the nest in the future. The quality of unoccupied nests was also assessed and placed into categories of good, fair, poor, or non-functional. Good nests were those that could support nesting activity with minimal rebuild or maintenance. Fair nests were those that would require substantial rebuild or maintenance. Poor nests were those that had evidence of nest structure but would require an entire rebuild of the nest. Non-functional nests were those that had only marginal evidence of past nesting (a few sticks on a ledge), had been destroyed, or had completely fallen from the nest substrate.

Ground surveys were conducted to monitor the status of occupied nests located during the aerial nest surveys and to search areas that were inaccessible during aerial surveys due to high winds or other weather conditions. For all occupied nests, ground surveys were conducted once every three weeks until a nest was determined to have fledged or failed at which time the nest was reclassified as unoccupied. During each visit, nests were surveyed for four hours or until current status was determined. Data collected included date and time of visit, condition of the nest, number of adults/eggs/nestlings present at the nest, behavior of the birds present, and any other notes pertinent to the current activity or status of the nest.

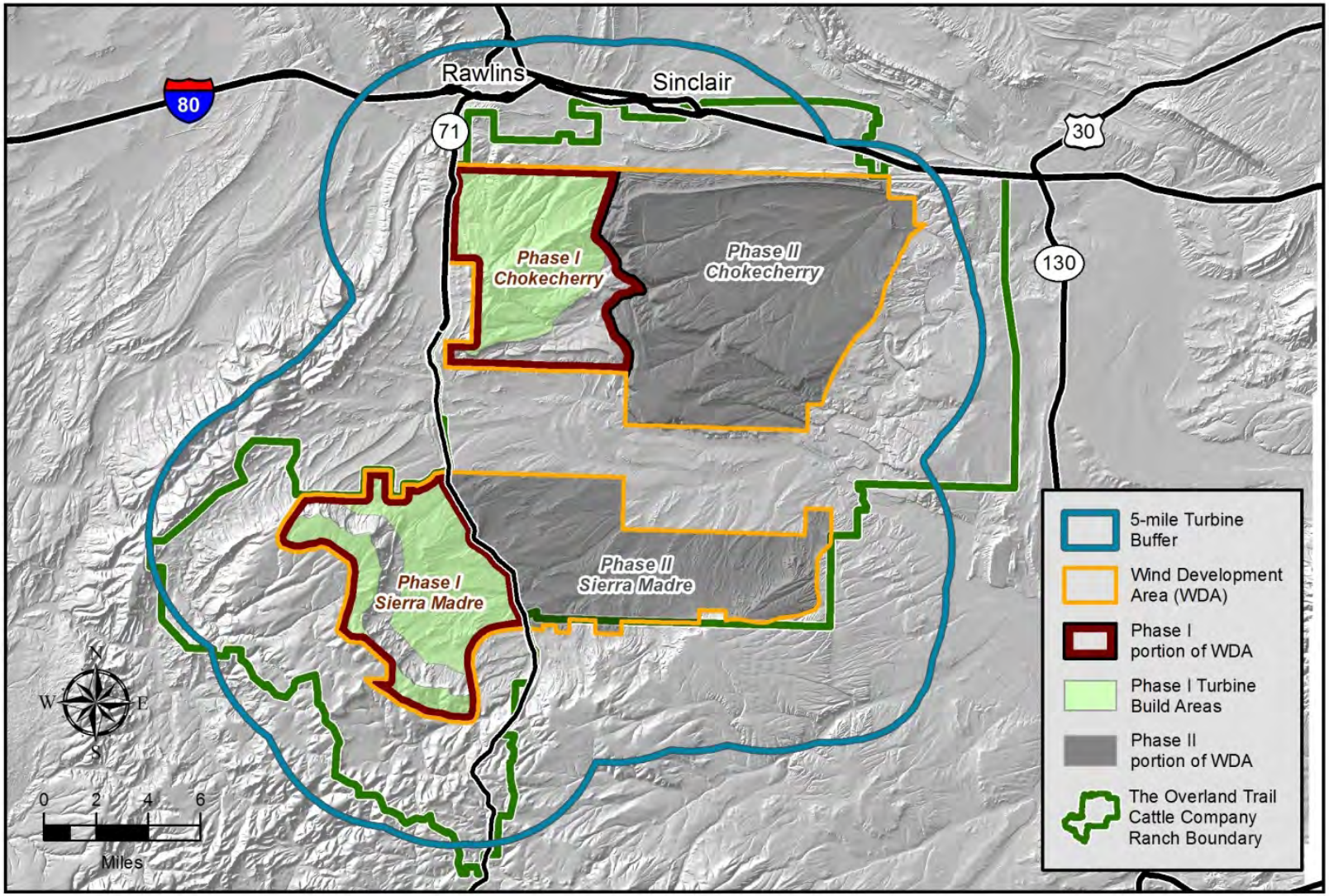

Figure 4.8. Aerial Raptor Nest Survey Area, 2011 through 2014.

2011 Nest Surveys

In 2011, aerial raptor nest surveys were conducted for the CCSM Project on May 25 and June 10 to assess nest activity. Follow-up ground surveys were completed between July 5 and August 2, 2011, to monitor the status of occupied nests. A total of 10 occupied non-eagle raptor nests (6 red-tailed hawk, 2 prairie falcon, 1 unknown *Buteo*, and 1 American kestrel) were located within the raptor nest survey area primarily outside of the CCSM Project WDAs. One additional prairie falcon nest was identified outside of the western boundary of the raptor nest survey area and therefore is not included in this analysis. *See Appendix F*. One occupied red-tailed hawk nest was located within the Phase I portion of the Chokecherry WDA, and one occupied American kestrel nest was located near the Phase I portion of the Chokecherry WDA. One occupied red-tailed hawk nest was located within the Phase I portion of the Sierra Madre WDA. *See Figure 4.9 & Figure 4.10.* Of the three nests located in Phase I, one red-tailed hawk nest fledged two nestlings; however, the fledging status of the other two nests (red-tailed hawk and American kestrel) could not be determined at the time of the final visits. Detailed information on nesting attempts and productivity is included in Appendix F.

In 2011, PCW also visited all historic ferruginous hawk nests within the raptor nest survey area that were recorded in the BLM nest database. These nests were surveyed to determine the current status and condition. Data collected included presence/absence of a nest at each site; a description of the condition of the nest (if a nest was detected); a description of the habitat surrounding the site; photographs of the nest and surrounding habitat; and the presence of other features that could suggest recent ferruginous hawk activity (e.g., feathers, whitewash, fresh nesting materials, etc.). All historic ferruginous hawk nests in the survey area were unoccupied in 2011, and many of the nests were categorized as non-functional. Of the 40 nests in the BLM database, only 15 nests were located, many with almost no structure remaining and only 2 to 3 in a condition that suggests they have recently supported nesting activities. *See Appendix F.*

2012 Nest Surveys

Aerial raptor nest surveys were conducted for the CCSM Project on April 25-26 and May 8, 2012, with follow-up ground surveys from May 24 to July 27, 2012

A total of 22 occupied non-eagle raptor nests (10 red-tailed hawk, 9 prairie falcon, 2 American kestrel, and 1 great horned owl) were located within the raptor nest survey area primarily outside of the CCSM Project WDAs. *See Figure 4.11 & Figure 4.12.* No occupied nests were located within the Phase I portion of the Chokecherry WDA. Two occupied red-tailed hawk nests were located within the Phase I portion of the Sierra Madre WDA. *See Figure 4.11 & 4.12*. No occupied ferruginous hawk nests were located in 2012. *See Appendix F*. Of the two nests (both red-tailed hawk) located in Phase I, one fledged one nestling, and the fledging status of the other nest could not be determined at the time of the last check. Detailed information on nesting attempts and productivity is included in Appendix F.

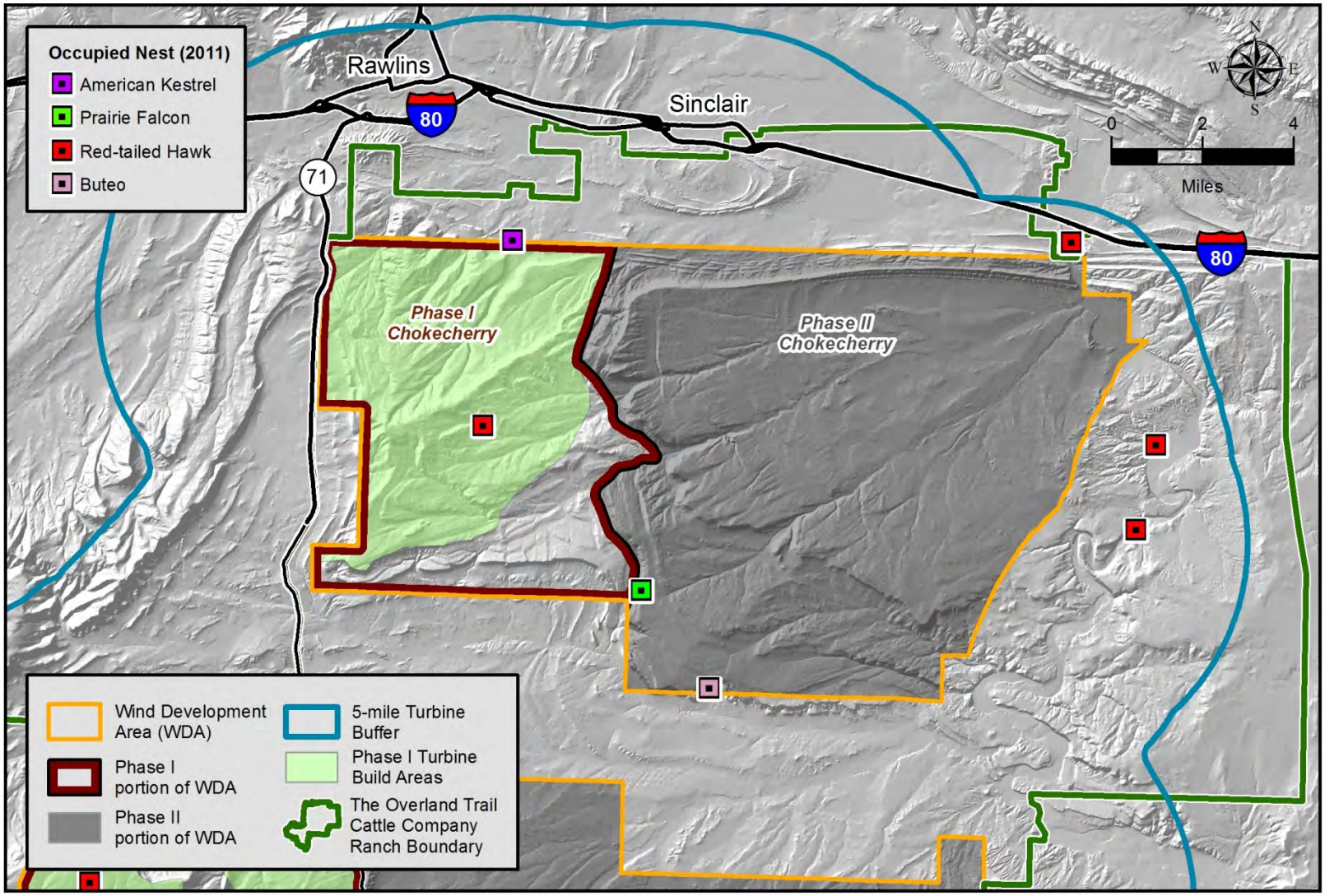

Figure 4.9. Chokecherry WDA Occupied Non-eagle Raptor Nests, 2011.

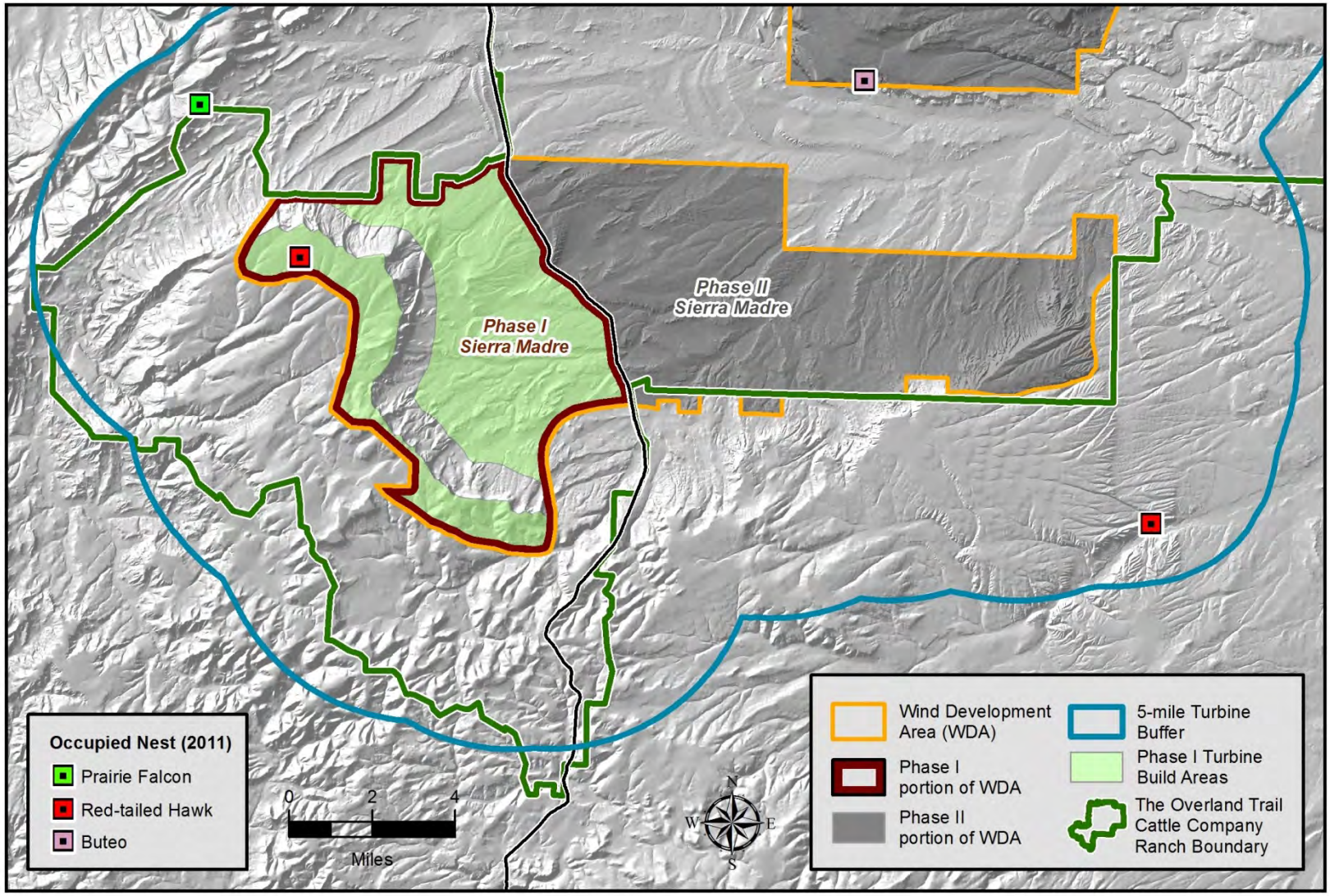

Figure 4.10. Sierra Madre WDA Occupied Non-eagle Raptor Nests, 2011.

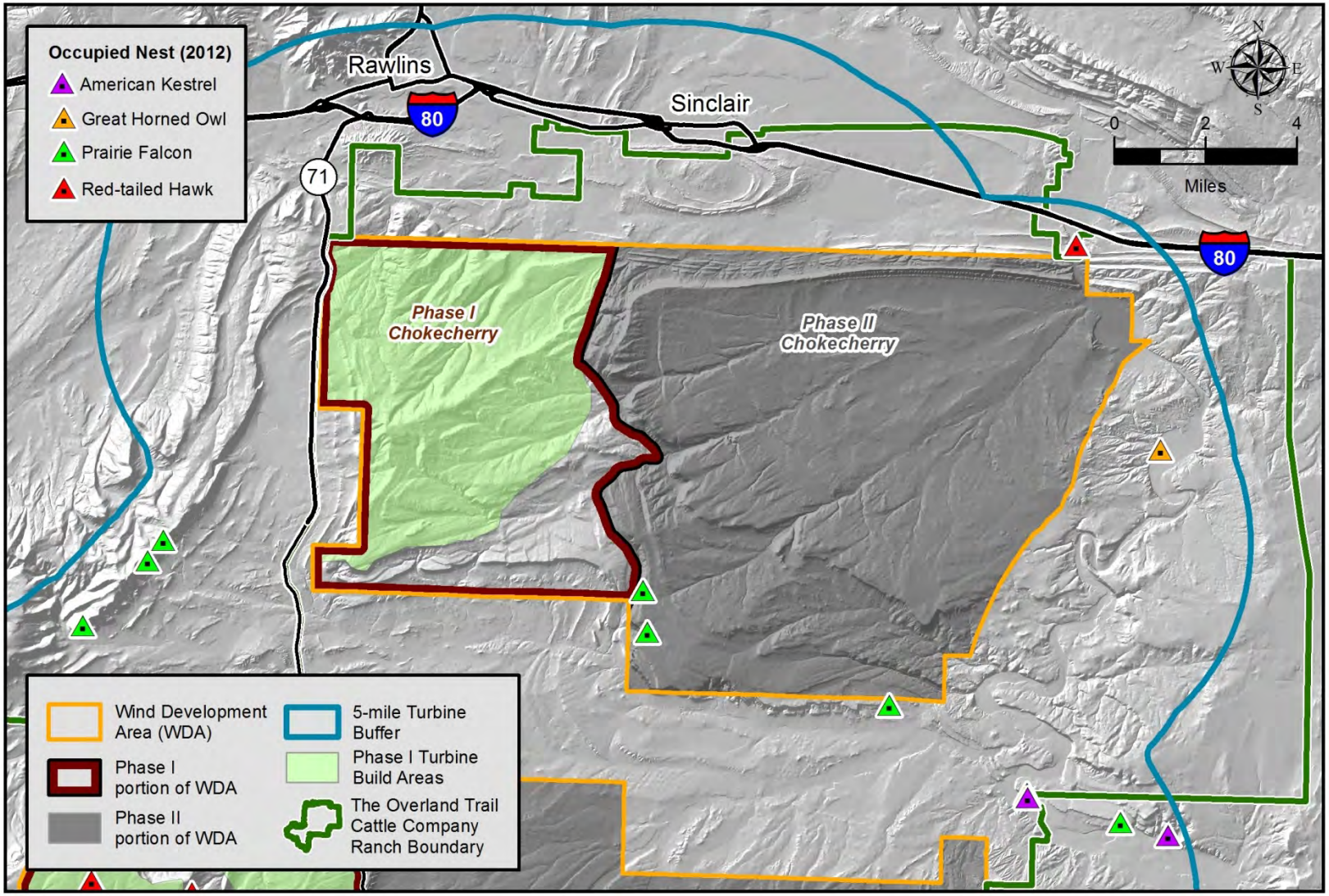

Figure 4.11. Chokecherry WDA Occupied Non-eagle Raptor Nests, 2012.

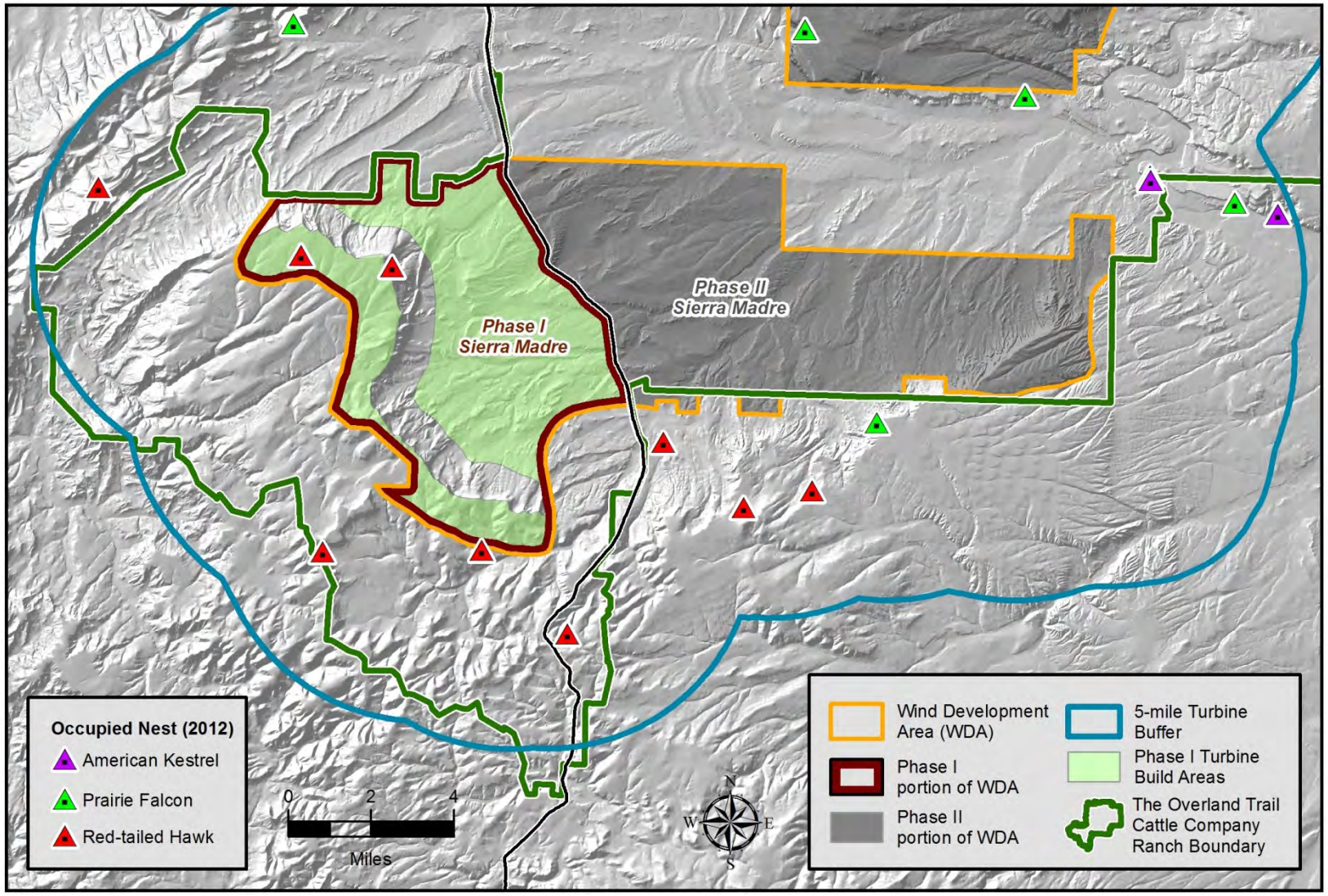

Figure 4.12. Sierra Madre WDA Occupied Non-eagle Raptor Nests, 2012.

2013 Nest Surveys

Aerial raptor nest surveys were conducted for the CCSM Project on April 24-25, 2013, with follow-up ground surveys conducted at select red-tailed hawk nests between May 21 and July 26.

A total of 14 occupied non-eagle raptor nests (6 red-tailed hawk, 4 prairie falcon, 3 great horned owl, and 1 American kestrel) were located in the survey area primarily outside of the CCSM Project WDAs. One occupied red-tailed hawk nest was located in the Phase I portion of the Chokecherry WDA. One occupied red-tailed hawk nest and one occupied American kestrel nest were located in the Phase I portion of the Sierra Madre WDA. *See Figure 4.13 & Figure 4.14. .* No occupied ferruginous hawk nests were located in 2013. *See Appendix F*. Of the two red-tailed hawk nests in Phase I, one was determined to have failed, and the other's status could not be determined at the time of the final check. Detailed information on nesting attempts and productivity is included in Appendix F.

2014 Nest Surveys

Aerial raptor nest surveys were conducted for the CCSM Project May 1 and 14, 2014.

A total of 24 occupied non-eagle raptor nests (12 red-tailed hawk, 5 great horned owl, 4 prairie falcon, 2 Swainson's hawk, and 1 unidentified *Buteo*) were located in the survey area primarily outside of the CCSM Project WDAs. One occupied red-tailed hawk nest and one occupied great horned owl nest were located in the Phase I portion of the Sierra Madre WDA. *See Figure 4.15 and 4.16.* No occupied ferruginous hawk nests were located in 2014. *See Appendix F*.

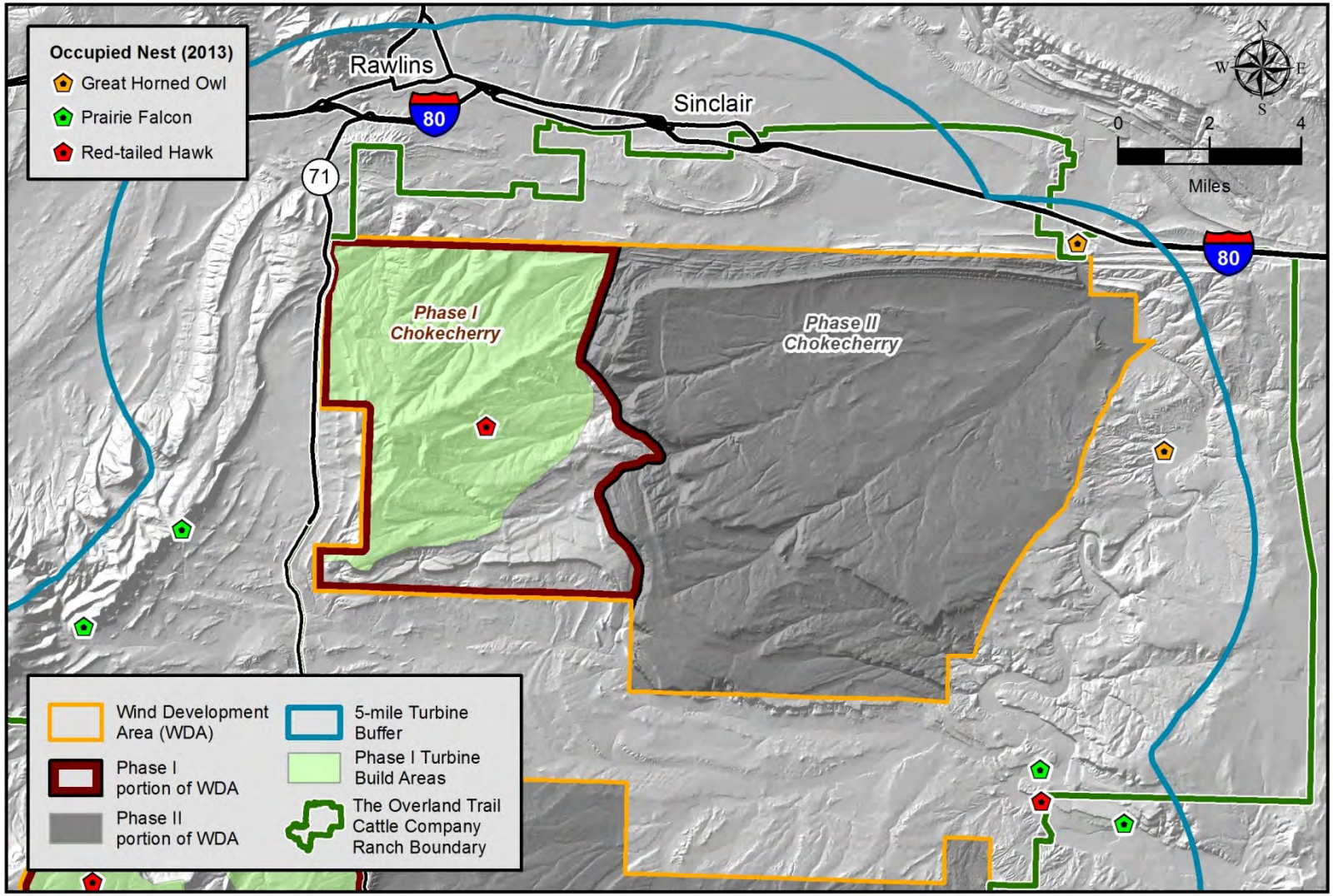

Figure 4.13. Chokecherry WDA Occupied Non-eagle Raptor Nests, 2013.

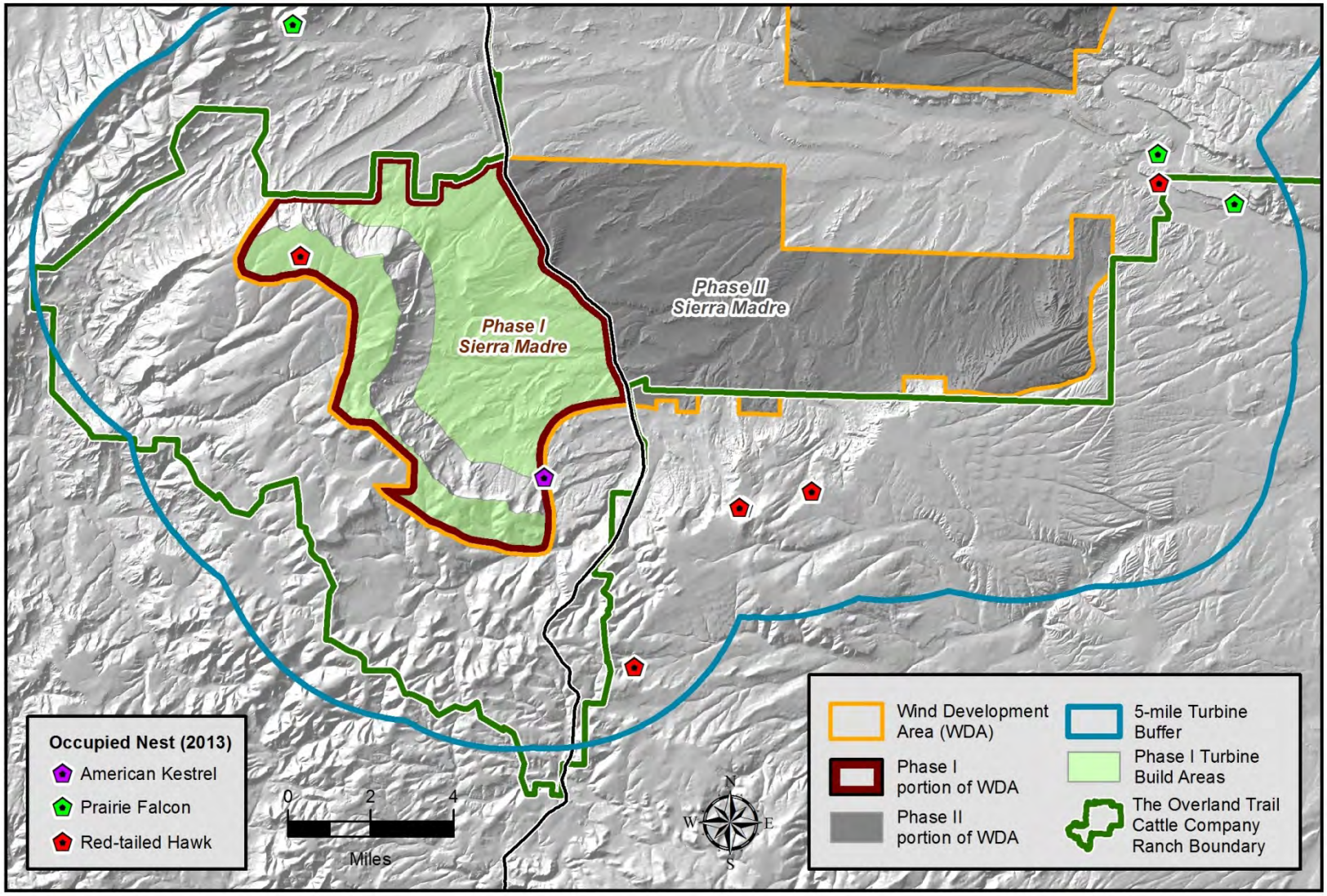

Figure 4.14. Sierra Madre WDA Occupied Non-eagle Raptor Nests, 2013.

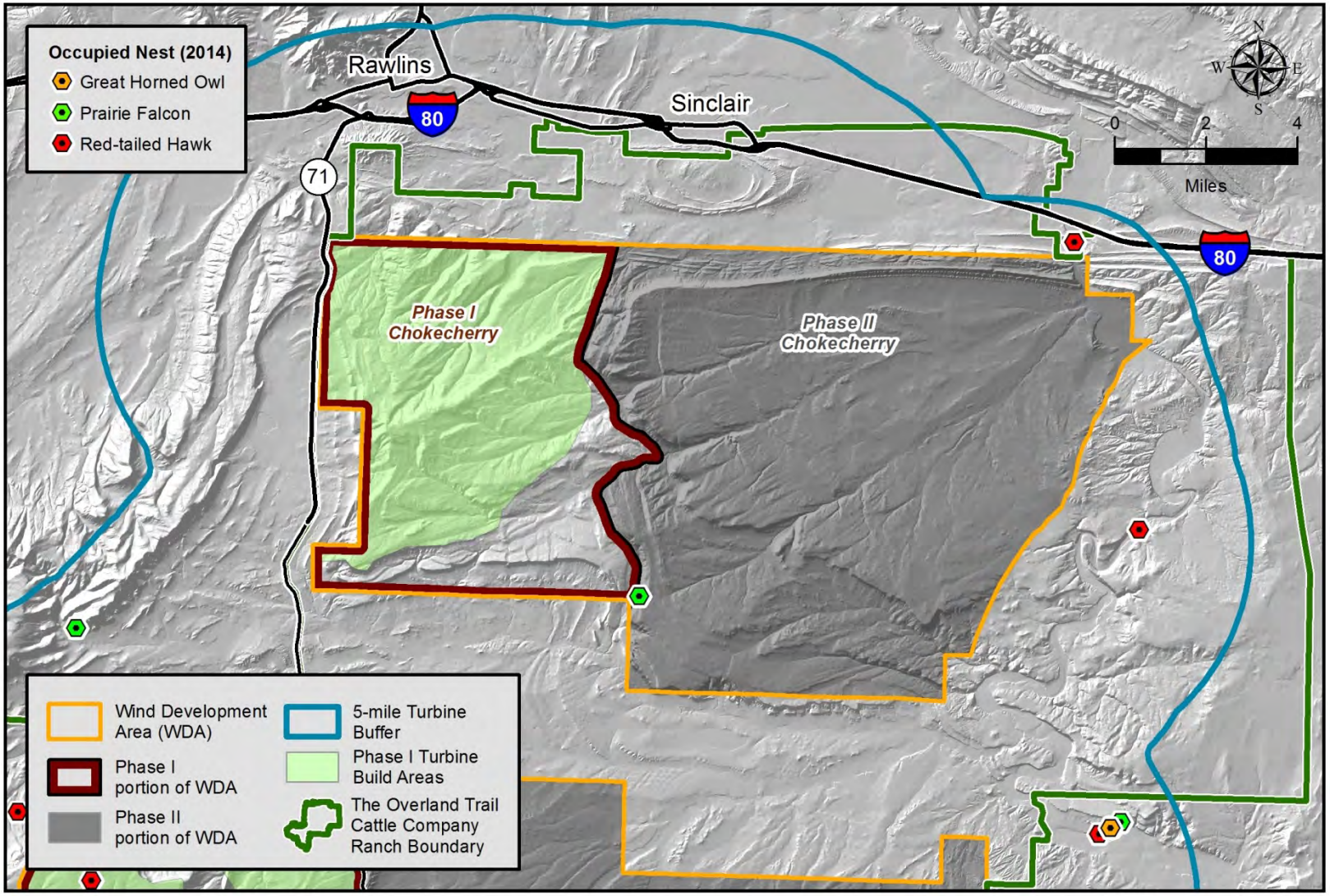

Figure 4.15. Chokecherry WDA Occupied Non-eagle Raptor Nests, 2014.

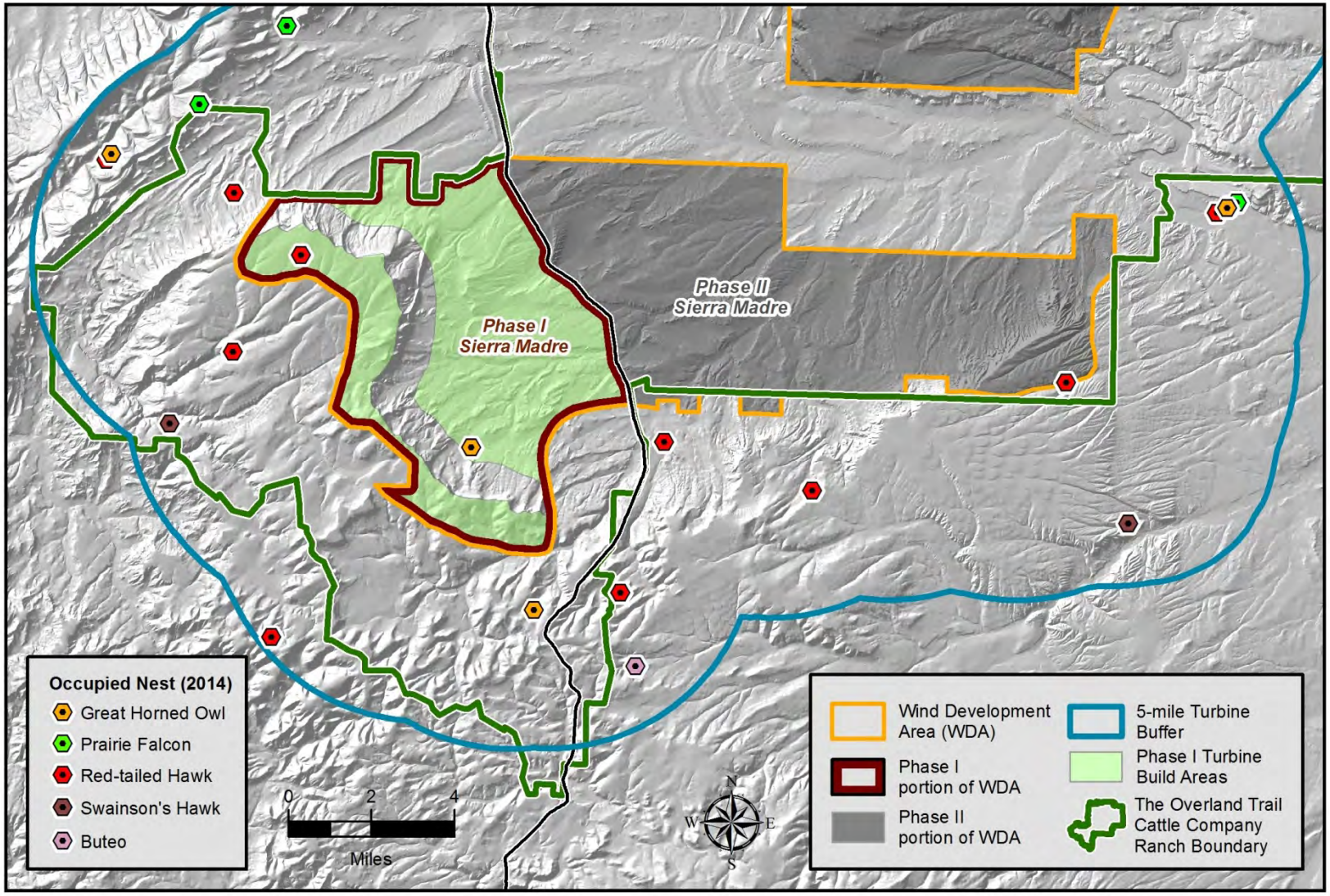

Figure 4.16. Sierra Madre WDA Occupied Non-eagle Raptor Nests, 2014.

Migratory Bird Surveys

Migratory bird surveys were conducted from April 2011 through March 2012 at survey locations identified in coordination with USFWS, BLM, and WGFD. During this time, PCW completed 295 migratory bird point count surveys at 15 locations across the CCSM Project Site with 136 surveys completed at the 7 locations within the Phase I Development Area. *See Figure 4.17.* Migratory bird point count surveys were completed in conjunction with long-watch raptor surveys using protocols developed in coordination with USFWS, BLM, and WGFD. *See "Long-watch Raptor Surveys."* Similar to the long-watch raptor surveys, the duration and frequency of the migratory bird point count surveys varied by season in accordance with the recommendations of the federal and state agencies. However, survey minutes were evenly distributed across all daylight hours and between sites within each season.

Migratory bird point count surveys were conducted for 20 minutes at each survey location. Migratory bird point count surveys were conducted in 200-meter radius plots strategically distributed across the two WDAs to maximize coverage for the purposes of determining diversity and relative abundance. Habitats surveyed were characteristic of Phase I and appropriate for assessment of migratory bird use within Phase I. The protocols used for the migratory bird point count surveys are included in Appendix D. Data collected for each observation included species, number of individuals, distance from observer, flight behavior, and general demographics. Variables used to characterize migratory bird use in Phase I include number of species, number of individuals, number of flocks, species frequency (the percentage of 20-minute surveys on which a species was observed), occurrence frequency (percentage of surveys with at least one bird detection), and mean use (average number of individuals per 20-minute survey).

From April 2011 to March 2012, 753 individuals in 453 flocks representing 34 species were recorded during the 136 migratory bird point count surveys in the Phase I Development Area.[28] There were no birds observed for 33 (24%) of those surveys. Across all seasons, mean observed migratory bird use was 5.6 individuals per 20-minute survey. Horned lark was the most commonly observed individual accounting for 401 individuals (53%) with a mean use of 2.9 individuals per 20-minute survey. Horned lark was also the most frequently encountered species with the species recorded during 85 surveys (63%). Following the horned lark, the most abundant species regularly recorded were Brewer's sparrow with 41 individuals recorded (14 surveys at 6 Phase I survey locations) and vesper sparrow with 34 individuals recorded (16 surveys at 7 Phase I survey locations). More American crows were observed than Brewer's sparrows or vesper sparrows. However, all 55 American crow recorded were from two large flocks observed in October 2011 during fall migration. The number of migratory birds observed per survey in the Phase I Development Area remained relatively consistent throughout the spring, summer, and fall survey periods. However, use in winter months was much lower than that observed in

[28] When combined with the point count information collected in 2008, April 2011 through March 2012 migratory bird survey data can be used to assess potential interannual variability of the diversity and relative abundance of migratory birds. Survey s were completed across all daylight hours and all habitats that occur in Phase I. While seasonal, inter-annual, or site-specific patterns of use may vary, the collective results of the survey efforts are suitable to characterize expected migratory bird patterns of use and relative abundance within Phase I.

the other three seasons with only 15 birds (12 horned larks, 2 common ravens, and 1 mountain bluebird) observed from December 1, 2011, through April 1, 2012. *See Table 4.6.*

Table 4.6. Migratory Birds Observations by Species, 2011-2012 Migratory Bird Surveys.

Species/Species Group	Spring 2011	Summer 2011	Fall 2011	Winter 2011-2012	Total
Corvids					
American Crow	0	0	55	0	**55**
Black-billed Magpie	3	0	2	0	**5**
Common Raven	9	0	3	2	**14**
Passerines					
American Goldfinch	0	2	2	0	**4**
American Robin	6	3	9	0	**18**
Brewer's Sparrow	23	14	4	0	**41**
Green-tailed Towhee	4	2	0	0	**6**
Horned Lark	131	61	197	12	**401**
Mountain Bluebird	2	6	5	1	**14**
Rock Wren	4	3	2	0	**9**
Sagebrush Sparrow	20	8	2	0	**30**
Sage Thrasher	15	3	1	0	**19**
Song Sparrow (*Melospiza melodia*)	3	1	0	0	**4**
Tree Swallow (*Tachycineta bicolor*)	1	4	0	0	**5**
Vesper Sparrow	24	9	1	0	**34**
Violet-green Swallow (*Tachycineta thalassina*)	3	1	0	0	**4**
Western Meadowlark	9	7	8	0	**24**
Other Passerines[1]	16	24	16	0	**56**

Species/Species Group	Spring 2011	Summer 2011	Fall 2011	Winter 2011-2012	Total
Non-Eagle Raptors, Owls, and Allies					
American Kestrel	1	1	3	0	**5**
Northern Harrier	1	0	0	0	**1**
Red-tailed Hawk	1	0	0	0	**1**
Other Birds					
Northern Flicker	2	0	0	0	**2**
Rufous Hummingbird (*Selasphorus rufus*)	0	1	0	0	**1**
Total	**278**	**150**	**310**	**15**	**753**

Notes:

1. Other passerines include unknown passerines that could not be identified to species level, as well as species that were observed fewer than 4 times during surveys, e.g. western kingbird (*Tyrannus verticalis*), Brewer's blackbird, dark-eyed junco, brown-headed cowbird (*Molothrus ater*), and savannah sparrow (*Passerculus sandwichensis*). Appendix B lists all passerine species that have been observed across the CCSM Project Site, including Phase I.

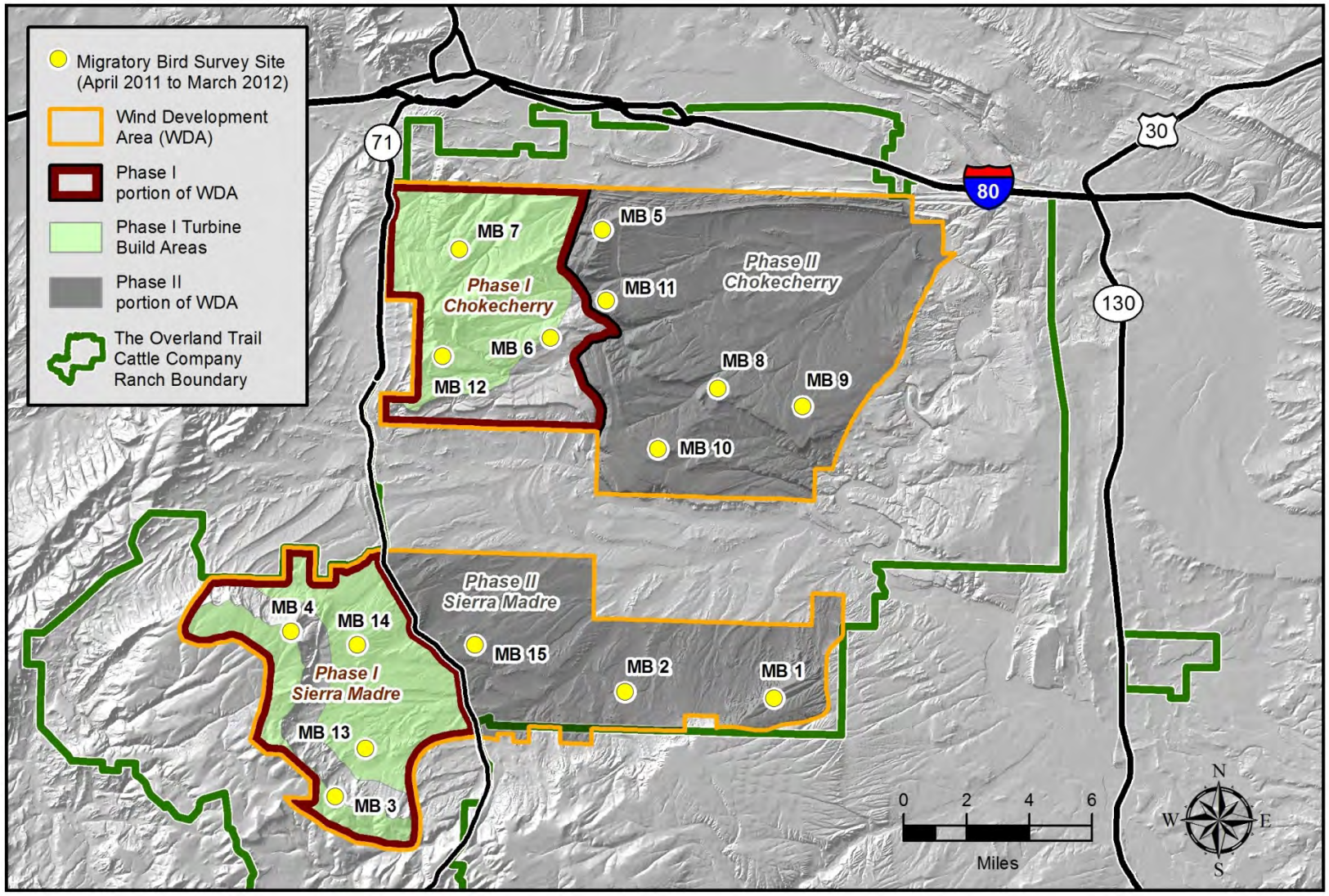

Figure 4.17. Migratory Bird Survey Locations, April 2011-March 2012.

Avian Radar Surveys

A DeTect Merlin avian radar system was used to map bird and bat use across the CCSM Project Site to identify bird and bat use areas. The radar was installed in March 2011 and operated through the end of March 2013 at nine different locations across the CCSM Project Site covering 100% of the Phase I wind turbine locations. *See Figure 4.18.* The radar is a trailer-mounted system with a 200-watt horizontal solid-state S-band radar and a 10-kilowatt vertically operating X-band open array radar. The horizontal scanning radar (HSR) has a range of up to 7.4 kilometers (4.6 miles) for raptors and other large targets in a 360-degree pattern around the unit. The HSR is able to record how targets use topographic features within the CCSM Project Site by collecting accurate location data for each target as it moves through the radar scanning area. The vertical scanning radar (VSR) has a 24-degree beam width and detects flight paths up to 3 kilometers (2 miles) or more for raptors and other large targets above the unit. The HSR does not collect altitudinal data for biological targets; however, the elevation of targets may be collected if they pass through the footprint of the VSR. These data are critical for determining the relative percentage of targets passing through the RSZ versus those flying above and below the RSZ, as well as annual, seasonal, and daily variability in those relative percentages. However, data cannot be used to quantify actual bird use of the CCSM Project Site due to limitations associated with radar technology. The radar ran continuously, collecting data for movements of birds and bats throughout the day and night. The relative numbers of birds and bats passing through the scanning area, as well as the relative size of each target, can be derived from the radar data.

Between March 2011 and March 2013, the radar collected more than 5,000 hours of data on birds and bats that crossed through the scanning radius of the HSR and/or VSR, whether they were individual targets, small flocks, or broad-front migratory movements. However, two primary factors limit the use of this avian radar data. First, radar technology cannot detect avian use when it occurs in close proximity to topographic relief that reflects the radar signature. Therefore, avian use can only be detected and recorded when there is a minimal amount of backscatter from the radar. For this reason, many of the topographic features commonly associated with raptor use (ridgelines, cliffs, etc.) cannot be mapped using the avian radar system. Second, current avian radar technology is unable to distinguish between different avian and bat species. Data for each target identified by the radar is recorded as a series of more than 60 variables based on different measures of recorded pixel size and shape. These variables can differ greatly within species and even for a single individual; therefore, it is not possible to definitively determine species from the dataset recorded by the radar system. Targets could be grouped based upon their relative size, but this can be problematic as well due to variance in individuals and overlap in variable values between species.

Due to limitations of radar technology, it is likely that not all targets were detected. Nonetheless, estimates of passage rates and flight heights are informative for comparing annual, seasonal, and daily patterns of avian and bat use. While the radar dataset has limitations, it was essential in the analysis of broad-front migratory bird movements across the CCSM Project Site, including Phase I. The data collected by the radar and analyzed by DeTect for the CCSM Project Site, including Phase I, consistently

demonstrated that the highest average number of targets per hour occurred at night during the spring, summer and fall seasons. This is consistent with expected migratory pulses passing through the area. *See Appendix G.* Radar data collected throughout the survey period also show that the mean and median height of these biological targets are well above the rotor height of the wind turbines indicating that the majority of the targets are not at risk of collision, as demonstrated by Figure 4.19.[29] *See Appendix G.* In fact, avian radar data from 2011-2012 demonstrate that 93% of targets were above rotor height during that period. *See Figure 4.20 through Figure 4.23.* Data also demonstrate that during migration events, migratory bird and bat species generally pass over the CCSM Project Site indicating that the area is not used as a stopover location. Data from the radar for the CCSM Project was analyzed by DeTect in two reports that are summarized below by season. *See Appendix G.* For purposes of comparison, the activity levels calculated from the avian radar survey data are reported in number of targets (birds or bats) within a 1-kilometer front per hour (targets per hour).[30] Targets per hour are further reported by the time of day using the following defined periods:

- **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
- **Night** – 30 minutes after sunset to 30 minutes before sunrise

Spring Season Radar Summary

Results from the spring season radar surveys (April 1 to June 30) were generally consistent across 2011 and 2012. *See Table 4.7.* The highest activity levels occurred during mid- to late April and late May to early June, primarily at night. The highest number of targets detected by the VSR both years was during the night, averaging 86.7 targets per hour in 2011 and 86.3 targets per hour in 2012. In 2011, the activity levels, as indicated by the number of targets per hour, during the dawn, day and dusk periods remained relatively consistent, ranging from 15.6 to 20.8 targets per hour. However, the 2012 radar surveys showed a greater contrast in diurnal activity levels, with an average of 7.4 targets per hour at dawn, 26 targets per hour during the day, and 35.6 targets per hour at dusk.

The average mean target height during the spring season was highest at night for both 2011 and 2012 (432 meters [1,420 feet] in 2011 and 451 meters [1,480 feet] in 2012), with the lowest average mean target height occurring at dawn in 2011 (315 meters [1,030 feet]) and during the day in 2012 (407 meters [1,340 feet]). Target direction recorded by the HSR shows the bulk of targets recorded moving in a northwesterly direction during the dawn, dusk and night periods in 2011 and during dawn and night periods in 2012. The daytime period in 2011 and dusk period in 2012 showed no specific directional trend. Targets during the daytime period in 2012 generally moved in a northeasterly direction.

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[29] The top rotor height for the Phase I wind turbines is 117 to 160 meters (383 to 525 feet). *See Figure 3.3 & Table 3.1.*

[30] Due to limitations of radar technology, it is likely that not all targets were detected. Nonetheless, targets per hour is informative as a relative index for comparing annual, seasonal, and daily patterns of avian and bat use.

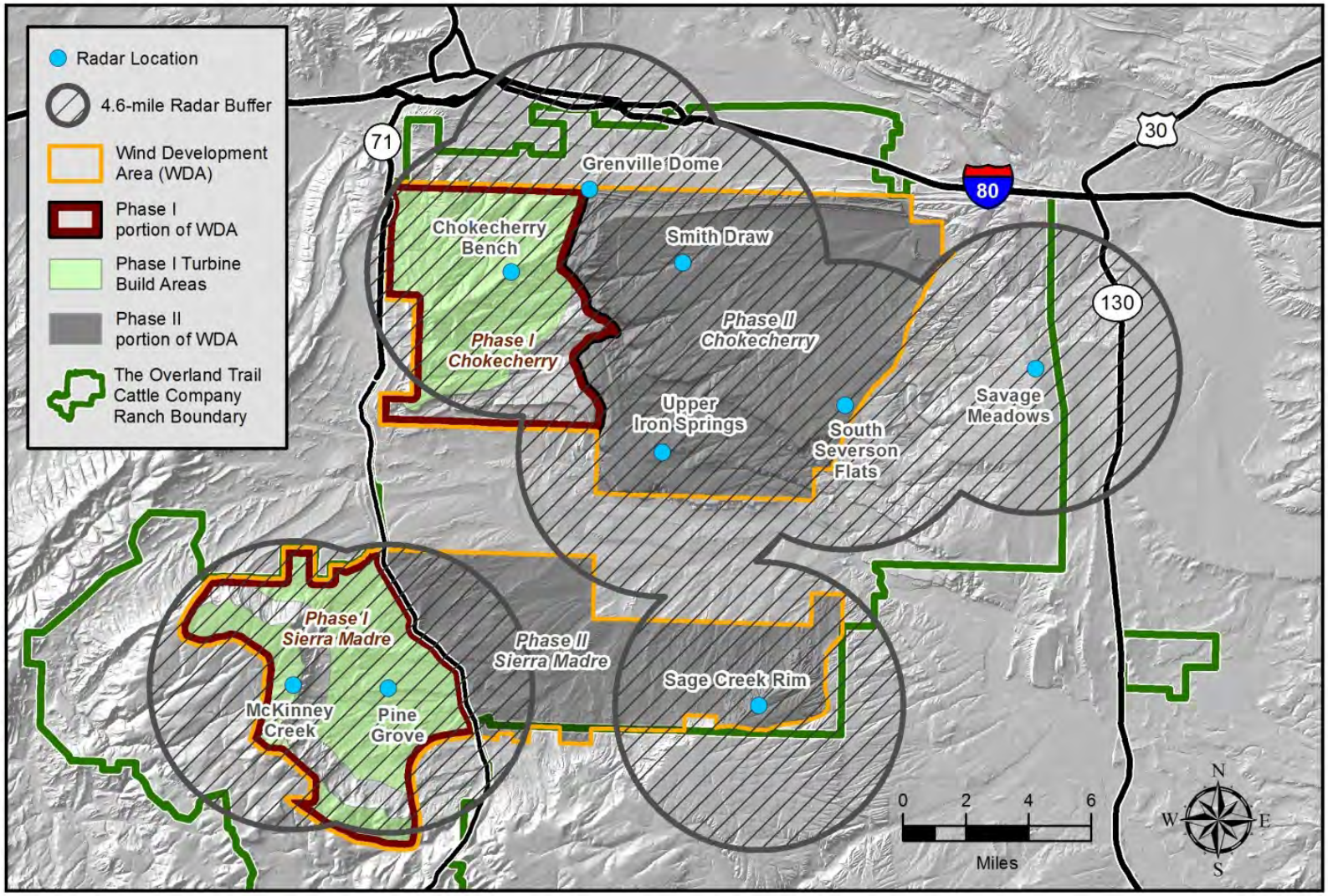
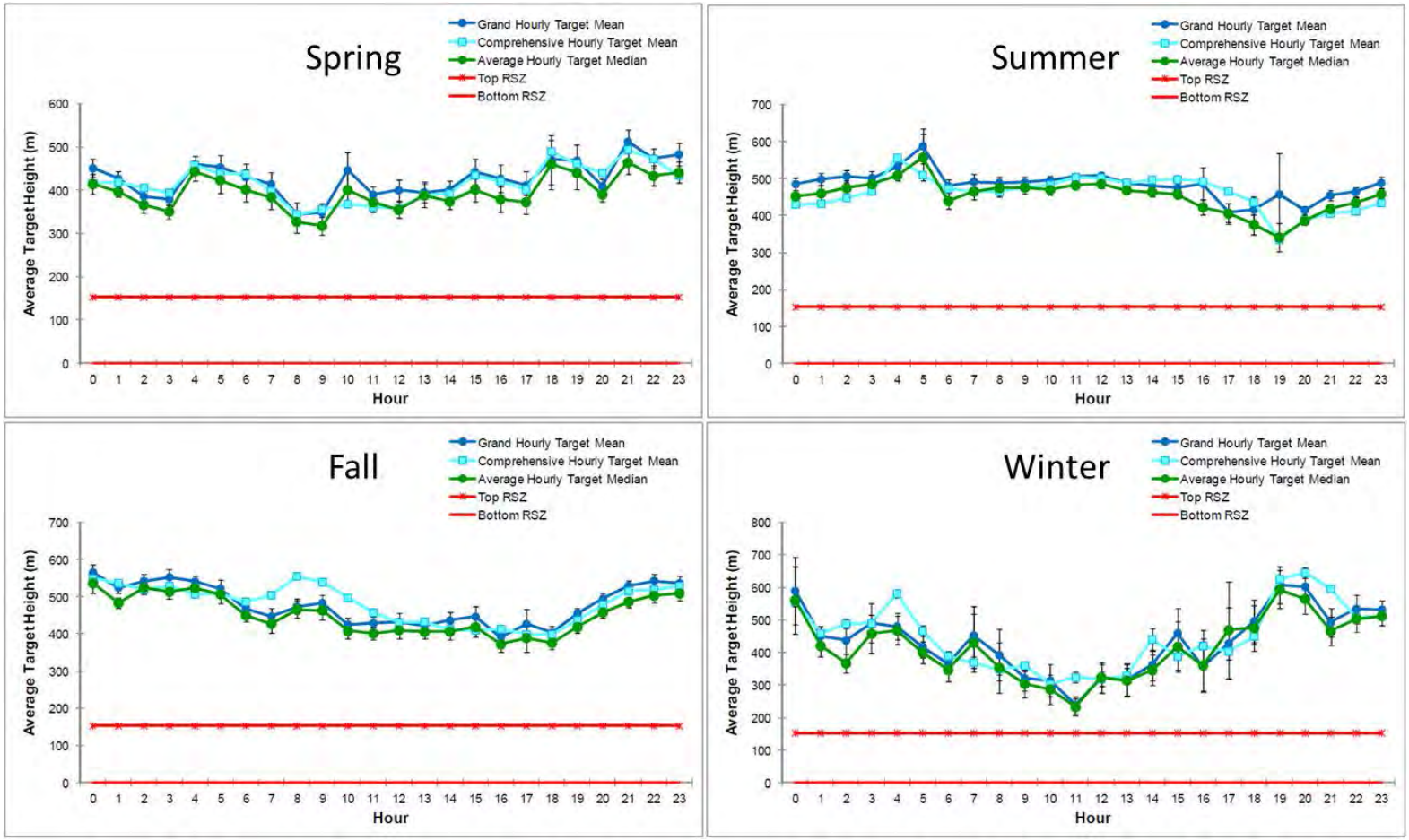


Figure 4.18. Avian Radar Locations, March 2011 to March 2013.



Notes:

1. Error bars represent one standard error for each hour.
2. Red lines represent the area between the ground and the maximum height of the rotor above the ground
3. Top RSZ shown on figure is 154.2 meters [500 feet].

Figure 4.19. Mean and Median Hourly Target Height by Season.

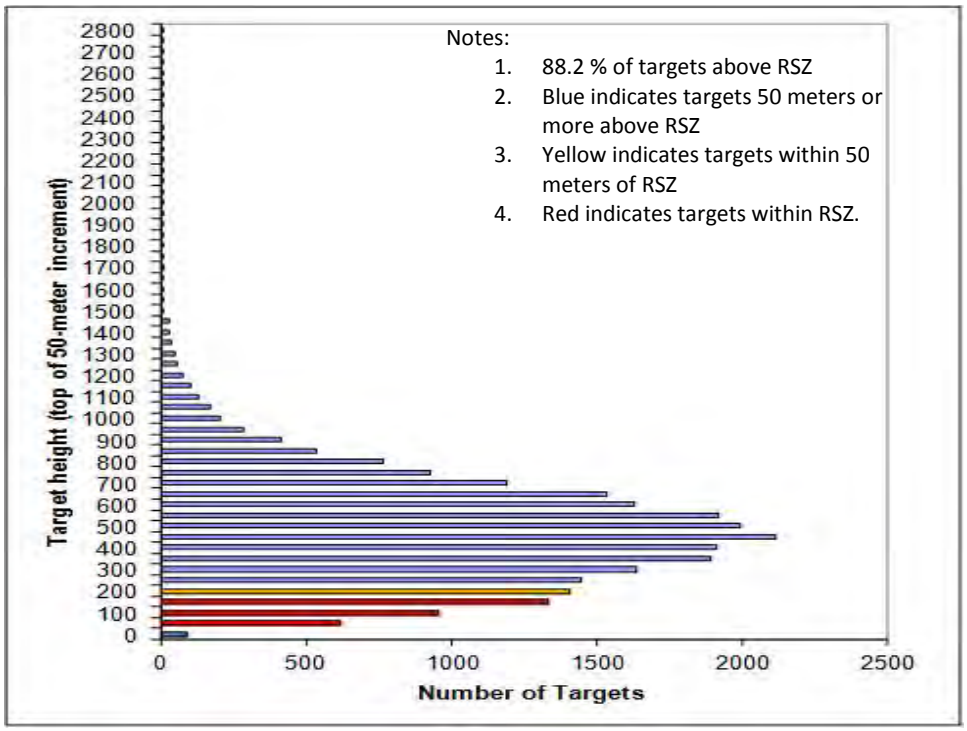


Figure 4.20. Target Height in 50-meter Increments, Spring 2011.

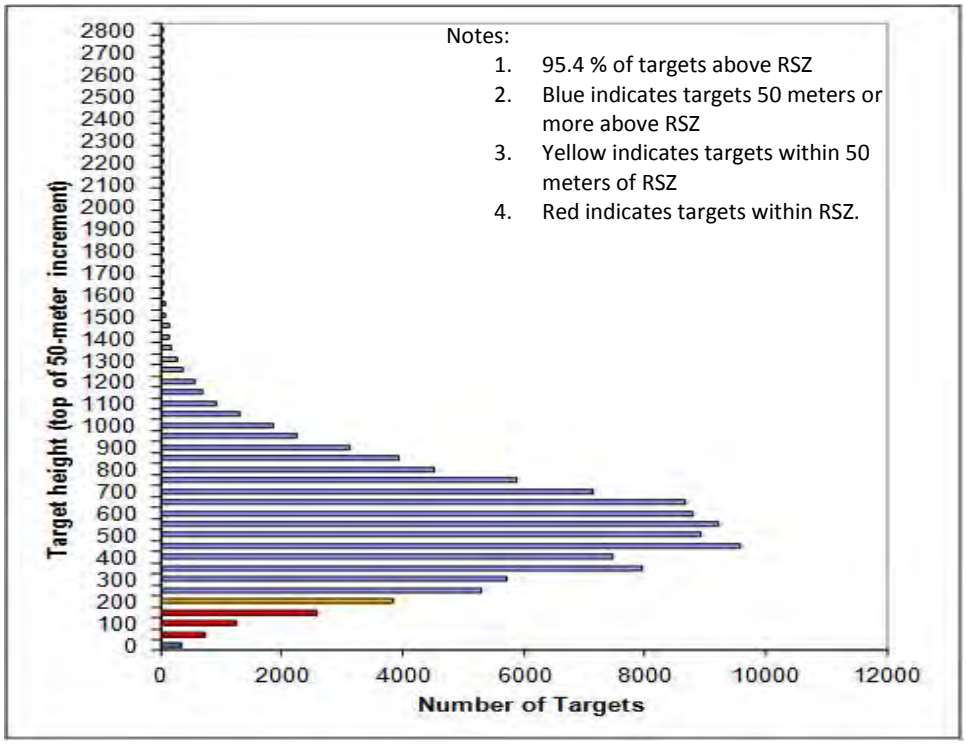


Figure 4.21. Target Height in 50-meter Increments, Summer 2011.

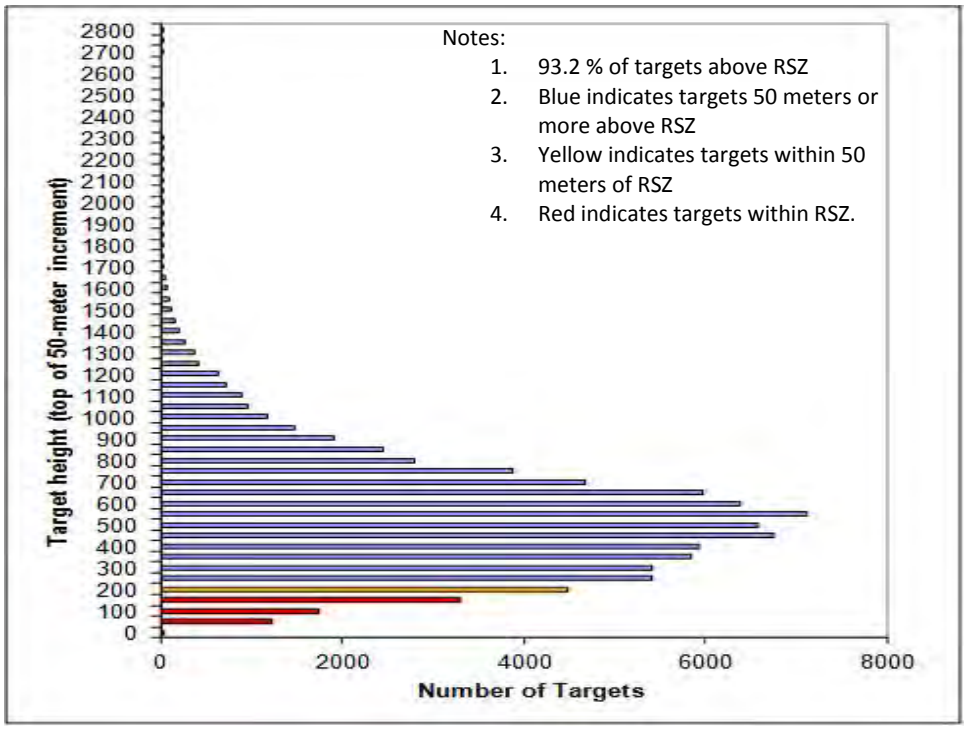


Figure 4.22. Target Height in 50-meter Increments, Fall 2011.

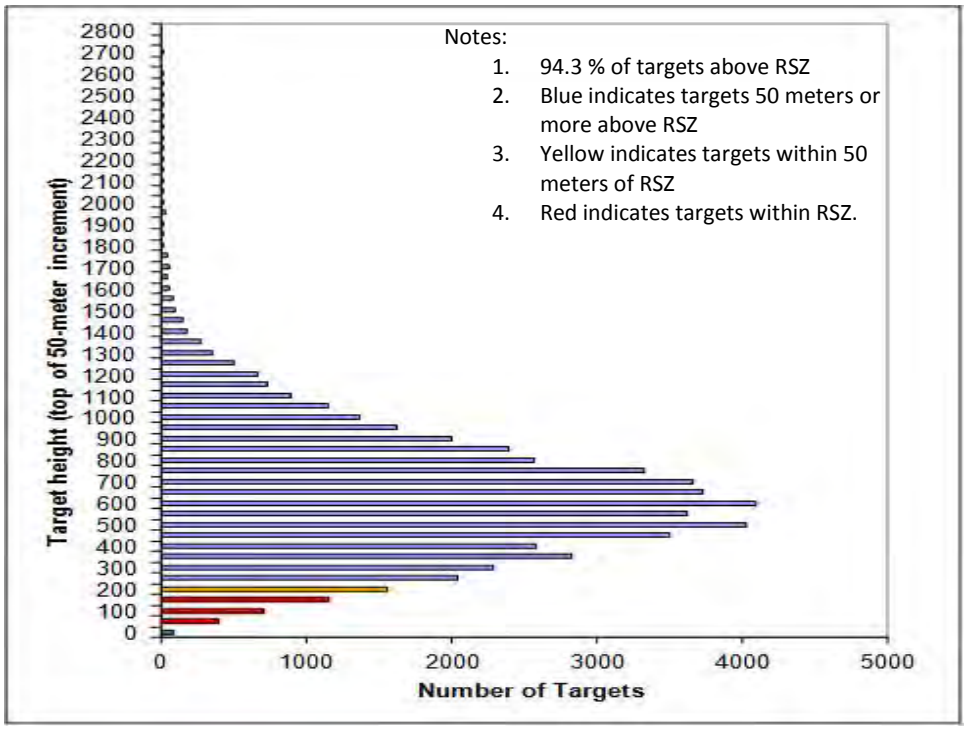


Figure 4.23. Target Height in 50-meter Increments, Winter 2011-2012.

Summer Season Radar Summary

During the summer season (July 1 to August 15), the highest number of targets detected by the VSR was during the night, averaging 233.2 targets per hour in 2011 and 298.5 targets per hour in 2012. *See Table 4.7.* Dawn and dusk target counts were significantly lower with a mean of 53.4 (dawn) and 37.6 (dusk) targets per hour in 2011 and 64.0 (dawn) and 60.3 (dusk) targets per hour in 2012. The highest activity levels occurred from the end of July to mid-August in 2011. In 2012 the highest activity level, as indicated by the number of targets recorded per hour, occurred in early July and from the end of July through mid-August.

In 2011 and 2012, the average mean target height during the summer season was highest at dawn (692 meters [2,270 feet] in 2011 and 587 meters [1,930 feet] in 2012) and was lowest at dusk (437 meters [1,430 feet] in 2011 and 355 meters [1,160 feet] in 2012). Hourly average target heights and mean target heights remained relatively consistent throughout the summer season in both years. Target direction recorded by the HSR showed a consistent southeasterly movement throughout the summer season in both years.

Fall Season Radar Summary

Similar to the spring and summer seasons, the highest number of targets detected in the fall (August 15 to November 14) was during the night, averaging 148.1 targets per hour in 2011 and 117.1 targets per hour in 2012. The average number of targets during the dawn and day periods remained relatively consistent (77.3 [dawn] and 83.8 [day] targets per hour in 2011 and 67.7 [dawn] and 57.2 [day] targets per hour in 2012), with dusk being the lowest activity period at 52.2 targets per hour in 2011 and 29.2 targets per hour in 2012. *See Table 4.7.* In both years, the majority of the activity, as indicated by the number of targets recorded per hour, occurred between mid-August and early-October, which is consistent with the end of fall southerly migratory movements. After early-October, the average number of targets per hour dropped substantially.

The average mean target height was highest at dawn (592 meters [1,940 feet] in 2011 and 526 meters [1,730 feet] in 2012). However, there was little variation in target height for all day and night periods combined; the average mean target height ranged between 461 meters (1,510 feet) and 592 meters (1,940 feet) in 2011 and between 428 meters (1,400 feet) and 526 meters (1,730 feet) in 2012. Hourly average target heights also remained relatively consistent throughout the fall season in both years. Target direction recorded by the HSR were consistent between 2011 and 2012, showing southeasterly movement throughout the dawn, dusk, and night periods, while daytime movements shifted to a more easterly direction.

Winter Season Radar Summary

Radar data collected during the winter season (November 16 – March 31) in 2011-2012 and 2012-2013 demonstrates that overall bird use in the CCSM Project Site is extremely low relative to other seasons. *See Table 4.7.* Patterns of low use begin in mid-October at the end of seasonal migration and remain low through early to mid-March when spring migration activities begin. *See Appendix G*. Similar to other seasons, activity during winter months was highest during the nighttime period but was 94-99% lower than the use observed in other seasons. The average number of targets across all parts of the day was very low in winter months (3.5 [dawn], 2.8 [day], 2.9 [dusk], and 5.6 [night] targets per hour in 2011-2012 and 1.6 [dawn], 1.2 [day], 0.6 [dusk], and 2.8 [night] targets per hour in 2012-2013). *See Table 4.7*

The average mean target height during the winter season was highest during nighttime in 2011-2012 (486 meters [1,590 feet]) and the dusk period in 2012-2013 (362 meters [1,190 feet]). The average mean target height was lowest during the day (220 meters [720 feet] in 2011-2012 and 255 meters [837 feet] in 2012-2013). Target direction recorded by the HSR showed a tendency towards northerly and easterly movements throughout all hours in both years. However, strong directional movement patterns were not as evident during winter months.

Table 4.7. Average Targets per Hour and Target Height Summary.

Season	Targets Per Hour (targets/km/hr)				Average Target Height (meters)			
	Dawn	Day	Dusk	Night	Dawn	Day	Dusk	Night
Spring 2011	15.6	20.8	18.8	86.7	315.3	417.8	416.6	432.2
Summer 2011	53.4	139.1	37.6	233.2	691.7	530.7	436.5	551.7
Fall 2011	77.3	83.8	52.2	148.1	592.2	461.0	478.1	567.4
Winter 2011-2012	3.5	2.8	2.9	5.6	442.0	274.8	366.9	524.8
Spring 2012	7.4	26.0	35.6	86.3	421.0	407.0	408.2	450.6
Summer 2012	64.0	83.8	60.3	298.5	586.9	479.8	354.9	484.7
Fall 2012	67.7	57.2	29.2	117.1	434.1	427.8	444.8	525.7
Winter 2012-2013	1.6	1.2	0.6	2.8	312.8	221.1	286.1	437.8

Breeding Bird Density Surveys

Breeding bird density surveys were completed at 15 survey grids across the CCSM Project Site, with 9 of the survey grids located within the Phase I Development Area. *See Figure 4.24.* Each survey grid consisted on 16 sampling points for a total of 240 point counts across the CCSM Project Site, with 144 of these point counts occurring within the Phase I Development Area. Breeding bird density surveys were conducted following the grid survey protocols published by the Rocky Mountain Bird Observatory. *See Hanni et al. 2010.* Survey locations were selected using a generalized random tessellation stratified design to ensure spatially balanced sampling stratified within each WDA and across major vegetation and habitat types within the CCSM Project Site. Breeding bird density surveys were conducted at each survey grid between June 7 and June 30, 2011, all within five hours of sunrise. *See Appendix D.*

Each survey grid consisted of 16 point count locations arranged in a 4 x 4 grid, with 250 meter spacing between each of the 16 points in the 4 x 4 grid. Surveys were initiated within 30 minutes of sunrise and were completed within approximately 4 hours. Surveys were completed at each of the 16 points within a survey grid for six minutes. Data collected at each point included species, number of individuals, distance from observer, flight behavior, and general demographics. Variables used to characterize breeding bird use in Phase I include number of species, number of individuals, number of flocks, species frequency (the percentage of surveys on which a species was observed), occurrence frequency (percentage of surveys with at least one bird detection), and mean use (average number of individuals per survey). Vegetation and general habitat data were also collected for each point count location to assist in the analysis of breeding bird habitats. Observations of species of concern were recorded if those species were detected during travel between the 16 point count locations in each survey grid. *See Table 1.1.*

Each of the 9 survey grids within the Phase I Development Area consisted of 16 sampling locations for a total of 144 individual point counts. For all Phase I breeding bird point counts combined, 1,118 individuals representing more than 50 species were recorded. The most common species, based on total number of individuals recorded and frequency of detection, was horned lark (219 individuals, 100% occurrence on the 9 grids, and 88% occurrence on the 144 sampling points). Following horned lark, Brewer's sparrow (152 individuals, 100% grid occurrence, 77% sampling point occurrence), vesper sparrow (148 individuals, 89% grid occurrence, 77% sampling point occurrence), green-tailed towhee (76 individuals, 89% grid occurrence, 48% sampling point occurrence), and sage thrasher (71 individuals, 67% grid occurrence, 51% sampling point occurrence) were the next most common species. These five species combined accounted for 666 individuals or 60% of all detections in the Phase I Development Area. *See Appendix D*. *See Table 4.8.*

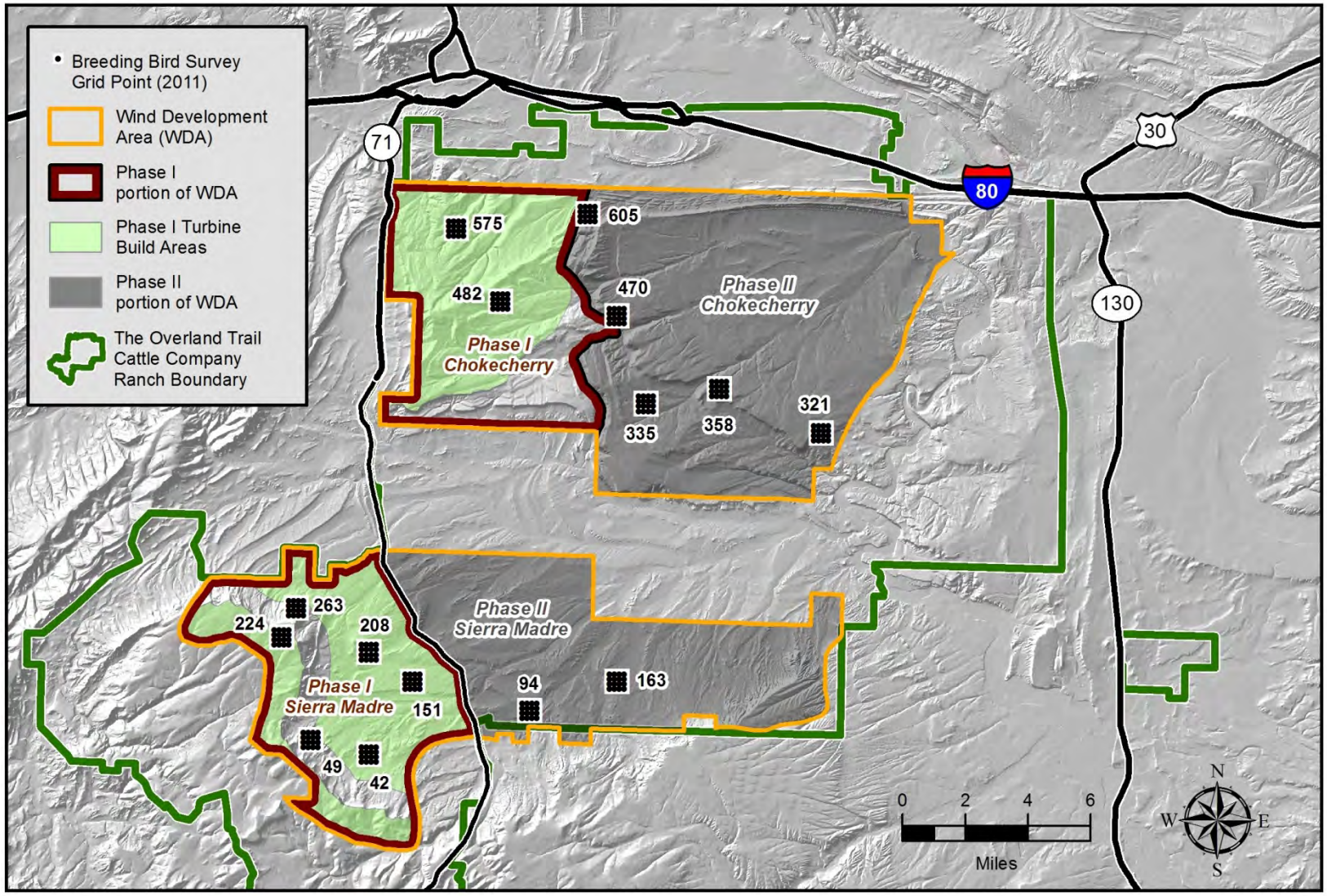


Figure 4.24. Breeding Bird Grid Survey Locations.

Table 4.8. Phase I Observations, Breeding Bird Density Surveys.

Species/Species Group	Number Observed
Corvids	
Common Raven	28
Passerines	
American Goldfinch	14
American Robin	30
Brewer's Sparrow	152
Brown-headed Cowbird	27
Chipping Sparrow	13
Common yellowthroat (*Geothlypis trichas*)	4
Dusky Flycatcher (*Empidonax oberholseri*)	11
Green-tailed Towhee	76
Horned Lark	219
House Wren	22
MacGillivray's Warbler (*Geothlypis tolmiei*)	15
Mountain Bluebird	13
Orange-crowned Warbler (*Oreothlypis celata*)	9
Red-winged Blackbird (*Agelaius phoeniceus*)	7
Rock Wren	50
Sage Sparrow	41
Sage Thrasher	71
Savannah Sparrow	7
Say's phoebe (*Sayornis saya*)	4
Tree swallow	4
Vesper Sparrow	148

Species/Species Group	Number Observed
Warbling Vireo (*Vireo gilvus*)	21
Western Meadowlark	11
Yellow Warbler (*Setophaga petechia*)	12
Other Passerines[1]	47
Non-eagle Raptors, Owls, and Allies	
American Kestrel	1
Northern Harrier	2
Red-tailed Hawk	7
Waterfowl, Waterbirds, and Wading Birds	
Common Merganser (*Mergus merganser*)	2
Killdeer	5
Sora (*Porzana carolina*)	9
Wilson's Snipe (*Gallinago delicata*)	4
Other Birds	
Broad-tailed Hummingbird (*Selasphorus platycercus*)	4
Common Nighthawk	15
Common Poorwill (*Phalaenoptilus nuttallii*)	1
Mourning Dove	5
Northern Flicker	7
Total	**1,118**

Notes:

1. Other passerines include unknown passerines that could not be identified to species level, as well as species that were observed fewer than 4 times during surveys, e.g. ruby-crowned kinglet *(Regulus calendula*), western wood-peewee (*Contopus sordidulus*), lark sparrow (*Chondestes grammacus*), and yellow-rumped warbler (*Setophaga coronata*). Appendix B lists all passerine species that have been observed across the CCSM Project Site, including Phase I.

Waterbird/ Waterfowl Surveys

Waterbird/waterfowl surveys were conducted in 2011 during spring (April 26–May 4), summer (August 23–24), and fall (October 20–21) at each of the four major reservoirs (Kindt, Rasmussen, Sage Creek, and Teton) near the CCSM Project Site. *See Figure 3.4. See Appendix D.* Surveys were conducted using spotting scopes to maximize coverage from an optimal number of viewing locations, as well as to facilitate species identification. In addition, care was taken not to double-count individuals if more than one location was necessary to survey a reservoir. Along with standard survey information (e.g., date, location, observer, time, weather conditions), species-specific data collected included species, age, sex, and number of individuals. While waterbird/waterfowl surveys were conducted only across three seasons in one year and cannot be used to assess interannual variability, the survey data provide a useful index to evaluate waterbird/waterfowl species use and to assess spatiotemporal abundance across the four reservoirs.

Spring waterbird/ waterfowl surveys resulted in a total count of 1,417 individuals representing 35 species. American coot (*Fulica americana*) was the most abundant species accounting for 364 individuals (26% of total count). Lesser and greater scaup (*Scaup* sp.), western and Clark's grebes (*Aechmophorus* sp.), and eared grebe (*Podiceps nigricollis*) were the next most abundant species with 351, 209, and 113 individuals, respectively. Collectively, the above four species accounted for 1,037 individuals or 73% of all birds detected. More species and individuals were counted at Kindt Reservoir (25 species, 808 individuals) than the other three reservoirs. The fewest species and number of individuals (12 species, 165 individuals) were recorded at Sage Creek Reservoir during spring surveys. *See Appendix D*. *See Table 4.9.*

During summer waterbird/ waterfowl surveys, 1,708 individuals representing 29 species were recorded. Redhead duck (*Aythya americana*) had the highest number of individuals (815) accounting for 48% of all birds detected during summer surveys. Lesser scaup (*Aythya affinis*), mallard (*Anas platyrhynchos*), and American coot were the next most abundant species with 157, 149, and 99 individuals, respectively. Collectively, the above four species accounted for 1,221 individuals or 71% of all birds detected. The highest number of individuals (920) was recorded at Rasmussen Reservoir, where 89% (780 individuals) were redheads. Nearly all of the season's redheads (780 of 815) were recorded at Rasmussen Reservoir. Despite the high number of birds recorded at Rasmussen Reservoir, biologists recorded the fewest number of species (12) at that location. *See Appendix D*. *See Table 4.9.*

Waterbird/ waterfowl surveys during fall, including fall migration, recorded 11,473 individuals representing 29 species. Similar to spring waterbird/ waterfowl surveys, American coot accounted for a majority of the individuals during fall surveys (8,024, 70% of total individuals). A total of 1,692 American wigeon (*Anas americana*) were also recorded. Combined, American coot and American wigeon accounted for 9,716 individuals (85% of all individuals). More individuals (8,773) and species (22) were recorded at Kindt Reservoir during fall surveys than at other reservoirs. Of the 8,024 American coots and 1,692 American wigeons recorded at all reservoirs combined, the survey at Kindt Reservoir accounted for 5,810 coots (66%) and 1,690 wigeons (99%). *See Appendix D*. *See Table 4.9.*

Table 4.9. Waterbird/ Waterfowl Survey Summary Data.

Species	Spring 2011	Summer 2011	Fall 2011	Total Observations
Aechmophorus sp.	71	---	---	**71**
American Avocet (*Recurvirostra americana*)	8	25	8	**41**
American Coot	364	99	8,024	**8,487**
American White Pelican	6	24	---	**30**
American Wigeon	6	11	1,692	**1,709**
Black-crowned Night-Heron	---	7	---	**7**
Blue-winged Teal (*Anas discors*)	---	20	---	**20**
Bufflehead (*Bucephala albeola*)	10	---	3	**13**
Calidris sp.	3	---	---	**3**
California Gull (*Larus californicus*)	2	2	---	**4**
Canada Goose (*Branta canadensis*)	5	28	43	**76**
Canvasback (*Aythya valisineria*)	4	---	6	**10**
Cinnamon Teal (*Anas cyanoptera*)	3	---	---	**3**
Clark's Grebe (*Aechmophorus clarkii*)	1	---	---	**1**
Common Loon (*Gavia immer*)	5	2	2	**9**
Common Merganser	74	17	70	**161**
Double-crested Cormorant (*Phalacrocorax auritus*)	6	11	---	**17**
Eared Grebe (*Podiceps nigricollis*)	113	50	110	**273**
Gadwall (*Anas strepera*)	32	36	577	**645**
Great Blue Heron (*Ardea herodias*)	---	2	---	**2**
Greater Scaup (*Aythya marila*)	4	---	---	**4**
Greater Yellowlegs (*Tringa melanoleuca*)	2	---	4	**6**

Species	Spring 2011	Summer 2011	Fall 2011	Total Observations
Green-winged Teal (*Anas crecca*)	14	68	87	**169**
Herring Gull (*Larus argentatus*)	---	3	3	**6**
Hooded Merganser (*Lophodytes cucullatus*)	---	---	3	**3**
Horned Grebe (*Podiceps auritus*)	1	---	34	**35**
Killdeer	22	10	---	**32**
Least Sandpiper (*Calidris minutilla*)	1	---	---	**1**
Lesser Scaup	103	157	24	**284**
Lesser Yellowlegs (*Tringa flavipes*)	1	---	---	**1**
Long-billed Dowitcher (*Limnodromus scolopaceus*)	---	---	4	**4**
Mallard	6	149	152	**307**
Marbled Godwit (*Limosa fedoa*)	8	---	---	**8**
Northern Pintail (*Anas acuta*)	3	10	57	**70**
Northern Shoveler (*Anas clypeata*)	8	---	13	**21**
Pectoral Sandpiper (*Calidris melanotos*)	---	---	1	**1**
Pied-billed Grebe (*Podilymbus podiceps*)	1	10	9	**20**
Redhead	85	815	359	**1,259**
Ring-billed Gull (*Larus delawarensis*)	2	6	28	**36**
Ring-necked Duck (*Aythya collaris*)	26	---	84	**110**
Ruddy Duck (*Oxyura jamaicensis*)	9	9	34	**52**
Scaup sp.	244	---	---	**244**
Snowy Egret (*Egretta thula*)	---	1	---	**1**
Spotted Sandpiper (*Actitis macularius*)	---	4	---	**4**

Species	Spring 2011	Summer 2011	Fall 2011	Total Observations
Surf Scoter (*Melanitta perspicillata*)	---	---	6	**6**
Unknown dabbling duck	---	47	---	**47**
Unknown gull	---	14	---	**14**
Western Grebe (*Aechmophorus occidentalis*)	137	67	33	**237**
White-faced Ibis (*Plegadis chihi*)	3	---	---	**3**
White-winged Scoter (*Melanitta fusca*)	---	---	3	**3**
Willet (*Tringa semipalmata*)	21	1	---	**22**
Wilson's Phalarope (*Phalaropus tricolor*)	3	3	---	**6**
Total Observations	**1,417**	**1,708**	**11,473**	**14,598**
Total Number of Species	**35**	**29**	**29**	**52**

Acoustic Bat Surveys

Similar to 2008 acoustic bat surveys, AnaBat detection systems manufactured by Titley Electronics were used for acoustic bat surveys conducted on the CCSM Project Site during 2011 and 2012. *See Section 4.3.1.* For acoustic bat surveys conducted on the CCSM Project Site in 2011 and 2012, a standard index of bat activity was generated by counting the number of bat passes per detector-night at each survey location. *See Hayes 1997; Kunz et al. 2007.* All bat passes were categorized through assessment of both qualitative (e.g., shape) and quantitative (e.g., characteristic frequency) qualities as demonstrated by Weller and Baldwin (2012). Bat passes were classified as pertaining to low (≤25 kHz), mid (~30-40 kHz), and high (≥40 kHz) frequency groups. Further refinement in the dataset in 2011 and 2012 was intended to provide more differentiation as to what species may be represented in the low frequency group. The low frequency category in the 2008 dataset may also have included some bat species with a characteristic frequency around 30 kHz, such as long-eared myotis, fringed myotis, Townsend's big-eared bat, and pallid bat. *See Griscom et al. 2012; Keinath undated.* Diagnostic call sequences in the datasets were labeled only for hoary bats as that species has a unique call pattern easily distinguished from other bat species.

The 2011 and 2012 acoustic bat surveys were coupled with radar surveys. The survey approach was developed in coordination with the USFWS, BLM, and WGFD to characterize bat use and potentially aid in the evaluation of radar datasets. Acoustic bat monitoring was completed from June 15 to October 20, 2011, and June 27 to August 29, 2012, at five locations co-located with the radar system (Chokecherry Bench, Smith Draw, Upper Iron Springs, McKinney Creek, and Pine Grove) to characterize patterns of

nightly bat activity. *See Figure 4.18.* Collectively, sites were surveyed for 95 detector-nights in 2011 and 62 detector-nights in 2012. In total, 185 and 134 bat passes were recorded in 2011 and 2012, respectively, for an average of 2.0 bat passes/detector-night across years, similar to the 1.9 bat passes/detector-night observed in 2008. *See Section 4.3.1. See Appendix E.*

Activity levels were variable during the 2011 and 2012 survey periods. There was an increase in the number of bat passes on July 24, 2011, (26 total bat passes) and over the nights of July 11, 2012, (17 bat passes) and July 12, 2012 (15 bat passes). These peaks in activity are similar in timing to a spike in activity noted in the 2008 survey data on July 27. *See Section 4.3.1.*

In 2011, activity levels decreased in mid-August and remained low from September 23 to October 20 averaging less than 1 bat pass/detector-night. This low activity is similar to that reported for the September to October period in 2008. *See Section 4.3.1.* The 2011 surveys recorded more mid- and high-frequency bat passes (156; 84% of all bat passes) than low-frequency (29; 16%) bat passes. Hoary bat comprised 4% of all bat passes and was identified on four nights (July 30 and August 12-14). Surveys in 2012 had a similar trend with mid- and high-frequency bat passes accounting for 115 (86%) of the 134 total bat passes. Ten bat passes were attributable to hoary bat (7% of all bat passes) evenly spaced across seven nights between July 26 and August 29, 2012. While the survey protocols developed in coordination with USFWS, BLM, and WGFD were not intended to result in datasets covering the entire CCSM Project Site across all months in which bats may be present, these bat survey data provide a useful index to assess bat patterns of use.

4.4.2 Field Study and Impact Prediction Questions

As detailed above, in compliance with Tier 3 of the USFWS Wind energy Guideline and Tier 2 of the WGFC Wind Energy Recommendations, PCW conducted additional site-specific field studies for the CCSM Project Site, including Phase I, since the 2008-2009 site characterization process described in section 4.3. These additional field studies were designed in coordination with USFWS, BLM, and WGFD to assess the potential risk of the CCSM Project, including Phase I, to migratory bird and bat species and to inform appropriate measures to avoid and minimize that risk. PCW's response to the field study and impact prediction questions and its risk assessment are based on the analysis conducted during the site evaluation and site characterization processes, as well as the field study data currently available for the CCSM Project, including Phase I.

The USFWS Wind Energy Guidelines identify the need to consider the duration, scope, and intensity of an impact to determine significance of risks and note the need for consistency in evaluating significance over time. *See USFWS 2012 at p. 63.* PCW has considered these factors in the evaluation of potential risks to migratory bird and bat species. To provide a consistent and reasoned approach, the significance criteria identified for fisheries and wildlife resources in the BLM FEIS are used throughout this Phase I BBCS. *See BLM 2012b at p. 4.14-6*. According to the BLM FEIS, significant impacts would occur if: 1) Substantial loss of habitat function or disruption of life history requirements of a species or population segment that would make them eligible for listing under the ESA; 2) Decreased viability or increased

mortality of threatened and endangered, proposed and candidate species, or reduction or alteration of their critical habitats; 3) Management actions that result in substantial disruption or irreplaceable loss of vital and high value habitats, as defined in the WGFD (2004b) Mitigation Policy; 4) Substantial loss of habitat function or disruption of life history requirements of special status species that would preclude improvement of their status; or 5) Actions preclude attainment of conservation goals, as stated in conservation plans and strategies for special status species. *See BLM 2012b at p. 4.14-6*

USFWS Wind Energy Guidelines

1. *Do field studies indicate that species of concern[31] are present on or likely to use the proposed site?*

   As discussed in section 1.2, PCW has identified 117 species of migratory birds within the CCSM Project Site, including Phase I. *See Appendix B, USFWS 2016a.* In addition, 13 bat species have been observed, acoustically detected, or documented in the vicinity of the CCSM Project. *See Orabona et al. 2012; BLM 2012b.* Based on existing data and pre-construction surveys for the CCSM Project, PCW identified 22 migratory bird and 9 bat special status species that occur or have the potential to occur on the CCSM Project Site, including Phase I. *See Table 1.1 & Table 1.2.* These species include migratory bird and bat species listed on the BLM Wyoming Sensitive Species Policy and List or included in the Wyoming SWAP as SGCN. *See BLM 2012b; PCW 2014a at App. S*; *WGFD 2010*.

2. *Do field studies indicate the potential for significant adverse impacts on affected population of species of habitat fragmentation concern?*

   USFWS identified habitat fragmentation as a potential impact that could occur as a result of construction and operation of Phase I. *See USFWS 2016a*. However, they did not identify any specific species of habitat fragmentation concern. PCW has evaluated the findings from site characterization and site evaluation studies and determined that sagebrush obligate species (sagebrush sparrow, sage thrasher, and Brewer's sparrow) are potential species of habitat fragmentation concern for Phase I. This is consistent with the findings of the Wyoming Basin Ecoregional Assessment. *See Carr and Melcher 2015*. No other species of habitat fragmentation concern have been identified in the CCSM Project Site, including Phase I[32]. The site-specific data collected during field studies indicate that Brewer's sparrow, sagebrush sparrow, and sage

[31] This Phase I BBCS adopts the definition of species of concern from the USFWS Wind Energy Guidelines. However, in recognition of agency management priorities, discussions of species of concern are primarily focused on special status species that have been identified by federal and state agencies. *See Section 1.2.*

[32] The USFWS and other federal agencies have yet to designate species of habitat fragmentation concern for Wyoming. It is possible that there are other species of habitat fragmentation concern in Phase I. However, as they have not been identified, they cannot be specifically addressed in this BBCS. If additional species of habitat fragmentation concern are identified by the agencies, they may be addressed through the adaptive management process described in Section 8, as appropriate.

thrasher are among the most common migratory bird species within Phase I. This is a result of the availability of sagebrush steppe habitat in Phase I as well as the availability of this habitat throughout southern Wyoming. *See Carr and Melcher 2015*

Localized risks may be present to some individual sagebrush obligates from Phase I, generally due to surface disturbance and human presence; however, it is anticipated these impacts would be temporary, primarily during construction, and surrounding areas would generally be available for use by these species. Some indirect impacts including displacement or barrier effects may occur though the life of the project. Further, Phase I has been designed to minimize overall surface disturbance. This will reduce long-term fragmentation of habitats used by sagebrush obligates resulting in lower risks to the species. Finally, sagebrush habitats are available throughout southern Wyoming as well as large areas of the remainder of the western United States and the abundance of these species throughout that area make it unlikely that the risk of adverse impacts resulting from the construction and operation of Phase I would result in population level declines. These findings are consistent with the site characterization findings and the analyses presented in the BLM FEIS that concluded there would be no significant impacts to sagebrush obligate species from the CCSM Project. *See Section 4.3.2. See BLM 202b at p. 4.14-25.*

3. *What is the distribution, relative abundance, behavior, and site use of species of concern identified in Tiers 1 or 2, and to what extent do these factors expose these species to risk from the proposed wind energy project?*

Patterns of abundance and site use of the potential migratory bird species of concern identified in Table 1.1 are evaluated in Table 4.10. Consistent with the USFWS DEIS and BLM FEIS, PCW has identified that passerines are the group of migratory birds likely to have the greatest overall risk for impacts from Phase I. *See BLM 2012b, USFWS 2016a*. Generally, while localized risk from Phase I may be present for these and other migratory bird species, the risk has been avoided and minimized through the Phase I design process and the application of the measures identified in chapter 5.0. The risks to the potential migratory bird species of concern described in Table 4.10 are also characteristic of the potential risk to other migratory bird species that might occur in Phase I of the CCSM Project; however, due to the large number of other migratory bird species, only the potential species of concern are addressed individually. *See Appendix B.*

Based on site characterization and field study data, overall bat use of Phase I is relatively low; therefore, risks to the bat species listed in Table 1.2 from Phase I are anticipated to be low. While the species in Table 1.2 may use Phase I for migration or foraging, most are not commonly present. Consistent with the site evaluation for Phase I and BLM's FEIS, there is a low risk to the three BLM sensitive bat species (long-eared myotis, fringed myotis, and Townsend's big-eared bat) due to their limited occurrence in Phase I. *See Section 4.2.2.* Hoary bats are known to be uncommon in Phase I. However, fatalities of hoary bats are expected and, as disclosed in the USFWS DEIS, may be higher than indicated by pre-construction survey efforts. *See USFWS 2016a*. Of all bat species, it is likely that little brown bat, big brown bat, and silver-haired bat would have the greatest risk for impacts resulting from Phase I because they have the highest probability of occurrence and are known to be at risk for collision with wind turbines. *See BLM 2012b at p. 4.14-17; USFWS 2016a*. However, the avoidance, minimization, and conservation measures described in chapter 5.0 will avoid and minimize these risks to the extent practicable.

Table 4.10. Potential Risk to Migratory Bird and Bat Special Status Species of Concern[33].

Common Name	Phase I Occurrence	Assessment of Risk[34]
Passerines		
Brewer's Sparrow	Common across Phase I and southern Wyoming in sagebrush habitats.	Localized risk associated with habitat fragmentation and possible collision with wind turbines. Site evaluation and characterization found that impacts would not be significant.
Lark Bunting	Rare in Phase I. Phase I is on edge of species range and does not provide suitable habitat.	Very low risk. Species and its habitats are uncommon in Phase I. Site evaluation and characterization found that impacts would not be significant.
Loggerhead Shrike	Uncommon in Phase I.	Localized risk from habitat fragmentation and collision with wind turbines. Site evaluation and characterization found that impacts would not be significant.
Sagebrush Sparrow	Common across Phase I and southern Wyoming in sagebrush habitats.	Localized risk associated with habitat fragmentation and possible collision with wind turbines. Site evaluation and characterization found that impacts would not be significant.
Sage Thrasher	Common across Phase I and southern Wyoming in sagebrush habitats.	Localized risk associated with habitat fragmentation and possible collision with wind turbines. Site evaluation and characterization found that impacts would not be significant.
Raptors		
Burrowing Owl	Uncommon in Phase I. Limited occurrence in white-tailed prairie dog colonies.	Low potential for risk to migrating individuals. Low potential for collision with wind turbines. Site evaluation and characterization found that impacts would not be significant.
Ferruginous Hawk	Uncommon in Phase I. No occupied nests in more than 5 years of monitoring.	Low potential for risk to migrating individuals or non-breeding individuals that infrequently visit Phase I.
Merlin	Uncommon in Phase I. No occupied nests in more than 5 years of monitoring.	Low potential for risk to migrating individuals that infrequently visit Phase I. Site evaluation and characterization found that impacts would not be significant.

[33] This Phase I BBCS adopts this definition of species of concern from the USFWS Wind Energy Guidelines. However, in recognition of agency management priorities, this Phase I BBCS is primarily focused on special status species that have been identified by federal and state agencies. *See Section 1.2.*

[34] To provide a consistent and reasoned approach to determining significance, this Phase I BBCS adopts the significance criteria identified for fisheries and wildlife resources in the BLM FEIS. *See Section 4.4.2 at p.4-73.*

Common Name	Phase I Occurrence	Assessment of Risk[34]
Northern Goshawk	Uncommon in Phase I. No occupied nests in more than 5 years of monitoring. Very limited suitable habitat within 5 miles of the CCSM Project.	Low potential for risk to migrating individuals that infrequently visit Phase I. Site evaluation and characterization found that impacts would not be significant.
Peregrine Falcon	Uncommon in Phase I. Suitable nesting habitat does not occur.	Low potential for risk to migrating individuals that infrequently visit Phase I. Site evaluation and characterization found that impacts would not be significant.
Prairie Falcon	Common in Phase I. Nesting locations known in both Chokecherry and Sierra Madre WDAs.	Risk to species is associated with potential collision with wind turbines during migration and foraging. No Phase I wind turbines are located within suitable nesting habitat. Site evaluation and characterization found that impacts would not be significant.
Swainson's Hawk	Common in Phase I. Nesting locations known in the vicinity of the CCSM Project Site.	Risk to species is associated with potential collision with wind turbines during migration and foraging. No Phase I wind turbines are located within suitable nesting habitat. Site evaluation and characterization found that impacts would not be significant.
Waterbirds/ Waterfowl		
Black-crowned Night-heron	Uncommon in Phase I.	Low risk for impacts. Habitats used by black-crowned night are not common in Phase I. Site evaluation and characterization found that impacts would not be significant.
Canvasback	Uncommon in Phase I. Generally occur in proximity to reservoirs during spring and fall migration periods.	Low risk for impacts. Low potential for collision during migration because wind turbines are not located near reservoirs. Site evaluation and characterization found that impacts would not be significant.
Clark's Grebe	Uncommon in Phase I. Generally occur in proximity to reservoirs during spring and fall migration periods.	Low risk for impacts. Low potential for collision during migration because wind turbines are not located near reservoirs. Site evaluation and characterization found that impacts would not be significant.
Lesser Scaup	Uncommon in Phase I. Generally occur in proximity to reservoirs during spring and fall migration periods.	Low risk for impacts. Low potential for collision during migration because Phase I wind turbines are not located near reservoirs. Site evaluation and characterization found that impacts would not be significant.

Common Name	Phase I Occurrence	Assessment of Risk[34]
Long-billed Curlew	Uncommon in Phase I. Several individuals have been observed in grassland habitats in the central basin between the WDAs.	Low risk for impacts. Minimal risk to individuals because of lack of suitable grassland habitat and infrequent use of Phase I. Site evaluation and characterization found that impacts would not be significant.
Mountain Plover	Uncommon in Phase I. Several individuals have been observed in upland grassland and barren habitats in the Phase I.	Low potential for risk to this ground-based species. Some potential for collision with wind turbines as individuals migrate to and from Phase I. Risk highest in saltbush communities upland grasslands in Lower Miller Hill within the Phase I portion of the Sierra Madre WDA. Site evaluation and characterization found that impacts would not be significant.
Northern Pintail	Uncommon in Phase I. Generally occur in proximity to reservoirs during spring and fall migration periods.	Low risk for impacts. Low potential for collision during migration because Phase I wind turbines are not located near reservoirs. Site evaluation and characterization found that impacts would not be significant.
Redhead	Seasonally common in proximity to reservoirs during spring and fall migration periods.	Low risk for impacts. Low potential for collision during migration because Phase I wind turbines are not located near reservoirs. Site evaluation and characterization found that impacts would not be significant.
Sandhill Crane	Uncommon in Phase I. Only one individual seen in the Sierra Madre WDA near wetland habitat.	Low risk for impacts. Phase I is not a known breeding or migration area for the species and habitat availability is limited. Site evaluation and characterization found that impacts would not be significant.
White-faced Ibis	Uncommon in Phase I. Generally occur in proximity to reservoirs.	Low risk for impacts. Low potential for collision because Phase I wind turbines are not located near reservoirs. Site evaluation and characterization found that impacts would not be significant.

4. *What are the potential risks of adverse impacts of the proposed wind energy project to individuals and local populations of species of concern*[35] *and their habitats? (In the case of rare or endangered species, what are the possible impacts to such species and their habitats?)*

There are no known occurrences of threatened or endangered migratory bird or bat species in the CCSM Project Site, including Phase I, or in the surrounding areas. In addition, no rare migratory bird or bat species of concern were identified during Phase I site-specific survey efforts. As such, no impacts will occur to rare, threatened, or endangered species or their habitats.

Based on the site characterization and field study data and as described below, it is also unlikely that any population level impacts would occur to any species of concern because the species most commonly observed in Phase I are ubiquitous in Phase I, the CCSM Project Site, and the Ranch. *See USFWS 2016a, BLM 2012b*. The species and their habitat are also common across much of the Wyoming Basin and surrounding states. *See Carr and Melcher 2015*. It has been documented by some studies that there is little or no relationship between pre-construction avian survey results and the actual mortality risk resulting from wind projects. *See Ferrer et al. 2012; Erickson et al. 2014.* However, it has also been shown that passerines are among the most common fatalities observed at operational wind facilities (Erickson et al. 2002a,b, 2001; Johnson and Stephens 2011) because passerines were the most common order of birds observed in the Phase I area PCW has assumed that fatalities would be proportional to the pre-construction relative abundance for each species for purposes of evaluating risks.

Assuming that fatalities would be proportional to species-specific abundance of non-corvids observed as part of migratory bird point counts in Phase I, horned lark would make up approximately 60% of all fatalities. Sagebrush obligates (sagebrush sparrow, Brewer's sparrow, sage thrasher,) would make up 14% of all fatalities with sagebrush sparrow and Brewer's sparrow being most impacted among the four species in this guild. As described in sections 4.2.2 and 4.3.2, analyses completed as part of the site evaluation and characterization process found that impacts to sagebrush obligates are not expected to be significant. Vesper sparrow (5% of expected fatalities), western meadowlark (4%), and American robin (3%) make up the remainder of the species most likely to be impacted; none of which are special status species. The remaining 15% of fatalities would be expected to be associated with the species using Phase I in proportion to their abundance. For non-eagle raptors, it is expected that fatalities would most commonly be associated with American kestrel, red-tailed hawk, and prairie falcon.

[35] This Phase I BBCS adopts this definition of species of concern from the USFWS Wind Energy Guidelines. However, in recognition of agency management priorities, this Phase I BBCS is primarily focused on special status species that have been identified by federal and state agencies. *See Section 1.2.*

The potential impacts to migratory birds and bats from the CCSM Project, including Phase I, were analyzed in the BLM FEIS. The BLM FEIS identifies direct impacts consisting of fatalities and loss of habitat, as well as indirect impacts associated with habitat loss, modification, and displacement. *See BLM 2012b at pp.4.14-15 & 4.14-18.* Impacts to migratory birds and bats were estimated in BLM's FEIS based on pre-construction bird and bat use of the original Application Area and fatality estimates at other wind energy facilities in the western U.S., assuming there is a linear relationship between observed pre-construction use and post-construction mortality on a per MW basis.

The impacts estimated in BLM's FEIS are for the CCSM Project as a whole. BLM recognizes that "[t]he magnitude of these impacts depends upon the number of wind turbines and other infrastructure constructed for each alternative and the amount of direct and indirect habitat lost due to construction and operation of the project." *See BLM 2012b at p. 4.14-18.* Given that Phase I consists of half the wind turbines and a subset of the total disturbance for the CCSM Project, the impacts from Phase I will be substantially less than those estimated in the FEIS. Further, the BLM fatality estimates are based on pre-construction bird and bat use of the original Application Area and fatality estimates at other wind energy facilities in the western U.S., many of which did not develop avian and bat protection plans or other avoidance, minimization and mitigation measures to reduce mortalities while designing and operating the projects. *See Section 5.1.1*.

Predicting avian risk from pre-construction point count data is difficult and can result in estimates of mortality that do not match post-construction monitoring results. It has been documented by some studies that there is little or no relationship between pre-construction avian survey results and the actual mortality risk resulting from wind projects. *See Ferrer et al. 2012; Erickson et al. 2014*. Rather, levels of project risk are associated with site-specific characteristics around wind turbines and associated infrastructure. *See Ferrer et al. 2012*. Given the limitations of the existing fatality estimation methods to account for the substantial redesign of the CCSM Project and the micrositing process, PCW has not updated the migratory bird and bat fatality estimates for the CCSM Project or Phase I and has instead focused its efforts on avoiding and minimizing impacts to migratory birds and bats to the extent practicable, as described in chapter 5.0, and the development of a robust post-construction monitoring program to evaluate impacts and monitor conservation measure effectiveness, as described in chapter 6.0. As discussed in chapter 5.0, the measures included in this Phase I BBCS to avoid and minimize impacts to migratory birds and bats will likely result in observed impacts below those originally predicted by BLM. *See BLM 2012b at pp. 4.14-16 & 4.14-22.*

5. *How can developers mitigate identified significant adverse impacts?*

   Using the site-specific data for the CCSM Project, the USFWS Wind Energy Guidelines, and the WGFC Wind Energy Recommendations, PCW has worked cooperatively with USFWS, BLM, and WGFD to develop and apply appropriate avoidance, minimization, and mitigation measures to the CCSM Project, including Phase I, as described in chapter 5.0. *See USFWS 2016a*. These measures are designed to avoid and minimize impacts to migratory birds and bats from the CCSM Project, including Phase I, to the extent practicable.

6. *Are there studies that should be initiated at this stage that would be continued in post-construction?*

   PCW has coordinated with USFWS, BLM and WGFD to identify appropriate post-construction monitoring for migratory birds and bats to evaluate impacts and monitor conservation measure effectiveness. The migratory bird and bat post-construction monitoring program for Phase I is described in chapter 6.0 of this Phase I BBCS.

WGFC Wind Energy Recommendations

1. *Does pre-construction monitoring indicate that SGCN are present on or likely to use the proposed site?*

   Based on existing data and pre-construction surveys for the CCSM Project, PCW identified 22 migratory bird and 9 bat special status species that have the potential to occur on the CCSM Project Site, including Phase I. *See Table 1.1 & Table 1.2.* These species include migratory bird and bat species listed on the BLM Wyoming Sensitive Species Policy and List or included in the Wyoming SWAP as SGCN. *See BLM 2012b; PCW 2014a at App. S*; *WGFD 2010*. See response to questions 1 through 4 above under USFWS Wind Energy Guidelines.

2. *Does monitoring indicate the potential for adverse impacts on the wildlife species or habitat?*

   The potential impacts to migratory birds and bats from the CCSM Project, including Phase I, were analyzed in the BLM FEIS. The BLM FEIS identifies direct impacts consisting of fatalities and loss of habitat, as well as indirect impacts associated with habitat loss, modification, and displacement. *See BLM 2012b at pp. 4.14-15 & 4.14-18.* See response to questions 1 through 4 above under USFWS Wind Energy Guidelines.

3. *If adverse impacts are predicted to a species or habitat, can these impacts be avoided (preferable) or mitigated?*

   PCW has developed measures to avoid and minimize impacts to migratory birds and bats from the CCSM Project, including Phase I, to the extent practicable, as described in chapter 5.0. See response to question 5 above under USFWS Wind Energy Guidelines.

4. *Is monitoring needed for construction and post-construction?*

   The migratory bird and bat post-construction monitoring program for Phase I is described in chapter 6.0 of this Phase I BBCS. See response to question 6 above under USFWS Wind Energy Guidelines.

4.4.3 Field Study and Impact Prediction Risk Assessment

This Phase I field study and impact prediction risk assessment is the culmination of data collected and analyses completed in accordance with the tiered process set forth in the USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations. As such, it reflects data collected and analyzed since 2006 resulting in a thorough evaluation of potential risks to migratory bird and bat species from Phase I. The results of these risk assessments informed the development and application of the avoidance, minimization, and conservation measures presented in chapter 5.0 and the post-construction monitoring program described in chapter 6.0 of this Phase I BBCS.

The field study and impact prediction questions concluded that there are no threatened or endangered migratory birds or bat species present on the CCSM Project Site. However, it was determined that migratory bird or bat species of concern[36] are be present and that these species may be adversely affected by Phase I. *See Appendix B.* The majority of these impacts are likely to be localized rather than at a population-level. Risks to migratory birds and bats from Phase I include collision with operating wind turbines, collision with project-area vehicle traffic, loss of habitat associated with impacts from Phase I , and behavioral avoidance by some species during construction and operation of Phase I. Due to differences in patterns of use and potential risks from Phase I, separate risk assessments have been completed for non-eagle raptors, other migratory birds, and bats.

[36] This Phase I BBCS adopts this definition of species of concern from the USFWS Wind Energy Guidelines. However, in recognition of agency management priorities, this Phase I BBCS is primarily focused on special status species that have been identified by federal and state agencies. *See Section 1.2.*

Migratory Birds

Impacts to non-raptor migratory birds are expected to be seasonal and primarily occur during spring, summer, and fall months when migratory birds regularly use habitats within Phase I. Species-specific risk to migratory birds was evaluated using data for non-corvid migratory birds because impacts to larger corvids (common raven, black-billed magpie, American crow) from Phase I are assumed to be very low due to a high-level of avoidance. *See Sterner et al. 2007; Devereux et al. 2008*. Assuming that risk to other migratory bird species is proportional to observed species abundance, horned lark would be most at risk from Phase I (60% of occurrences). Based on Phase I survey data, sagebrush obligates (sagebrush sparrow, Brewer's sparrow, and sage thrasher) would also be at risk (14% of all occurrences) with risks to sagebrush sparrow and Brewer's sparrow being most prevalent. However, as described earlier, detailed analyses completed for the BLM FEIS found that impacts to sagebrush obligates are not expected to be significant. *See BLM 2012b at p. 4.14-25.* The remainder of the migratory bird species most likely to be at risk from Phase I include common species such as vesper sparrow (5% of occurrences), western meadowlark (4%), and American robin (3%). During winter months (November to March), direct and indirect impacts are expected to be less than in other seasons because of the low migratory bird activity on site.

Non-eagle Raptors

Risks to non-eagle raptors are anticipated be less than those to other migratory birds due to their relatively low abundance on-site. Further, non-eagle raptors use different habitats and have different patterns of use than other migratory birds. Risks to non-eagle raptors from Phase I are expected to be seasonal and similar to migratory birds are anticipated to be roughly proportional to the abundance of each species observed during Phase I surveys. Risks to non-eagle raptors are expected during spring, summer, and fall months when non-eagle raptors regularly use habitats in Phase I. During winter months, non-eagle raptor use is extremely low indicating a low overall risk.

Data collected across Phase I indicate that American kestrel, red-tailed hawk, and prairie falcon are at the greatest risk for impact. While Northern harrier was among the most abundant non-eagle raptor observed in Phase I, the species nests on the ground and forages by flying very close to the ground. Therefore, risks to northern harrier are expected to be less than risks to red-tailed hawk, American kestrel, and prairie falcon. American kestrel, red-tailed hawk, and prairie falcon species are known to nest and forage in Phase I portions of both the Chokecherry and Sierra Madre WDAs. The combination of their resident nesting status and foraging behavior is expected to increase their risk when compared to other non-eagle raptors species that are not as common or have more specific habitat requirements. However, red-tailed hawks and American kestrels are known to be more tolerant of human presence and disturbance than some raptor species indicating they may be less at risk of disturbance from human activities. *See Chace and Walsh 2006.*

Bats

Impacts to bats are anticipated to be seasonal. As described in the BLM FEIS, it is expected that risk to bats are greatest during late summer and early fall during migration and foraging activities. *See BLM 2012b at p. 4.14-16.* In Phase I, there is minimal risk to bats from late fall through early spring based on the expected lack of bat activity during this winter period. Based on the evaluation of the Phase I data, there is low risk to the three BLM sensitive bat species (long-eared myotis, fringed myotis, and Townsend's big-eared bat) due to the fact that they have never been documented among the 2,285 bat fatalities recorded from 21 wind energy facilities in the western United States. *See BLM 2012b.* Further, risks to the hoary bats are expected to be low as they are known to be uncommon in the CCSM Project Site (only 7% of all bat detections were attributed to the hoary bats). It is likely silver-haired bat would have the greatest risk for impacts from Phase I because they are likely to occur in the CCSM Project Site and are known to be at risk for collision with wind turbines in the western United States. *See BLM 2012b at p. 4.14-17.* Little brown bat and big brown bat may also be at risk for impacts because they are known to infrequently collide with wind turbines in the United States and are likely to occur in the CCSM Project Site. *See Appendix D.* However, because ground-level bat activity measured using passive acoustic monitoring on the CCSM Project Site was relatively low during the period over which data were collected and the flight heights of any potential migrating bats or avian species recorded by the avian radar are well above the rotor swept zone, impacts to bat species are expected to be minimal for the CCSM Project, including Phase I.

Overall Risk Assessment

Throughout the development of the CCSM Project, PCW has worked cooperatively with USFWS, BLM and WGFD to evaluate risks to migratory birds and bats, collecting progressively more detailed site-specific data using state-of-the-art surveys. PCW has shared the data collected during the CCSM Project and Phase I field studies with USFWS, BLM, and WGFD to facilitate the development of appropriate measures to avoid and minimize impacts to migratory birds and bats from Phase I. Consistent with the USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations, PCW has evaluated the detailed site-specific data collected for the CCSM Project and has determined that development Phase I is consistent with the USFWS Wind Energy Guidelines based on the extensive avoidance, minimization and mitigation measures incorporated into Phase I and the robust post-construction monitoring proposed for the site. *See Chapters 5.0 & 6.0.*

The BLM FEIS analyzes the potential impacts of the CCSM Project on migratory birds and bats based on the original Application Area. *See BLM 2012a.* Since publication of the BLM FEIS, PCW has continued to work cooperatively with USFWS, BLM, and WGFD to use the migratory bird and bat data to substantially redesign the CCSM Project and to microsite Phase I to avoid and minimize impacts, including identifying over 105,000 acres of the Ranch as wind turbine avoidance areas and proposing extensive conservation measures for areas that would be developed. *See Chapter 5.0.* As a result of this continued collaboration, the additional data collection, the substantial project redesign, and the measures described in chapter 5.0 to avoid and minimize risk, PCW has determined that advancement of Phase I is consistent with the USFWS Wind Energy Guidelines.

Chapter 5.0 of this Phase I BBCS describes the extensive avoidance, minimization and conservation measures PCW has developed for Phase I in cooperation with USFWS, BLM, and WGFD. Chapter 6.0 of this Phase I BBCS describes the post-construction monitoring program developed by PCW to evaluate impacts to migratory birds and bats, as well as to evaluate the effectiveness of the Phase I conservation measures.

5.0 Measures to Avoid and Minimize Risk

The USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations provide standard BMPs for wind energy projects and recommend early and ongoing coordination with agency personnel to develop additional site-specific avoidance, minimization, and conservation measures. *See USFWS 2012a; WGFC 2010.* As recommended by USFWS and WGFC, PCW has coordinated extensively with USFWS, BLM, and WGFD to finalize the Phase I wind turbine layout and to develop site-specific measures for migratory birds, bats, and other wildlife species based on the data collected for the CCSM Project, including Phase I. *See Chapter 4.0.*

PCW used the best available scientific data, including the extensive data collected for Phase I, to develop the avoidance and minimizations measures that were incorporated into the Phase I wind turbine layout. This chapter outlines the avoidance and minimization process that PCW implemented during the Phase I siting consistent with USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations, including considering alternative locations for reducing migratory bird and bat risk and adjusting the Phase I wind turbine layout using site-specific avian and bat use data.

The following sections describe the substantial redesign that PCW has completed since first applying for two Type-II Wind Energy Project Area Grants for wind energy site testing and monitoring, submitting a POD for the CCSM Project to BLM, and applying for a Type-III Wind Energy Development Grant. *See Section 1.3.2.* PCW's iterative design and siting approach resulted in a substantial reconfiguration of the CCSM Project including several revisions of the wind turbine layout for Phase I. These are exactly the type of actions contemplated and recommended by Tier 3 of the USFWS Wind Energy Guidelines and Tier 2 of the WGFC Wind Energy Recommendations. The evolution of the CCSM Project and Phase I described in this chapter illustrates: (1) PCW's attention to the early determination of potential environmental risks at the landscape scale; (2) PCW's evaluation of potential environmental risks based on site-specific data; and (3) PCW's adjustment of the Phase I design using that site-specific data.

The measures identified in this chapter include the BMPs identified in the USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations; avoidance and minimization measures identified in the BLM's CCSM Project ROD; additional conservation measures designed to avoid and minimize impacts to migratory bird and bat species as well as other wildlife; and other site-specific measures based on pre-construction migratory bird and bat risk assessments. *See Chapter 4.0.* These BMPs and other measures address the recommendations contained in the USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations.

As contemplated in the USFWS Wind energy Guidelines and WGFC Wind Energy Recommendations, the Phase I BMPs and conservation measures will be implemented based on site-specific characteristics, monitoring data, and results of post-construction monitoring efforts. Collectively, these measures avoid or minimize, to the extent practicable, direct and indirect impacts to migratory bird and bat species including potential collisions and fatalities; disturbance, displacement, and behavioral changes; and habitat loss, degradation, and fragmentation. The conservation measures contained in the following sections also address habitat-related impacts and other indirect impacts to migratory bird and bat species that may occur.

5.1 Phase I Risk Avoidance and Minimization Process

This BBCS is limited in scope to Phase I of the CCSM Project. Phase II of the CCSM Project will have a separate BBCS; however, portions of this section describe the CCSM Project as a whole to provide context for the migratory bird and bat risk avoidance and minimization effort.

PCW has used the site-specific data collected as part of the pre-construction migratory bird and bat risk assessment process along with recommendations from USFWS, BLM, and WGFD in re-designing the CCSM Project and developing the final wind turbine layout for Phase I. Phase I avoids and minimizes risks to migratory birds and bats consistent with the USFWS Wind Energy Guidelines, the WGFC Wind Energy Recommendations, and the BLM ROD. The Phase I wind turbine layout - when combined with the best management practices, conservation measures, monitoring, and adaptive management described in this Phase I BBCS - avoids and minimizes risks to migratory birds and bats to the extent practicable.

5.1.1 Wind Energy Site Testing and Monitoring Application Area

PCW has an easement from TOTCO for wind development on the privately owned sections of the Ranch; however, PCW must also obtain the proper authorizations for wind development on the interspersed federal land. *See Chapter 1.0.* In November of 2006, PCW applied to BLM for two ROW grants for wind energy site testing and monitoring on federal land (Type-II Wind Energy Project Area Grants) in two areas of the Ranch. *See BLM 2008b.* The northern area was identified as Chokecherry and the southern area was identified as Sierra Madre. BLM approved the Chokecherry Wind Energy Project Area Grant on June 11, 2007, and the Sierra Madre Wind Energy Project Area Grant on June 15, 2007, covering the Wind Energy Site Testing and Monitoring Application Area (Application Area) in which wind energy development was proposed. The Application Area, located almost entirely within the Ranch, encompassed 169,500 acres. PCW installed its first meteorological (or "met") towers for monitoring and measuring wind speed, direction and behavior in June 2007, with additional met tower installations shortly thereafter. The data from these met towers were used to generate a site-specific wind map of the Application Area and inform the wind turbine layout for PCW's original Proposed Action. *See Figure 5.1.*

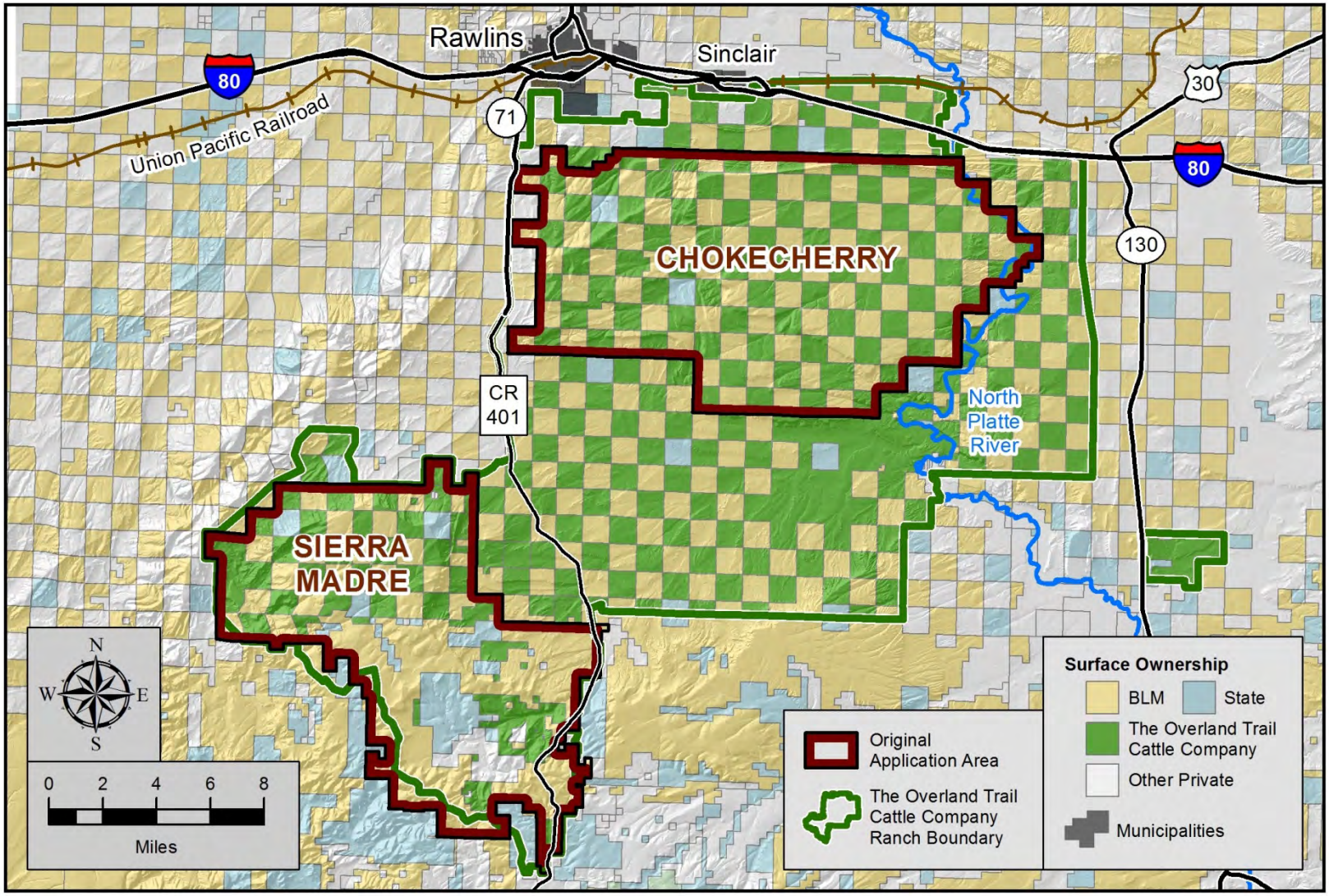


Figure 5.1. Wind Energy Site Testing and Monitoring Application Area – June 2007.

5.1.2 Original Proposed Action

To develop a wind energy generation project on BLM-administered federal land, a Type-III Wind Energy Development Grant is needed from BLM. *See BLM 2008b.* In January 2008, PCW applied for a Type-III Wind Energy Development Grant, which would authorize PCW to construct, operate, maintain and decommission the CCSM Project on BLM-administered land within the Application Area.

In support of its application for a Type-III Wind Energy Development Grant, PCW submitted a POD to BLM in March 2009, which included a proposed wind turbine layout for the CCSM Project (Original Proposed Action). The Original Proposed Action was based on siting the CCSM Project wind turbines to take advantage of the Ranch's best wind resources as verified from the wind data collected since 2007. The Original Proposed Action had 675 wind turbines in Chokecherry and 325 in Sierra Madre, with no wind turbines on Sage Creek Rim or in Lower Miller Hill or the Sage Creek Basin. Wind turbines were planned throughout the full extent of Upper Miller Hill including within the Red Rim-Grizzly WHMA, and along the hogback feature in the north portion of Chokecherry. *See Figure 3.4 & Figure 5.2.*

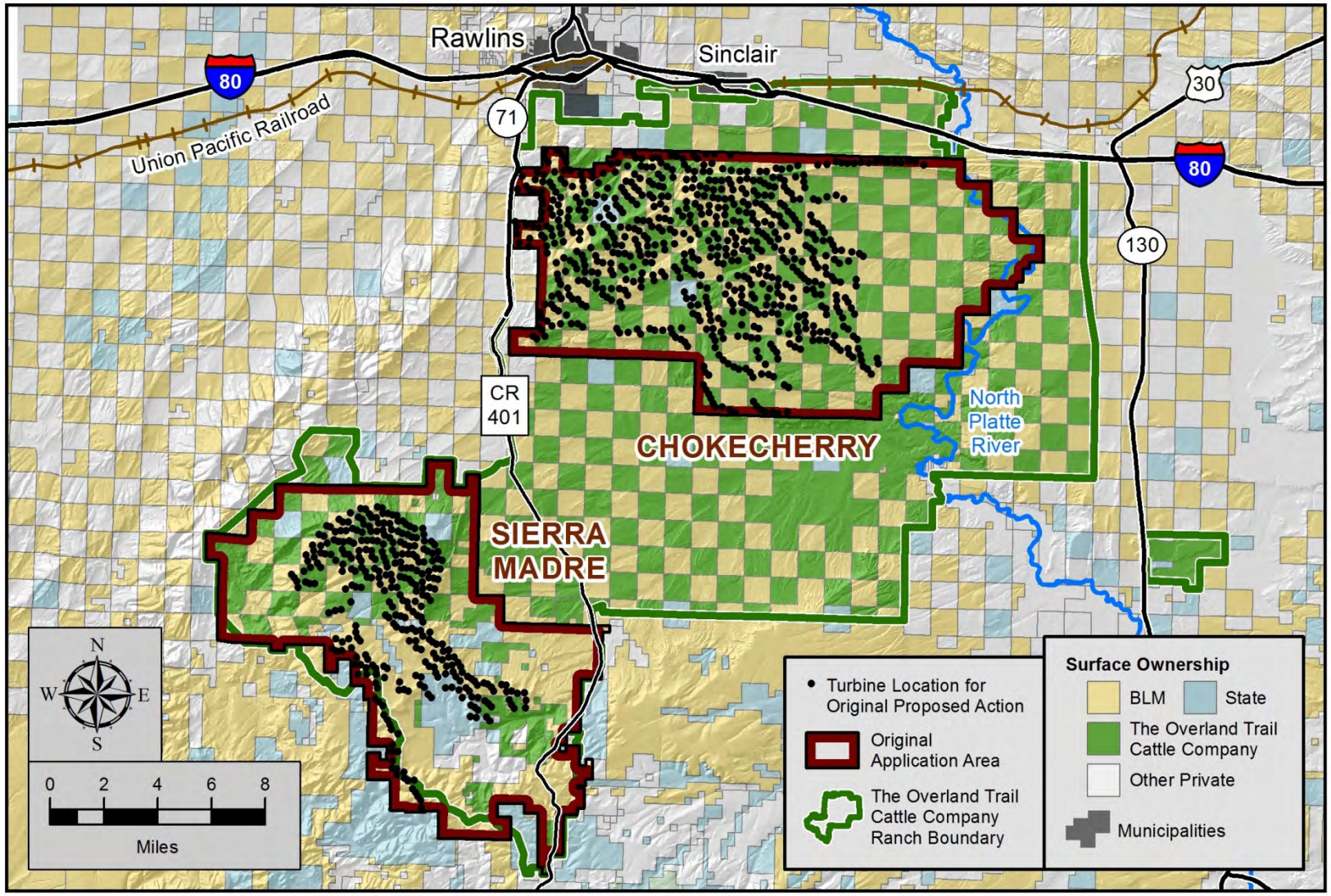


Figure 5.2. Original Proposed Action in Plan of Development – March 2009.

5.1.3 Revision 1, Revised Proposed Action – April 2010

Consistent with Tiers 1 and 2 of the USFWS Wind Energy Guidelines and Tier 1 of the WGFC Wind Energy Recommendations, following the submittal of the Original Proposed Action, PCW conducted a broad, landscape-scale evaluation of the Application Area using the results of the 2008-2009 baseline wildlife surveys. *See Section 4.1.* This included an evaluation of the locations of multiple resources including raptor nest locations and habitat for avian and other wildlife species. The evaluation also included identification of preliminary environmental constraints based on the RMP for the BLM RFO and the best available environmental information and datasets for the Ranch.

As a result of the initial avoidance and minimization effort associated with PCW's review of the Original Proposed Action, over 30% of the wind turbine locations in the Original Proposed Action (approximately 340 wind turbine locations) were removed from consideration. This included proposed wind turbine locations in the southernmost portion of Sierra Madre and the western portion of Upper Miller Hill (also in Sierra Madre). Accordingly, PCW amended its Type-II Wind Energy Project Area Grants to add potential development areas in Sierra Madre (Lower Miller Hill, Sage Creek Basin, and Sage Creek Rim). The Application Area along with these expanded areas form the Amended Application Area evaluated by BLM in its FEIS (with a few additional minor adjustments). The Amended Application Area encompasses approximately 216,000 acres, including all of Phase I.

Following amendment of its Type-II Wind Energy Project Area Grants, PCW revised its Original Proposed Action (the Revised Proposed Action). The Revised Proposed Action moved proposed wind turbine locations from the southernmost portion of Sierra Madre and the western portion of Upper Miller Hill to areas in Lower Miller Hill, Sage Creek Basin, and Sage Creek Rim. When compared with the Original Proposed Action, these wind turbine relocations resulted in decreased impacts to multiple resources, including areas of high quality sagebrush habitat, aspen/mixed conifer woodlands, and mountain shrub communities. The reduction of impacts in these areas benefits sagebrush obligate species as well as raptors and other migratory bird and bat species of concern. The Revised Proposed Action was provided to BLM in April 2010. *See Figure 5.3.*

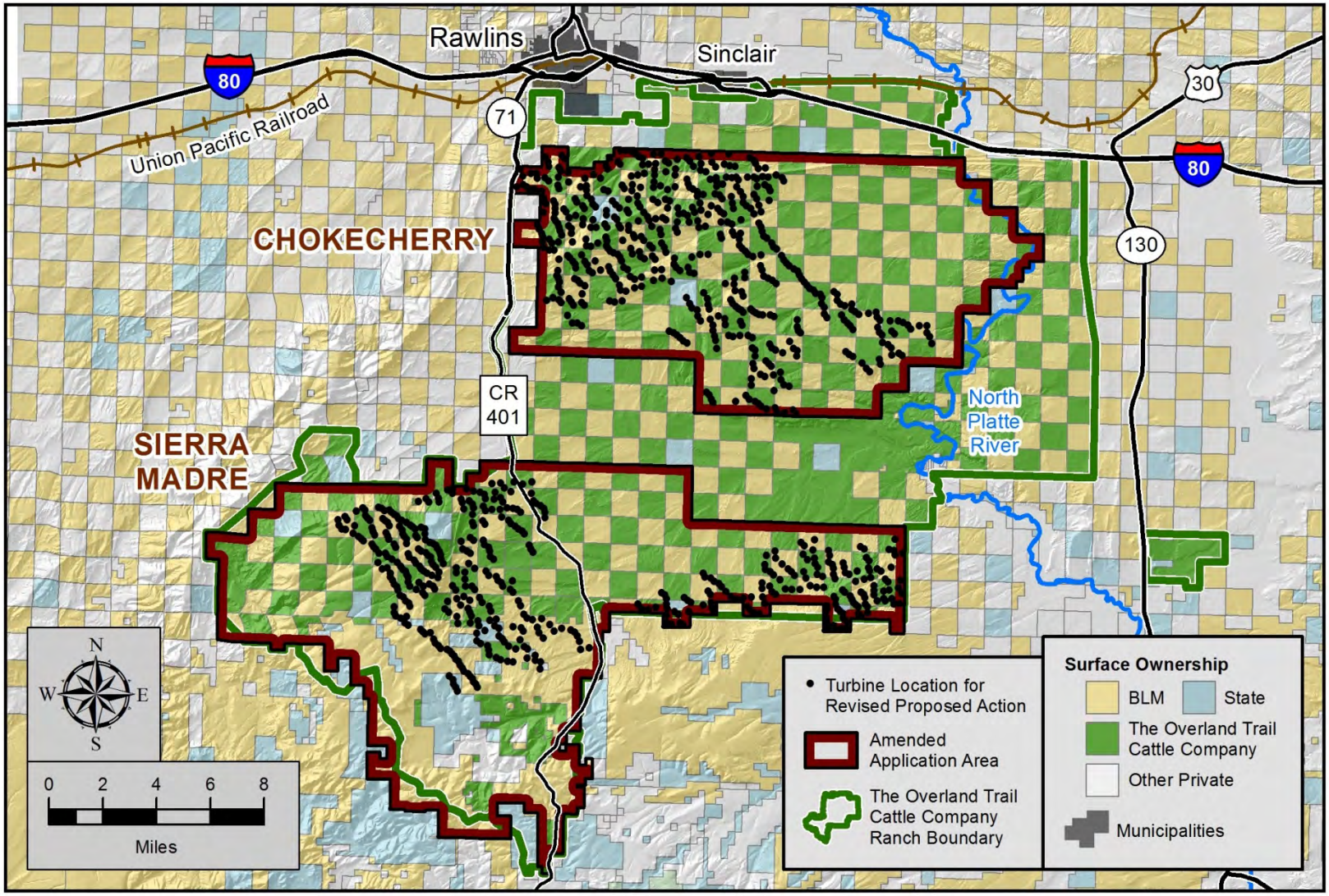


Figure 5.3. Revision 1: Revised Proposed Action – April 2010.

5.1.4 Revision 2, Applicant Proposed Alternative – August 2010

In August 2010, PCW again revised the CCSM Project by removing all wind energy development from greater sage-grouse Core Areas as designated in the Wyoming Governor's Executive Order 2010-4 (and subsequently Executive Order 2011-5). The State of Wyoming Core Area conservation strategy for greater sage-grouse limits development and disturbance in large areas of public, private, and state land across Wyoming. In the vicinity of the CCSM Project, habitats along and east of the North Platte River and habitats south and west of the Sierra Madre WDA are identified as Core Areas for greater sage-grouse conservation. These areas include high quality sagebrush habitat, aspen/mixed conifer woodlands, and mountain shrub communities. The removal of proposed wind turbine locations in these areas benefits sagebrush obligate species as well as raptors and other migratory bird and bat species of concern.

PCW modified the Revised Proposed Action by relocating 68 wind turbines, primarily from western and southern Upper Miller Hill, where the best wind resources are located, to areas outside of greater sage-grouse Core Areas and the associated high quality sagebrush habitat. This is in addition to the over 300 wind turbines that were relocated between the Original Proposed Action and the Revised Proposed Action, most of which were also originally sited in what are now designated greater sage-grouse Core Areas. Revision 2 to the CCSM Project wind turbine layout was submitted to BLM in August 2010 as the Applicant Proposed Alternative. BLM analyzed the Applicant Proposed Alternative as Alternative 1R in its Draft EIS. *See BLM 2011b*. *See Figure 5.4.*

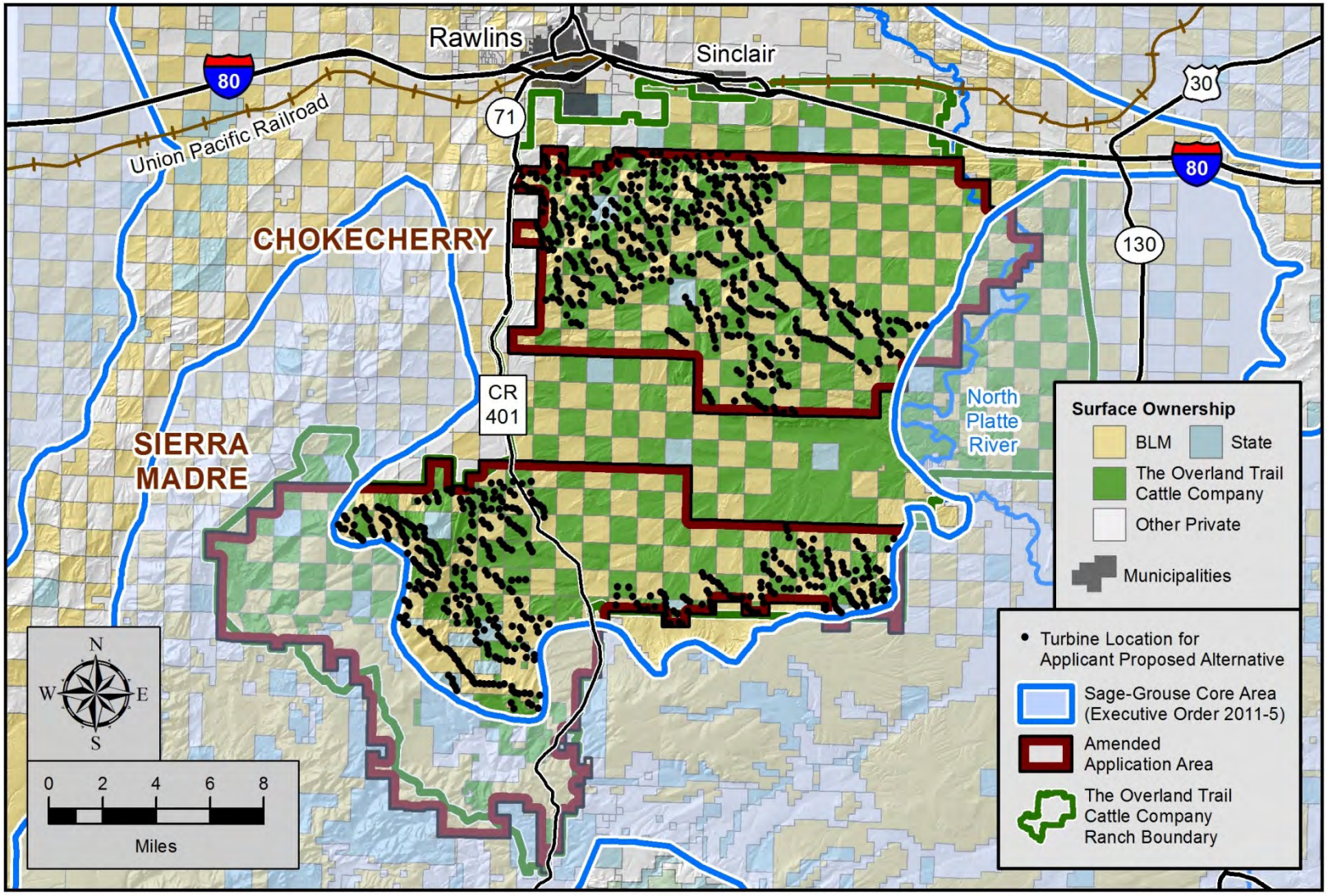


Figure 5.4. Revision 2: Applicant Proposed Alternative – August 2010.

5.1.5 Revision 3, Revised Plan of Development – January 2012

Following the release of BLM's Draft EIS in July 2011, PCW revised the CCSM Project again in its POD dated January 2012. This revision considered the analysis contained in the BLM Draft EIS and incorporated updated ACMs and a revised wind turbine layout. Many of the ACMs are consistent with conservation practices recommended in the USFWS Wind Energy Guidelines, WGFC Wind Energy Recommendations and other additional recommendations made by USFWS, BLM, and WGFD. Specifically, in the January 2012 POD, PCW worked to further reduce surface disturbance and habitat fragmentation and to provide flight/movement corridors for migratory bird and bat species throughout the CCSM Project by aligning wind turbines into rows. In addition, wind turbines were also removed north of the hogback and south of Rasmussen Reservoir to further reduce potential risk to migratory bird and bat species and other wildlife from the CCSM Project. This revised wind turbine layout formed the basis of BLM's analysis in the FEIS. *See Figure 5.5.*

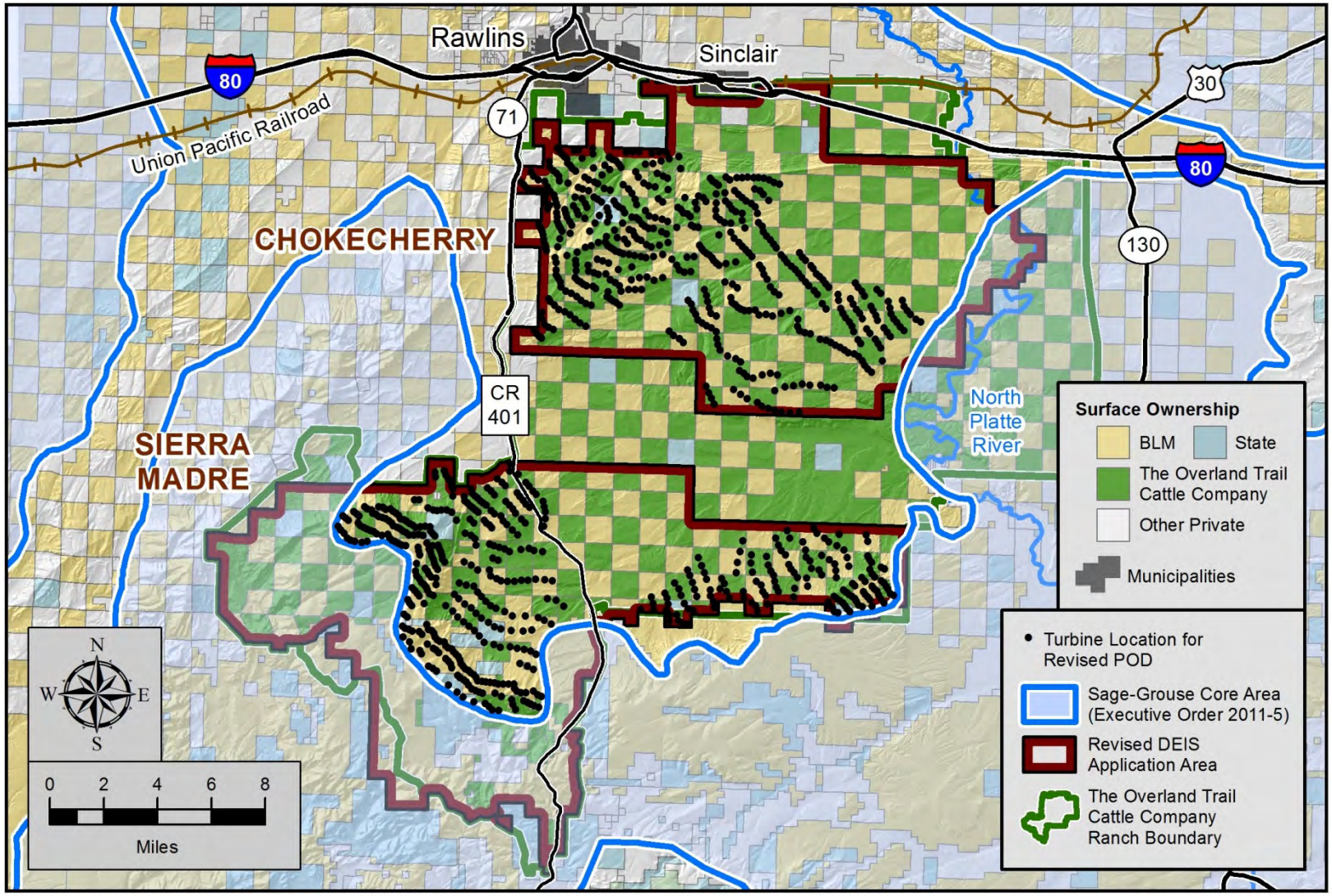


Figure 5.5. Revision 3: Revised Plan of Development – January 2012.

5.1.6 Revision 4, Turbine No-Build Areas – July 2012

Beginning in 2010, PCW coordinated and consulted with USFWS, BLM, and WGFD to identify additional surveys necessary to identify and document migratory bird and bat use areas, potential migration areas, nesting areas, and other resources associated with migratory bird and bat use of the CCSM Project Site. The purpose of these surveys was to inform additional avoidance and minimization efforts to reduce risks to migratory birds and bats by identifying areas of highest use within the CCSM Project Site. These surveys were conducted between April 2011 and July 2012. *See Section 4.4.*

Based on the site-specific data collected through July 2012 and the recommendations made by USFWS, PCW further revised the wind turbine layout in its January 2012 POD (Revision 4). PCW provided Revision 4, which included Turbine No-Build Areas, to USFWS on July 18, 2012. Revision 4's Turbine No-Build Areas total over 105,000 acres across the Ranch and were designed to reduce impacts to migratory birds and bats by avoiding placement of wind turbines in and adjacent to many of the documented avian use areas, flight/movement corridors, and raptor nesting and foraging habitats. The Turbine No-Build Areas were identified through a kernel density analysis of the long-watch raptor survey data, observed raptor flight paths, incidental observations, and consideration of recommendations from USFWS regarding important avian use areas.

In addition to designating Turbine No-Build Areas, Revision 4 removed wind turbines from the Red Rim-Grizzly WHMA located west and south of the Miller Hill portion of the Sierra Madre WDA. The Red Rim-Grizzly WHMA is managed to benefit wildlife species including migratory birds and bats. According to WGFD, the Red Rim-Grizzly WHMA also provides habitat for migratory birds such as ferruginous hawks, red-tailed hawks, and passerines. *See WGFD 2013.* Survey data demonstrates that locations adjacent to and within the Red Rim-Grizzly WHMA had relatively high raptor use compared to other areas that are currently proposed for the CCSM Project. Removal of wind turbines from the Red Rim-Grizzly WHMA reduces potential impacts to migratory birds and bats and will ensure that the Red Rim-Grizzly WHMA continues to provide important habitat for these species and a conservation benefit to local and regional migratory bird and bat populations.

Approximately 66 wind turbines were moved in Revision 4 such that no wind turbines will be constructed in or overhang the boundaries of the Turbine No-Build Areas. Revision 4 of the CCSM Project wind turbine layout, referred to as the Turbine No-Build Areas layout, formed the foundation for the further avoidance and minimization discussions between PCW and USFWS, BLM, and WGFD. The designated Turbine No-Build Areas are described in additional detail below. *See Figure 5.6 & Figure 5.7.*

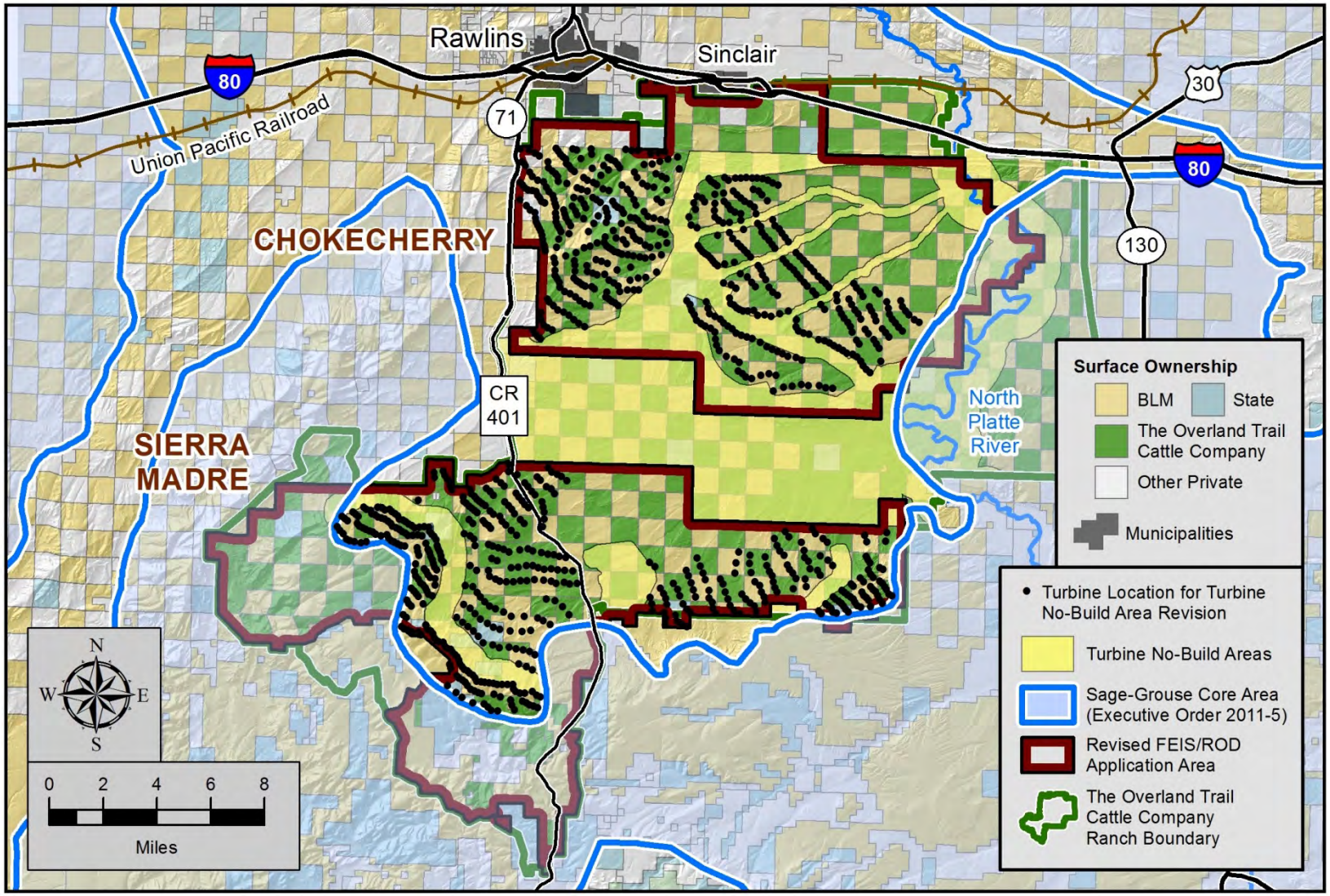


Figure 5.6. Revision 4: Turbine No-Build Areas – July 2012.

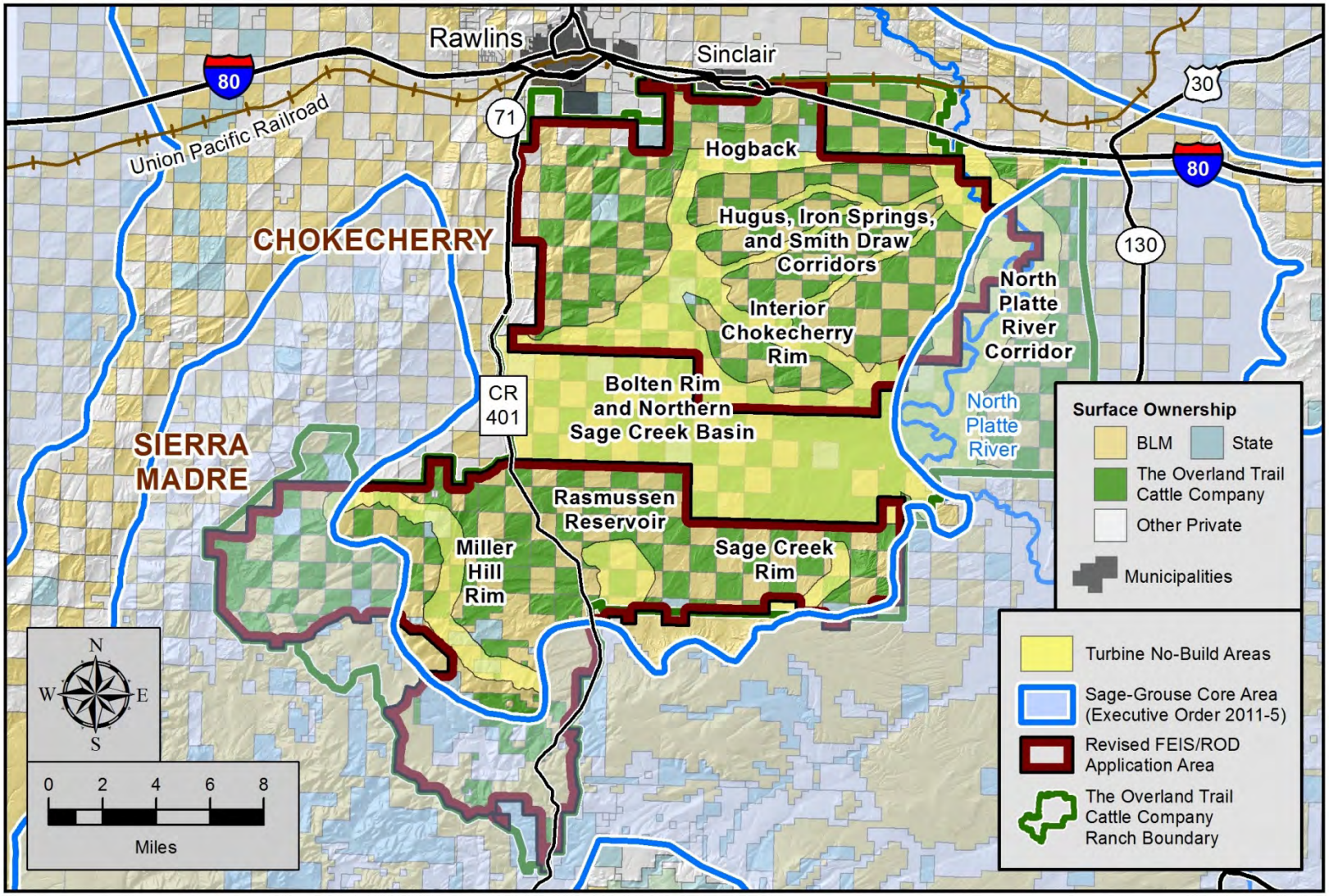


Figure 5.7. Turbine No-Build Areas for the CCSM Project.

Bolten Rim and Northern Sage Creek Basin

A Turbine No-Build Area was designated from the Bolten Rim south to the northern extent of the Sierra Madre WDA and from the Bolten Rim north into adjacent portions of the Chokecherry WDA. *See Figure 5.7.* This Turbine No-Build Area was developed based on survey observations made during long-watch raptor surveys and radar observations of golden eagle use surrounding occupied nests along the Bolten Rim. Observations of golden eagle use surrounding occupied nests on the Bolten Rim demonstrate that the majority of use occurs in the Turbine No-Build Area south of the Bolten Rim where raptor prey resources, perching locations, and suitable soaring conditions are present. The observations are consistent with the observed use of raptors using the Bolten Rim for nesting and perching opportunities.

The Bolten Rim and Northern Sage Creek Basin Turbine No-build Area consists of intact tracts of salt-desert shrub, sagebrush steppe, upland grassland, open water reservoirs, and agricultural pastures. These vegetation communities provide suitable habitat for most migratory bird and bat species of concern that occur within the CCSM Project Site. *See Section 4.3.1.* The Bolten Rim also provides suitable nesting and perching substrate for a number of raptor species; known nesting areas of white-throated swifts and cliff swallows; and potential roost locations for crevice-roosting bats. Designation of the Turbine No-Build Area conserves habitat for the majority of the migratory bird and bat species of concern listed in Table 1.1 and Table 1.2.

South of the Bolten Rim, the Turbine No-Build Area is 5- to 6-kilometers (3- to 4-miles) wide to avoid placement of wind turbines in the highest quality raptor foraging locations identified within the CCSM Project Site and near reservoirs used by waterbird/ waterfowl species. The area south of the Bolten Rim contains the highest density white-tailed prairie dog colonies within the Ranch and three reservoirs (Kindt, Sage Creek, and Teton) that are used by multiple waterbird/ waterfowl species throughout much of the year. *See PCW 2015a. See Section 4.4.1.* Avoiding placement of wind turbines near the reservoirs will reduce impacts to the waterbird/ waterfowl species that use the reservoirs and surrounding areas for migration and nesting activities. In addition, this area provides a suitable, wide flight/movement corridor from Atlantic Rim and Miller Hill to the North Platte River.

Along the eastern half of the Bolten Rim to the north, the Bolten Rim and Northern Sage Creek Rim Turbine No-Build Area provides a 1600- to 2400-meter-wide (1- to 1.5-mile-wide) setback from the rim. Along the western half of the Bolten Rim to the north the Turbine No-Build Area provides a 800- to 3200-meter-wide (0.5- to 2-mile-wide) setback. The setbacks north of the rim avoid and minimize risks to identified nests and nesting substrates for raptors and cliff-dwelling migratory birds and bats. The setbacks also avoid and minimize impacts to species that may use the Bolten Rim for soaring, kiting, perching, or foraging activities. This setback also benefits the other migratory bird and bat species that utilize the habitats contained in this Turbine No-Build Area.

Hogback

A Turbine No-Build Area was designated along the hogback feature north of Chokecherry WDA. *See Figure 5.7*. PCW's Original Proposed Action identified wind turbine locations in this area. During raptor nest and avian use surveys of the CCSM Project Site several occupied raptor nests were identified along the hogback. This Turbine No-Build Area minimizes risks to nesting raptors and other migratory birds and bats by removing the potential for wind turbine development in this area.

In addition to avoiding and minimizing impacts to raptors, this Turbine No-Build Area conserves habitat for many of the migratory bird and bat species of concern listed in Table 1.1 and Table 1.2. Vegetation communities in this Turbine No-Build area consist of salt-desert shrub, sagebrush steppe, upland grassland, barren/sparsely vegetated, and disturbed/developed areas. These vegetation communities provide suitable habitat for many of the upland avian species that occur within the CCSM Project Site, including the passerines and raptors listed in Table 1.1 as well as long-billed curlew and mountain plover. The area also provides potential roost locations for crevice-roosting bats.

Interior Chokecherry Rim

Long-watch raptor surveys identified that raptor use immediately west of the Interior Chokecherry Rim was substantially higher relative to other areas of the CCSM Project Site. The aspect of the Interior Chokecherry Rim is west to southwest and, as that is the predominant wind direction at the CCSM Project Site, the rim provides suitable topography to create uplift and slope-soaring conditions for movement through the Chokecherry WDA. The designation of a Turbine No-Build Area in the 1200- to 3200-meter-wide (0.75- to 2-mile-wide) corridor west and southwest of the Interior Chokecherry Rim provides connectivity to the area north of the Chokecherry WDA, the North Platte River corridor, and the Turbine No-Build Areas adjacent to the Bolten Rim; thus, providing for the use of this contiguous area as a flight/movement corridor. *See Figure 5.7*.

While this Turbine No-Build Area primarily benefits raptors, the avoidance of wind turbine development in the sagebrush steppe and upland grassland habitats adjacent to the Interior Chokecherry Rim will protect and conserve other migratory bird species that use these habitats. Additionally, the width of the corridor provides a substantial movement and migration corridor through the Chokecherry WDA for all migratory bird and bat species.

North Platte River Corridor

While this Turbine No-Build Area is outside of Phase I, PCW has committed to not construct wind turbines within 1600 meters (1 mile) of the North Platte River. Surveys have identified that the North Platte River corridor provides nesting habitat for a number of raptor, migratory bird, waterbird/ waterfowl, and bat species. This corridor provides the only forested riparian habitat in the vicinity of the CCSM Project. This habitat type provides nesting, foraging, and migratory habitat for a number of avian species, including the raptor, bat, and waterbird/ waterfowl species listed in Table 1.1 and Table 1.2. In addition, the cliff habitats adjacent to the river provide suitable nesting substrate for raptors as well as several migratory bird species including cliff swallows and white-throated swifts. *See Figure 5.7*. Finally, the forested riparian habitat and cliff habitat within this Turbine No-Build Area also provides suitable habitat for tree-roosting bat species and crevice-roosting bat species, as well as the highest quality foraging habitat for bats in the vicinity of the CCSM Project.

Hugus, Iron Springs, and Smith Draw Corridors

While this Turbine No-Build Area is outside of Phase I, data collected during long-watch raptor surveys indicate that raptors periodically use the areas immediately over Smith, Iron Springs, and Hugus draws to move between the Interior Chokecherry Rim and the North Platte River corridor. To reduce potential impacts, PCW has designated a 250-meter-wide area on either side of each draw as a Turbine No-Build Area to provide contiguous flight/movement corridors between the North Platte River and Interior Chokecherry Rim. *See Figure 5.7*. In addition to protecting raptors, this Turbine No-Build Area conserves habitat for a number of migratory bird species that use the sagebrush steppe and salt-desert shrub habitats located along these ephemeral drainages. These habitat types provide suitable nesting and foraging habitat for sagebrush-obligate bird species as well other migratory birds in the CCSM Project Site.

Miller Hill Rim

The area 1,200 to 1,600 meters (0.75 to 1 mile) east and north of Miller Hill Rim was designated as a Turbine No-Build Area to avoid and minimize impacts to raptors and other migratory bird and bat species that use mountain shrub and aspen-mixed conifer habitats. *See Figure 5.7*. The corridor adjacent to Miller Hill Rim also provides a flight/movement corridor between areas south of the CCSM Project in greater sage-grouse Core Areas with the Atlantic Rim and other areas north of the CCSM Project. Because prevailing winds are from the west and southwest, Miller Hill Rim does not provide suitable uplift and slope-soaring conditions for raptors except in the rare event of winds from the east and north. In addition to providing flight corridors through the CCSM Project Site, the Miller Hill Rim Turbine No-Build Area also conserves the aspen/mixed conifer woodland, mountain shrub, sagebrush steppe, and other habitats adjacent to Miller Hill. These habitats provide suitable nesting and foraging conditions for a number of migratory bird species, including American robin, black-capped chickadee, dark eyed junco, green-tailed towhee, northern flicker, American goldfinch, mountain bluebird, and rock wren, and the bat species listed in Table 1.2. *See Section 4.2.1.*

Rasmussen Reservoir

While the area surrounding Rasmussen Reservoir is outside of Phase I, a 2.4- to 3.2-kilometer-wide (1.5- to 2-mile-wide) Turbine No-Build Area was established south of the reservoir to provide a foraging and flight/movement corridor for nesting bald eagles. *See Figure 5.7*. While originally designated for the benefit of bald eagles, the designation of this corridor also benefits other raptor and migratory bird species. Waterbird/ waterfowl surveys at Rasmussen Reservoir identified more than 30 species of waterbird/ waterfowl that use the reservoir for migration, foraging, or nesting. *See Section 4.4.1.*

Sage Creek Rim

While this area is outside of Phase I, PCW established a Turbine No-Build Area north of the Sage Creek Rim to maintain a flight/movement corridor that was observed during raptor use surveys. *See Figure 5.7*. During 2011 and 2012 long-watch raptor surveys, flight path data indicated that a corridor 800- to 1200-meters (0.5- to 0.75-mile) wide north of the Sage Creek Rim was consistently used by raptors moving from the west to the east along the southern edge of the Sierra Madre WDA. The aspect of the Sage Creek Rim faces to the northwest and provides potential soaring opportunities as the predominantly southwesterly and westerly winds interact with this topographic feature. In addition to providing protections for raptors, this Turbine No-Build Area also conserves mountain shrub and salt-desert shrub habitats; these habitats provide nesting and foraging opportunities for a number of migratory bird species in the CCSM Project Site.

5.1.7 Revision 5, Initial Phase I Site-Specific Plan of Development - April 2013

As described in chapter 1.0 of this Phase I BBCS, BLM's ROD outlined a specific process in which PCW will submit site-specific PODs to BLM for subsequent tiered NEPA analysis. In compliance with this process, PCW divided the CCSM Project into two phases for final design and subsequent analysis. For purposes of developing the site-specific PODs for Phase I, PCW again revised the wind turbine layout for the CCSM Project to create the initial wind turbine layout for Phase I. Revision 5 to the layout incorporated the Turbine No-Build Areas and all of the requirements set out in BLM's ROD. The Revision 5 layout also considered the most recent environmental data and information for Phase I, including the most recent migratory bird and bat survey data.

Revision 5 to the wind turbine layout incorporated appropriate avoidance and minimization measures related to migratory bird and bat use areas, the terms and conditions of Carbon County's Conditional Use Permit for the CCSM Project, and the USFWS avoidance and minimization recommendations received prior to the revision. *See Figure 5.8.*

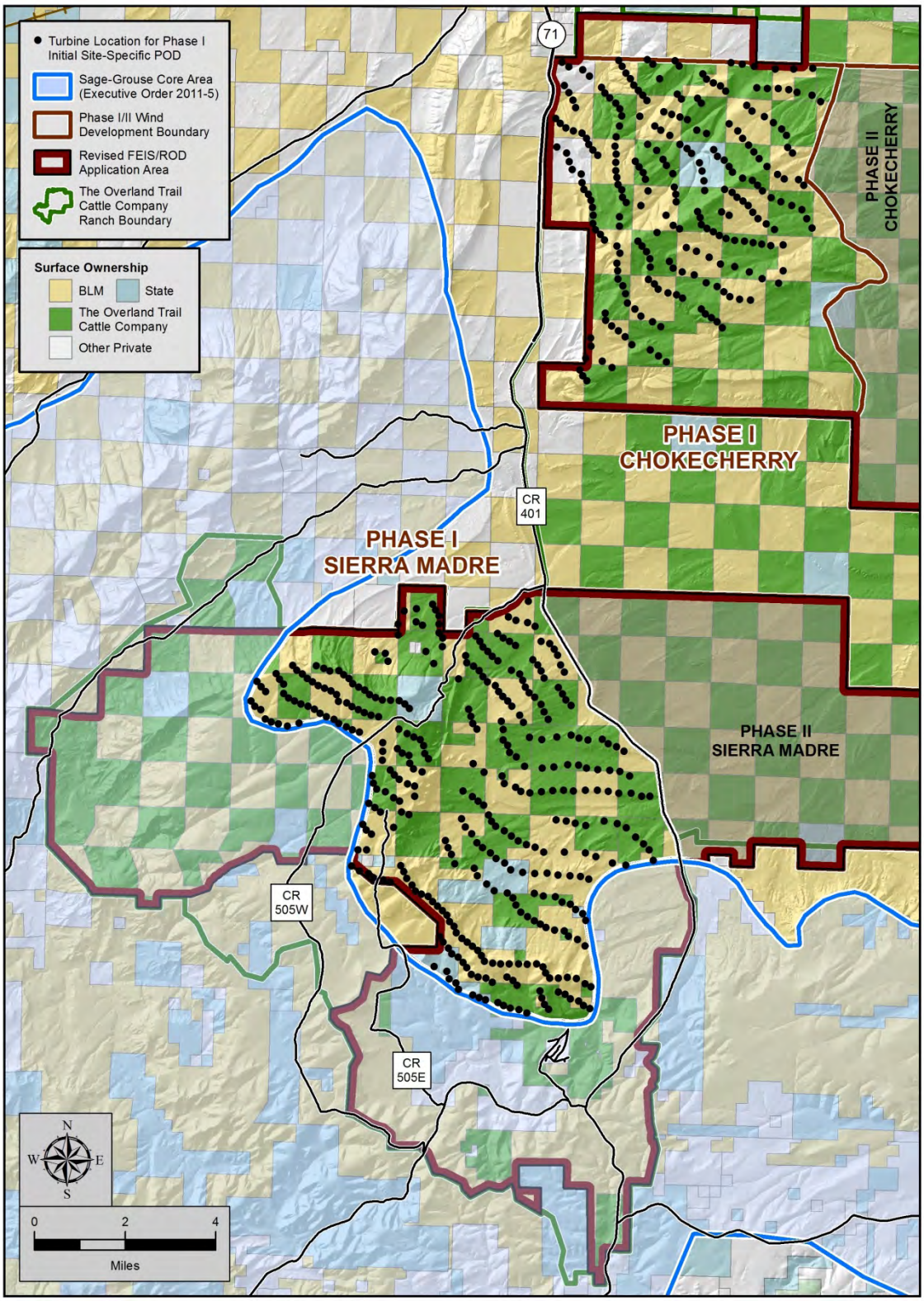


Figure 5.8. Revision 5: Initial Phase I Site-Specific Plan of Development – April 2013.

5.1.8 Revision 6, Final Phase I Site-Specific Plan of Development – January 2014

Revision 5 of the Phase I wind turbine layout was the basis for PCW's micrositing process and pre-construction surveys for Phase I. *See Section 3.1.1.* Beginning in April 2013, PCW conducted engineering field reviews and pre-construction surveys for BLM sensitive species and USFWS threatened and endangered species, Class III cultural resource surveys, and soil, vegetation and aquatic surveys for Phase I, as well as other required pre-construction surveys and inventories. Concurrent with micrositing and pre-construction surveys, PCW continued to work with USFWS and BLM through the remainder of 2013 to refine the Phase I wind turbine layout. In January 2014, PCW revised the Phase I wind turbine layout again. Through the application of additional avoidance and minimization measures designed to reduce risk to migratory birds and bats, PCW incorporated the best available scientific data, including the extensive migratory bird and bat survey data collected for Phase I. *See Chapter 4.0*. Over 110 of the 500 Phase I wind turbines were moved to new locations within Phase I to address USFWS and BLM requirements and recommendations. *See Figure 5.9.* The final Phase I wind turbine layout represents the culmination of the extensive data collection and avoidance and minimization effort for Phase I that began in 2008.

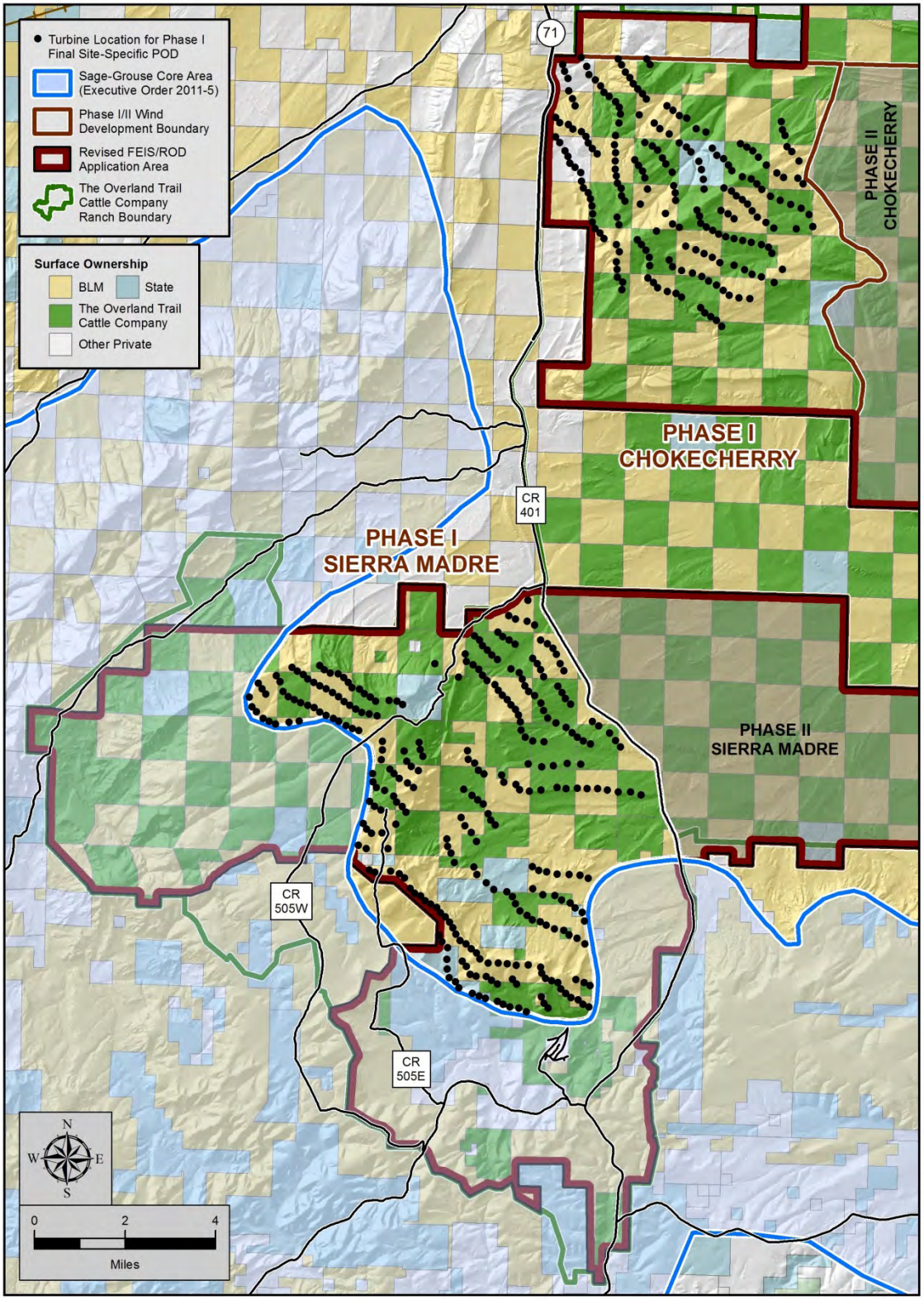


Figure 5.9. Revision 6: Final Phase I Site-Specific Plan of Development – January 2014.

5.2 Best Management Practices and Avoidance, Minimization, and Conservation Measures

In accordance with the USFWS Wind Energy Guidelines and the WGFC Wind Energy Recommendations, PCW has developed BMPs and site- specific avoidance, minimization, and conservation measures for Phase I, including federal, state, and private lands.

Collectively, these measures will reduce risks to migratory birds and bats from Phase I to the extent practicable. It is expected that over the life of Phase I, additional BMPs and conservation measures will be developed. As such, post-construction monitoring and adaptive management will be employed to evaluate the effectiveness of the Phase I BMPs and avoidance, minimization, and conservation measures. Based on the monitoring results, PCW may implement new measures and adjust existing measures as appropriate. *See Chapter 6.0*.

5.2.1 Site-specific Avoidance and Minimization Measures

PCW has developed extensive measures to avoid and minimize risks to migratory birds and bats from Phase I. These include: (1) measures identified in BLM's ROD for the CCSM Project; (2) other project-specific measures to address the risk to migratory birds and bats from the Phase I; and (3) measures to avoid and minimize risks to bald and golden eagles, many of which also provide a benefit to migratory birds and bats. *See PCW 2015a.* Together, these measures avoid and minimize risks to migratory birds and bats from Phase I to the extent practicable.

BLM Record of Decision Avoidance and Minimization Measures

As described in PCW's site-specific PODs, PCW will comply with the avoidance, minimization, and mitigation measures identified in BLM's ROD for the CCSM Project. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*. Many of the avoidance, minimization and mitigation measures included in the ROD were developed for the benefit of migratory birds and bats, including measures in the following categories:

- Timing stipulations to avoid impacts during sensitive time periods, e.g. nesting seasons
- Spatial stipulations to avoid impacts in sensitive locations, e.g. nest locations
- Measures to avoid impacts to sensitive habitats, e.g. wetland and riparian avoidance areas
- Measures to minimize project impacts, e.g. infrastructure collocation.

PCW has reviewed the BLM Environmental Constraints, Applicant Committed Measures, Applicant Committed Best Management Practices, and Proposed Mitigation Measures included in the ROD to identify those measures that provide a benefit to migratory birds and bats. *See BLM 2012a at App. D.* PCW has identified these measures and described their benefits to migratory birds and bats in Appendix I. Adherence to the avoidance, minimization, and mitigation measures identified in BLM's ROD will substantially avoid and minimize impacts to migratory bird and bat species. *See Appendix I.*

The BLM Environmental Constraints, Applicant Committed Measures, Applicant Committed Best Management Practices, and Proposed Mitigation Measures (collectively, BLM Measures) were designed to address BLM requirements. *See Appendix I.* PCW will apply the BLM Measures applicable to migratory birds and bats to all lands regardless of ownership or jurisdiction, where practicable, provided that, for non-federal lands and lands under the jurisdiction of an agency other than the BLM, if a landowner or agency requests different or conflicting measures or actions on such lands it owns or manages, the specific BLM Measures shall not apply. In the event that the BLM Measures are not applied, PCW will identify alternative mitigation measures to protect migratory birds and bats.[37] Such measures may include monitoring of active nests to insure that take does not occur; alternate timing or spatial restrictions to prevent take of migratory birds, removal of nest substrate outside the migratory bird nesting season, or measures to discourage nesting on human-constructed structures and facilities.

Other Project-Specific Measures to Address the Risk to Migratory Birds and Bats from Phase I

PCW has identified additional avoidance and minimization measures and BMPs to address risks to migratory birds and bats from Phase I, including project construction, operation and maintenance, and the overhead electrical system. Risks to migratory birds and bats from Phase I may include collision, electrocution, habitat loss and degradation, habitat fragmentation, displacement and behavioral changes, and various indirect effects. *See Section 4.1.* PCW will implement the following measures to avoid and minimize these risks to migratory bird and bat species from Phase I:

1. *APLIC Recommendations*

Though overhead electric power lines and associated facilities may provide some benefit to migratory bird species by providing increased perching, roosting and nesting opportunities, the addition of an overhead electric power system also creates risks to migratory birds. *See Section 4.1.* This Phase I BBCS incorporates the applicable recommendations in the APLIC APP Guidelines. *See APLIC 2005.* In addition, the Phase I overhead electrical system, including its substations, is designed to meet APLIC recommendations by ensuring there is sufficient separation between components and that appropriate insulating or isolating measures are applied. *See APLIC 2006; APLIC 2012.*

PCW will construct and maintain its overhead electrical system in accordance with all applicable APLIC construction recommendations and suggested practices. *See APLIC 2006; APLIC 2012*. More specifically, as recommended by APLIC, PCW will use the following general construction guidance for the Phase I overhead electrical system:

[37] Measures to protect eagles are included in the Phase I ECP. PCW has not identified any threatened or endangered migratory bird or bat species within Phase I. In the event threatened or endangered migratory bird and bat species are identified within Phase I, and the construction, operation or maintenance of Phase I may affect these species, PCW will consult with the USFWS.

- The overhead electrical system will be designed to meet National Electric Safety Code (NESC) requirements with specialized construction designs for avian use areas.
- The overhead electrical system will be designed to prevent electrocutions by providing adequate conductor separation distances appropriate to the largest species expected in Phase I.[38] When this is not feasible, insulation or isolating measures will be used, e.g. insulator/conductor covers, bushing covers, arrester covers, cutout covers, and jumper wire cover.
- The Phase I overhead electrical system equipment will include bushing covers and covered jumpers.
- The Phase I overhead electrical system arresters and cutouts will be installed with wildlife caps and covered jumpers.
- The Phase I overhead electrical system primary jumpers that do not meet separation requirements will be covered with insulation.

2. Flight Diverters and Line Markers

In areas posing a high-risk for avian collisions (e.g., near open bodies of water, wetlands, nesting habitats, ridgelines) or in areas of high collision mortality identified through post-construction monitoring, PCW will install flight diverters or line markers on overhead electric power lines as appropriate.

3. Vegetation Removal

In areas necessary for construction, or in areas requiring vegetation disturbance as part of operations and maintenance activities, during the active migratory bird breeding season (March through mid-August) vegetation that might support migratory bird nesting activities will be surveyed by a qualified biologist not more than 7 days prior to the vegetation disturbance activity to determine if active nests of any bird species are present within the work area. If no migratory bird nests are found during these surveys, then the activity will proceed as planned. If an active nest is present, then PCW will implement appropriate nest management measures even if the active nest is discovered after the activity is initiated. *See Figure 5.10 and Project-specific Avoidance and Minimization Measure #4.* Alternatively, PCW may remove vegetation outside the active migratory bird breeding season to minimize the likelihood of nest establishment and impacts during construction activities.

[38] Golden eagles are the largest avian species in the vicinity of Phase I. Separation distances recommended for golden eagles are currently 60 inches of horizontal separation and 40 inches of vertical separation for phase-to-phase and phase-to-neutral (or phase-to-ground). These separation distances were developed for eagles with dry feathers.

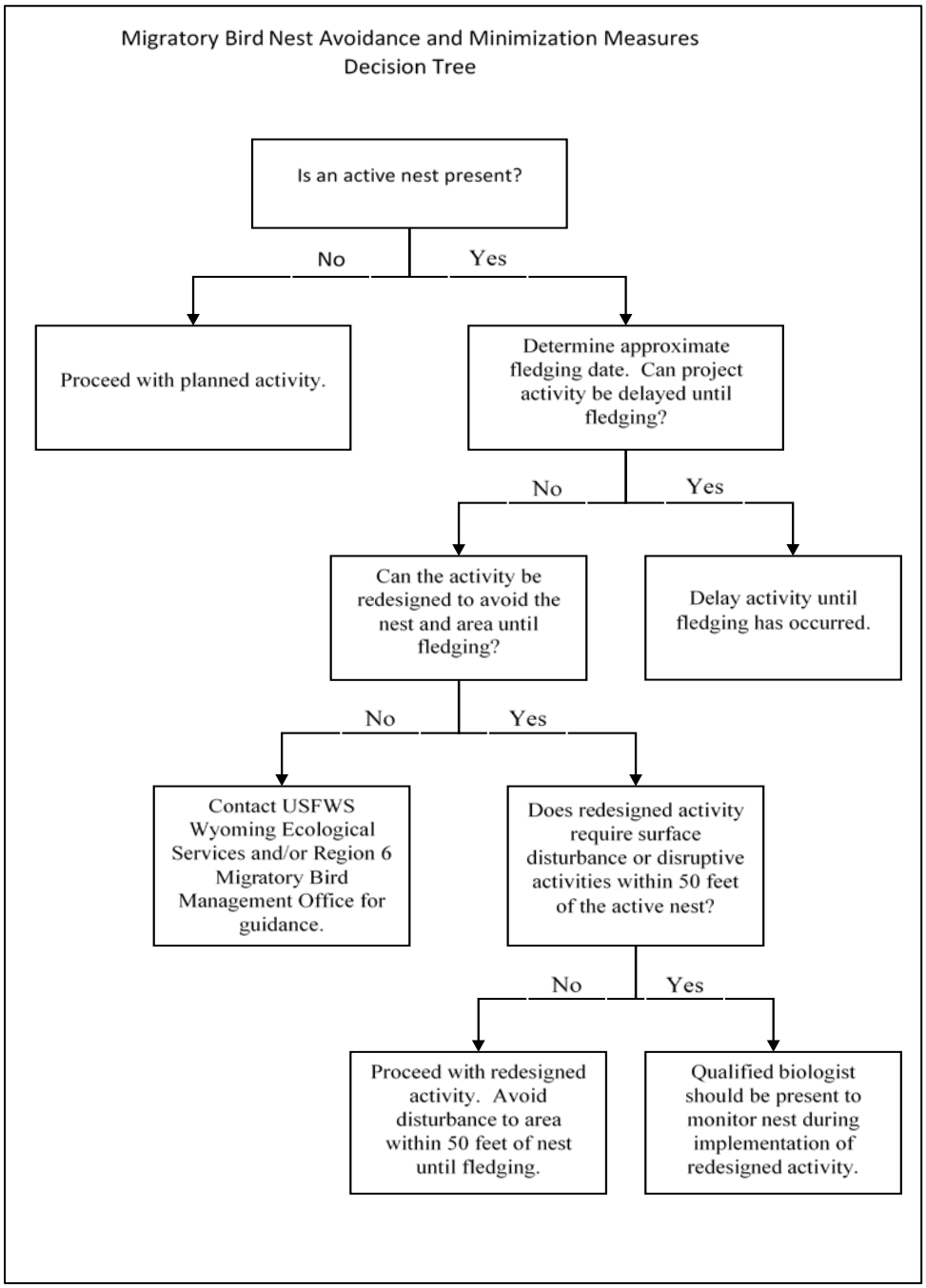


Figure 5.10. Application of Migratory Bird Nest Avoidance and Minimization Measures.[39]

[39] Where species-specific or nest-specific buffers have been identified through the Phase I ECP, BLM Record of Decision, or other project commitments, the species-specific or nest-specific buffers will be applied in lieu of the 50-foot-buffer.

4. Nest Management

PCW has incorporated nest management measures in this Phase I BBCS to properly manage nests to avoid and minimize risks to migratory birds for all lands in Phase I. All migratory birds and their active nests are legally protected under the MBTA. During the active migratory bird breeding season (March through mid-August), PCW will survey all areas requiring vegetation disturbance as a part of construction, operations and maintenance activities not more than 7 days prior to the vegetation disturbance activity to determine if active nests of any bird species are present within the work area. If no migratory bird nests are found during these surveys, then the activity will proceed as planned. If an active nest is present, then PCW will implement appropriate nest management measures even if the active nest is discovered after the activity is initiated. *See Figure 5.10.* Alternatively, PCW may remove vegetation outside the active migratory bird breeding season to minimize the likelihood of nest establishment and impacts during construction activities.

For nest management, it is important to determine which species built the nest and whether the nest is active. The MBTA does not clearly define what an active nest is. This being the case, it is left to qualified biologists to determine what constitutes an active nest. For the purposes of applying the avoidance and minimization measures in this Phase I BBCS, a nest will be considered active if it contains eggs or young, and its formal status will remain active as long as adults, viable eggs, and/or living young are present at the nest. A nest may be abandoned, fail, or fledge young and become inactive during the breeding season. *See USFWS 2003.*

PCW will manage migratory bird nests for Phase I overhead electric power lines, wind turbines, and other project infrastructure in compliance with MBTA. Inactive nests may be removed and/or destroyed in compliance with the MBTA, unless they are nests of federally-listed species or eagles. When possible, PCW will manage nests between late-August and early-January. If nest management is not possible during this period, PCW will have the nest checked by a qualified biologist as appropriate to determine whether the nest is active. If active, nest management decisions will be made following the Migratory Bird Nest Avoidance and Minimization Measures. *See Figure 5.10*. These measures are consistent with USFWS Region 6 recommendations "Migratory Bird Conservation Actions for Projects to Reduce the Risk of Take during the Nesting Season." *See USFWS 2014.*

5. Nest Removal

Removal of active nests is unlikely and will only occur under conditions where there are concerns for human health and safety, safety of the nesting bird, or potential damage to project infrastructure. PCW will address the need for removal of active problem nests on a case-by-case basis and as authorized by the USFWS. As needed, inactive nests will be removed from project infrastructure between late-August and early-January to dissuade birds from re-nesting.

Phase I ECP Avoidance and Minimization Measures

As described in the Phase I ECP, PCW and USFWS have worked cooperatively since 2010 to avoid and minimize impacts to bald and golden eagles from Phase I. USFWS provided PCW with detailed avoidance and minimization recommendations for Phase I and PCW developed appropriate site-specific measures to address those recommendations in the Phase I ECP. Many of the avoidance and minimization measures developed by PCW to reduce risks to bald and golden eagles also provide benefits to migratory bird and bat species that use the same nesting substrates, habitats, foraging areas, and topographic features. *See Table 5.1.* In addition, the wind turbine avoidance areas established in the Phase I ECP include habitats used by other migratory bird and bats species, e.g. sagebrush steppe, salt-desert shrub, and upland grassland habitats. The benefits to migratory birds and bats from the wind turbine avoidance areas established in the Phase I ECP are captured in the discussion of the Phase I risk avoidance and minimization process in section 5.1 and are further detailed in Table 5.1. Please refer to the Phase I ECP for a more detailed discussion of the Phase I ECP avoidance and minimization measures. *See PCW 2015a.*

Table 5.1. Phase I ECP Avoidance and Minimization Measure Benefits to Migratory Birds and Bats

Measure or Type of Measure	Description of Measure	Benefits to migratory birds and bats
Eagle Nest-specific Measures	Measures include seasonal curtailment strategies and identification of nest buffers in which no turbines would be constructed that are specific to individual eagle nests or territories.	Benefits avian and bat species using areas surrounding the specific eagle nests for which site-specific avoidance and minimization measures have been identified. Specific benefits are expected for non-eagle raptors, other avian species, and bats that nest, roost, or forage along cliff bands associated with eagle nests and territories.
Occupied Nest Measures	Measures include seasonal curtailment strategies used when nest-specific or territory-specific measures have not been identified.	Benefits avian species using areas surrounding occupied eagle nests. Specific benefits are expected for non-eagle raptors, other avian species, and bats that nest, roost, or forage along cliff bands associated with eagle nests and territories.
Unoccupied Nest Measures	Measures include seasonal curtailment strategies used when nest-specific or territory-specific measures have not been identified.	Benefits avian species using areas surrounding unoccupied eagle nests. Specific benefits are expected for non-eagle raptors, other avian species, and bats that nest, roost, or forage along cliff bands associated with eagle nests and territories.
Prey Resource Areas	Twenty-eight turbines were removed from a portion of Phase I Sierra Madre where eagle foraging activities or opportunities were identified.	Benefits avian species using identified areas as prey resources. The habitats contained within the prey resource areas primarily consist of sagebrush steppe, upland grasslands, barren slopes, and salt desert shrub. Removal of turbines from this area will benefit foraging raptors that utilize the same prey resources as well as other bat and avian species (including sagebrush obligates, mountain plover, loggerhead shrike, and other species of interest) that use these habitats for foraging, breeding and migratory purposes.
Miller Hill Rim Activity Area	Turbines were set back from the rim of Miller Hill to reduce collision potential for avian species utilizing the habitats along the rim as well as the movement corridor provided by the Miller Hill Rim Turbine No-Build Area	Benefits avian and bat species using habitats along the rim and immediately under the rim of Miller Hill in Phase I. Habitats in this area include upland grasslands, barren slopes, aspen mixed-conifer woodlands, sagebrush steppe, and mountain shrub communities. Species utilizing these habitats and specifically benefiting from this measure include, but are not limited to, raptors, sagebrush obligates, and forest and montane ecosystem specialists.

Measure or Type of Measure	Description of Measure	Benefits to migratory birds and bats
McKinney Creek Activity Area	Four turbines were removed immediately south of the Miller Hill Road in the headwaters of McKinney Creek to provide a movement corridor between undeveloped portions of Miller Hill, the Miller Hill Turbine No-Build Area, and greater sage-grouse Core Areas	Benefits avian and bat species using the Miller Hill Road as a movement corridor, sagebrush steppe habitats on Miller Hill, and habitats along the rim and immediately under the rim of Miller Hill in Phase I. Habitats in this area include upland grasslands, barren slopes, aspen mixed-conifer woodlands, sagebrush steppe, and mountain shrub communities. Species utilizing these habitats and specifically benefiting from this measure include, but are not limited to, raptors, sagebrush obligates, and forest and montane ecosystem specialists.
Lower Miller Hill	Fourteen turbines were removed from areas identified as having eagle and raptor soaring and kiting activities along slopes in the Lower Miller Hill portion of Phase I.	Benefits are primarily to raptors and other avian species that use the same features for soaring and kiting activities. Also benefits other avian and bat species using the habitats within the area for breeding, foraging, or migratory activities.
Eagle Activity Area	Seventeen turbines were removed from an area north of Miller Hill in Phase I where eagle activity was observed during pre-construction survey efforts.	Area is adjacent to the Miller Hill Rim Turbine-No Build area and will benefit all avian and bat species using the corridor provided by that area. Also benefits avian and bat species using the area for foraging, nesting, or migration activities. Habitats in this area include upland grasslands, barren slopes, aspen mixed-conifer woodlands, sagebrush steppe, and mountain shrub communities. Species utilizing these habitats and specifically benefiting from this measure include, but are not limited to, raptors, sagebrush obligates, and forest and montane ecosystem specialists.
Infrastructure Avoidance and Minimization Measures	Avoidance and minimization measures were developed for the North Platte River Water Extraction Facility, the Road Rock Quarry, and the Phase I Haul Road and Transmission Lines where these facilities are proximate to certain eagle nests.	Benefits avian species using areas surrounding the specific eagle nests included in the measure. Specific benefits are expected for non-eagle raptors, other avian species, and bats that nest, roost, or forage along cliff bands associated with eagle nests and territories.

5.2.2 Best Management Practices

Chapter 7 of the USFWS Wind Energy Guidelines and Appendix A of the WGFC Wind Energy Recommendations provide a list of standard BMPs for wind energy projects. As noted by USFWS and WGFC, these BMPs are not applicable to every wind project; instead, they are intended to be applied based on site-specific data and project characteristics. PCW has reviewed the USFWS and WGFC recommended BMPs and has incorporated the applicable recommendations into Phase I as described below.

USFWS Construction and Operation BMPs

In accordance with chapter 7 of the USFWS Wind Energy Guidelines, PCW has incorporated BMPs for construction and operation into Phase I. *See USFWS 2012a.* The implementation of these BMPs will reduce potential impacts to migratory bird and bat species. As recommended by USFWS in the Wind Energy Guidelines, PCW has developed the following BMPs benefitting migratory bird and bat species for Phase I: [40]

1. PCW has minimized, to the extent practicable, the area disturbed by pre-construction site monitoring and testing activities and installations.

2. PCW has avoided locating wind energy facilities in areas identified as having a demonstrated and un-mitigatable high risk to migratory birds and bats.

3. PCW has used available data from state and federal agencies, specifically BLM, WGFD and USFWS, to identify sensitive resources and establish the layout of roads, power lines, fences, and other infrastructure.

4. PCW has minimized, to the extent practicable, roads, power lines, fences, and other infrastructure. PCW will use wildlife compatible design standards for fencing, e.g. chain link security fencing around hazards with 3- or 4-strand barbed wire fencing with smooth wire on the bottom used in all other areas.

5. PCW will use native species when seeding or planting during reclamation in compliance with the Reclamation Plans for Phase I. *See PCW 2015b.*

6. PCW has located collection system power lines underground and away from high bird crossing locations (i.e., between roosting and feeding areas or between lakes, rivers, prairie grouse and sage grouse leks, and nesting habitats) to the extent practical. All overhead power lines for Phase I are designed to meet APLIC recommendations. *See APLIC 2006; APLIC 2012*.

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[40] The numbering of this BMP list corresponds to the numbering of the BMP recommendations in chapter 7 of the USFWS Wind Energy Guidelines. *See USFWS 2012a at pp.49:51.*

7. All permanent meteorological and communication towers for Phase I will be self-supporting, i.e. not guyed. *See PCW 2015b.*

8. PCW has designed Phase I to include the minimum number of permanent meteorological towers necessary.

9. PCW will use construction and management practices that minimize activities that may attract prey and predators. *See Appendix I.*

10. Lighting of Phase I wind turbines will meet FAA requirements and will likely consist of medium intensity synchronized red LED lights. Only a portion of the wind turbines will be lit. *See PCW 2015b.*

11. Exterior lighting at operation and maintenance facilities and substations for Phase I will be shielded downward and is designed to use a combined switch and motion-detection system for exterior lights to minimize the time the lights are on while providing adequate safety for personnel. All internal wind turbine nacelle and tower lighting will be used only when personnel are inspecting or maintaining the wind turbine. *See PCW 2014c; PCW 2015b.*

12. PCW has designed Phase I to comply with the spatial and timing stipulations required by BLM in the ROD. These stipulations address sensitive habitats and species. *See Appendix I.*

13. PCW has designated Turbine No-build Areas to provide flight/movement corridors for migratory bird and bat species.

14. PCW has created an Erosion Control Plan and a preliminary Stormwater Pollution Prevention Plan for Phase I. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

15. PCW will use tubular wind turbine towers to reduce ability of birds to perch and to reduce risk of collision. *See PCW 2015b.*

16. PCW has agreed to work with BLM and TOTCO to close unnecessary roadways and reclaim such roads where practicable. *See Appendix I.*

17. PCW has minimized the number, size, and length of Phase I roads to the extent practicable. *See Appendix I.*

18. PCW has designed Phase I to minimize impacts to wetlands and waters of the U.S. *See Appendix I.*

19. PCW will instruct personnel to drive at appropriate speeds, be alert for wildlife, and use additional caution in low visibility conditions.

20. All employees, contractors, and site visitors will receive a site orientation during which they will be instructed to avoid harassment and disturbance of wildlife. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

21. PCW will comply with fire prevention standards and will develop a fire safety plan to reduce fire hazard from vehicles and human activities. The health and safety plan will address measures to be taken in the event of a wildfire. *See Appendix I.*

22. PCW will develop a hazardous material management plan as part of the health and safety plan. This plan will address employee training and spill response procedures. *See Appendix I.*

23. PCW has developed a weed management plan for Phase I that will reduce the introduction and spread of invasive species. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

24. PCW will comply with all applicable rules and regulations for invasive species control.

25. PCW has developed a waste management plan for Phase I that includes appropriate good housekeeping procedures. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

26. PCW will promptly remove large animal carcasses from Phase I (e.g. big game, domestic livestock, or feral animal). Where feasible, carcass removal will occur within 24-48 hours of discovery. Carcasses may be buried to reduce risk for accidental wildlife exposures to contaminants if poisoning or shooting is suspected as the cause of mortality.

27. PCW will not locate wildlife habitat enhancements or improvements such as ponds, guzzlers, rock or brush piles for small mammals, bird nest boxes, nesting platforms, wildlife food plots, etc. within Phase I.[41]

[41] In addition, PCW will not locate these habitat enhancements or improvements within Phase II.

USFWS Decommissioning BMPs

In accordance with chapter 7 of the USFWS Wind Energy Guidelines, PCW has incorporated best management practices for decommissioning and reclamation into Phase I. *See USFWS 2012a.* The use of these best management practices will reduce potential impacts to migratory bird and bat species. As recommended by USFWS in the Wind Energy Guidelines, PCW has developed the following BMPs benefitting migratory bird and bat species for Phase I: [42]

1. PCW will decommission Phase I to minimize new surface disturbance and minimize the removal of native vegetation, to the extent practicable. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

2. PCW will remove the pedestal portion of the wind turbine foundations. *See PCW 2015b.*

3. PCW has developed a Reclamation Plan for Phase I that addresses removal and storage of topsoil, as well as appropriate revegetation. *See PCW 2015b.*

4. PCW has developed a Reclamation Plan for Phase I that addresses soil stabilization and revegetation. *See PCW 2015b.*

5. PCW has developed a Reclamation Plan for Phase I that addresses landscape restoration, including hydrology. *See PCW 2015b.*

6. PCW has developed weed control plans that address the monitoring and control of noxious weeds. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*. In addition, the Reclamation Plan for Phase I includes monitoring during revegetation until reclamation standards are achieved. *See PCW 2015b.*

7. At the end of the CCSM Project, PCW will decommission unnecessary overhead power lines, including poles. *See PCW 2015b.*

8. PCW will install and monitor erosion control measures during reclamation in accordance with the Reclamation Plan for Phase I until reclamation standards are achieved. *See PCW 2015b.*

9. At the end of the CCSM Project, PCW will remove any unnecessary fencing. *See Appendix I.*

[42] The numbering of this BMP list corresponds to the numbering of the BMP recommendations in chapter 7 of the USFWS Wind Energy Guidelines. *See USFWS 2012a at p. 52.*

10. PCW has developed preliminary Spill Prevention Control and Countermeasures Plans for Phase I to address petroleum product releases. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*. These plans will be finalized prior to the commencement of Phase I construction. In addition, the Reclamation Plan and Waste Management Plan for Phase I address the proper disposal of unsuitable soil, including contaminated soil. *See PCW 2015b.*

WGFC Wind Energy Development BMPs

In accordance with Appendix A of the WGFC Wind Energy Recommendations, PCW has incorporated BMPs for wind energy development into Phase I. *See WGFC 2010 at App. A.* The implementation of these BMPs will reduce risks to migratory bird and bat species. *See WGFC 2010.* Many of the BMP recommendations for wind energy development included in the WGFC Wind Energy Recommendations are applicable to wildlife species other than migratory birds and bats. Only those BMPs that apply to migratory birds and bats are addressed in this section. As recommended by WGFC in the Wind Energy Recommendations, PCW has developed the following BMPs benefitting migratory bird and bat species for Phase I:

1. PCW has coordinated extensively with WGFD to assess risks and avoid and minimize potential impacts to migratory birds and bats from Phase I.

2. PCW has completed vegetation and habitat mapping as appropriate for Phase I.

3. PCW will post and enforce speed limits during construction, operation, maintenance, and decommissioning of Phase I. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

4. PCW will construct and maintain overhead electric lines in accordance with APLIC construction recommendations. *See APLIC 2006; APLIC 2012*. *See Section 5.2.1.*

5. PCW has designed Phase I roads to minimize stream crossings to the extent practicable.

6. PCW will use non-guyed meteorological towers for Phase I. *See PCW 2015b.*

7. PCW, in coordination with WGFD and USFWS, has determined appropriate wind turbine set-backs from topographic features for Phase I based upon site-specific data and information. *See Section 5.1.*

8. PCW has minimized the surface disturbance associated with the Phase I, including roads, fences and other ancillary features, to the extent practicable to meet the needs of the Phase I. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

9. PCW will install fencing and signage as needed to protect public safety and prevent unauthorized access. Existing public access to federal and state lands will remain unchanged. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

10. As described in this Phase I BBCS, PCW has designed Phase I to avoid and minimize migratory bird and bat collisions.

11. PCW has designed permanent lighting for ancillary facilities to be motion-activated and shielded downward. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

12. PCW will consult with existing landowners, BLM, and WGFD to evaluate the location and design of any proposed new fences for Phase I. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

13. PCW has incorporated appropriate timing and spatial stipulations into Phase I, as described in the CCSM Project ROD. *See BLM 2012b at App. D.*

14. PCW has inventoried noxious and invasive plants within Phase I and has developed a Weed Management Plan to control the spread of noxious and invasive plant species. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*.

5.2.3 Conservation Measures

In addition to site-specific avoidance and minimization measures and BMPs, PCW has developed conservation measures to further reduce impacts to migratory birds and bats from Phase I. These measures will reduce impacts by removing threats from wind turbines and other infrastructure, as well as reduce risks that could be associated with changes in the availability of habitat within Phase I. The following conservation measures have been incorporated into Phase I:

1. Land Management

PCW's affiliate, TOTCO, currently manages an agricultural operation consisting primarily of cattle grazing and hay production within the Phase I Development Area and in adjacent portions of the Ranch. TOTCO uses active livestock management to minimize impacts of grazing activities on wildlife and wildlife habitat. PCW and TOTCO have entered into an agreement to promote and maintain through collaborative efforts the availability and use of high quality habitat to sustain and enhance terrestrial and aquatic wildlife populations on the Ranch in conjunction with various land uses, including the continuation of ranching and other agricultural operations as well as development of the wind energy resource. *See Appendix H & J*. The commitments made by PCW and TOTCO in the Conservation Plan and Landowner Agreement include but are not limited to continuing active management of the Ranch with a goal of meeting the Wyoming Standards for Healthy Rangeland, implementing reclamation with the objective of ecosystem reconstruction, and implementing appropriate weed management. These commitments and the other measures

described in the Conservation Plan and Landowner Agreement will be implemented in coordination with BLM and WGFD and will reduce impacts to migratory birds and bats by conserving or enhancing habitat for the life of the CCSM Project, including Phase I.

2. Conservation Easement

PCW will forego installing wind turbines on about 27,500 acres of private land owned by TOTCO that is subject to a wind energy development agreement between PCW and TOTCO. Much of these private lands and the adjoining federal lands have some of the best wind resources in the entire Application Area and they had been proposed for wind energy development. Instead, in conjunction with the commencement of commercial operation of Phase I, PCW will join with TOTCO to place this land into a conservation easement. The conservation easement will prohibit in perpetuity wind development activities on the lands subject to the easement. While the conservation easement will be placed on the 27,500 acres of private land owned by TOTCO on which PCW has wind development rights, the easement will also effectively prevent wind energy development on the interspersed sections of federal land due to the checkerboard land ownership pattern. Therefore, the easement essentially protects approximately 48,000 acres of land. The easement is primarily located in high quality sagebrush steppe habitat located within greater sage-grouse Core Areas. *See Figure 5.11.* By prohibiting wind energy development in these areas, risk to sagebrush obligate bird species, raptors, and many other migratory bird and bat species and their habitats from wind energy development will be eliminated in perpetuity. As set forth in of the USFWS DEIS, when compared to other compensatory mitigation measures for birds (other than eagles), a wind conservation easement provides the greatest benefit to bird species (other than eagles) by preventing future injuries and fatalities from wind turbines. *See USFWS 2016a at Table 3-24.*

3. Sagebrush Steppe Habitat Conservation and Enhancement

PCW has implemented a Sage-Grouse Conservation Plan that provides for monitoring of greater sage-grouse within the Ranch and adjacent areas. *See BLM 2012a, App. B at App. N.* PCW's Sage-Grouse Conservation Plan includes conservation measures that will improve habitat and minimize and/or reduce potential threats to greater sage-grouse and other wildlife species. The measures included in the Sage-Grouse Conservation Plan are designed to conserve greater sage-grouse populations and habitat; however, they also have direct benefits to migratory birds and bats by maintaining/restoring contiguous habitat patches, conserving and promoting prey base populations, and improving sagebrush steppe habitat quality throughout the Ranch.

The conservation measures that will be implemented for the CCSM Project, including Phase I, include the minimization or removal of some existing threats to greater sage-grouse survival and productivity such as, removal and marking of fences, water development projects, and riparian/wetland habitat enhancement. Collectively, these improvements will also benefit migratory bird species, especially sagebrush obligates, and bat species. The Greater Sage-Grouse Conservation Plan also provides for the identification of additional conservation projects that will serve to achieve conservation goals. *See BLM 2012a, App. B at App. N.*

Examples of habitat improvement projects completed to date and future projects include:

a. *Fence Removal.*

Since 2010, PCW and TOTCO have removed over 10 miles of fence within the Ranch. Fences consisted primarily of woven-wire fences (i.e., sheep fence) in close proximity to sage-grouse leks and brooding habitat that PCW identified as high-risk (i.e., within 0.6 of a mile of a lek). Removing fences:

- Reduces mortality caused by fence collisions, especially for greater sage-grouse;
- Increases contiguous patches of shrub-steppe habitat;
- Removes localized grazing pressure and increases habitat availability; and
- Reduces potential predation by removing travel conduits along fences.

b. *Fence Marking.*

Since 2010, PCW and TOTCO have marked over 17 miles of fence within the Ranch. Marked fences consisted primarily of barbed-wire fences in close proximity to sage-grouse leks and brooding habitat that PCW identified as high-risk (i.e., within 0.6 of a mile of a lek). Fence marking reduces mortality caused by fence collisions, especially for greater sage-grouse.

c. *Fence Conversion.*

In 2014, PCW and TOTCO converted nearly six miles of fence to a wildlife-friendly design approved by BLM and WGFD (i.e., three strands of barbed-wire over a bottom strand of smooth wire) from a woven-wire fence. The fence is located in an area of sage-grouse winter habitat. Fence marking reduces mortality caused by fence collisions, especially for greater sage-grouse.

d. Noxious weed control.

Noxious weed control reduces susceptibility to noxious weed invasions and pests outbreaks and maintains native vegetative plant communities. This benefits migratory birds and bats by reducing habitat alteration and fragmentation. For several years TOTCO in cooperation with BLM has conducted an active noxious weed control program along Little Sage Creek. During construction, operation and maintenance of Phase I, PCW will implement a rigorous weed management program approved and overseen by BLM.

e. Road Closures.

Following construction of Phase I, PCW will identify existing unused and redundant two-track Ranch roads and reclaim in accordance with the approved Phase I reclamation plan. At this time, such unused and redundant roads cannot be identified. Reclaiming unused and redundant roads will:

- Reduce habitat fragmentation benefiting all wildlife species including migratory birds and bats;
- Increase contiguous patches of shrub-steppe habitat benefiting all sagebrush obligates;
- Increase sagebrush cover over time benefiting all sagebrush obligates; and
- Reduce susceptibility to noxious weed invasions by eliminating possible dispersal conduits and establishing healthy native plant communities.

4. Sequencing

BLM analyzed mitigation measure GEN-1 in its FEIS. GEN-1 states:

> "Limit surface disturbance to areas where turbines would be constructed within 12 months with a goal to mitigate impacts from surface disturbance to wildlife, soils, water, and vegetation (e.g., weeds)."

Sequencing construction to minimize the duration of surface disturbance minimizes impacts to habitats used by all migratory bird and bat species. In addition, sequencing construction minimizes the area being constructed at any given time and allows for reclamation of areas where construction has been completed while construction in other areas is underway; thus, minimizing disruption and disturbance. Simultaneous reclamation minimizes habitat disturbance and leads to earlier reclamation success as opposed to waiting to begin reclamation until the completion of Phase I construction. While sequencing will not eliminate the long term effects of habitat fragmentation, it will reduce effects though earlier reclamation success and minimization of the area disturbed at any given time.

5. Mesic Habitat Improvement

PCW has committed to implement mesic habitat improvement projects on the Ranch. These projects will be implemented prior to commercial operation of Phase I. The primary objective of PCW's proposed mesic habitat improvement projects is to modify water sources to create and enhance natural free-flowing water and wet meadow habitats that are used by many wildlife species including migratory birds and bats. Habitat improvement projects may include installation of upland "bubblers" and water diversions to create and enhance natural free-flowing water, enhance wet meadow habitat, and flood bottomland draws. "Bubblers" may be supplied with water from both artesian wells and other wells actively pumped by windmills. Other habitat improvement projects may include development of additional water sources through water diversion pipelines from existing reservoirs and stock tank pipeline networks. Habitat improvement projects will be completed in a manner to minimize standing water and discourage use by mosquitoes, which might carry West Nile virus. Use of existing water sources to create downstream wet areas will benefit greater sage-grouse and other sagebrush obligates as well as migratory birds that rely upon wet areas and riparian zones. Wet areas and riparian zones provide habitat for numerous bird species, including food, water, nest sites, and shelter.

6. Relic Agricultural Field Enhancements

There are approximately 2,023 acres of relic agricultural fields in the eastern portion of the Ranch within the proposed conservation easement that are currently dominated with either monocultures of cheatgrass (*Bromus tectorum*), crested wheatgrass (*Agropyron cristatum* sp.) or other introduced species. Many areas in these relic agricultural fields currently provide limited value for wildlife, including migratory birds and bats. However, selected migratory bird species including horned larks, mountain plover, killdeer, and other grassland or disturbed habitat specialists currently use these areas. Additionally, three of the relic agricultural fields currently support occupied leks for greater sage-grouse. The areas surrounding the lek locations would not be restored to ensure that the important biological function of these locations is not compromised.

The primary objective of the relic agricultural field enhancement projects is to establish conditions suitable for year-round use by wildlife species. Of the 2,023 acres of relic agricultural fields, PCW has identified approximately 900 acres of sagebrush steppe habitat that could be initially restored while not compromising other important wildlife uses, including greater sage-grouse lek locations. Restoration of these areas back to sagebrush habitat and other native vegetated communities would provide suitable habitat for the benefit of avian and bat species by providing new nesting, foraging, and migration locations for migratory birds and bats; reducing habitat fragmentation or barrier effects caused by existing disturbance; and supporting connectivity between habitat patches. PCW will initiate the relic agricultural field enhancements prior to commercial operation of Phase I; however, it is anticipated that full restoration will require a number of growing seasons.

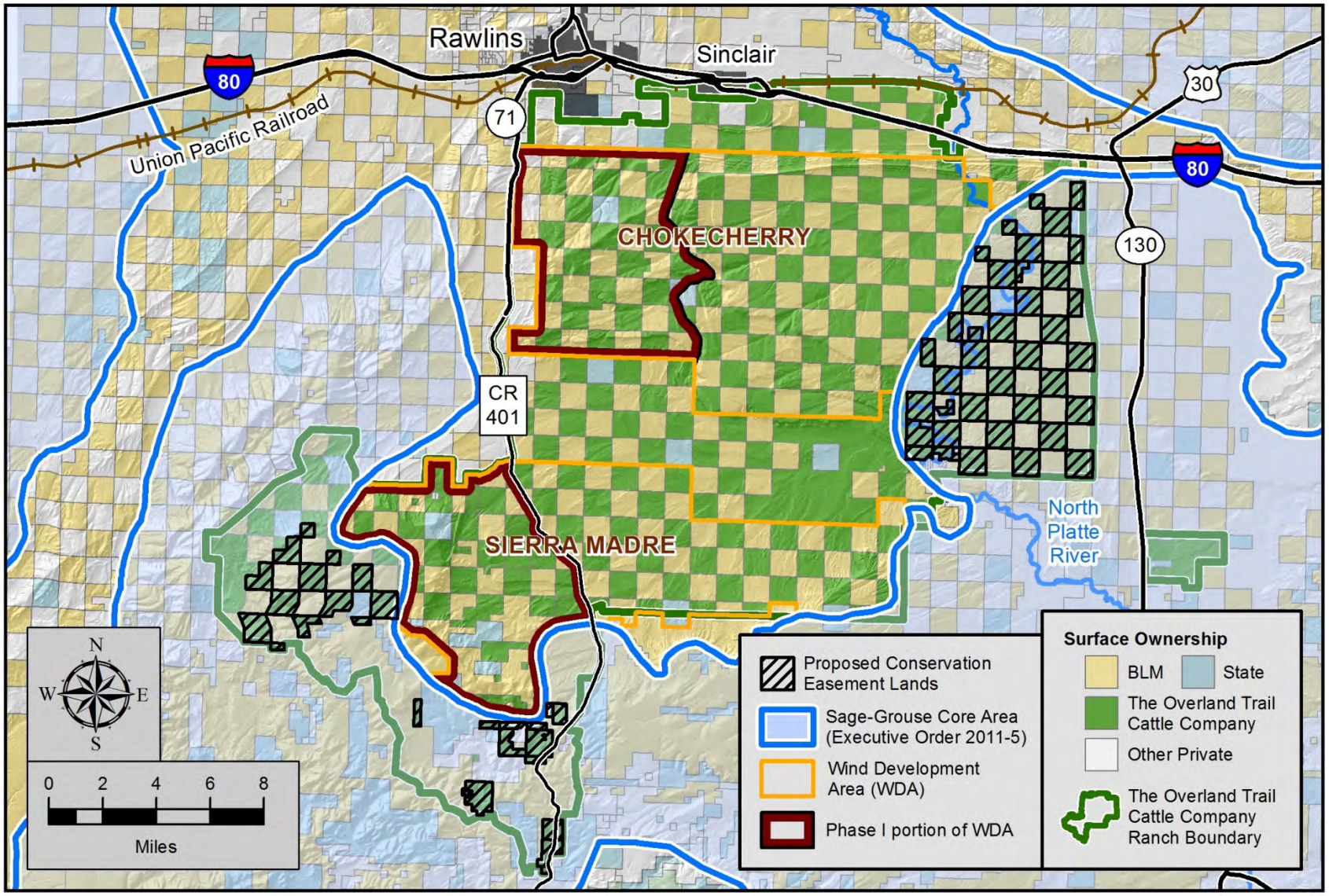

Figure 5.11. Conservation Easements Proposed by PCW in Coordination with TOTCO.

7. Wildfire Emergency Stabilization and Burned Area Rehabilitation

Wildfire, particularly in low-elevation Wyoming big sagebrush systems, has resulted in significant habitat loss primarily because of subsequent invasion by cheatgrass and other invasive species. *See BLM 2011a*. PCW will work with BLM to prioritize stabilization and burned area revegetation projects on the Ranch to: (1) maintain unburned intact sagebrush habitat when at risk from adjacent threats; (2) stabilize soils; (3) re-establish hydrologic function; (4) promote biological integrity; (5) promote plant resiliency; (6) limit expansion or dominance of invasive species; and (7) re-establish native species. For example, in 2010, a 170-acre wildfire occurred within the Chokecherry WDA. Following the fire, PCW and TOTCO seeded portions of the burned area to stabilize soils, reduce the risk of non-native plant invasion, and encourage use by wildlife species, including migratory birds. Rehabilitating burned areas and conserving intact unburned habitats reestablishes habitat function and use by wildlife species resulting in benefits to migratory bird and bat populations.

8. Water Tank Escape Ramps

PCW collaborated with the Saratoga High School chapter of the Future Farmers of America to construct and install metal mesh avian escape ladders in water tanks on the Ranch. Escape ramps reduce the risk of drowning to all avian species as well as other wildlife species. *See Lafón 2006*. To date, PCW has worked with TOTCO to install approximately 30 escape ramps across the Ranch in multiple habitat types including sagebrush steppe, upland grassland, and salt desert shrub communities. PCW will continue to install escape ramps in water tanks across the Ranch where there is an identified risk to wildlife.

9. Elimination of Greater Sage-grouse Hunting

TOTCO has indefinitely suspended access for hunting of greater sage-grouse on all of its private land and other areas under its control, thereby reducing direct mortality of greater sage-grouse, a prey species for several raptor species as well as a potential source of carrion for avian scavengers. Suspension of greater sage-grouse hunting access will continue throughout the life of the CCSM Project, including Phase I, or as otherwise agreed to between PCW, TOTCO and WGFD. Elimination of greater sage-grouse hunting removes any potential carcasses that would be created from injured or unrecovered birds shot by hunters. This removes a potential source of injured birds or carrion containing lead shot that might otherwise attract raptors and avian scavengers. This measure will reduce avian fatalities resulting from lead shot ingestion. Studies have concluded that elevated blood lead levels are prevalent and quantifiable in both bald and golden eagles, and may have a significant impact on eagle populations. *See Allison 2012; Cochrane et al. 2015*. Similar to eagles, risks of lead ingestion may impact raptor and avian scavenger populations. In addition, reduction of mortality to greater sage-grouse, a potential prey species of some raptors, will enhance prey availability and benefit those predator species.

10. Carcass Removal and Handling

All operation and maintenance staff will be trained to appropriately handle, remove, and dispose of all large animal carcasses that are encountered within the CCSM Project Site, including Phase I. Disposal protocols will be developed in coordination with USFWS and WGFD to ensure compliance with relevant state and federal wildlife statutes. Disposal areas will be located outside of the Phase I Development Area to avoid attracting avian scavengers and other species. Preferred disposal areas might include the conservation easement east of the North Platte River; this would add foraging opportunities for avian scavengers in areas away from Phase I. Carcasses may also be buried to reduce risk for accidental wildlife exposures to contaminants if poisoning or shooting is suspected as the cause of mortality.

11. Winter Access

Roads will be maintained in winter in accordance with PCW's Winter Access Plan, attached as an appendix to the site-specific PODs for Phase I. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*. PCW's Winter Access Plan specifies that where roads are plowed, breaks will be created in any snow banks alongside roads to allow for passage of ungulates across the landscape. This will minimize the likelihood of concentrated ungulate use along roads that may result in increased vehicle collisions that could attract avian scavengers to roadways.

12. Monitoring of Efficacy of Conservation Measures

Through its on-going, long-term research on greater sage-grouse, PCW will monitor the efficacy of its conservation measures to migratory birds and bats, in particular sagebrush obligates. *See Appendix H. See BLM 2012a (Appendix B at Appendix N).* It is expected that greater sage-grouse and sagebrush obligate utilization will increase in areas where habitat services have been increased through implementation of conservation measures such as habitat enhancement. Greater sage-grouse utilization can be measured through telemetry data. Greater sage-grouse populations may also be measured through annual lek counts. Increased use by greater sage-grouse can be used as an indication of increased habitat quality and availability for sagebrush obligates and other migratory bird species in multiple habitat types.

In addition, PCW will establish photo-points at a number of locations in each of the relic agricultural fields to monitor restoration. On an annual basis PCW will visit each photo-point during the peak of the growing season (typically early-June through mid-July) to document success of enhancement activities including changes in the diversity and structure of vegetation. Photo-point documentation will consist of photographs in the cardinal and ordinal directions as well as a photograph of the nadir of the photo point taken from approximately 4 feet above the ground surface.

5.3 Phase I Risk Assessment

Consistent with Tiers 1 through 3 of the USFWS Wind Energy Guidelines and Tiers 1 and 2 of the WGFC Wind Energy Recommendations, PCW identified the risks to migratory birds and bats from Phase I of the CCSM Project. *See Chapter 4.0.* Through the implementation of the BMPs and avoidance, minimization, and conservation measures described in chapter 5.0, PCW has reduced the risk to migratory birds and bats from Phase I to the extent practicable; as a result of PCW's extensive efforts, significant adverse impacts (as defined in the USFWS Wind Energy Guidelines) to species of concern from Phase I are not anticipated. *See USFWS 2012a at p. 33.* Therefore, consistent with the recommendations of the USFWS Wind Energy Guidelines, additional mitigation beyond that described in this Phase I BBCS is not necessary. *See USFWS 2012a at p. 53.*

Through the risk avoidance and minimization process described in section 5.1 PCW substantially redesigned the CCSM Project, including Phase I to avoid risk to migratory birds and bats. PCW coordinated with USFWS, BLM, and WGFD to use the extensive data collected in accordance with the USFWS Wind Energy Guidelines and WGFC Wind Energy Recommendations to develop the final Phase I wind turbine layout. The final Phase I wind turbine layout represents the culmination of the extensive data collection and avoidance and minimization effort for Phase I that began in 2008. The final Phase I wind turbine layout minimizes collision risk and habitat impacts and avoids many of the areas identified as having relatively high use by migratory bird and bat species. *See Section 5.1*.

Following project siting, the remaining risks to migratory birds and bats from Phase I were further minimized through the application of the site-specific avoidance and minimization measures and BMPs identified in section 5.2. These measures include, but are not limited to: (1) timing stipulations to avoid impacts during sensitive time periods; (2) spatial stipulations to avoid impacts in sensitive locations; (3) measures to avoid impacts to sensitive habitats; (4) measures to minimize project impacts; and (5) measures to avoid electrocutions and collisions from Phase I electrical facilities.

The USFWS Wind Energy Guidelines define mitigation as "avoiding or minimizing significant adverse impacts, and when appropriate, compensating for unavoidable significant adverse impacts…" Together with the Phase I siting effort, the measures described in sections 5.2.1 and 5.2.2 avoid and minimize the remaining risks to migratory birds and bats such that significant adverse impacts (as defined in the USFWS Wind Energy Guidelines) to species of concern from Phase I are not anticipated. *See USFWS 2012a at p. 33.* In addition, the conservation measures described in section 5.2.3, e.g. the conservation easement and mesic habitat improvements, provide further benefits to migratory birds and bats by creating, enhancing, and protecting habitats used by migratory birds and bats and removing risks of mortality that are associated with other land use activities that are not related to Phase I.

While complete avoidance of all risks to migratory bird and bat species from Phase I is impossible, the combination of PCW's Phase I risk avoidance and minimization process along with implementation of the site-specific avoidance and minimization measures, BMPs and conservation measures, ensures that remaining impacts to migratory birds and bats from Phase I are reduced to levels that are not significant to any single species or species group (as defined in the USFWS Wind Energy Guidelines). *See USFWS 2012a at p. 33.* As a result, the development of Phase I of the CCSM Project is appropriate and is consistent with the USFWS Wind Energy Guidelines, WGFC Wind Energy Recommendations, the requirements of BLM's FEIS and ROD, and the long-term conservation of migratory bird and bat species.

6.0 Post-Construction Migratory Bird and Bat Studies (USFWS Wind Energy Guidelines – Tiers 4 and 5; WGFC Wind Energy Recommendations – Tier 3)

Consistent with Tiers 4 and 5 of the USFWS Wind Energy Guidelines and Tier 3 of the WGFC Wind Energy Recommendations, PCW has committed to conduct post-construction migratory bird and bat studies for Phase I. Post-construction studies are intended to assess ongoing risk to migratory bird and bat species from Phase I, calculate estimated fatality rates for migratory bird and bat species from Phase I, as well as to evaluate the effectiveness of conservation measures. *See USFWS 2012a at pp. 34:38; WGFC 2010 at p. 38.* Consistent with the USFWS and WGFC recommendations, PCW used the results of the Phase I pre-construction risk assessment to determine the appropriate duration and level of effort for the Phase I post-construction studies. *See USFWS 2012a at p. 34.* Post-construction monitoring will be conducted for Phase I in accordance with the USFWS recommendations for Phase I, including fatality monitoring, searcher efficiency and carcass removal trials, in order to determine whether the migratory bird and bat fatality rate for Phase I is within the expected range and to determine the effectiveness of the conservation measures developed for Phase I in limiting the number of fatalities. *See USFWS 2016b*. PCW will use the adaptive management process described in section 8.4 of this Phase I BBCS to routinely evaluate its post-construction studies and to modify its survey methods and protocols as appropriate.

6.1 Migratory Bird and Bat Fatality Monitoring

PCW will complete post-construction fatality monitoring for migratory birds and bats for Phase I. The primary objectives of the Phase I fatality monitoring are to: (1) determine whether there are any patterns of fatalities within Phase I such that factors associated with those fatalities can be identified and addressed; (2) quantify estimated fatality rates for birds and bats for Phase I and compare those results with data collected during pre-constructions surveys; and (3) evaluate the effectiveness of the Phase I BBCS conservation measures.

PCW's post-construction fatality monitoring for Phase I will assess the magnitude and patterns of migratory bird and bat fatality, species composition, and spatial and temporal attributes of fatalities at Phase I. PCW will divide Phase I into sample areas (i.e., Western Chokecherry, Upper Miller Hill, and Lower Miller Hill;) that represent similar topography, vegetation and other model covariates, and will use a stratified sample approach to ensure that each sample area is surveyed with the same approximate intensity relative to the number of wind turbines and the types of habitats that occur within each area.

As provided for in this Phase I BBCS, PCW will review the results of the Phase I migratory bird and bat fatality monitoring program at least annually and, if deemed appropriate, the fatality monitoring program may be modified through the adaptive management process described in section 8.4, which includes coordination and consultation with the USFWS, BLM, and WGFD, as appropriate.

6.1.1 Migratory Bird and Bat Fatality Monitoring Duration and Frequency

PCW will conduct migratory bird and bat fatality monitoring during the 24 months following commencement of commercial operation for Phase I. The annual migratory bird and bat fatality monitoring will be split into 4 separate seasons that are reflective of different migratory bird and bat use patterns: (1) spring season (April 15 through June 15) when spring migration is most likely to occur and prior to initiation of the majority of migratory bird nesting activities; (2) summer season (June 15 through August 1) during the active nesting period for migratory birds; (3) fall season (August 1 through September 30) prior to winter weather conditions when fall migration is most likely to occur; and (4) late fall/winter season (October 1 through April 14) when avian use decreases substantially and few species of birds are present.[43] A total of 50% of the operational Phase I wind turbines will be monitored once per month during all seasons to provide an indication of species-specific, habitat-specific, and geographic patterns of mortality. In addition, 50% of the wind turbines selected for the bird and bat fatality monitoring (25% of the total wind turbines) will be monitored once per week from April 15 to June 15 and August 1 to September 30 to provide additional survey coverage during the spring and fall migratory periods.

The wind turbines to be monitored will be randomly selected from the Phase I wind turbines using a Generalized Random Tessellation Stratified selection process to provide spatially-balanced sample stratification across Phase I and its associated habitat types.

Further, the eagle fatality monitoring described in the Phase I ECP requires monthly fatality monitoring for all Phase I wind turbines. During the eagle fatality monitoring, all migratory bird and bat fatalities detected at the 50% of turbines not being surveyed under the Phase I BBCS bird and bat fatality monitoring will be recorded. While data on these fatalities will be collected monthly at the wider transect spacing used for the Phase I ECP monitoring, they can still be used to supplement and further inform the data collection under this Phase I BBCS.

6.1.2 Migratory Bird and Bat Fatality Monitoring Protocol

PCW will conduct migratory bird and bat fatality surveys within a 160 meter by 160 meter square plot oriented such that the largest distance searched (i.e., the diagonal of the square) is aligned in the direction of prevailing winds. *See Erickson et al. 2003*. Line transects within each search plot will be spaced at 6-meter intervals such that the entire search plot area will be covered during each survey. Each searcher will scan for carcasses out to approximately 3 meters with occasional scans out to approximately 10 meters. Following initial surveys, transect widths and search plot sizes for surveys may be adjusted to reflect site-specific conditions.

[43] Note that searches will not be performed when weather conditions make wind turbines inaccessible or unsafe to access in a standard road vehicle.

PCW will collect the following information for each migratory bird and bat fatality monitoring survey:

1. Date
2. Start time
3. End time
4. Interval since last search
5. Searcher name
6. Which wind turbine plot was searched (including decimal-degree latitude longitude or UTM coordinates and datum)
7. Habitat and vegetation characteristics, site topography, and any noticeable changes in conditions since previous visit (i.e., fire, increased or decreased herbaceous canopy height or cover, etc.)
8. Weather data for each search, including wind speed or Beaufort wind scale precipitation, snow cover, cloud cover, or other relevant weather condition
9. Global positioning system (GPS) track of the search path

If a migratory bird or bat fatality is discovered, the searcher will mark the carcass with a flag. After completing the search of that wind turbine, the searcher will immediately return to the flagged carcass to collect carcass data as described below. All carcasses, parts, or feathers will be photo-documented. All potential injuries or lack thereof, signs of scavenging, and identifying characteristics will be documented. The preferred method of recording data will be electronically using a data recording device (such as a field computer or notepad), but the searcher may also record information on a paper form. The searcher will record the following information for each fatality:

1. Date
2. Species
3. Age and sex, if possible
4. Band number and notation if wearing a marker
5. Observer name
6. Wind turbine number or other identifying characteristic
7. Distance of the carcass from the wind turbine
8. Azimuth of the carcass from the wind turbine
9. Decimal-degree latitude longitude or UTM coordinates of the wind turbine and carcass
10. Habitat surrounding the carcass
11. Condition of the carcass (entire, partial, scavenged)
12. Description of the carcass
13. A rough estimate of the time since death (e.g., <1 day, > a week), and how estimated
14. A series of digital photographs of the carcass and landscape surrounding the location
15. Information on carcass disposition

All carcasses will be identified using resources such as The Sibley Guide to Birds, The Feather Atlas, A Field Guide to Mammals of North America, or other appropriate references. *See Sibley 2014; USFWS 2012b; Reid 2006*. For bats in particular, geography, morphometric measures (particularly forearm, but also head and body, tail, ear, foot, and tragus), and other field marks (e.g., hair color, presence of keeled calcar) will be used for identification of each specimen. As needed, PCW will obtain the necessary permits for the collection of carcasses. *See Chapter 7.0.* The information collected (including photographs) will be reviewed annually, as described in section 8.3.

6.1.3 Carcass Persistence Trials

As recommended by the USFWS, PCW will conduct carcass persistence trials during migratory bird and bat fatality monitoring. *See USFWS 2016b.* Carcass persistence trials will be conducted once each season during migratory bird and bat fatality monitoring. Carcass persistence trials will be conducted at the locations used for searcher efficiency trials immediately after the placement of carcasses. PCW will revisit carcasses placed as part of carcass persistence trials on days 1 through 7, 14, 21, and 28. *See Erickson et al. 2003; Young et al. 2003*. If carcasses are still present on day 28, they will be visited by PCW weekly until they are scavenged or for 90 days, whichever is sooner. Seasonal carcass persistence trials will account for the effects of weather, differential carcass decay/desiccation rates, scavenger densities, and scavenger behavior across seasons.

During carcass persistence trials, biologists will record presence or absence of each carcass and any relevant notes (e.g., signs of scavenging or partial scavenging). The length of time a carcass persists in Phase I will be calculated as the midpoint between the day the carcass was known to be present and the day it was no longer present. The data from the carcass persistent trials will be used in a suitable statistical estimator to account for imperfect carcass detectability and to produce unbiased estimates of fatality. *See Section 6.1.5.* The data may also be used to adjust the post-construction fatality search interval and sampling coverage as approved by USFWS through the adaptive management process described in section 8.4.

6.1.4 Searcher Efficiency Trials

As recommended by the USFWS, PCW will conduct searcher efficiency trials during migratory bird and bat fatality monitoring.[44] *See USFWS 2016b.* Searcher efficiency trials will be conducted once each season for the first 24 months of fatality monitoring. Searcher efficiency will be calculated as the proportion of trial carcasses found by a searcher relative to the total number of carcasses placed for that searcher's trial. Searcher efficiency trials will be conducted blindly, without the knowledge of the searcher involved, and simultaneously with formal fatality monitoring at a subset of the searched wind turbines. Each searcher efficiency trial will be conducted using the same search protocols described above for fatality monitoring. *See Section 6.1.2.* The trials will be conducted seasonally to account for

[44] In addition, searcher efficiency trials for migratory birds and bats would be conducted as part of the eagle searcher efficiency trials using migratory birds and bats or appropriate surrogates. *See PCW 2015a.*

different field conditions (e.g., vegetation growth, snow) that may affect the ability of the searchers to locate carcasses. Separate searcher efficiency rates will be calculated for each season, carcass-size category, searcher, and sample area or vegetation type (visibility class).

For each searcher efficiency trial, carcasses will be placed during the morning (on the same day as searches) before searches are conducted. The person conducting the blind test (the tester) will place the carcasses at randomly generated locations within the survey plot and drop the carcasses from waist level to ensure the carcasses land in a random position and location. The location of the placed carcasses and vegetation type will be recorded by the tester with a handheld Global Positioning System (GPS) unit. To ensure the trials are blind, searchers will be unaware of the chosen date, the wind turbine plots selected, and the specific locations and number of carcasses placed for each trial. The tester will distinguish the placed carcasses with unique leg bands or other appropriate means to ensure the placed carcasses are distinguishable from carcasses potentially attributable to Phase I. The marking method used will not increase the visibility of the carcass to ensure that searcher efficiency trials are unbiased.

When available, intact, salvaged specimens will be used for searcher efficiency trials. When suitable salvaged specimens are not available, adult geese (or similar), adult chickens (or similar), 1-week-old quail (or similar), and 14- to 18-day-old dark hopper mice (or similar) will be used as surrogates, representing very large birds, large birds, small birds, and bats, respectively. In all cases, carcasses used will either be species collected and possessed from Phase I through all appropriate permits, carcasses provided by an authorized agency explicitly for use in searcher efficiency trials, or non-protected species purchased for the purpose of searcher efficiency trials.

No more than three total carcasses will be placed in each selected monitoring plot to avoid over-seeding (i.e., scavenger swamping; Smallwood 2007). As confidence in estimates of searcher efficiency and carcass persistence – and related error in the adjusted fatality estimate model – are influenced by sample size, a minimum of 75 carcasses will be placed for each fatality group parameter (e.g., 75 per season, and 75 per carcass type over the entire year; Strickland et al. 2011). Based on these constraints, carcasses will be placed at approximately 75 turbines during each season.

6.1.5 Adjusted Fatality Estimates

Data collected during migratory bird and bat fatality monitoring, including searcher efficiency and carcass persistence trials, will be used in an appropriate statistical estimator (e.g., Huso et al. 2012, Péron and Hines 2014, Dalthorp et al. 2014) to calculate a fatality estimate for migratory birds and bats. Fatality estimates are based on observed carcasses found during fatality monitoring, the probability that a searcher will miss a carcass (searcher efficiency correction factor), the probability that a carcass will be removed before a searcher can locate it (carcass persistence correction factor), the date of the last search at a particular search plot prior to finding a carcass (search interval), the proportion of wind turbines searched to the total number of wind turbines at the facility, and the proportion of searchable areas beneath each wind turbine (or similar search area correction). Categorical covariates (i.e., season,

carcass type, sample area, searcher, vegetation attributes) that significantly improve the fit of the searcher efficiency and carcass persistence models will be used, as applicable, in the adjusted fatality estimate.

Annual adjusted fatality estimates will be prepared for the facility and per MW. These estimates will be compared to adaptive management thresholds to determine whether a threshold has been exceeded. Per turbine estimates may be prepared if, during the adaptive management process, it is determined that a finer resolution is needed to understand patterns of fatality. *See Chapter 8*.

6.2 Other Migratory Bird and Bat Monitoring

PCW has incorporated the post-construction fatality monitoring for migratory birds and bats described in section 6.1 into its Conservation Plan and Landowner Agreement with TOTCO. *See Appendix H.* The Conservation Plan and Landowner Agreement also describes the circumstances under which additional bat acoustic surveys, migratory bird point counts, and raptor nest searches would be conducted for the CCSM Project, including Phase I. The Conservation Plan and Landowner Agreement was developed in coordination with WGFD and is based on the recommendations contained in the WGFC Wind Energy Recommendations. WGFD concurred with the terms and conditions of the Conservation Plan and Landowner Agreement and acknowledged that the agreement satisfies the applicable requirements of the WGFC Wind Energy Recommendations. The post-construction monitoring commitments described in the Conservation Plan and Landowner Agreement will be implemented in coordination with BLM and WGFD.

6.3 Incidental Discoveries

All operations and maintenance staff working on the CCSM Project will be trained on how to identify migratory bird or bat fatalities. Instructions and procedures that personnel must follow in the event that an injured or dead migratory bird or bat is discovered on-site shall be included with the educational information, including whom to notify and what actions must be taken.

Operations and maintenance personnel will not disturb any carcass, but will instead document the location of the migratory bird or bat fatality and notify their supervisor as soon as possible. The supervisor will contact a qualified biologist to record the fatality following the procedures set forth in section 6.1.2 and using a form similar to the one provided as Appendix J.

Incidental discoveries will be recorded year-round during Phase I construction and operation, including after the completion of formal post-construction fatality monitoring. Any migratory bird or bat fatality discovered during times other than the formal migratory bird and bat fatality surveys described in section 6.1.2 will be considered an incidental record. Incidental records will be reviewed with other post-construction monitoring results as described in section 8.3.

6.4 Disposition of Carcasses and Injured Migratory Birds or Bats

If the necessary permits have been obtained (e.g., a Migratory Bird Special Purpose Utility Permit [SPUT] from the Migratory Bird Program or a Scientific Collection Permit from WGFD), then following the collection of carcass-specific data, PCW (or other permit holder) will remove the carcass from the field as necessary. A list of state- and federally-permitted wildlife rehabilitation facilities will be maintained for when injured birds or bats are encountered in Phase I. This list will be posted in the Operations Center and will be updated regularly to ensure wildlife rehabilitators can be reached quickly if needed. *See Section 8.1.* Injured birds and bats will be recorded as fatalities and included in fatality rate analyses when they are encountered during formal migratory bird and bat fatality monitoring. Final disposition of carcasses, including any use in migratory bird and bat fatality monitoring carcass persistence or searcher efficiency trials, will be in accordance with permit terms and conditions or directions from the applicable federal or state agency.

7.0 Project Wildlife Permits

PCW may need to obtain the following permits related to migratory bird and bat species from either USFWS or WGFD for Phase I:

- USFWS-issued permits:
    - MBTA 21.23 Scientific Collection Permits
    - MBTA 21.27 Migratory Bird Special Purpose Utility Permit. *See 50 C.F.R. §21.27.*

      A Special Purpose Utility Permit is necessary only if PCW plans to collect, transport, or possess dead migratory birds or parts (including for purposes of conducting searcher efficiency or carcass persistence trials) or contract someone to conduct these activities on its behalf. More detailed information on the applicability of this permit and its requirements are set out in the Service's handout titled "What you should know about a Federal Migratory Bird Special Purpose Utility Permit," which can be accessed at: http://www.fws.gov/forms/3-200-81.pdf
- WGFD-issued permits:
    - Wildlife possession permits. *See Wyoming Game and Fish Commission Regulations, Chapter 10.*
    - Scientific collection permits. *See Wyoming Game and Fish Commission Regulations, Chapter 33.*

The need for additional wildlife permits for Phase I, if any, will be identified as part of the adaptive management process. *See Section 8.1.*

USFWS will determine and provide the conditions of any permits issued by USFWS. State permit conditions will be determined and provided by WGFD.

8.0 Administration

Information related to the administration of this Phase I BBCS is outlined below. This chapter contains: (1) contact information for key personnel; (2) a brief description of PCW's training program for Phase I personnel; (3) information on the Phase I BBCS recordkeeping; and (4) a description of the Phase I BBCS adaptive management program.

8.1 Contact Information

The Environmental and Construction Compliance Monitoring Program for Phase I designates the key management and environmental personnel who will be responsible for compliance during construction of Phase I. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*. However, as construction of Phase I is not yet underway, the majority of the construction management and compliance personnel are identified by title only. In addition, PCW will provide contact information for state- and federally-permitted wildlife rehabilitation facilities. Table 8.1 will be updated to include construction management staff, compliance personnel, and appropriate wildlife rehabilitation centers and provided to USFWS and WGFD prior to commencement of construction for Phase I. Table 8.1 will be posted in the Operations Center for use in the event any injured birds or bats are found during construction or operation of Phase I

Table 8.1. Phase I Contact Information.

Position	Name	Phone
Vice President, Land and Environmental Affairs	Garry Miller	303-298-1000
Vice President and General Counsel	Roxane Perruso	303-298-1000
Director of Engineering	Ryan Jacobson	303-298-1000
Senior Environmental Engineer	Kelly Cummins	303-298-1000
Project Manager	To Be Determined	To Be Determined
Construction Manager	To Be Determined	To Be Determined
Compliance Manager	To Be Determined	To Be Determined
Senior Biologist	To Be Determined	To Be Determined
Permitted Wildlife Rehabilitation Center(s)	To Be Determined	To Be Determined

8.2 Personnel Training

As part of the Environmental Compliance and Monitoring Plan for Phase I, PCW will implement an environmental training program to support compliance with environmental permits, including the permit requirements and conservation measures outlined in this Phase I BBCS. *See PCW 2014b; PCW 2014c; PCW 2014d; PCW 2015b*. The training program will be designed to consistently communicate requirements for Phase I to every individual working on-site so that both managers and workers understand PCW's expectations, the permit requirements, and how to incorporate them into their daily work activities. All personnel working on Phase I will be required to attend environmental training prior to working on-site. PCW will maintain environmental training attendance records on-site.

Elements of PCW's environmental training program will follow the training course format recommended by APLIC and will incorporate site-specific training to minimize risks to migratory birds and bats. *See APLIC 2006; APLIC 2012.* Further, all construction, operation and maintenance staff working on Phase I will be trained on how to identify migratory bird or bat fatalities. Instructions and procedures that personnel must follow in the event that an injured or dead migratory bird or bat is discovered on-site shall be provided with the environmental training information, including whom to notify and what actions must be taken.

8.3 Recordkeeping and Reporting

PCW will keep detailed electronic records of the post-construction migratory bird and bat fatality monitoring. The records will include all fatality data collected, including incidental records. PCW will review the results of the post-construction migratory bird and bat fatality monitoring annually. Post-construction fatality monitoring results will be reviewed in the context of spatial and seasonal distribution. As warranted, PCW will propose modifications to the monitoring protocol and/or conservation measures for consideration under the adaptive management framework. *See Section 8.4.* Following the completion of post-construction fatality monitoring, PCW will continue to collect incidental fatality records for Phase I. PCW will review these records annually using the adaptive management framework. *See Section 8.4.* Following PCW's annual review of this Phase I BBCS and the recorded migratory bird and bat mortality, PCW will provide USFWS and WGFD with a summary of the Phase I migratory bird and bat mortality and a description of any modifications to the post-construction monitoring protocols or conservation measures. In addition, PCW will report information to USFWS and WGFD in accordance with the requirements and conditions of any applicable scientific collection, wildlife possession, or special purpose utility permits. *See Chapter 7.0.*

All post-construction monitoring reports PCW submits to USFWS, WGFD, BLM and other state and federal agencies will be considered confidential and not subject to public disclosure, as provided for under the exemptions applying to confidential commercial information under the Freedom of Information Act and Wyoming state statutes. *See U.S.C. § 552(b)(4) & W.S. 16-4-203(d)(v).*

8.4 Adaptive Management

As described in the USFWS Wind Energy Guidelines, "[a]daptive management is an iterative learning process producing improved understanding and improved management over time." *See USFWS 2012a at p. 8 (citing Williams et al. 2009).* The adaptive management process described by USFWS in the Wind Energy Guidelines "gives special emphasis to uncertainty about management effects, iterative learning to reduce uncertainty, and improved management as a result of learning." *See USFWS 2012a at p. 8.* In fact, the USFWS Wind Energy Guidelines were designed to embody adaptive management by "collecting increasingly detailed information that is used to make decisions about project design, construction, and operation…" *See USFWS 2012a at p. 8.*

In support of the USFWS adaptive management approach to managing risk and uncertainty, PCW has collected a robust pre-construction data set and has also designed an intensive post-construction monitoring program for Phase I. *See Chapters 4.0 & 6.0.* Further, PCW has developed its own adaptive management program for Phase I to use the post-construction data to proactively incorporate adaptive management into Phase I operation.

The intent of the Phase I adaptive management process is to provide a frequent opportunity during post-construction monitoring to evaluate and minimize the uncertainty related to the factors that influence the risk to migratory birds and bats from Phase I. While the goal of this Phase I BBCS is to avoid migratory bird and bat fatalities, it is anticipated that some level of unavoidable mortality will occur despite the application of robust conservation measures. As a result, the Phase I adaptive management process is intended to proactively adjust post-construction monitoring protocols, conservation measures, and BMPs when warranted.

Adaptive management for Phase I has three primary components: (1) quantifiable thresholds that would initiate adaptive management; (2) PCW's adaptive management process that provides an opportunity for PCW to review the Phase I post-construction monitoring results and the observed take in the context of the predicted take and to consult and coordinate as necessary with USFWS or WGFD; and (3) potential adaptive management actions that may be considered in the event that the adaptive management thresholds are exceeded.

8.4.1 Adaptive Management Thresholds

In keeping with the adaptive management approach, PCW recognizes that adaptive management for Phase I will depend heavily on the information collected as part of pre-construction surveys and comparison of those data to post-construction fatality monitoring data. PCW has utilized the pre-construction data summarized in Chapter 4.0 to identify thresholds that will initiate adaptive management for purposes of evaluating the need for additional conservation measures and BMPs. These thresholds have been identified for the protection of migratory bird and bat species, as well as BLM sensitive species, WGFD species of greatest conservation need, or other species of interest, including bats. The following thresholds would initiate PCW's adaptive management process[45]:

1. **Migratory bird adaptive management thresholds** - The USFWS DEIS identified that between 3,150 and 5,400 avian fatalities could occur annually during operation of Phase I. *See USFWS 2016a*. The USFWS recognized that these are likely overestimates of actual fatality as evidenced by results of recent post-construction monitoring efforts in Wyoming and elsewhere. However, these estimates were used as overall adaptive management thresholds as it is recognized that fatalities above these levels would be higher than expected after the measures in this Phase I BBCS are implemented.

   Adaptive management would be initiated for migratory birds as a whole if modeled estimates of fatality for migratory birds exceeds 4,725 (150% of 3,150 predicted fatalities and 87.5% of 5,400 predicted fatalities)

2. **Migratory bird species-specific adaptive management thresholds** – Pre-construction avian use data for BLM sensitive species, WGFD species of greatest conservation need, or other species of interest were evaluated to identify adaptive management thresholds that would be implemented if species-specific or guild-specific estimates of fatality exceeded certain thresholds. The following species-specific or guild-specific adaptive management thresholds were developed for Phase I:
   a. Adaptive management would be implemented if modeled fatality estimates for sagebrush obligate passerine species exceed 17% of all modeled passerine fatalities in any year (25% greater than expected fatality rate based on relative abundance of sagebrush obligate passerines when compared to all other passerine species as presented in Table 4.6)

[45] In the event that the fatality estimates presented in the USFWS DEIS are revised in the USFWS FEIS, the adaptive management triggers will be revised to be consistent with the USFWS FEIS.

b. If the guild-specific threshold for fatality is not met, adaptive management would be implemented when modeled fatality estimates for any of the individual sagebrush obligate species exceed the following thresholds:
    i. Brewer's sparrow – modeled fatality estimates exceed 8% of all modeled passerine fatalities in any year (25% greater than expected fatality rate based on relative abundance of Brewer's sparrow when compared to all other passerine species as presented in Table 4.6)
    ii. Sagebrush sparrow - modeled fatality estimates exceed 6% of all modeled passerine fatalities in any year (25% greater than expected fatality rate based on relative abundance of sagebrush sparrow when compared to all other passerine species as presented in Table 4.6)
    iii. Sage thrasher - modeled fatality estimates exceed 4% of all modeled passerine fatalities in any year (25% greater than expected fatality rate based on relative abundance of sage thrasher when compared to all other passerine species as presented in Table 4.6)

c. Adaptive management would be implemented if modeled fatality estimates for ferruginous hawk exceed 7% of all modeled non-eagle raptor fatalities in any year (25% greater than expected fatality rate based on relative abundance of ferruginous hawk when compared to all other non-eagle raptor species as presented in Table 4.5)

d. Adaptive management would be implemented if modeled estimates for Swainson's hawk exceed 29% of all modeled non-eagle raptor fatalities in any year (25% greater than expected fatality rate based on relative abundance of Swainson's hawk when compared to all other non-eagle raptor species as presented in Table 4.5)

3. **Bat adaptive management thresholds** - The USFWS DEIS identified that up to 4,605 bat fatalities could occur annually during operation of Phase I. *See USFWS 2016a.* The USFWS recognized the uncertainty in this estimate due to lack of available post-construction datasets from which estimates of fatality could be derived, inconsistent survey protocols where bat fatality data were available and inappropriate comparisons of fatality among wind energy projects with different habitat types and environmental conditions. However, this estimate was used as an adaptive management threshold as it is recognized that fatalities above these levels would be higher than expected after the measures in this Phase I BBCS are implemented.

   Adaptive management would be implemented for bats if modeled estimates of fatality for bats exceed 3,450 (approximately 75% of the 4,605 potential fatalities identified in the USFWS DEIS).

8.4.2 Adaptive Management Process

PCW will implement the adaptive management process at least annually through the Phase I Annual Review, or more frequently if the thresholds described in section 8.4.1 have been exceeded. The Phase I adaptive management process would be completed annually even when the thresholds described above are not exceeded. The Phase I Annual Review is intended to provide a routine adaptive management review process in which the uncertainty related to the factors that influence the risk to migratory birds and bats from Phase I can be monitored, evaluated, and minimized to the extent practicable. The Phase I Annual Review will also evaluate patterns of mortality across Phase I to identify specific turbines or groups of turbines that might be disproportionately impacting migratory bird or bat species. The Phase I adaptive management process will be implemented as follows:

1. PCW will implement the post-construction monitoring protocols, conservation measures, and BMPs set forth in this Phase I BBCS.

2. PCW will review the Phase I post-construction monitoring results and conservation measures in the context of the risk to migratory birds and bats from Phase I and the thresholds identified in section 8.4.1.

3. Following review of the post-construction monitoring results and conservation measures, PCW, in coordination and consultation with USFWS, BLM, and WGFD, will consider adjustments to the post-construction monitoring protocols, conservation measures, and BMPs as needed.

4. As warranted, PCW will implement the adjustments to the post-construction monitoring protocols, conservation measures, and BMPs deemed necessary during the Phase I adaptive management review.

The Phase I adaptive management process will provide an opportunity for PCW to review the implementation of the monitoring protocols and the avoidance, minimization, and conservation measures included in this Phase I BBCS in coordination and consultation with USFWS, BLM, and WGFD.

8.4.3 Adaptive Management Actions

Using the thresholds identified above, implementation of the adaptive management process will compare the results of post-construction monitoring (Tier 4 of the USFWS Wind Energy Guidelines) to expected fatalities predicted using the pre-construction data collected consistent with Tier 3 of the USFWS Wind Energy Guidelines. If, through the adaptive management process, it is identified that additional actions are needed to avoid and minimize impacts to migratory birds or bats, PCW will identify the necessary adaptive management actions in coordination and consultation with USFWS, WGFD, and BLM.

Actions to be considered may be turbine-specific, site-specific, or project-specific in nature. Examples of actions that may be considered as part of the Phase I adaptive management process include, but are not limited to:

- Modifications to post-construction monitoring efforts
- Adjustment of turbine cut-in speeds
- Modification to adaptive management thresholds
- Implementation of additional conservation measures
- Modifications to project lighting
- Modifications to timing of project activities
- Marking above-ground electrical transmission and gathering system conductors
- Implementation of additional APLIC mitigation measures for the transmission and collection system

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APPENDIX A

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United States Department of the Interior

FISH AND WILDLIFE SERVICE

Ecological Services
5353 Yellowstone Road, Suite 308A
Cheyenne, Wyoming 82009

APR 20 2011

In Reply Refer To:
ES-61411/WY11CPA0147

Memorandum

To: Field Manager, Bureau of Land Management, Rawlins Field Office, Rawlins, Wyoming

From: Field Supervisor, U.S. Fish and Wildlife Service, Wyoming Field Office, Cheyenne, Wyoming

Subject: Avian Protection Plan Concurrence for the Sierra Madre-Chokecherry Wind Energy Project

Thank you for your letter of December 9, 2011, regarding the proposed Power Company of Wyoming's (PCW) Sierra Madre-Chokecherry Wind Energy Project (Project). The proposed Project is located south/southwest of the city of Rawlins, Carbon County, Wyoming. The Project is a proposed 2,000-MW electrical generating facility consisting of up to 1,000 2-MW wind turbines.

You have requested that the U.S. Fish and Wildlife Service (Service) determine if an Avian Protection Plan (APP) is appropriate for this Project to minimize the potential "take" of eagles. Our response to your request is based on the two-step process identified in the Bureau of Land Management's (Bureau) Instruction Memorandum No. 2010-156 (IM-2010-156), which is:

1) The Service determines that developing an APP is an appropriate option for this Project to avoid and minimize the potential for golden eagle take; therefore, the Bureau's Authorized Officer may issue a Record of Decision approving the project; and

2) The Bureau's Authorized Officer shall not authorize a Notice to Proceed for this Project until the Service has evaluated the APP and determines that it is adequate.

Following the two-step process, we have determined that developing an APP is an appropriate option to avoid and minimize the potential take of eagles (based on the Bureau's IM-2010-156), and migratory birds and bats based on PCW's commitment to meeting the following criteria:

a) Three years of surveys evaluating eagle, migratory bird and bat use of the Project area, as per Service guidance, conducted prior to Project construction; and

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b) Turbine numbers and layout are adjusted to provide effective buffers for eagle and other raptor nest sites as well as areas with high bird and bat utilization, as evidenced by the survey data.

To avoid and minimize impacts to migratory bird species protected by the Migratory Bird Treaty Act (MBTA), 16 U.S.C. 703, as well as eagles protected under the Bald and Golden Eagle Protection Act (Eagle Act), 16 U.S.C. 668, the APP will need to address all migratory bird species. The MBTA prohibits the taking, killing, possession, transportation, and importation of migratory birds, their eggs, parts, and nests, except when specifically authorized by the Department of the Interior. While the MBTA has no provision for allowing unauthorized take, the Service realizes that some birds may be killed even if all reasonable measures to protect them are used. The Service's Office of Law Enforcement (OLE) carries out its mission to protect migratory birds through investigations and enforcement, as well as by fostering relationships with individuals, companies, and industries that have taken effective steps to minimize their impacts on migratory birds, and by encouraging others to enact such programs. It is not possible to absolve individuals, companies, or agencies from liability even if they implement avian mortality avoidance or similar conservation measures. However, the OLE focuses its resources on investigating individuals and companies that take migratory birds without regard for their actions or without following an agreement to avoid take.

We advise the Bureau's Authorized Officer to not authorize a "Notice to Proceed" until the completed APP is delivered to the Service for evaluation and the Service determines the APP is adequate as documented in formal correspondence. The Service's determination as to the adequacy of the APP will depend upon the quality of the survey results used to develop the APP, how survey information was used to design a project layout that minimizes impacts, and how conservation measures will be applied during construction and operation.

We suggest that a programmatic APP, containing conservative conservation measures (e.g., no turbines within 4 miles of a golden eagle nest), be developed initially to provide guidance in lieu of area-specific information. This APP should be incorporated into the Project's Environmental Impact Statement (EIS). Any subsequent Project phases that rely upon an Environmental Assessment, which tiers to the EIS, will also form the basis for an individual Plan of Development (POD) APP. We expect that site-specific PODs will have higher levels of information about bird use, and their APP can be tailored to each specific area. We caution that it may not be reasonable to expect that the entire Project area can be developed (e.g., some Project areas may not be suitable for construction and should remain undeveloped).

The Service appreciates the Bureau's efforts to conserve golden eagles, other migratory birds, and bats in Wyoming. If you have questions regarding this letter or the MBTA and the Eagle Act, please contact Travis Sanderson of my staff at the letterhead address or phone (307) 328-4333.

cc: BLM, High Desert District Manager, Rock Springs, WY (J. Ruhs)
BLM, RECO Wildlife Biologist, Rawlins, WY (C. Morton)
BLM, Project Manager, Rawlins, WY (P. Murdoch)
BLM, RECO Project Manager, Cheyenne, WY (T. Engles)
BLM, State RECO Manager, Cheyenne, WY (M. Valle)
USFWS, Regional Energy Coordinator, Lakewood, CO (T. Modde)
USFWS, Branch Chief Energy, Water, Climate, Lakewood, CO (P. Repp)
USFWS, Chief, Branch of Conservation Planning Assistance, Washington, D.C (L. Bright)
WGFD, Non-Game Coordinator, Lander, WY (B. Oakleaf)
WGFD, Statewide Habitat Protection Coordinator, Cheyenne, WY (M. Flanderka)

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APPENDIX B

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LIST OF MIGRATORY BIRD SPECIES THAT HAVE BEEN OBSERVED IN THE CCSM PROJECT SITE AND THEIR ASSOCIATED CONSERVATION STATUS. [1]

Species Group	Common Name	Scientific Name	Conservation Status[1]
Corvids	American Crow	*Corvus brachyrhynchos*	
	Black-billed Magpie	*Pica hudsonia*	
	Clark's Nutcracker	*Nucifraga columbiana*	
	Common Raven	*Corvus corax*	
Passerines	American Goldfinch	*Spinus tristis*	
	American Robin	*Turdus migratorius*	
	Barn Swallow	*Hirundo rustica*	
	Bewick's Wren	*Thryomanes bewickii*	
	Black-capped Chickadee	*Poecile atricapillus*	
	Blue-gray Gnatcatcher	*Polioptila caerulea*	
	Brewer's Blackbird	*Euphagus cyanocephalus*	
	Brewer's Sparrow	*Spizella breweri*	USFWS-CC, BLM-S, WGFD-SGCN
	Brown-headed Cowbird	*Molothrus ater*	
	Chipping Sparrow	*Spizella passerina*	
	Cliff Swallow	*Petrochelidon pyrrhonota*	
	Common Yellowthroat	*Geothlypis trichas*	
	Dark-eyed Junco	*Junco hyemalis*	
	Dusky Flycatcher	*Empidonax oberholseri*	
	Evening Grosbeak	*Coccothraustes vespertinus*	
	Grasshopper Sparrow	*Ammodramus savannarum*	
	Gray-crowned Rosy-finch	*Leucosticte tephrocotis*	
	Green-tailed Towhee	*Pipilo chlorurus*	
	Hammond's Flycatcher	*Empidonax hammondii*	
	Hermit Thrush	*Catharus guttatus*	
	Horned Lark	*Eremophila alpestris*	
	House Finch	*Carpodacus mexicanus*	
	House Wren	*Troglodytes aedon*	
	Lark Bunting	*Calamospiza melanocorys*	WGFD-SGCN
	Lark Sparrow	*Chondestes grammacus*	
	Lincoln's Sparrow	*Melospiza lincolnii*	
	Loggerhead Shrike	*Lanius ludovicianus*	USFWS-CC, BLM-S
	MacGillivray's Warbler	*Geothlypis tolmiei*	
	Mountain Bluebird	*Sialia currucoides*	
	Mountain Chickadee	*Poecile gambeli*	

[1] Consistent with the scope of the Phase I BBCS, this table does not include eagles or greater sage-grouse.

Species Group	Common Name	Scientific Name	Conservation Status[1]
	Northern Rough-winged Swallow	*Stelgidopteryx serripennis*	
	Orange-crowned Warbler	*Oreothlypis celata*	
	Red-winged Blackbird	*Agelaius phoeniceus*	
	Rock Wren	*Salpinctes obsoletus*	
	Ruby-crowned Kinglet	*Regulus calendula*	
	Sagebrush Sparrow	*Artemisiospiza nevadensis*	USFWS-CC, BLM-S, WGFD-SGCN
	Sage Thrasher	*Oreoscoptes montanus*	USFWS-CC, BLM-S, WGFD-SGCN
	Savannah Sparrow	*Passerculus sandwichensis*	
	Say's Phoebe	*Sayornis saya*	
	Snow Bunting	*Plectrophenax nivalis*	
	Song Sparrow	*Melospiza melodia*	
	Swainson's Thrush	*Catharus ustulatus*	
	Townsend's Solitaire	*Myadestes townsendi*	
	Tree Swallow	*Tachycineta bicolor*	
	Vesper Sparrow	*Pooecetes gramineus*	
	Violet-green Swallow	*Tachycineta thalassina*	
	Warbling Vireo	*Vireo gilvus*	
	Western Kingbird	*Tyrannus verticalis*	
	Western Meadowlark	*Sturnella neglecta*	
	Western Wood-pewee	*Contopus sordidulus*	
	Wilson's Warbler	*Wilsonia pusilla*	
	Yellow Warbler	*Dendroica petechia*	
	Yellow-breasted Chat	*Icteria virens*	
	Yellow-rumped Warbler	*Dendroica coronata*	
Non-eagle Raptors, Owls, and Allies	American Kestrel	*Falco sparverius*	
	Burrowing Owl	*Athene cunicularia*	USFWS-CC, BLM-S, WGFD-SGCN
	Cooper's Hawk	*Accipiter cooperii*	
	Ferruginous Hawk	*Buteo regalis*	USFWS-CC, BLM-S, WGFD-SGCN
	Great Horned Owl	*Bubo Virginianus*	
	Merlin	*Falco columbarius*	WGFD-SGCN
	Northern Goshawk	*Accipiter gentilis*	BLM-S, WGFD-SGCN
	Northern Harrier	*Circus cyaneus*	
	Osprey	*Pandion haliaetus*	
	Peregrine Falcon	*Falco peregrinus*	USFWS-CC, BLM-S, WGFD-SGCN
	Prairie Falcon	*Falco mexicanus*	USFWS-CC
	Red-tailed Hawk	*Buteo jamaicensis*	

Species Group	Common Name	Scientific Name	Conservation Status[1]
	Rough-legged Hawk	*Buteo lagopus*	
	Sharp-shinned Hawk	*Accipiter striatus*	
	Swainson's Hawk	*Buteo swainsoni*	USFWS-CC, WGFD-SGCN
	Turkey Vulture	*Cathartes aura*	
Waterfowl, Waterbirds, and Wading Birds	American Avocet	*Recurvirostra americana*	
	American Coot	*Fulica americana*	
	American White Pelican	*Pelecanus erythrorhynchos*	
	American Wigeon	*Anas americana*	
	Black-crowned Night-heron	*Nycticorax nycticorax*	WGFD-SGCN
	Bufflehead	*Bucephala albeola*	
	Canada Goose	*Branta canadensis*	
	Canvasback	*Aythya valisineria*	WGFD-SGCN
	Cinnamon Teal	*Anas cyanoptera*	
	Clark's Grebe	*Aechmophorus clarkii*	WGFD-SGCN
	Common Loon	*Gavia immer*	
	Common Merganser	*Mergus merganser*	
	Double-crested Cormorant	*Phalacrocorax auritus*	
	Eared Grebe	*Podiceps nigricollis*	
	Gadwall	*Anas strepera*	
	Great Blue Heron	*Ardea herodias*	
	Greater Scaup	*Aythya marila*	
	Greater Yellowlegs	*Tringa melanoleuca*	
	Green-winged Teal	*Anas crecca*	
	Horned Grebe	*Podiceps auritus*	
	Killdeer	*Charadrius vociferus*	
	Least Sandpiper	*Calidris minutilla*	
	Lesser Scaup	*Aythya affinis*	WGFD-SGCN
	Lesser Yellowlegs	*Tringa flavipes*	
	Long-billed Curlew	*Numenius americanus*	USFWS-CC, BLM-S, WGFD-SGCN
	Mallard	*Anas platyrhynchos*	
	Marbled Godwit	*Limosa fedoa*	
	Mountain Plover	*Charadrius montanus*	USFWS-CC, BLM-S, WGFD-SGCN
	Northern Pintail	*Anas acuta*	WGFD-SGCN
	Northern Shoveler	*Anas clypeata*	
	Pied-billed Grebe	*Podilymbus podiceps*	
	Redhead	*Aythya americana*	WGFD-SGCN
	Ring-billed Gull	*Larus delawarensis*	
	Ring-necked Duck	*Aythya collaris*	

Species Group	Common Name	Scientific Name	Conservation Status[1]
	Ruddy Duck	*Oxyura jamaicensis*	
	Sandhill Crane	*Grus canadensis*	WGFD-SGCN
	Sora	*Porzana carolina*	
	Western Grebe	*Aechmophorus occidentalis*	
	White-faced Ibis	*Plegadis chihi*	BLM-S, WGFD-SGCN
	Willet	*Tringa semipalmata*	
	Wilson's Phalarope	*Phalaropus tricolor*	
	Wilson's Snipe	*Gallinago delicata*	
Other	Broad-tailed Hummingbird	*Selasphorus platycercus*	
	Common Nighthawk	*Chordeiles minor*	
	Common Poorwill	*Phalaenoptilus nuttallii*	
	Mourning Dove	*Zenaida macroura*	
	Northern Flicker	*Colaptes auratus*	
	Rufous Hummingbird	*Selasphorus rufus*	
	White-throated Swift	*Aeronautes saxatalis*	

APPENDIX C

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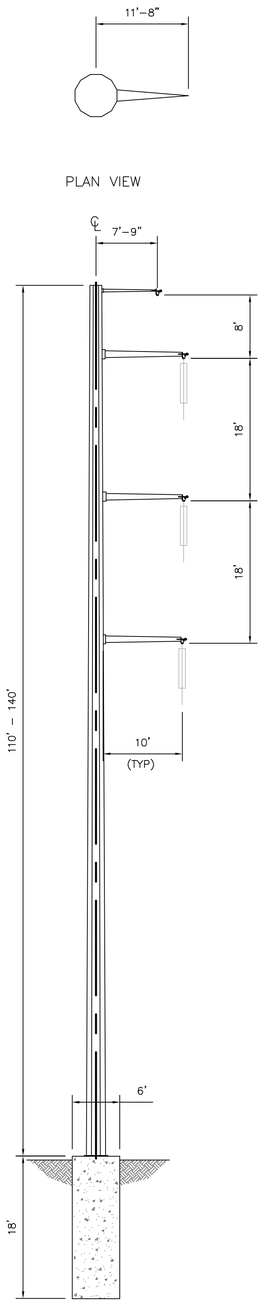
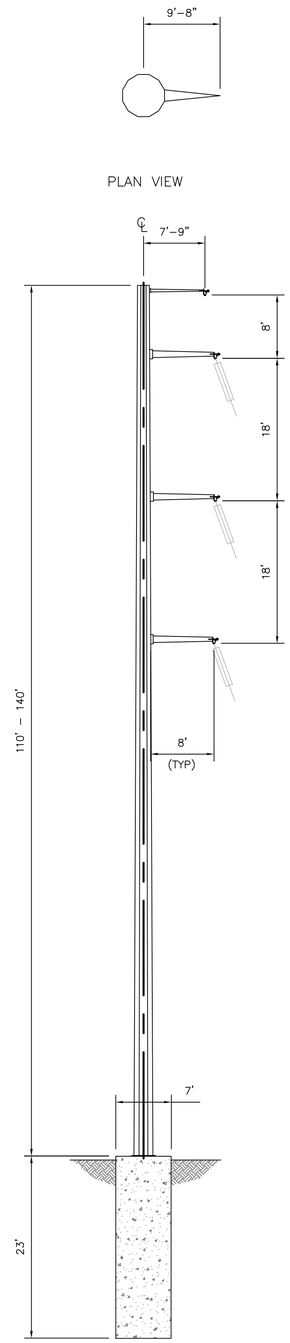
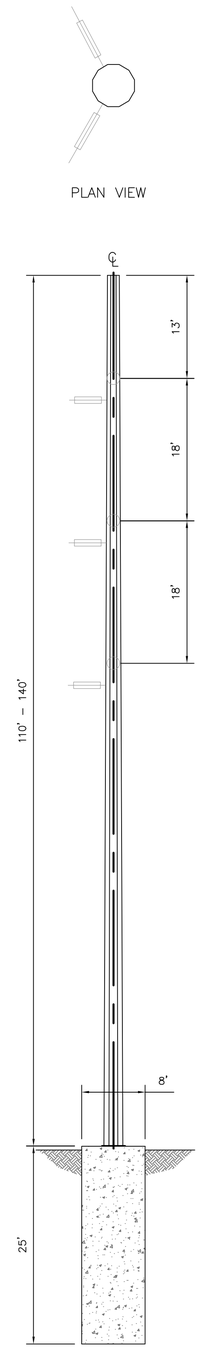


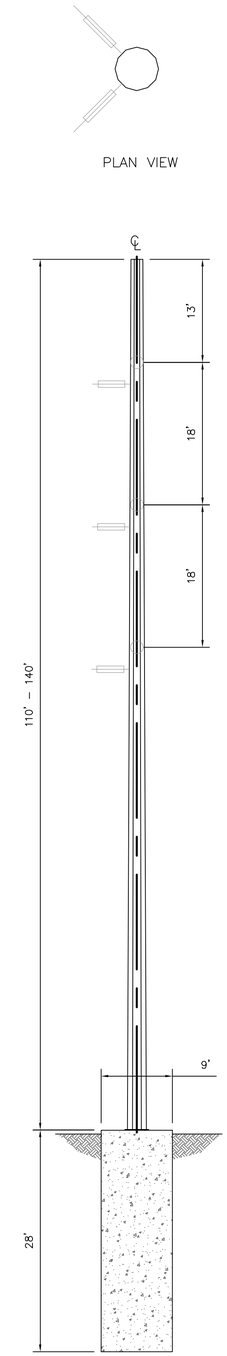
SINGLE CIRCUIT
0° – 1° TANGENT



SINGLE CIRCUIT
1° – 30° SUSPENSION ANGLE



SINGLE CIRCUIT
0° – 60° LIGHT DEADEND



SINGLE CIRCUIT
60° – 90° HEAVY DEADEND

NOTES:
1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR PROJECT CONDITIONS.

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CENTENNIAL CO, 80111

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Revisions:

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Prepared for:

Power Company of Wyoming LLC

555 Seventeenth Street, Suite 2400
Denver, CO 80202 USA

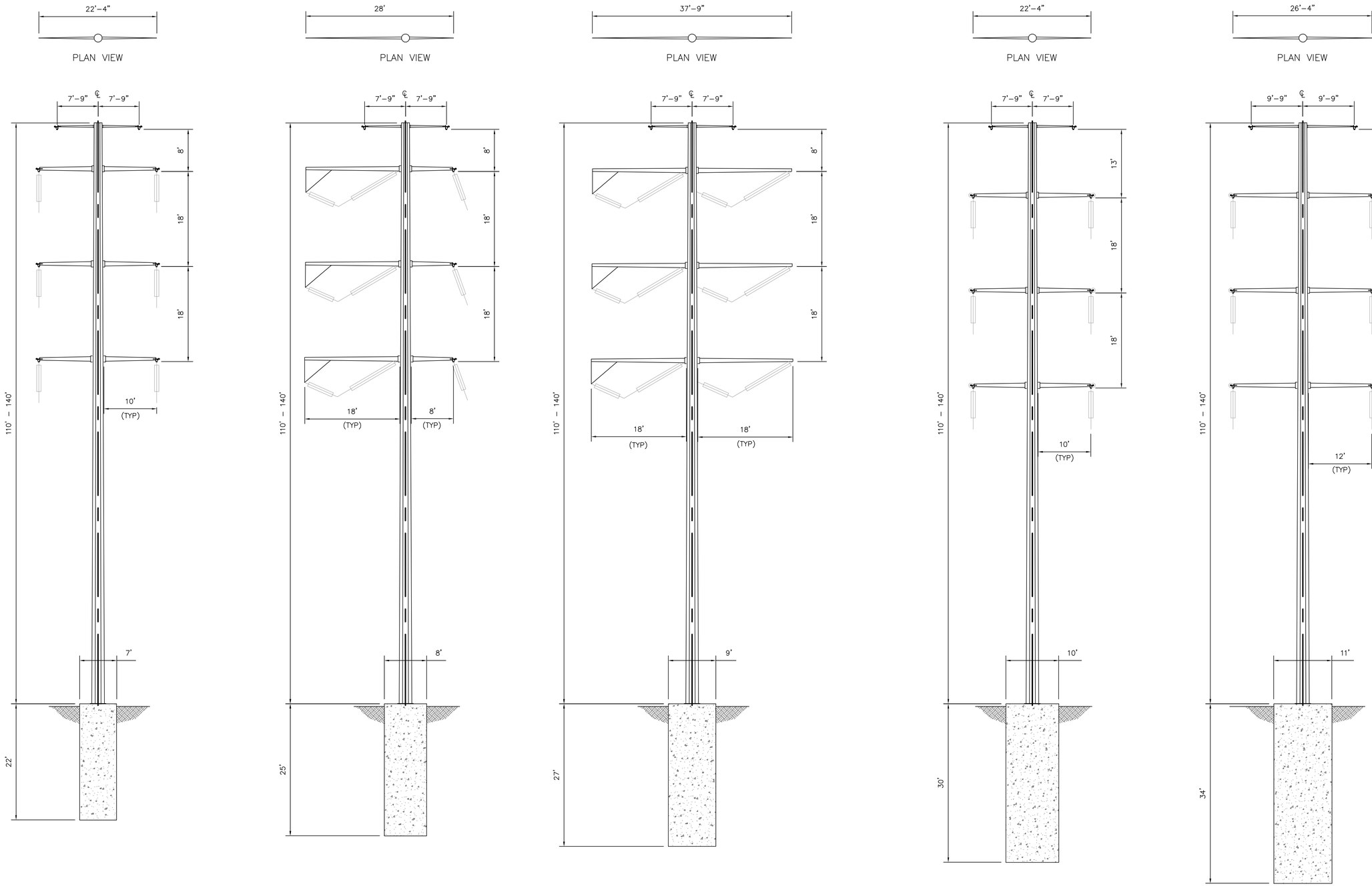
Chokecherry and Sierra Madre Wind Energy Project

Carbon County, Wyoming

230KV Single Circuit Steel Pole Structures

Phase I Wind Development Area Wind Turbine Sites & Related Infrastructure
NOT FOR CONSTRUCTION

Date: 01/05/15
Sheet: 38 of 254



NOTES:

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Carbon County, Wyoming

230KV Double Circuit Steel Pole Structures

Phase I Wind Development Area Wind Turbine Sites & Related Infrastructure
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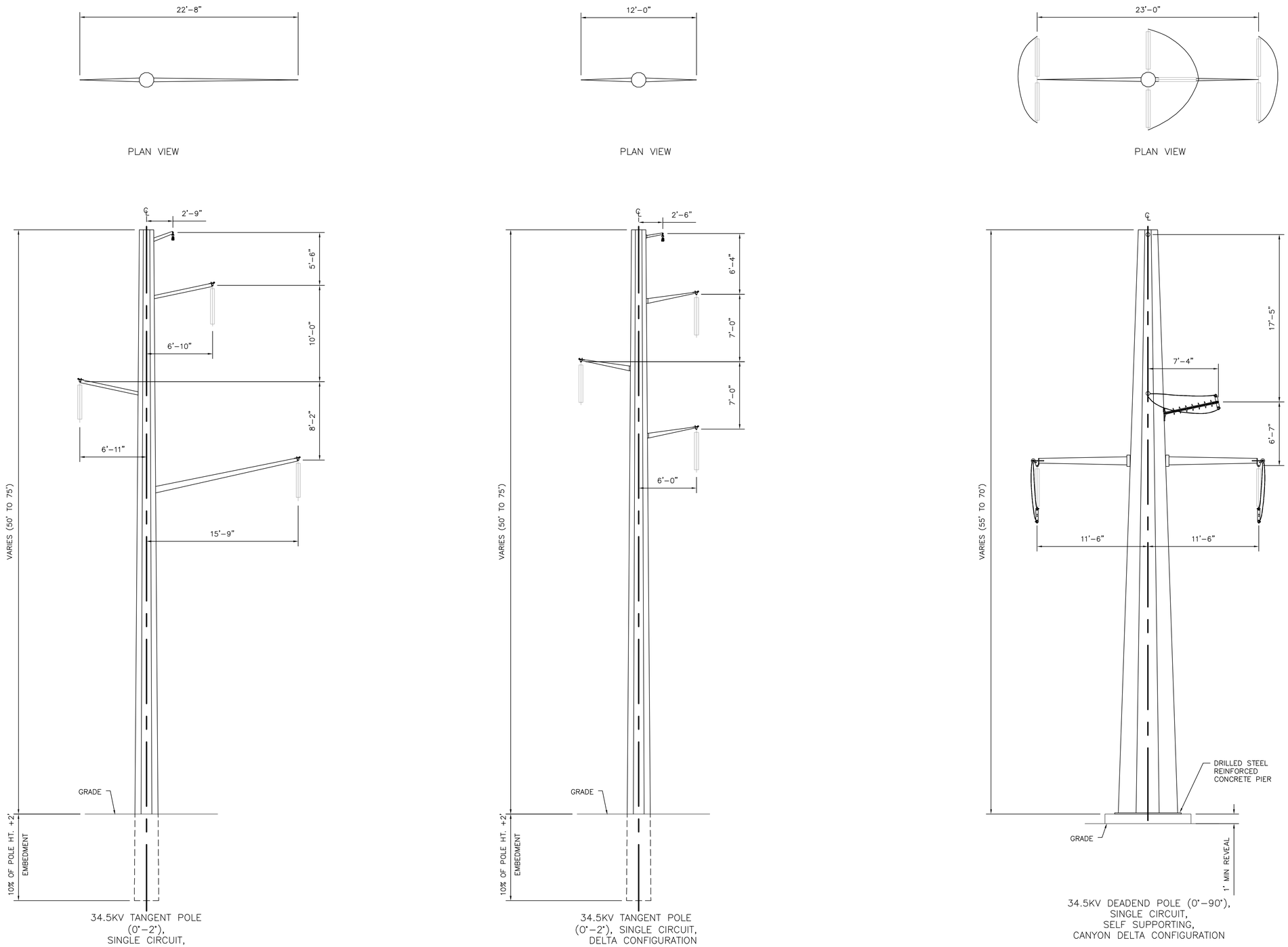

NOTES:

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2. POLE TYPE SHOWN IS STEEL; HOWEVER, FINAL DESIGN MAY UTILIZE WOOD AND/OR STEEL POLES DEPENDING ON GEOTECH AND LOADING COMBINATIONS.
3. FOUNDATIONS ARE TO BE TYPICAL AUGER DRILLED AND BACKFILLED WITH NATIVE MATERIAL., UNLESS NOTED OTHERWISE.

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Carbon County, Wyoming

34.5KV Steel Single Circuit Pole Structures

Phase I Wind Development Area Wind Turbine Sites & Related Infrastructure

NOT FOR CONSTRUCTION

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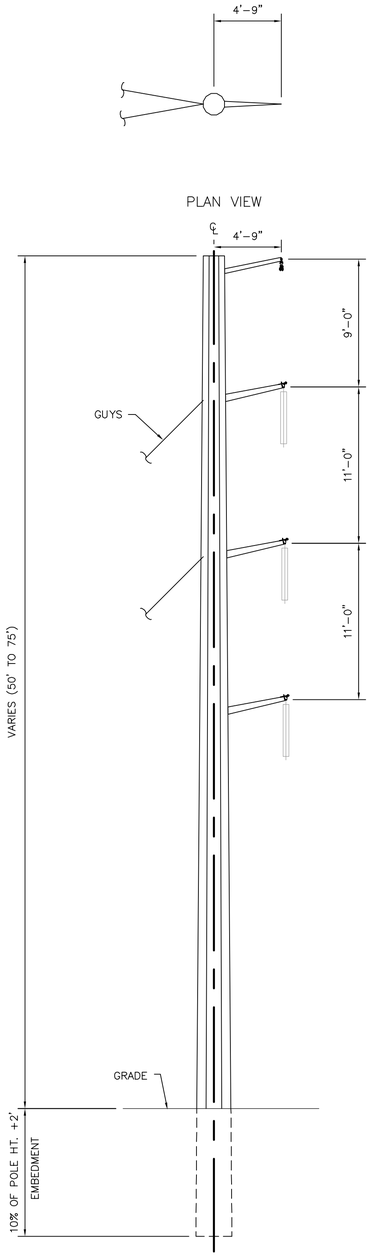
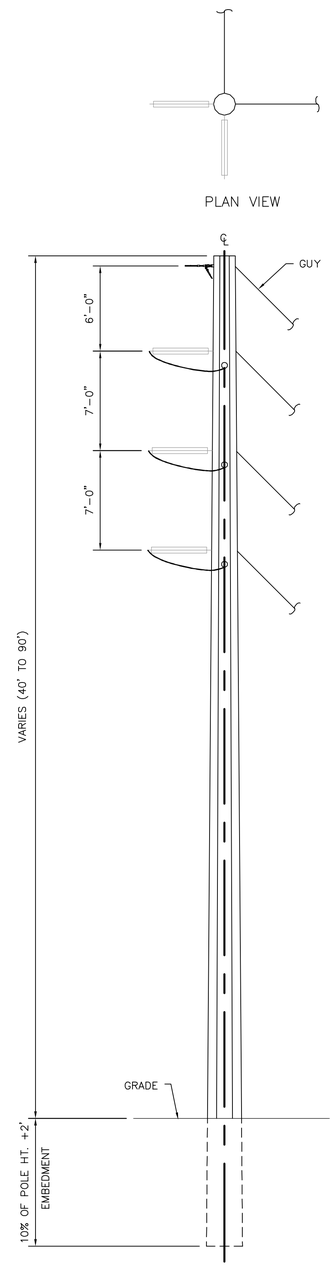
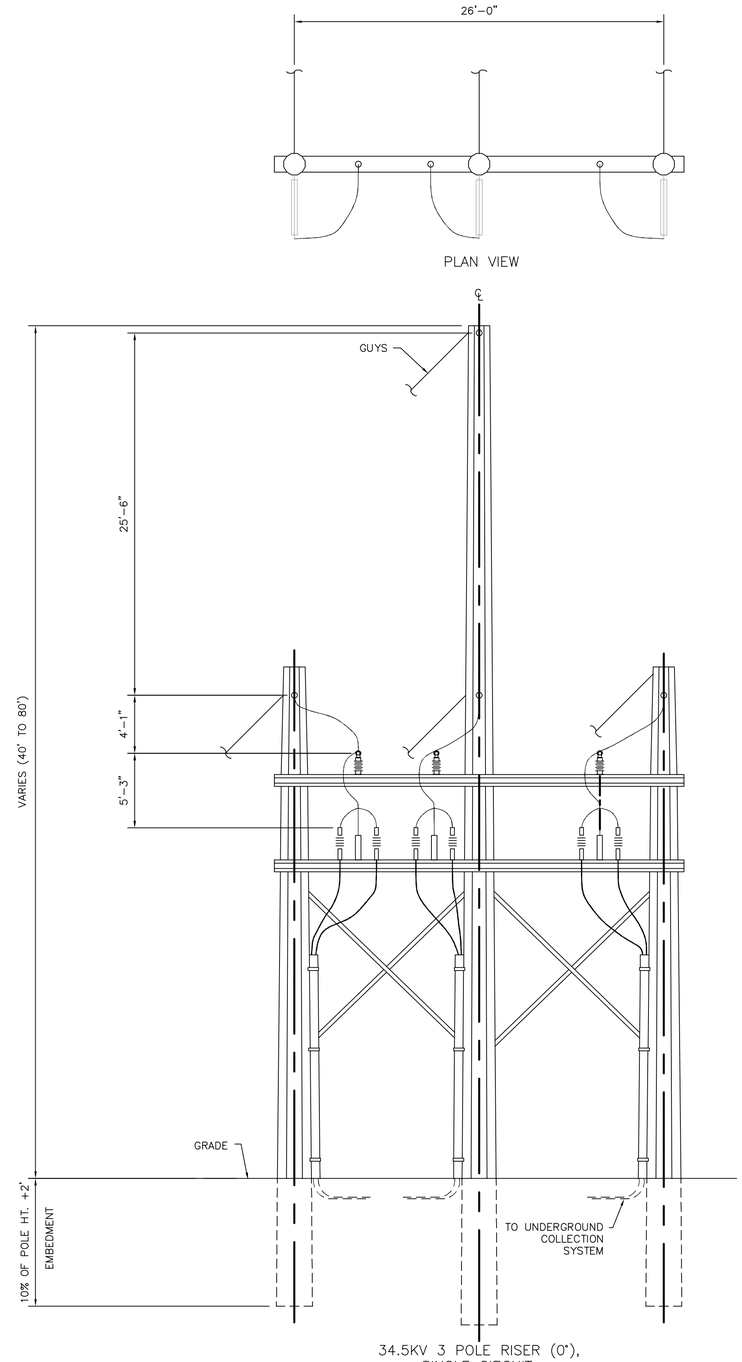


34.5KV RUNNING ANGLE POLE
(2°–25°),
SINGLE CIRCUIT,
GUYED VERTICAL CONFIGURATION



34.5KV DEADEND POLE
(>25°), SINGLE CIRCUIT,
GUYED VERTICAL
CONFIGURATION



34.5KV 3 POLE RISER (0°),
SINGLE CIRCUIT,
GUYED HORIZONTIAL
CONFIGURATION

NOTES:

1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR PROJECT CONDUTIONS.
2. POLE TYPE SHOWN IS STEEL; HOWEVER, FINAL DESIGN MAY UTILIZE WOOD AND/OR STEEL POLES DEPENDING ON GEOTECH AND LOADING COMBINATIONS.
3. FOUNDATIONS ARE TO BE TYPICAL AUGER DRILLED AND BACKFILLED WITH NATIVE MATERIAL., UNLESS NOTED OTHERWISE.

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Carbon County, Wyoming

34.5KV Steel Single Circuit Pole Structures

Phase I Wind Development Area Wind Turbine Sites & Related Infrastructure
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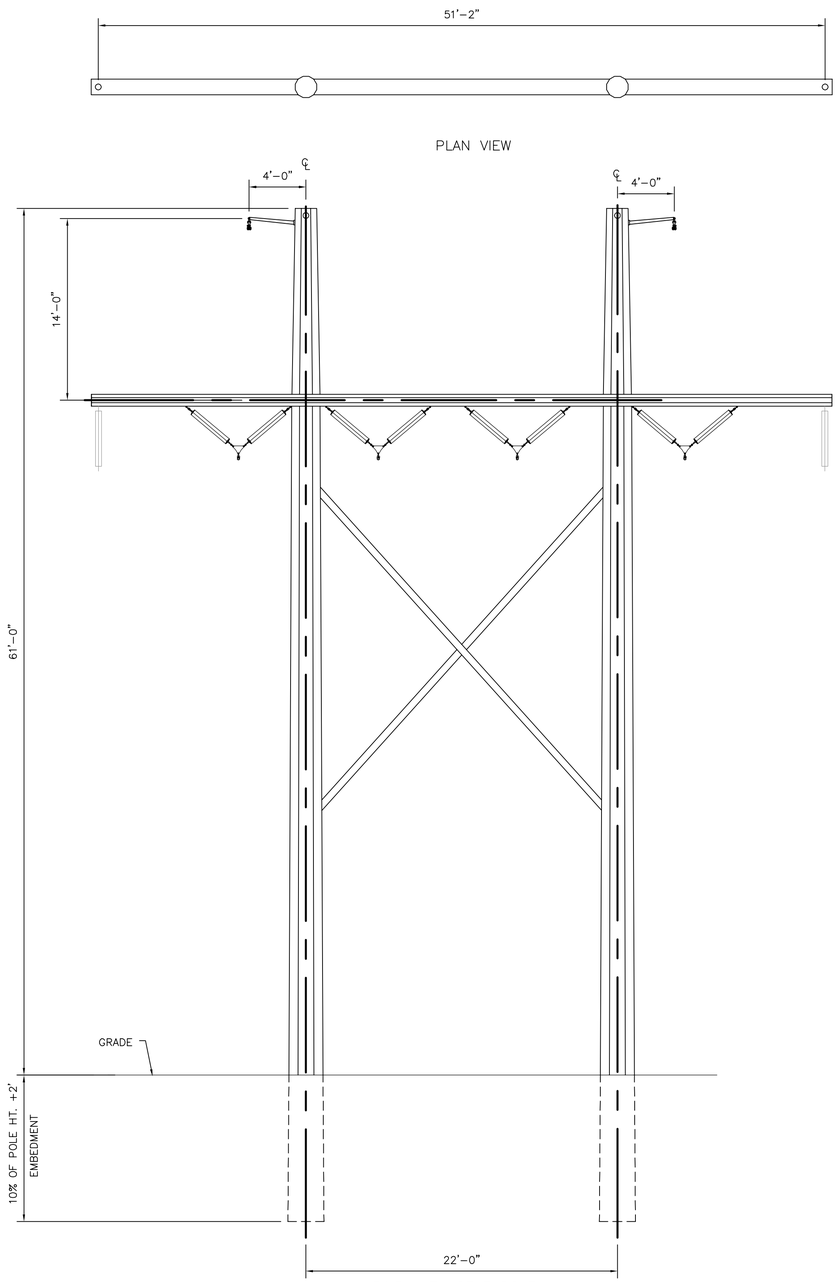
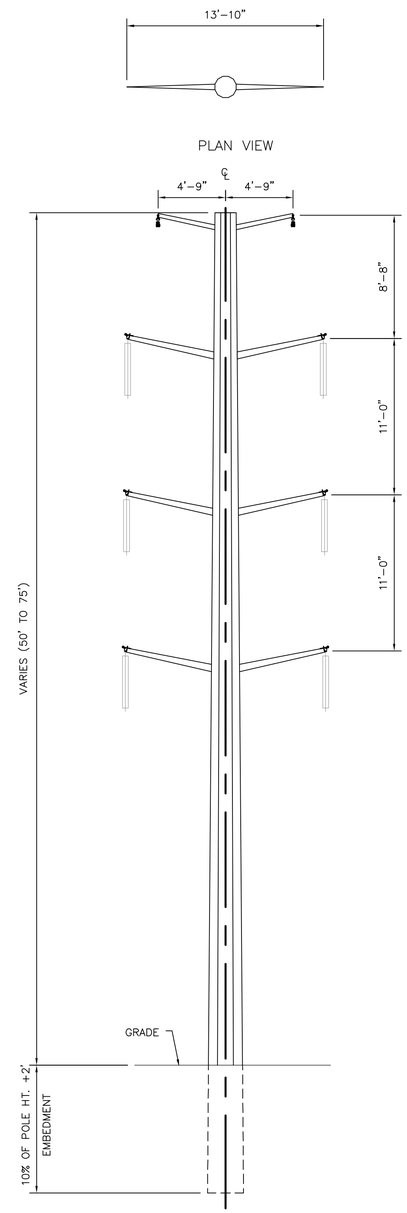
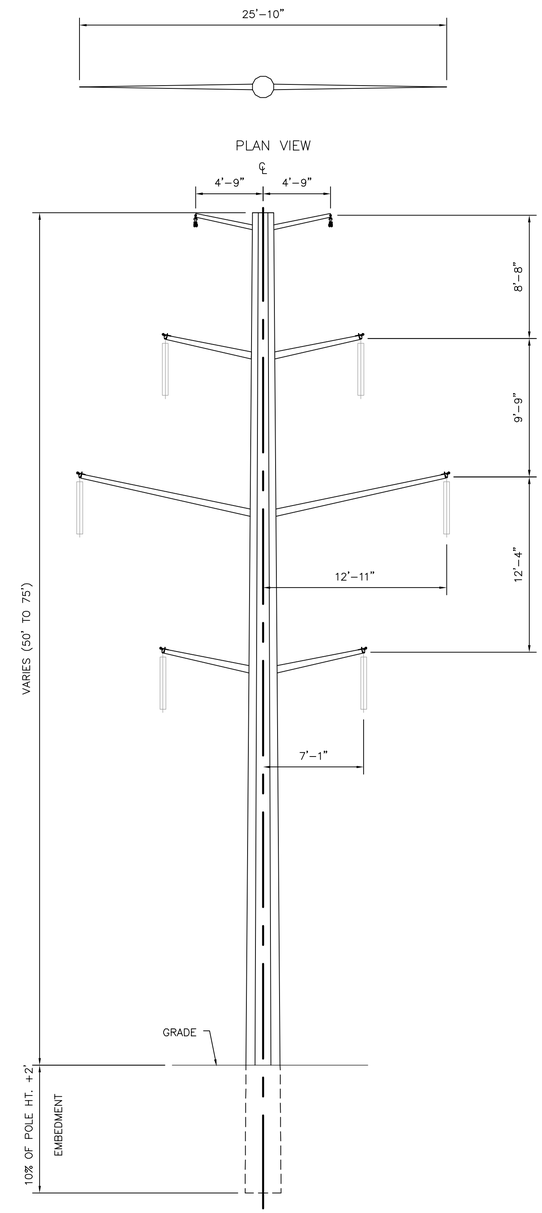
Sheet: 45 of 254



34.5KV TANGENT POLE
(0°-2°),
DOUBLE CIRCUIT,
HORIZONTAL CONFIGURATION



34.5KV TANGENT POLE
(0°-2°),
DOUBLE CIRCUIT,
VERTICAL CONFIGURATION



34.5KV TANGENT POLE
(0°-2°),
DOUBLE CIRCUIT,
VERTICAL CONFIGURATION

NOTES:

1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR PROJECT CONDUTIONS.
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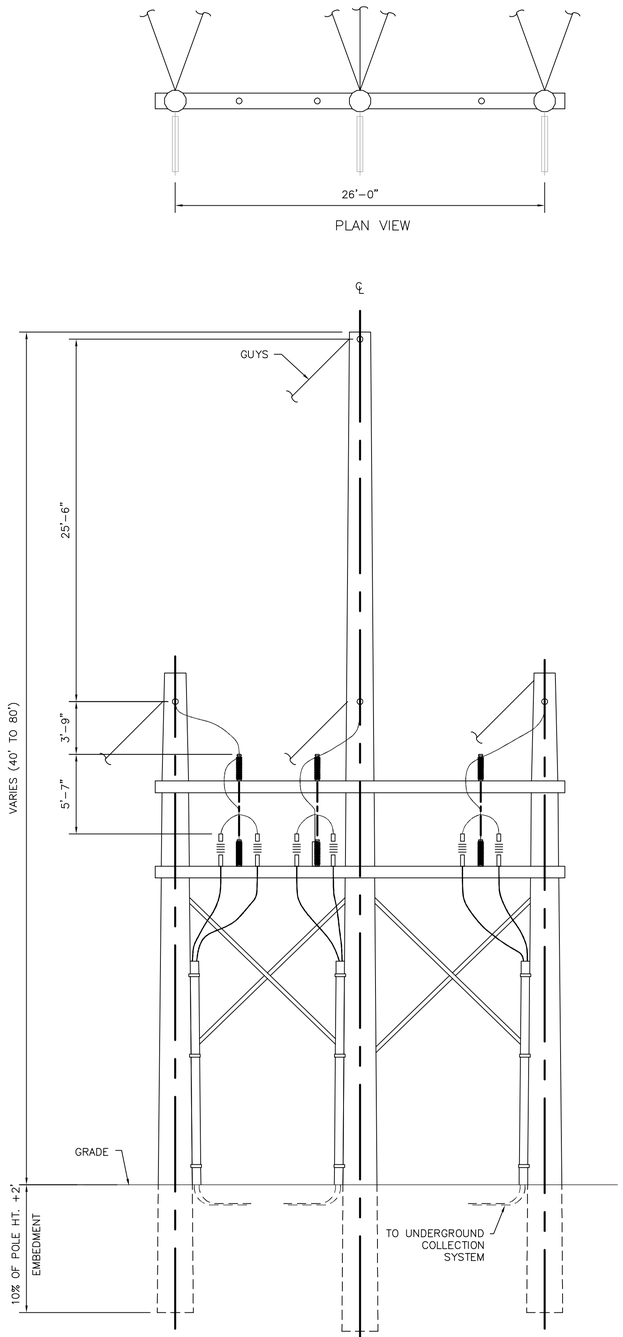
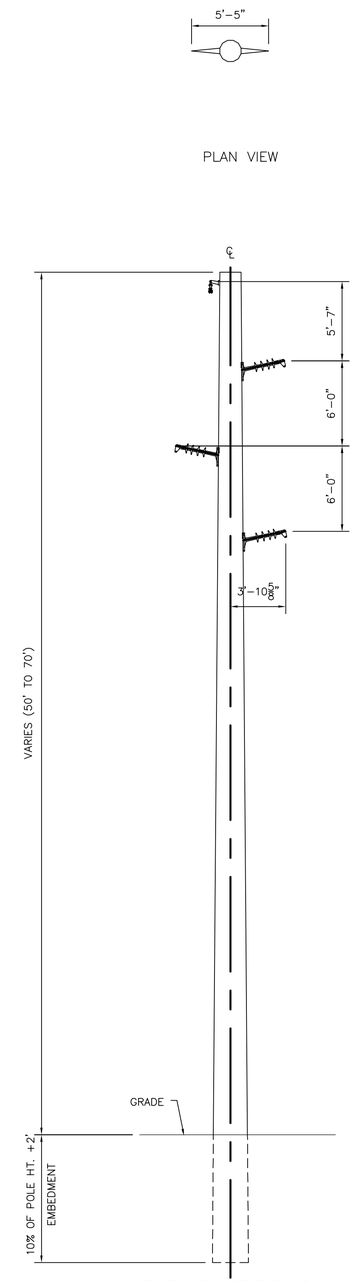
34.5KV Steel Double Circuit Pole Structures

Phase I Wind Development Area Wind Turbine Sites & Related Infrastructure
NOT FOR CONSTRUCTION

Date: 01/05/15
Sheet: 46 of 254



34.5KV 3 POLE RISER (0°), SINGLE CIRCUIT, GUYED HORIZONTIAL CONFIGURATION



34.5KV TANGENT POLE (0°-2°), SINGLE CIRCUIT, DELTA CONFIGURATION

NOTES:

1. DIMENSIONS ARE PRELIMINARY AND WILL VARY DEPENDING GRADE AND LINE ANGLES. TYPICAL POLE HEIGHTS ARE DESIGNED FOR PROJECT CONDUTIONS.
2. POLE TYPE SHOWN IS STEEL; HOWEVER, FINAL DESIGN MAY UTILIZE WOOD AND/OR STEEL POLES DEPENDING ON GEOTECH AND LOADING COMBINATIONS.
3. FOUNDATIONS ARE TO BE TYPICAL AUGER DRILLED AND BACKFILLED WITH NATIVE MATERIAL., UNLESS NOTED OTHERWISE.

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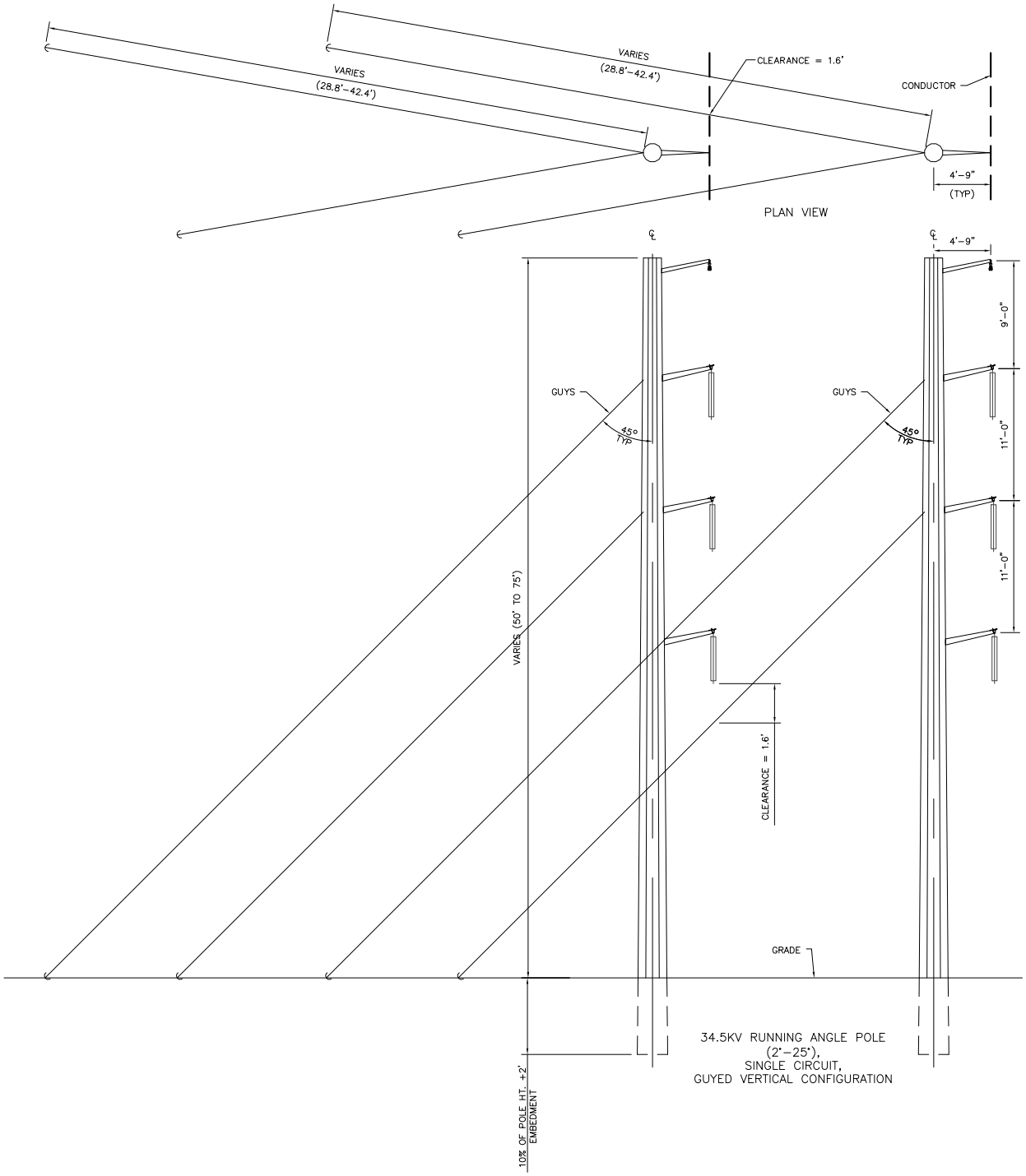
34.5KV Wood Single Circuit Pole Structures

Phase I Wind Development Area Wind Turbine Sites & Related Infrastructure
NOT FOR CONSTRUCTION

Date: 01/05/15
Sheet: 47 of 254



CLEARANCE	MIN (FT)	MAX (FT)
CONDUCTOR TO GUY	1.6'	9.9'
CONDUCTOR TO CONDUCTOR	7.0'	29.9'

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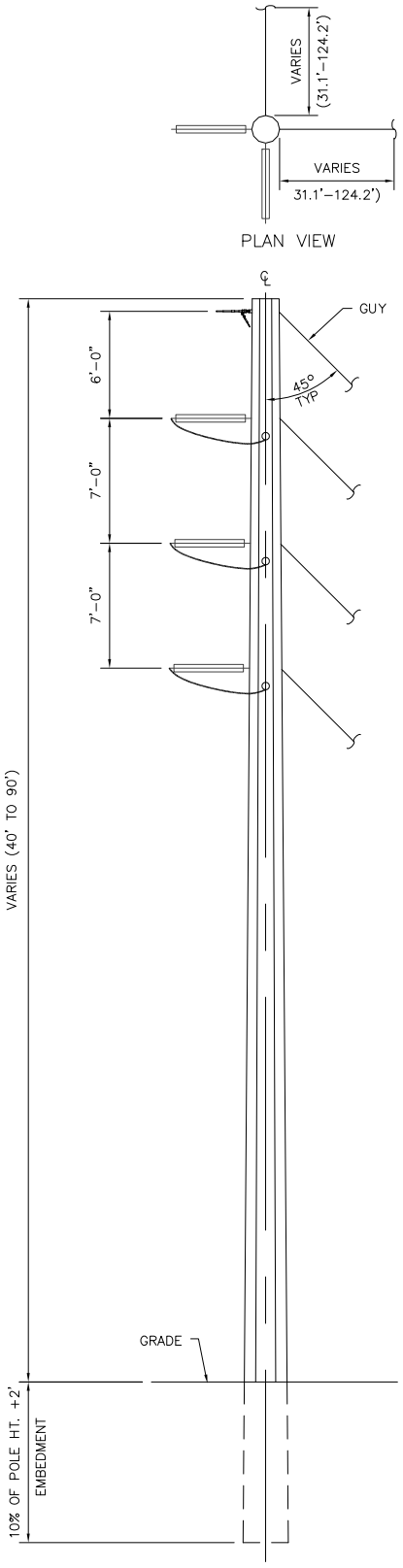
34.5kV RUNNING ANGLE POLE
DOUBLE CIRCUIT
GUYED VERTICAL CONFIGURATION

CLEARANCE REFERENCE DRAWING

7/24/15

Project No.
185028

FIGURE 1



34.5KV DEADEND POLE (>25'), SINGLE CIRCUIT, GUYED VERTICAL CONFIGURATION

CLEARANCE	MIN (FT)	MAX (FT)
CONDUCTOR TO GUY	1.7'	5.8'
CONDUCTOR TO CONDUCTOR	6.6'	29.9'

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34.5kV DEADEND POLE
SINGLE CIRCUIT
GUYED VERTICAL CONFIGURATION

CLEARANCE REFERENCE DRAWING

7/24/15

Project No.
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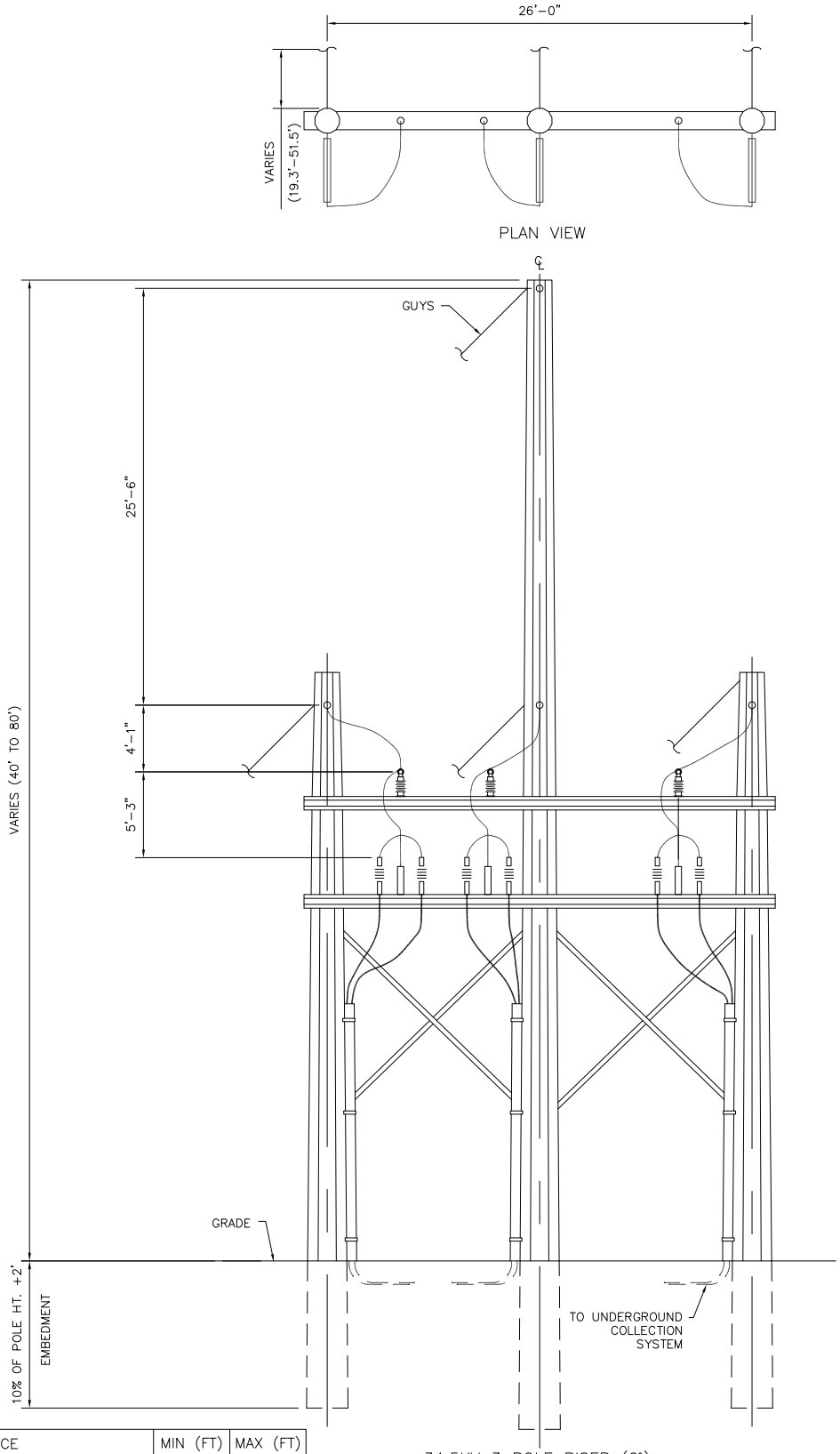
FIGURE 2



CLEARANCE	MIN (FT)	MAX (FT)
CONDUCTOR TO GUY	5.2'	9.9'
CONDUCTOR TO CONDUCTOR	6.7'	29.8'

34.5KV 3 POLE RISER (0°),
SINGLE CIRCUIT,
GUYED HORIZONTIAL
CONFIGURATION

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34.5kV 3 POLE RISER (0°)

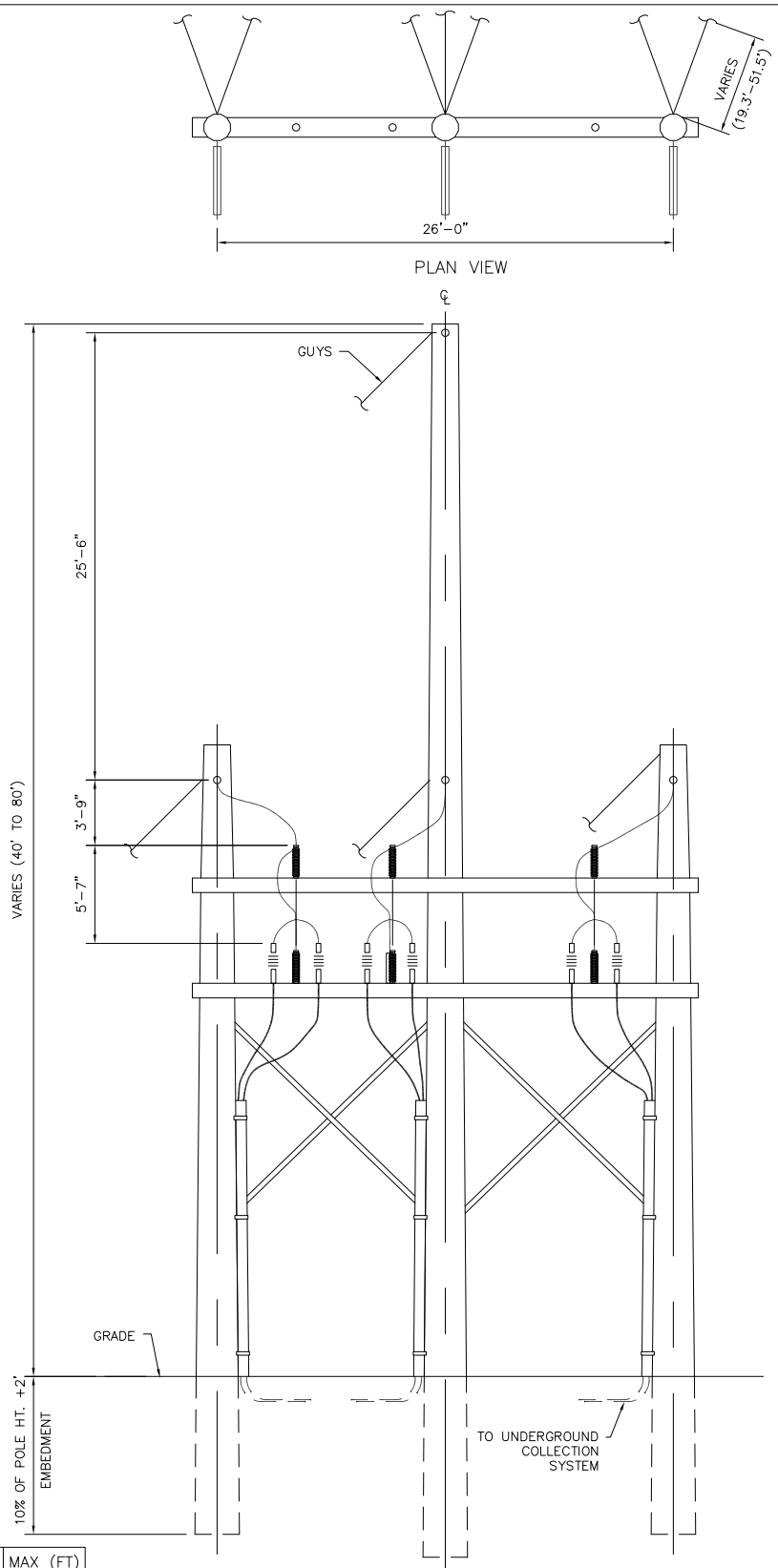
SINGLE CIRCUIT
GUYED HORIZONTIAL CONFIGURATION

CLEARANCE REFERENCE DRAWING

7/24/15

Project No.
185028

FIGURE 3



CLEARANCE	MIN (FT)	MAX (FT)
CONDUCTOR TO GUY	5.2'	9.9'
CONDUCTOR TO CONDUCTOR	6.7'	29.8'

34.5KV 3 POLE RISER (0°),
SINGLE CIRCUIT,
GUYED HORIZONTIAL
CONFIGURATION

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34.5kV 3 POLE RISER (0°)

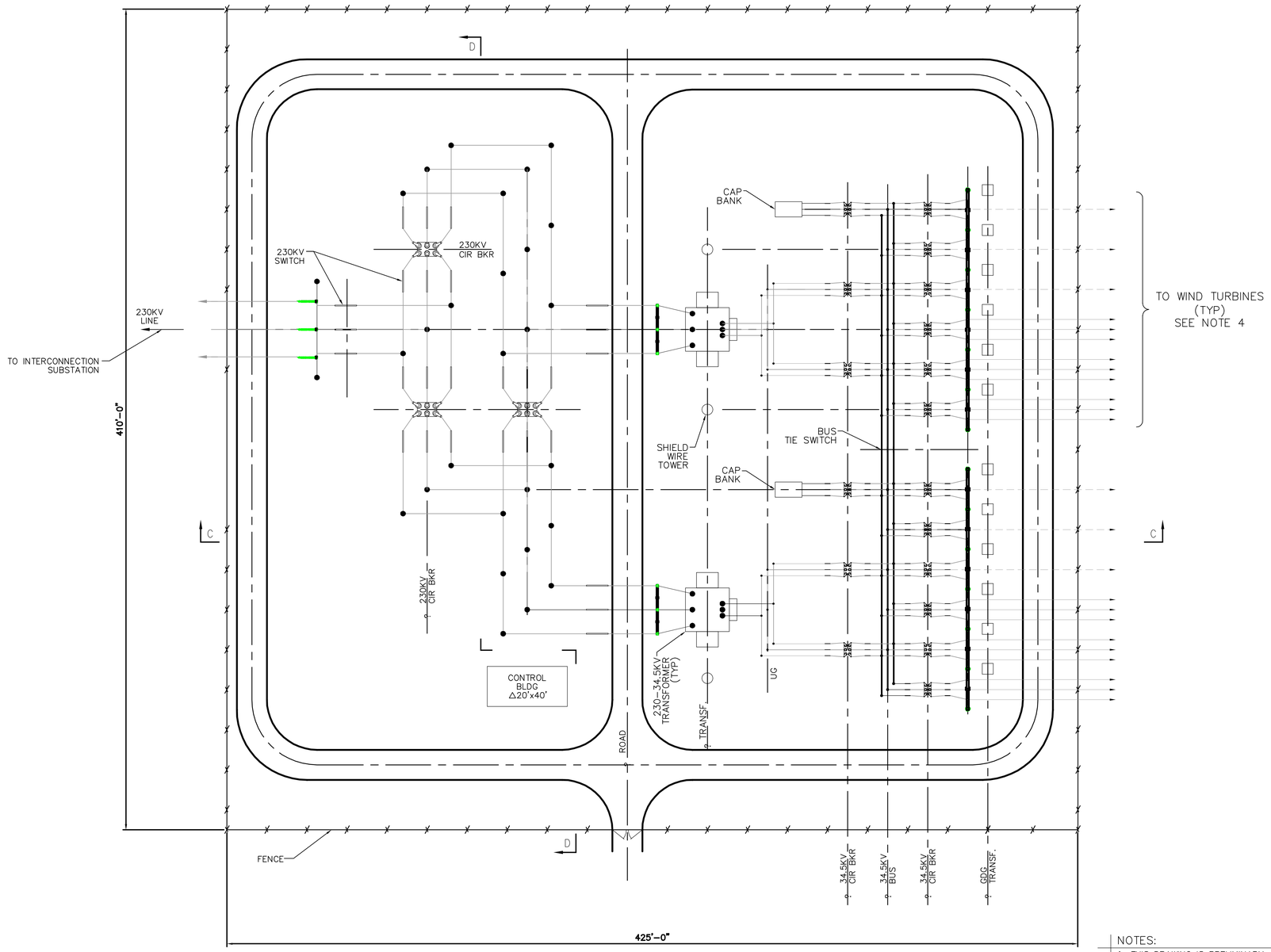
SINGLE CIRCUIT
GUYED HORIZONTIAL CONFIGURATION

CLEARANCE REFERENCE
DRAWING

7/24/15

Project No.
185028

FIGURE 4



30' 15' 0 15' 30' 60'

SCALE IN FEET
1"=30'-0"

NOTES:

1. THIS DRAWING IS PRELIMINARY AND INTENDED TO SHOW THE GENERAL SIZE AND DIMENSIONS OF A TYPICAL ARRANGEMENT BASED ON THE CURRENT CONCEPTUAL DESIGN.
2. ACTUAL NUMBER OF 34.5KV CIRCUITS PER TRANSFORMER BANK COULD VARY BETWEEN 4–6 CIRCUITS. 6 CIRCUITS ARE SHOWN AS A CONSERVATIVE MEASURE.
3. 34.5KV BUS CONFIGURATION IS PRELIMINARY. ACTUAL CONFIGURATION TO BE DETERMINED LATER BASED ON FINALIZED LAYOUTS, DESIGN PARAMETERS, AND OPERATIONS.
4. 34.5KV CIRCUITS FROM WIND TURBINES WILL ENTER THE SUBSTATION AS AN OVERHEAD OR UNDERGROUND CIRCUIT. BOTH OVERHEAD AND UNDERGROUND ARRANGEMENTS ARE SHOWN ON THIS DRAWING.
5. BUS TIE SWITCHES INTENDED TO BE NORMALLY OPEN. IN THE EVENT OF A XFMR FAILURE, THE BUS TIE SWITCH WOULD BE CLOSED TO MINIMIZE LOSS OF GENERATION. THIS SITUATION WOULD REQUIRE SPECIAL OPERATING PROCEDURES AND MAY REQUIRE SOME CURTAILING IN ORDER TO STAY WITHIN EQUIPMENT RATINGS.
6. SEE SHEET 35 FOR CONCEPTUAL ELEVATION VIEWS.

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Chokecherry and Sierra Madre Wind Energy Project

Carbon County, Wyoming

34.5/230KV Substation Plan View 2 Transformer Layout

Phase I Wind Development Area Wind Turbine Sites & Related Infrastructure
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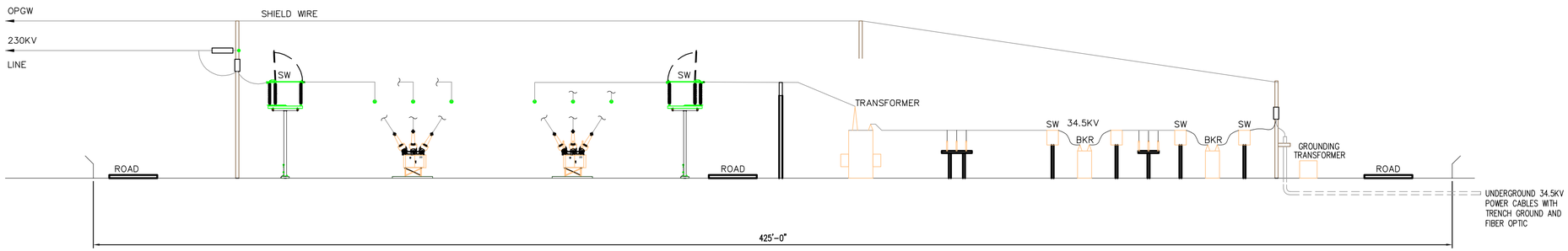
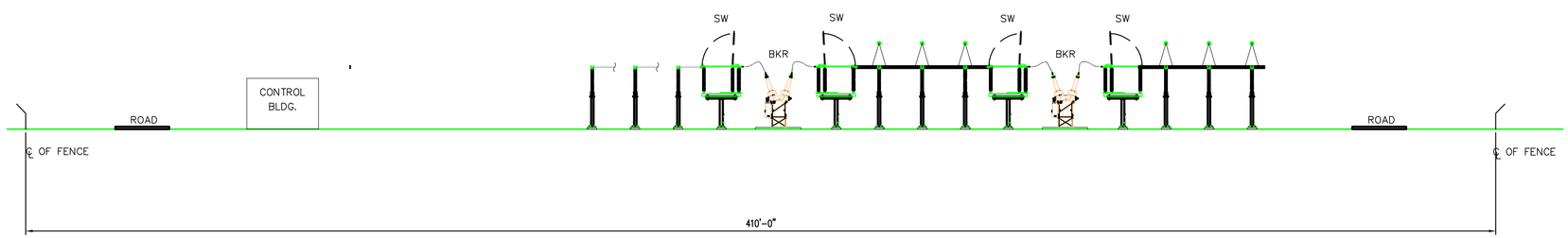
Date: 01/05/15
Sheet: 42 of 254



SECTION C–C



SECTION D–D

20' 10' 0 10' 20' 40'

SCALE IN FEET
1"=20'-0"

NOTES:

1. SEE SHEET 34 FOR CONCEPTUAL PLAN VIEW.

BLACK & VEATCH CORP.
6300 S SYRACUSE WY
SUITE 300
CENTENNIAL CO, 80111

Designed: AGR
Checked: -
Drawn: JEF
Record Drawing by/date:

Revisions:

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Prepared for:

Power Company of Wyoming LLC

555 Seventeenth Street, Suite 2400
Denver, CO 80202 USA

Chokecherry and Sierra Madre Wind Energy Project

Carbon County, Wyoming

34.5/230KV
Substation Elevation
2 Transformer Layout

Phase I Wind Development Area Wind Turbine Sites & Related Infrastructure
NOT FOR CONSTRUCTION

Date: 01/05/15
Sheet: 43 of 254

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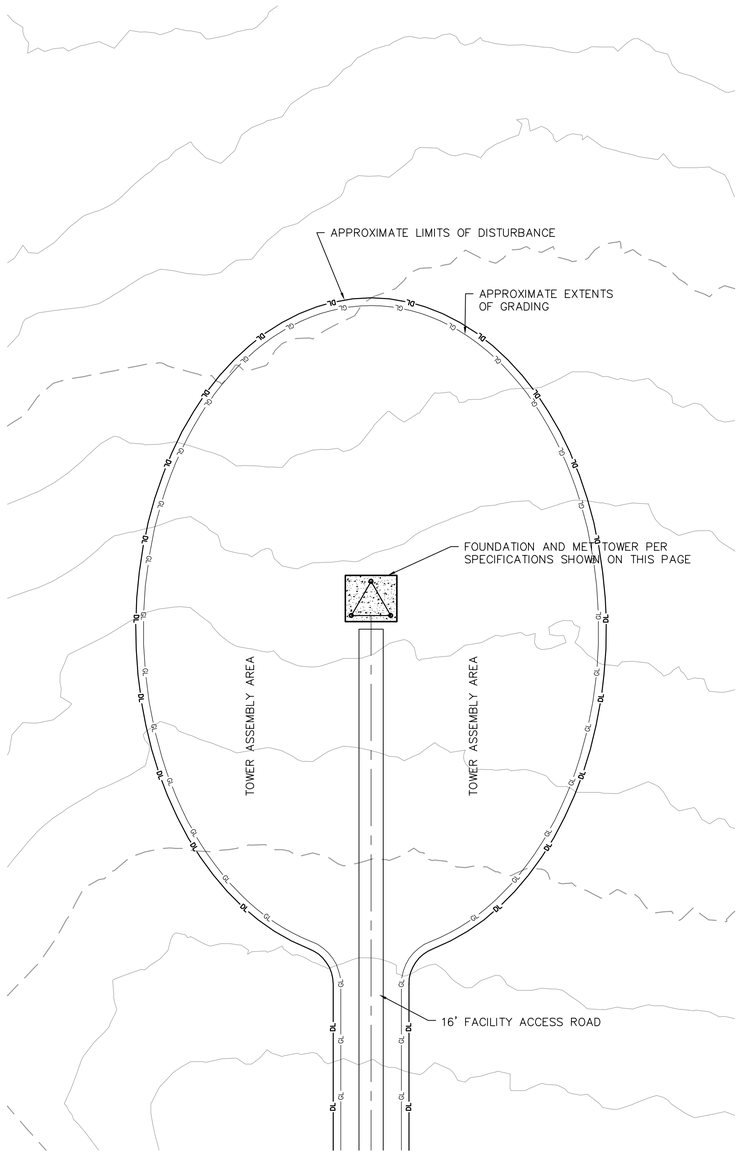
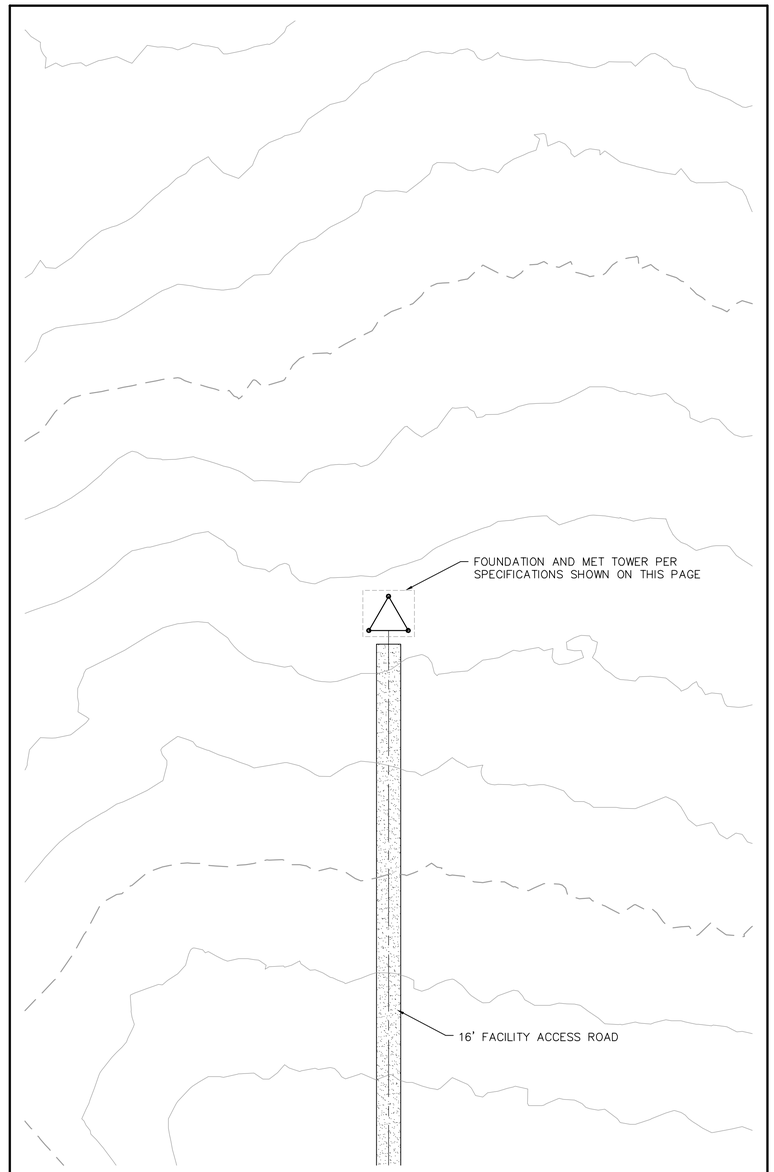


TYPICAL MET TOWER SITE (DURING CONSTRUCTION)

LAST REVISED: 11/13/13

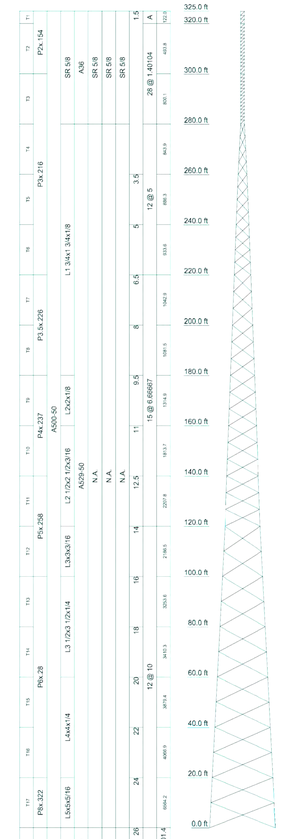
TS16

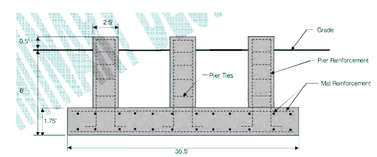


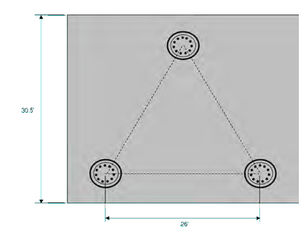
TYPICAL MET TOWER SITE (POST CONSTRUCTION)

LAST REVISED: 11/13/13

TS17







TOWER & FOUNDATION DESIGN PROVIDED BY:

Nello Corporation
211 W. Washington Street, Suite 2000
South Bend, IN 46601-1705
Phone: (574)288-3632
FAX: (574)288-5860

RFQ50164
Project:
Client: AWS Truewind | Drawn by: Nello Corporation | Appr'd:
Code: TIA-222-G | Date: 11/08/13 | Scale: NTS
Path: | Dwg No: E-1

DESIGNS PROVIDED ARE PRELIMINARY AND SUBJECT TO CHANGE. REFER TO FINAL PLANS FOR CONSTRUCTION INFORMATION.

Westwood Professional Services, Inc.
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Designed: DK/KM
Checked: RC/PC
Drawn: KM/TR
Record Drawing by/date:

Revisions:

#	DATE	DESCRIPTION
.	.	.

Prepared for:

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Chokecherry and Sierra Madre Wind Energy Project

Carbon County, Wyoming

Met Tower Details

Phase I Wind Development Area Wind Turbine Sites & Related Infrastructure
NOT FOR CONSTRUCTION

Date: 01/05/15

Sheet: 19 OF 254

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APPENDIX D

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Avian and Bat Monitoring Protocols for the Chokecherry and Sierra Madre Wind Energy Project

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March 2011

Review of Agency Recommendations

The following protocols have been developed in accordance with the following agency recommendations:

U.S. Fish and Wildlife Service (USFWS)
Wind Turbine Guidelines Advisory Committee *Recommendations on Developing Effective Measures to Mitigate Impacts to Wildlife and Their Habitats Related to Land-Based Wind Energy Facilities* (USFWS 2010)
USFWS Draft Land-Based Wind Energy Guidelines (USFWS 2011a)
Draft Eagle Conservation Plan Guidance (USFWS 2011b)

Wyoming Department of Game and Fish (WGFD)
Wildlife Protection Recommendations for Wind Energy Development in Wyoming (WGFD 2010)

Bureau of Land Management (BLM)
Rawlins Field Office *Wildlife Survey Protocols for Wind Energy Development*,

Generally, UFWS survey recommendations (USFWS 2010, 2011a, and 2011b) include using standard sampling methods to determine avian use of a project area, fatality risk in a project area, the presence of sensitive species and other species of interest, and to provide a baseline for assessing displacement effects and habitat loss. USFWS recommends that sampling frequency, type, and duration be sufficient to account for variability of avian use between and within sampling periods. When more precise estimates of density are required for a special status species, other methods, including radar or nocturnal surveys have been recommended when risks for collision are expected.

Similarly, the Bureau of Land Management (BLM) Rawlins Field Office Wildlife Survey Protocols for Wind Energy Development recommends that surveys be sufficient to detect temporal and spatial use patterns within the project area. Special emphasis is placed on surveys for raptors and sensitive avian species. BLM survey protocols recommend weekly, 20-minute point counts to record avian use of a project area. Survey times are recommended to be varied weekly to ensure that avian use during daylight hours is adequately documented. In addition to weekly surveys, marine radar is recommended to better define avian foraging, dispersal, and migration paths.

Wyoming Game and Fish Department's (WGFD) Wildlife Protections Recommendations for Wind Energy Development in Wyoming recommend sufficient numbers of weekly point count surveys during spring and fall migration periods following similar protocols as specific by BLM with survey periods of twenty minutes at each point. WGFD recommends that four surveys be conducted during winter months to capture overwintering avian species. For raptor species, WGFD recommends nest surveys and weekly day-long surveys during spring and fall migration periods.

Review of Existing Data

In compliance with its obligations under the National Environmental Policy Act of 1969 (NEPA), BLM is preparing an environmental impact statement (EIS) analyzing the potential impacts of the Chokecherry and Sierra Madre Wind Energy Project (Project) on lands and resources within the Project area. Between June 2008 and June 2009, avian use data were collected for much of the Project area as part of the BLM NEPA process [Johnson et al. 2008]. Data were collected using standard point count methods at 19 locations in all months except January and February when much of the Project area was inaccessible due to adverse weather conditions. All sites except for three were visited 31 times during the survey period.

WEST, Inc. (WEST) conducted avian point surveys of the Project area between June 26, 2008 and June 15, 2009. A portion of these data are analyzed in WEST's report, "*Baseline Avian Use Studies for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Summer and Fall Interim Report, June 26-October 14, 2008*" (Johnson et al. 2008). WEST also prepared a report summarizing bat surveys conducted between July 13 through October 13, 2008 titled, "*Bat Surveys for the Chokecherry and Sierra Madre Wind Resource Areas, Carbon County, Wyoming: Final Report*" (Solick et al. 2008). SWCA has completed additional analyses of all data collected in 2008 and 2009 to determine compliance with various agency monitoring recommendations.

Data collected during the 2008 and 2009 surveys are sufficient to provide estimates of avian use of the Project area as well as to provide initial estimates of the frequency of each species at rotor-swept heights. Horned lark (*Eremophila alpestris*) was predominantly the most common avian species detected in the 2008 and 2009 surveys, having over 800 individual detections. The next most common species were the common raven (*Corvus corax*) with less than 200 detections, and vesper sparrow (*Pooecetes gramineus*) with less than 150 detections. Golden eagle (*Aquila chrysaetos*), red-tailed hawk (*Buteo jamaicensis),* and common raven were most commonly observed within the rotary height of the turbines.

Data collected during 2008 and 2009 comply with the agency wind energy survey recommendations described in the previous section and serve as one year of suggested pre-construction monitoring data. Data collected for purposes of NEPA compliance provide estimates of collision and fatality risk and enable determination of avian use of the Project area, the presence of sensitive species and other species of interest, as well as providing a baseline for assessing displacement effects and habitat loss.

Project-Specific Protocols

To supplement the 2008-2009 dataset and to better identify concentrated avian use areas for development of a Project-specific Avian Protection Plan (APP) and an Eagle Conservation Plan (ECP), an intensive one-year survey will be used to better identify avian use areas in the Project area. Protocols have been developed following the various agency recommendations discussed above and in coordination with local USFS, BLM, and WGFD biologists. The protocols are consistent with agency recommendations and will provide more detailed site-specific use data than the protocols individually recommended by any of the agencies.

A combination of avian radar, raptor count stations, standard grid sampling, and point count surveys will be used to determine avian use across the Project area with emphasis on large raptors including golden eagles. Avian radar technology has been identified by the BLM and USFWS as a desired method to map areas of high avian use. The sampling design will follow recommendations made by the USFWS, BLM, and WGFD by combining radar surveys with standard point count and breeding bird methodologies. The radar technology will also enable better identification of bat use areas and relative densities of bats in the Project area.

A DeTect Merlin Avian Radar System will be used to map avian use across the Project area. The DeTect Merlin radar system is a trailer-mounted system with a 200-watt horizontal solid-state S-band radar and a 10–kilowatt (kW) vertically operating X-band open array radar. The horizontal radar has a range of 2 to 5 miles in a 360-degree pattern around the unit. The vertical radar has a 24-degree beam width and detects flight paths 0.75 to 2.00 miles above the unit.

The avian radar system requires weekly maintenance and fueling and cannot be moved over extremely rough terrain on a regular basis. Additionally, the system will not differentiate between large raptors such as golden eagles and other large birds including geese, other large raptors, and possibly even ravens and; therefore, will be used in conjunction with field surveys to validate radar recorded data. However, the radar system, when coupled with point count verification of avian use, will allow for accurate horizontal and vertical mapping of avian use in the Project area. The radar system will also enable mapping of high use areas for bat species.

A combination of raptor and point surveys and breeding bird grid surveys will be conducted in concert with the radar survey. This design will provide intensive survey information regarding avian use patterns within the radar survey perimeter for each season. Raptor count stations, point counts, and breeding bird surveys will be used to validate the radar data and provide estimates of species-specific use patterns. Raptor stations and point count surveys will record the location, flight path, approximate height, and time of use for any individual observed from the count location. Raptor count locations will be surveyed for 8-12 hours per day during periods with the highest likelihood for detection of migrating birds and/or large raptors. Standard 20-minute point counts will be completed at each raptor count location. Timing of point count surveys at each location will be varied to determine patterns of avian use during daylight hours.

In addition to the raptor, point count, and radar surveys, breeding bird surveys will be completed at 15 locations across the Project area. Breeding bird surveys will be conducted following the grid monitoring protocols published by the Rocky Mountain Bird Observatory (RMBO) (Hanni et al. 2010). Grid survey locations will be randomly selected using a generalized random tessellation stratified design to ensure a spatially balanced design stratified by major vegetation and habitat types in the Project area. Data collected as part of the grid monitoring efforts will also be used to validate radar data and better determine avian species use. As part of the breeding bird surveys, waterfowl and water bird use surveys will be conducted three times annually (springs, summer, and fall) to identify migrating and resident species.

Locations for placement of the radar and for conducting point count surveys (Figure 1) and breeding bird surveys were determined using a four-tiered approach:

- Tier 1 – Survey areas should determine avian use within the Project area.

- Tier 2 – Survey areas should overlap possible foraging areas for large raptors (winter range areas, prairie dog towns, waterfowl use areas, etc.).
- Tier 3 – Survey areas should be in locations to allow for detection of avian movement into and out of the Project area.
- Tier 4 – Survey areas should capture variability in habitat and topography.

Locations of radar placement were refined following attendance at DeTect's radar training courses and during coordination with DeTect's radar placement specialists. Figure 1 reflects the revised radar locations. Final placement of the radar unit and final point locations for survey will be determine in early spring 2011 following radar unit delivery.

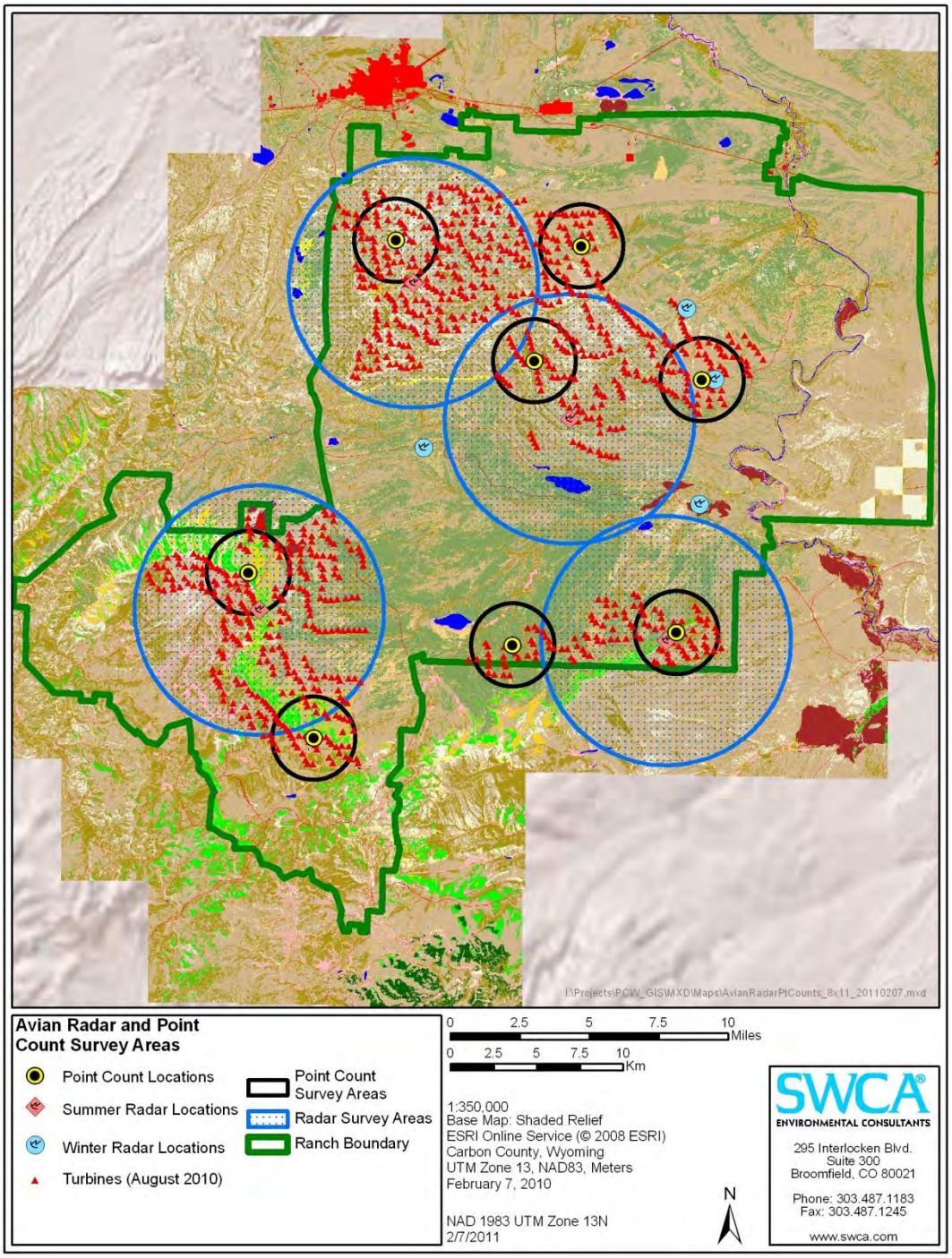

Figure 1. Approximation of area surveyed using avian radar and traditional point count methodologies with respect to possible wind turbine locations. Spring, summer, and fall radar installation locations are the center point of the large blue circles. Proposed point count locations are the center points of the small black circles. Potential winter radar locations are the four blue points. Final locations for survey will be determined in coordination with BLM, WGFD, and USFWS.

The radar unit will be placed at five locations within the Project area (Figure 1). Point counts will be completed at nine additional locations to map avian use patterns where radar coverage is not possible. Eight of these point counts will be completed at permanent sampling locations. The ninth point count location will be completed at the radar site to validate the data being collected by the radar unit. During winter months, the radar will be placed in a location that has high probability of access on a weekly basis. Much of the project area is covered in snow and large drifts during winter; therefore, radar placement in winter will likely be near the Bolton Ranch headquarters, south of I-80 near the North Platte River, on the Bolton Road east of Teton Reservoir, or on the north side of the Chokecherry project area (Figure 1). Winter point count survey locations will also be adjusted as needed to account for winter weather conditions, access issues, and safety concerns.

Based on a four mile radius for radar surveys and a one mile radius for point count surveys, approximately 90-93% of the turbine locations, depending on winter radar placement, will be directly surveyed. It is likely that this percentage is higher than 90-93% for large raptors including bald and golden eagles as many of the point count locations have visibility of several miles and recent radar advancements may allow for detection of large raptors out to 5+ miles. Point count locations outside of the radar survey perimeters have been placed to allow for detection of raptors moving into the Project area and between radar surveyed zones.

Helicopter flights will be completed in mid-April or early May to document eagle nesting activity as well as nesting activity of other raptors that are incidentally observed. Aerial nest activity surveys will be completed in accordance with the recent draft eagle guidance (USFWS 2011b). Following identification of active eagle nests, follow-up productivity surveys will be completed from the ground above/below the nest to determine nesting and fledging success.

The protocols and schedule outlined below will be followed for monitoring and mapping avian and bat use across the Project area using the marine radar system, point counts, and breeding bird surveys.

1. Winter 2010/2011 – Radar construction, programming, and training. The Draft APP/ECP will be delivered to USFWS, BLM, and WGFD for review in late winter/early spring. Among other descriptive sections, the preliminary plan will contain the detailed sampling protocols, preliminary mitigation and avoidance measures, and detailed adaptive management protocols. Monthly reconnaissance surveys will be completed to document eagle use of the Project area during winter months and to help determine best locations for winter 2011/2012 deployment of the radar system.

2. Spring and Early Summer 2011 – Radar surveys will begin in the southern portion of the Project area. The radar system will be moved once during the spring migration period to capture as much data as possible during this period. During the migration period, weekly migratory bird counts and raptor use surveys will be conducted at the eight point counts identified in Figure 1 as well as at the point where the radar system is placed. Breeding bird surveys will be completed at 15 locations across the Project area. Surveys for waterfowl and other waterbirds will be conducted once during the spring migration at Kindt, Rasmussen, Sage Creek, and Teton reservoirs. Analysis of the radar data will be

used to identify areas with high avian and bat use. The following schedule will be used for spring and early summer 2011 surveys:

a. March 15 – May 15, 2011: Radar system will be initialized and debugged prior to main migratory period. Initial installation will occur at the southeastern-most radar survey location identified on Figure 1. This survey location will detect migrating birds in areas adjacent to the Platte River corridor and along the ridgeline north of the Jack Creek road. Weekly point count locations will be completed at the eight point count locations identified in Figure 1 as well as at the radar location.

b. May 15–July 31, 2011: Radar system will be moved to the northeastern survey location (Figure 1). This survey location will detect migrating birds adjacent to and along the Bolten Rim as well as in the basin below the Bolten Rim. Migratory use and raptor soaring locations within and adjacent to the ridgelines in this portion of Chokecherry will also be surveyed using the radar system. Between May 15 and June 30, weekly point surveys will be conducted at the eight locations identified on Figure 1 as well as at the radar location. During the month of July, the point count locations will be visited twice instead of every week in compliance with BLM and WGFD recommendations. Additionally, this time is between migratory periods and typically bird movements are lower because of nesting activities. A point count will be conducted weekly at the radar installation location during this period during routine maintenance activities.

c. May 25–June 30, 2011: Breeding bird surveys will be completed once at each of 15 locations across the Project area to determine relative abundance, species richness, and habitat use patterns. Breeding bird surveys will follow RMBO grid survey protocols (Hanni et al. 2010). Bird flight patterns will be documented to better define risks of wind development activities. All raptors as well as their flight paths and heights will be recorded at all breeding bird locations regardless of whether the raptor falls within the grid survey area.

d. May 1, 2011: An agency meeting will be scheduled to discuss preliminary analyses of radar data from early spring migration to allow for more informed use of the radar and survey data that will be used in the APP/ECP.

3. Late Summer – Fall 2011: The radar system will be moved once during the fall migration period to capture as much data as possible during this period. During the migration period, weekly migratory bird counts and raptor use surveys will be conducted at the eight point counts identified in Figure 1 as well as at the point where the radar system is placed. Waterfowl and wading bird surveys will be conducted once during late summer to detect nesting activity and once during fall migration at Kindt, Rasmussen, Sage Creek, and Teton reservoirs. Analysis of the radar data collected during spring and early summer will be completed to evaluate bird and bat use and to identify appropriate mitigation measures that could be implemented. The following schedule will be used for late summer and fall 2011 surveys:

a. August 1: A revised APP/ECP will be delivered to the agencies for review and approval. The revised APPECP will contain the mitigation measures that will be applied to remove or minimize risks to avian species. The revised APP/ECP will also identify the adaptive management process that will be followed to update the APP/ECP and apply additional site-specific mitigation measures as additional data are obtained prior to, during and after construction. An interim report of radar data trends and observations will also be provided with the revised APP/ECP.

b. August 1– September 30, 2011: Radar system will be installed at the western radar location in the Chokecherry project area radar survey location identified on Figure 1. This survey location will detect migrating birds in the western portion of Chokecherry as well as along the rim of Chokecherry and the basin between Chokecherry and Atlantic Rim. During the month of August, the point count locations will be visited twice instead of every week. A point count will be conducted weekly at the radar installation location during August as part of routine maintenance activities. During September, weekly point count locations will be completed at the eight point count locations identified in Figure 1 as well as at the radar location.

c. October 1–November 15, 2011: Radar system will be moved to a location along the rim of Miller Hill in the southwestern portion of the project area (Figure 1). This survey location will detect birds in the Miller Hill area and below the Miller Hill rim in the Sage Creek Basin. Weekly point count surveys will be conducted at the eight locations identified on Figure 1 as well as at the radar location.

4. Winter 2011/2012 (November 16, 2011–March 30, 2012) – A final APP/ECP will be delivered to the agencies for review. The final APP/ECP will identify the avoidance, minimization, and mitigation measures to reduce threats to eagles and other avian species. The radar system will be deployed in a suitable location to ensure weekly maintenance is possible during winter months. Weekly bird observations will be recorded during routine maintenance activities at the radar location. Weather permitting, monthly counts will be conducted at the point count locations in Figure 1.

5. Spring 2012 – PCW and the agencies will initiate the adaptive management process identified and approved in the final APP to incorporate site-specific mitigation and avoidance measures into final project designs and the Final Environmental Impact Statement and Record of Decision. A final report documenting the results of the radar and point count efforts will be provided at least two weeks prior to the initiation of the adaptive management process to ensure adequate review time prior to discussions.

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2012 – 2013 800-meter Raptor Survey Protocols

Chokecherry and Sierra Madre Wind Energy Project

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August 31, 2012

Introduction

The Power Company of Wyoming LLC (PCW) recently initiated revisions to the methodologies currently used to survey for raptors at the Chokecherry and Sierra Madre Wind Energy Project (Project). Based on conversations with U.S. Fish and Wildlife Service (Service) personnel, and in an effort to collect data that are appropriate for use in the Service's model that predicts the potential fatality rate of eagles for wind energy projects (hereafter, the Service's model), raptor survey protocols were revised for the fall 2012 season and for future raptor survey efforts. These survey methodology revisions are fully compliant with the recommendations for raptor surveys set forth by the Service in their Draft Eagle Conservation Plan Guidance (Draft ECP Guidance), the Eagle Conservation Plan Guidance Module 1 – Land-based Wind Energy Technical Appendices (Technical Appendices; as received from Kevin Kritz, Service Region 6, on August 4, 2012), and the Land-Based Wind Energy Guidelines, while still maintaining expansive coverage of the Project site.

Year Two and Year Three 4,000-meter-radius long-watch raptor surveys were fully compliant with the recommendations set forth by the Service's Draft ECP Guidance (Service 2011) and Land-Based Wind Energy Guidelines (Service 2012a), the Bureau of Land Management's (BLM's) Wildlife Survey Protocols for Wind Energy Development (BLM 2008), and the Wyoming Game and Fish Department's (WGFD's) Wildlife Protection Recommendations for Wind Energy Development (WGFD 2010). These surveys were successful in identifying concentrated raptor use areas across the Project that could be used to design avoidance areas in order to minimize avian impacts. Additionally, 4,000-meter data were instructive in showing the Project site is not a strong migratory corridor for raptors, and the flight paths digitized from these data were used to identify high eagle-use areas as recommended by the Service's Technical Appendices (Service 2012b).

Because the Service's model requires data from 800-meter point count survey efforts, the 4,000-meter data were truncated to include only those observations that occurred within 800 meters (Figure 1). However, due to the 4,000-meter raptor count locations being placed on promenades, ridgelines, and in areas where there was an expectation of high raptor use, estimates of use, and therefore risk calculations that were developed for use across the entire Project site, were overstated due to many of these data being collected in identified high-use areas. Because use estimates were being driven upwards for the Project by many of the data being collected in high-use areas, unrealistic projections of eagle risk were being generated by the Service's model. This in part facilitated the revision to survey protocols.

800-meter Raptor Survey Protocols

The revised raptor count protocols follow the 800-meter radius point count methodology recommended by the Service's Technical Appendices (Service 2012b), and are also in accordance with the aforementioned guidance documents produced by the Service, BLM, and WGFD. PCW also sought consultation with Dr. Joshua Millspaugh (Professor of Wildlife Management, University of Missouri) to ensure the development of a rigorous sampling design that would result in the collection of data appropriate for the analysis methods and fatality model currently being used by the Service.

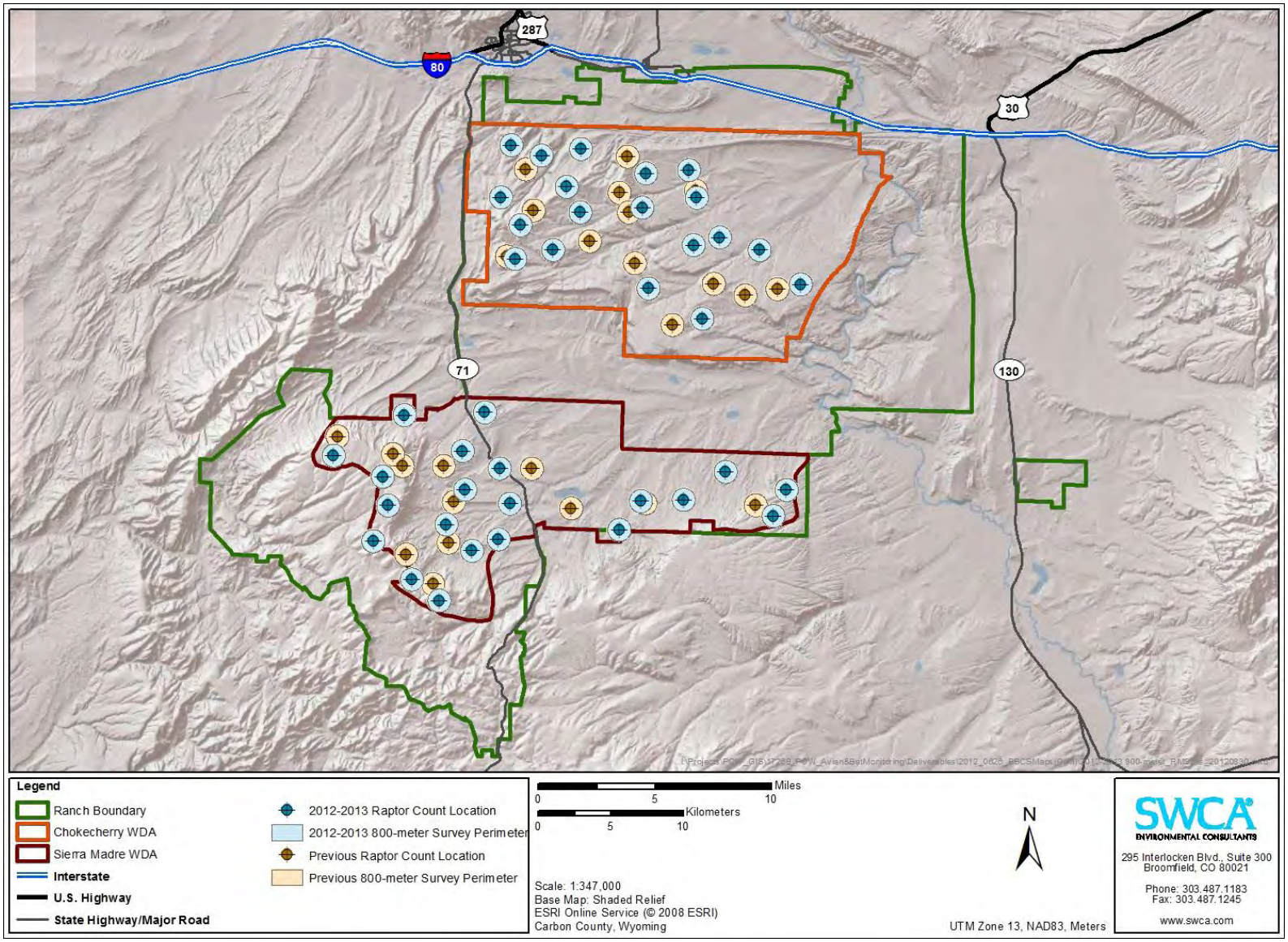

Figure 1. All 800-meter raptor count locations and survey perimeters on the Project site.

Based upon agency guidance and logistical considerations, the revised protocols were designed to include 40, 800-meter raptor count locations throughout areas of the Project site where turbine development was likely (Figure 1). Locations were selected using a spatially balanced random selection process with the number of 800-meter raptor count locations per area determined by the relative turbine density in the different areas of the Project. Raptor count locations were selected such that no overlap occurs between survey locations or with the avoidance areas that PCW has committed to as part of the Project Eagle Conservation Plan (ECP). Once the initial 800-meter raptor count locations were selected, some minimal micrositing of the locations was conducted to ensure full visibility of the survey areas and safe and consistent accessibility on the part of field personnel. Coordinates for each of the final 800-meter raptor survey locations are listed in Table 1. Landmarks and lathe stakes were located within each survey location perimeter to provide distance references for field personnel completing survey efforts. When the 800-meter radius survey areas of the new 40 point count locations are combined with the 800-meter radius survey areas of the Year Two and Year Three sites, 34.7% of the probable development areas are covered by raptor count surveys, which is greater than the 30% recommendation made by the Service (Service 2012b).

Table 1. Names and Coordinates for 2012 – 2013 800-meter Raptor Count Locations.

Location	Easting	Northing
CB1	326414	4597515
CB2	321985	4595451
CB3	323462	4597428
CB4	329306	4599449
CC1	316611	4621251
CC2	315166	4616447
CC3	318351	4619090
CC4	314539	4621971
CC5	317418	4614741
CC6	319335	4621702
CC7	313825	4618366
CC8	314807	4614119
CC9	319294	4617332
CMD1	334482	4612363
CMD2	331648	4614732
HB1	323818	4620014
HB2	326781	4620243
MH1	302291	4600564
MH2	305677	4599125
MH3	307684	4592030

Location	Easting	Northing
MH4	305024	4594675
MH5	309573	4590571
MH6	306043	4597131
PG1	313663	4594801
PG2	311358	4598224
PG3	307172	4603361
PG4	314434	4597259
PG5	313730	4599682
PG6	312721	4603547
PG7	310058	4595825
PG8	311832	4594006
PG9	311187	4600886
SCR1	333505	4598194
SCR2	332597	4596408
SR1	323560	4617658
SR2	327318	4618336
UH1	328912	4615606
UH2	327099	4615081
UI1	323987	4612091
UI2	327702	4610001

Surveys will be conducted at each raptor count location for two hours per guidance in the Technical Appendices (Service 2012b). Two avian technicians will each survey two locations a day for a total of 20 locations per week. Each location will be surveyed bi-weekly. A schedule for all 40 raptor count locations was designed to provide survey coverage across all daylight hours for each of the 40 sites. The schedule was also designed such that the four

raptor count surveys conducted on any given day are separated temporally and spatially to provide independence of any observations that are made.

Avian technicians are equipped with binoculars, spotting scopes, laser rangefinders, and aerial maps to assist with accurate detection and documentation of all raptors observed within the 800-meter survey area. Each aerial map is displayed with relevant landforms occurring in the area, locations of lathe stakes, and concentric rings at each 200-meter interval to facilitate accurate distance estimation (Attachment 1). Each raptor flight path is recorded by technicians on the provided aerial maps. Additional data collected include species, number of individuals per observation, age, sex, behavior, bearing to bird, distance to bird, heading of bird, altitude of bird, the beginning and ending time for each observation, and hourly weather data (Attachment 2).

At present, the 800-meter raptor counts are scheduled to continue bi-weekly at each location through the fall migration period (November 15). Surveys are tentatively slated to occur once per month at each location during the winter season (December 2012 through March 2013) due to accessibility and safety concerns. The end of winter surveys in March 2013 will complete three full years of data collection for the Project. Consultations are ongoing with Service personnel to determine the scope of potential survey efforts beyond March 2013.

References

Bureau of Land Management (BLM). 2008. Wildlife Survey Protocols for Wind Energy Development.

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———. 2012a. Land Based Wind Energy Guidelines. Wind Turbine Guidelines Advisory Committee. U.S. Fish and Wildlife Service, Department of the Interior, Washington D.C. Available online at http://www.fws.gov/windenergy/docs/WEG_final.pdf. Accessed August 2012.

———. 2012b. Eagle Conservation Plan Guidance Module 1 – Land-based Wind Energy Technical Appendices. Received from Kevin Kritz, Service Region 6, on August 4, 2012.

Wyoming Game and Fish Department (WGFD). 2010. Wildlife Protection Recommendations for Wind Energy Development in Wyoming. Wyoming Game and Fish Commission Approved November 17, 2010. Wyoming Game and Fish Department, Cheyenne, WY.

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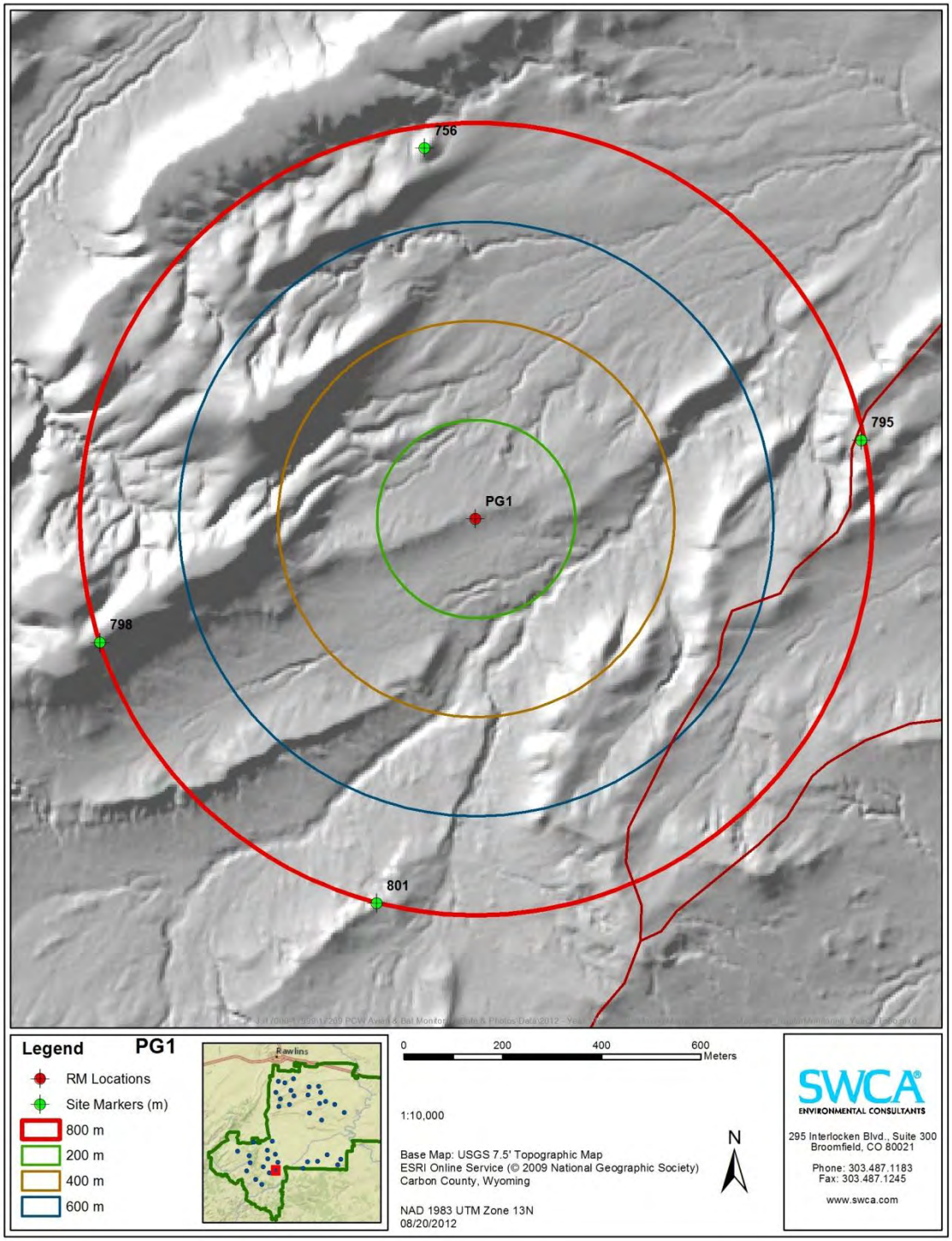
ATTACHMENT 1

Example Aerial Map Used to Map Flight Paths during 800-meter Raptor Count Surveys



Aerial map example.

ATTACHMENT 2

Data Sheets Used to Collect Data during 800-meter Raptor Count Surveys

PCW 2011 Raptor Survey

Field Observer: _____

Survey Location: _____

Start time: _____

End time: _____

Date: _____

Page: ____ **of** _____

Target #	Obs #	Species	# Birds	Age	Sex	Behav	Bearing to Bird (°)	Distance to Bird (m)	Angle of Bird (°)	Heading of Bird	0-30	30-150	150+	Time Begin	Time End

PCW 2011 Raptor Survey Notes

Field Observer: _____ **Survey Pt:** ____

Date: _____ **Page:** _____ of _____

Other species and Notes:

Weather Conditions				
		Wind		
Time	Sky	Dir	Spd	Temp (°F)

Incidental Species Observations

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Revised 2012-2013 800-meter Raptor Survey Protocols

Chokecherry and Sierra Madre Wind Energy Project

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November 2012

The Power Company of Wyoming (PCW) recently initiated revisions to the methodologies currently used to survey for raptors at their Chokecherry and Sierra Madre Wind Energy Project (Project). Based on conversations with U.S. Fish and Wildlife Service (Service) personnel, and in an effort to collect data that are appropriate for use in the Service's model that predicts the potential fatality rate of eagles for wind energy projects (hereafter, the Service's model), raptor survey protocols were revised for the fall 2012 season and for future raptor survey efforts. On August 31, 2012, PCW provided the Service with a revised protocol for conducting eagle and raptor surveys at 40 800-meter point count survey sites throughout the Project. PCW began surveying the 40 locations at the beginning of the autumn 2012 survey season and it is anticipated that those survey efforts will continue through October 2012 at which time the revised protocols discussed in this document will be initiated. On September 28, 2012, the Service issued a letter recommending slight modifications to the August 31, 2012 protocols. This revised protocol addresses the comments made by the Service and specific responses to each comment made are provided in Attachment 1.

These survey methodology revisions are fully consistent with the recommendations for raptor surveys set forth by the Service in their Draft Eagle Conservation Plan Guidance (Draft ECP Guidance), the Eagle Conservation Plan Guidance Module 1 – Land-based Wind Energy Technical Appendices (Technical Appendices; as received from Kevin Kritz, Service Region 6, on August 4, 2012), and the Land-Based Wind Energy Guidelines, while still maintaining expansive coverage of the Project Site.

Year Two and Year Three long-watch raptor surveys were fully consistent with the recommendations set forth by the Service's Draft ECP Guidance (Service 2011) and Land-Based Wind Energy Guidelines (Service 2012a), the Bureau of Land Management's (BLM's) Wildlife Survey Protocols for Wind Energy Development (BLM 2008), and the Wyoming Game and Fish Department's (WGFD's) Wildlife Protection Recommendations for Wind Energy Development (WGFD 2010). These surveys were very successful in identifying concentrated raptor use areas across the Project that could be used to design avoidance areas to minimize avian impacts. Additionally, long-watch survey data were instructive in showing the Project Site is not a strong migratory corridor for raptors, and the flight paths digitized from these data were used to identify high eagle use areas as recommended by the Service's Technical Appendices (Service 2012b).

The revised raptor count protocols follow the 800-meter radius point count methodology recommended by the Service's Technical Appendices (Service 2012b), and are also in accordance with the aforementioned guidance documents produced by the Service, BLM, and WGFD. PCW also sought consultation with Dr. Joshua Millspaugh (Professor of Wildlife Management, University of Missouri) to ensure the development of a rigorous sampling design that would result in the collection of data appropriate for the analysis methods and fatality model currently being used by the Service.

Based upon agency guidance and logistical considerations, the revised protocols were designed to include 60, 800-meter raptor count survey sites throughout the Chokecherry and Sierra Madre Wind Development Areas (WDAs) where turbine development is likely (Figures 1 and 2). Most of the 60 survey sites are identical to the original 40 sites identified in the August 31, 2012 protocols. However, some of those 40 sites were shifted slightly to

accommodate the placement of the additional 20 survey sites and ensure that no overlap occurs between samples. Seven of the new sites correspond to raptor monitoring locations that were used in 2011 and spring 2012 survey efforts (RM2, RM7, RM9, RM10, RM12, RM14, and RM15). Efforts were made to resample as many of the previous sampling sites as possible. However, because of PCW's Project re-design efforts identified in the Project Eagle Conservation Plan (ECP), many of the previous sampling locations are outside or on the very edge of the current development area and could not be included without violating the spatially balanced design that is critical to these protocols.

A spatially balanced sampling design was used to capture the variability in habitat conditions, terrain features, and turbine numbers and densities. Minimum convex polygons (MCPs) were placed around each of 10 discrete potential development areas that are separated by Turbine No-Build areas, topography, or other factors (Figures 1 and 2). MCPs were evaluated for differences in habitat characteristics, forage potential, and topography. While differences in habitat characteristics, forage potential, and topography occur among the 10 MCPs, within each MCP, these factors are similar and additional stratification beyond the MCP level was not necessary.

Using the "Create Spatially Balanced Points" tool in ArcGIS Geostatistical Analyst, 250 spatially balanced locations were generated within the MCPs. Using the spatially balanced points, survey sites were selected sequentially in a manner that was consistent with the recommendations made by the Service while ensuring that no overlap occurs between survey areas. Total number of sampling sites per MCP was based on the relative surface area and number of turbines in the MCP. Two primary selection criteria were used to select sampling sites. First, no overlap of sampling areas was permitted (sites had to be separated by more than 1,650 meters). Second, because of logistical considerations, sampling sites were required to be reasonably accessible from the existing road network and in a safe location. If a potential sampling location violated either of the selection criteria it was dropped and the next point was evaluated. Tables 1 and 2 provide the locations of each sampling site in the WDAs as well as information specific to the MCPs and sampling sites.

The first 36 survey sites that were selected correspond to locations that were identified in the August 31, 2012 protocols. These were sequentially selected using the spatially balanced points that were generated as part of the process described above while controlling for site overlap and logistical considerations for survey. Of the remaining 24 sites, 4 correspond with the original 40 sites with locations slightly shifted to avoid overlap with new sites, 7 correspond with the long-watch raptor monitoring sites that were surveyed in 2011 and spring/summer 2012, 3 were selected outside of the current probable turbine footprint, and 10 were selected using the remaining spatially balanced points. Some minimal micrositing of the new locations is anticipated to ensure maximum visibility of the survey areas as well as safe and consistent accessibility on the part of field personnel.

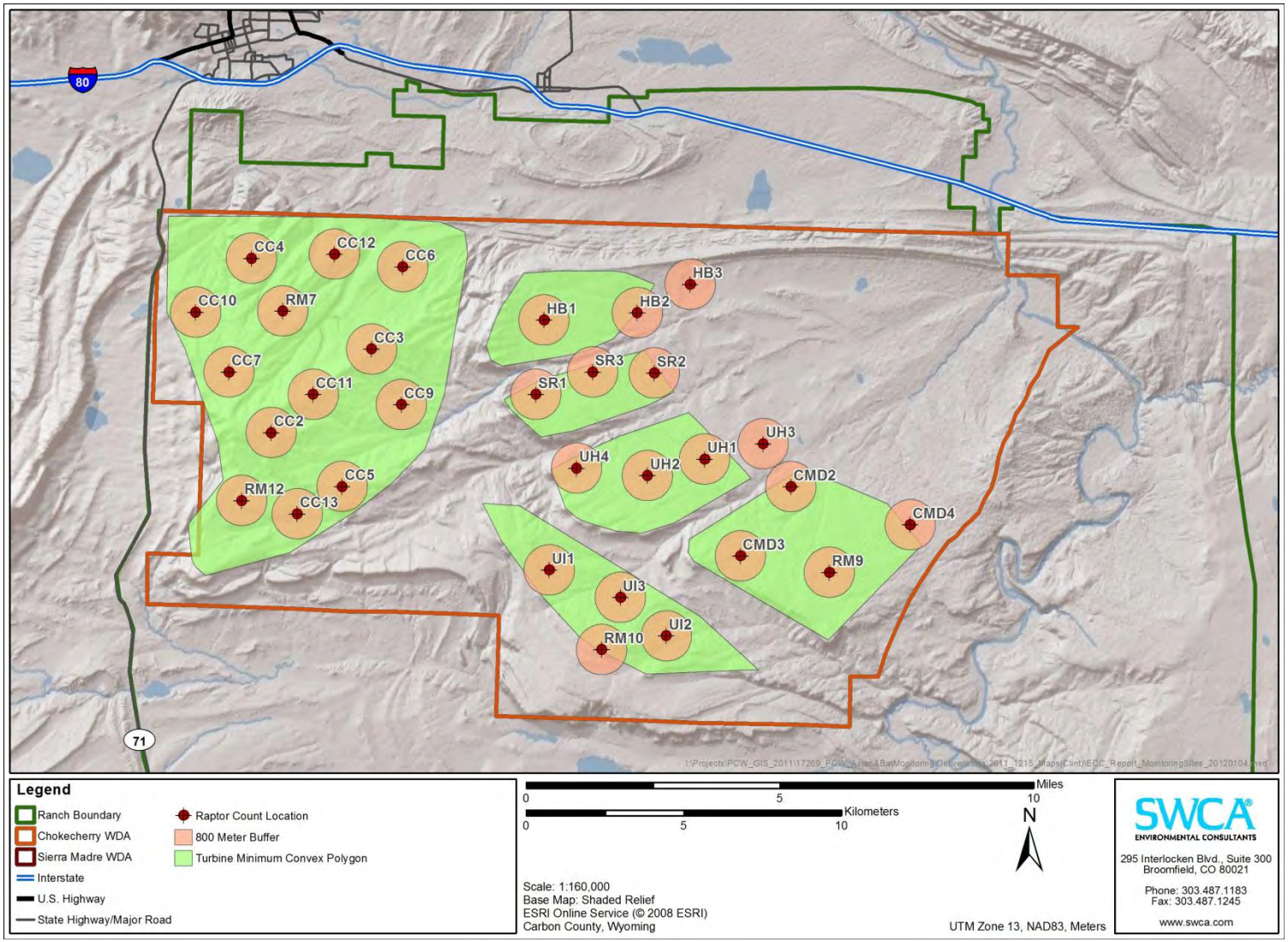

Figure 1. Minimum Convex Polygons, 800-meter raptor count locations and survey perimeters for Chokecherry.

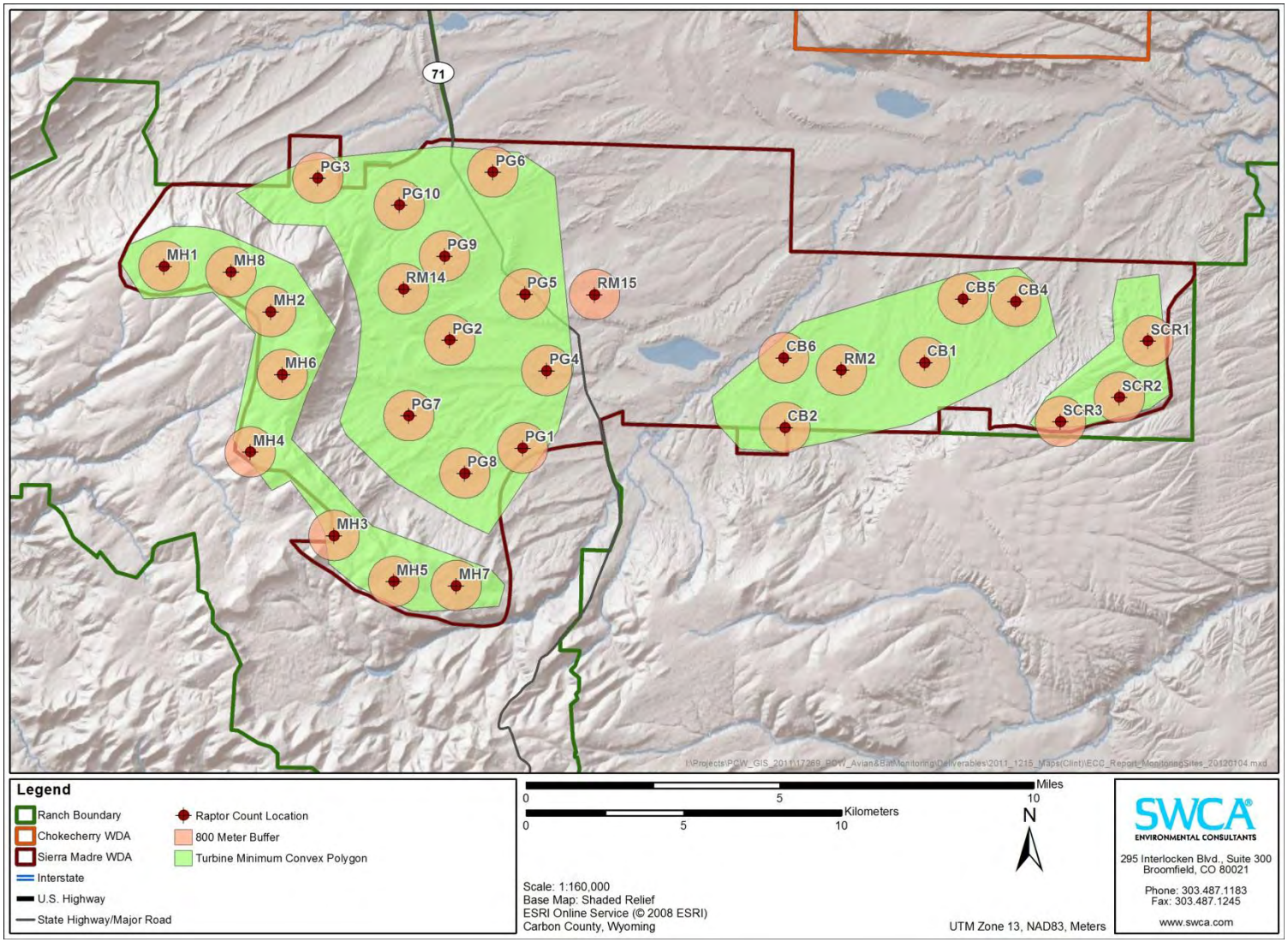

Figure 2. Minimum Convex Polygons, 800-meter raptor count locations and survey perimeters for Sierra Madre.

Table 1. Fall 2012-2013 Avian Monitoring Survey Locations for the Chokecherry WDA.

WDA	MCP	Site Name	Survey Site Status	Easting*	Northing*
Chokecherry	Chokecherry	CC2	Original Fall 2012 Site	315166	4616447
		CC3	Original Fall 2012 Site	318351	4619090
		CC4	Original Fall 2012 Site	314539	4621971
		CC5	Original Fall 2012 Site	317418	4614741
		CC6	Original Fall 2012 Site	319335	4621702
		CC7	Original Fall 2012 Site	313825	4618366
		CC9	Original Fall 2012 Site	319294	4617332
		CC10	New 2012 Survey Site	312770	4620262
		CC11	New 2012 Survey Site	316501	4617656
		CC12	New 2012 Survey Site, original CC1 site shifted north to eliminate overlap with RM7	317170	4622100
		CC13	New 2012 Survey Site, original CC8 site shifted southeast to eliminate overlap with RM12	315993	4613871
		RM7	2011-2012 Long-watch Site	315531	4620298
		RM12	2011-2012 Long-watch Site	314228	4614294
	Coal Mine Draw	CMD2	Original Fall 2012 Site	331648	4614732
		CMD3	New 2012 Survey Site	330049	4612535
		CMD4	New 2012 Survey Site, original CMD1 site shifted east to eliminate overlap with RM9	335437	4613524
		RM9	2011-2012 Long-watch Site	332870	4612018
	Hogback South	HB1	Original Fall 2012 Site	323818	4620014
		HB2	Original Fall 2012 Site	326781	4620243
		HB3	New 2012 Survey Site	328457	4621145
	Smith Rim	SR1	Original Fall 2012 Site	323560	4617658
		SR2	Original Fall 2012 Site	327318	4618336
		SR3	New 2012 Survey Site	325362	4618367
	Upper Hugus	UH1	Original Fall 2012 Site	328912	4615606
		UH2	Original Fall 2012 Site	327099	4615081
		UH3	New 2012 Survey Site	330772	4616091
		UH4	New 2012 Survey Site	324853	4615321
	Upper Iron Springs	UI1	Original Fall 2012 Site	323987	4612091
		UI2	Original Fall 2012 Site	327702	4610001
		UI3	New 2012 Survey Site	326242	4611221
		RM10	2011-2012 Long-watch Site	325646	4609568

*UTM Zone 13, NAD83, Meters

Table 2. Fall 2012-2013 Avian Monitoring Survey Locations for the Sierra Madre WDA.

WDA	MCP	Site Name	Survey Site Status	Easting*	Northing*
Sierra Madre	Central Basin	CB1	Original Fall 2012 Site	326414	4597515
		CB2	Original Fall 2012 Site	321986	4595452
		CB4	Original Fall 2012 Site	329306	4599449
		CB5	New 2012 Survey Site	327638	4599529
		CB6	New 2012 Survey Site, original CB3 site shifted west to eliminate overlap with RM2	321942	4597660
		RM2	2011-2012 Long-watch Site	323776	4597273
	Miller Hill	MH1	Original Fall 2012 Site	302291	4600564
		MH2	Original Fall 2012 Site	305677	4599125
		MH3	Original Fall 2012 Site	307684	4592030
		MH4	Original Fall 2012 Site	305024	4594675
		MH5	Original Fall 2012 Site	309573	4590571
		MH6	Original Fall 2012 Site	306043	4597131
		MH7	New 2012 Survey Site	311561	4590443
		MH8	New 2012 Survey Site	304412	4600385
	Pine Grove	PG1	Original Fall 2012 Site	313663	4594801
		PG2	Original Fall 2012 Site	311358	4598224
		PG3	Original Fall 2012 Site	307172	4603361
		PG4	Original Fall 2012 Site	314434	4597259
		PG5	Original Fall 2012 Site	313730	4599682
		PG6	Original Fall 2012 Site	312721	4603547
		PG7	Original Fall 2012 Site	310058	4595825
		PG8	Original Fall 2012 Site	311832	4594006
		PG9	Original Fall 2012 Site	311187	4600886
		PG10	New 2012 Survey Site	309753	4602508
		RM14	2011-2012 Long-watch Site	309884	4599843
		RM15	2011-2012 Long-watch Site	315948	4599668
	Sage Creek Rim	SCR1	Original Fall 2012 Site	333505	4598194
		SCR2	Original Fall 2012 Site	332596	4596407
		SCR3	New 2012 Survey Site	330727	4595638

*UTM Zone 13, NAD83, Meters

Landmarks will be identified and visible stakes will be placed around each survey location perimeter to provide distance references for field personnel completing survey efforts. The 800-meter radius survey areas of the new 60 point count locations provide coverage for approximately 35% of the probable turbine locations, which is greater than the 30% recommendation made by the Service (Service 2012b). Additionally, 46.7% of the raptor monitoring sites that were surveyed in 2011 will be resurveyed as part of the 60 point counts. Resurvey of 50% of all previous survey sites was not possible because many fall outside of the current project layout in Turbine No-Build areas and use of those sites would violate the spatially balanced study design in addition to sampling areas that are already known as high use areas for eagles and other raptors. Additionally, several sites that were only surveyed in spring/summer 2012 do not have a full year of data and would not be appropriate for comparison with ongoing and future data collection efforts. However, many of the 60 new survey sites overlap with areas previously surveyed as part of 2011 and 2012 raptor monitoring efforts. When these areas are included, 50.3% of the area surveyed as part of previous raptor monitoring efforts is within the perimeter of the 60 new point count survey sites.

Surveys will be conducted at each site for one hour per guidance in the ECP Technical Appendices (Service 2012b). Three avian technicians will each survey two locations per day for a total of 6 locations per day and 60 locations in a 10 day period. Each location will be surveyed twice per month. A schedule for all 60 raptor count locations was designed to provide survey coverage across all daylight hours for each of the 60 sites. The schedule was also designed such that the six raptor count surveys conducted on any given day are separated temporally and spatially to ensure independence of any observations that are made.

Avian technicians will be equipped with binoculars, spotting scopes, laser rangefinders, and aerial maps to assist with accurate detection and documentation of all raptors observed within the 800-meter survey area. Each aerial map is displayed with relevant landforms occurring in the area, locations of stakes, and concentric rings at each 200-meter interval to facilitate accurate distance estimation (Attachment 2). Each raptor flight path is recorded by technicians on the provided aerial maps. Additional data collected include species, number of individuals per observation, age, sex, behavior, bearing to bird, distance to bird, heading of bird, altitude of bird, the beginning and ending time for each observation, interactions with other birds, and hourly weather data among other variables (Attachment 3).

Surveys at the 60 800-meter raptor counts will begin in November 2012 and are scheduled to continue bi-weekly at each location through August of 2013. Surveys during winter months will be completed on the same schedule as the remainder of the year and efforts will be made to survey at least 50% of all locations twice per month during winter. However, winter surveys are subject to cancellation or delay based on weather conditions and safety of the field technicians.

REFERENCES

Bureau of Land Management (BLM). 2008. Wildlife Survey Protocols for Wind Energy Development.

U.S. Fish and Wildlife Service (Service). 2011. Draft Eagle Conservation Plan Guidance. Available online at http://www.fws.gov/windenergy/. Accessed December 2011.

———. 2012a. Land Based Wind Energy Guidelines. Wind Turbine Guidelines Advisory Committee. U.S. Fish and Wildlife Service, Department of the Interior, Washington D.C. Available online at http://www.fws.gov/windenergy/docs/WEG_final.pdf. Accessed August 2012.

———. 2012b. Eagle Conservation Plan Guidance Module 1 – Land-based Wind Energy Technical Appendices. Received from Kevin Kritz, Service Region 6, on August 4, 2012.

Wyoming Game and Fish Department (WGFD). 2010. Wildlife Protection Recommendations for Wind Energy Development in Wyoming. Wyoming Game and Fish Commission Approved November 17, 2010. Wyoming Game and Fish Department, Cheyenne, WY.

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ATTACHMENT 1

Response to Survey Recommendations Made in the Service's September 28, 2012 Letter

The following recommendations were made by the Service in the September 28, 2012 letter to Garry Miller (PCW) regarding Eagle Use Sampling Considerations and Recommendations for the proposed Chokecherry-Sierra Madre Wind Energy Development Project. A response is provided to document how each recommendation has been incorporated into the revised 800-meter point count survey protocols. Recommendations are presented in italics below.

1. *We recommend focusing sampling efforts within the most recently proposed project footprint in order to quantify eagle use in areas where turbines are planned for location. By collecting eagle and raptor use data in areas of likely development, we believe it will be easier to obtain a more reliable estimate of risk to eagles in these areas, from which more informed, site-specific, predictions can be made.*

   Response: The revised protocols and placement of the 60 point count sites are based on the most recent proposed Project footprint and probable turbine locations. The most recent Project footprint reflects PCW's commitment to the Turbine No-Build areas identified in the Project ECP.

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

   Response: Three of the 60 point count survey sites (RM15, HB3, and UH3) are placed outside of the most current probable turbine locations. Several additional locations (e.g., CMD2, HB2, RM10, SR2) have a substantial portion of their survey areas that fall outside of the current probable turbine locations. Each of these sites provides survey coverage in areas of the Project Site where turbines could be located if the current probable turbine location footprint changes.

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

example, the use (and hence risk) might have been the same for all survey points, but sampling different points across years would lead to the erroneous conclusion. Resampling some points across years can reduce this uncertainty by creating an index or allow for scaling of observations across years.

Response: Nearly 50% (46.7%) of the raptor monitoring sites that were surveyed in 2011 will be resurveyed as part of the 60 point counts. Resurvey of 50% of previous survey sites is not possible because many fall outside of the current project layout in Turbine No-Build areas. Additionally, several sites that were only surveyed in spring/summer 2012 do not have a full year of data and would not be appropriate for comparison with ongoing and future data collection efforts. Many of the 60 new survey sites overlap with areas previously surveyed as part of 2012 raptor monitoring efforts. When those areas are included, 50.3% of the area surveyed as part of 2012 raptor monitoring efforts is within the perimeter of the 60 new point count survey sites.

4. *Previous long-watch raptor surveys were based on an unlimited radius, and analysis of data from these surveys suggests that the detectability of eagles dropped off after 600 to 800 meters. We recommend using a distance of no more than 800 meters for point counts intended to collect data on eagles and other large raptors. This recommendation is found in our draft Eagle Conservation Plan Guidance (Service 2012, Appendix C, p. 18) and in other literature (e.g., Strickland et al. 2011). While it is acceptable to collect data on eagles and other raptors beyond 800 meters (e.g., location, flight height, flight path)—since they may be useful to identify travel corridors and areas of eagle use—the collection of this information should not distract surveyors from collecting data within the 800-meter point count. In addition, because only those data collected within 800 meters will be used in the models to predict eagle fatalities, data collected at distances more than 800 meters should be separated from data collected within 800 meters.*

   Response: Previous long-watch raptor surveys recorded any eagle observed to help identify high use areas per the protocols developed collaboratively between the Service, BLM, and PCW. The analysis of detectability of eagles presented in the Service's comments does not consider that the reason eagle use was higher within 800 meters of previously sampled sites is because those sites were placed on ridgelines and terrain features known to attract or concentrate eagle use, making the likelihood of observing an eagle within 800 meters of a survey site higher than if the point was placed randomly in the landscape where varying terrain features may or may not occur. The implementation of the previous surveys was extremely successful and resulted in the development of Turbine No-Build areas that will avoid impacts to eagles and other avian species in the majority of the high use areas that were identified. To be consistent with with the Service's Draft ECP Guidance, the Service's eagle risk model, and the recommendation made above, all surveys will be conducted using a distance of 800-meters.

5. *Based on recommendations in the draft Eagle Conservation Plan Guidance, the sampling goal should provide a "minimal spatial coverage of at least 30% of the project footprint" (i.e., the total area sampled in any given year should be thirty percent of the total project footprint) (Service 2012, Appendix C, p. 1 8). We recognize that even this level of effort will not provide specific information for seventy percent of the project area; however, it may be assumed that the information is representative of the remaining project area, provided the sample points are appropriately located (e.g., stratified and spatially balanced). To achieve the desired goal of at least 30 percent coverage of the Chokecherry Sierra Madre Proposed Project footprint, we calculate up to 70 survey points are needed, depending on how the project footprint is portrayed.*

   Response: Using the conceptual turbine footprint that PCW provided to the Service, 35% of all turbine locations fall within the 800-meter survey perimeters of the 60 point count sites. As stated above, the entirety of 3 sites and substantial portions of 3 others fall outside of the probable Project footprint in areas where turbines could be placed. These provide adequate coverage of areas outside of the current probable turbine footprint. When combined with the 800-meter radius surveyed areas from previous survey events (2011 and spring/summer 2012), 42% of probable turbine locations are included within the perimeter of 800-meter point count sites.

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

   Response: The spatially balanced design that is discussed in the revised protocols above is reflective of the variability in habitat conditions, terrain features, and turbine numbers and densities. The revised protocols describe the methods used to select sites and the sampling strata and selection criteria that were used to place sites. The 60 sampling sites described in the revised protocols provide coverage in areas that provide some level of foraging, contain sage-grouse leks, and have variable topography that could influence eagle and raptor behavior. Site placement near active eagle nests is difficult because most nests have been avoided and are within the Turbine No-Build areas along the Bolten Rim or North Platte River corridor and, as seen in the data previously collected for the Project, active nests locations change each year.

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

   Response: Surveys will be conducted at each site for one hour per guidance in the ECP Technical Appendices (Service 2012b). As stated in the revised protocols, the survey methods follow the 800-meter radius point count methodology recommended by the Service's Technical Appendices to the Draft ECP Guidance, and are consistent with other guidance documents produced by the Service, BLM, and WGFD.

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

   Response: As stated in the revised protocols, the survey methods follow the 800-meter radius point count methodology recommended by the Service's Technical Appendices to the Draft ECP Guidance, and are consistent with other guidance documents produced by the Service, BLM, and WGFD. The sampling schedule will provide survey coverage across all daylight hours for each of the 60 sites. The schedule also makes certain that the six raptor count surveys conducted on any given day are separated temporally and spatially to ensure independence of any observations that are made.

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

   Response: Should an eagle or ferruginous hawk nest become active within 800 meters of a survey site, PCW will coordinate with the Service and BLM to evaluate the most appropriate methods to take to ensure that survey activities do not disrupt nesting. With PCW's Turbine No-Build areas and Project re-design efforts, most eagle and raptor nests in the Project Site have been avoided by 800 meters or more. However, some survey sites are located within 800 meters of historically active nests. As stated above, sampling locations have been selected in a spatially balanced, stratified manner using methods recommended by the Service. Maintaining the sites that are located within 800 meters of historically active nests is necessary to maintain this spatially balanced design. Since Project survey efforts began in 2008, no active ferruginous hawk nests have been identified.

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

    Response: Only those observations occurring within 800 meters of the survey sites will be recorded. As described in the protocols and illustrated on the data collection forms in Attachment 3, data collection efforts will provide all of the information recommended by the Service.

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

    Response: Data on all raptors and other species of interest will be collected in a manner identical as that used for eagles unless those efforts interfere with data collection for eagles.

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

    Response: Data will be collected through August of 2013. Our interpretation of eagle use in winter and summer periods differs from the Service's interpretation. The Service's interpretation assumes that each minute of eagle use is independent and evenly distributed across the landscape. Based on the survey data, it is clear that most of the eagle minutes recorded across all seasons are not independent and that the simple statistic of flight minutes per survey minute does not consider that observations are not independent in space or time and therefore mischaracterizes seasonal use and risk. As an example, 72 of the 141 minutes (51%) of winter use observed in the Project Site occurred at two sites on two days. On December 8, 2011, 35 eagle flight minutes were recorded at RM11 and on March 9, 2012 37 minutes of eagle use were recorded at RM14. On both days, field technicians wrote on datasheets that the use was associated with 2-3 individuals who were using the area for a long period of time. If the three eagles at RM14 had not been observed on March 9, no winter use would

have been observed within 800 meters of that sampling site. Similarly, if the use at RM11 would not have been observed on December 8, only 3 minutes of eagle use over would have been observed at that site during winter months and use would have been decreased by 95%. The observed activity on December 8 and March 9 is indicative of short duration, concentrated use by a few individuals rather than of high eagle use of the Project throughout the entire winter period. The data also indicate that for most of the Project Site there is no risk or very low risk to eagles during winter. Summer data are very similar to winter data. During summer 2011, only 71 eagle minutes were recorded. Nearly 60% of these minutes were associated with only 3 observations of individual circle soaring birds at RM14 and RM5. This indicates that the high use the Service cites is not from adults feeding young or young learning to fly. Rather, the behavior observed indicates that this is localized use by individual birds utilizing thermals created by warm summer temperatures.

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

    Response: The recommended changes have been made. The term "compliant" has been changed to "consistent". As stated above, 35% of the probable turbine locations will be surveyed using the revised protocols.

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

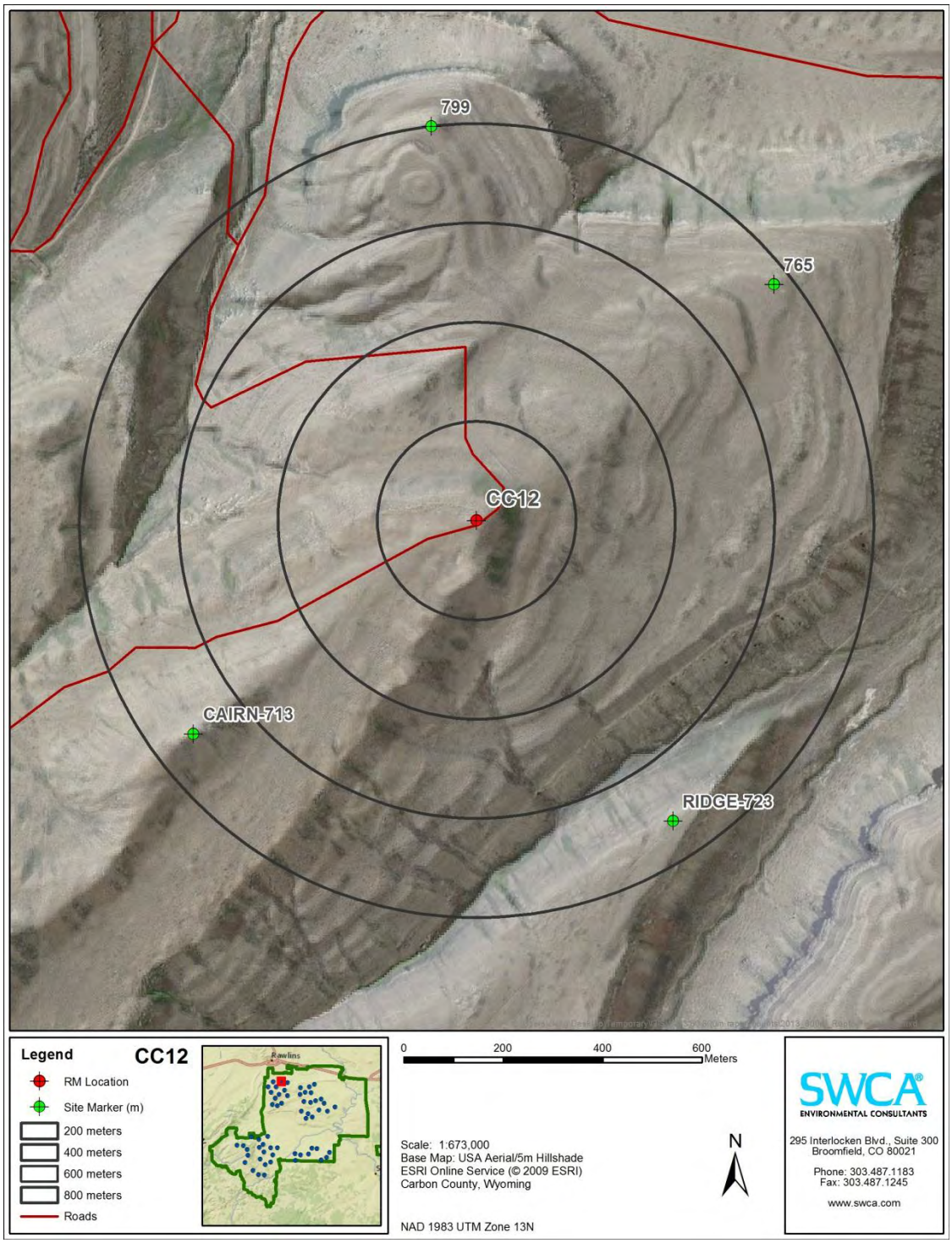
Response: The comments made above have been addressed in the revised protocols, the prey-base report submitted to the Service, and the Project ECP. We concur that within the context of the Service's eagle fatality model, the revised protocols will help address uncertainties.

15. *The data sheet attached to the protocol provided by PCW does not appear to have a means of recording flight path in data. It should be clear how flight path data will be collected on the existing data sheet, or additional datasheets should be included if there is more than one.*

    Response: Attachment 2 contains an example figure that is used to record flight paths for eagles and other raptors. Additionally, multiple rows of data are recorded for each eagle observed which results in multiple spatial points per individual bird. Fitting a line between each point for each observed eagle provides another mechanism to create flight paths. The methods used to collect data are described in the revised protocols.

ATTACHMENT 2

Example Aerial Map Used to Map Flight Paths during 800-meter Raptor Count Surveys



Aerial map example. Numbers next to site markers indicate distance from raptor monitoring location to the site marker location. Concentric rings around raptor monitoring location indicate 200-meter distance intervals to aid in estimation of distance. Other features on the landscape (roads, rock cairns, etc.) are also noted on each map to aid in distance and location estimation.

ATTACHMENT 3

Data Sheets Used to Collect Data during 800-meter Raptor Count Surveys

PCW 2012-2013 Raptor Survey

Field Observer: _____

Survey Location: _____

Start time: _____

End time: _____

Date: _____

Page: ____ **of** _____

Target #	Obs #	Species	# Birds	Age	Sex	Behav	Bearing to Bird (°)	Distance to Bird (m)	Angle of Bird (°)	Heading of Bird	0-30	30-150	150+	Time Begin	Time End

PCW 2012-2013 Raptor Survey Notes

Field Observer: _____ **Survey Pt:** ____

Date: _____ **Page:** _____ of _____

Other species and Notes.

Weather Conditions

Time	Sky	Wind Dir	Wind Spd	Temp (°F)

Incidental Species Observations
for eagles and raptors note distance and bearing

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APPENDIX E

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Avian Baseline Studies for the Chokecherry-Sierra Madre Wind Resource Area Carbon County, Wyoming

Final Report
June 26, 2008 – June 16, 2009

Prepared for:

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September 8, 2009

EXECUTIVE SUMMARY

The Power Company of Wyoming has proposed a wind-energy facility in Carbon County, Wyoming, capable of producing 2,000 megawatts of energy with 1,000 wind turbines. To assist with preparing an Environmental Impact Statement for the proposed facility, AECOM contracted Western Ecosystems Technology, Inc. to conduct surveys and monitor wildlife resources in the Chokecherry-Sierra Madre Wind Resource Area to estimate the impacts of project construction and operations on wildlife. The following document contains results for fixed-point bird use surveys and incidental wildlife observations.

The principal objectives of the study were to (1) provide site specific bird use data that would be useful in evaluating potential impacts from the proposed wind-energy facility; (2) provide information that could be used in project planning and design of the facility to minimize impacts to birds; and (3) recommend further studies or potential mitigation measures, if warranted.

The proposed wind-energy facility is composed primarily (77%) of scrub-scrub habitat dominated by big sagebrush. The remaining areas are covered by grassland (19.3%), evergreen forest (1.4%) deciduous forest (0.7%), and emergent wetlands (0.6%), with smaller patches of open water, developed space, barren habitat, mixed forest, woody wetlands, and pastures.

The study used fixed-point bird use surveys to estimate the seasonal, spatial, and temporal use of the study area by birds, particularly raptors. Fixed-point surveys were conducted from June 26, 2008 through June 16, 2009 at nineteen points established throughout the Chokecherry-Sierra Madre Wind Resource Area. A total of 433 20-minute fixed-point surveys were completed and 50 bird species were identified.

A total of 2,005 individual bird observations within 1,301 separate groups were recorded during the fixed-point surveys. The most abundant large bird species recorded was the common raven (175 observations) and the most abundant small bird species was horned lark (805). A total of 230 individual raptors were recorded within the Chokecherry-Sierra Madre Wind Resource Area, representing 12 species. The most abundant raptor observed was golden eagle (69 observations).

Use by waterbirds and shorebirds was relatively low (0.10 and 0.01 birds/plot/20-minute survey, respectively) and these bird types were only observed during the spring season. Raptor use was highest during the fall (0.62 birds/plot/20-min survey) and lowest during the winter (0.17). Vultures were only recorded during the fall and spring (0.01 birds/plot/20-minute survey for both seasons). Upland gamebird use, limited to greater sage-grouse, ranged from 0.09 birds/plot/20-minute survey in the winter to zero in the summer. Large corvids had the highest use in the fall (0.73 birds/plot/20-minute survey) and the lowest use in the winter (0.34). Passerine use ranged from 0.02 birds/plot/20-minute survey in winter to 5.00 in spring; however, the focus for small birds was within a 100 meter viewshed and passerine use is not directly comparable to the other bird types, which were recorded out to 800 m.

During the study, 311 single or groups of large birds totaling 467 individuals were observed flying during fixed-point bird use surveys. For all large bird species combined, 67.0% of birds were observed flying below the likely zone of risk, 29.3% were within the zone of risk, and 3.6%

were observed flying above the zone of risk for typical turbines that could be used in the Chokecherry-Sierra Madre Wind Resource Area. Bird types with at least 20 individuals observed flying most often observed flying within the turbine zone of risk were raptors (30.4%) and large corvids (24.8%). A total of 1,046 passerines and other small birds in 596 groups were recorded flying within 100 meters of the survey plots in the proposed wind resource area, with 99.8% flying below the zone of risk, 0.2% within the zone of risk, and none observed above the zone of risk.

For large bird species with at least 25 separate groups of flying birds, golden eagles were observed most often within the zone of risk (45.0%) based on initial observations. Based on the use (measure of abundance) of the study area by each species and the flight characteristics observed for that species, the common raven had the highest probability of turbine exposure, with an exposure index of 0.09. The raptor species with the highest exposure index was the golden eagle, which was ranked second of all species at 0.06. All other raptor species had an exposure index of 0.02 or less. For passerines and other small birds, the species with the highest exposure index was horned lark, though its exposure index was less than 0.01.

Levels of bird use varied within the study area by point. For all large bird species combined, use was highest at point 12, with 3.18 birds/20-minute survey. The higher mean use at point 12 was due mostly to high use by large corvids at this point (2.50 birds/20-minute survey). Use at the other points ranged from 0.32 to 2.55 birds/20-minute survey for large bird species. Waterbird use was highest at point 16, with 0.67 birds/20-minute survey, and mean shorebird use was only recorded at point 17, with 0.17 birds/20-minute survey. Raptor use was highest at point four (0.93 birds/20-minute survey), and ranged from 0.10 to 0.83 birds/20-minute survey at other points. Vultures were only seen at points six and eleven (0.03 and 0.04 birds/20-minute survey, respectively) and upland gamebird use was highest at point 13 (0.14 birds/20-minute survey). Passerine use, limited to birds observed within 100 meters of the survey point, was highest at point 13, with 5.10 birds/20-minute survey, and ranged from 1.81 to 4.70 at the other points.

No obvious flyways or concentration areas were observed. No strong association with topographic features within the study area was noted for raptors or other large birds. Although some differences in bird use were detected among survey points, the differences are not large enough to suggest that any portions of the Chokecherry-Sierra Madre Wind Resource Area should be avoided when siting turbines due to very high bird use.

The objective of incidental wildlife observations was to provide a record of wildlife seen outside of the standardized surveys. There were 12 bird species observed incidentally, totaling 270 individuals within 157 separate groups during the study. The most abundant large bird species recorded incidentally were greater sage-grouse (123 individuals), golden eagle (52 observations), and northern harrier (38 observations). Three bird species were only observed incidentally and were not observed during fixed-point surveys. Four mammal species totaling 3,083 individuals in 304 groups were also observed incidentally at the CSMWRA. The most commonly recorded mammal species was pronghorn antelope with 2,879 observations in 285 groups.

Based on fixed-point bird use data collected for the Chokecherry-Sierra Madre Wind Resource Area, mean annual raptor use was 0.46 raptors/plot/20-minute survey. The annual rate was low

relative to raptor use at 36 other wind-energy facilities that implemented similar protocols to the present study and had data for three or four different seasons. Mean raptor use in the Chokecherry-Sierra Madre Wind Resource Area was low compared to the other wind resource areas, ranking twenty-second among the 36 studies.

A regression analysis of raptor use and mortality for 13 new-generation wind-energy facilities, where similar methods were used to estimate raptor use and mortality, found that there was a significant correlation between use and mortality (R^2 = 69.9%; Figure 8). Using this regression to predict raptor collision mortality at the CSMWRA, based on an adjusted mean raptor use of 0.46 raptors/plot/20-min survey, yields an estimated fatality rate of 0.04 fatalities/MW/year, or four raptor fatalities per year for each 100-MW of wind-energy development, which would equate to an estimate of 80 raptors per year for a 2,000-MW development. A 90% prediction interval around this estimate is zero to 0.30 fatalities/MW/year. Based on species composition of the most common raptor fatalities at other western wind-energy facilities and species composition of raptors observed at the Chokecherry-Sierra Madre Wind Resource Area during the surveys, the majority of the fatalities of diurnal raptors will likely consist of red-tailed hawk, American kestrel and golden eagle. Based on the seasonal use estimates, it is expected that risk to raptors would be unequal across seasons, with the lowest risk in the winter, and highest risk during the fall. However, the winter use estimates were only based on three surveys that were completed prior to the area becoming inaccessible due to snow. Therefore, winter use as based on these three surveys may not be representative of actual use throughout the entire winter, but is the best data available for predicting winter use of the study area by raptors.

Some species considered to be sensitive or of conservation concern were observed within the Chokecherry-Sierra Madre Wind Resource Area. During all surveys and incidental observations, one petitioned species, the greater sage-grouse, was recorded within the proposed wind resource area. Furthermore, 10 other bird species and one mammal species classified by the Wyoming Game and Fish Department as Native Species Status 2, 3, or 4 were also recorded during fixed-point bird use surveys or as incidental wildlife observations. A total of 538 individual birds in 293 groups, representing 11 sensitive bird species, and five white-tailed prairie dogs in one group were recorded. This is a tally that in some cases may represent repeated observations of the same individual. Some potential exists for wind turbines to displace these species within the study area. Research concerning displacement impacts of wind-energy facilities is limited, but some show the potential for small scale displacement of 180 meters (591 feet) or less for small birds, while impacts to densities of small birds at larger scales have not been shown.

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INTRODUCTION

The Power Company of Wyoming has proposed a wind-energy facility in Carbon County, Wyoming (Figures 1 and 2), capable of producing 2,000 megawatts (MW) of energy with 1,000 wind turbines. To assist with preparing an Environmental Impact Statement for the proposed facility, AECOM contracted Western Ecosystems Technology, Inc. to conduct surveys and monitor wildlife resources in the Chokecherry-Sierra Madre Wind Resource Area (CSMWRA) to estimate the impacts of project construction and operations on wildlife.

The principal objectives of the study were to (1) provide site specific bird use data that would be useful in evaluating potential impacts from the proposed wind-energy facility; (2) provide information that could be used in project planning and design of the facility to minimize impacts to birds; and (3) recommend further studies or potential mitigation measures, if warranted. The protocols for the baseline studies are similar to those used at other wind-energy facilities across the nation, and follow the guidance of the National Wind Coordinating Collaborative (Anderson et al. 1999). The protocols have been developed based on WEST's experience studying wildlife at proposed wind-energy facilities throughout the US; and were designed to help predict potential impacts to bird species (particularly raptors).

Baseline surveys, conducted from June 26, 2008 through June 16, 2009 at the CSMWRA, included fixed-point bird use surveys and incidental observations. Sensitive species of wildlife observed during either the fixed-point surveys or observed incidentally were also recorded. In addition to site-specific data, this report presents existing information and results of studies conducted at other wind-energy facilities. The ability to estimate potential bird mortality at the proposed CSMWRA is greatly enhanced by operational monitoring data collected at existing wind-energy facilities. For several wind-energy facilities, standardized data on fixed-point surveys were collected in association with standardized post-construction (operational) monitoring, allowing comparisons of bird use with bird mortality. Where possible, comparisons with regional and local studies were made.

STUDY AREA

The proposed CSMWRA is located in Carbon County (Figure 1) approximately four miles (6.4 kilometers [km]) south of Rawlins, Wyoming, within T 16 N – T 18N, R 88 W – R 89W and T 19 N – T21N, R 85 W – R 88W. The CSMWRA is comprised of two portions, the Chokecherry Wind Resource Area (WRA) to the north and the Sierra Madre WRA to the south. Approximately 77% of the study area is covered by scrub-scrub habitat, which is dominated primarily by big sagebrush (*Artemisia tridentata*). The remaining areas are covered by grassland (19.3%), evergreen forest (1.4%) deciduous forest (0.7%), and emergent wetlands (0.6%), with smaller patches of open water, developed space, barren habitat, mixed forest, woody wetlands, and pastures (Table 1; Figure 3).

Topography in the Chokecherry WRA is rolling hills throughout much of the Chokecherry WRA, with topography becoming more varied in the southern portion (Figure 2). A distinct rim

with a steep cliff face dominates the southern boundary of the Chokecherry WRA. The general land practice is cattle grazing.

The Sierra Madre WRA is dominated by sagebrush steppe with pockets of quaking aspen (*Populus tremuloides*). Topography in the Sierra Madre WRA ranges from gently rolling plains in the northern portion to rolling hills in the southern portion (Figure 2). The escarpment of Miller Hill dominates the northern boundary of the Sierra Madre WRA. Drainages in the southern portion are dominated by willow (*Salix* spp.) and the general land practice is also cattle grazing.

METHODS

Fixed-Point Bird Use Surveys

Fixed-point bird use surveys were used to estimate the seasonal, spatial, and temporal use of the study area by birds, particularly raptors, defined here as kites, accipiters, buteos, harriers, eagles, falcons, and owls. Fixed-point surveys (variable circular plots) were conducted using methods described by Reynolds et al. (1980). The points were selected to survey representative habitats and topography of the study area, while providing relatively even coverage. All birds seen during each 20-minute (min) fixed-point survey were recorded.

Bird Use Survey Plots
At the start of the study, 16 points were selected to achieve relatively even coverage of the study area and survey representative habitats and topography within the study area. Due to snow conditions which prevented access to much of the study area, three additional points were added north of the Sierra Madre WRA in the spring, for a total of 19 points (Figure 4). Each survey plot was a variable circular plot, and all birds seen during each survey were recorded. Using this method, all birds that are seen or heard are recorded and later analysis can truncate observations to set distances (Reynolds et al. 1980).

Bird Survey Methods
All species of birds observed during fixed-point surveys were recorded. Observations of large birds beyond 800 m (2,625 feet [ft]) were recorded, but were not included in the statistical analyses; for small birds observations beyond a 100-m (328 ft) radius were excluded. A unique observation number was assigned to each observation.

The date, start and end time of the survey period, and weather information such as temperature, wind speed, wind direction, and cloud cover were recorded for each survey. Species or best possible identification, number of individuals, sex and age class (if possible), distance from plot center when first observed, closest distance, altitude above ground, activity (behavior), and habitat(s) were recorded for each observation. The behavior of each bird observed, and the vegetation type in which or over which the bird occurred, were recorded based on the point of first observation. Approximate flight height and flight direction at first observation were recorded to the nearest 5-m (16-ft) interval. Other information recorded included whether or not

the observation was auditory only and in which of the two 10-min intervals of the 20-min survey it was first observed.

Locations of raptors, other large birds, and species of concern seen during fixed-point bird use surveys were recorded on field maps by observation number. Flight paths and perch locations were digitized using ArcGIS 9.3. Any comments were recorded in the comments section of the data sheet. Any wildlife observations were recorded on the incidental datasheets.

Observation Schedule
Sampling intensity was designed to document bird use and behavior by habitat and season within the study area. Fixed-point surveys were conducted from June 26, 2008, through June 16, 2009. Surveys were conducted approximately once a week during spring (March 16 to May 31) and fall (September 1 to November 15), once every two weeks during summer (June 1 to August 31), and three times during the winter (November 16 to December 31). Only three surveys were completed in winter before snow conditions made the area inaccessible. Surveys were conducted during daylight hours and survey periods were varied to approximately cover all daylight hours during a season. To the extent practical, each point was surveyed about the same number of times each season. The three additional points (points 17, 18, and 19) were added during spring surveys because winter snows made much of the CCWRA inaccessible. The purpose of surveying at these three points was to capture south to north migration through the study area.

Incidental Wildlife Observations

Incidental wildlife observations provided a record of wildlife seen outside of the standardized surveys. All raptors, unusual or unique birds, sensitive species, mammals, reptiles, and amphibians were recorded in a similar fashion to standardized surveys. The observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, height above ground (for bird species), habitat, and, in the case of sensitive species, the Universal Transverse Mercator (UTM) location was recorded with a global positioning system (GPS) unit.

Statistical Analysis

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. A sample of records from an electronic database was compared to the raw data forms and any errors detected were corrected. 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 used to store, organize, and retrieve survey data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent QA/QC and

data analysis. All data forms, field notebooks, and electronic data files were retained for reference.

Fixed-Point Bird Use Surveys

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, including all observations of birds detected regardless of their distance from the observer. Species richness was calculated as the mean number of species observed per survey (i.e., number of species/plot/20-min survey). Bird diversity and species richness were compared between seasons for fixed-point bird use surveys.

Bird Use, Composition, and Frequency of Occurrence

For the standardized fixed-point bird use estimates, only observations of large birds detected within the 800-m radius plot were used; small bird observations were limited to 100 m. Estimates of mean bird use (i.e., number of birds/plot/20-min survey) were used to compare differences between bird types, seasons, and other wind-energy facilities. Two different viewsheds were utilized when calculating the various statistics such as species richness, use, percent composition, percent frequency, and exposure index; a circle with a radius of 800 m for large birds and 100 m for small birds.

The frequency of occurrence was calculated as the percent of surveys in which a particular species or bird type was observed. Percent composition was calculated as the proportion of the overall mean use for a particular species or bird type. Frequency of occurrence and percent composition provide relative estimates of species exposure to the proposed wind-energy facility. For example, a species may have high use estimates for an area based on just a few observations of large groups; however, the frequency of occurrence will indicate that the species occurs during very few of the surveys and therefore, the species may be less likely affected by the wind energy development.

Bird Flight Height and Behavior

To calculate potential risk to bird species, the first flight height recorded was used to estimate the percentages of birds flying within the likely "zone of risk" (ZOR) for collision with turbine blades of 35 m to 130 m (114 – 427 ft) above ground level (AGL), which is the blade height of typical turbines that could be used at the CSMWRA.

Bird Exposure Index

A relative index of collision 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 ZOR.

This index is only based on initial flight height observations and relative abundance (defined as the use estimate) and does not account for other possible collision risk factors such as foraging or courtship behavior.

Spatial Use

Data were analyzed by comparing use among plots. Mapped flight paths were qualitatively compared to study area features such as topographic features. The objective of mapping observed bird locations and flight paths was to look for areas of concentrated use by raptors and other large birds and/or consistent flight patterns within the study area. This information can be useful in turbine layout design or adjustments of individual turbines for micro-siting.

RESULTS

Fifty-three bird species and four mammal species were identified during surveys completed at the CSMWRA. Results of the fixed-point surveys and incidental wildlife observations, and the specific numbers of unique species for each survey type, are discussed in the sections below.

Fixed-Point Bird Use Surveys

Bird Diversity and Species Richness

A total of 433 20-minute fixed-point surveys were conducted at the CSMWRA (Table 2). Fifty unique species were observed over the course of all fixed-point bird use surveys. More unique species were observed during the spring (36 species) and summer (32) than in the fall (25) and winter (six). Mean use was 0.63 birds/plot/20-min survey for large bird species and 1.19 birds/100-m plot/20-min survey for small bird species (Table 2). The mean number of species per plot per survey for large birds was higher in the fall (0.81 species/800-m plot/20-min survey) compared to spring (0.61), summer (0.60), and winter (0.40). For small birds, the mean number of species per plot per survey was higher in the summer (2.05 species/100-m plot/20-min survey) and spring (1.62), compared to the fall (0.43) and winter (0.02; Table 2).

A total of 2,005 individual bird observations within 1,301 separate groups were recorded during the fixed-point surveys (Table 3). One species, horned lark (*Eremophila alpestris*), composed 40.1% of all bird observations. All other species comprised less than 10% of the total observations. The most abundant large bird species recorded was the common raven (*Corvus corax;* 175 observations). A total of 230 individual raptors were recorded within the CSMWRA, representing 12 species (Table 3). The most abundant raptor observed was golden eagle (*Aquila chrysaetos*; 69 observations).

Bird Use, Composition, and Frequency of Occurrence by Season

Mean bird use, percent composition, and frequency of occurrence by season were calculated (Tables 4a and 4b). The highest overall large bird use occurred in the fall (1.37 birds/plot/20-min survey), followed by the summer (1.08), spring (0.98), and winter (0.60; Table 4a). For all small

birds, use was highest in the spring (5.00 birds/plot/20-min survey), followed by the summer (4.18), fall (1.57), and winter (0.02; Table 4b).

Waterbirds

Waterbirds were only observed during the spring season (Table 4a), with a mean use of 0.10 birds/plot/20-min survey. Waterbirds accounted for 10.5% of all bird use during the spring and the frequency of occurrence was relatively low (1.4% of spring surveys; Table 4a). The only waterbird species observed were American white pelican (*Pelecanus erythrorhyncos*) and great blue heron (*Ardea herodias*).

Shorebirds

Shorebirds were also only observed during the spring season (Table 4a), with a use of 0.01 birds/plot/20-min survey. Shorebirds accounted for less than 1% of overall bird composition during the spring, and were recorded during less than 1% of spring surveys (Table 4a). The only shorebird species observed was killdeer (*Charadrius vociferous*).

Raptors

Raptor use was highest in the fall (0.62 birds/plot/20-min survey), followed by summer (0.58), spring (0.35) and winter (0.17; Table 4a). Higher use in the summer and spring was primarily due to high use of the area by American kestrels (*Falco sparverius*; 0.18 and 0.12 birds/plot/20-min survey, respectively). Higher use in the fall and winter was primarily due to use of the area by golden eagles (0.25 and 0.14 birds/plot/20-min survey, respectively). Raptors comprised 53.1% of overall bird use during the summer, 45.2% during the fall, 36.1% during the spring, and 27.9% during the winter. Raptors were observed during 37.2% of summer surveys, 36.8% of fall surveys, 28.6% of spring surveys, and 16.7% of winter surveys (Table 4a).

Vultures

Vultures, limited to turkey vulture (*Cathartes aura*), were only recorded during the fall and spring (0.01 birds/plot/20-min survey for both seasons; Table 4a). Vultures accounted for less than 1% of overall bird use and were recorded during less than 1% of all surveys during both seasons (Table 4a).

Upland Gamebirds

Upland gamebird use, limited to greater sage-grouse (*Centrocercus urophasianus*) was highest during the winter (0.09 birds/plot/20-min survey) compared to the spring (0.06), fall (0.01), and summer (0; Table 4a). Greater sage-grouse accounted for 15.1% of all bird use during the winter, 5.9% in the spring, and 1.1% in the fall. Greater sage-grouse were recorded during 5.8% of spring surveys, 4.9% winter surveys, and less than 1% of fall surveys (Table 4a).

Large Corvids

Large corvids, consisting of American crow (*Corvus brachyrhynchos*), black-billed magpie (*Pica pica*), and common raven, had the highest use in the fall (0.73 birds/plot/20-min survey), followed by spring (0.45), summer (0.44) and winter (0.34; Table 4a). Large corvids accounted for 57.0% of all bird use during the winter, 53.2% in the fall, 45.9% in the spring, and 40.5% in the summer. Large corvids were recorded during 29.7% of fall surveys, 20.5% of spring surveys, 16.0% of winter surveys, and 7.7% of summer surveys (Table 4a).

Passerines

A 100-m radius viewshed was used for small bird data analysis, therefore, results are not directly comparable to the other large bird types, which were recorded out to 800 m. Passerine use was highest in spring (4.97 birds/plot/20-min survey), compared to summer (4.04), winter (1.57), and fall (0.02; Table 4b). Horned lark had the highest use by any one species in all seasons (spring 3.38 birds/plot/20-min survey; summer 1.83; fall 1.15; winter 0.02). Passerines were observed during more than 80% of the surveys in the summer and spring, 29.4% of fall surveys, and only 2.1% of winter surveys (Table 4b). After horned lark (805 observations; Table 3), the most common small passerine species recorded were: vesper sparrow (*Pooecetes gramineus*; 121), Brewer's sparrow (*Euphagus cyanocephalus*: 80), western meadowlark (*Sturnella neglecta*; 69), and sage thrasher (*Oreoscoptes montanus*; 65).

Bird Flight Height and Behavior

Flight height characteristics were estimated for both bird types and bird species (Tables 5 and 6). During the study, 311 single large birds or groups totaling 467 individuals were observed flying within the 800-m radius plot (Table 5). Overall, 29.3% of large birds observed flying were recorded within the ZOR for collision with turbine blades (35 to 135 m AGL), 67.0% were below the ZOR, and 3.6% were flying above the ZOR (Table 5). More than half (61.8%) of flying raptors were observed below the ZOR, 30.4% were within the ZOR, and only 7.7% were above the ZOR. Waterbirds had the highest percentage of flying birds within the ZOR (100%), although this was only based on two groups totaling 16 individuals. Fifty percent of turkey vultures were observed flying within the ZOR, but this percentage was based on only two vultures observed flying. Raptors had the third highest percentage of birds within the ZOR, primarily due to 45.2% of eagle observations and 43.6% of buteo observations recorded at this height. Shorebirds, doves/pigeons, large corvids, and upland gamebirds were typically observed flying below the ZOR (Table 5). The majority of passerines within the 100-m plot were observed below the ZOR (99.8%), while 0.2% were recorded within the ZOR and none were recorded above the ZOR (Table 5).

Of all large bird species, five species had at least 25 groups observed flying; golden eagle was the most commonly observed species flying within the likely ZOR based on initial observations (45.0%; Table 6a). Three species were always seen flying within the likely ZOR based on initial; observations; however, these were based on only one or two observations. Of all passerine and small bird species, four species had at least 30 groups observed flying, with only one species, horned lark, recorded flying within the ZOR based on initial observations (Table 6b).

Bird Exposure Index

A relative exposure index was calculated for each bird species (Tables 6a and 6b). Common raven (0.09) and golden eagle (0.06) had exposure indices higher than any other species. All other raptor species had an exposure index of 0.02 or less (Table 6a). The passerine species with the highest exposure index was horned lark, with an index of less than 0.01 (Table 6b). All identified small birds had exposure indices of zero because they were not observed flying within the ZOR based on initial observations.

Spatial Use
For all large bird species combined, use was highest at point 12 (3.18 birds/20-min survey). Bird use at other points ranged from 0.32 to 2.55 birds/20-min survey (Figure 5). The high mean use estimate for point 12 was largely due to high use at this point by large corvids (2.50 birds/20-min survey), and use by large corvids at the remaining points ranged from zero to 1.05 birds/20-min survey. Waterbird use was highest at point 16, with 0.67 birds/20-min survey, and were only observed at one other point (point one; 0.07 birds/20-min survey). Mean shorebird use was only recorded at point 17, with 0.17 birds/20-min survey at this point. Raptor use was highest at point four (0.93 birds/20-min survey), and ranged from 0.10 to 0.83 birds/20-min survey at other points. Vultures were only seen at points six and eleven (0.03 and 0.04 birds/20-min survey, respectively). Upland gamebird use was highest at point 13 (0.14 birds/20-min survey), and ranged from zero to 0.09 bird/20-min survey at other points. Passerine use was highest at point 13 (5.10 birds/20-min survey), and ranged from 1.81 to 4.70 at other points (Figure 5).

Flight paths for waterbirds, waterfowl, shorebirds, raptors, and vultures were digitized and mapped (Figures 6a-f). No obvious flyways or concentration areas were observed for any species. The available data do not indicate that any portions of the study area warrant being excluded from development due to very high bird use.

Sensitive Species Observations
Ten sensitive bird species totaling 269 individuals in 215 groups were observed during fixed-point bird use surveys (Tables 3 and 7). As with all avian surveys, this is a tally that in some cases may represent repeated observations of the same individual. The greater sage-grouse has been petitioned for listing as a federal threatened species (ECOS 2009). A total of 28 greater sage-grouse were recorded during fixed-point bird use surveys within the CSMWRA (Table 7). The greater sage-grouse is also a Wyoming Native Species Status (NSS) 2 species. Nine other NSS2, NSS3, or NSS4 species (WGFD 2005; WYNDD 2009) were also recorded during fixed-point surveys. The most abundant sensitive species recorded during fixed-point surveys were Brewer's sparrow (80 observations), sage thrasher (65), and sage sparrow (*Amphispiza belli*; 59).

Incidental Wildlife Observations

There were 12 bird species observed incidentally, totaling 270 individuals within 157 separate groups during the study (Table 8). Four mammal species totaling 3,083 individuals in 304 groups were also observed incidentally at the CSMWRA.

Bird Observations
The most abundant bird species recorded as an incidental wildlife observation were greater sage-grouse (123 observations), golden eagle (52 observations), and northern harrier (*Circus cyaneus*; 38 observations). All other bird species recorded incidentally had less than 20 observations (Table 8). Three bird species, American goldfinch (*Carduelis tristis*), burrowing owl (*Athene cunicularia*), and snow bunting (*Plectrophenax nivalis*), were only observed incidentally and were not observed during fixed-point surveys.

Mammal Observations
The most commonly recorded mammal species in the CSMWRA was pronghorn antelope (*Antilocapra americana*) with 2,879 observations in 285 groups (Table 8). Three additional mammal species were also recorded incidentally: elk (*Cervus elephus*; 189 observations), mule deer (*Odocoileus hemionus*; 10), and white-tailed prairie dog (*Cynomys leucurus*; five).

Sensitive Species Observations
Six sensitive species totaling 146 individuals in 49 groups were recorded during incidental observations (Table 7; WGFD 2005; ECOS 2009; WYNDD 2009). A total of 123 greater sage-grouse in 29 groups were recorded incidentally within the CSMWRA. All other sensitive bird species, classified as NSS2, NSS3, or NSS4 species, had ten or fewer observations recorded. One sensitive mammal species, the white-tailed prairie dog (NSS4), was also observed incidentally, with a total of five individuals observed in one group.

DISCUSSION AND IMPACT ASSESSMENT

Bird Impacts

Direct Effects
The most probable direct impact to birds from wind-energy facilities is direct mortality or injury due to collisions with turbines or guy wires of meteorological (met) towers. Collisions may occur with resident birds foraging and flying within the study area or with migrant birds seasonally moving through the study area. Project construction could affect birds through loss of habitat, or potential fatalities from construction equipment. Impacts from the decommissioning of the facility are anticipated to be similar to construction in terms of noise, disturbance, and equipment. Potential mortality from construction equipment is expected to be very low. Equipment used in wind-energy facility construction generally moves at slow rates or is stationary for long periods (e.g., cranes). The risk of direct mortality to birds from construction is most likely potential destruction of a nest for ground- and shrub-nesting species during initial site clearing.

Substantial data on bird mortality at wind-energy facilities are available from studies in California and throughout the West and Midwest. Of 841 bird fatalities reported from California studies (>70% from the Altamont Pass facility in California), about 39% were diurnal raptors, about 19% were passerines (excluding house sparrows [*Passer domesticus*] and European starlings [*Sturnus vulgaris*]), and about 12% were owls. Non-protected birds, including house sparrows, European starlings, and rock pigeons (*Columba livia*) comprised about 15% of the fatalities. Other bird types generally made up less than 10% of the fatalities (Erickson et al. 2002b). During 12 fatality monitoring studies conducted outside of California, diurnal raptor fatalities comprised about 2% of the wind-energy facility-related fatalities and raptor mortality averaged 0.03 fatalities/turbine/year. Passerines (excluding house sparrows and European starlings) were the most common collision victims, comprising about 82% of the 225 fatalities documented. For all bird species combined, estimates of the number of bird fatalities per turbine per year from individual studies ranged from zero at the Searsburg wind-energy facility in Vermont (Kerlinger 1997) and the Algona facility in Iowa (Demastes and Trainer 2000), to 7.7 at

the Buffalo Mountain facility in Tennessee (Nicholson 2003). Using mortality data from a 10-year period from wind-energy facilities throughout the entire United States, the average number of bird collision fatalities is 3.1 fatalities/MW/year, or 2.3 fatalities/turbine/year (NWCC 2004).

Raptor Use and Exposure Risk

The annual mean raptor use at the CSMWRA (0.46 raptors/plot/20-min survey) was compared with other wind-energy facilities that implemented similar protocols and had data for three or four seasons. Similar studies were conducted at 36 other wind-energy facilities. The annual mean raptor use at these wind-energy facilities ranged from 0.09 to 2.34 raptors/plot/20-min survey (Figure 7). Based on the results from these wind-energy facilities, a ranking of seasonal raptor mean use was developed as: low (0 – 0.5 raptors/plot/20-min survey); low to moderate (0.5 – 1.0); moderate (1.0 – 2.0); high (2.0 – 3.0); and very high (> 3.0). Under this ranking, mean raptor use (number of raptors divided by the number of 800-m plots and the total number of surveys) at the CSMWRA is considered to be low, with the CSMWRA ranking twenty-second when compared with the 36 other wind-energy facilities (Figure 7).

Although high numbers of raptor fatalities have been documented at some wind-energy facilities (e.g. Altamont Pass), a review of studies at wind-energy facilities across the United States reported that only 3.2% of casualties were raptors (Erickson et al. 2001a). Indeed, although raptors occur in most areas with the potential for wind-energy development, individual species appear to differ from one another in their susceptibility to collision (NRC 2007). Results from Altamont Pass in California suggest that mortality for some species is not necessarily related to abundance (Orloff and Flannery 1992). American kestrels, red-tailed hawks (*Buteo jamaicensis*), and golden eagles were killed more often than predicted based on abundance. Thus far, only three northern harrier fatalities at existing wind-energy facilities have been reported in publicly available documents, despite the fact they are commonly observed during point counts at these facilities (Erickson et al. 2001a; Whitfield and Madders 2006). Because northern harriers often forage close to the ground, risk of collision with turbine blades is considered low for this species. Relative use by American kestrels at the High Winds facility is almost six times the use by American kestrels at the Altamont Pass facility (Kerlinger 2005). It is likely that many factors, in addition to abundance, are important in predicting raptor mortality.

Exposure indices analysis may also provide insight into what species have a higher likelihood of turbine casualties. The index considers relative probability of exposure based on abundance, proportion of daily activity spent flying, and proportion of flight height of each species within the ZOR for turbines likely to be used at the wind-energy facility. For the CSMWRA, the raptor species with the highest exposure index was the golden eagle, which was ranked second of all species, at 0.06 (Table 6a). The relatively higher exposure index for golden eagle was due to flight height data showing that 45.0% of flying observations were within the ZOR based on initial observations. The exposure index analysis is based on observations of birds during the daylight period and does not take into consideration flight behavior (e.g., during foraging or courtship) or abundance of nocturnal migrants. It also does not take into consideration habitat selection, the ability to detect and avoid turbines, and other factors that may vary among species and influence likelihood for turbine collision. For these reasons, the actual risk for some species may be lower or higher than indicated by this index. Based on species composition of the most common raptor fatalities at other western wind-energy facilities and species composition of

raptors observed at the Chokecherry-Sierra Madre Wind Resource Area during the surveys, the majority of the fatalities of diurnal raptors will likely consist of red-tailed hawk, American kestrel, and golden eagle. Based on the seasonal use estimates, it is expected that risk to raptors would be unequal across seasons, with the lowest risk in the winter and the highest risk during the fall. However, the winter use estimates were only based on three surveys that were completed prior to the area becoming inaccessible due to snow. Therefore, winter use as based on these three surveys may not be representative of actual use throughout the entire winter, but is the best data available for predicting winter use of the study area by raptors.

A regression analysis of raptor use and mortality for 13 new-generation wind-energy facilities, where similar methods were used to estimate raptor use and mortality, found that there was a significant correlation between use and mortality ($R^2 = 69.9\%$; Figure 8). Using this regression to predict raptor collision mortality at the CSMWRA, based on an adjusted mean raptor use of 0.46 raptors/plot/20-min survey, yields an estimated fatality rate of 0.04 fatalities/MW/year. A 90% prediction interval around this estimate is zero to 0.30 fatalities/MW/year. The estimate of 0.04 raptor fatalities/MW/year would equate to an estimate of 80 raptor fatalities per year for a 2,000-MW development. These fatalities would be spread over several species, seasons, and between resident and migrant birds. Nevertheless, this level of fatality might result in a measurable adverse effect on the demographics of the local population of golden eagles.

Non-Raptor Use and Exposure Risk

Most bird species in the US are protected by the Migratory Bird Treaty Act (MBTA 1918). Passerines (primarily perching birds) have been the most abundant bird fatality at wind energy facilities outside California (Erickson et al. 2001a, 2002b), often comprising more than 80% of the bird fatalities. Both migrant and resident passerine fatalities have been observed. Given that passerines made up a large proportion of the birds observed during the baseline study, passerines would be expected to make up the largest proportion of fatalities at the CSMWRA. Exposure indices, based on observations within 100 m, indicate that horned lark is the most likely passerine to be exposed to collision from wind turbines at the CSMWRA (Table 6b). Most non-raptors had relatively low exposure indices due to the majority of individuals flying below the likely zone of risk. Due to the low exposure risks at CSMWRA, it is unlikely that non-raptor populations will be adversely affected by direct mortality from the operation of the wind-energy facility.

Wind-energy facilities with year-round use by water dependent species have shown the highest mortality, although the levels of waterfowl/waterbird/shorebird mortality appear insignificant compared to the use of the facilities by these groups. Of 1,033 bird carcasses collected at US wind-energy facilities, waterbirds comprised about 2%, waterfowl comprised about 3%, and shorebirds comprised less than 1% (Erickson et al. 2002b). At the Klondike, Oregon wind-energy facility, only two Canada goose (*Branta canadensis*) fatalities were documented (Johnson et al. 2003) even though 43 groups totaling 4,845 individual Canada geese were observed during pre-construction surveys (Johnson et al. 2002a). The recently constructed Top of Iowa wind-energy facility is located in cropland between three Wildlife Management Areas (WMAs) with historically high bird use, including migrant and resident waterfowl. During a recent study, approximately one million goose-use days and 120,000 duck-use days were recorded in the WMAs during the fall and early winter, and no waterfowl fatalities were documented during

concurrent and standardized wind-energy facility fatality studies (Jain 2005). Similar findings were observed at the Buffalo Ridge wind-energy facility in southwestern Minnesota, which is located in an area with relatively high waterfowl/waterbird use and some shorebird use. Snow geese (*Chen caerulescens*), Canada geese, and mallards (*Anas platyrhynchos*) were the most common waterfowl observed. Three of the 55 fatalities observed during the fatality monitoring studies were waterfowl, including two mallards and one blue-winged teal (*Anas discors*). Two American coots (*Fulica americana*), one grebe, and one shorebird fatality were also found (Johnson et al. 2002b). Based on available evidence, waterfowl, waterbirds and shorebirds do not seem especially vulnerable to turbine collisions and significant impacts are not likely.

Sensitive Species Use and Exposure Risk

No federally-listed threatened or endangered species were observed in the CSMWRA during fixed-point bird use surveys (Table 3) or incidentally (Table 8). Thirty-five groups totaling 151 greater sage-grouse were observed (Table 7). This species has been petitioned for listing under the Endangered Species Act (ESA 1973), with a determination expected in February 2010; the greater sage-grouse is also classified by the Wyoming Game and Fish Department (WGFD) as NSS2. Ten other bird species considered sensitive (NSS) by the WGFD were also observed within the CSMWRA. Wyoming sensitive species of most concern are those classified as NSS1 or NSS2. No NSS1 bird species were observed and the only NSS2 species observed was bald eagle (*Haliaeetus leucocephalus*), with a total of six individuals recorded (Table 7). Due to very low use of the CSMWRA by bald eagle, it is unlikely that significant collision mortality would occur. Of those species classified as NSS3 or NSS4, the most frequently observed bird species were Brewer's sparrow (80 individuals), sage thrasher (65), and sage sparrow (59). As with all of the avian surveys, these are tallies that in some cases represent repeated observations of the same individuals. Brewer's sparrows, sage thrashers, and sage sparrows were never observed flying within the turbine ZOR. Therefore, significant risk of collision mortality is not expected for these species. Use of the CSMWRA by the other sensitive species recorded was relatively low and no significant direct impacts are likely to occur.

Indirect Effects

The presence of wind turbines may alter the landscape so that wildlife use patterns are affected, displacing wildlife away from the project facilities and suitable habitat. Some studies from wind-energy facilities in Europe consider displacement effects to have a greater impact on birds than collision mortality (Gill et al. 1996). However, one study conducted in England to assess displacement of wintering farmland birds by wind turbines located in an agricultural landscape found that only common (ring-necked) pheasants (*Phasianus colchicus*) apparently avoided turbines. The other species/bird groups examined, including granivores, red-legged partridge (*Alectoris rufa*), Eurasian skylark (*Alauda arvensis*), and corvids, showed no displacement from wind turbines. In fact, Eurasian skylarks and corvids showed increased use of areas close to turbines, possibly due to increased food resources associated with disturbed areas (Devereux et al. 2008).

The greatest concern with displacement impacts for wind-energy facilities in the US has been where these facilities have been constructed in grassland or other native habitats (Leddy et al. 1999; Mabey and Paul 2007), While Crockford (1992) suggests that disturbance appears to impact feeding, resting, and migrating birds, rather than breeding birds, results from studies at

the Stateline wind-energy facility in Washington and Oregon (Erickson et al. 2004) and the Buffalo Ridge wind-energy facility in Minnesota (Johnson et al. 2000a) suggest that breeding birds are also affected by wind-facility operations.

Raptor Displacement

In addition to possible direct effects on raptors within the study area (discussed above), indirect effects caused by disturbance-type impacts, such as construction activity near an active nest or primary foraging area, also have a potential impact on raptor species. Birds displaced from wind-energy facilities might move to areas with fewer disturbances, but with lower quality habitat, 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, 2003; Madders and Whitfield 2006). Notable exceptions to this 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 Buffalo Ridge, Minnesota, where raptor nest density on 101 square miles (mi^2; 262 km^2) of land surrounding a wind-energy facility was 5.94 nests/39 mi^2 (5.94 nests/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 even though no nests were found, only two nests would be expected for an area 12 mi^2 in size if the nests were distributed uniformly. At a wind-energy facility in eastern Washington, based on extensive monitoring using helicopter flights and ground observations, raptors still nested in the study area at approximately the same levels after construction, and several nests were located within 0.5 miles (0.8 km) 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 were located within one mile (1.6 km) of the wind-energy facility successfully fledged young (Johnson et al. 2000b). The golden eagle pair successfully nested 0.5 mile from the facility for three different years after it became operational. A Swainson's hawk also nested within 0.25 mile (0.4 km) of a turbine string at the Klondike I wind-energy facility in Oregon after the facility was operational (Johnson et al. 2003). These observations suggest that there will be limited nesting displacement of raptors at the CSMWRA, although the creation of a buffer surrounding known nests when siting turbines will further reduce any potential disturbance impact, and perhaps reduce the risk of collisions with turbines.

Displacement of Non-Raptor Bird Species

Studies concerning displacement of non-raptor species have concentrated on grassland passerines and waterfowl/waterbirds (Winkelman 1990; Larsen and Madsen 2000; Mabey and Paul 2007). Wind-energy facility construction appears to cause small-scale local displacement of grassland passerines and is likely due to the birds avoiding turbine noise and maintenance activities.

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 feet) 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 in Minnesota. 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 the 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 feet) of turbine strings, but areas further away from turbine strings did not have reduced bird use.

Displacement effects of wind-energy facilities on waterfowl and shorebirds appear to be mixed. Studies from the Netherlands and Denmark suggest that densities of these types of species near turbines were lower compared to densities in similar habitats away from turbines (Winkelman 1990; Pedersen and Poulsen 1991). However, a study from a facility in England, found no effect of wind turbines on populations of cormorant (*Phalacrcorax xarbo*), purple sandpipers (*Calidris maritima*), eiders (*Somateria mollissima*), or gulls, although the cormorants were temporarily displaced during construction (Lawrence et al. 2007). At the Buffalo Ridge wind-energy facility in Minnesota, the abundance of several bird types, including shorebirds and waterfowl, were found to be significantly lower at survey plots with turbines than at reference plots without turbines (Johnson et al. 2000a). The report concluded that the area of reduced use was limited primarily to those areas within 100 m of the turbines. Disturbance tends to be greatest for migrating birds while feeding and resting (Crockford 1992; NRC 2007).

Much debate has occurred recently regarding the potential impacts of wind-energy facilities on prairie grouse, including greater sage-grouse. Under a set of voluntary guidelines, the US Fish and Wildlife Service (USFWS) has taken a precautionary approach and recommends wind turbines be placed at least five miles (eight km) from known prairie grouse lek locations (USFWS 2003). The USFWS argues that because prairie grouse evolved in habitats with little vertical structure, placement of tall man-made structures, such as wind turbines, in occupied prairie grouse habitat may result in a decrease in habitat suitability (USFWS 2004). While the potential exists for wind turbines to displace greater sage-grouse from occupied habitat, well-designed studies examining the potential impacts of wind turbines on prairie grouse are currently lacking. Ongoing research conducted by Kansas State University to examine response of greater prairie-chickens (*Tympanuchus cupido*) to wind-energy development in Kansas, and by WEST, Inc. to examine response of greater sage-grouse to wind-energy development in Wyoming, will help address the potential for impacts to prairie grouse.

CONCLUSIONS AND RECOMMENDATIONS

Based on data collected during this study, raptor and all bird use of the CSMWRA is generally similar to most WRAs evaluated throughout the western and midwestern US using similar

methods. Based on the results of the studies to date, bird mortality at the CSMWRA would likely be similar or lower than that documented at other wind-energy facilities located in the western and Midwestern US, where bird collision mortality has been relatively low.

Currently, few published studies are available from the western US that compare bird use to bird mortality rates. Based on research conducted at wind-energy facilities throughout the US, raptor use at the CSMWRA is generally lower than levels recorded at other wind-energy facilities. Raptor fatality rates are expected to be within the range of fatality rates observed at other facilities where raptor use levels are lower. To date, no relationships have been observed between overall use by other bird types, and fatality rates of those bird types at wind-energy facilities. However, the flight characteristics and foraging habits of some species may result in increased exposure for these species at the CSMWRA. The surveys conducted for the proposed CSMWRA also do not address the impacts of the proposed facility to nocturnal migrants, such as passerines. To date, overall fatality rates for birds (including nocturnal migrants) at wind-energy facilities have been relatively low and consistent in the West. As more research is conducted at facilities in the West, more information regarding the potential direct impacts of wind-energy facilities to bird species will be obtained.

The proposed wind-energy facility is comprised of native habitats such as scrub-shrub and grasslands (Table 1, Figure 3). Several species considered to be sensitive were observed breeding within these habitats at the CSMWRA, and some potential exists for wind turbines to displace breeding birds. Research concerning displacement impacts to passerines, waterfowl, and waterbirds associated with wind-energy facilities is limited, but some studies show the potential for small scale (200 m [656 ft] or less) displacement, while impacts to densities of birds at larger scales have not been shown.

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Table 1. The land cover types, coverage, and composition within the Chokecherry-Sierra Madre Wind Resource Area.

Habitat	Acres	% Composition
Scrub-Shrub	171,092.00	76.9
Grassland	42,948.20	19.3
Evergreen Forest	3,067.66	1.4
Deciduous Forest	1,607.75	0.7
Emergent Wetlands	1,222.09	0.6
Barren	948.87	0.4
Woody Wetlands	386.59	0.2
Developed, Open Space	385.12	0.2
Open Water	383.29	0.2
Pasture/Hay	332.81	0.2
Developed, Low Intensity	154.4	0.1
Mixed Forest	44.33	<0.1
Developed, Medium Intensity	25.25	<0.1
Developed, High Intensity	4.88	<0.1
Total	**222,603.24**	**100**

Data from the National Landcover Database (USGS NLCD 2001).

Table 2. Summary of species richness (species/plot[a]/20-min survey), and sample size by season and overall during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

Season	Number of Visits	# Surveys Conducted	# Unique Species	Species Richness	
				Large Birds	Small Birds
Summer	9	142	32	0.60	2.05
Fall	9	142	25	0.81	0.43
Winter	3	31	6	0.40	0.02
Spring	10	118	36	0.61	1.62
Overall	**31**	**433**	**50**	**0.63**	**1.19**

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

Table 3. Total number of individuals and groups for each bird type and species[a], by season and overall, during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area[a] , June 26, 2008 – June 16, 2009.

		Summer		Fall		Winter		Spring		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Waterbirds		**0**	**0**	**0**	**0**	**0**	**0**	**2**	**16**	**2**	**16**
American white pelican	*Pelecanus erythrorhyncos*	0	0	0	0	0	0	1	14	1	14
great blue heron	*Ardea herodias*	0	0	0	0	0	0	1	2	1	2
Shorebirds		**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**1**	**1**
killdeer	*Charadrius vociferus*	0	0	0	0	0	0	1	1	1	1
Raptors		**77**	**86**	**80**	**88**	**3**	**3**	**51**	**53**	**211**	**230**
Accipiters		*0*	*0*	*5*	*5*	*0*	*0*	*1*	*1*	*6*	*6*
Cooper's hawk	*Accipiter cooperii*	0	0	2	2	0	0	0	0	2	2
sharp-shinned hawk	*Accipter striatus*	0	0	1	1	0	0	1	1	2	2
unidentified accipiter		0	0	2	2	0	0	0	0	2	2
Buteos		*23*	*26*	*20*	*21*	*1*	*1*	*11*	*12*	*55*	*60*
ferruginous hawk	*Buteo regalis*	1	1	2	2	1	1	1	1	5	5
red-tailed hawk	*Buteo jamaicensis*	14	16	6	6	0	0	7	8	27	30
rough-legged hawk	*Buteo lagopus*	0	0	9	9	0	0	2	2	11	11
Swainson's hawk	*Buteo swainsoni*	7	8	0	0	0	0	1	1	8	9
unidentified buteo		1	1	3	4	0	0	0	0	4	5
Northern Harrier		*15*	*15*	*19*	*22*	*0*	*0*	*5*	*5*	*39*	*42*
northern harrier	*Circus cyaneus*	15	15	19	22	0	0	5	5	39	42
Eagles		*17*	*19*	*33*	*37*	*2*	*2*	*13*	*14*	*65*	*72*
bald eagle	*Haliaeetus leucocephalus*	0	0	0	0	0	0	2	2	2	2
golden eagle	*Aquila chrysaetos*	17	19	32	36	2	2	11	12	62	69
unidentified eagle		0	0	1	1	0	0	0	0	1	1
Falcons		*22*	*26*	*3*	*3*	*0*	*0*	*20*	*20*	*45*	*49*
American kestrel	*Falco sparverius*	21	25	2	2	0	0	16	16	39	43
prairie falcon	*Falco mexicanus*	1	1	1	1	0	0	4	4	6	6
Other Raptors		*0*	*0*	*0*	*0*	*0*	*0*	*1*	*1*	*1*	*1*
osprey	*Pandion haliaetus*	0	0	0	0	0	0	1	1	1	1

Table 3. Total number of individuals and groups for each bird type and species[a], by season and overall, during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area[a] , June 26, 2008 – June 16, 2009.

		Summer		Fall		Winter		Spring		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
Vultures		**0**	**0**	**1**	**1**	**0**	**0**	**1**	**1**	**2**	**2**
turkey vulture	*Cathartes aura*	0	0	1	1	0	0	1	1	2	2
Upland Gamebirds		**0**	**0**	**1**	**2**	**3**	**24**	**2**	**2**	**6**	**28**
greater sage grouse	*Centrocercus urophasianus*	0	0	1	2	3	24	2	2	6	28
Doves/Pigeons		**8**	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**8**	**10**
mourning dove	*Zenaida macroura*	8	10	0	0	0	0	0	0	8	10
Large Corvids		**14**	**65**	**62**	**105**	**9**	**15**	**30**	**60**	**115**	**245**
American crow	*Corvus brachyrhynchos*	4	49	0	0	0	0	2	16	6	65
black-billed magpie	*Pica pica*	0	0	2	3	2	2	0	0	4	5
common raven	*Corvus corax*	10	16	60	102	7	13	28	44	105	175
Passerines		**467**	**600**	**95**	**255**	**2**	**4**	**379**	**588**	**943**	**1,447**
American robin	*Turdus migratorius*	1	1	0	0	0	0	0	0	1	1
barn swallow	*Hirundo rustica*	0	0	0	0	0	0	2	2	2	2
Brewer's blackbird	*Euphagus cyanocephalus*	8	9	0	0	0	0	2	26	10	35
Brewer's sparrow	*Spizella breweri*	51	57	5	5	0	0	14	18	70	80
Clark's nutcracker	*Nucifraga columbiana*	1	1	0	0	0	0	0	0	1	1
cliff swallow	*Petrochelidon pyrrhonota*	0	0	0	0	0	0	1	1	1	1
grasshopper sparrow	*Ammodramus savannarum*	0	0	0	0	0	0	4	4	4	4
green-tailed towhee	*Pipilo chlorurus*	1	1	0	0	0	0	0	0	1	1
horned lark	*Eremophila alpestris*	177	264	48	172	1	1	224	368	450	805
house wren	*Troglodytes aedon*	8	13	3	3	0	0	0	0	11	16
lark bunting	*Calamospiza melanocorys*	3	3	0	0	0	0	1	12	4	15
lark sparrow	*Chondestes grammacus*	0	0	2	2	0	0	0	0	2	2
Lincoln's sparrow	*Melospiza lincolnii*	0	0	0	0	0	0	2	2	2	2
loggerhead shrike	*Lanius ludovicianus*	2	2	0	0	0	0	2	2	4	4
mountain bluebird	*Sialia currucoides*	3	4	4	16	0	0	7	14	14	34
rock wren	*Salpinctes obsoletus*	7	7	0	0	0	0	4	6	11	13
sage sparrow	*Amphispiza belli*	7	7	0	0	0	0	48	52	55	59

Table 3. Total number of individuals and groups for each bird type and species[a], by season and overall, during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area[a] , June 26, 2008 – June 16, 2009.

		Summer		Fall		Winter		Spring		Total	
Species/Type	**Scientific Name**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
sage thrasher	*Oreoscoptes montanus*	52	55	2	2	0	0	6	8	60	65
Say's phoebe	*Sayornis saya*	1	1	0	0	0	0	1	1	2	2
song sparrow	*Melospiza melodia*	0	0	2	3	0	0	0	0	2	3
Townsend's solitaire	*Myadestes townsendi*	0	0	1	1	0	0	0	0	1	1
tree swallow	*Tachycineta bicolor*	3	3	0	0	0	0	0	0	3	3
unidentified blackbird		0	0	1	4	0	0	0	0	1	4
unidentified passerine		28	43	16	30	1	3	1	6	46	82
unidentified sparrow		9	9	3	5	0	0	0	0	12	14
unidentified swallow		4	4	0	0	0	0	0	0	4	4
unidentified wren		2	2	0	0	0	0	0	0	2	2
vesper sparrow	*Pooecetes gramineus*	65	79	3	4	0	0	32	38	100	121
western kingbird	*Tyrannus verticalis*	1	1	1	1	0	0	0	0	2	2
western meadowlark	*Sturnella neglecta*	33	34	4	7	0	0	28	28	65	69
Other Birds		**10**	**22**	**0**	**0**	**0**	**0**	**3**	**4**	**13**	**26**
common nighthawk	*Chordeiles minor*	5	6	0	0	0	0	0	0	5	6
northern flicker	*Colaptes auratus*	1	1	0	0	0	0	1	1	2	2
unidentified hummingbird		2	2	0	0	0	0	0	0	2	2
white-throated swift	*Aeronautes saxatalis*	2	13	0	0	0	0	2	3	4	16
Overall		**576**	**783**	**239**	**451**	**17**	**46**	**469**	**725**	**1,301**	**2,005**

[a] Regardless of distance from observer.

Table 4a. Mean bird use (number of birds/800-plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**
Waterbirds	**0**	**0**	**0**	**0.10**	**0**	**0**	**0**	**10.5**	**0**	**0**	**0**	**1.4**
American white pelican	0	0	0	0.09	0	0	0	9.0	0	0	0	0.6
great blue heron	0	0	0	0.02	0	0	0	1.6	0	0	0	0.8
Shorebirds	**0**	**0**	**0**	**0.01**	**0**	**0**	**0**	**0.8**	**0**	**0**	**0**	**0.8**
killdeer	0	0	0	0.01	0	0	0	0.8	0	0	0	0.8
Raptors	**0.58**	**0.62**	**0.17**	**0.35**	**53.1**	**45.2**	**27.9**	**36.1**	**37.2**	**36.8**	**16.7**	**28.6**
Accipiters	*0*	*0.03*	*0*	*0.01*	*0*	*2.3*	*0*	*0.6*	*0*	*2.4*	*0*	*0.6*
Cooper's hawk	0	0.01	0	0	0	0.8	0	0	0	1.0	0	0
sharp-shinned hawk	0	0.01	0	0.01	0	0.5	0	0.6	0	0.7	0	0.6
unidentified accipiter	0	0.01	0	0	0	1.0	0	0	0	1.4	0	0
Buteos	*0.18*	*0.15*	*0.03*	*0.08*	*16.8*	*11.1*	*4.7*	*8.0*	*14.1*	*8.7*	*2.8*	*7.3*
ferruginous hawk	0.01	0.01	0.03	0.01	0.7	1.0	4.7	1.5	0.7	1.4	2.8	1.4
red-tailed hawk	0.11	0.04	0	0.04	10.3	3.1	0	3.9	8.4	2.9	0	3.8
rough-legged hawk	0	0.07	0	0.02	0	4.8	0	2.0	0	5.1	0	2.0
Swainson's hawk	0.06	0	0	0.01	5.2	0	0	0.6	4.9	0	0	0.6
unidentified buteo	0.01	0.03	0	0	0.6	2.2	0	0	0.7	2.2	0	0
Northern Harrier	*0.10*	*0.16*	*0*	*0.03*	*9.0*	*11.5*	*0*	*3.3*	*8.3*	*10.1*	*0*	*2.4*
northern harrier	0.10	0.16	0	0.03	9.0	11.5	0	3.3	8.3	10.1	0	2.4
Eagles	*0.11*	*0.26*	*0.14*	*0.08*	*10.4*	*19.1*	*23.3*	*8.3*	*9.6*	*20.3*	*13.9*	*6.1*
bald eagle	0	0	0	0.01	0	0	0	1.3	0	0	0	1.3
golden eagle	0.11	0.25	0.14	0.07	10.4	18.5	23.3	7.0	9.6	19.6	13.9	5.4
unidentified eagle	0	0.01	0	0	0	0.5	0	0	0	0.7	0	0
Falcons	*0.18*	*0.02*	*0*	*0.15*	*16.8*	*1.3*	*0*	*15.2*	*14.0*	*1.8*	*0*	*13.4*
American kestrel	0.18	0.01	0	0.12	16.2	0.8	0	12.1	13.3	1.1	0	11.1
prairie falcon	0.01	0.01	0	0.03	0.6	0.5	0	3.1	0.7	0.7	0	3.0
Other Raptors	*0*	*0*	*0*	*0.01*	*0*	*0*	*0*	*0.6*	*0*	*0*	*0*	*0.6*
osprey	0	0	0	0.01	0	0	0	0.6	0	0	0	0.6

Table 4a. Mean bird use (number of birds/800-plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each large bird type and species by season during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**
Vultures	**0**	**0.01**	**0**	**0.01**	**0**	**0.5**	**0**	**0.8**	**0**	**0.7**	**0**	**0.8**
turkey vulture	0	0.01	0	0.01	0	0.5	0	0.8	0	0.7	0	0.8
Upland Gamebirds	**0**	**0.01**	**0.09**	**0.06**	**0**	**1.1**	**15.1**	**5.9**	**0**	**0.7**	**4.9**	**5.8**
greater sage grouse	0	0.01	0.09	0.06	0	1.1	15.1	5.9	0	0.7	4.9	5.8
Doves/Pigeons	**0.07**	**0**	**0**	**0**	**6.4**	**0**	**0**	**0**	**4.9**	**0**	**0**	**0**
mourning dove	0.07	0	0	0	6.4	0	0	0	4.9	0	0	0
Large Corvids	**0.44**	**0.73**	**0.34**	**0.45**	**40.5**	**53.2**	**57.0**	**45.9**	**7.7**	**29.7**	**16.0**	**20.5**
black-billed magpie	0	0.02	0.05	0	0	1.7	8.1	0	0	1.5	4.9	0
common raven	0.10	0.71	0.29	0.34	9.1	51.5	48.8	35.1	5.7	29.0	13.9	19.1
American crow	0.34	0	0	0.11	31.4	0	0	10.8	2.1	0	0	1.4
Overall	**1.08**	**1.37**	**0.60**	**0.98**	**100**	**100**	**100**	**100**				

Table 4b. Mean use (number of birds/100-m plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**
Passerines	**4.04**	**1.57**	**0.02**	**4.97**	**96.8**	**100.0**	**100.0**	**99.5**	**83.4**	**29.4**	**2.1**	**89.2**
American robin	0.01	0	0	0	0.2	0	0	0	0.7	0	0	0
barn swallow	0	0	0	0.02	0	0	0	0.3	0	0	0	1.6
Brewer's blackbird	0.06	0	0	0.14	1.4	0	0	2.7	4.3	0	0	1.1
Brewer's sparrow	0.39	0.03	0	0.12	9.4	1.8	0	2.4	24.1	1.7	0	7.6
Clark's nutcracker	0	0	0	0	0	0	0	0	0	0	0	0
cliff swallow	0	0	0	0.01	0	0	0	0.1	0	0	0	0.5
grasshopper sparrow	0	0	0	0.03	0	0	0	0.5	0	0	0	1.9
green-tailed towhee	0.01	0	0	0	0.2	0	0	0	0.7	0	0	0
horned lark	1.83	1.15	0.02	3.38	43.7	73.1	100.0	67.6	55.6	19.8	2.1	79.2
house wren	0.09	0.02	0	0	2.2	1.3	0	0	4.2	1.4	0	0
lark bunting	0.02	0	0	0.12	0.5	0	0	2.4	2.1	0	0	1.0
lark sparrow	0	0.01	0	0	0	0.9	0	0	0	0.7	0	0
Lincoln's sparrow	0	0	0	0.01	0	0	0	0.3	0	0	0	1.3
loggerhead shrike	0.01	0	0	0.01	0.2	0	0	0.3	0.7	0	0	0.6
mountain bluebird	0.01	0.11	0	0.19	0.4	6.7	0	3.8	1.5	2.5	0	9.4
rock wren	0.05	0	0	0.05	1.2	0	0	1.1	3.6	0	0	2.6
sage sparrow	0.05	0	0	0.37	1.2	0	0	7.5	4.4	0	0	20.6
sage thrasher	0.32	0.01	0	0.06	7.6	0.9	0	1.2	27.0	1.4	0	3.9
Say's phoebe	0.01	0	0	0.01	0.2	0	0	0.2	0.7	0	0	1.0
song sparrow	0	0.02	0	0	0	1.4	0	0	0	1.4	0	0
Townsend's solitaire	0	0.01	0	0	0	0.4	0	0	0	0.7	0	0
tree swallow	0.02	0	0	0	0.5	0	0	0	2.2	0	0	0
unidentified blackbird	0	0	0	0	0	0	0	0	0	0	0	0
unidentified passerine	0.29	0.10	0	0.03	6.8	6.3	0	0.6	14.8	6.4	0	0.5
unidentified sparrow	0.06	0.04	0	0	1.4	2.2	0	0	5.7	2.1	0	0
unidentified swallow	0.03	0	0	0	0.7	0	0	0	2.8	0	0	0

Table 4b. Mean use (number of birds/100-m plot/20-min survey), percent of total composition (%), and frequency of occurrence (%) for each small bird type and species by season during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

	Use				% Composition				% Frequency			
Species/Type	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**	**Summer**	**Fall**	**Winter**	**Spring**
unidentified wren	0.01	0	0	0	0.2	0	0	0	0.7	0	0	0
vesper sparrow	0.56	0.03	0	0.23	13.4	1.8	0	4.6	26.2	2.1	0	11.5
western kingbird	0.01	0	0	0	0.2	0	0	0	0.7	0	0	0
western meadowlark	0.23	0.05	0	0.19	5.4	3.2	0	3.9	17.5	2.2	0	15.4
Other Birds	**0.13**	**0**	**0**	**0.03**	**3.2**	**0**	**0**	**0.5**	**4.4**	**0**	**0**	**2.0**
common nighthawk	0.01	0	0	0	0.3	0	0	0	1.4	0	0	0
northern flicker	0.01	0	0	0.01	0.2	0	0	0.2	0.8	0	0	0.8
unidentified hummingbird	0.01	0	0	0	0.3	0	0	0	0.7	0	0	0
white-throated swift	0.10	0	0	0.02	2.3	0	0	0.4	1.5	0	0	1.3
Overall	**4.18**	**1.57**	**0.02**	**5.00**	**100**	**100**	**100**	**100**				

Table 5. Flight height characteristics by bird type during fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009. Large bird observations were limited to within 800 m and small birds were limited to within 100 m.

Bird Type	# Groups Flying	# Obs Flying	Mean Flight Height (m)	% Obs Flying	% within Flight Height Categories 0-35 m	35-130 m	> 130 m
Waterbirds	2	16	87.50	100	0	100	0
Shorebirds	1	1	10.00	100	100	0	0
Raptors	192	207	52.65	92.8	61.8	30.4	7.7
Accipiters	*6*	*6*	*23.33*	*100*	*66.7*	*33.3*	*0*
Buteos	*51*	*55*	*51.39*	*94.8*	*50.9*	*43.6*	*5.5*
Northern Harrier	*37*	*40*	*12.97*	*97.6*	*90.0*	*10.0*	*0*
Eagles	*57*	*62*	*106.75*	*91.2*	*35.5*	*45.2*	*19.4*
Falcons	*40*	*43*	*19.05*	*87.8*	*86.0*	*11.6*	*2.3*
Other Raptors	*1*	*1*	*20.00*	*100*	*100*	*0*	*0*
Vultures	2	2	27.50	100	50.0	50.0	0
Upland Gamebirds	4	6	2.25	75.0	100	0	0
Doves/Pigeons	4	5	4.25	50.0	100	0	0
Large Corvids	106	230	23.49	95.8	74.8	24.8	0.4
Large Birds Overall	**311**	**467**	**41.36**	**93.4**	**67.0**	**29.3**	**3.6**
Passerines	586	1,023	4.25	71.0	99.8	0.2	0
Other Birds	10	23	13.30	95.8	100	0	0
Small Birds Overall	**596**	**1,046**	**4.40**	**71.4**	**99.8**	**0.2**	**0**

ZOR: The likely "zone of risk" for potential collision with a turbine blade, or 35-130 m above ground level (AGL).

Table 6a. Relative exposure index and flight characteristics by large bird species during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
common raven	98	0.35	95.9	27.6	0.09	42.9
golden eagle	55	0.14	92.3	45.0	0.06	68.3
American crow	5	0.14	98.5	18.8	0.03	18.8
American white pelican	1	0.02	100	100	0.02	100
red-tailed hawk	25	0.06	96.4	29.6	0.02	55.6
rough-legged hawk	11	0.02	100	72.7	0.02	100
Swainson's hawk	8	0.02	100	66.7	0.01	88.9
northern harrier	37	0.08	97.6	10.0	0.01	22.5
American kestrel	34	0.09	86.0	8.1	0.01	16.2
great blue heron	1	<0.01	100	100	<0.01	100
prairie falcon	6	0.01	100	33.3	<0.01	66.7
unidentified accipiter	2	<0.01	100	100	<0.01	100
ferruginous hawk	5	0.01	100	20.0	<0.01	20.0
unidentified buteo	2	0.01	60.0	33.3	<0.01	100
turkey vulture	2	<0.01	100	50.0	<0.01	50.0
bald eagle	2	<0.01	100	50.0	<0.01	50.0
greater sage grouse	4	0.03	75.0	0	0	0
mourning dove	4	0.02	50.0	0	0	0
black-billed magpie	3	0.01	60.0	0	0	0
sharp-shinned hawk	2	<0.01	100	0	0	0
Cooper's hawk	2	<0.01	100	0	0	0
killdeer	1	<0.01	100	0	0	0
unidentified eagle	0	<0.01	0	0	0	0
osprey	1	<0.01	100	0	0	100

ZOR: The likely "zone of risk" for potential collision with a turbine blade, or 35-130 m above ground level (AGL).

Table 6b. Relative exposure index and flight characteristics for small birds during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
horned lark	381	1.78	89.1	0.1	<0.01	1.3
unidentified passerine	38	0.12	87.8	1.4	<0.01	1.4
vesper sparrow	39	0.25	38.8	0	0	2.1
Brewer's sparrow	39	0.16	55.0	0	0	0
western meadowlark	8	0.14	13.0	0	0	0
sage thrasher	10	0.12	15.4	0	0	0
sage sparrow	12	0.12	23.7	0	0	0
mountain bluebird	10	0.08	55.9	0	0	0
Brewer's blackbird	10	0.05	100	0	0	0
lark bunting	3	0.04	93.3	0	0	0
white-throated swift	4	0.04	100	0	0	87.5
house wren	2	0.03	31.3	0	0	0
rock wren	3	0.03	30.8	0	0	0
unidentified sparrow	11	0.03	92.9	0	0	0
unidentified swallow	4	0.01	100	0	0	25.0
tree swallow	3	0.01	100	0	0	0
grasshopper sparrow	0	0.01	0	0	0	0
song sparrow	1	0.01	33.3	0	0	0
loggerhead shrike	3	0.01	100	0	0	0
Say's phoebe	2	<0.01	100	0	0	0
northern flicker	1	<0.01	50.0	0	0	0
common nighthawk	3	<0.01	100	0	0	50.0
unidentified hummingbird	2	<0.01	100	0	0	0
barn swallow	2	<0.01	100	0	0	0
lark sparrow	1	<0.01	50.0	0	0	0
Lincoln's sparrow	1	<0.01	50.0	0	0	0
American robin	1	<0.01	100	0	0	0

Table 6b. Relative exposure index and flight characteristics for small birds during the fixed-point bird use surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

Species	# Groups Flying	Overall Mean Use	% Flying	% Flying within ZOR based on initial obs	Exposure Index	% Within ZOR at anytime
green-tailed towhee	0	<0.01	0	0	0	0
unidentified wren	0	<0.01	0	0	0	0
western kingbird	1	<0.01	50.0	0	0	0
Townsend's solitaire	0	<0.01	0	0	0	0
cliff swallow	1	<0.01	100	0	0	100

ZOR: The likely "zone of risk" for potential collision with a turbine blade, or 114-427 ft (35-130 m) above ground level (AGL).

Table 7. Summary of sensitive species observed at the Chokecherry-Sierra Madre Wind Resource Area during fixed-point bird use surveys (FP) and as incidental wildlife observations (Inc.), June 26, 2008 – June 16, 2009.

			FP		Inc.		Total	
Species	**Scientific Name**	**Status**	**# of grps**	**# of obs**	**# of grps**	**# of obs**	**# of grps**	**# of obs**
greater sage-grouse	*Centrocercus urophasianus*	NSS2, P	6	28	29	123	35	151
Brewer's sparrow	*Spizella breweri*	NSS4	70	80	0	0	70	80
sage thrasher	*Oreoscoptes montanus*	NSS4	60	65	0	0	60	65
sage sparrow	*Amphispiza belli*	NSS4	55	59	0	0	55	59
Swainson's hawk	*Buteo swainsoni*	NSS4	8	9	7	10	15	19
lark bunting	*Calamospiza melanocorys*	NSS4	4	15	0	0	4	15
ferruginous hawk	*Buteo regalis*	NSS3	5	5	8	8	13	13
bald eagle	*Haliaeetus leucocephalus*	NSS2	2	2	4	4	6	6
grasshopper sparrow	*Ammodramus savannarum*	NSS4	4	4	0	0	4	4
great blue heron	*Ardea herodias*	NSS4	1	2	0	0	1	2
burrowing owl	*Athene cunicularia*	NSS4	0	0	1	1	1	1
Bird Subtotal	**11 species**		**215**	**269**	**49**	**146**	**293**	**538**
white-tailed prairie dog	*Cynomys leucurus*	NSS4	0	0	1	5	1	5
Total	**12 species**		**215**	**269**	**50**	**151**	**294**	**543**

P= petitioned for Federal listing.

NSS1= Populations greatly restricted or declining, extirpation possible OR ongoing significant loss of habitat.

NSS2= Populations declining, extirpation possible; habitat restricted or vulnerable but no recent or ongoing significant loss; species likely sensitive to human disturbance OR populations declining or restricted in numbers or distribution, extirpation not imminent; ongoing significant loss of habitat.

NSS3= Populations greatly restricted or declining, extirpation possible; habitat not restricted, vulnerable but no loss; species not sensitive to human disturbance OR populations declining or restricted in numbers or distribution, extirpation not imminent; habitat restricted or vulnerable but no recent or ongoing significant loss; species likely sensitive to human disturbance OR species widely distributed; population status or trends unknown but suspected to be stable; on-going significant loss of habitat.

NSS4= Populations greatly restricted or declining, extirpation possible; habitat stable and not restricted OR populations declining or restricted in numbers or distribution, extirpation not imminent; habitat not restricted, vulnerable but no loss; species not sensitive to human disturbance OR species widely distributed, population status or trends unknown but suspected to be stable; habitat restricted or vulnerable but no recent or on-going significant loss; species likely sensitive to human disturbance OR populations stable or increasing and not restricted in numbers or distribution; on-going significant loss of habitat

(From Wyoming Game and Fish Department [WGFD 2005] and Wyoming's Natural Diversity Database [WYNDD 2009]).

Table 8. Incidental wildlife observed while conducting all surveys at the Chokecherry-Sierra Madre Wind Resource Area, June 26, 2008 – June 16, 2009.

Species	Scientific Name	#grps	# obs
American goldfinch	*Carduelis tristis*	1	1
bald eagle	*Haliaeetus leucocephalus*	4	4
burrowing owl	*Athene cunicularia*	1	1
ferruginous hawk	*Buteo regalis*	8	8
golden eagle	*Aquila chrysaetos*	44	52
greater sage-grouse	*Centrocercus urophasianus*	29	123
northern harrier	*Circus cyaneus*	34	38
prairie falcon	*Falco mexicanus*	8	8
red-tailed hawk	*Buteo jamaicensis*	14	18
rough-legged hawk	*Buteo lagopus*	6	6
snow bunting	*Plectrophenax nivalis*	1	1
Swainson's hawk	*Buteo swainsoni*	7	10
Bird Subtotal	**12 species**	**157**	**270**
elk	*Cervus elephus*	14	189
white-tailed prairie dog	*Cynomys leucurus*	1	5
mule deer	*Odocoileus hemionus*	4	10
pronghorn	*Antilocapra americana*	285	2,879
Mammal Subtotal	**4 species**	**304**	**3,083**

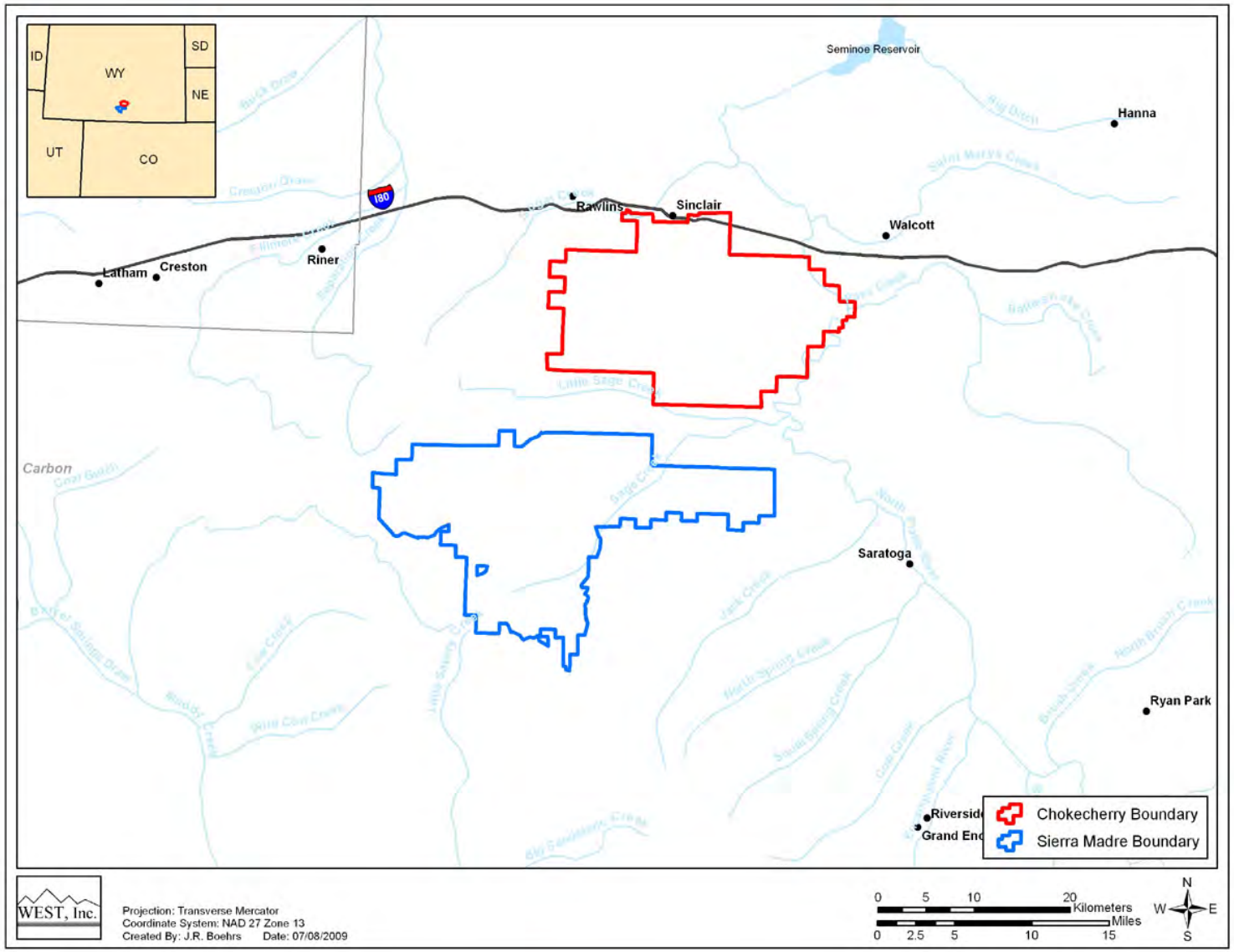


Figure 1. Location of the Chokecherry-Sierra Madre Wind Resource Areas.

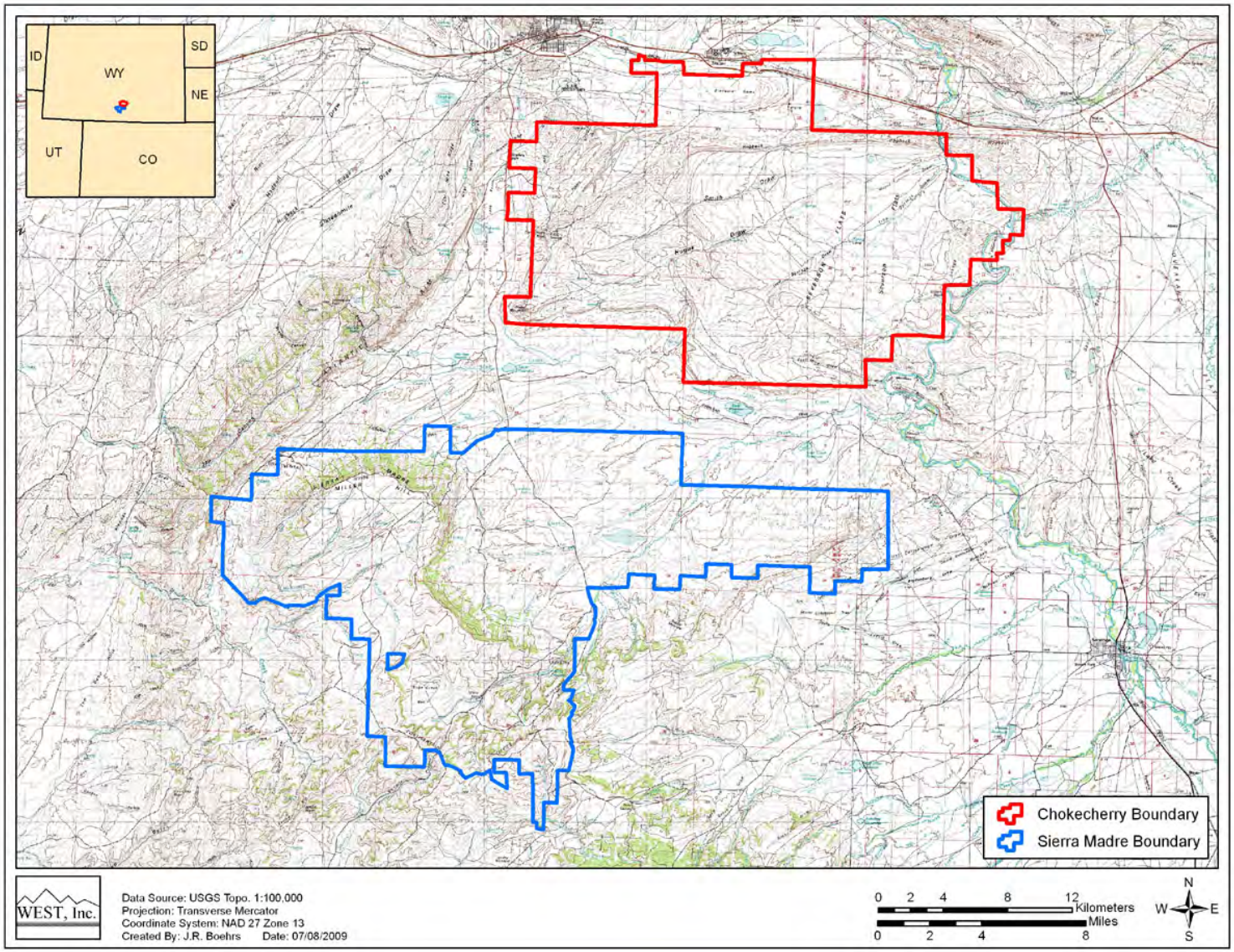


Figure 2. Elevation and topography of the Chokecherry-Sierra Madre Wind Resource Areas.

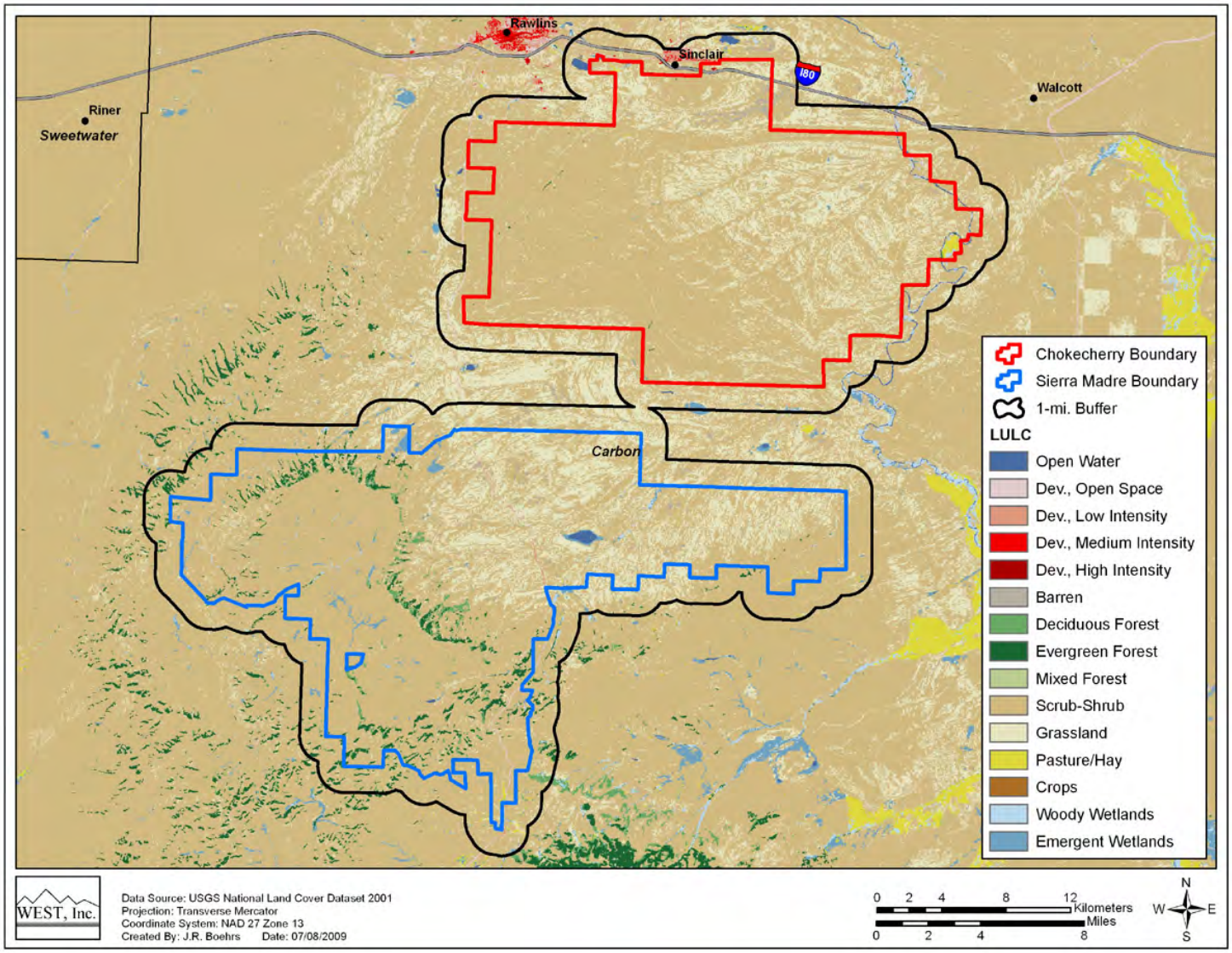


Figure 3. The land cover types and coverage within the Chokecherry-Sierra Madre Wind Resource Areas (USGS NLCD 2001).

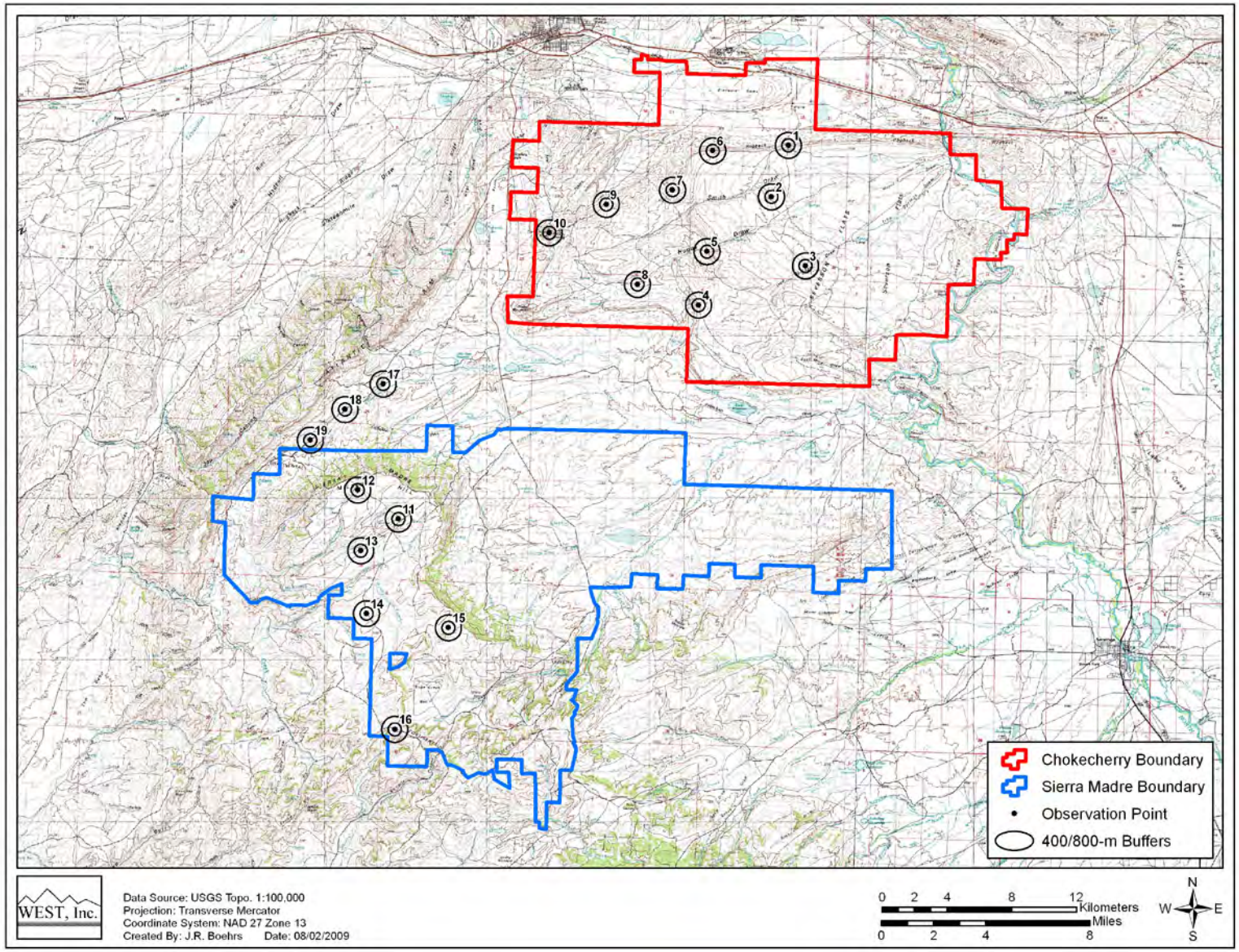


Figure 4. Fixed-point bird use survey points at the Chokecherry-Sierra Madre Wind Resource Areas.

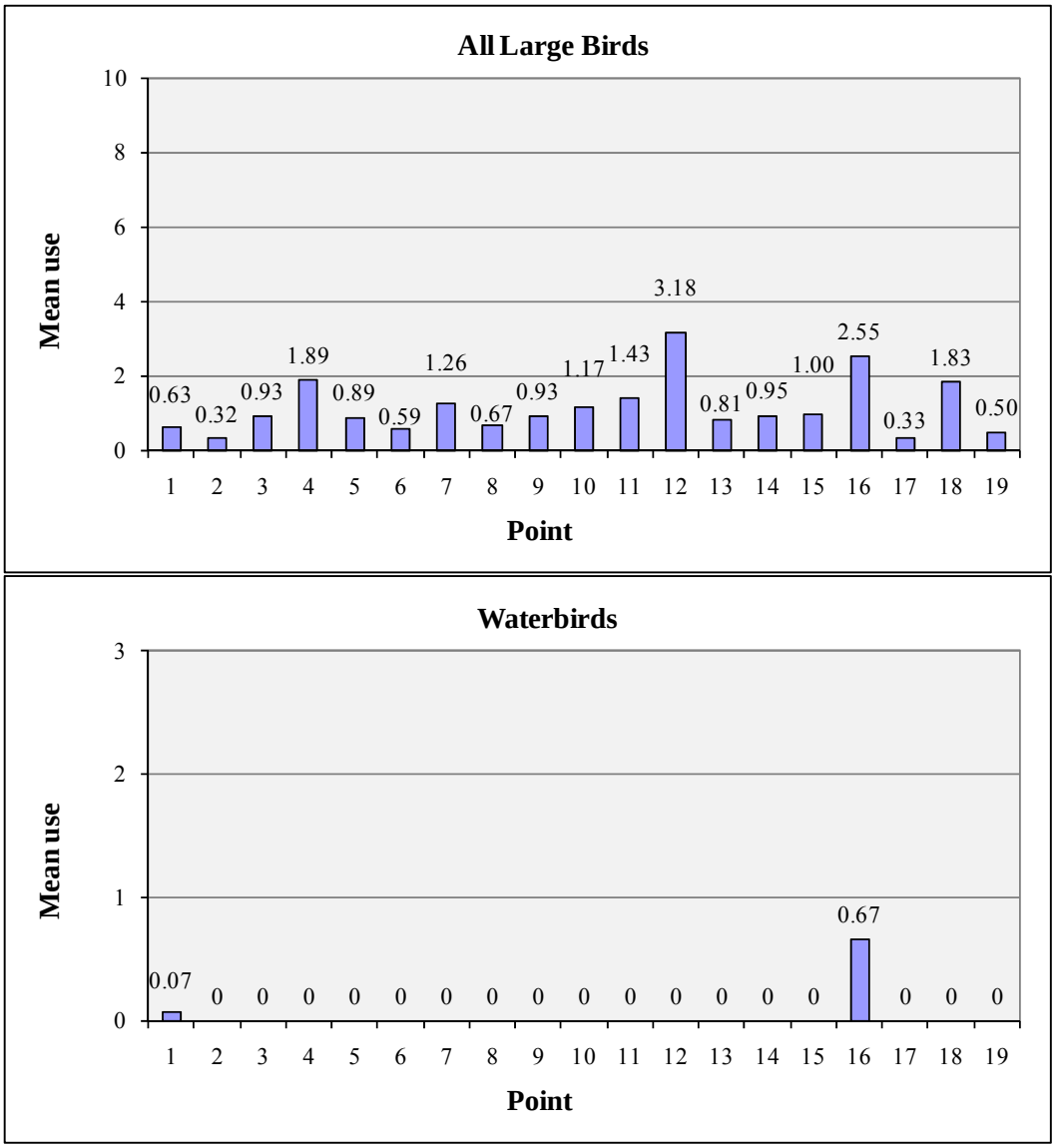


Figure 5. Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.

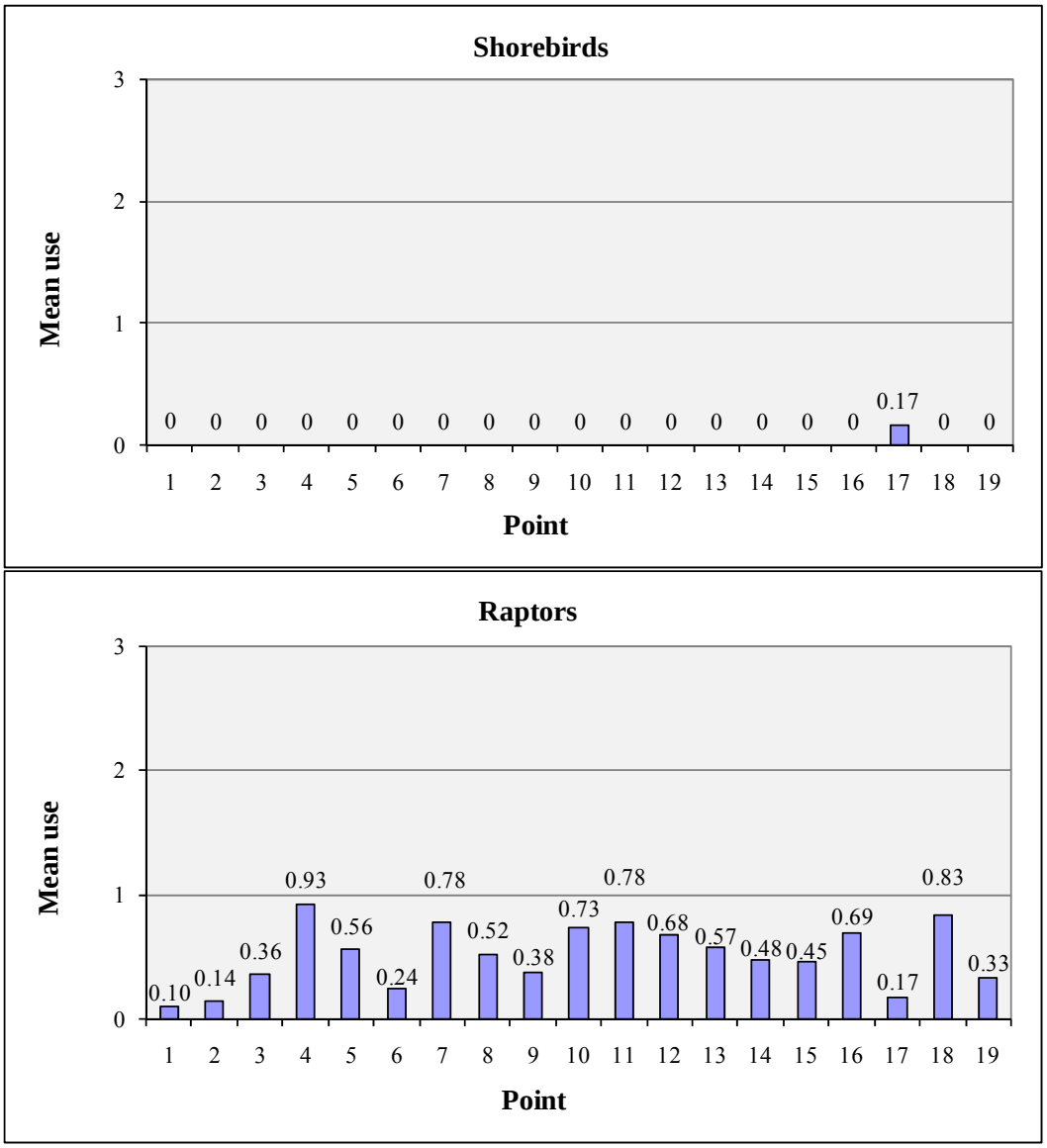
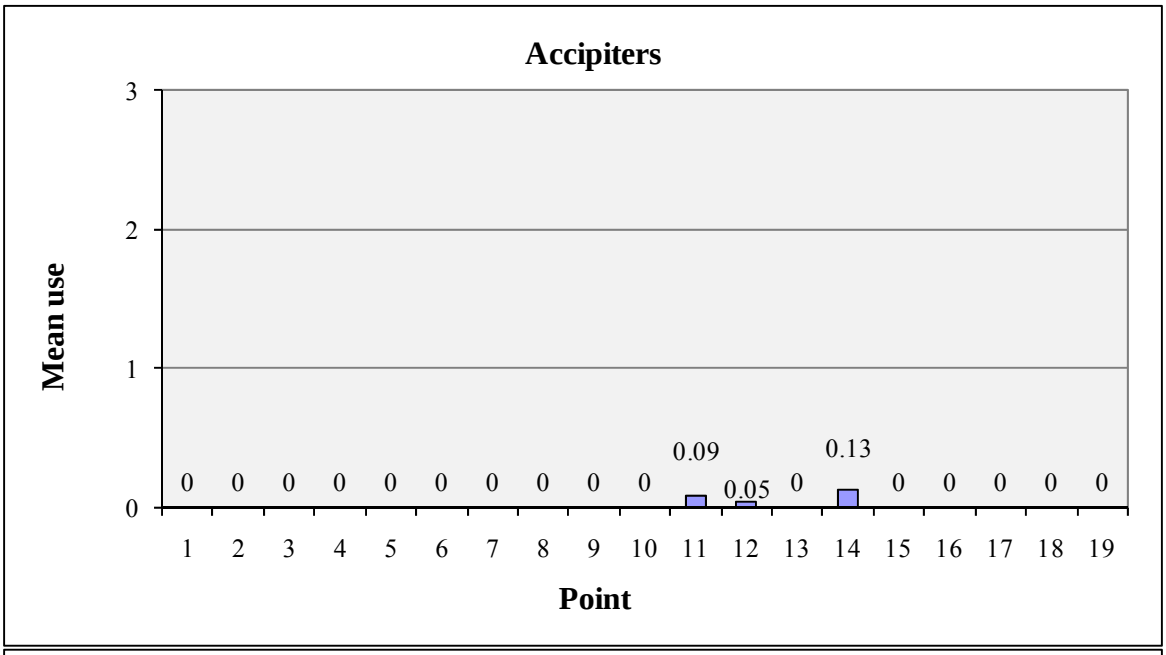


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.



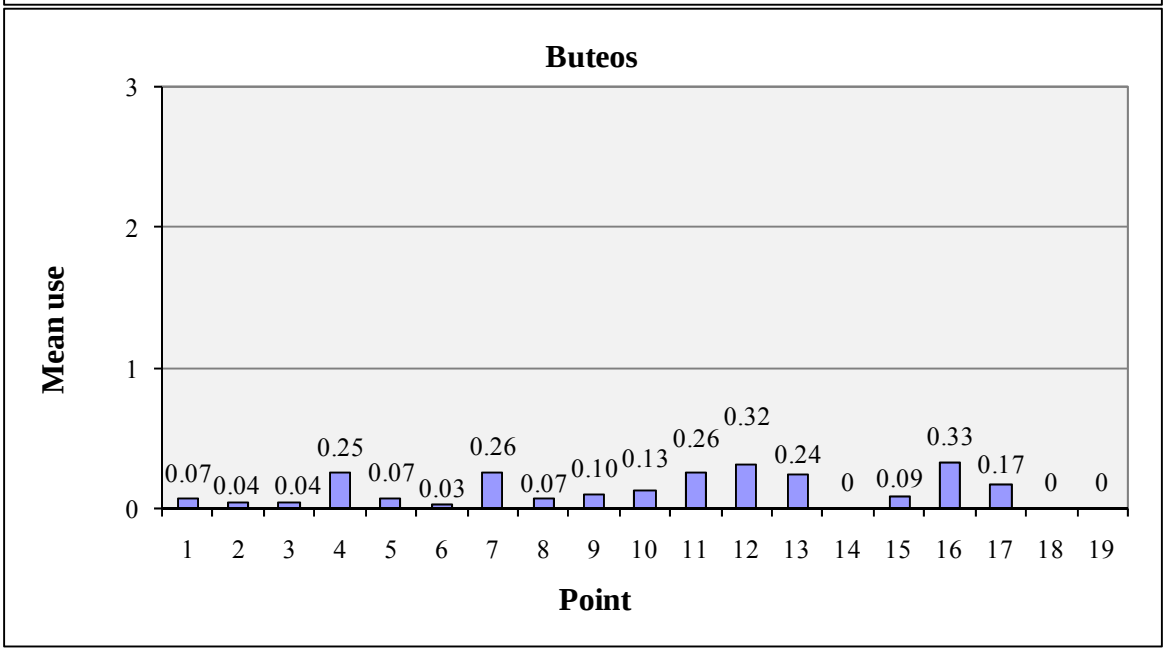
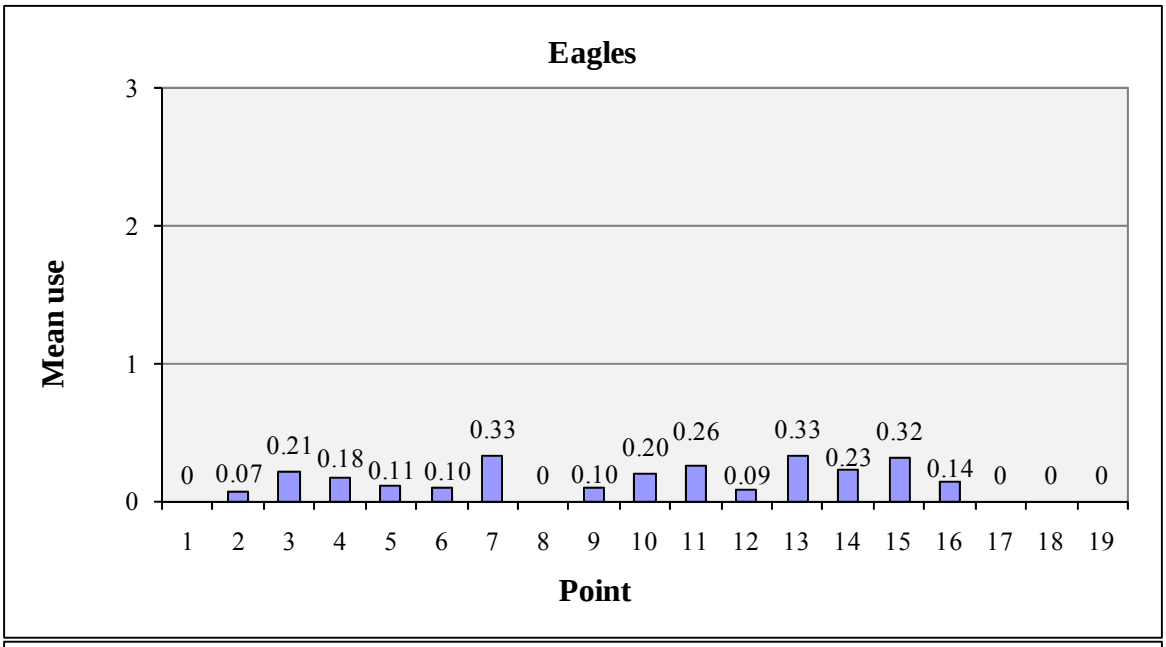


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.



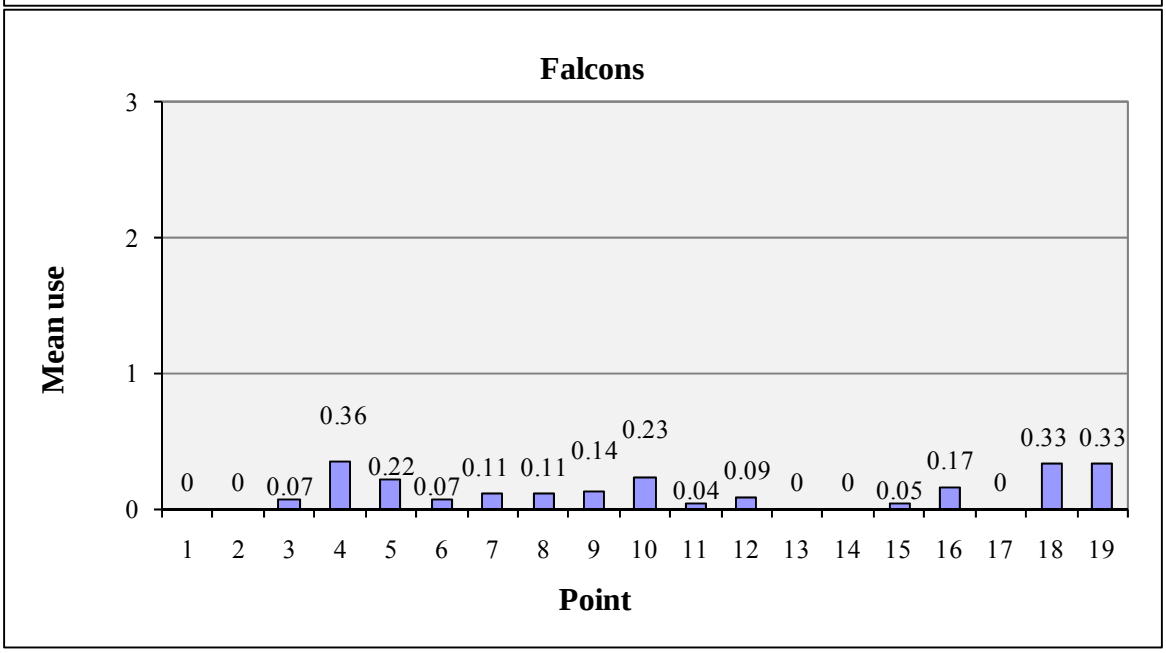
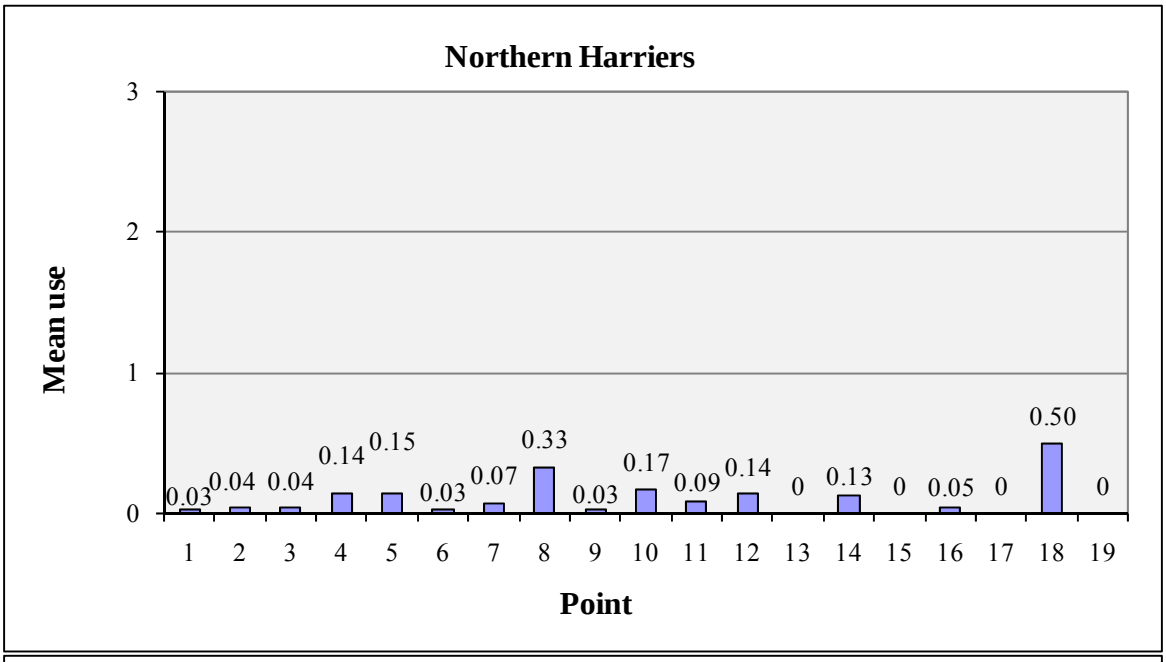


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.



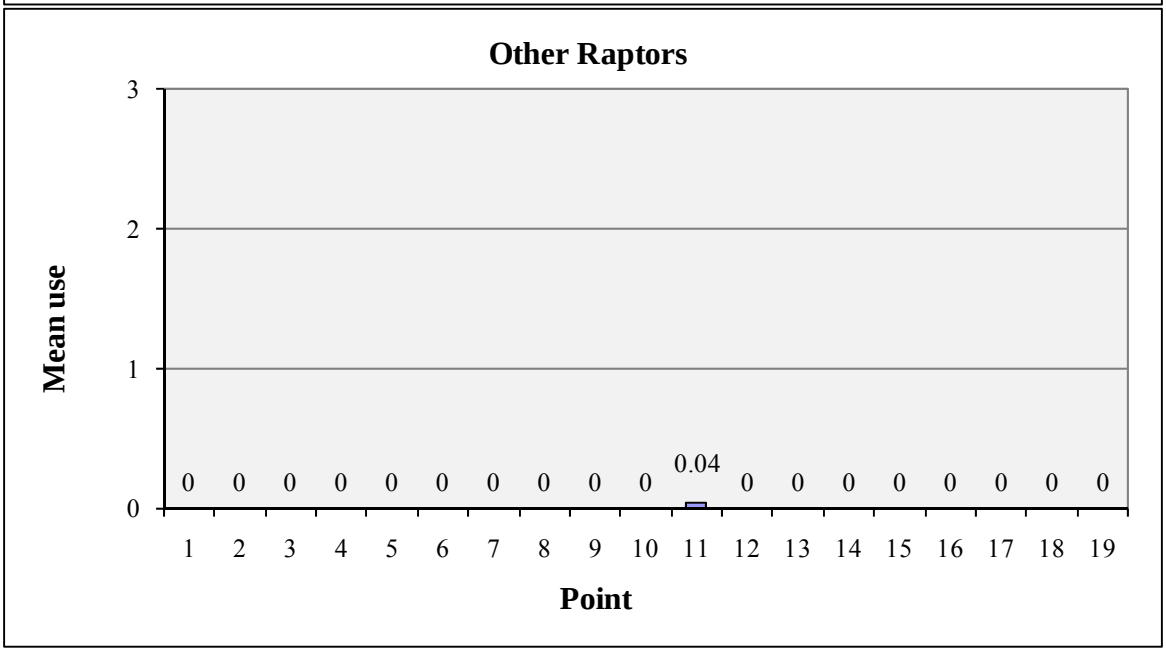


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.

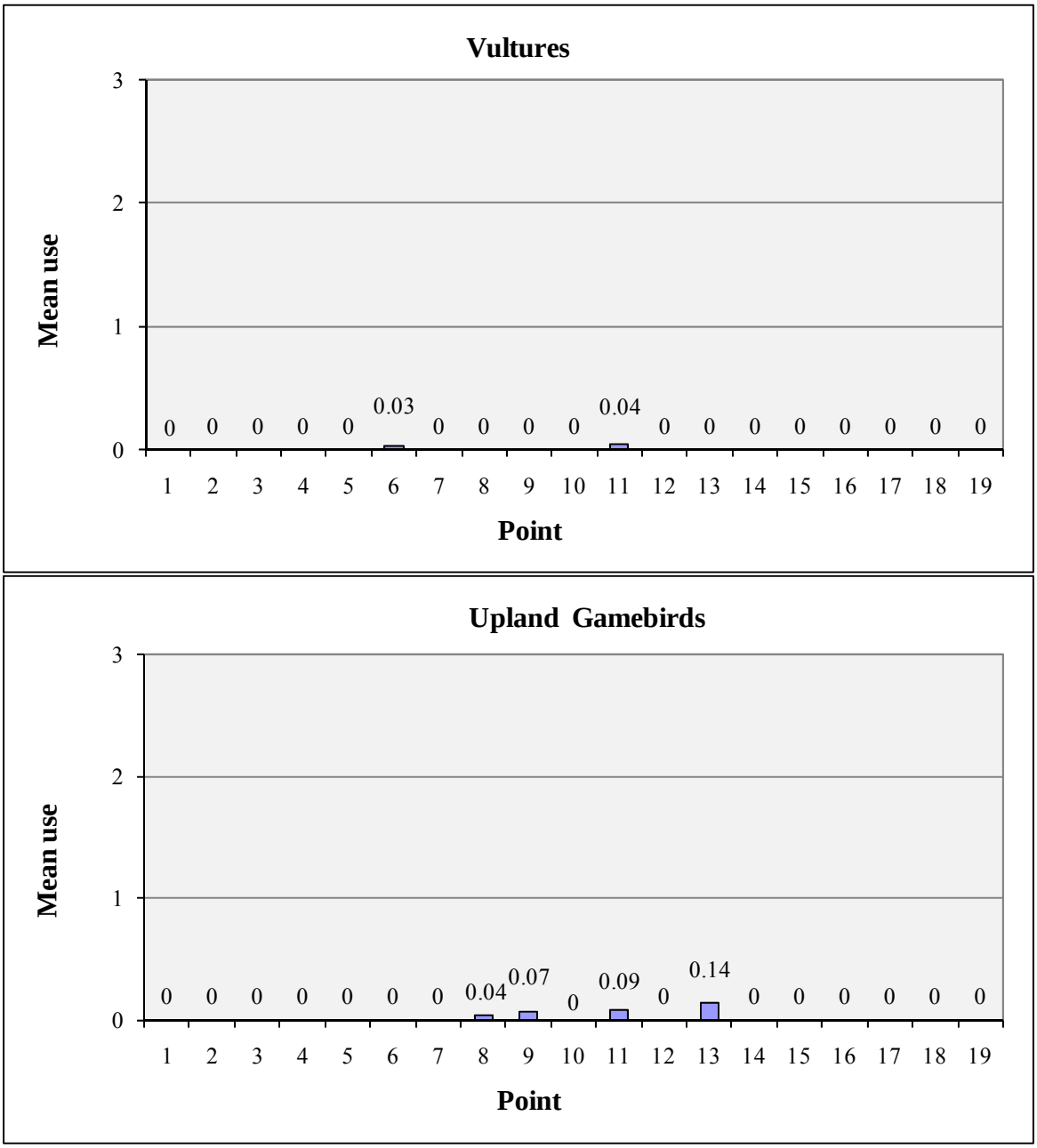
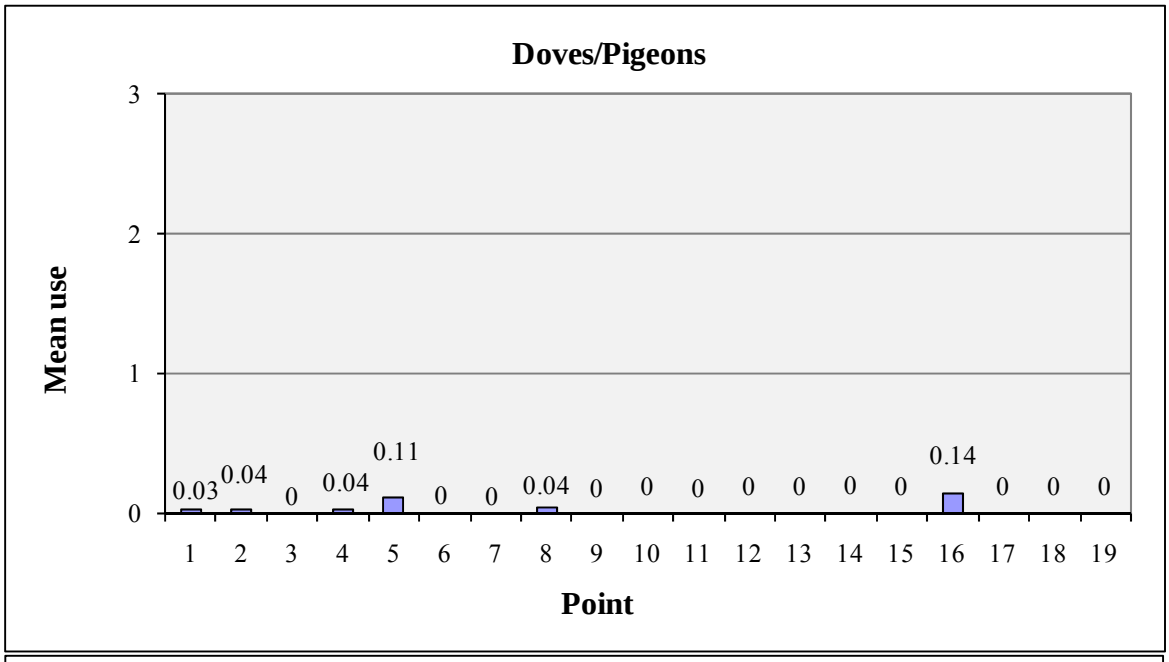


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.



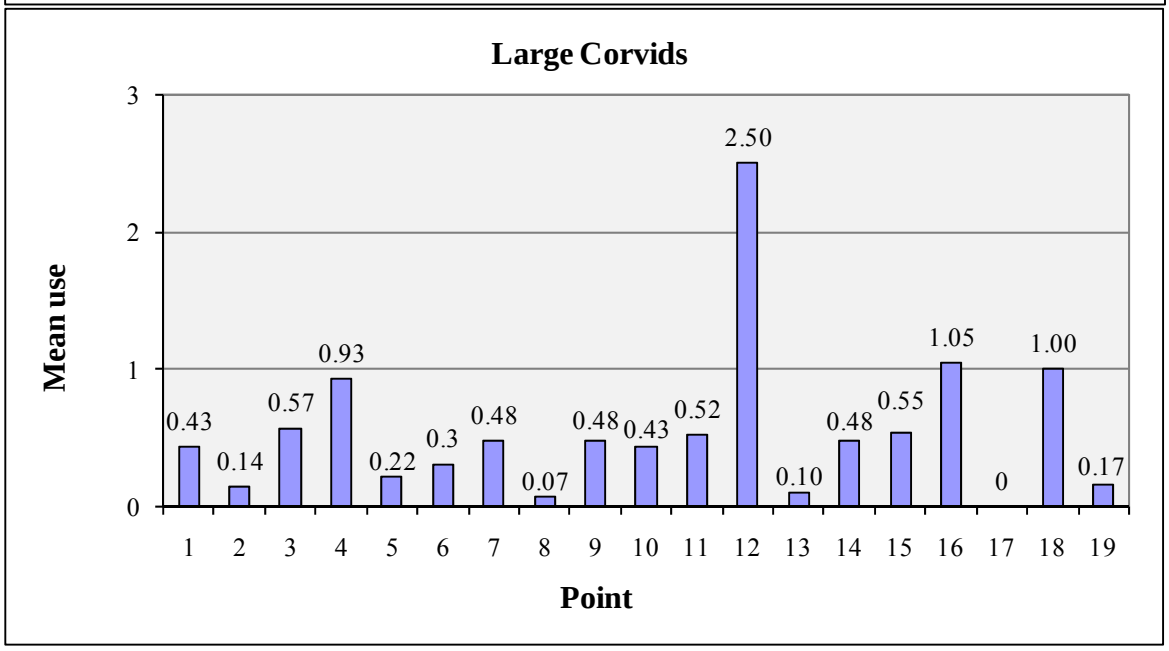


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area.

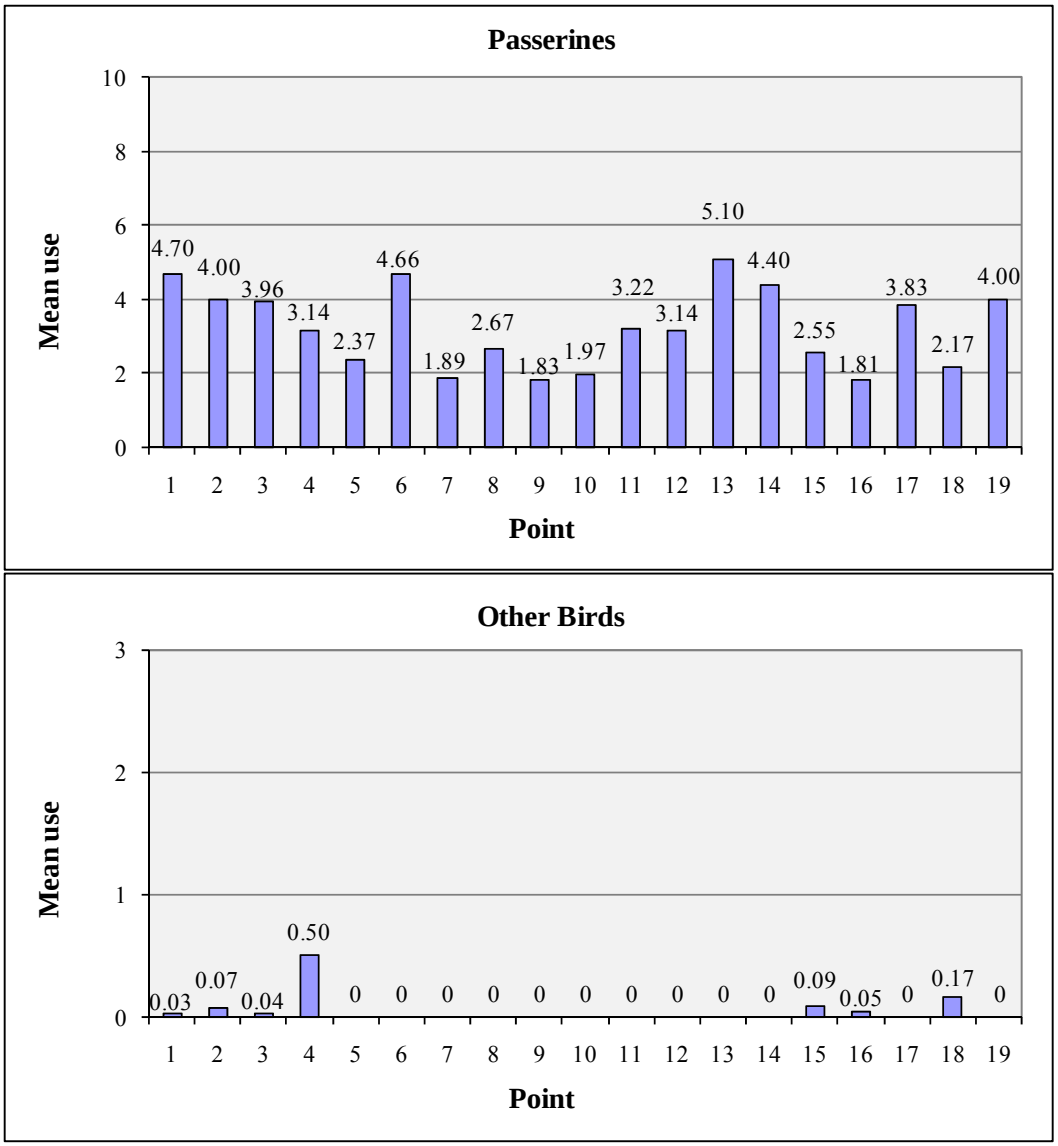


Figure 5 (*continued*). Mean use (number of birds/20-min survey) at each fixed-point bird use survey point for all birds and major bird types at the Chokecherry-Sierra Madre Wind Resource Area. Passerine and other bird observations were focused within 100-m viewsheds.

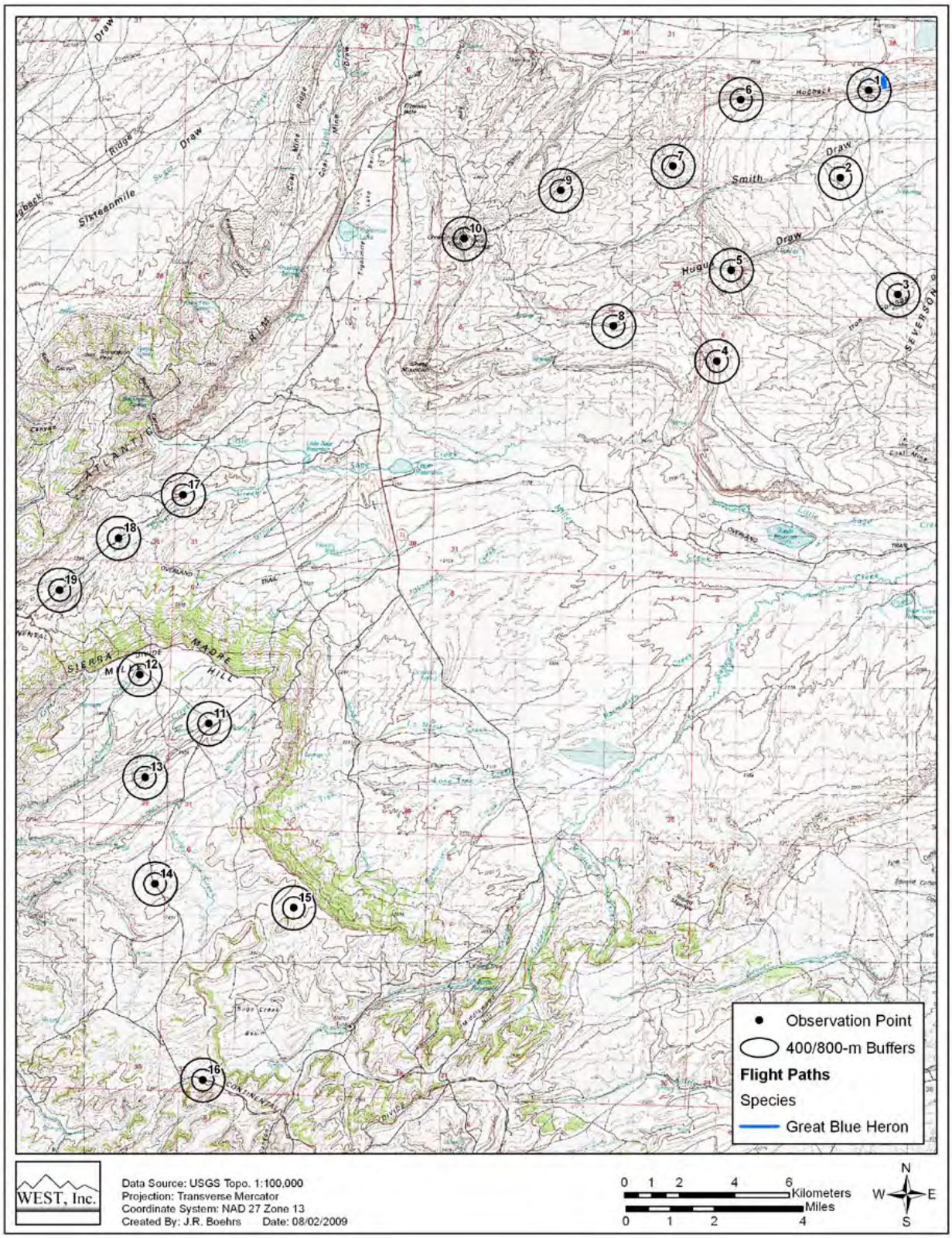


Figure 6a. Flight paths of waterbirds at the Chokecherry-Sierra Madre Wind Resource Area.

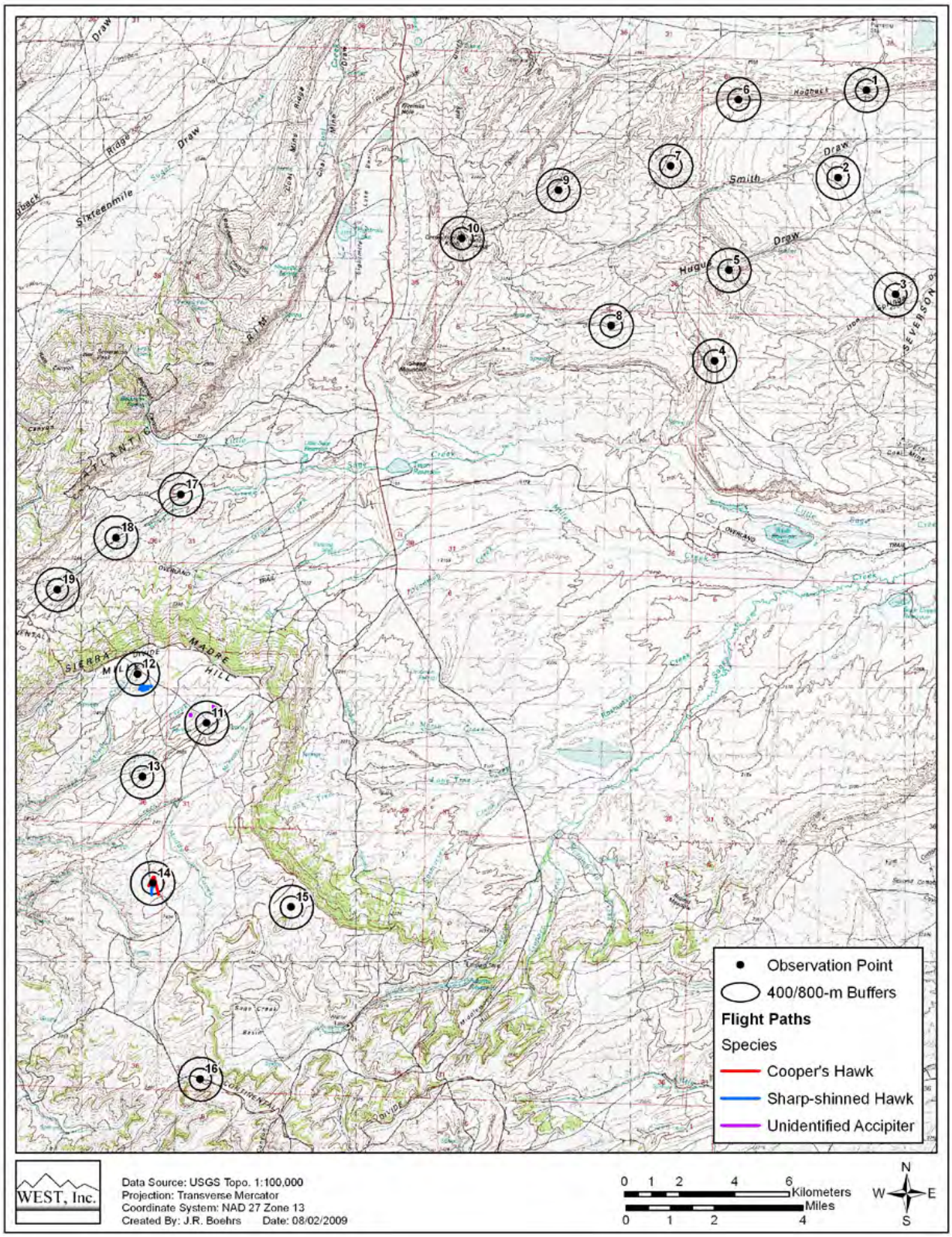


Figure 6b. Flight paths of accipiters at the Chokecherry-Sierra Madre Wind Resource Area.

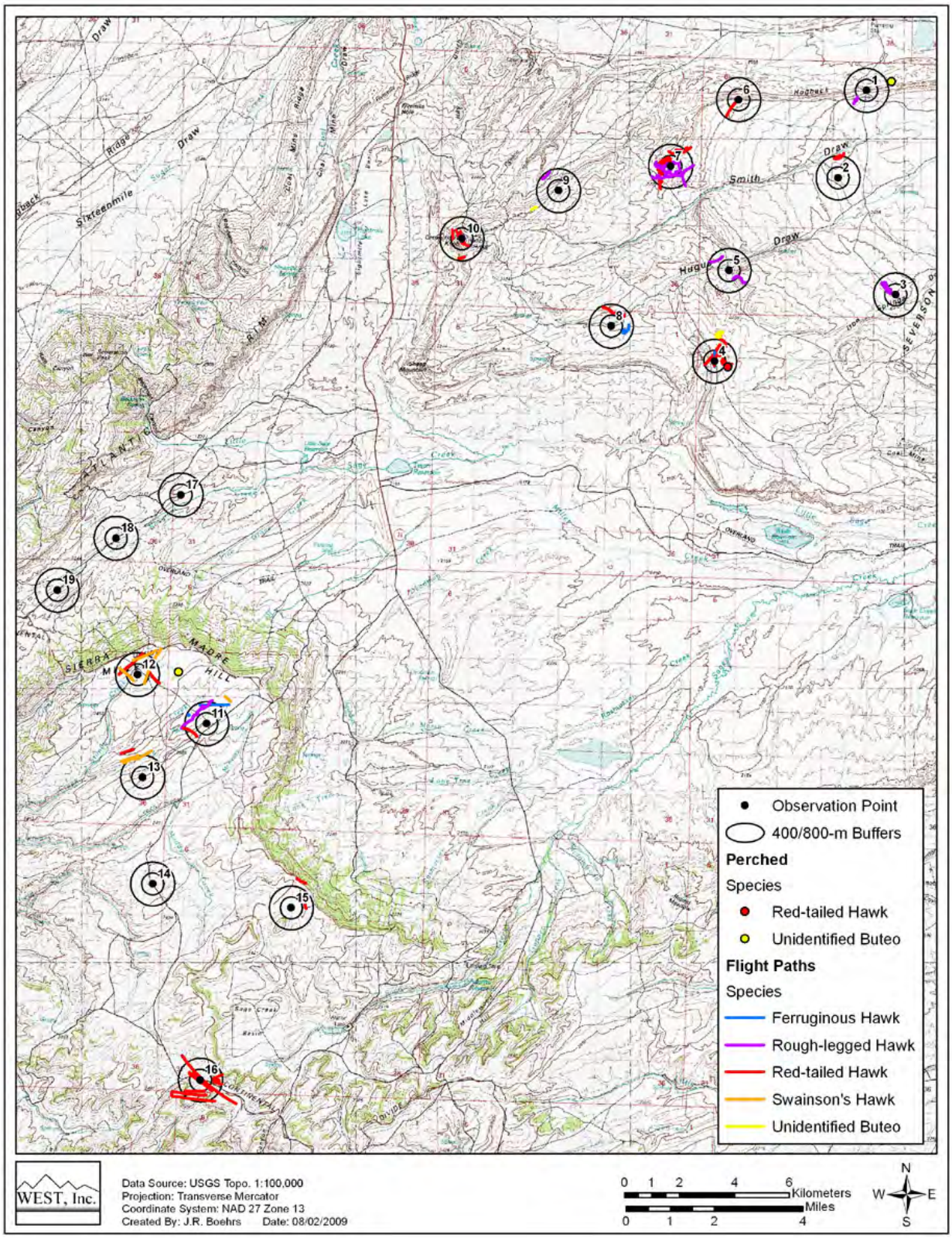


Figure 6c. Flight paths of buteos at the Chokecherry-Sierra Madre Wind Resource Area.

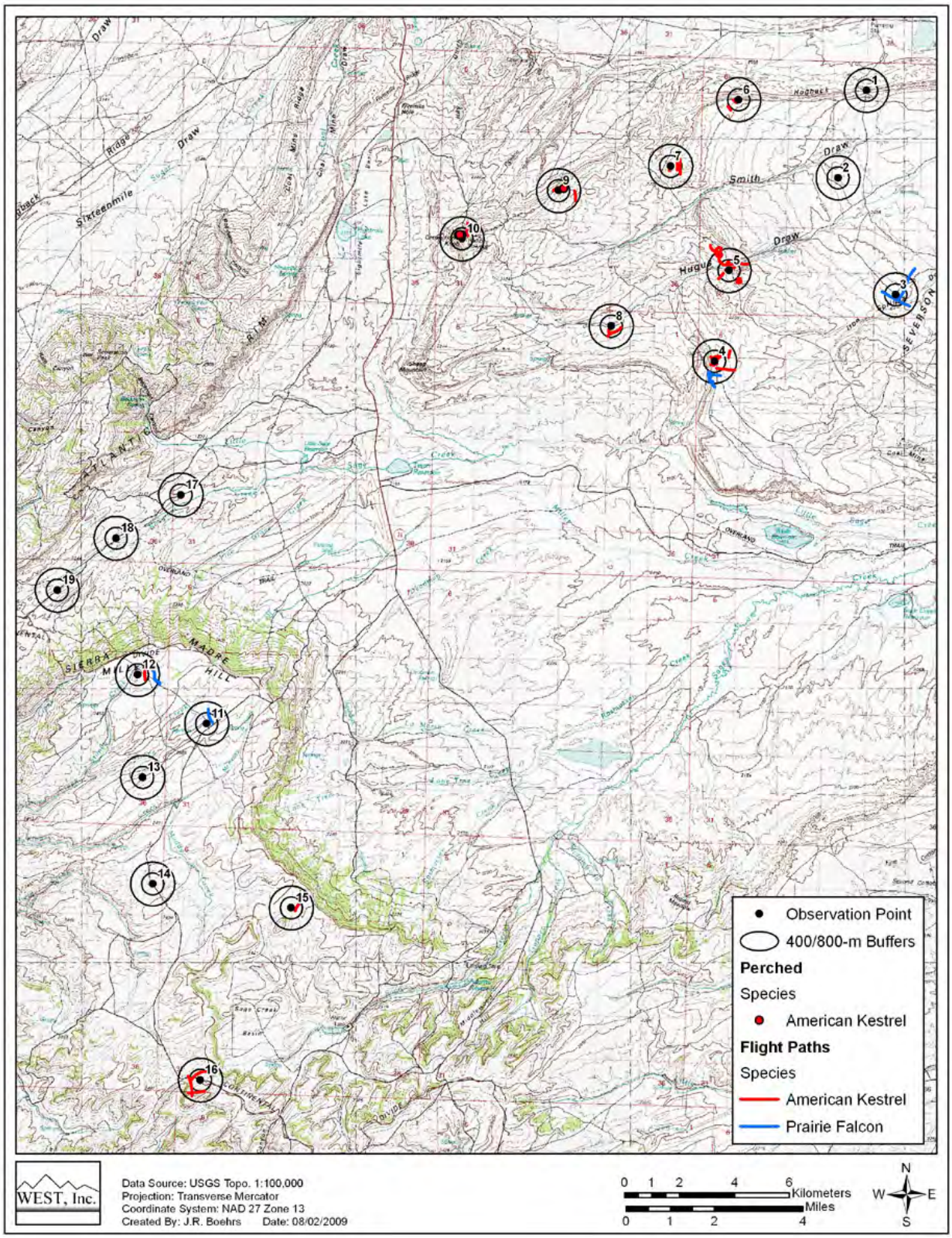


Figure 6d. Flight paths of falcons at the Chokecherry-Sierra Madre Wind Resource Area.

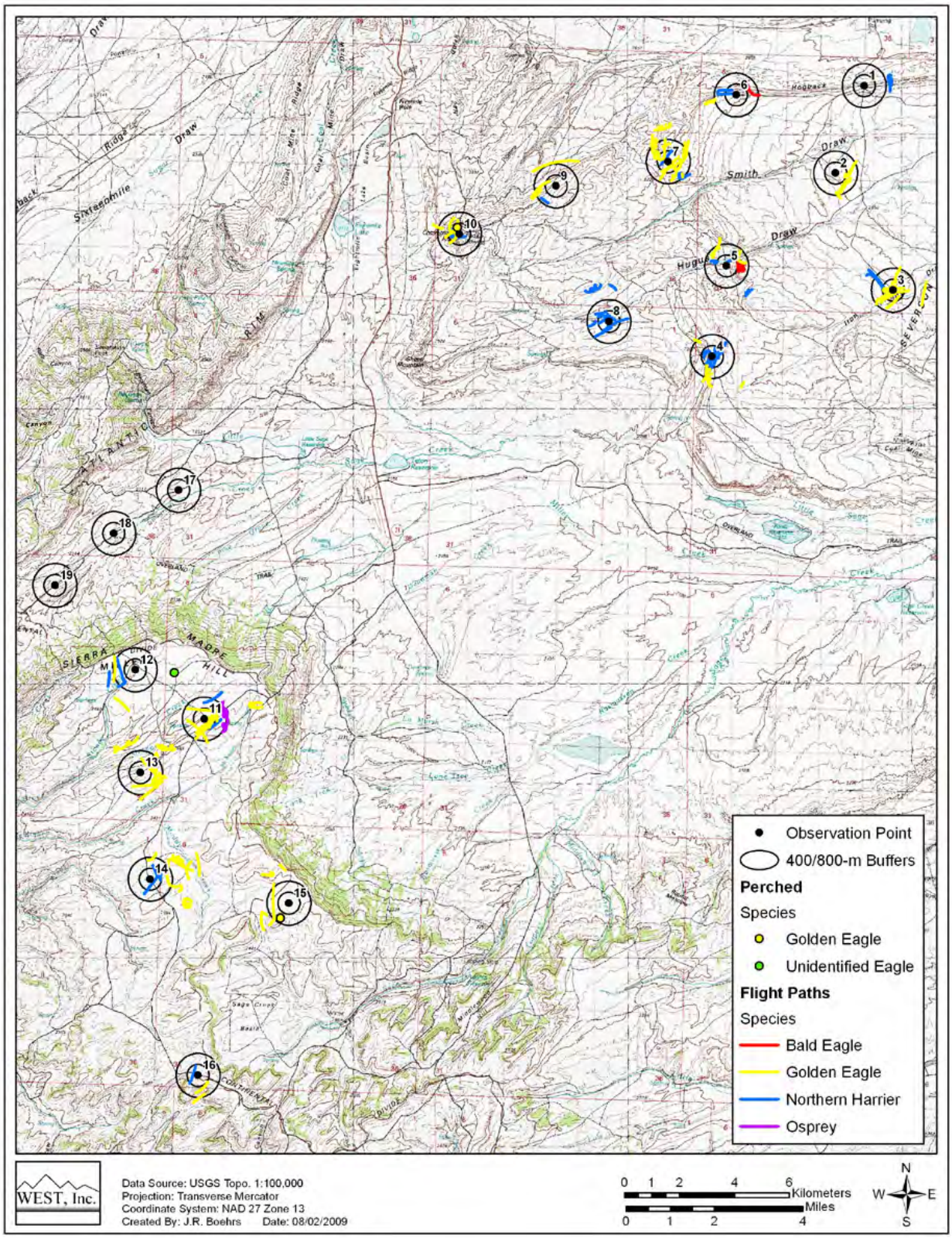


Figure 6e. Flight paths of eagles, northern harriers, and other raptors at the Chokecherry-Sierra Madre Wind Resource Area.

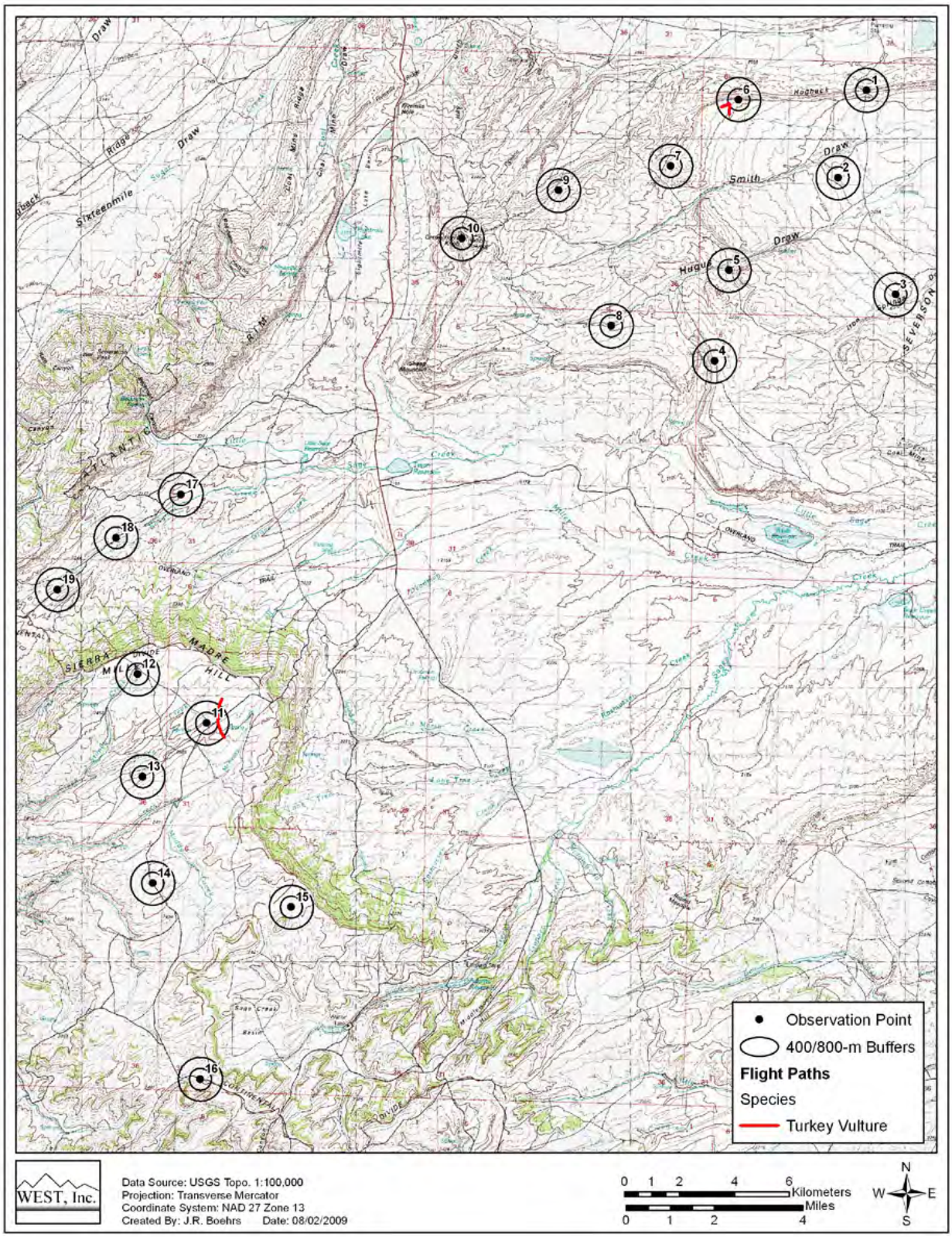


Figure 6f. Flight paths of vultures at the Chokecherry-Sierra Madre Wind Resource Area.

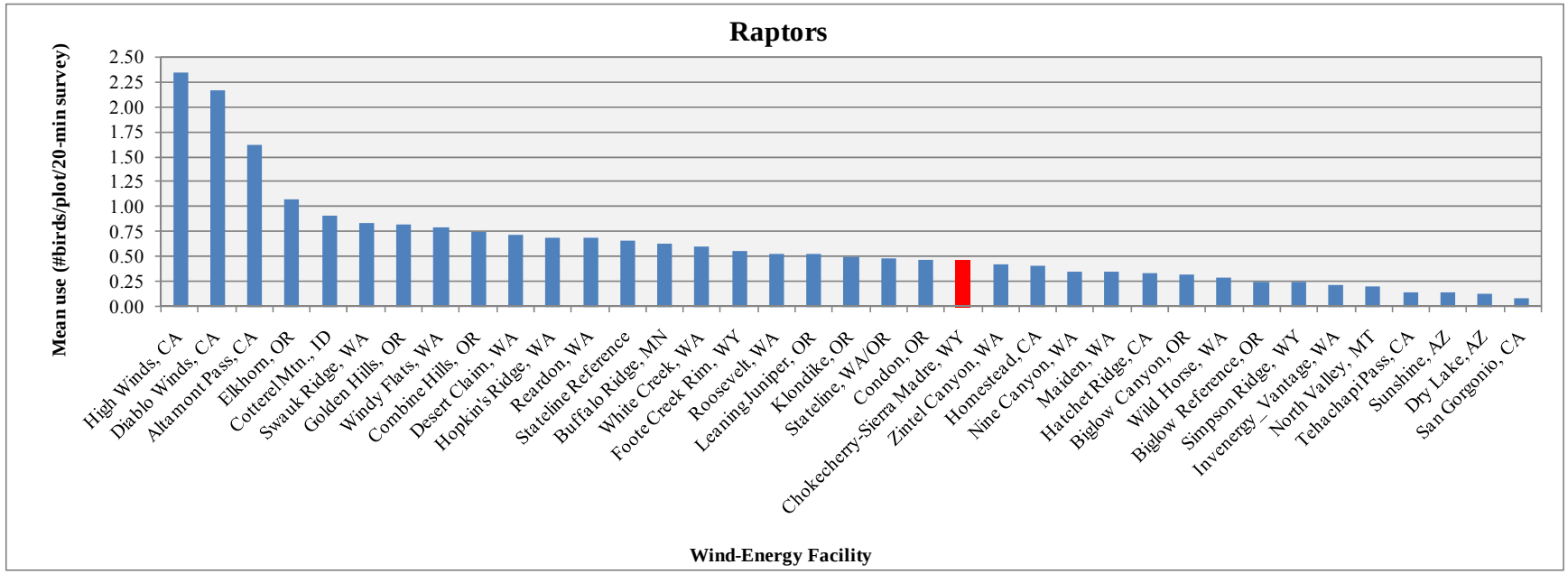
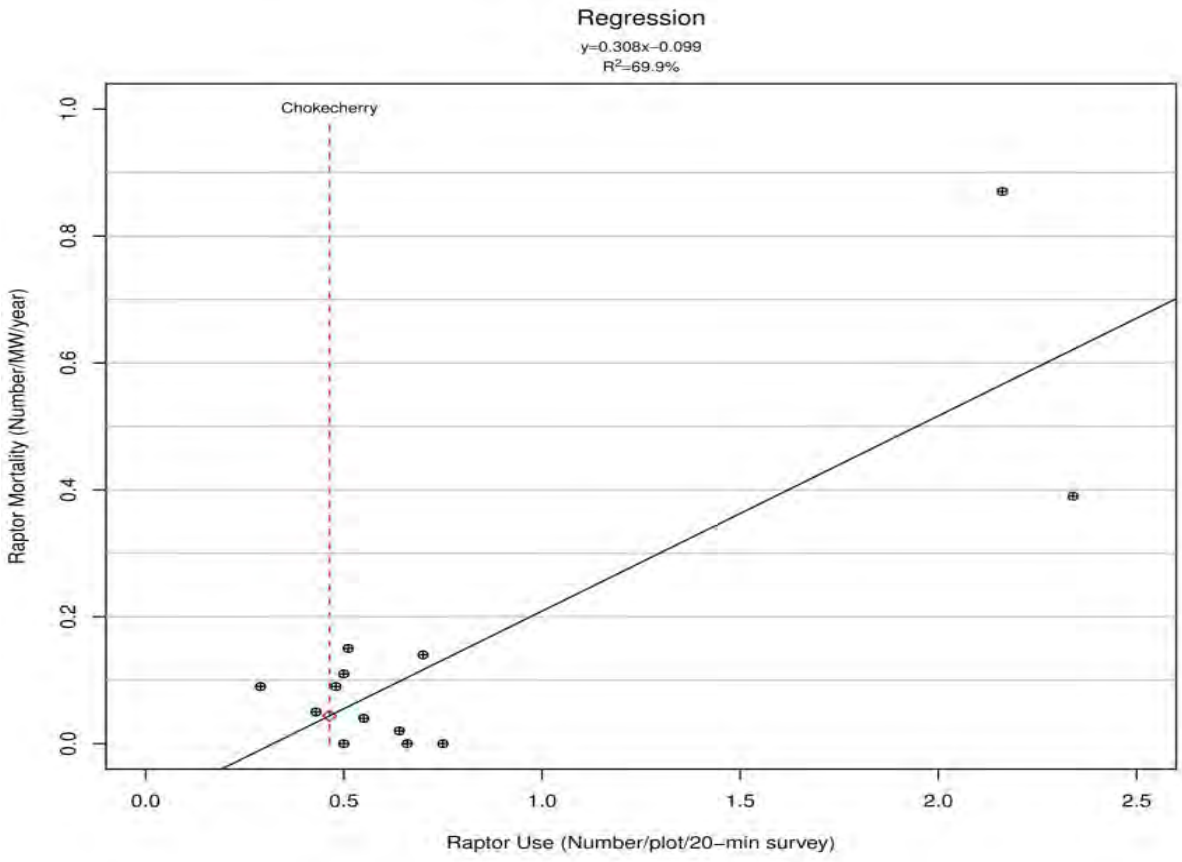


Figure 9. Comparison of annual raptor use between the Chokecherry-Sierra Madre Wind Resource Area and other US wind-energy facilities.

Data from the following sources:

Chokecherry-Sierra Madre, WY	This study.				
High Winds, CA	Kerlinger et al. 2005	Stateline Reference	URS et al. 2001	Maiden, WA	Erickson et al. 2002b
Diablo Winds, CA	WEST 2006a	Buffalo Ridge, MN	Erickson et al. 2002b	Hatchet Ridge, CA	Young et al. 2007b
Altamont Pass, CA	Erickson et al. 2002b	White Creek, WA	NWC and WEST 2005a	Biglow Canyon, OR	WEST 2005c
Elkhorn, OR	WEST 2005a	Foote Creek Rim, WY	Erickson et al. 2002b	Wild Horse, WA	Erickson et al. 2003a
Cotterel Mtn., ID	Cooper et al. 2004	Roosevelt, WA	NWC and WEST 2004	Biglow Reference, OR	WEST 2005c
Swauk Ridge, WA	Erickson et al. 2003b	Leaning Juniper, OR	NWC and WEST 2005b	Simpson Ridge, WY	Johnson et al. 2000b
Golden Hills, OR	Jeffrey et al. 2008	Klondike, OR	Johnson et al. 2002a	Invenergy_Vantage, WA	WEST 2007
Windy Flats, WA	Johnson et al. 2007	Stateline, WA/OR	Erickson et al. 2002b	North Valley, MT	WEST 2006b
Combine Hills, OR	Young et al. 2003c	Condon, OR	Erickson et al. 2002b	Tehachapi Pass, CA	Erickson et al. 2002b
Desert Claim, WA	Young et al. 2003b	Zintel Canyon, WA	Erickson et al. 2002a	Sunshine, AZ	WEST and the CPRS 2006
Hopkin's Ridge, WA	Young et al. 2003a	Homestead, CA	WEST et al. 2007	Dry Lake, AZ	Young et al. 2007c
Reardon, WA	WEST 2005b	Nine Canyon, WA	Erickson et al. 2001b	San Gorgonio, CA	Erickson et al. 2002b



Overall Raptor Use 0.46
Predicted Fatality Rate 0.04 fatalities/MW/year
90.0% Prediction Interval (0, 0.30 fatalities/MW/year)

Figure 10. Regression analysis comparing raptor use estimates versus estimated raptor mortality.

Data from the following sources:

Study and Location	Raptor Use (birds/plot /20-min survey)	Source	Raptor Mortality (fatalities/MW/yr)	Source
Buffalo Ridge, MN	0.64	Erickson et al. 2002b	0.02	Erickson et al. 2002b
Combine Hills, OR	0.75	Young et al. 2003c	0.00	Young et al. 2005
Diablo Winds, CA	2.161	WEST 2006a	0.87	WEST 2006a
Foote Creek Rim, WY	0.55	Erickson et al. 2002b	0.04	Erickson et al. 2002b
High Winds, CA	2.34	Kerlinger et al. 2005	0.39	Kerlinger et al. 2006
Hopkins Ridge, WA	0.70	Young et al. 2003a	0.14	Young et al. 2007a
Klondike II, OR	0.50	Johnson 2004	0.11	NWC and WEST 2007
Klondike, OR	0.50	Johnson et al. 2002a	0.00	Johnson et al. 2003
Stateline, WA/OR	0.48	Erickson et al. 2002b	0.09	Erickson et al. 2002b
Vansycle, OR	0.66	WCIA and WEST 1997	0.00	Erickson et al. 2002b
Wild Horse, WA	0.29	Erickson et al. 2003a	0.09	Erickson et al. 2008
Zintel, WA	0.43	Erickson et al. 2002a	0.05	Erickson et al. 2002b
Bighorn, WA	0.51	Johnson and Erickson 2004	0.15	Kronner et al. 2008

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April 2011–March 2012 Supplemental Wildlife Report
Chokecherry and Sierra Madre Wind Energy Project

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October 2012

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INTRODUCTION

Between April 2011 and March 2012, SWCA Environmental Consultants (SWCA) performed a second year of avian and bat surveys for the Power Company of Wyoming, LLC (PCW) within the Chokecherry and Sierra Madre Wind Energy Project (Project) site. These Year Two survey efforts included long-watch raptor surveys, aerial raptor nest surveys within 5-miles of the Project, migratory bird point counts, breeding bird grid surveys, waterbird surveys, greater sage-grouse monitoring, and acoustic bat monitoring. Year One surveys were conducted between June 2008 and June 2009 with the primary intent of collecting data for the development of an Environmental Impact Statement (EIS) for the Project. Year One surveys consisted primarily of 20-minute avian point counts, aerial raptor nest surveys within 1-mile of the Project, greater sage-grouse monitoring, and acoustic bat monitoring.

All protocols and survey methodologies used to assess wildlife in the Project site during Year Two surveys were developed in consultation with the U.S. Fish and Wildlife Service (Service), and are in accordance with recommendations made by the Service, the Bureau of Land Management (BLM), and the Wyoming Game and Fish Department (WGFD). Many of the Year Two data pertaining to eagles, raptors, nests, and greater sage-grouse have been previously analyzed and presented in the Project Eagle Conservation Plan (ECP), Bird and Bat Conservation Strategy (BBCS), 2011 and 2012 Summary Nest Reports, and Sage-grouse Conservation Plan, respectively. More detailed summaries of data from other survey efforts are contained herein.

RAPTOR SURVEYS

Bi-weekly long-watch raptor surveys were completed at 15 sites between April 4 and November 16, 2011. Monthly surveys were completed between December 2011 and March 2012. Long-watch raptor surveys were conducted at 4,000-meter (m) radius plots strategically distributed across the Chokecherry and Sierra Madre Wind Development Areas (WDAs). Fixed-point surveys were conducted in a 4,000-m radius to maximize areal coverage for the purposes of identifying high-use areas while maintaining observer confidence in species identification. For the purposes of this report, only a brief summary is presented for raptor surveys; more detailed summaries and analyses for eagles and raptors are provided in the Project ECP and BBCS, respectively.

Year Two surveys were conducted for a total of 129,750 minutes, or 49.4% of the total 262,800 daylight minutes in the year. During Year Two, 324 long-watch raptor surveys were conducted between April 2011 and March 2012. Of the 324 total surveys, 109 were conducted in the spring, 45 in the summer, 110 in the fall, and 60 during the winter (Table 1). The total 129,750 minutes of survey conducted during all Year Two long-watch surveys were evenly distributed between sites and between spring and fall; however, summer and winter survey minutes were lower because the survey effort was scaled down between July 2 and August 14, and between November 17 and March 31.

Table 1. Summary of Observations from Year Two Long-watch Surveys.

Season	Surveys	Raptor Observations
Spring	109	486
Summer	45	94
Fall	110	341
Winter	60	102
Total	**324**	**1,023**

In total, 178 surveys were conducted in the Chokecherry WDA, while 146 surveys were conducted in the Sierra Madre WDA. Across all seasons, 1,023 raptor observations were made at all long-watch locations; however, most of the observations were likely the same birds being observed multiple times per survey date. This is often detailed in observational notes taken by field personnel during raptor surveys, and is further exemplified by the raptor use calculations presented in the Project BBCS, as well as information presented in the 2011 and 2012 Summary Nest Reports. The Raptor use calculations presented in the BBCS show relatively consistent use between all seasons during Year Two, which indicates there are not large influxes of migrant raptors moving into the Project during the spring and fall months. Additionally, the results presented in the 2011 and 2012 Summary Nest Reports show relatively low numbers of nesting raptors occurring in the Project site and immediate surrounding area. These data indicate that the majority of the 1,023 raptor observations are likely repeat observations of the same resident individuals as there does not appear to be strong raptor migration through the area, nor are there high numbers of nesting raptors occurring in the Project.

MIGRATORY BIRD SURVEYS

Migratory bird point count surveys were completed in conjunction with the long-watch raptor surveys, and therefore the number of sites as well as the weekly scheduling was identical to the raptor surveys. Each migratory bird survey point was established in representative habitat near each raptor monitoring site at sufficient distance to ensure that the observer for the raptor surveys would not likely impact migratory bird species behavior at the point count location.

Point count surveys were conducted across all daylight hours to account for time-of-day effects. For any individual point, surveys were conducted between 7:30 am and 6:30 pm on a pre-determined, systematic schedule. All birds detected within a 200-m radius were recorded during the point count surveys. The data collected during these counts included species, number of individuals, radial distance from observer, behavior, and general demographic data. Standard survey and environmental data (e.g., time, date, wind speed, temperature) were also collected.

The metrics used to characterize avian use are number of species, number of individuals, number of flocks, species frequency (the percentage of 20-minute surveys on which a species was observed), occurrence frequency (percentage of surveys with at least one bird detection), and mean use (average number of individuals per 20-minute survey).

Vegetation data collected across 500 transect surveys conducted by SWCA in 2009 was used to characterize major habitat types at each point. Table 2 summarizes the percentage of major habitat types (minimum 5% of total acreage) within the 200-m radius survey area (31.03 acres) of each location center.

Table 2. Percentage of Major Habitat Categories within 200-m Radius of Migratory Bird Survey Points (Minimum 5%).

Survey Site	Habitat Category							
	Aspen-Mixed Conifer	Dense Sagebrush	Sagebrush Steppe	Salt Desert Shrub	Upland Grassland	Sparsely Vegetated	Lowland Mesic Zone	Montane Shrubland
1		18	74		6			
2				95				
3	39		54					
4	23		30		30	5		6
5			62	6	30			
6			67		31			
7			52		43			
8		16	69		14			
9			75	9	11			
10			89	7				
11		11	75		9			
12			45		51			
13		17	70				8	
14			16	63		18		
15		13	45	37				

Note: Due to rounding error and minimum requirement of 5% coverage, total habitat coverage may not equal 100%.

Sagebrush steppe comprised a substantial portion (≥30%) of 13 survey sites. Salt desert shrub dominated at survey sites 2 and 14 (95% and 63%, respectively). Aspen-mixed conifer was well-represented at survey sites 3 and 4 (39% and 23%, respectively), as was upland grassland with ≥30% coverage at survey sites 4, 5, 6, 7, and 12. Dense sagebrush, sparsely vegetated, lowland mesic zone, and montane shrubland were also identified with >5% coverage at several survey sites. Barren ground was the only major habitat category to not register at least 5% coverage on any site.

Between April 4, 2011, and March 27, 2012, 295 migratory bird surveys were conducted. Point count locations were each surveyed 16 to 23 times, with the variation in number of surveys due to safety and accessibility concerns arising from inclement weather. These same factors are also the cause of differences in the overall number of migratory bird surveys relative to long-watch raptor surveys.

In sum, 1,518 individuals in 969 flocks representing 43 species were recorded during all surveys combined in the 12-month survey period (Table 3). Of the 295 surveys completed, no birds were recorded on 74 of the surveys for an occurrence frequency of 75% (221 of 295 surveys). Mean use was 5.1 individuals/survey. Horned lark (*Eremophila alpestris*)

dominated the number of observations, accounting for 951 (62%) individuals with a mean use of 3.2 individuals/survey. Horned lark was also the most frequently encountered species on surveys, with the species recorded on 67% of surveys.

Table 3. The Number of Individuals, Flocks, Species Frequency, and Mean Use for All Migratory Bird Survey Point Locations Combined, April 2011–March 2012.

Species	# of Individuals	# of Flocks	Species Frequency (as %) (n = 295)	Mean Use
Horned Lark	935	530	67	3.2
Brewer's Sparrow	70	65	13	0.2
Vesper Sparrow	68	67	15	0.2
American Crow	55	2	<1	0.2
Rock Wren	43	40	11	0.1
Sage Thrasher	41	39	11	0.1
Sage Sparrow	42	34	6	0.1
Common Raven	34	27	8	0.1
Western Meadowlark	29	25	6	0.1
Sparrow sp.	29	19	6	0.1
American Robin	18	10	3	0.1
Greater Sage-grouse	18	3	1	0.1
Mountain Bluebird	16	11	4	0.1
Common Nighthawk	12	9	2	0.0
Undetermined sp.	12	11	3	0.0
Passerine sp.	9	6	2	0.0
American Kestrel	8	7	2	0.0
Green-tailed Towhee	7	7	3	0.0
White-throated Swift	6	1	<1	0.0
Barn Swallow	5	3	1	0.0
Black-billed Magpie	5	3	1	0.0
Tree Swallow	5	4	1	0.0
American Goldfinch	4	4	2	0.0
Song Sparrow	4	4	2	0.0
Violet-green Swallow	4	4	1	0.0
Warbler sp.	4	2	1	0.0
Chipping Sparrow	3	3	1	0.0
Evening Grosbeak	3	3	<1	0.0
Mourning Dove	3	2	1	0.0
Savannah Sparrow	3	3	1	0.0
Brown-headed Cowbird	2	2	1	0.0
Dark-eyed Junco	2	2	1	0.0
Northern Flicker	2	2	1	0.0
Gray-crowned Rosy-Finch	2	1	<1	0.0
Turkey Vulture	2	1	<1	0.0
Brewer's Blackbird	1	1	1	0.0
Golden Eagle	1	1	<1	0.0
House Finch	1	1	<1	0.0
House Wren	1	1	1	0.0
Killdeer	1	1	<1	0.0

Species	# of Individuals	# of Flocks	Species Frequency (as %) (n = 295)	Mean Use
Loggerhead Shrike	1	1	<1	0.0
Northern Harrier	1	1	<1	0.0
Red-tailed Hawk	1	1	<1	0.0
Rufous Hummingbird	1	1	<1	0.0
Sharp-shinned Hawk	1	1	<1	0.0
Swallow sp.	1	1	<1	0.0
Western Kingbird	1	1	<1	0.0
Woodpecker sp.	1	1	<1	0.0
Total (43)	**1,518**	**969**	**75***	**5.1**

* Seventy-four surveys resulted in zero bird detections; therefore, percentage of surveys with at least one bird detection was 75%.

Note: Because of rounding error, mean use values may not equal total shown.

Summary results for individual point count locations are presented in Table 4. Values for number of species (range = 6–18), number of individuals (range = 26–168), number of flocks (range = 23–94), and mean use (range = 1.3–8.1) varied between sites.

Table 4. Summary of Key Metrics for Individual Migratory Bird Point Count Locations, April–November 2011.

Survey Site	# of Surveys	# of Species	# of Individuals	# of Flocks	% of Surveys w/ Bird Detections	Mean Use[1]
1	20	6	86	60	60	4.3
2	20	6	26	23	70	1.3
3	16	17	120	57	81	7.5
4	19	11	76	50	84	4.0
5	20	9	113	76	70	5.7
6	20	10	111	94	70	5.6
7	20	7	67	41	70	3.4
8	21	11	118	93	81	5.6
9	19	6	94	64	79	4.9
10	20	12	161	72	80	8.1
11	20	10	88	71	75	4.4
12	19	10	99	70	74	5.2
13	23	18	168	91	74	7.3
14	19	8	116	50	79	6.1
15	19	9	75	57	79	3.9
Total	**295**	**43[2]**	**1,518**	**969**	**75%[3]**	**5.1**

[1] Because of rounding error, mean use values may not equal total shown.

[2] The same species were observed at multiple sites; therefore, this total represents the number of individual species observed at all sites.

[3] Seventy-four surveys resulted in zero bird detections; therefore, percentage of surveys with at least one bird detection was 75%.

Survey site 2 had relatively few birds (26 individuals; mean use = 1.3) recorded on the 20 surveys conducted at that site. Survey sites 10 and 13 had the highest number of individuals (161 and 168, respectively), and sites 3 and 10 had the highest mean use (7.5 and 8.1, respectively). All sites had at least three surveys when no birds were recorded.

BREEDING BIRD SURVEYS

SWCA established and conducted 15 breeding bird survey grids in the Project site following protocols established in Rocky Mountain Bird Observatory's *Field Protocol for Spatially Balanced Sampling of Landbird Populations* (Hanni et al. 2010). This study design allows for analyses of population trends for diurnal, regular-breeding landbird species. Its application in the Project site would allow for integration into and comparison with Rocky Mountain Bird Observatory's similar efforts in the Atlantic Rim Natural Gas Development Project Area (Van Lanen et al. 2011), as well those across broader landscapes where similar studies are conducted (see White et al. 2011).

Survey areas for each grid were selected using generalized random-tessellation stratification (GRTS), a spatially balanced sampling algorithm (Stevens and Olsen 2004), without sample weighting (i.e., not accounting for any factor expected to influence a species' distribution [e.g., habitat type]). By using GRTS, data-embedded information on spatial autocorrelation can increase density estimate precision. This spatially balanced sampling design also allows for adjustment of sampling effort among years while preserving a random sampling design (Hanni et al. 2010).

Each survey site consisted of 16 point count locations in a 4 × 4 grid, with 250 m spacing between points. Each grid was surveyed once in June 2011. Surveys were initiated within 30 minutes of local sunrise and were completed by 10:00 am. Habitat information was collected at each point count location prior to conducting the avian count to allow birds time to adjust to the presence of field personnel. Habitat data collected included proximity to human-made structures (e.g., roads, fences) and variables used to describe overstory, shrub layer, and groundcover components. Standard weather (e.g., wind speed, cloud cover) variables were also collected prior to starting the avian survey. Upon completion of the habitat data collection, biologists conducted an avian survey at each point for 6 minutes. All bird detections were recorded regardless of distance. Data for each detection included species, number of individuals, horizontal distance from observer, age, sex, and how detected.

The 15 grids of 16 point counts were surveyed in June 2011 for a total of 240 individual sampling points. For all sites combined, 1,944 individuals representing 63 species were recorded (Table 5). The most prevalent species, based on total number of individuals recorded and frequency of detection (on grids and individual points), was horned lark (411 individuals, 100% occurrence on the 15 grids, and on 73% of the 240 point counts). Following horned lark, in order of prevalence, were Brewer's sparrow (*Spizella breweri*; 283, 100%, 65%), vesper sparrow (*Pooecetes gramineus*; 216, 93%, 55%), and sage thrasher (*Oreoscoptes montanus*; 138, 80%, 46%), all species closely associated with sagebrush communities. These four species combined for 1,048 individuals or 54% of all detections.

Table 5. Summary Statistics for Grid-based Breeding Bird Surveys, June 2011.

Species	# of Individuals	% Frequency on Grids (n = 15)	% Frequency on Individual Points (n = 240)
Horned Lark	411	100	73
Brewer's Sparrow	283	100	65
Vesper Sparrow	216	93	55
Sage Thrasher	138	80	46
Green-tailed Towhee	116	87	35
Rock Wren	104	67	31
Sage Sparrow	89	47	25
Western Meadowlark	58	60	15
Brown-headed Cowbird	49	60	13
American Robin	47	40	16
Common Raven	41	73	13
Sparrow sp.	32	93	10
Common Nighthawk	28	53	10
Greater Sage-grouse	23	13	<0.5
Warbling Vireo	23	27	8
House Wren	22	20	6
American Goldfinch	21	27	5
Yellow Warbler	21	20	6
Red-winged Blackbird	17	13	5
MacGillivray's Warbler	16	27	5
Mountain Bluebird	15	33	4
Chipping Sparrow	14	20	3
Dusky Flycatcher	11	7	3
Sora	10	13	3
Orange-crowned Warbler	9	13	3
Brewer's Blackbird	8	7	3
Killdeer	8	20	2
Mourning Dove	8	20	2
Savannah Sparrow	8	13	3
Northern Flicker	7	20	3
N. Rough-winged Swallow	7	20	1
Red-tailed Hawk	7	27	2
Undetermined sp.	7	27	3
Song Sparrow	6	20	2
Broad-tailed Hummingbird	5	20	2
Common Yellowthroat	4	7	1
Say's Phoebe	4	13	1
Tree Swallow	4	20	2
Wilson's Snipe	4	7	1
Ruby-crowned Kinglet	3	7	1
Western Wood-Pewee	3	7	1
American Kestrel	2	13	<0.5
Bald Eagle	2	7	1

Species	# of Individuals	% Frequency on Grids (n = 15)	% Frequency on Individual Points (n = 240)
Black-capped Chickadee	2	7	1
Black-crowned Night Heron	2	7	<0.5
Common Merganser	2	7	<0.5
Common Poorwill	2	13	1
Dark-eyed Junco	2	13	<0.5
Hermit Thrush	2	13	1
Lark Sparrow	2	7	<0.5
Northern Harrier	2	7	<0.5
Yellow-rumped Warbler	2	7	<0.5
Barn Swallow	1	7	<0.5
Bewick's Wren	1	7	<0.5
Black-billed Magpie	1	7	<0.5
Blackbird sp.	1	7	<0.5
Blue-gray Gnatcatcher	1	7	<0.5
Cliff Swallow	1	7	<0.5
Empidonax sp.	1	7	<0.5
Hammond's Flycatcher	1	7	<0.5
Loggerhead Shrike	1	7	<0.5
Mountain Chickadee	1	7	<0.5
Oriole sp.	1	7	<0.5
Swainson's Thrush	1	7	<0.5
Violet-green Swallow	1	7	<0.5
Wilson's Warbler	1	7	<0.5
Yellow-breasted Chat	1	7	<0.5
Total (63)	**1,944**	**100**	**99***

* One point count survey resulted in zero bird detections; although rounding to the nearest whole number would result in a 100% frequency (239 of 240 = 99.58%); this table shows 99% to recognize the single point count with no birds.

The number of species and number of individuals varied between survey grid sites (Table 6). The mean number of species per grid was 16 (range of 9–30), while the mean number of individuals was 130 (range of 58–182). Although the number of species at four survey locations (sites 42, 49, 94, and 263) differed from the mean by more than 50%, only one site (163) differed by 50% from the mean in the number of individuals recorded.

Table 6. The Number of Species and Number of Individuals per Grid-based Breeding Bird Survey Site, June 2011.

Grid Identifier	# of Species	# of Individuals
42	30	182
49	29	131
94	30	157
151	10	113
163	11	58
208	10	92
224	9	121
263	28	169
321	15	143
335	15	173
358	13	155
470	12	119
482	12	121
575	12	123
605	10	87
Total	**63**[1]	**1,944**

[1] The same species were observed at multiple sites; therefore, this total represents the number of individual species observed at all sites.

WATERBIRD SURVEYS

Waterbird surveys were conducted in 2011 during spring (April 26–May 4), summer (August 23–24), and fall (October 20–21) at each of the four major reservoirs (Kindt, Rasmussen, Sage Creek, and Teton) occurring within the Project site and surrounding area. These surveys were conducted to help build a baseline of potential prey species and assess their spatiotemporal abundance in the Project site at locations with the potential to attract and/or concentrate eagles and other raptor species. Surveys were conducted using spotting scopes to maximize coverage from a minimal number of viewing locations, as well as to facilitate species identification. Along with standard survey information (i.e., date, location, observer, time, weather conditions), species-specific data collected included species, age, sex, and number of individuals.

SPRING SURVEYS

Spring waterbird surveys were conducted between April 26 and May 4, 2011. These surveys resulted in a total count of 1,415 individuals representing 35 species (Table 7). American coot (*Fulica americana*) was the most abundant species accounting for 364 individuals (26% of total count). Scaup (*Aythya* sp.), *Aechmophorus* grebes (i.e., western and Clark's), and eared grebe (*Podiceps nigricollis*) were the next most abundant species with 351, 209, and 113 individuals, respectively. Collectively, those four groups accounted for 1,037 individuals or 73% of all birds detected.

Table 7. Species, Number of Individuals, and Spring Survey Dates of Waterbird Surveys at Four Major Reservoirs within the Chokecherry-Sierra Madre Wind Resource Area, 2011.

Species	Kindt 5/2/11	Rasmussen 5/4/11	Sage Creek 4/26/11	Teton 5/4/11	Total Count
Aechmophorus sp.		71			**71**
American Avocet	2	4	2		**8**
American Coot	198	5	100	61	**364**
American White Pelican	2	1		3	**6**
American Wigeon	5	1			**6**
Bufflehead	6	2	1	1	**10**
Calidris sp.	3				**3**
Canada Goose				5	**5**
Canvasback	4				**4**
Cinnamon Teal				3	**3**
Clark's Grebe				1	**1**
Common Loon		4	1		**5**
Common Merganser	53		7	14	**74**
Double-crested Cormorant				6	**6**
Eared Grebe	59	31	6	17	**113**
Gadwall	8	8	5	11	**32**
Greater Scaup	4				**4**
Greater Yellowlegs	2				**2**
Green-winged Teal	2	6		6	**14**
Horned Grebe			1		**1**
Killdeer	16		5	1	**22**
Least Sandpiper	1				**1**
Lesser Scaup	84	19			**103**
Lesser Yellowlegs	1				**1**
Mallard	4			2	**6**
Marbled Godwit	7	1			**8**
Northern Pintail	2			1	**3**
Northern Shoveler		2		6	**8**
Pied-billed Grebe			1		**1**
Redhead	69	11		5	**85**
Ring-billed Gull		1		1	**2**
Ring-necked Duck	8	2		16	**26**
Ruddy Duck	9				**9**
Scaup sp.	200	44			**244**
Western Grebe	39	50	34	14	**137**
White-faced Ibis		3			**3**
Willet	17	2	2		**21**
Wilson's Phalarope	3				**3**
Total	**808**	**268**	**165**	**174**	**1,415**
Number of Species	**25**	**18**	**12**	**19**	**35**

More species and individuals were counted at Kindt Reservoir (25 species, 808 individuals) than the other three reservoirs (Table 7). The fewest species and number of individuals (12 species, 165 individuals) were recorded at Sage Creek Reservoir during spring surveys.

SUMMER SURVEYS

A total of 1,708 individuals representing 29 species were recorded on summer waterbird surveys conducted on August 23 and 24, 2011 (Table 8). Redhead (*Aythya americana*) had the highest number of individuals (815) accounting for 48% of all birds detected during summer surveys. Lesser scaup (*Aythya affinis*), mallard (*Anas platyrhynchos*), and American coot were the next most abundant species with 157, 149, and 99 individuals, respectively. Collectively, those four species accounted for 1,221 individuals or 71% of all birds detected.

The highest number of individuals (920) was recorded at Rasmussen Reservoir, where 89% (780 individuals) were redheads (Table 8). Nearly all of the season's redheads (780 of 815) were recorded at Rasmussen Reservoir. Despite the high number of birds recorded at Rasmussen Reservoir, biologists recorded the fewest number of species (12) at that location.

Table 8. Species, Number of Individuals, and Summer Survey Dates of Waterbird Surveys at Four Major Reservoirs within the Chokecherry-Sierra Madre Wind Resource Area, 2011.

Species	Kindt 8/23/11	Rasmussen 8/24/11	Sage Creek 8/23/11	Teton 8/24/11	Total Count
American Avocet	10	4	5	6	**25**
American Coot	30		45	24	**99**
American White Pelican	10		12	2	**24**
American Wigeon	2		4	5	**11**
Black-crowned Night Heron			4	3	**7**
Blue-winged Teal		14	6		**20**
California Gull				2	**2**
Canada Goose	16	12			**28**
Common Loon		2			**2**
Common Merganser	1	16			**17**
Double-crested Cormorant			5	6	**11**
Eared Grebe	27	9	7	7	**50**
Gadwall	26			10	**36**
Great Blue Heron			1	1	**2**
Green-winged Teal	26			42	**68**
Herring Gull	3				**3**
Killdeer	1	5	1	3	**10**
Lesser Scaup	80	18	59		**157**
Mallard	102	13	25	9	**149**
Northern Pintail	4		6		**10**
Pied-billed Grebe	3			7	**10**
Redhead		780	35		**815**
Ring-billed Gull		4	2		**6**
Ruddy Duck			9		**9**

Species	Kindt 8/23/11	Rasmussen 8/24/11	Sage Creek 8/23/11	Teton 8/24/11	Total Count
Snowy Egret			1		**1**
Spotted Sandpiper	2		2		**4**
Unknown dabbling duck			35	12	**47**
Unknown gull		13		1	**14**
Western Grebe	3	30	24	10	**67**
Willet	1				**1**
Wilson's Phalarope				3	**3**
Total	**347**	**920**	**288**	**153**	**1,708**
Number of Species	**18**	**12**	**19**	**16**	**29**

FALL SURVEYS

Surveys during the fall migration period on October 20 and 21, 2011, resulted in a total of 11,473 individuals of 29 species recorded (Table 9). Similar to spring, in the fall American coot accounted for the majority of individuals (8,024, 70% of total individuals). A total of 1,692 American wigeon (*Anas americana*) were also recorded. Combined, American coot and American wigeon accounted for 9,716 individuals (85% of all individuals).

More individuals (8,773) and species (22) were recorded at Kindt Reservoir during fall surveys than at other reservoirs (Table 9). Of the 8,024 American coots and 1,692 American wigeons recorded at all reservoirs combined, the survey at Kindt Reservoir accounted for 5,810 coots (66%) and 1,690 wigeon (99%).

Table 9. Species, Number of Individuals, and Fall Survey Dates of Waterbird Surveys at Four Major Reservoirs within the Chokecherry-Sierra Madre Wind Resource Area, 2011.

Species	Kindt 10/21/11	Rasmussen 10/21/11	Sage Creek 10/20/11	Teton 10/20/11	Total Count
American Avocet			8		**8**
American Coot	5,810	2,088		126	**8,024**
American Wigeon	1,690	1	1		**1,692**
Bufflehead	2			1	**3**
Canada Goose	38		5		**43**
Canvasback	5		1		**6**
Common Loon		2			**2**
Common Merganser			64	6	**70**
Eared Grebe	3	98	9		**110**
Gadwall	554	20	3		**577**
Greater Yellowlegs	4				**4**
Green-winged Teal	10	33	44		**87**
Herring Gull		1		2	**3**
Hooded Merganser			3		**3**
Horned Grebe	16	13	5		**34**
Lesser Scaup	24				**24**

Species	Kindt 10/21/11	Rasmussen 10/21/11	Sage Creek 10/20/11	Teton 10/20/11	Total Count
Long-billed Dowitcher	4				**4**
Mallard	121	20	8	3	**152**
Northern Pintail	50	4	3		**57**
Northern Shoveler	1	1	11		**13**
Pectoral Sandpiper	1				**1**
Pied-billed Grebe	6	3			**9**
Redhead	328	27	4		**359**
Ring-billed Gull	1	7	11	9	**28**
Ring-necked Duck	84				**84**
Ruddy Duck	17	13	4		**34**
Surf Scoter		6			**6**
Western Grebe	4	25	3	1	**33**
White-winged Scoter		3			**3**
Total	**8,773**	**2,365**	**187**	**148**	**11,473**
Number of Species	**22**	**18**	**17**	**7**	**29**

ACOUSTIC BAT MONITORING

Anabat (Titley Electronics, Australia) is a bat detection system that uses a broadband microphone that can detect ultrasonic sounds and record them onto a compact flash data card. This system uses a frequency division technique called Zero-Crossings Analysis to produce sonograms that can be viewed on a PDA or computer screen using the AnalookW program. These sonograms display the shape of individual pulses on a frequency graph plotted against time. Bat species produce echolocation vocalizations based on their ecological niche requirements, which may demand different frequency bandwidth, pulse duration, and other characteristics discernible in the sonograms. Sonograms produced through Zero-Crossings Analysis generally have enough information to label a pulse sequence as belonging to a group of bats with similar acoustic characteristics (e.g., 25-kilohertz [kHz] bats) and even allow for identification of acoustically distinctive species (e.g., hoary bat [*Lasiurus cinereus*]) (Kunz et al. 2007). In North America, *Myotis* bat species are generally recognized as being the most difficult to differentiate due to similarities in vocalization characteristics and pulses are often placed within a frequency group (e.g., 40-kHz Myotis).

An index of bat activity was calculated by counting the number of bat passes per detector-hour past sunset (Kunz et al. 2007) for data collected in 2011. The number of detector-hours per night was calculated by summing the number of minutes surveyed between sunset and sunrise and dividing by 60 for each night surveyed. A bat pass was defined as a pulse sequence (commonly referred to as a "call") consisting of at least one individual pulse that was separated by >1 second from the next pulse (White and Gehrt 2001). An index of activity is used because the number of bats cannot be quantified from acoustic data (Kunz et al. 2007). Individual bats are not identifiable in an acoustical dataset as pulses may have been produced by the same or different individuals over the course of a single night survey period (Hayes 2000 in Kunz et al. 2007). All bat passes were categorized through assessment of both qualitative (e.g., shape) and quantitative (e.g., characteristic frequency) qualities (Weller and

Baldwin 2012). Individual passes were labeled by characteristic frequency type (e.g., 25 kHz, 30 kHz, 40 kHz), then grouped into low (<25 kHz), mid- (30–40 kHz), and high (>50 kHz) characteristic frequency groups. Diagnostic call sequences were labeled by species. For reporting purposes, except where indicated, species-specific passes were combined with the appropriate frequency group.

In 2011, four locations (sites 2-1, 3-1, 3-2, and 4-1) were surveyed for nightly bat activity. Table 10 provides the level of effort (number of nights and number of survey-hours), the total number of bat passes, and the number of passes per survey-hour.

Table 10. Level of Effort and Bat Pass Summary for Locations Surveyed in 2011.

Site	Date Span	# of Survey Nights	# of Survey-Hours	Total # of Bat Passes	# of Bat Passes per Survey-Hour
2-1	Jun 15–27	13	114.4	19	0.2
3-1	Jun 30–Jul 26	27	244.9	79	0.3
3-2	Jul 27–Aug 22	27	267.1	33	0.1
4-1	Sep 23–Oct 20	28	349.7	7	0.0
Total	**Jun 15–Oct 20**	**95**	**976.1**	**138**	**0.1**

The average number of bat passes per survey-hour across a season may be beneficial to delineate approximate dates of local bat activity, including arrival of spring migrants and departure of fall migrants. Furthermore, variation in the number of bat passes per night at an individual site may be useful in identifying migratory pulses.

Activity levels were inconsistent during the survey period (Figure 1). This inconsistency is likely due to lack of recognizable foraging areas (e.g., slow-moving streams, ponds, wooded sites) at the survey locations and the seemingly random occurrence of a bat traveling between roost and foraging sites being detected by the Anabat. The steep increase in the number of bat passes on July 24 (26 bat passes in 9.3 survey-hours = 2.8 bat passes/survey-hour) is four times higher than the next highest average count at that site. Activity levels decreased in mid-August. No survey data were collected from August 23 to September 22 due to system error. Activity levels were low during the September 23 to October 20 survey period with no more than 0.1 bat pass per survey-hour on any given night.

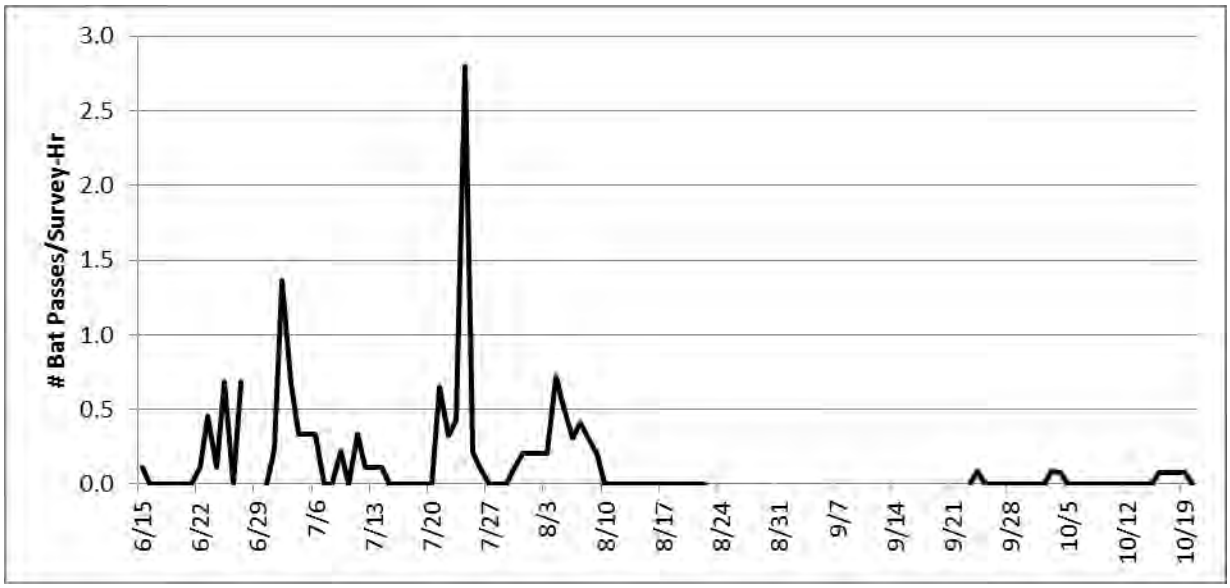

Figure 1. Average number of bat passes per survey-hour, June 15–October 20, 2011.

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Bat Survey Report

Chokecherry and Sierra Madre Wind Energy Project

Prepared for

Power Company of Wyoming, LLC

Prepared by

SWCA Environmental Consultants

May 2015

Bat Survey Report
Chokecherry and Sierra Madre Wind Energy Project

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May 2015

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INTRODUCTION

Power Company of Wyoming LLC (PCW) proposes to construct, operate, maintain and decommission the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project), located in Carbon County, Wyoming. The CCSM Project will consist of 1,000 wind turbines capable of generating up to 3,000 megawatts (MW) of clean, renewable wind energy. PCW is developing the CCSM Project in two phases (Figure 1). Phase I will include 500 wind turbine generators located in the western portions of two Wind Development Areas (WDAs) referred to as "Chokecherry" and "Sierra Madre" and associated infrastructure including the Road Rock Quarry, West Sinclair Rail Facility and Phase I Haul Road and Facilities. Phase II will include 500 wind turbine generators and associated infrastructure located in the eastern portions of the Chokecherry and Sierra Madre WDAs.

This Bat Survey Report (Report) describes surveys conducted by PCW to characterize bat use across the CCSM Project for purposes of informing siting decisions and reducing potential impacts on bats and their habitats. In 2012, the U.S. Fish and Wildlife Service (USFWS) issued its Land-Based Wind Energy Guidelines (USFWS 2012). The guidelines seek to assist developers in identifying species of concern that may potentially be affected by a proposed project and recommend a "tiered approach" for assessing potential adverse effects to those species and their habitats. The tiered approach is an iterative decision-making process for collecting information in increasing detail; quantifying the possible risks of proposed wind energy projects to species of concern and their habitats; and evaluating those risks to make siting, construction, and operation decisions (USFWS 2012). To identify potential risks to bats from the CCSM Project, PCW collected baseline data for bat use across the CCSM Project Site. Specifically, PCW conducted monitoring for bats in 2008, 2011, 2012, and 2013 through the use of AnaBat passive acoustic monitors and a DeTect Merlin radar system.

ENVIRONMENTAL SETTING

The CCSM Project is located south of the city of Rawlins, primarily within the bounds of the Overland Trail Ranch (Ranch). Current land use across the Ranch consists of agricultural operations, including cattle grazing and hay production. The Ranch, including the CCSM Project Site, is dominated by three topographic features, Chokecherry Plateau, Miller Hill, and Sage Creek Rim, separated by the Sage Creek Basin (Figure 1). Chokecherry Plateau is the most topographically varied, consisting of ridges and rolling hills that generally slope northeasterly towards the North Platte River. Miller Hill and Sage Creek Rim are relatively level and gently sloped in a southwesterly direction. The Sage Creek Basin is a flat, high desert basin.

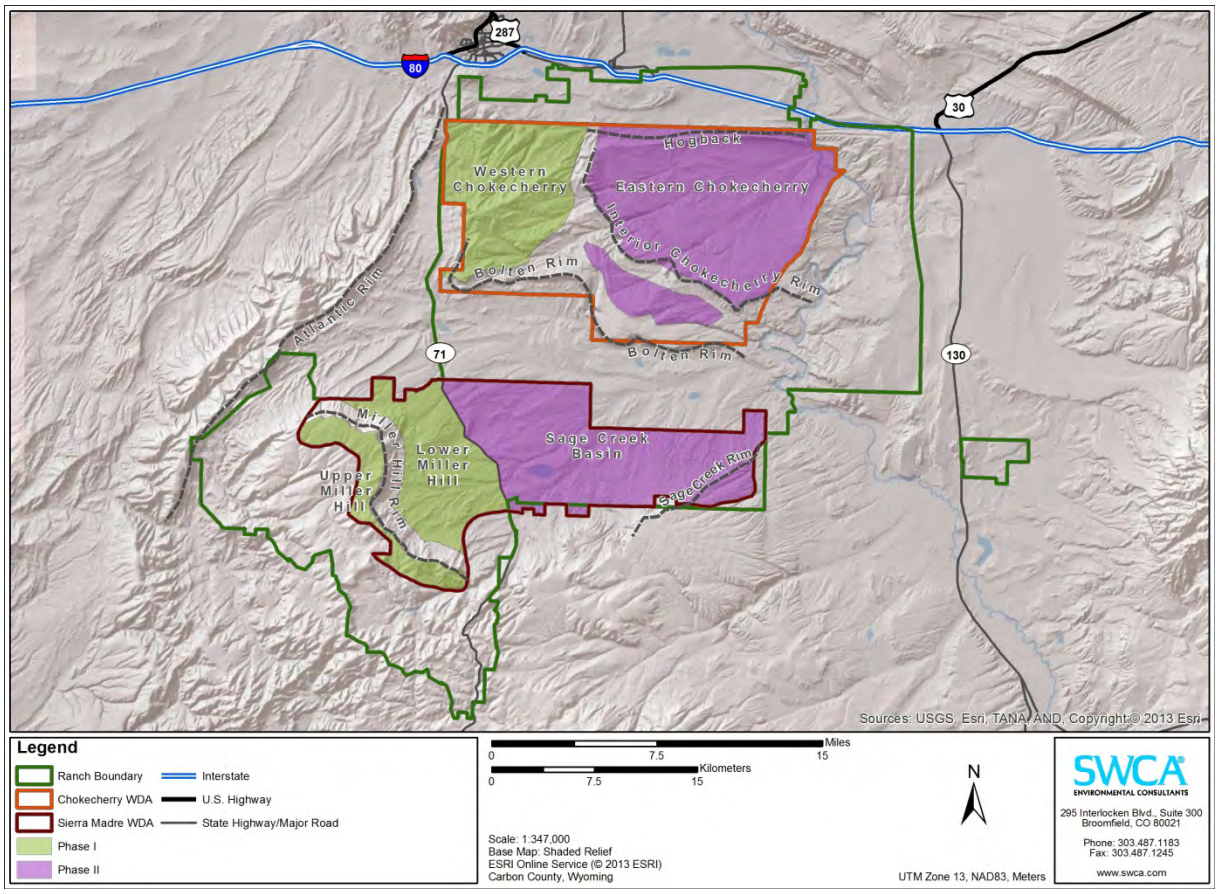

Figure 1. CCSM Project overview.

Vegetation cover in the CCSM Project Site is typical of Wyoming Basin and Southern Rockies ecoregions, defined by rolling sagebrush steppe, salt desert shrub basins, and foothill shrublands (Chapman et al. 2004). Sagebrush steppe communities are interspersed with bunchgrass/rhizomatous grass communities and allied shrubs, and generally have relatively low forb cover. Surface water sources on the Ranch include the North Platte River and several small tributaries. In addition, several small ephemeral streams and a few isolated springs are located throughout the Ranch. There are also reservoirs located within Sage Creek Basin, including Kindt, Rasmussen, Sage Creek, and Teton Reservoirs.

Of the eight bat species or subspecies in the contiguous U.S. currently listed or proposed for listing under the Endangered Species Act (USFWS 2014), none are expected to occur in the vicinity of the CCSM Project. The Bureau of Land Management (BLM 2010) lists fringed myotis, long-eared myotis, spotted bat (*Euderma maculatum*), and Townsend's big-eared bat as Sensitive Species. According to Orabona et al. (2012), bat species that have been observed or acoustically detected in the general vicinity of the CCSM Project (Latilong 25 in Orabona et al. 2012) include, California myotis (*Myotis californicus*), western small-footed myotis (*M. ciliolabrum*), long-eared myotis (*M. evotis*), little brown myotis (*M. lucifugus*), fringed myotis (*M. thysanodes*), long-legged myotis (*M. volans*), Yuma myotis (*M. yumanensis*), eastern red

bat (*Lasiurus borealis*), hoary bat (*L. cinereus*), silver-haired bat (*Lasionycteris noctivagans*), big brown bat (*Eptesicus fuscus*), Townsend's big-eared bat (*Corynorhinus townsendii*), and pallid bat (*Antrozous pallidus*). In fact, a recent survey conducted in southern Wyoming, including areas near the CCSM Project, found all of these species, except California myotis (Griscom et al. 2012).

METHODS

Acoustic Survey

AnaBat detection systems manufactured by Titley Electronics were used for acoustic bat surveys conducted on the CCSM Project Site. Bat species produce echolocation vocalizations based on their ecological niche requirements, which may demand different frequency bandwidth, pulse duration, and other characteristics discernible in sonograms. AnaBat systems are capable of detecting and recording these ultrasonic sounds and producing sonograms, individual pulses on a frequency graph plotted against time. AnaBat sonograms generally have enough information to label a pulse sequence to a group of bats with similar acoustic characteristics (e.g., 25-kilohertz [kHz] bats) and even allow for identification of acoustically distinctive species (e.g., hoary bat) (Kunz et al. 2007). In North America, *Myotis* bat species are generally recognized as being the most difficult to differentiate due to similarities in vocalization characteristics; therefore these pulses are often placed within a frequency group (e.g., 40-kHz Myotis).

For acoustic bat surveys conducted on the CCSM Project Site, a standard index of bat activity was generated by counting the number of bat passes per detector-night at each survey location (Hayes 1997; Kunz et al. 2007). A bat pass is defined as a pulse sequence (commonly referred to as a "call") consisting of at least one individual pulse that was separated by more than 1 second from the next pulse (White and Gehrt 2001). Individual bats are not identifiable in an acoustical dataset since pulses may have been produced by the same or different individuals over the course of a single night survey period (Hayes 2000 in Kunz et al. 2007); therefore, an index of activity is used because the exact number of bats cannot be quantified from acoustic data (Kunz et al. 2007).

All bat passes were categorized through assessment of both qualitative (e.g., shape) and quantitative (e.g., characteristic frequency) qualities as demonstrated by Weller and Baldwin (2012). Bat passes were classified as pertaining to low (<35 kilohertz [kHz]) or high (>35 kHz) characteristic frequency groups in 2008, and further subdivided into low (≤25 kHz), mid (~30-40 kHz), and high (≥40 kHz) frequency groups for subsequent surveys. Further refinement in the dataset was intended to provide more differentiation as to what species may be represented in the low frequency group. The low frequency category in the 2008 dataset may also have included some bat species with a characteristic frequency around 30 kHz, such as long-eared myotis, fringed myotis, Townsend's big-eared bat, and pallid bat (Griscom et al. 2012; Keinath undated). Diagnostic call sequences in the datasets were labeled only for hoary bat as that species has a unique call pattern easily distinguished from other bat species.

Radar Survey

A DeTect Merlin radar system was used to map avian and bat use from March 2011 through March 2013 at multiple locations within the CCSM Project Site. The radar is a trailer-mounted system with a 200-watt horizontal solid-state S-band radar and a 10-kilowatt (kW) vertically operating X-band open array radar. The horizontal scanning radar (HSR) has a range of up 4.6 miles in a 360-degree pattern around the unit. The HSR is able to record how targets use topographic features within the CCSM Project Site by collecting accurate location data for each target as it moves through the radar scanning area. The vertical scanning radar (VSR) has a 24-degree beam width and detects flight paths heights to 2.0 miles or more above the unit. The HSR does not collect altitudinal data for biological targets; however, the elevation of targets may be collected if they pass through the footprint of the VSR. These data are useful for determining the relative percentage of targets passing through the rotor swept zone (RSZ) versus those flying above and below the RSZ. The radar ran continuously, collecting data for movements of birds throughout the day, and birds and bats at night.

Current avian radar technology and software are not able to distinguish between taxonomic groups (e.g., bird or bat). Rather, data for each target is recorded in a series of more than 60 variables based on different measures of recorded pixel size and shape. These variables can differ greatly within species and even for a single individual. It is not possible to determine a target's specific identity from the dataset recorded by the radar system. Targets could be grouped based upon their relative size, but this is also problematic due to variance in the size of individuals and overlap in variable values between small bird and bat species. Though the radar dataset did not help in quantifying species-specific use on the CCSM Project Site, it did prove useful for analysis of nocturnal broad-front migratory patterns and flight heights.

RESULTS AND DISCUSSION

2008 Acoustic Survey Results

Passive acoustic bat surveys were conducted from July 13 to October 13, 2008 (Solick et al. 2008). Six sites were surveyed with eight AnaBat units (Figure 1), two of which were placed on meteorological towers approximately 45 meters above the ground, with the remaining six AnaBat units being ground-based. The study resulted in 3,021 bat passes across 669 detector-nights for an average of 4.52 bat passes/detector-night. However, this mean value is heavily influenced by site A3 located in Hugus Draw (Figure 2) which comprised 63% of all bat passes recorded during 2008 (average 20.62 passes/detector-night). Site A3 is located near a wetland/stock pond within a defined Turbine No-Build Area[1]. As no impacts to bats will occur at site A3 because of its location within a Turbine No-Build Area, it was removed from the dataset as an outlier. After removal of site A3, the remaining seven AnaBat sites demonstrated more consistent bat use with an average of 1.9 bat passes per detector-night (Table 1).

Bat activity in 2008 was highest from July 13 through the end of August, with activity peaks on July 27 and August 22. Very low activity was recorded in September and October. Temporal variation was similar among AnaBat sites across the CCSM Project.

Approximately 63% of all bat passes recorded were of high-frequency bats. Ground-based AnaBat units recorded similar ratios of low- and high-frequency bats, though there was variation between sites and across the survey period. However, elevated units deployed on meteorological towers consistently recorded disproportionately high numbers of low-frequency bat passes than high-frequency, with hoary bat comprising 7% of all bat passes. Trends in activity for hoary bat were concordant with patterns observed for all bat frequency groups, including a peak in activity on August 22.

Table 1. Number of bat passes per detector night for 2008, 2010, and 2011 passive acoustic bat surveys.

Year	Mid and High Frequency Bat Passes	Low Frequency Bat Passes	Hoary Bat Passes	Total Bat Passes	Detector Nights	Bat Passes/ Night
2008[2]	1909	895	217	1124	577	1.9
2011	156	22	7	185	95	1.9
2012	115	9	10	134	62	2.2
Total	**2180**	**926**	**234**	**1443**	**734**	**2.0**

[1] Designated areas where turbines would not be constructed or overhang (PCW 2015).

[2] 2008 data do not include bat passer or detector nights for bat monitoring site A3

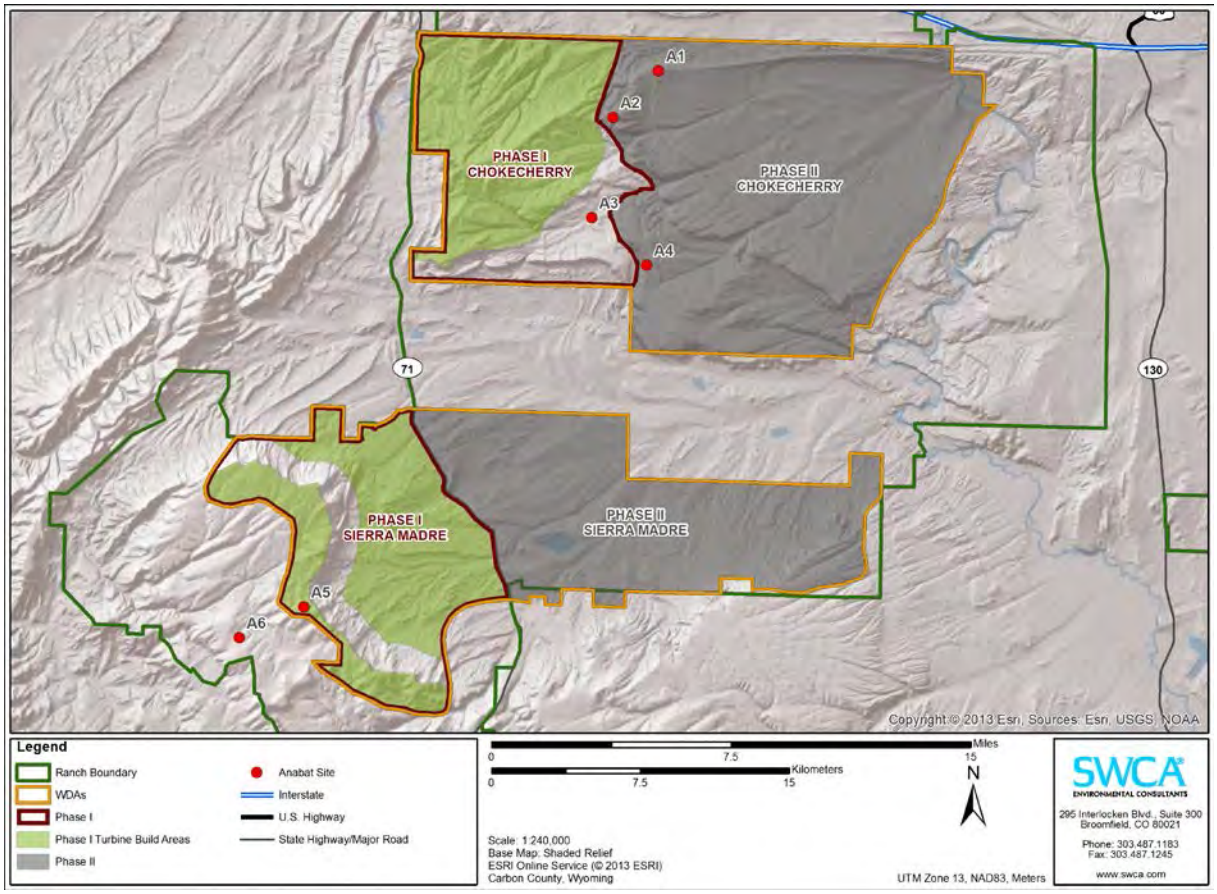

Figure 2. AnaBat sites surveyed in 2008.

2011 and 2012 Acoustic Survey Results

Bat surveys in 2011 and 2012 consisted of passive acoustic monitoring with ground-based AnaBats conducted in coordination with radar surveys. To complement data collected by the radar, acoustic bat monitoring was conducted at five locations collocated with the radar system (Chokecherry Bench, Smith Draw, Upper Iron Springs, McKinney Creek, and Pine Grove) (Figure 3) to characterize nightly bat activity during periods from June 15 to October 20, 2011, and June 27 to August 29, 2012. Collectively, sites were surveyed for 95 detector-nights in 2011 and 62 detector-nights in 2012. In total, 185 and 134 bat passes were recorded in 2011 and 2012, respectively, for an average of 2.0 bat passes/detector-night across years, nearly identical to the 1.9 bat passes/detector-night (after removal of the A3 site located in Hugus Draw) documented in 2008 (Table 1).

Activity levels were variable during the 2011 and 2012 survey periods. There was a spike in the number of bat passes on July 24, 2011 (26 total bat passes) and over the nights of July 11, 2012 (17 bat passes) and July 12, 2012 (15 bat passes). These peaks in activity are similar in timing to a spike in activity on July 27, 2008 (Solick et al. 2008).

In 2011, activity levels decreased in mid-August and remained low from September 23 to October 20, averaging less than 1 bat pass/detector-night. This low activity is similar to that

reported for the September to October period in 2008. The 2011 surveys recorded more mid- and high-frequency (156; 84% of all bat passes) than low-frequency (29; 16%) bat passes. Hoary bat comprised 4% of all bat passes and was specifically identified in the data on four nights (July 30, and August 12–14). Surveys in 2012 had trends similar to the 2011 surveys with mid- and high-frequency bat passes accounting for 115 (86%) of the 134 total bat passes. Ten bat passes were attributable to hoary bat (7% of all bat passes) evenly spaced across seven nights between July 26 and August 29, 2012.

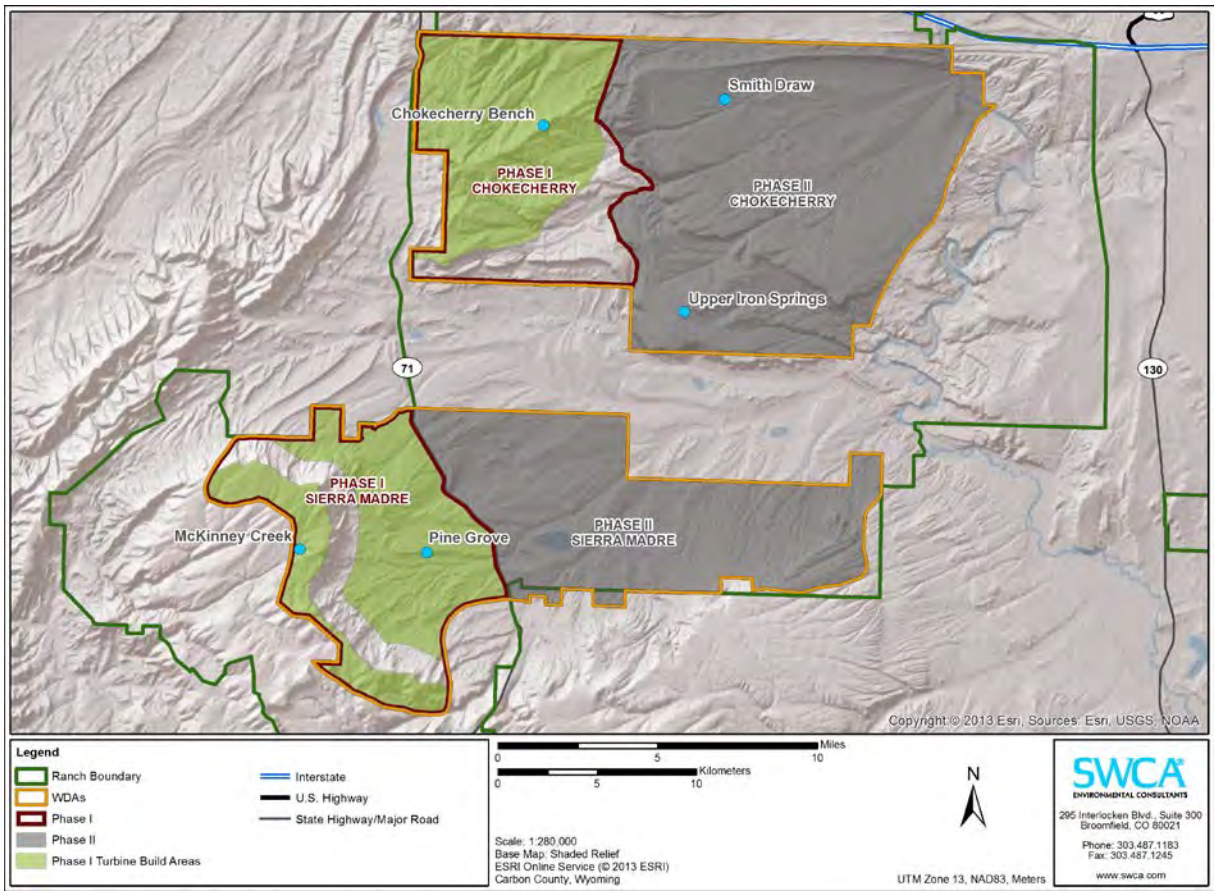

Figure 3. AnaBat sites surveyed in 2011 and 2012.

2011 through 2013 Radar Surveys

Bird and bat activity detected by the radar system does not correlate to the ground-based bat activity detected by the AnaBat unit. In fact, radar data collected during periods of increased AnaBat activity show a trend towards a period of low activity (DeTect 2013). However, the radar dataset is useful for analysis of broad-front migratory patterns of avian and bat species. The radar data consistently demonstrate that the highest average number of targets detected per hour on the CCSM Project Site occur at night during the spring and fall seasons. The summer seasons showed lower numbers of targets per hour distributed more evenly during the day and night, while the winter seasons showed a large decrease in the number of targets recorded per hour. This is consistent with expected avian and bat migratory events passing over the area. Further, the radar data show that 90% to 95% of all targets detected by the

radar, which includes both birds and bats, were flying above the wind turbine rotor swept zone at altitudes where there is no risk of collision.

SUMMARY

Acoustic bat surveys were conducted for the CCSM Project during the summer and fall seasons in 2008, 2011, and 2012. The average number of bat passes per night was consistent between survey years at 1.9 in 2008 (after removal of the A3 site outlier), 1.9 in 2011 and 2.2 in 2012. These bat passage rates are consistent with the 2.2 bat passes per night observed at the nearby Foote Creek Rim wind project (Gruver 2002). All three years of acoustic survey show the highest bat activity occurred in July and August during favorable weather conditions. Further, the surveys show that bat activity was relatively low in September and October indicating that resident bat activity as well as bat migration is tapering off during that period. In addition, data collected by the radar between 2011 and 2013 for all biological targets, including avian and bat species, showed that 90% to 95% of the flight paths occur above the wind turbine rotor swept zone; demonstrating that these targets would not be at risk of collision. Therefore, because ground level bat activity measured using passive acoustic monitoring on the CCSM Project site is relatively low and the recorded flight heights of any potential migrating bats or avian species are well above the rotor swept zone, impacts to bat species are expected to be minimal for the CCSM Project.

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APPENDIX F

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FINAL REPORT

Raptor Nest Surveys for the Chokecherry and Sierra Madre Wind Resource Areas Carbon County, Wyoming

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INTRODUCTION AND BACKGROUND

The Power Company of Wyoming has proposed a wind-energy facility in Carbon County, Wyoming, capable of producing 2,000 megawatts (MW) of energy with 1,000 wind turbines. The wind-energy facility will be constructed in two project areas, referred to as the Chokecherry and Sierra Madre Wind Resource Areas (WRAs; Figure 1). Both WRAs are a mixture of Bureau of Land Management (BLM), State of Wyoming, and private lands.

In the preferred alternative of the Environmental Impact Statement (EIS) prepared for the new Resource Management Plan for the Rawlins District (BLM 2008), the "no surface occupancy" buffer for raptor nests is 1,200 feet (ft; 0.23 miles; 0.37 kilometers [km]) for ferruginous hawks (*Buteo regalis*) and 825 ft (0.16 miles; 0.25 km) for all other raptor species. In addition, no construction activities are allowed within one mile (1.61 km) of active golden eagle (*Aquila chrysaetos*) and ferruginous hawk nests or within 0.75 miles (1.20 km) of all other raptor species during the nesting season. Depending on species, the seasonal timing restrictions to protect nesting raptors covers the period February 1 to July 31. The objectives of this study were to locate and map raptor nests in and within one mile of the WRAs so that nest locations can be considered when siting wind energy facilities, planning construction activities, and characterizing use of the WRAs by nesting raptors.

STUDY AREA

The proposed WRAs are located in Carbon County (Figure 1) approximately four miles (6.4 kilometers [km]) south of Rawlins, Wyoming, within T 16 N – T 18N, R 88 W – R 89W and T 19 N – T21N, R 85 W – R 88W. The Chokecherry WRA is dominated by sagebrush steppe and mixed grass prairie. Topography in the area is rolling hills throughout much of the WRA, with topography becoming more varied in the southern portion (Figure 1). A distinct rim with a steep cliff face dominates the southern boundary of the WRA. The general land practice is cattle grazing.

The Sierra Madre WRA is dominated by sagebrush steppe with pockets of quaking aspen (*Populus tremuloides*). Topography in the WRA ranges from gently rolling plains in the northern portion to rolling hills in the southern portion. The escarpment of Miller Hill dominates the northern boundary of the WRA. Drainages in the southern portion are dominated by willow (*Salix* spp.). The general land practice is also cattle grazing.

METHODS

The goal of the nesting raptor survey was to gather information on nesting species visible from the air, locations of the nests, and timing of nesting by raptor species in the WRAs. The nest search area included each WRA and an approximate one-mile (1.6 km) buffer, which totaled approximately 183.2 square miles (mi^2; 474.5 square kilometers [km^2]) for the Chokecherry WRA and 86.2 mi^2 (223.3 km^2) for the Sierra Madre WRA. The survey was conducted by helicopter from May 14 to May 30, 2008.

Raptor nests were surveyed for by flying in a helicopter and searching suitable habitat (stands of trees, rocky areas and cliffs) for nests. Surveys were conducted while flying at a maximum altitude of 250 ft (76.2 meters [m]) and an approximate airspeed of 30 miles per hour (mph; 48.3 kilometers per hour [kph]). If a nest was observed, the helicopter was moved to a position where it could be determined if the nest was occupied and what species was using the nest. Efforts were made to minimize disturbance to breeding raptors, including keeping the helicopter at a maximum distance from the nest in which the species could be determined. Locations of inactive nests were also recorded as they may become occupied during subsequent years. All nests, whether active or inactive, were given a unique identification number and the Universal Transverse Mercator (UTM) location was recorded with a global positioning system (GPS). In addition to the aerial surveys, raptor nests observed while conducting other study activities at the WRAs (e.g., burrowing owl [*Athene cunicularia*]) were recorded and mapped.

To supplement data collected during the 2008 nesting season, all raptor nest records for the Chokecherry and Sierra Madre WRAs maintained by the BLM were obtained. These records include nests located since 1980 (a 28–year period) and therefore do not reflect expected raptor nesting activity for any given year. Prior to 1996, the BLM mapped raptor nest locations opportunistically. Since 1996, specific surveys have been conducted to map raptor nests in the Rawlins Field Office. These records have been supplemented with raptor nests located as part of the permitting process for development activities such as pipelines and oil and gas developments (Heath Cline, Wildlife Biologist, BLM Rawlins Field Office, personal communication 10-22-08).

RESULTS

Twenty-four active raptor nests, consisting of 11 nests of red-tailed hawk (*Buteo jamaicensis*), five of prairie falcon (*Falco mexicanus*), five of great horned owl (*Bubo virginianus*), and three of golden eagle were located during 2008 aerial surveys of the WRAs (Table 1). Two burrowing owls were also observed from the ground on the Chokecherry WRA, and it is assumed the burrowing owls were nesting in the area.

Twelve of the active raptor nests were found in or within one mile (1.6 km) of the Chokecherry WRA, and 12 were found in or within one mile of the Sierra Madre WRA (Figure 2). Fourteen (58%) of the active raptor nests were located in trees while the remaining 10 (42%) were located on cliffs (Table 1). Three of the four great horned owl and 10 of the 11 red-tailed hawk nests were in trees, whereas one great horned owl, one red-tailed hawk, and all golden eagle and prairie falcon nests were located on cliffs. Either eggs or chicks were observed in all active nests (Table 1).

A total of 110 inactive nests were also located, with 55 in or within one mile (1.6 km) of the Chokecherry WRA and 55 in or within one mile of the Sierra Madre WRA (Figure 3). Forty-eight percent of the inactive nests were on cliffs, 51% were in trees and 1% was on rock. All inactive nests were classified as being in good condition.

Most of the active and inactive raptor nests on the Chokecherry WRA were located along the extreme southern end of the WRA, although several also occurred along a ridgeline that runs east-west through the northern end of the project area (Figures 2 and 3). Very few active or inactive nests were located within the project boundary of the Sierra Madre WRA; the vast majority were located just outside the project boundary along steep, wooded slopes that lead away from the WRA (Figures 2 and 3).

In addition to raptors, seven active common raven (*Corvus corax*) nests and one active Canada goose (*Branta canadensis*) nest were located during aerial surveys (Table 2; Figure 2). Three of the common raven nests were in trees and four were on cliffs. The Canada goose nest was located in a tree along the North Platte River just east of the Chokecherry WRA.

Since 1980, the BLM has mapped 141 active raptor nests in or within one mile (1.6 km) of the WRAs, including 132 nests at the Chokecherry WRA, and nine at the Sierra Madre WRA (Figure 4). Over this 28-year period, golden eagle nests have been most common, with 42 active nests documented, followed by red-tailed hawk (31), ferruginous hawk (25), and prairie falcon (23). Other raptor nests located included three Cooper's hawks (*Accipiter cooperii*), three great horned owls, three American kestrels (*Falco americanus*), and one Swainson's hawk. The nest records also include two unidentified buteos and seven unidentified raptors. Most of the nests at the Chokecherry WRA occurred along the southern boundary of the WRA, although several nests were located throughout the WRA. Most of the nests found at the Sierra Madre WRA occur along the northern and eastern boundaries.

DISCUSSION

Active raptor nest density was 0.07 nests/mi^2 within the Chokecherry WRA and the one-mile (1.6-km) buffer, and 0.14 nests/mi^2 within the Sierra Madre WRA and the one-mile buffer. This is low to moderate in comparison to 16 other WRAs evaluated in the western U.S., where active raptor nest density ranged from 0.03 to 0.43 nests/mi^2 and averaged 0.22 nests/mi^2 (Table 3). The low active raptor nest density of the Chokecherry and Sierra Madre WRAs will minimize the potential impact on nesting raptors. Since few raptor species targeted during nest surveys have been observed as fatalities at newer wind-energy facilities, correlations are very low between the number of collision fatalities and raptor nest density within one-mile of the wind-energy facility. Raptors nesting closest to turbines likely have higher probabilities of being impacted from collision with turbines, but data on nests very close to turbines (e.g., within a half-mile [0.8 km]) are currently inadequate to determine the level of these impacts. The existing wind-energy facility with the highest reported nest density is the Foote Creek Rim wind-energy facility in Wyoming, which lies approximately 60 miles (96.6 km) east of Rawlins. Most of the nests within two miles (3.2 km) of the wind-energy facility are of red-tailed hawk (Johnson et al. 2000b), but no red-tailed hawk fatalities have been documented at this site (Young et al. 2003d, 2003e).

In addition to possible direct effects on raptors within the WRAs through collision mortality, indirect effects caused by disturbance-type impacts, such as construction activity near an active nest, also have a potential impact on raptors. Birds displaced from wind-energy facilities might

move to areas with fewer disturbances, but with lower habitat quality, and therefore possibly 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, 2003; Madders and Whitfield 2006). At a wind-energy facility in eastern Washington, based on extensive monitoring using helicopter flights and ground observations, raptors still nested in the area at approximately the same levels after construction, and several nests were located within a half-mile (0.80 km) 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 (0.78 km) of the turbine strings, and seven red-tailed hawk nests, one great horned owl nest, and one golden eagle nest located within one mile (1.6 km) of the wind-energy facility successfully fledged young (Johnson et al. 2000b). The golden eagle pair successfully nested a half-mile from the wind-energy facility for three different years after it became operational. A Swainson's hawk also nested within a quarter-mile (0.4 km) of a turbine string at the Klondike I wind-energy facility in Oregon after the facility was operational (Johnson et al. 2003).

Notable exceptions to this 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). The only published report of avoidance of wind turbines by nesting raptors occurred at Buffalo Ridge, Minnesota, where raptor nest density on 101 mi^2 (261.6 km^2) of land surrounding a wind-energy facility was 5.94 nests/39 mi^2 (5.94 nests/101.0 km^2), yet no nests were present in the 12 mi^2 (31.1 km^2) wind-energy facility itself, even though habitat was similar (Usgaard et al. 1997). However, this analysis assumed that raptor nests are uniformly distributed across the landscape, an unlikely event, and even though no nests were found, only two nests would be expected for an area 12 mi^2 in size if the nests were distributed uniformly. A subsequent study at the Buffalo Ridge wind-energy facility in Minnesota found evidence of northern harriers (*Circus cyaneus*) avoiding turbines on both a small scale (< 328 ft [100 m] from turbines) and a larger scale (344-17,958 ft [105–5,364 m] from the nearest turbine) in the year following construction (Johnson et al. 2000a). Two years following construction, however, no large-scale displacement of northern harriers was detected. These observations suggest that there will be limited nesting displacement of raptors at the Chokecherry and Sierra Madre WRAs, although the creation of a buffer surrounding known nests when siting turbines will further reduce any potential impact.

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Table 1. Composition and description of active raptor nests on the Chokecherry and Sierra Madre Wind Resource Areas in Carbon County, Wyoming, Spring 2008.

Species	Nest Status	Nest Condition	Nest Substrate
Chokecherry WRA			
great horned owl	Active-chicks	Good	Tree
great horned owl	Active-chicks	Good	Tree
great horned owl	Active-chicks	Good	Cliff
red-tailed hawk	Active-eggs	Good	Cliff
golden eagle	Active-chicks	Good	Cliff
golden eagle	Active-chicks	Good	Cliff
golden eagle	Active-chicks	Good	Cliff
prairie falcon	Active-eggs	Good	Cliff
prairie falcon	Active-eggs	Good	Cliff
prairie falcon	Active-eggs	Good	Cliff
prairie falcon	Active-eggs	Good	Cliff
prairie falcon	Active-eggs	Good	Cliff
Subtotal	12 nests		
Sierra Madre WRA			
great horned owl	Active-chicks	Good	Tree
great horned owl	Active-chicks	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
red-tailed hawk	Active-eggs	Good	Tree
Subtotal	12 nests		
Total	24 nests		

Table 2. Composition and description of active non-raptor nests on the Chokecherry and Sierra Madre Wind Resource Areas in Carbon County, Wyoming, Spring 2008.

Species	Nest Status	Nest Condition	Nest Substrate
Chokecherry WRA			
common raven	Active-chicks	Good	Cliff
common raven	Active-eggs	Good	Cliff
common raven	Active-chicks	Good	Cliff
common raven	Active-chicks	Good	Cliff
Canada goose	Active-eggs	Good	Tree
Sierra Madre WRA			
common raven	Active-chicks	Good	Tree
common raven	Active-eggs	Good	Tree
common raven	Active-chicks	Good	Tree
Total	**8 nests**		

Table 3. Estimated raptor nest densities from other proposed and existing wind-energy facilities located primarily in the western U.S.

Wind Resource Area	Density (# nests/mi^2)
Chokecherry, Wyoming	0.07
Sierra Madre, Wyoming	0.14
Biglow, Oregon	0.15
Klondike III,Oregon	0.16
Leaning Juniper, Oregon	0.41
Stateline, Oregon-Washington	0.21
Nine Canyon, Washington	0.03
Zintel Canyon, Washington	0.08
Buffalo Ridge, Minnesota	0.15
Klickitat County, Washington	0.12
Combine Hills, Oregon	0.24
Columbia Hills, Washington	0.30
Ponnequin, Colorado	0.06
Hopkins Ridge, Washington	0.43
Maiden, Washington	0.18
Wild Horse, Washington	0.16
Kittitas Valley, Washington	0.09
Desert Claim, Washington	0.34
Average	**0.19**

Biglow, OR	WEST 2005	Combine Hills, OR	Young et al. 2003c
Klondike III, OR	Mabee et al. 2005	Columbia Hills, WA	BPA 1995
Leaning Juniper, OR	NWC and WEST 2005	Ponnequin, CO	Kerlinger et al. 2000
Stateline, OR/WA	URS and WEST 2001	Hopkins Ridge, WA	Young et al. 2003a
Nine Canyon, WA	Erickson et al. 2005	Maiden, WA	WEST and NWC 2002a
Zintel Canyon, WA	WEST and NWC 2002b	Wild Horse, WA	Erickson et al. 2003b
Buffalo Ridge, MN	Johnson et al. 2000	Kittitas Valley, WA	Erickson et al. 2003a
Klickitat County, WA	Erickson et al. 1999	Desert Claim, WA	Young et al. 2003b

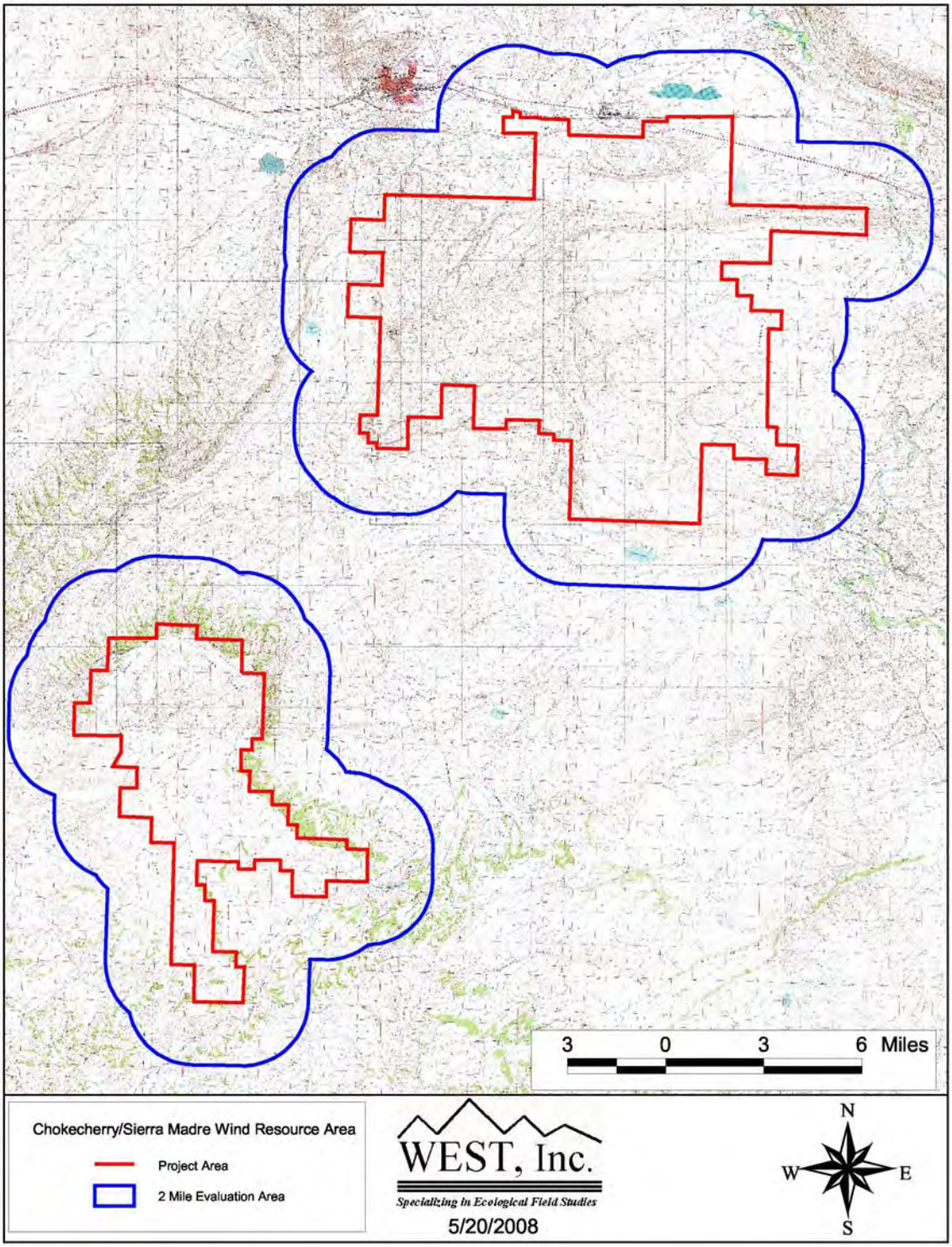

Figure 1. Location of the Chokecherry and Sierra Madre Wind Resource Areas in Carbon County, Wyoming.

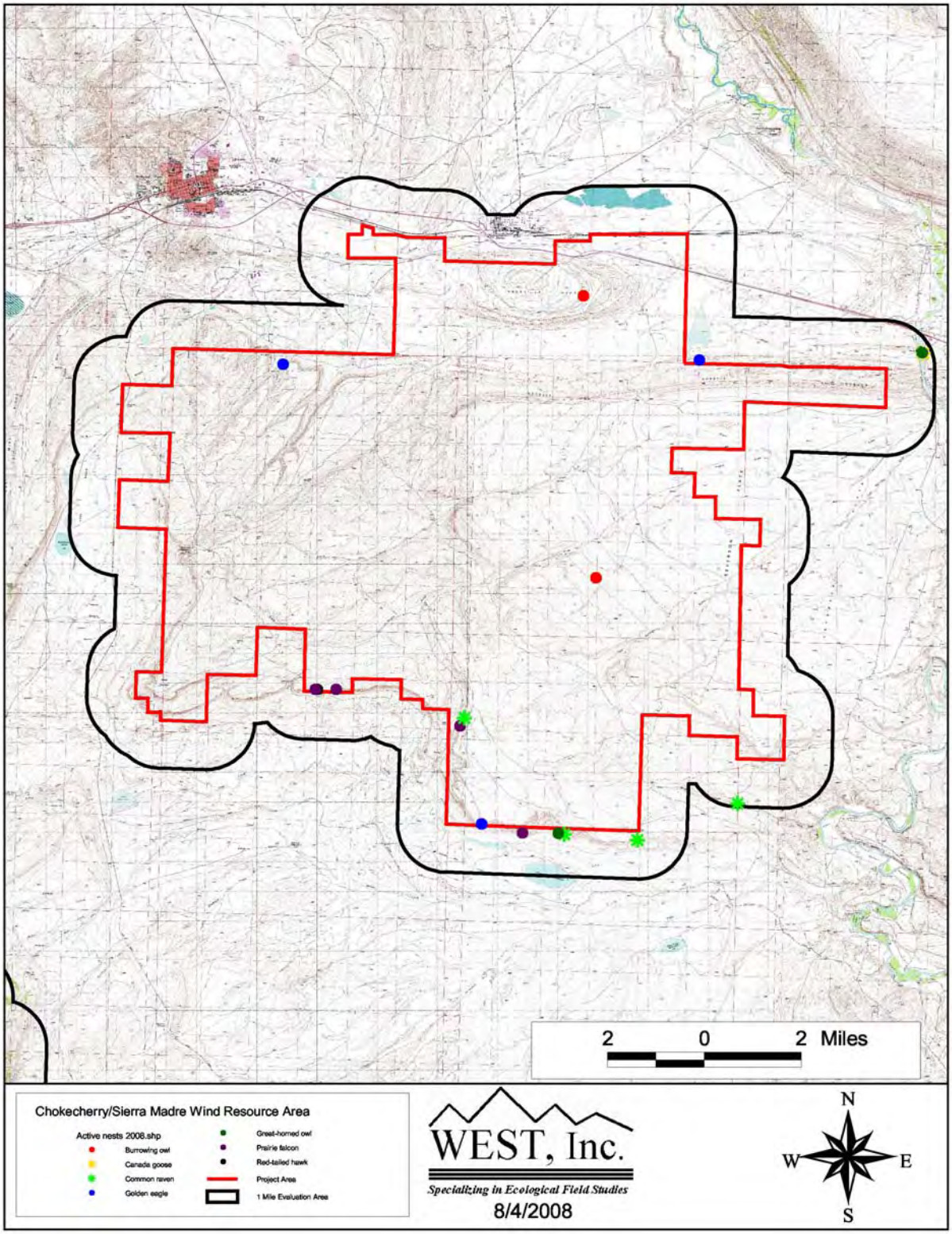

Figure 2a. Locations of active raptor nests at the Chokecherry WRA in Carbon County, Wyoming, April 2008.

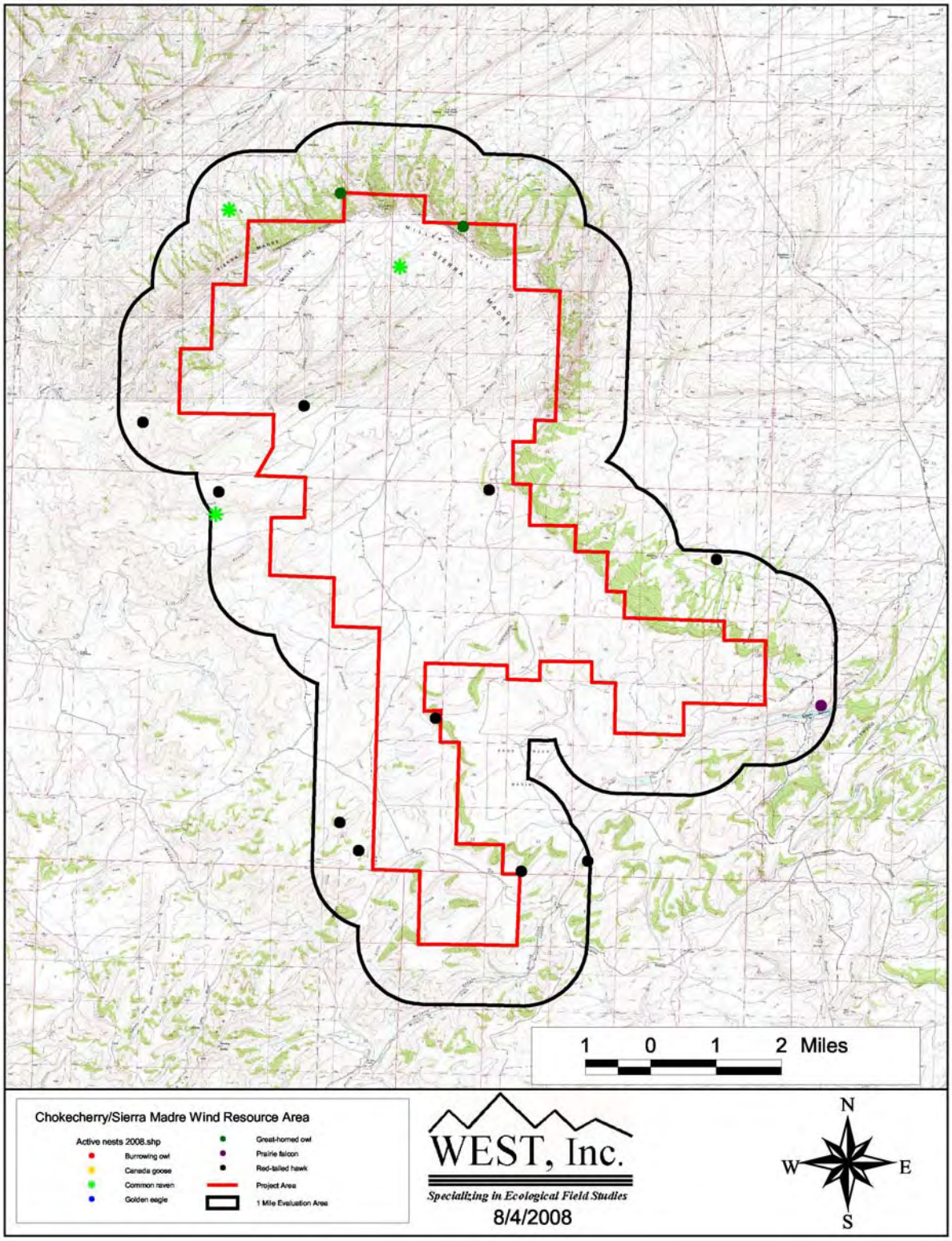

Figure 2b. Locations of active raptor nests at the Sierra Madre WRA in Carbon County, Wyoming, April 2008.

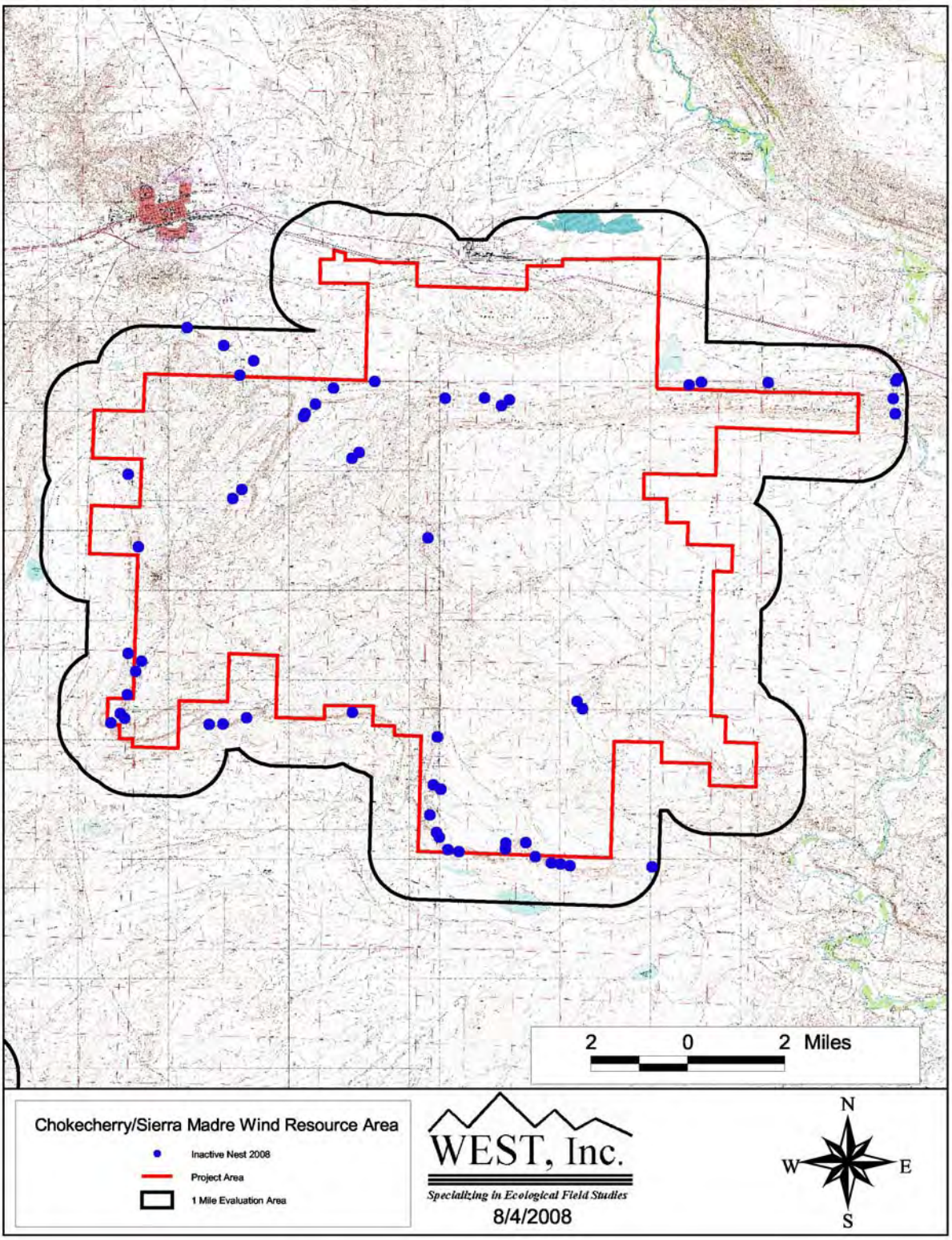

Figure 3a. Locations of inactive raptor nests at the Chokecherry WRA in Carbon County, Wyoming, April 2008.

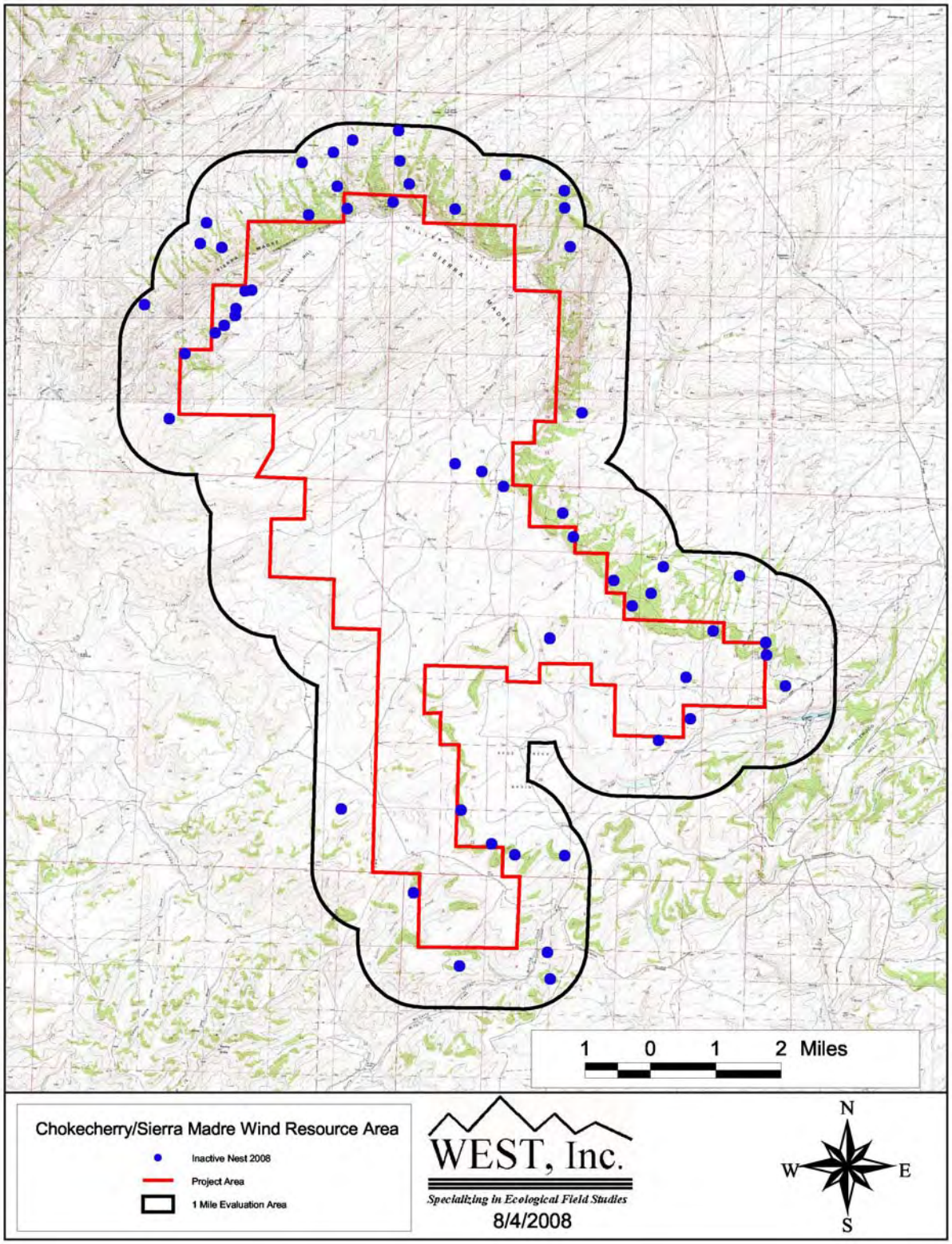

Figure 3b. Locations of inactive raptor nests at the Sierra Madre WRA in Carbon County, Wyoming, April 2008.

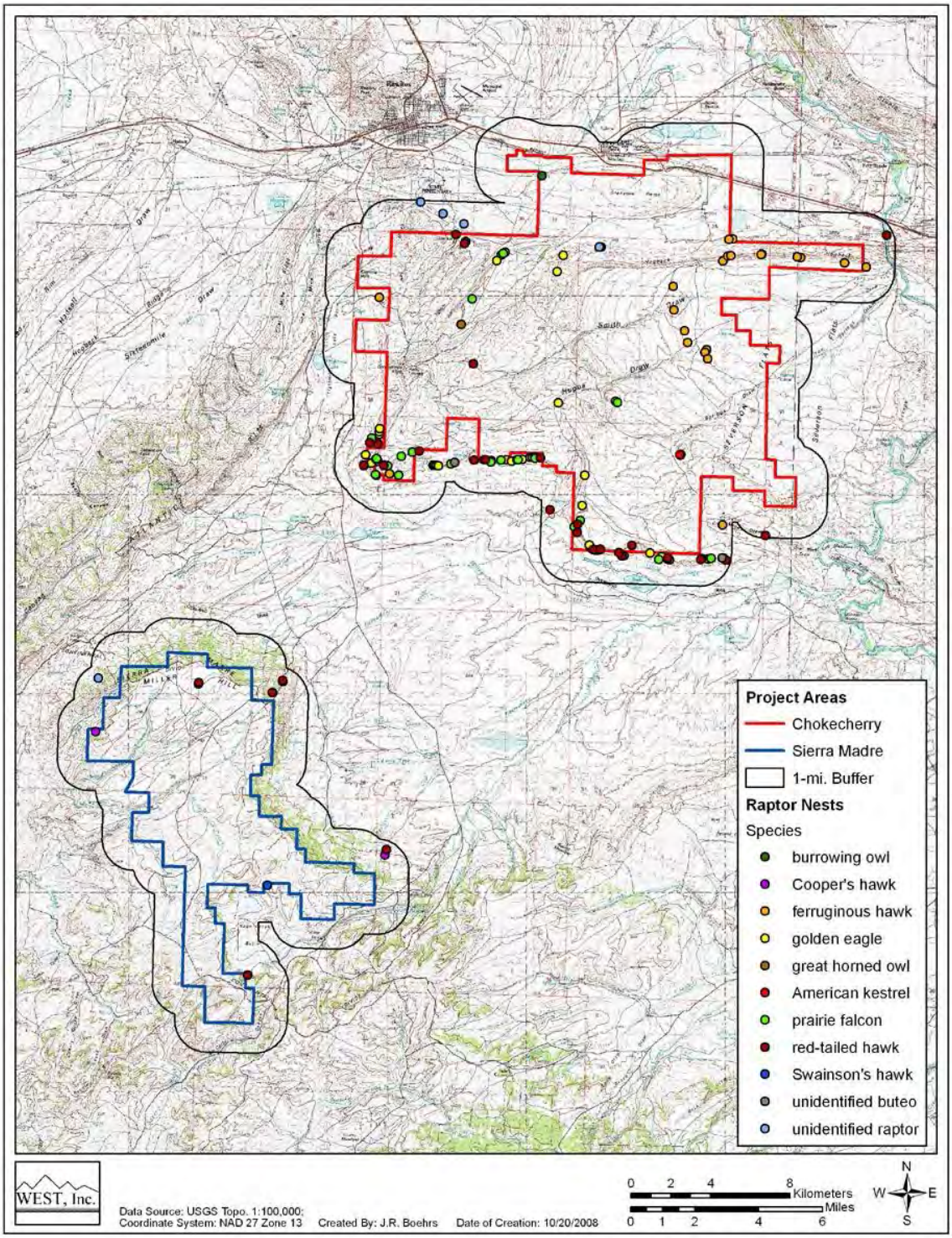

Figure 4. Locations of active raptor nests from BLM records at the Chokecherry and Sierra Madre Wind Resource Areas in Carbon County, Wyoming.

Summary Report for 2011 Nest Surveys
Chokecherry and Sierra Madre Wind Energy Project

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INTRODUCTION

In May and June 2011, SWCA Environmental Consultants (SWCA) conducted raptor nest surveys within the Chokecherry and Sierra Madre Wind Energy Project (Project) development footprint and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project. The selection of a 5-mile turbine buffer was made through consultation with the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Land Management (BLM). This buffer was agreed upon since the existing BLM raptor nest database could be used as a basis for where to search for nests, and because terrain features that had high potential for nesting raptors were well known and established. A 5-mile turbine buffer was also deemed acceptable due to the robust avian monitoring efforts already underway within the Project area, which could also assist in identifying potential nesting raptors. Additionally, BLM regularly conducts raptor nest monitoring in areas that fall outside of the 5-mile turbine buffer. Data from those BLM monitoring efforts will be considered during development of the Avian Protection Plan and Eagle Conservation Plan.

Three types of survey methods were used to identify nests, determine nest condition and activity, and assess nesting success. Helicopter surveys were used to evaluate all known nests and all potential nesting habitats along cliff bands, on steep slopes, and along the North Platte River corridor. Ground surveys were used to identify nests not readily identified from helicopter surveys and to assess nests that were not identified or observable during the helicopter survey flight path. All ferruginous hawk (*Buteo regalis*) nests in the Project footprint were visited to assess current condition. Multiple nest monitoring visits were made to all active eagle nests and many of the active *Buteo* nests identified during helicopter and ground surveys. Nest monitoring visits were made until fledging was confirmed or until juveniles were no longer present on the nest. All nest survey and monitoring activities were conducted in accordance with the protocols submitted to and accepted by the USFWS.

AERIAL SURVEYS

During aerial nest surveys, two biologists and a pilot flew in a Bell 206B3 helicopter on May 25 and June 10. Surveys on May 25 were completed primarily for the Chokecherry portion of the Project and the North Platte River corridor. Surveys on June 10 were completed for the Sierra Madre portion of the Project area as well as the Atlantic Rim. During the June 10 flight, several of the active nests identified during the May 25 surveys were revisited to assess nest activity and the development stage of the chick(s) on the nest.

Nineteen hours were spent flying the Project area and associated buffer. SWCA biologists used historic nest locations provided by the BLM Rawlins Field Office (RFO) for guidance in surveying existing and undocumented nest locations. Aerial surveys focused on known and potential nesting habitat for golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), and ferruginous hawk, as well as previously documented nest locations for these species and other large *Buteos*, falcons, and accipiters. These habitat types included cliff bands, rock outcrops and promenades, steep slopes, riparian zones and river corridors, and forested areas with large trees capable of supporting large nest structures. While the focus of the nest flights was on the three previously mentioned species, any active raptor nest that was

encountered during the course of the flights was documented. Additionally, all inactive or historic nests in poor condition that were observed during aerial surveying efforts were recorded. Data collected at each nest site included documentation of the nest substrate and location, nest condition, nest status (e.g., active or inactive, number of nestlings, etc.), global positioning system (GPS) location, and photo documentation of the nest when feasible and safe.

GROUND SURVEYS

Ground surveys were used to evaluate potential nesting habitat that could not be surveyed or readily observed during aerial flights. Ground surveys focused on treed habitats with known nesting structures that could not be observed during helicopter surveys as well as selected known *Buteo* and accipter nests in the Project area. Ground surveys also identified a previously unknown bald eagle nest. Due to an abundance of late season snowpack, areas around the base of Miller Hill were inaccessible until late spring, at which time the groves of quaking aspen (*Populus tremuloides*) had fully leafed out. While locating nests in these groves proved mostly unsuccessful, any raptor activity occurring in these areas would be captured by the four raptor monitoring points located around Miller Hill. Ground surveys also included visits to all historic ferruginous hawk nests in the Project area to evaluate current nest condition and determine when the nest had last been active. All ferruginous hawk nests in the survey area were inactive in 2011 and many of the historic nests identified in the BLM datasets were no longer viable for nesting activities (Appendix A). All ground survey locations were accessed on foot or with trucks and all-terrain vehicles. Data collected during ground surveys were identical to the data recorded during aerial surveys.

In total, 23 active raptor nests were located within the Project area and associated 5-mile buffer (Figure 1). The species composition of the active raptor nests were as follows: eight golden eagle, four bald eagle, six red-tailed hawk (*Buteo jamaicensis*), three prairie falcon (*Falco mexicanus*), one unknown *Buteo* (likely red-tailed hawk), and one American kestrel (*Falco sparverius*). An additional three active non-raptor nests were located during the flights and included one turkey vulture (*Cathartes aura*), one common raven (*Corvus corax*), and one unknown large species. The unknown large species nest was a medium-sized stick nest in a crevice of a cliff band, and was likely either a *Buteo* species or a common raven. All active golden eagle and bald eagle nests were located outside of the wind development footprint although three of the eagle nests (two golden eagle and one bald eagle) were located within 1 mile of potential turbine locations. Most active eagle nests were located east and southeast of the Chokecherry portion of the Project along cliff bands on the Bolten Rim and the North Platte River. One active eagle nest was located on the Sierra Madre portion of the Project. The remaining active eagle nests were located south of Middlewood Hill along Jack Creek and in the south Sage Creek Basin. All of the active golden eagle and bald eagle nests were observed to have one to two nestlings present, while the majority of the other active raptor nests appeared to be in the incubation or brooding stages. Appendix B contains representative photographs of the types of active and inactive nests that were observed during surveys.

NEST MONITORING

Follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests in the Project area between July 5 and August 2. By July 20, four golden eagle and two bald eagle nests were confirmed as fledged or inactive. Additionally, three other *Buteo* and falcon nests were confirmed as fledged or inactive. As of August 2, the final four golden eagle and two bald eagle nests were confirmed as fledged or inactive. Of the remaining active *Buteo* and falcon nests, four were confirmed as fledged or inactive. Two red-tailed hawk nests remained active as of August 2, and two falcon nests were unable to be relocated during ground surveys due to the nests being built into cavities and tight crevasses along cliff bands.

SUMMARY

In addition to the 23 active raptor nests, 158 inactive nests were also located and documented during the nest flights and other nest searching activities. These nests were located across the Project area and associated buffer; however, the vast majority were located along the Bolten Rim and around the perimeter of the Chokecherry plateau. While all nests observed during the nest flights were documented, it is possible that nests of certain species (e.g., American kestrel, prairie falcon, common raven, etc.) were not able to be located due to the nature of aerial surveys, and because of the way their nests are structured (i.e., oftentimes built in cavities or tight crevasses along cliff bands). All of the inactive nests marked were large in size and were considered potential raptor nests; however, as these nests were inactive, it is not possible to know exactly what species built and/or used the nest.

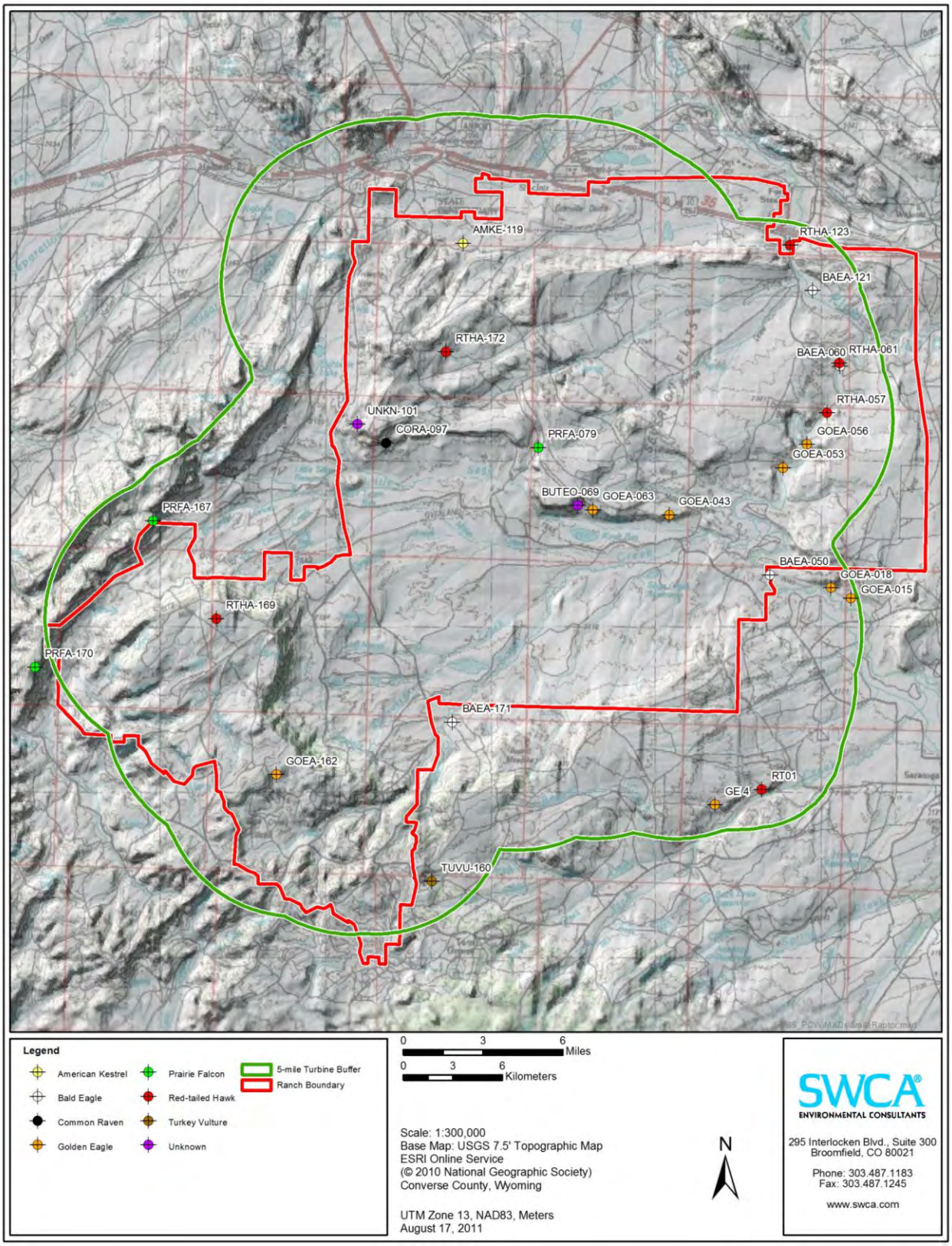

Figure 1. Project area boundary, 5-mile turbine buffer, and all active nests located within the 5-mile turbine buffer in 2011.

APPENDIX A
BLM Ferruginous Hawk Dataset

BLM FERRUGINOUS HAWK DATASET

In May and June 2011, SWCA Environmental Consultants (SWCA) conducted raptor nest surveys within the Chokecherry and Sierra Madre Wind Energy Project (Project) development footprint and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project. As part of SWCA's nest survey and monitoring effort, ground surveys were conducted to determine the status and condition of all ferruginous hawk (*Buteo regalis*) nests documented by the Bureau of Land Management (BLM) within the Project footprint. Forty ferruginous hawk nest sites were identified in the Project area from data shared by the BLM, and each of these nest sites was visited during 2011 ground surveys (Figure A-1). Data collected included presence/absence of a nest at each site; a description of the state of the nest (if a nest was detected); a description of the habitat surrounding the site; photographs of the nest and surrounding habitat (photographs are provided in Appendix B); and the presence of other features that could suggest recent ferruginous hawk activity (e.g., feathers, whitewash, fresh nesting materials, etc.). Of the 40 nest sites identified from the BLM data, 15 nest structures in various stages of condition and quality were located, some with almost no structure remaining. Additionally, seven historic sites were observed that may have once supported a nest; however, now only a few deteriorated sticks remain. Few of these nest structures were located at the BLM sites; however, SWCA surveyed at minimum 100 meters (m) around each of the BLM sites for nest structures as they were likely marked during aerial surveys, which can lead to some degree of inaccuracy in each location. Results for each BLM ferruginous hawk nest site are listed below.

FH18851701: No nest was detected at this site, which is located on a rocky hilltop (Appendix B, Photo 14). An historic nest site is located approximately 22 m northwest of the BLM site (Universal Transverse Mercator [UTM] 13T 0334724, 4599927). The nest is in extremely poor condition with only a few sticks on a small rock outcrop (Appendix B, Photo 15). There were no signs of recent ferruginous hawk activity.

FH18870101: This site contains the remnants of an historic nest, mainly consisting of a few deteriorated sticks and a small amount of old whitewash, but no remaining nest structure (Appendix B, Photo 16). No signs of recent ferruginous hawk activity were observed.

FH18870201: This site is located in a drainage with no evidence of active or historic nests within 100 m of the site (Appendix B, Photo 17). No signs of recent ferruginous hawk activity were observed.

FH18870202: No nest was detected at this site. The site is located on a hillslope, and no signs of recent ferruginous hawk activity were present (Appendix B, Photo 18). A nest is located approximately 64 m north of the BLM site (UTM 13T 0320037, 4603851). This nest is located on a hillslope and is in fair condition; however, there were no other signs of recent ferruginous hawk activity (Appendix B, Photo 19).

FH19860301: A nest is located approximately 15 m east of this site (UTM 13T 0327708, 4612200). The nest is in good condition, likely used in the recent past (Appendix B, Photo 20), with a small amount of whitewash observed around the nest. This nest was also recorded during SWCA's flights across the Project area (nest FEHA-153).

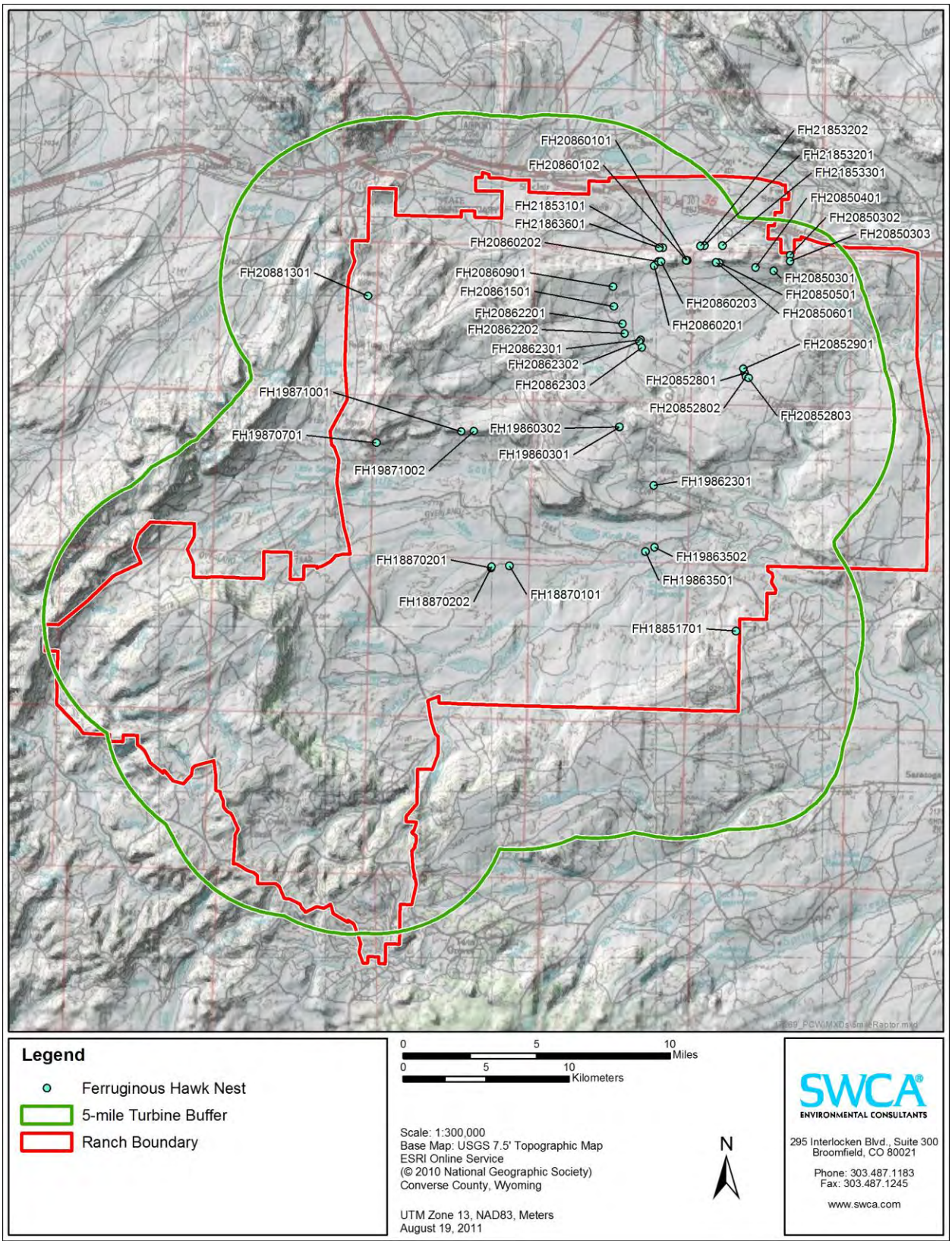

Figure A-1. Project area boundary, 5-mile turbine buffer, and all BLM ferruginous hawk nest sites within the Project area.

FH19860302: No nest was detected at this site. The site is on a rocky hilltop (Appendix B, Photo 21) and is located approximately 35 m north of FH1986031. The area surrounding both of these sites was searched, but no additional nests were detected. No signs of recent ferruginous hawk activity were observed.

FH19862301: No nest was detected at this site. This site is located in sagebrush and bare ground on a hillslope below a cliff band (Appendix B, Photo 22). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH19863501: A nest was detected approximately 20 m north of the BLM site (UTM 13T 0329290, 4604725). The nest is located on a hilltop and is in fair condition, likely having been used in recent years (Appendix B, Photo 23). No other signs of recent ferruginous hawk activity were observed. This nest was also recorded during SWCA's flights across the Project area (nest FEHA-154).

FH19863502: This site contains the remnants of an historic nest, mainly consisting of a few deteriorated sticks, but no remaining nest structure (Appendix B, Photo 24). No signs of recent ferruginous hawk activity were observed.

FH19870701: No nest was detected at this site, which is located partway down a cliff band (Appendix B, Photo 25). There were no signs of active or historic nests within 100 m of the site; however, some signs of recent whitewash were observed along the cliff wall.

FH19871001: No nest was detected at this site, which is located at the base of a cliff band above a rock outcrop (Appendix B, Photo 26). There were no signs of active or historic nests within 100 m of the site; however, some signs of recent whitewash were observed along the cliff wall.

FH19871002: No nest was detected at this site. The site is located at the base of a cliff band (Appendix B, Photo 27) with signs of recent whitewash along the cliff band. A nest is located approximately 84 m northwest of the BLM site (UTM 13T 0318857, 4612023). The nest is located at the base of the cliff band on a rock outcrop and is in poor condition (Appendix B, Photo 28). No other signs of recent ferruginous hawk activity were observed.

FH20850301: No nest was detected at this site. The site is located in sagebrush and a bare ground drainage at the base of a small hillslope (Appendix B, Photo 29). There were no signs of active or historic nests within 100 m of the site; however, some signs of recent whitewash were observed on a perch 70 m to the north.

FH20850302: This site contains a large nest on a rock outcrop near the North Platte River (Appendix B, Photo 30). The nest is in good condition with relatively fresh grass woven into the inner bowl of the nest; the nest was likely used in the recent past. No feathers, whitewash, or other signs of recent ferruginous hawk activity were observed.

FH20850303: A nest was detected approximately 25 m south of the BLM site. The nest is located on a rock outcrop near the North Platte River. The nest is in poor condition and

appeared to be falling off the rock shelf on which it was originally built, which led to the structure being compromised (Appendix B, Photo 31). No signs of recent ferruginous hawk activity were observed.

FH20850401: No nest was detected at this site. The nest site is located on bare ground at the base of a hillslope (Appendix B, Photo 32). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20850501: No nest was detected at this site. The nest site is located in sagebrush and bare ground on a hillslope (Appendix B, Photo 33). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20850601: No nest was detected at this site. The nest site is located in sagebrush and bare ground on a hillslope (Appendix B, Photo 34). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20852801: The remnants of an historic nest are located approximately 16 m west of the BLM nest site at the base of a rock outcrop. The site mainly consists of a few deteriorated sticks, but there is no remaining nest structure (Appendix B, Photo 35). A small amount of old whitewash was observed on the rock outcrop, but there were no signs of recent ferruginous hawk activity.

FH20852802: A nest is located approximately 18 m north of the BLM site (UTM 13T 0335323, 4615247) on a rock outcrop. The nest is in fair to good condition with good structure, but is slightly collapsed (Appendix B, Photo 36). There were no signs of recent ferruginous hawk activity.

FH20852803: No nest was detected at this site, which is located on bare ground in a basin (Appendix B, Photo 37). The remnants of an historic nest are located approximately 95 m east of the BLM site (UTM 13T 0335585, 4615203) on a rock outcrop. The nest is in very poor condition and is mainly a pile of deteriorated sticks (Appendix B, Photo 38). No signs of recent ferruginous hawk activity were observed.

FH20852901: No nest was detected at this site. The site is located on bare ground near saltbush and next to a creek bed (Appendix B, Photo 39). A nest is located approximately 200 m north of the BLM site (UTM 13T 0335189, 4615940) on a rock outcrop. The nest is in fair condition and has potential for reuse in the future (Appendix B, Photo 40). Old whitewash is present at the site, but no other signs of recent ferruginous hawk activity.

FH20860101: No nest was detected at this site, which is located on rocky ground on a hilltop (Appendix B, Photo 41). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20860102: No nest was detected at this site, which is located on rocky ground on a hillslope (Appendix B, Photo 42). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20860201: No nest was detected at this site, which is located on a rocky hillslope (Appendix B, Photo 43). A nest is located approximately 80 m northeast of the BLM site (UTM 13T 0329868, 4622032) on a small rock outcrop. The nest is in fair to good condition and has potential for reuse in the future (Appendix B, Photo 44). There were no signs of recent ferruginous hawk activity.

FH20860202: No nest was detected at this site, which is located on rocky ground on a hillslope (Appendix B, Photo 45). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20860203: No nest was detected at this site, which is located on a rock outcrop on a hilltop (Appendix B, Photo 46). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20860901: No nest was detected at this site, which is located in a sagebrush basin (Appendix B, Photo 47). There are signs of an historic nest on a rock outcrop located approximately 45 m northeast of the BLM site; however, the site mainly consists of a few deteriorated sticks. This site was also recorded during SWCA's flights across the Project area (nest FEHA-151). There were no signs of other nests or recent ferruginous hawk activity within 100 m of the site.

FH20861501: No nest was detected at this site, which is located in a sagebrush basin (Appendix B, Photo 48). There are signs of an historic nest on a rock outcrop located approximately 110 m south of the BLM site; however, the site mainly consists of a few deteriorated sticks. This site was also recorded during SWCA's flights across the Project area (nest FEHA-150). There were no signs of other nests or recent ferruginous hawk activity within 100 m of the site.

FH20862201: No nest was detected at this site, which is located in a sagebrush basin (Appendix B, Photo 49). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20862202: No nest was detected at this site, which is located in sagebrush at the bottom of a small hillslope (no photo available). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20862301: No nest was detected at this site, which is located in sagebrush at the base of a small rock outcrop. There are signs of an historic nest on a rock outcrop located approximately 78 m northwest of the BLM site. The nest is in very poor condition and consists a pile of sticks with no cohesive structure (Appendix B, Photo 50). This site was also recorded during SWCA's flights across the Project area (nest FEHA-149). There were no signs of other nests or recent ferruginous hawk activity within 100 m of the site.

FH20862302: This site contains a large nest beside a rock outcrop. The nest is in good condition with a discernable inner bowl, and was likely used in the recent past (Appendix B, Photo 51). Newer whitewash was observed on the outcrop near the nest, but no other signs of

recent ferruginous hawk activity were observed. This nest was also recorded during SWCA's flights across the project area (nest FEHA-148).

FH20862303: No nest was detected at this site, which is located at the bottom of a small hillslope/rock outcrop (no photo available). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH20881301: No nest was detected at this site, which is located in sagebrush at the bottom of a hillslope (Appendix B, Photo 52). A nest is located approximately 75 m southeast of the BLM site (UTM 13T 0312604, 4620081). The nest is in good condition and built on a small rock outcrop on a hillslope and has potential for reuse in the future (Appendix B, Photo 53). Old whitewash was observed around the nest; however, no other signs of recent ferruginous hawk activity were observed.

FH21853101: No nest was detected at this site, which is located on a rock outcrop on a hilltop (Appendix B, Photo 54). A nest is located approximately 329 m east of the BLM site (UTM 13T 0330639, 4623027). The nest is in good condition and built along the side of a rock outcrop, and likely has been used in the recent past (Appendix B, Photo 55). Some old whitewash was observed along the rock outcrop; however, no other signs of recent ferruginous hawk activity were observed.

FH21853201: No nest was detected at this site, which is located on the side of a hillslope/rock outcrop. A nest is located approximately 115 m east of the BLM site (UTM 13T 0332949, 4623131). The nest is in fair condition and built along a rock outcrop and has potential for reuse in the future (Appendix B, Photo 56). This site was likely recorded during SWCA's flights across the Project area (nest GOEA-125). Some old whitewash was observed along the rock outcrop; however, no other signs of recent ferruginous hawk activity were observed.

FH21853202: No nest was detected at this site, which is located along the side of a rock outcrop (no photo available). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

FH21853301: No nest was detected at this site, which is located on the side of a hillslope. A nest is located approximately 100 m southwest of the BLM site (UTM 13T 0333852, 4623124). The nest is in poor condition, mostly deteriorated, and built on the top of a rock outcrop (Appendix B, Photo 57). Some old whitewash was observed along the rock outcrop; however, no other signs of recent ferruginous hawk activity were observed.

FH21863601: No nest was detected at this site, which is located on rocky ground on a hilltop (Appendix B, Photo 58). There were no signs of active or historic nests within 100 m of the site, nor was there evidence of recent ferruginous hawk activity.

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APPENDIX B
Photographs

Photo 1. Active golden eagle nest GOEA-018. Adult and downy nestling are present.

Photo 2. Active golden eagle nest GOEA-043. One downy nestling is present.

Photo 3. Active golden eagle nest GOEA-053. One downy nestling is present.

Photo 4. Active golden eagle nest GOEA-056. One downy nestling is present and a smaller dummy nest is located just right of the active nest.

Photo 5. Active golden eagle nest GOEA-063. Adult is brooding a downy nestling.

Photo 6. Active golden eagle nest GOEA-162. One downy nestling is present.

Photo 7. Active bald eagle nest BAEA-171. One fully feathered nestling is present.

Photo 8. Inactive stick nest, classified as fair condition.

Photo 9. Inactive stick nest, classified as poor condition.

Photo 10. Inactive stick nest, classified as good condition.

Photo 11. Inactive stick nests. The upper nest is classified as fair to poor condition, the lower nest is classified as good condition.

Photo 12. Inactive stick nest, classified as good condition.

Photo 13. Inactive stick nest, classified as good condition.

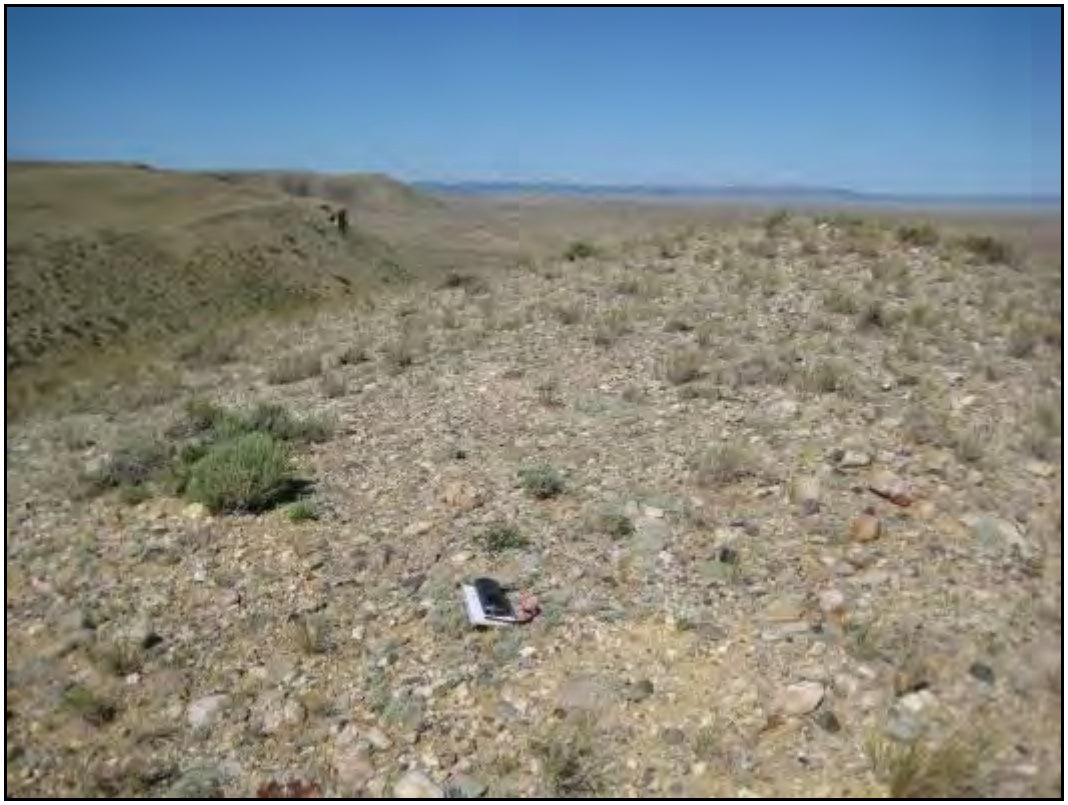

Photo 14. BLM nest site FH18851701. No nest is located at this site.

Photo 15. Remnants of a nest located 22 meters northwest of FH18851701.

Photo 16. BLM nest site FH18870101. Site consists of a small amount of deteriorated sticks, but no remaining nest structure.

Photo 17. BLM nest site FH18870201. No nest is located at or near this site.

Photo 18. BLM nest site FH18870202. No nest is located at this site.

Photo 19. Nest located 64 meters north of FH18870202.

Photo 20. A nest located 15 meters east of BLM nest site FH19860301.

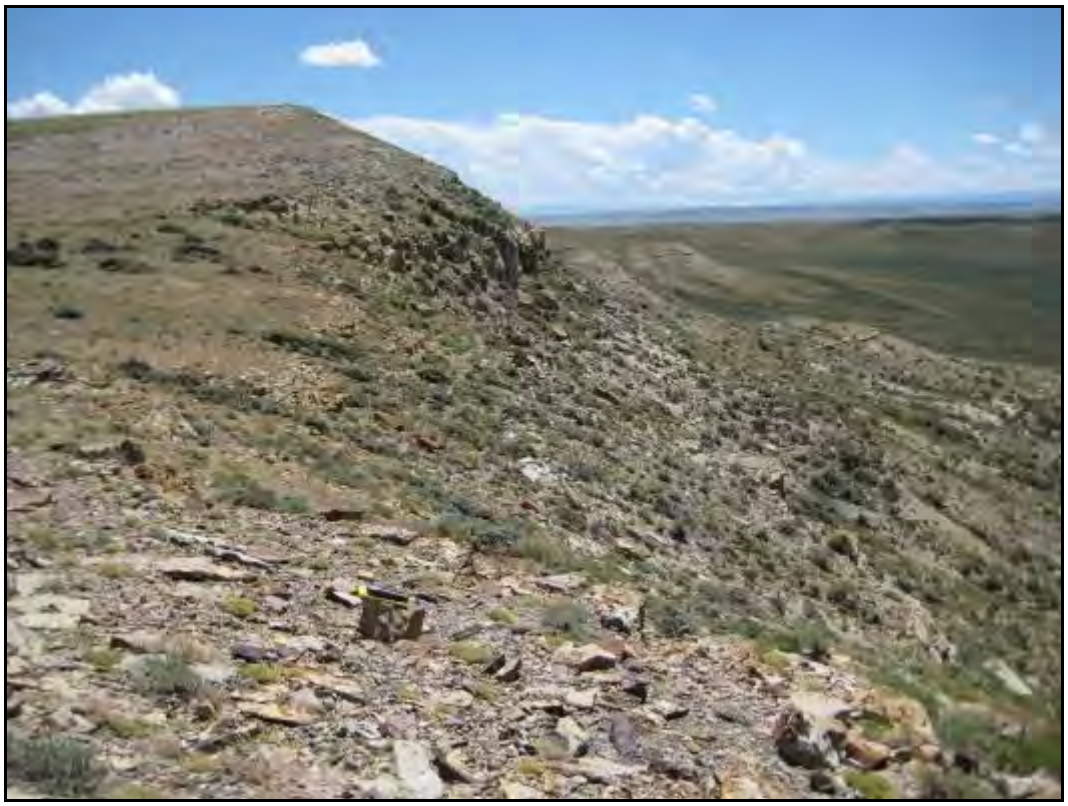

Photo 21. BLM nest site FH19860302. No nest is located at this site.

Photo 22. BLM nest site FH19862301. No nest is located at or near this site.

Photo 23. A nest located 20 meters north of BLM nest site FH19863501.

Photo 24. BLM nest site FH19863502. Site consists of a small amount of deteriorated sticks, but no remaining nest structure.

Photo 25. BLM nest site FH19870701. No nest is located at or near this site.

Photo 26. BLM nest site FH19871001. No nest is located at or near this site.

Photo 27. BLM nest site FH19871002. No nest is located at this site.

Photo 28. Nest located 84 meters northwest of FH19871002.

Photo 29. BLM nest site FH20850301. No nest is located at or near this site.

Photo 30. Nest located at BLM site FH20850302. Nest is in good condition and was likely used in the recent past.

Photo 31. Remnants of a nest located at BLM site FH20850303. Nest is in poor condition and falling off of the rock shelf on which it was built.

Photo 32. BLM nest site FH20850401. No nest is located at or near this site.

Photo 33. BLM nest site FH20850501. No nest is located at or near this site.

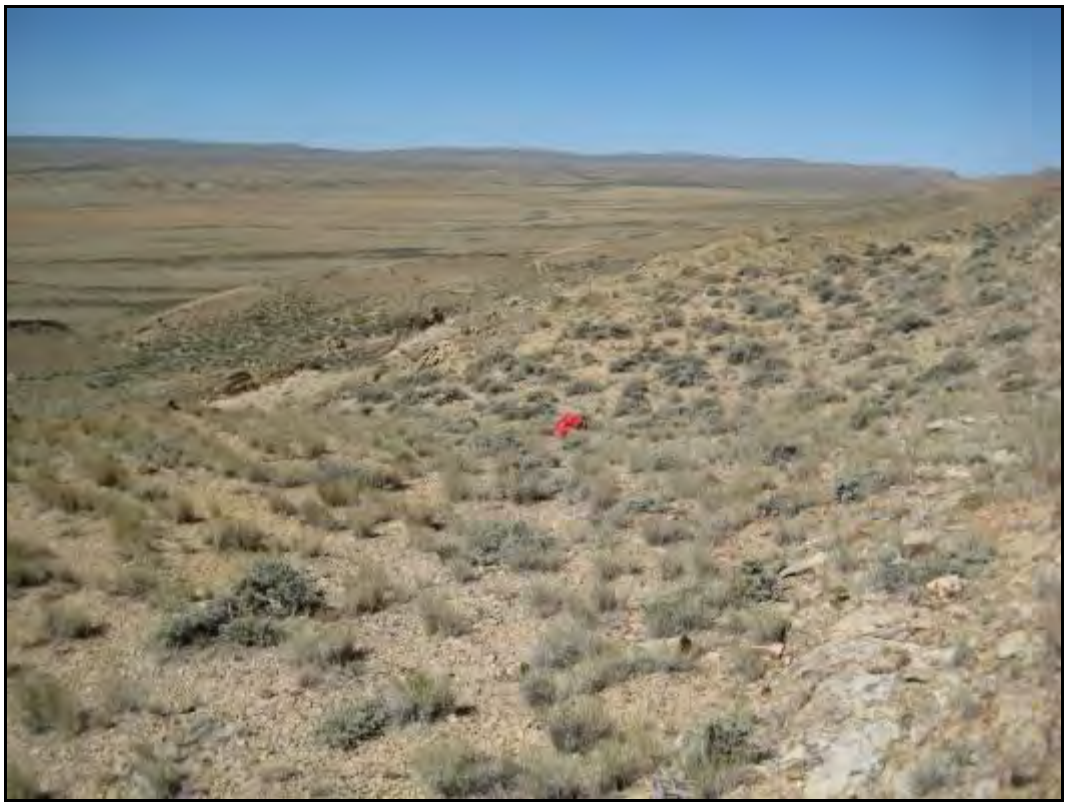

Photo 34. BLM nest site FH20850601. No nest is located at or near this site.

Photo 35. Remnants of a nest located 16 meters west of BLM site FH20852801. Site consists of some deteriorated sticks, but no remaining nest structure.

Photo 36. Nest located 18 meters north of FH20852802.

Photo 37. BLM nest site FH20852803. No nest is located at this site.

Photo 38. Remnants of a nest located 95 meters east of FH20852803.

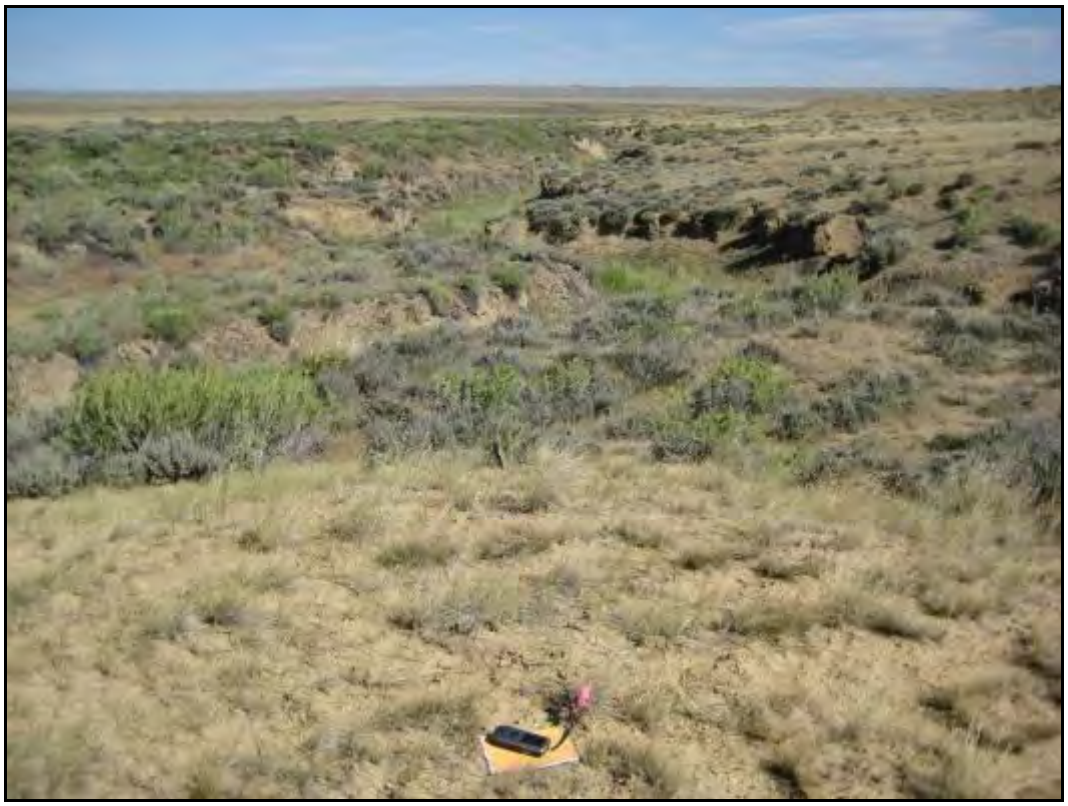

Photo 39. BLM nest site FH20852901. No nest is located at this site.

Photo 40. Nest located 200 meters north of FH20852901.

Photo 41. BLM nest site FH20860101. No nest is located at or near this site.

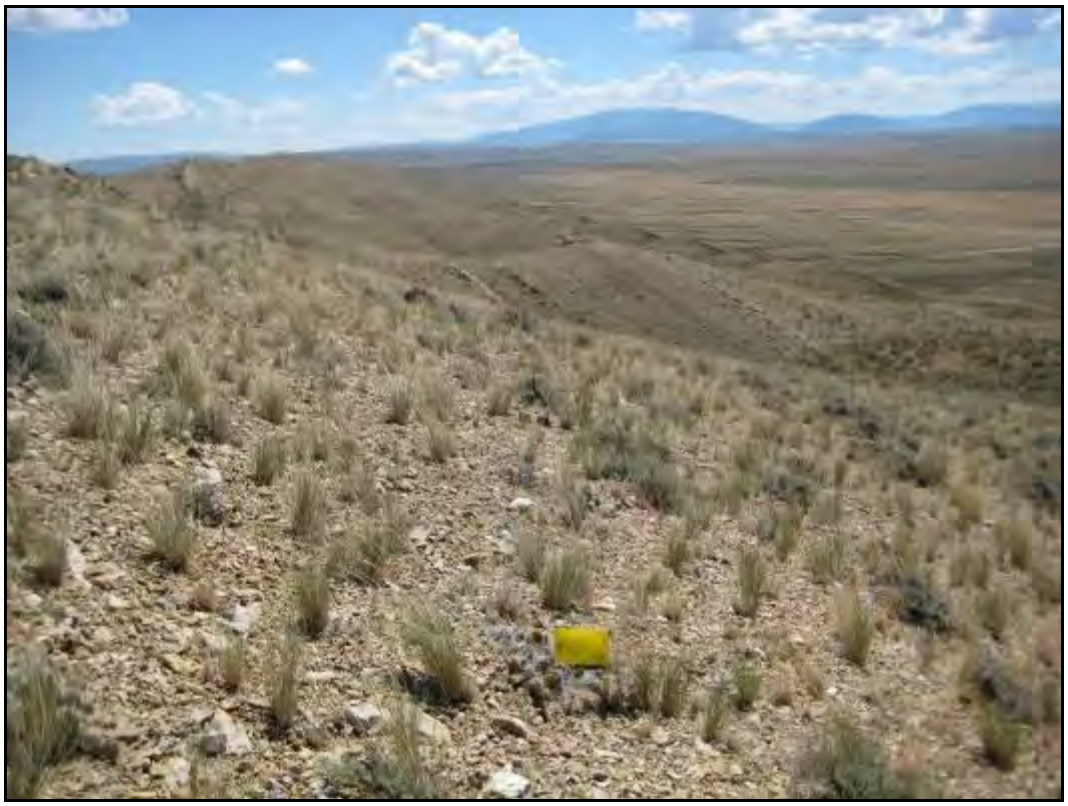

Photo 42. BLM nest site FH20860102. No nest is located at or near this site.

Photo 43. BLM nest site FH20860201. No nest was found at this site.

Photo 44. Nest located 80 meters northeast of FH20860201.

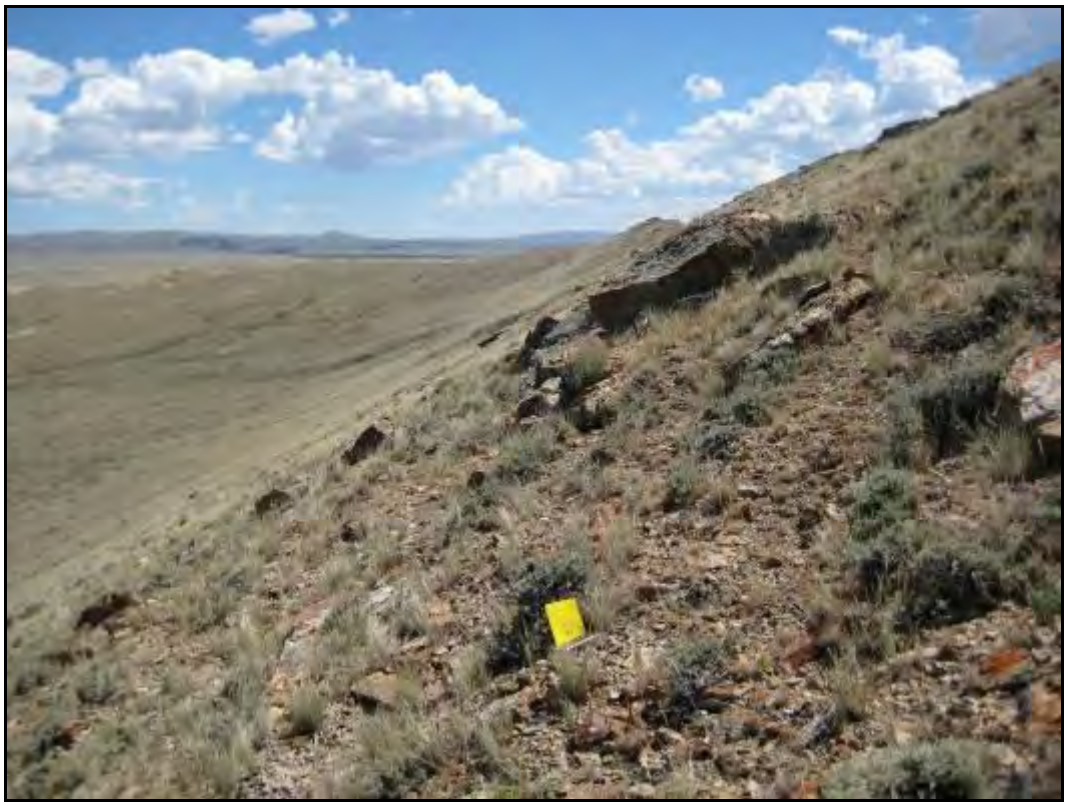

Photo 45. BLM nest site FH20860202. No nest is located at or near this site.

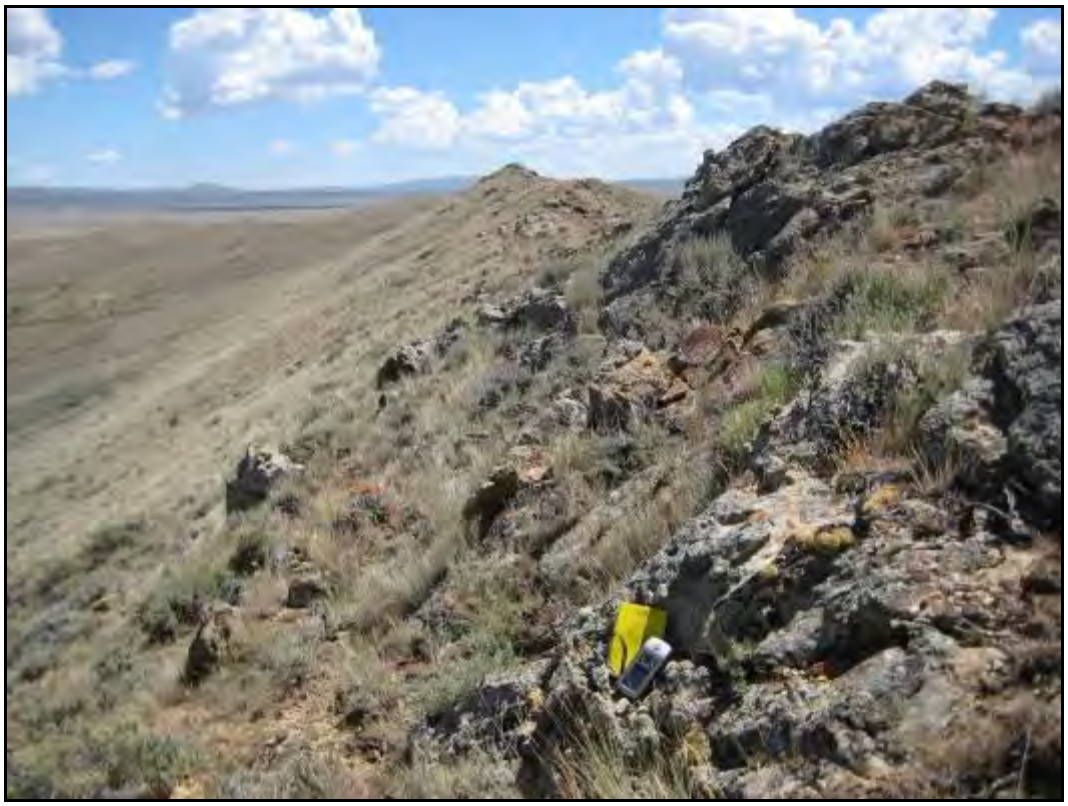

Photo 46. BLM nest site FH20860203. No nest is located at or near this site.

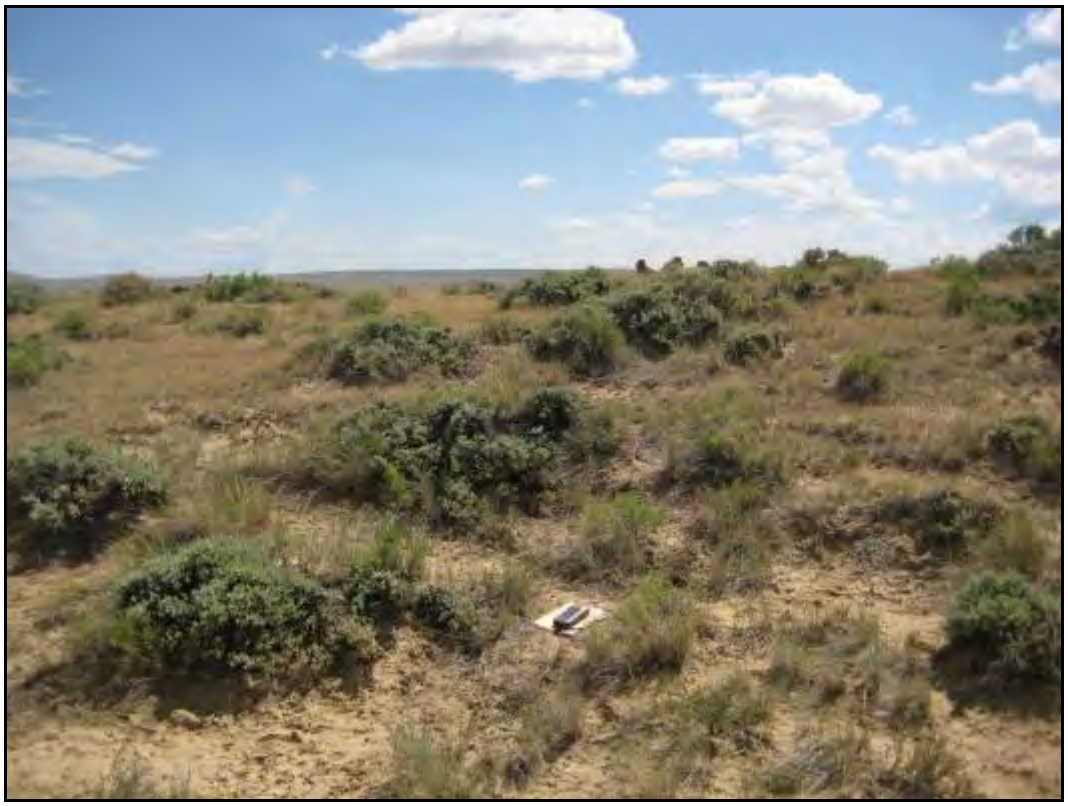

Photo 47. BLM nest site FH20860901. No nest is located at or near this site.

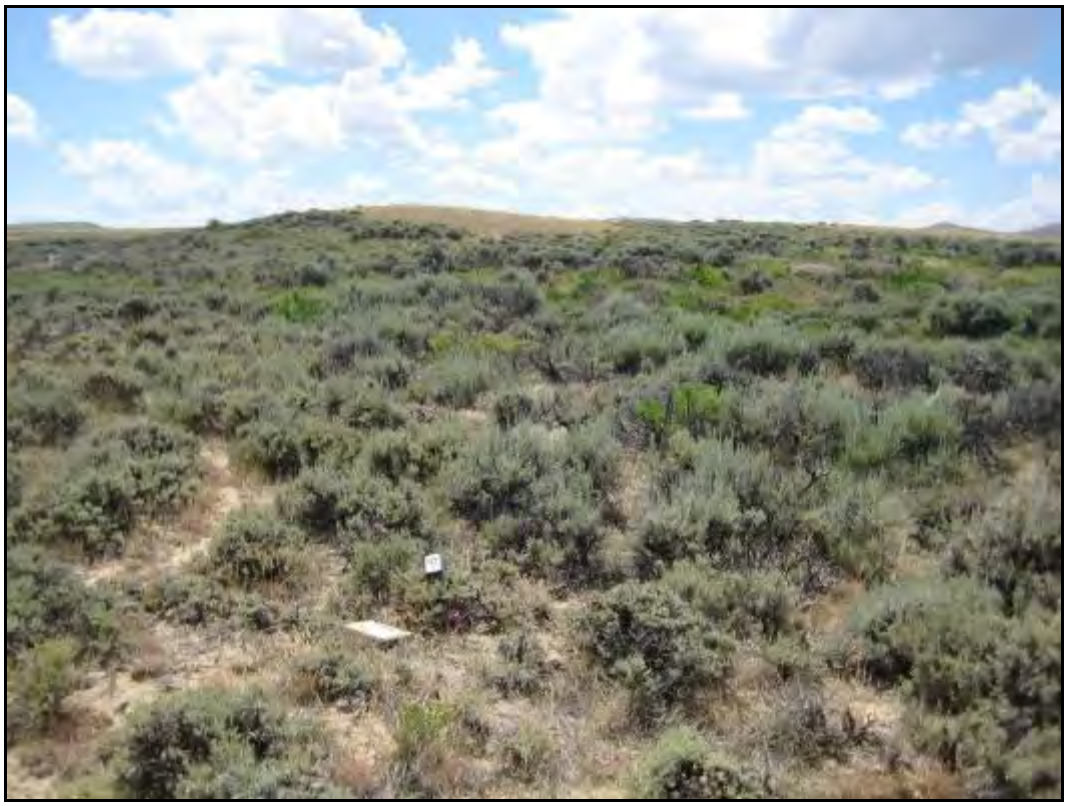

Photo 48. BLM nest site FH20861501. No nest is located at or near this site.

Photo 49. BLM nest site FH20862201. No nest is located at or near this site.

Photo 50. Remnants of a nest located 78 meters northwest of FH20862301. Photo taken during SWCA's nest flights.

Photo 51. Nest located at BLM site FH20862302.

Photo 52. BLM nest site FH20881301. No nest is located at this site.

Photo 53. Nest located 75 meters southeast of FH20881301.

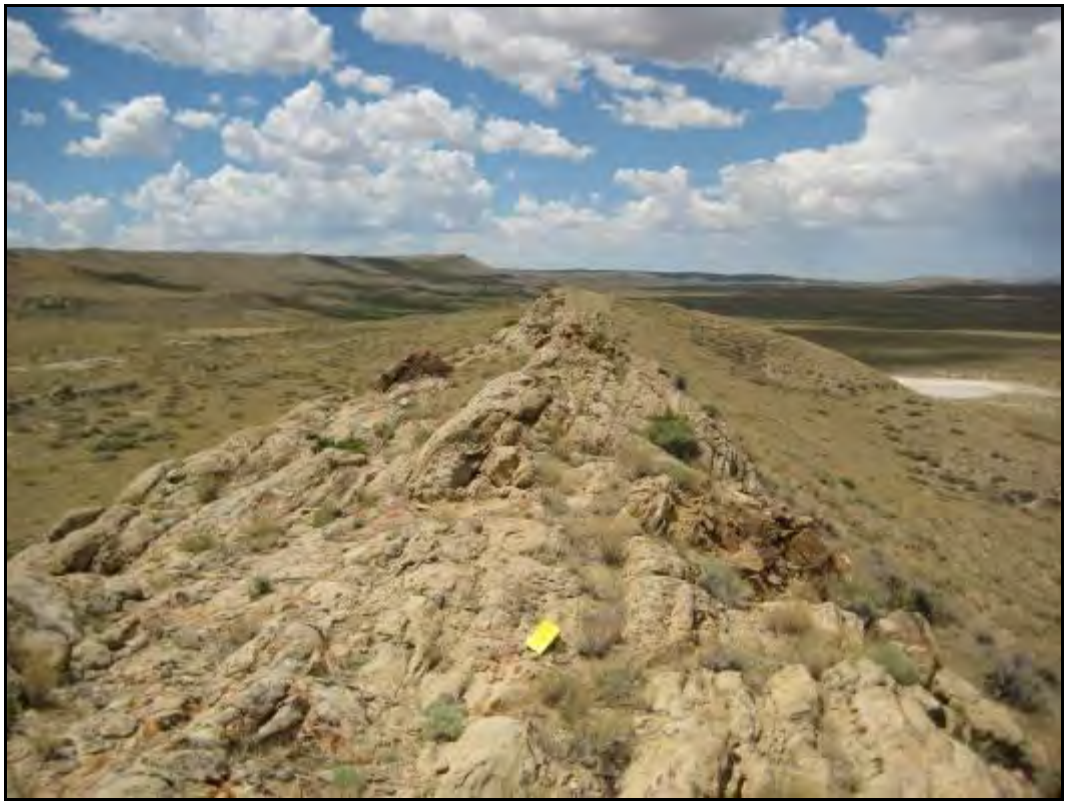

Photo 54. BLM nest site FH21853101. No nest was found at this site.

Photo 55. Nest located 329 meters east of FH21853101.

Photo 56. Nest located 115 meters east of FH21853201.

Photo 57. Remnants of a nest located 100 meters southwest of FH21853301.

Photo 58. BLM nest site FH21863601. No nest is located at or near this site.

Summary Report for 2012 Nest Surveys
Chokecherry and Sierra Madre Wind Energy Project

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INTRODUCTION

In April and May 2012, SWCA Environmental Consultants (SWCA) conducted raptor nest surveys within the Chokecherry and Sierra Madre Wind Energy Project (Project) site and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project (Figure 1). The selection of a 5-mile turbine buffer was made through consultation with the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Land Management (BLM). This buffer was agreed upon since the existing BLM raptor nest database could be used as a basis for where to search for nests, and because terrain features that had high potential for nesting raptors were well known and established. A 5-mile turbine buffer was also deemed acceptable due to the robust avian monitoring efforts already underway within the Project Site, which could also assist in identifying potential nesting raptors. Additionally, BLM regularly conducts raptor nest monitoring in areas that fall outside of the 5-mile turbine buffer.

Three types of survey methods were used to identify nests, determine nest condition and activity, and assess nesting success. Helicopter surveys were used to evaluate all known nests and all potential nesting habitats along cliff bands, on steep slopes, and along the North Platte River corridor. Ground surveys were used to identify nests not readily identified from helicopter surveys and to assess nests that were not identified or observable during the helicopter surveys. All viable ferruginous hawk (*Buteo regalis*) nests in the Project Site were visited to assess nesting status. Multiple nest monitoring visits were made to all active eagle nests and most other active raptor nests identified during helicopter and ground surveys. Nest monitoring visits were made until fledging was confirmed or until juveniles were no longer present on the nest. All nest survey and monitoring activities were conducted in accordance with the protocols submitted to and accepted by the USFWS.

AERIAL SURVEYS

During aerial nest surveys, two biologists and a pilot flew in a Bell 206B3 helicopter on April 25 and 26, and May 8, 2012. Surveys on April 25 and 26 were completed for the area surrounding the Chokecherry Wind Development Area (WDA) and the North Platte River corridor. Surveys on May 8 were completed for the area surrounding the Sierra Madre WDA and the Atlantic Rim.

Approximately 20 hours were spent flying the Project Site and associated buffer. SWCA biologists used historic nest locations provided by the BLM Rawlins Field Office (RFO) and data collected during 2011 nest surveys for guidance in surveying existing and undocumented nest locations. Aerial surveys focused on known and potential nesting habitat for golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), and ferruginous hawk, as well as previously documented nest locations for these species and other large *Buteos*, falcons, and accipiters. These habitat types included cliff bands, rock outcrops and promenades, steep slopes, riparian zones and river corridors, and forested areas with large trees capable of supporting large nest structures. All inactive nests that were observed during aerial surveying efforts were recorded; however, historical nest sites with no remaining nest structure were not recorded due to the low likelihood those nests will be used again.

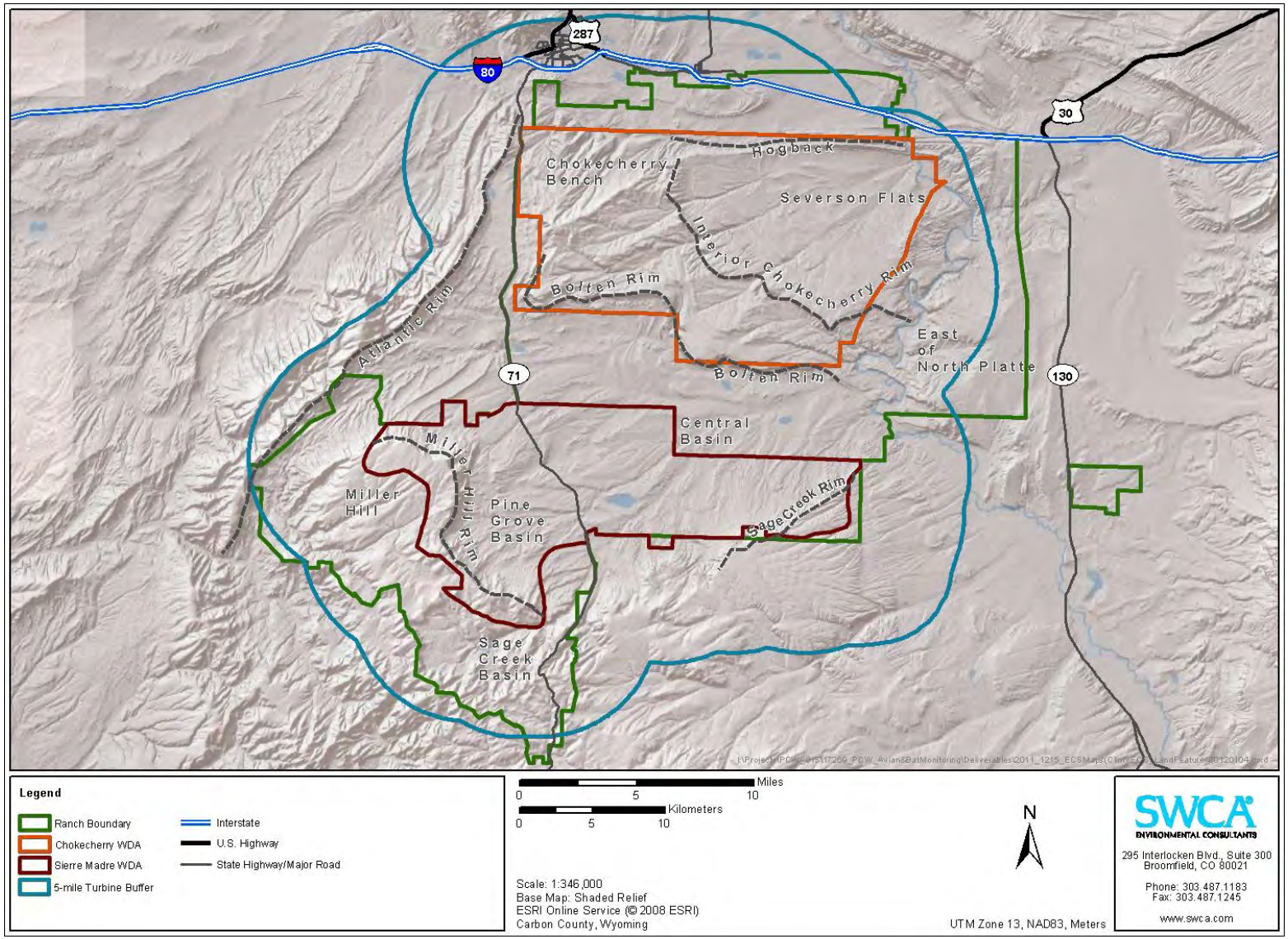

Figure 1. Project Site, 5-mile turbine buffer, and significant land features.

Data collected at each nest site included documentation of the nest substrate and location, nest condition, nest status (e.g., active or inactive, number of nestlings, etc.), global positioning system (GPS) location, and photo documentation of the nest when feasible and safe.

GROUND SURVEYS

Ground surveys were used to evaluate potential nesting habitat that could not be surveyed or readily observed during aerial flights. Ground surveys focused on treed habitats with known nesting structures that could not be observed during helicopter surveys as well as selected known *Buteo* and accipiter nests in the Project Site. Ground surveys also included visits to 12 historical ferruginous hawk nest locations on the Project Site to evaluate current nest condition and activity (Table 1). In 2011, 40 historical ferruginous hawk nests contained in the BLM's nest database and located on the Project Site were visited. During these surveys, the majority of the historical nest sites were either not located, or determined to be unviable as now only a few deteriorated sticks remain. All ground survey locations were accessed on foot or with trucks and all-terrain vehicles. Data collected during ground surveys were identical to the data recorded during aerial surveys.

Table 1. Existing Historical Ferruginous Hawk Nests on the Project Site.

Nest ID	Easting	Northing	Substrate	Condition	BLM Nest Association
FH20850302	338031	4622605	Rock outcrop	Good	N/A
FH20852802	335323	4615247	Rock outcrop	Poor	N/A
FH20862302	328919	4617385	Rock outcrop	Good	N/A
FH-N1	329868	4622032	Rock outcrop	Fair	Near BLM Nest FH20860201
FH-N2	330639	4623027	Rock outcrop	Good	Near BLM Nest FH21853101
FH-N3	312604	4620081	Rock outcrop	Good	Near BLM Nest FH20881301
FH-N4	318857	4612023	Rock outcrop	Poor	Near BLM Nest FH19871002
FH-N18	335189	4615940	Rock outcrop	Fair	Near BLM Nest FH20852901
FH-N21	327708	4612200	Rock outcrop	Good	Near BLM Nest FH19860301
FH-N22	329290	4604725	Hilltop	Fair	Near BLM Nest FH19863501
FH-N23	320037	4603851	Hill slope	Fair	Near BLM Nest FH18870202
FH-N24	332949	4623131	Rock outcrop	Fair	Near BLM Nest FH21853201

RESULTS

In total, 34 active raptor nests were located within the Project Site and associated 5-mile buffer (Figures 2 and 3). The species composition of the active raptor nests was as follows: 10 red-tailed hawk (*Buteo jamaicensis*), nine prairie falcon (*Falco mexicanus*), seven golden eagle, six bald eagle, and two American kestrel (*Falco sparverius*). An additional five active non-raptor nests were located during the flights and included two common raven (*Corvus corax*), one Canada goose (*Branta canadensis*), one great blue heron (*Ardea herodias*), and one great horned owl (*Bubo virginianus*). No ferruginous hawks were found nesting in any of the 12 potential nest locations surveyed in 2012; however, two of the active golden eagle nests (both along the Hogback) were at nest sites previously identified through the 2011 ferruginous hawk nest surveys.

Only the two active golden eagle nests along the Hogback (both likely used by the same pair of eagles after the first nest failed) were located near or within the Chokecherry WDA. These nests are located on the northern boundary of the WDA (one inside and one outside the WDA) and outside the area of likely turbine development. Four active golden eagle nests and four active bald eagle nests were located along the North Platte River corridor outside of the WDAs. One active bald eagle nest was located along the North Platte River within the Chokecherry WDA but within the 1-mile turbine exclusion setback from the North Platte River established for the Project to protect nesting raptors and other wildlife. The nest is well outside the area of likely turbine development and therefore risk from Project development is minimal. The higher observance of active bald eagle nests along the North Platte River may be due to conducting aerial surveys earlier in the year in 2012 as compared to 2011, before trees had fully leafed out.

With respect to the Sierra Madre WDA, no active eagle nests were located within the WDA. One active golden eagle nest was located approximately 1.5 miles south of the southern boundary of the WDA in the area of Sage Creek Rim; however, during a May 29 nest monitoring visit, it was discovered that this nest had been blown off of the cliff. One active bald eagle nest was located approximately 0.6 mile south of the WDA in a snag west of the base of Sage Creek Rim (the same location as observed in 2011).

Follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests in the Project Site between May 24 and July 27. By July 27, all seven golden eagle and six bald eagle nests were confirmed as fledged or inactive, and 15 other *Buteo* and falcon nests were confirmed as fledged or inactive (Table 2). The remaining nests were not included in the follow-up surveys due to being located on private land, or being located in cavities and tight crevasses along cliff bands where they could not be observed from the ground.

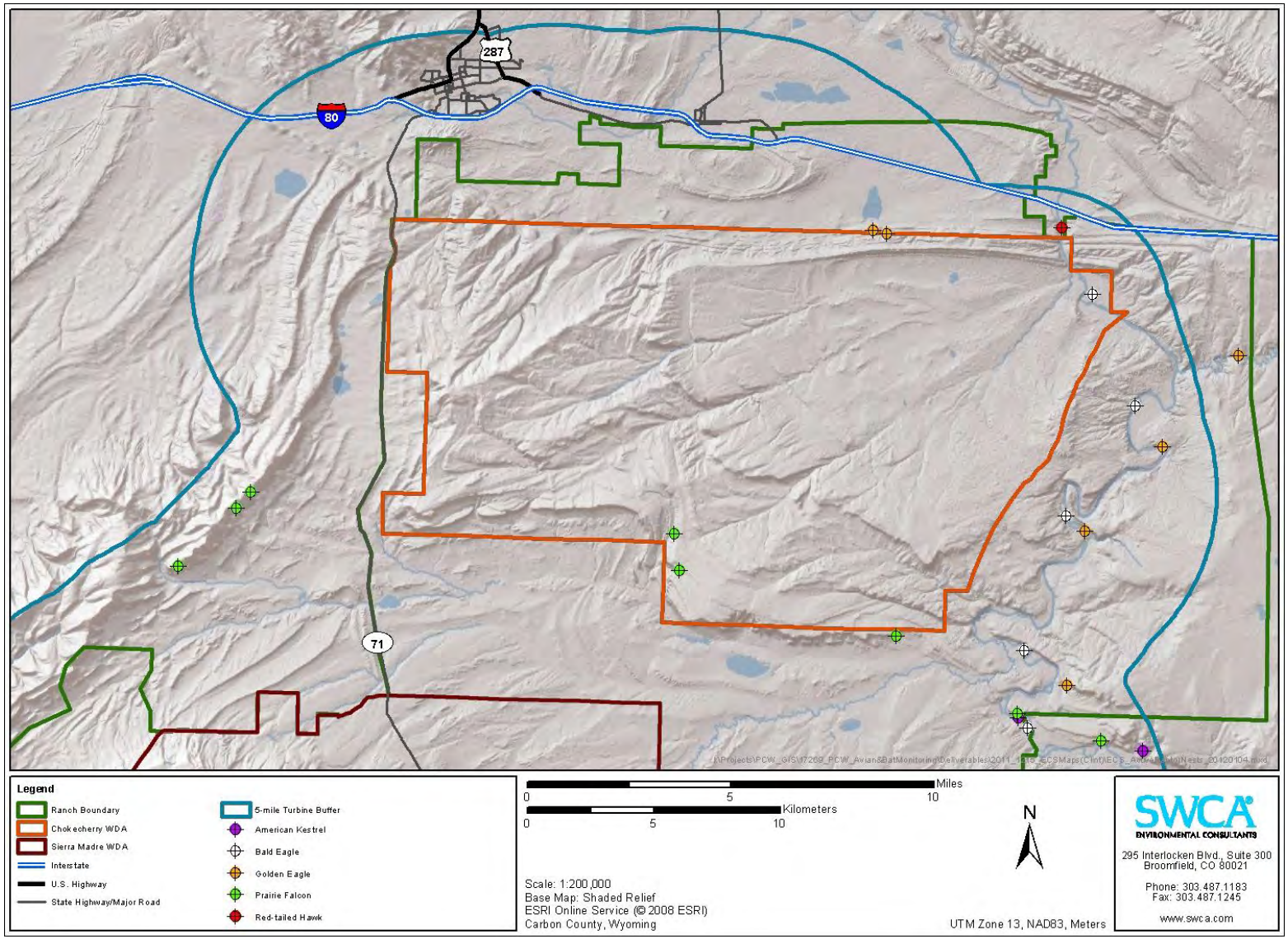

Figure 2. All active nests located in the vicinity of the Chokecherry WDA.

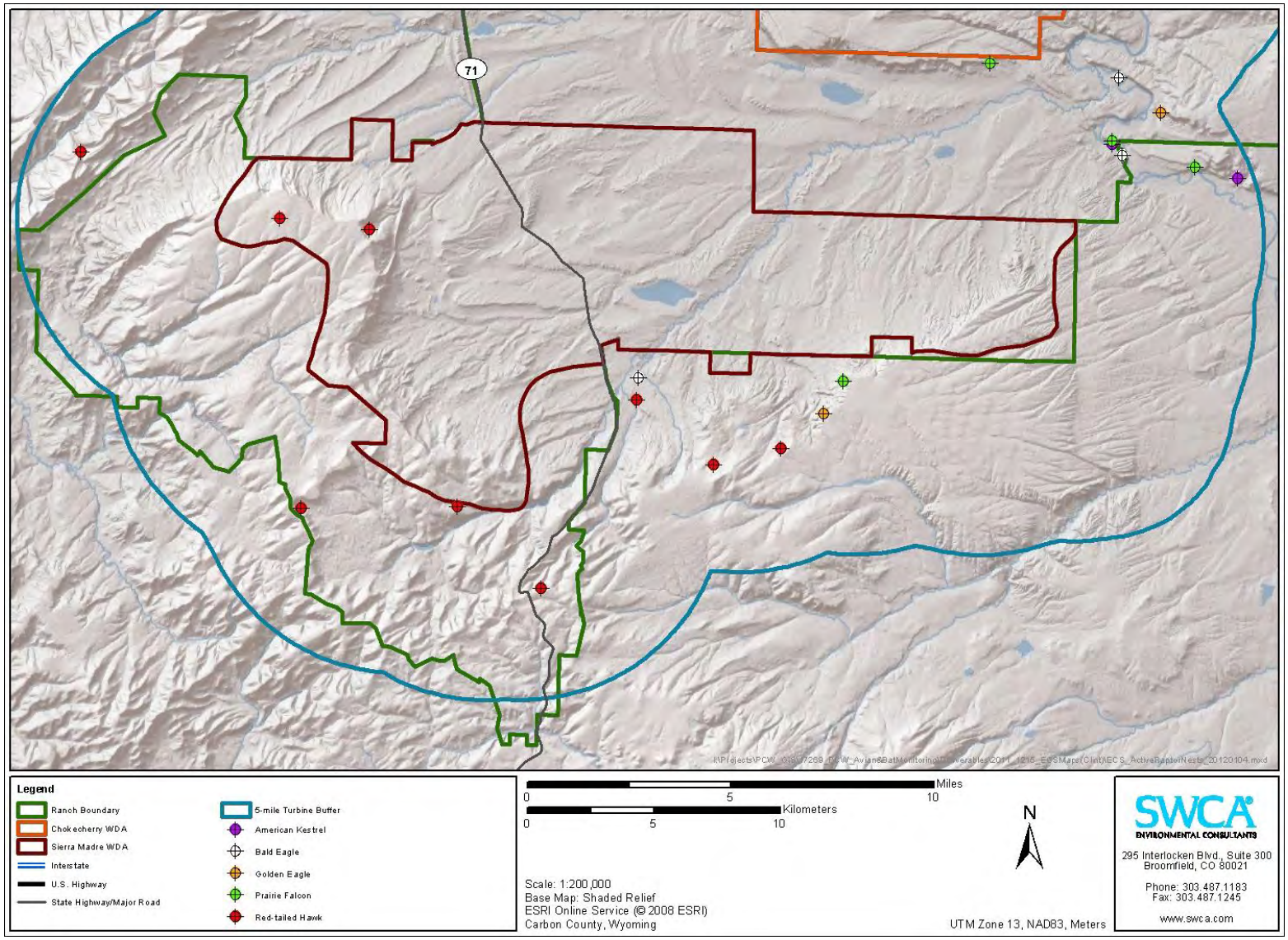

Figure 3. All active nests located in the vicinity of the Sierra Madre WDA.

Table 2. Nest Checks for All Active Bald and Golden Eagle Nests and Most Other Raptor Nests within the Project Site and Associated Buffer.

Species	Substrate	Easting	Northing	1st Check	2nd Check	3rd Check	4th Check
American Kestrel	Cliff cavity	341388	4602365	6/1: adult flushed from eyrie	6/22: likely fledged	N/A	N/A
American Kestrel	Cottonwood cavity	336444	4603689	5/24: incubating	6/26: 1 fledgling	N/A	N/A
Bald Eagle	Cottonwood	336820	4603277	4/25: 1 nestling	5/31: active; unknown number of nestlings	6/26: active; unknown number of nestlings	7/27: unknown
Bald Eagle	Cottonwood	336682	4606344	4/25: incubating	5/25: active; adult flushed from nest tree	6/22: active; 2 adults observed	7/23: fledged
Bald Eagle	Cottonwood	338325	4611699	4/25: 2 adults perched on nest	5/30: failed	N/A	N/A
Bald Eagle	Cottonwood	341067	4616070	4/25: incubating	6/1: active; unknown number of nestlings	6/30: failed	N/A
Bald Eagle	Cottonwood	339381	4620512	4/25: incubating	6/19: failed	N/A	N/A
Bald Eagle	Snag	317657	4594433	4/25: 2 adults perched on nest	5/30: 1 nestling	6/18: 1 nestling	7/23: fledged
Golden Eagle	Cliff	338361	4604961	4/25: incubating	5/25: unknown	6/22: unknown; likely inactive	7/23: failed
Golden Eagle	Cliff	339071	4611096	4/25: incubating	5/30: unknown	6/21: 1 nestling	7/23: fledged
Golden Eagle	Cliff	342167	4614447	4/25: incubating	5/30: failed	N/A	N/A
Golden Eagle	Rock outcrop	330685	4623050	4/25: incubating	6/19: failed	N/A	N/A
Golden Eagle	Cliff	345176	4618079	4/26: incubating	6/1: 2 nestlings	6/19: 2 nestlings	7/23: likely fledged
Golden Eagle	Cliff	324997	4593017	5/9: incubating	5/29: failed; nest blown off cliff	N/A	N/A

Species	Substrate	Easting	Northing	1st Check	2nd Check	3rd Check	4th Check
Golden Eagle	Rock outcrop	331228	4622914	6/27: failed	N/A	N/A	N/A
Prairie Falcon	Cliff cavity	322793	4611002	4/26: adult flushed from eyrie	5/31: unknown	6/30: 1 fledgling	N/A
Prairie Falcon	Cliff	323018	4609521	4/26: incubating	5/31: unknown	6:30: unknown; likely inactive	N/A
Prairie Falcon	Cliff	325753	4594280	5/8: 2 adults flushed from nest	5/29: active; adult perched near nest	6/20: active; 2 adults flushed	7/25: likely fledged
Prairie Falcon	Cliff	336428	4603842	5/25: adult flushed from nest	6/26: unknown; likely fledged	N/A	N/A
Red-tailed Hawk	Aspen	313788	4586085	5/8: incubating	5/31: active; adult observed	6/23: 2 nestlings	7/25: fledged
Red-tailed Hawk	Snag	304269	4589261	5/8: incubating	5/31: 1 nestling	6/23: 2 nestlings	7/24: fledged
Red-tailed Hawk	Aspen	320629	4590980	5/8: 2 adults flushed from area	5/29: unknown; 2 adults observed	6/20: unknown	7/25: unknown; 2 adults observed
Red-tailed Hawk	Aspen	323291	4591635	5/8: adult perched on nest	5/29: 2 nestlings	6/20: 3 nestlings	7/25: fledged
Red-tailed Hawk	Snag	306965	4600335	5/22: adult perched on nest	6/18: unknown; likely inactive	N/A	N/A
Red-tailed Hawk	Cottonwood	338160	4623133	6/1: incubating	6/19: 2 nestlings	7/23: likely fledged	N/A
Red-tailed Hawk	Snag	303433	4600759	6/29: 1 nestling	7/27: fledged	N/A	N/A
Red-tailed Hawk	Aspen	310451	4589317	6/23: 1 nestling	7/26: fledged	N/A	N/A
Red-tailed Hawk	Cottonwood	317580	4593539	5/8: adult perched in nest tree	5/30: unknown	6/18: 1 nestling	7/23: 1 nestling

SUMMARY

In addition to the 34 active raptor nests, 158 inactive nests were also located and documented during the nest flights and other nest searching activities. These nests were located across the Project Site and associated buffer; however, the vast majority were located around the perimeter of the Chokecherry WDA, the North Platte River corridor, and along the Atlantic Rim. While all nests observed during the nest flights were documented, it is possible that nests of certain species (e.g., American kestrel, prairie falcon, common raven, etc.) were not located due to the nature of aerial surveys, and because of the way their nests are structured (i.e., oftentimes built in cavities or tight crevasses along cliff bands). All of the inactive nests marked were large in size and were considered potential raptor nests; however, as these nests were inactive, it is not possible to know exactly what species built and/or used the nest.

The 2012 Year Three survey showed two active golden eagle nests located on the boundaries of the Chokecherry WDA (likely the same pair), but well outside the area of likely turbine development, and none were located within the Sierra Madre WDA. Five active golden eagle nests were located outside the Project Site but within the 5-mile buffer. There was one active bald eagle nest within the Chokecherry WDA but well outside the likely turbine development area. No other active bald eagle nests were within the Project Site. Five active bald eagle nests were outside the boundaries of the Project Site within the 5-mile buffer. Two active red-tailed hawk nests were located within the Sierra Madre WDA near the western boundary, while most others were located south of the Sierra Madre WDA and along the Atlantic Rim. Two prairie falcon nests were located along the Bolten Rim within the Chokecherry WDA, while most others were located along the North Platte River, the Sage Creek Rim, and Atlantic Rim. Multiple follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests within the Project site between May 24 and July 27, 2012, and the results of those surveys are summarized in Table 2.

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Summary Report for 2013 Nest Surveys
Chokecherry and Sierra Madre Wind Energy Project

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INTRODUCTION

In April 2013, SWCA Environmental Consultants (SWCA) conducted raptor nest surveys within the Chokecherry and Sierra Madre Wind Energy Project (Project) site and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the Project (Figure 1). The selection of a 5-mile turbine buffer was made through consultation with the U.S. Fish and Wildlife Service and the Bureau of Land Management (BLM). This buffer was agreed upon since the existing BLM raptor nest database could be used as a basis for where to search for nests, and because terrain features that had high potential for nesting raptors were well known and established. A 5-mile turbine buffer was also deemed acceptable due to the robust avian monitoring efforts already underway within the Project site, which could also assist in identifying potential nesting raptors. Additionally, the BLM regularly conducts raptor nest monitoring in areas that fall outside of the 5-mile turbine buffer.

Two types of survey methods were used to identify nests, determine nest condition and activity, and assess nesting success. Helicopter surveys were used to evaluate all known nests and all potential nesting habitats along cliff bands, on steep slopes, and along the North Platte River corridor. Ground surveys were used to identify nests not readily identified from helicopter surveys and to assess nests that were not identified or observable during the helicopter surveys. All viable ferruginous hawk (*Buteo regalis*) nests in the Project site were visited to assess nesting status. Multiple nest monitoring visits were made to all active eagle nests and most other active raptor nests identified during helicopter and ground surveys. Nest monitoring visits were made until fledging was confirmed or until juveniles were no longer present on the nest. All nest survey and monitoring activities were conducted in accordance with the protocols submitted to and accepted by the U.S. Fish and Wildlife Service.

AERIAL SURVEYS

During aerial nest surveys, two biologists and a pilot flew in a Bell 206B3 helicopter on April 24 and 25, 2013. Surveys on April 24 were completed for the area surrounding the North Platte River corridor and the Sierra Madre Wind Development Area (WDA). Surveys on April 25 were completed for the Chokecherry WDA and the area surrounding the Atlantic Rim.

Approximately 20 hours were spent flying the Project site and associated buffer. SWCA biologists used historic nest locations provided by the BLM Rawlins Field Office and data collected during 2011 and 2012 nest surveys for guidance in surveying existing and undocumented nest locations. Aerial surveys focused on known and potential nesting habitat for golden eagle (*Aquila chrysaetos*), bald eagle (*Haliaeetus leucocephalus*), and ferruginous hawk, as well as previously documented nest locations for these species and other large *Buteos*, falcons, and accipiters. These habitat types included cliff bands, rock outcrops and promenades, steep slopes, riparian zones and river corridors, and forested areas with large trees capable of supporting large nest structures. All inactive nests that were observed during aerial surveying efforts were recorded; however, historical nest sites with no remaining nest structure were not recorded due to the low likelihood those nests will be used again.

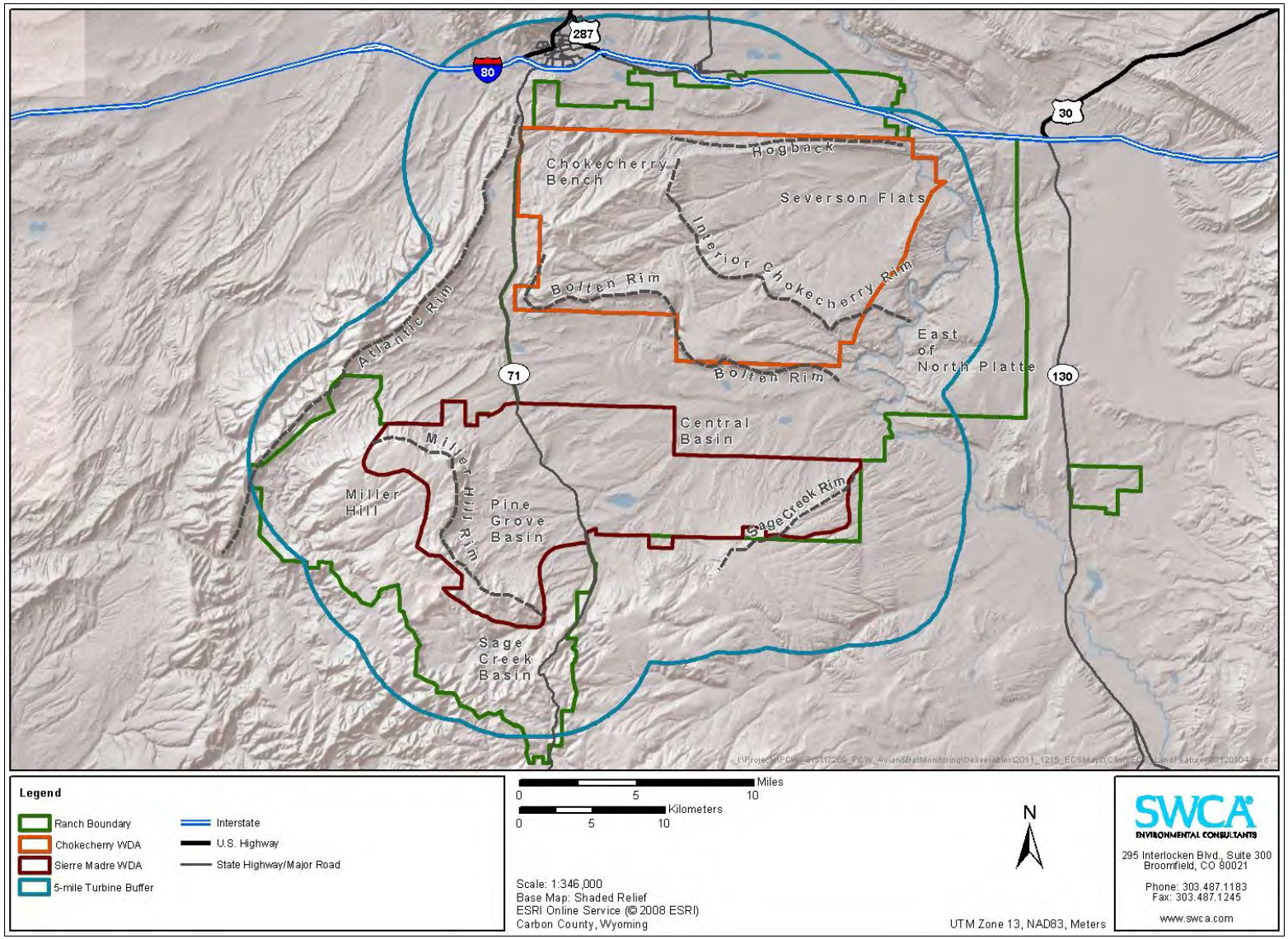

Figure 1. Project site, 5-mile turbine buffer, and significant land features.

Data collected at each nest site included documentation of the nest substrate and location, nest condition, nest status (e.g., active or inactive, number of nestlings, etc.), global positioning system (GPS) location, and photo documentation of the nest when feasible and safe.

GROUND SURVEYS

Ground surveys were used to evaluate potential nesting habitat that could not be surveyed or readily observed during aerial flights. Ground surveys focused on treed habitats with known nesting structures that could not be observed during helicopter surveys as well as selected known *Buteo* and accipiter nests in the Project site. Ground surveys also included visits to 12 historical ferruginous hawk nest locations on the Project site to evaluate current nest condition and activity (Table 1). In 2011, 40 historical ferruginous hawk nests contained in the BLM's nest database and located on the Project site were visited. During the 2013 surveys, the majority of the historical nest sites were either not located, or determined to be unviable as only a few deteriorated sticks remain. All ground survey locations were accessed on foot or with trucks and all-terrain vehicles. Data collected during ground surveys were identical to the data recorded during aerial surveys.

Table 1. Existing Historical Ferruginous Hawk Nests on the Project Site.

Nest ID	Easting	Northing	Substrate	Condition	BLM Nest Association
59	332949	4623131	Rock outcrop	Fair	Near BLM Nest FH21853201
211	338031	4622605	Rock outcrop	Fair	FH20850302
212	335323	4615247	Rock outcrop	Fair	FH20852802
234	328919	4617385	Rock outcrop	Fair	FH20862302
238	327708	4612200	Rock outcrop	Good	Near BLM Nest FH19860301
239	329290	4604725	Hilltop	Fair	Near BLM Nest FH19863501
241	309124	4608503	Hill slope	Fair	FH19882201
257	329868	4622032	Rock outcrop	Fair	Near BLM Nest FH20860201
258	312604	4620081	Rock outcrop	Good	Near BLM Nest FH20881301
259	318857	4612023	Rock outcrop	Poor	Near BLM Nest FH19871002
260	335189	4615940	Rock outcrop	Fair	Near BLM Nest FH20852901
263	320037	4603851	Hill slope	Fair	Near BLM Nest FH18870202

RESULTS

In total, 25 active raptor nests were located within the Project site and associated 5-mile buffer (Figures 2 and 3). The species composition of the active raptor nests was as follows: 7 bald eagle, 7 golden eagle, 6 red-tailed hawk (*Buteo jamaicensis*), 4 prairie falcon (*Falco mexicanus*), and 1 American kestrel (*Falco sparverius*). One additional occupied golden eagle nesting territory was identified in the Central Basin during other Project survey efforts, but no nest initiation was detected during multiple visits to the site. Seven active non-raptor nests were also located during the flights and included 4 common raven (*Corvus corax*) and 3 great horned owl (*Bubo virginianus*). No evidence of ferruginous hawk nesting or nest maintenance was found at any of the 12 nest locations surveyed in 2013 (Table 1).

Only 1 active golden eagle nest located on Kindt Point was identified within the Chokecherry WDA. This nest was located just within the southern boundary of the WDA and falls within the Turbine No-Build area that encompasses the entirety of the Bolten Rim and Interior Chokecherry Rim. This nest also falls more than 5 miles outside the boundaries of the Phase I development area for the Chokecherry WDA. Four active golden eagle nests and 5 active bald eagle nests were located along the North Platte River corridor outside of the WDAs. These nests are all 10 to 15 miles outside the boundaries of the Phase I development area for the Chokecherry WDA. One active bald eagle nest was located along the North Platte River within the Chokecherry WDA but within the 1-mile turbine exclusion setback from the North Platte River established for the Project to protect nesting raptors and other wildlife. The nest is well outside the area of likely turbine development and therefore risk from Project development is minimal.

With respect to the Sierra Madre WDA, no active eagle nests were located within the WDA. One active golden eagle nest was located approximately 0.50 mile south of the southern boundary of the WDA in the area of Sage Creek Rim, and another was located approximately 5.75 miles south of the southern boundary of the WDA, just inside the boundary of the survey buffer. These nests are both more than 5 miles outside the boundaries of the Phase I development area for the Sierra Madre WDA One active bald eagle nest was located approximately 0.6 mile south of the WDA in a snag at the base of Sage Creek Rim (the same location as observed in 2011 and 2012). This nest is approximately 1.5 miles outside the boundaries of the Phase I development area for the Sierra Madre WDA, and is located immediately south of a Turbine No-Build Area surrounding Rasmussen Reservoir that was created to protect foraging and use areas associated with this nest.

One additional occupied golden eagle nesting territory was identified in the Central Basin between the Chokecherry and Sierra Madre WDAs, approximately 0.75 mile west of Sage Creek Reservoir. This nest location is approximately 9 miles southeast of the Phase I development area for the Chokecherry WDA and 9 miles east of the Phase I development area for the Sierra Madre WDS. Individuals were observed perching and copulating on this nest; however, no signs of nest initiation were detected during multiple visits to the site. This nest falls within the Turbine No-Build area that encompasses much of the Central Basin between the Chokecherry and Sierra Madre WDAs.

Follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests in the Project site between May 21 and July 26. Of the 7 golden active eagle nests documented during 2013 nest surveys, 5 were determined to have failed by the end of June, and only one was determined to have fledged by the end of July. One was unable to be visited due to private land access issues. With regards to the 7 active bald eagle nests, 2 were confirmed as failed by the end of June, 2 were determined to have fledged and an additional 2 were about to fledge by the end of July. The status of one bald eagle nest was unable to be determined due to dense foliage surrounding the nest. Of the 6 active red-tailed hawk nests, 2 were confirmed to have fledged and 1 was confirmed to have failed by the end of June, and 2 were unable to be determined whether they had fledged or failed due to the timing of nest visits (Table 2). One red-tailed hawk nest was unable to be visited due to private land access issues. The remaining nests were not included in the follow-up surveys due to being located on private land, or being located in cavities and tight crevasses along cliff bands where they could not be observed from the ground.

In addition to the 25 active raptor nests, 196 inactive and historic nests were surveyed and assessed during the nest flights and other nest searching activities. These nests were located across the Project site and associated buffer; however, the vast majority were located around the perimeter of the Chokecherry WDA, the North Platte River corridor, and along the Atlantic Rim. While all nests observed during the nest flights were documented, it is possible that nests of certain species (e.g., American kestrel, prairie falcon, common raven, etc.) were not located due to the nature of aerial surveys, and because of the way their nests are structured (i.e., oftentimes built in cavities or tight crevasses along cliff bands). All of the inactive nests marked were large in size and were considered potential raptor nests; however, as these nests were inactive, it is not possible to know exactly what species built and/or used the nest.

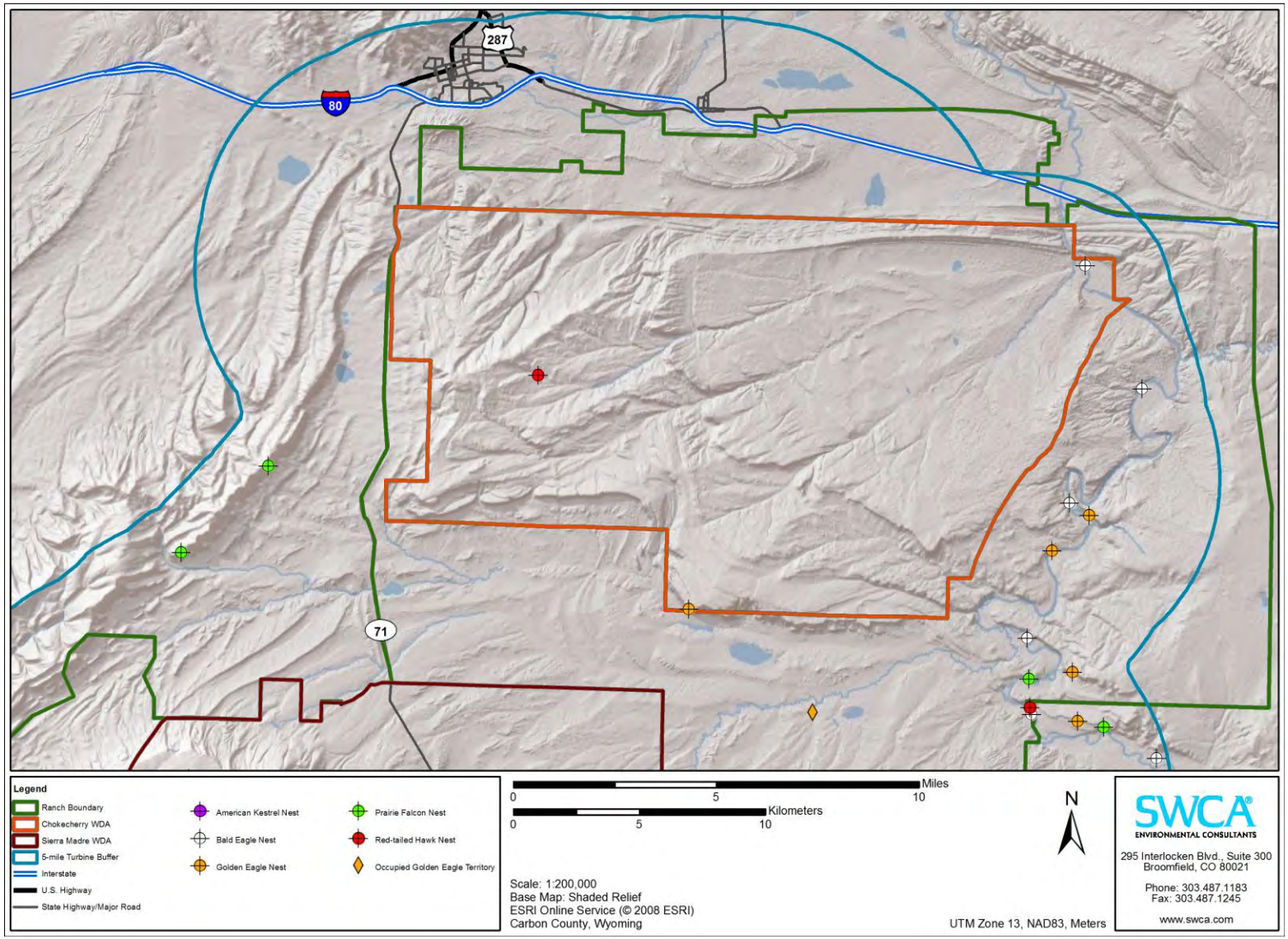

Figure 2. All active nests located in the vicinity of the Chokecherry WDA.

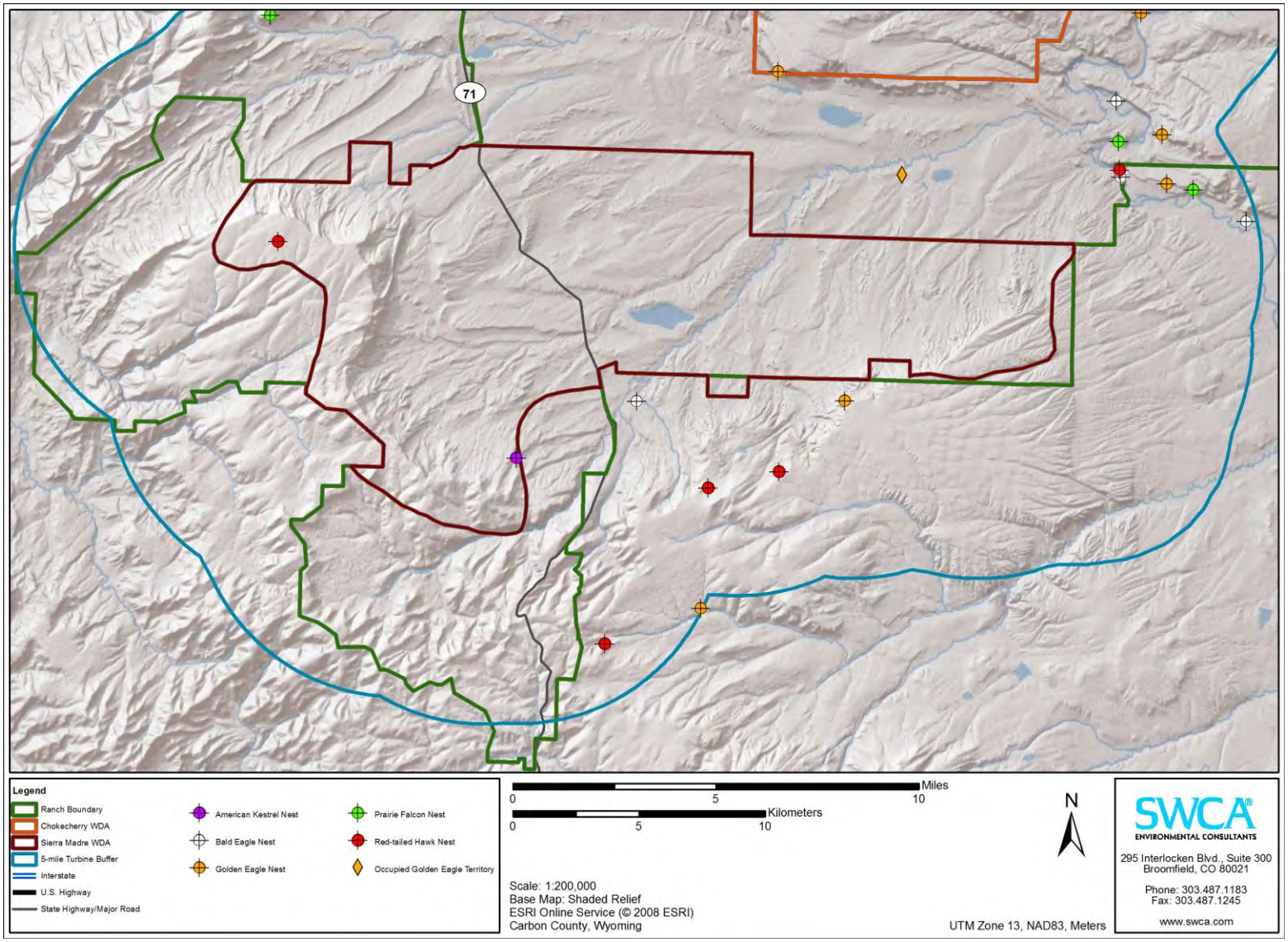

Figure 3. All active nests located in the vicinity of the Sierra Madre WDA.

Table 2. Nest Checks for All Active Bald and Golden Eagle Nests and Most Other Raptor Nests within the Project Site and Associated Buffer.

Species	Substrate	Easting	Northing	1st Check	2nd Check	3rd Check	4th Check
Bald eagle	Cottonwood	341820	4601564	4/24: 2 adults perched on nest	5/30: unable to check due to cattle in area (private land)	7/10: failed	N/A
Bald eagle	Cottonwood	336852	4603315	4/24: incubating	5/30: active; unknown number of nestlings	6/28: 1 nestling	7/24: fledged
Bald eagle	Cottonwood	336682	4606344	4/24: incubating	5/30: active; unknown number of nestlings	6/28: failed	N/A
Bald eagle	Cottonwood	338352	4611712	4/24: incubating	5/22: 1 nestling	6/27: 1 nestling	7/25: about to fledge
Bald eagle	Cottonwood	341240	4616259	4/24: 2 adults perched on nest	5/23: active; unknown number of nestlings	6/27: 1 nestling	7/25: fledged
Bald eagle	Cottonwood	338988	4621149	4/24: 2 adults perched on nest	5/23: active; unknown number of nestlings	6/26: active; unknown number of nestlings	7/23: unknown
Bald eagle	Snag	317657	4594433	4/24: incubating	6/4: active; unknown number of nestlings	7/1: 1 nestling	7/23: about to fledge
Golden eagle	Cliff	338676	4603051	4/25: incubating	5/30: unknown; likely inactive	6/28: failed	N/A
Golden eagle	Cliff	338483	4605000	4/25: incubating	5/30: unknown; likely inactive	6/29: failed	N/A
Golden eagle	Cliff	337660	4609823	4/25: incubating	5/21: active; unknown number of nestlings	6/27: failed	N/A
Golden eagle	Cliff	339131	4611220	4/25: incubating	5/22: unknown	6/27: failed	N/A

Species	Substrate	Easting	Northing	1st Check	2nd Check	3rd Check	4th Check
Golden eagle	Cliff	323263	4607504	4/25: incubating	5/29: active; unknown number of nestlings	6/29: 1 nestling	7/24: fledged
Golden eagle	Cliff	325909	4594456	4/24: incubating	5/29: unknown	7/2: failed	N/A
Golden eagle	Conifer	320199	4586224	4/24: incubating	N/A: private land, unable to check status	N/A	N/A
Golden eagle	Cliff	328174	4603404	3/15: adults observed copulating on nest	5/2: no activity	5/16: no activity	N/A
Red-tailed hawk	Cottonwood	336791	4603594	4/24: incubating	5/30: active; unknown number of nestlings	N/A	N/A
Red-tailed hawk	Cottonwood snag	317278	4616802	5/15: incubating	5/31: incubating	7/3: failed	N/A
Red-tailed hawk	Aspen	323291	4591635	4/24: incubating	5/29: likely active	6/26: unknown	N/A
Red-tailed hawk	Conifer snag	303433	4600759	4/24: incubating	5/28: active; unknown number of nestlings	6/27: likely fledged	N/A
Red-tailed hawk	Aspen	320485	4590999	4/24: incubating	5/29: active; unknown number of nestlings	6/26: likely fledged	N/A

SUMMARY

The 2013 nest surveys showed one active golden eagle nest located on the southern boundary of the Chokecherry WDA within a Turbine No-Build area, and none were located within the Sierra Madre WDA. Six active golden eagle nests were located outside the Project site but within the 5-mile buffer. One occupied golden eagle nesting territory was identified in the Central Basin in a Turbine No-Build area, but nest initiation was never detected. There was one active bald eagle nest within the Chokecherry WDA but well outside the likely turbine development area. No other active bald eagle nests were within the Project site. Six active bald eagle nests were outside the boundaries of the Project site within the 5-mile buffer. One active red-tailed hawk nest was located in the western area of the Chokecherry WDA, and one was located on top of Miller Hill in the Sierra Madre WDA. Most other red-tailed hawk nests were located south of the Sierra Madre WDA and one was located along the North Platte River. Two prairie falcon nests were located along the North Platte River, and two were located along the Atlantic Rim. Multiple follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests and many other raptor nests within the Project site between May 21 and July 26, 2013, and the results of those surveys are summarized in Table 2.

SWCA®
ENVIRONMENTAL CONSULTANTS
Sound Science. Creative Solutions.®

Summary Report for 2014 Nest Surveys

Chokecherry and Sierra Madre Wind Energy Project

Prepared for

Power Company of Wyoming, LLC

Prepared by

SWCA Environmental Consultants

August 2014

Summary Report for 2014 Nest Surveys
Chokecherry and Sierra Madre Wind Energy Project

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August 2014

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INTRODUCTION

This report documents SWCA Environmental Consultants (SWCA) raptor nest survey results for 2014 within the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project) Site and in suitable nesting habitats within a 5-mile buffer (approximately 700 square miles) surrounding the CCSM Project (Figure 1). The selection of a 5-mile turbine buffer was made through consultation with the U.S. Fish and Wildlife Service (USFWS) and the Bureau of Land Management (BLM). The USFWS and BLM concurred that the 5-mile buffer was appropriate because the existing raptor nest database could be used as a basis for where to search for nests, and because terrain features that had high potential for nesting raptors were well known and established. A 5-mile turbine buffer was also deemed acceptable due to the robust avian monitoring efforts that have been underway within the CCSM Project Site since 2010, which also assists in identifying potential nesting raptors. Additionally, BLM regularly conducts raptor nest monitoring in areas that fall outside of the 5-mile turbine buffer.

Two types of survey methods were used to identify nests, determine nest condition and activity, and assess nesting success. Helicopter surveys were used to evaluate all known nests and all potential nesting habitats along cliff bands, on steep slopes, and along the North Platte River corridor. Ground surveys were used to identify nests not readily identified from helicopter surveys and to assess nests that were not identified or observable during the helicopter surveys. All known viable ferruginous hawk (*Buteo regalis*) nests in and immediately adjacent to the CCSM Project Site were visited to assess nesting status. SWCA biologists made multiple nest monitoring visits to all active eagle nests identified during helicopter and ground surveys. Nest monitoring visits are made until fledging is confirmed or until juveniles are no longer present on the nest. All nest survey and monitoring activities were conducted in accordance with the protocols submitted to and accepted by USFWS.

AERIAL SURVEYS

During aerial nest surveys, two biologists and a pilot flew in an Aerospatiale AS355 helicopter on May 1, 13, and 14, 2014. Surveys on May 1 and 13 were completed for the area surrounding the North Platte River corridor, Chokecherry Wind Development Area (WDA), and the Atlantic Rim. Surveys on May 14 were completed for areas in and adjacent to the Sierra Madre WDA. Data collected at each nest site included documentation of substrate and location, nest condition, nest status (e.g., active or inactive, number of adults, eggs, nestlings, etc.), activity, and global positioning system (GPS) location.

Approximately 18 hours were spent flying the CCSM Project Site and 5-mile turbine buffer. Historic nest locations provided by BLM Rawlins Field Office and data collected during 2011, 2012, and 2013 nest surveys were used for guidance in surveying existing and undocumented nest locations. Surveys focused on known and potential nesting habitat for golden eagle (*Aquila chrysaetos*) and bald eagle (*Haliaeetus leucocephalus*), as well as previously documented nest locations for other large *Buteos*, falcons, and accipiters. Habitat types included cliff bands, rock outcrops and promenades, steep slopes, riparian zones and river corridors, and forested areas with large trees capable of supporting nest structures. All inactive nests observed during aerial surveys were recorded.

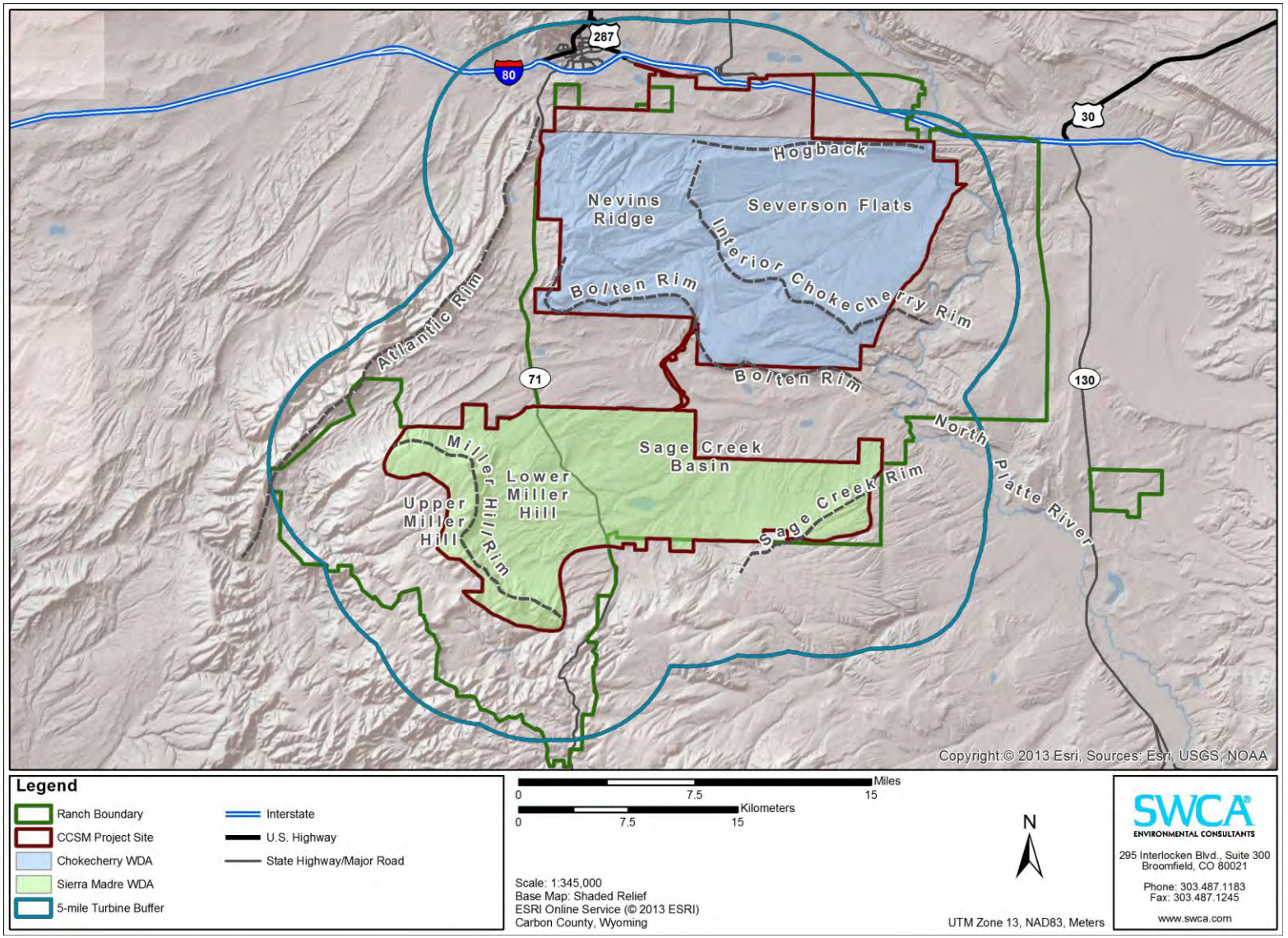

Figure 1. CCSM Project Site, Wind Development Areas, 5-mile turbine buffer, and notable land features.

GROUND SURVEYS

Ground surveys were used to evaluate potential nesting habitat that could not be surveyed or readily observed during aerial flights. Ground surveys focused on treed habitats with known nesting structures that could not be observed during helicopter surveys as well as selected known *Buteo* and accipiter nests in the CCSM Project Site. Ground surveys also included visits to 12 historical ferruginous hawk nest locations on and adjacent to the CCSM Project Site to evaluate current nest condition and activity (Table 1). In 2011, 40 historical ferruginous hawk nests contained in the BLM's nest database and located on or adjacent to the CCSM Project Site were visited. During the 2011 surveys, 28 of the historical nest sites were either not located or determined to be unviable as only a few deteriorated sticks remained. The 12 remaining historical ferruginous hawk nests have been accessed on foot or with trucks and all-terrain vehicles each subsequent year to survey for activity. Data collected during the 2014 ground surveys were identical to the data recorded during previous aerial and ground surveys.

Table 1. Existing Historical Ferruginous Hawk Nests on the CCSM Project Site.

Nest ID	Easting	Northing	Substrate	Condition	BLM Nest Association
59	332949	4623131	Rock outcrop	Fair	Near BLM Nest FH21853201
211	338031	4622605	Rock outcrop	Fair	FH20850302
212	335323	4615247	Rock outcrop	Fair	FH20852802
234	328919	4617385	Rock outcrop	Fair	FH20862302
238	327708	4612200	Rock outcrop	Good	Near BLM Nest FH19860301
239	329290	4604725	Hilltop	Fair	Near BLM Nest FH19863501
241	309124	4608503	Hill slope	Fair	FH19882201
257	329868	4622032	Rock outcrop	Fair	Near BLM Nest FH20860201
258	312604	4620081	Rock outcrop	Good	Near BLM Nest FH20881301
259	318857	4612023	Rock outcrop	Poor	Near BLM Nest FH19871002
260	335189	4615940	Rock outcrop	Fair	Near BLM Nest FH20852901
263	320037	4603851	Hill slope	Fair	Near BLM Nest FH18870202

RESULTS

During 2014 survey efforts, 43 active raptor nests were located within the CCSM Project Site and associated 5-mile buffer (Figures 2 and 3). The species composition of the active raptor nests was as follows: 17 golden eagle, 12 red-tailed hawk (*Buteo jamaicensis*), 7 bald eagle, 4 prairie falcon (*Falco mexicanus*), 2 Swainson's hawk (*Buteo swainsoni*), and 1 unidentified *Buteo* nest that was likely a red-tailed hawk. Eighteen active non-raptor nests were also located during the flights and included 12 common raven (*Corvus corax*), 5 great horned owl (*Bubo virginianus*), and 1 Canada goose (*Branta canadensis*). No evidence of ferruginous hawk nesting or nest maintenance was found at any of the 12 nest locations surveyed in 2014 (Table 1).

Nesting patterns in 2014 were consistent with results from 2011, 2012, and 2013 surveys. As observed during previous raptor nest surveys, the highest density of nesting raptors in the 5-mile buffer surrounding the CCSM Project Site was along the North Platte River. Of the 43 active raptor nests identified during 2014 surveys, 16 (37%) were located along the North Platte River corridor. The 16 nests were comprised of 6 bald eagle nests (86% of all active bald eagle nests in the survey area), 6 golden eagle nests (35% of all active golden eagle nests in the survey area), 3 red-tailed hawk nests, and 1 prairie falcon nest. The nests along the North Platte River fall within an identified turbine no-build area and are more than 17 kilometers (11 miles) from the nearest Phase I turbine location.

Six of the 43 raptor nests identified during 2014 surveys were located on the Bolten Rim, which roughly corresponds to the southern boundary of the Chokecherry WDA, and one was located on a rock outcrop just north of the Bolten Rim. All 7 nests were located within identified turbine no-build areas or other associated setbacks from the Bolten Rim that were established in redesigning the CCSM Project to avoid and minimize risks to eagles and other avian species. Six of the 7 nests along the Bolten Rim were occupied by golden eagles with the remaining nest occupied by a prairie falcon. Of the 6 active golden eagle nests, 2 are on the eastern half of the Bolten Rim and are 8.5 and 12.9 kilometers (5.3 and 8.7 miles) from the nearest Phase I turbine location. The remaining 4 golden eagle nests are on the western half of the Bolten Rim and were specifically addressed in redesigning the Phase I Wind Turbine Development to avoid and minimize risks to eagles and other avian species (Figures 2 and 3). Of these 4 nests, the 2 westernmost golden eagle nests are located more than 3.4 kilometers (2 miles) from the nearest Phase I turbine location. The other two golden eagle nests are located between 2 and 3 kilometers (1.2 and 1.8 miles) from the nearest Phase I turbine location.

One active golden eagle nest was located on a small cliff in the Sage Creek Basin between the Chokecherry and Sierra Madre WDAs, approximately 1.2 kilometers (0.8 mile) west of Sage Creek Reservoir. This nest is located in a Turbine No-Build Area established in the Sage Creek Basin and is 14.7 kilometers (9.1 miles) from the nearest Phase I turbine location. This nest was occupied by golden eagles in 2013 and 2014, but failed early into the nesting season both years. This year the majority of the nest collapsed off the cliff and is no longer viable in its current form. This nest location falls within the Turbine No-Build Area that encompasses much of the Sage Creek Basin between the Chokecherry and Sierra Madre WDAs

Two active golden eagle nests were located along the Atlantic Rim west of the Chokecherry and Sierra Madre WDAs. The northernmost nest on Atlantic Rim is approximately 8.7 kilometers (5.41 miles) north of the nearest Phase I turbine location in the Sierra Madre WDA, and is located completely outside of the CCSM Project Site. The southernmost nest on Atlantic Rim is 6.8 kilometers (4.2 miles) west of the nearest Phase I turbine location in the Sierra Madre WDA, and is located completely outside of the CCSM Project Site.

With respect to the Sierra Madre WDA, no active eagle nests were located within the WDA. One active golden eagle nest was located approximately 0.8 kilometer (0.5 mile) south of the southern boundary of the WDA in the area of Sage Creek Rim and is 11.4 kilometers (7.1 miles) from the nearest Phase I turbine location. One additional active golden eagle nest was located 8.4 milometers (5.2 miles) south of the southern boundary of the WDA, just inside the boundary of the survey buffer and 7.9 kilometers (4.9 miles) southeast of the nearest Phase I turbine location. One active bald eagle nest was located approximately 0.6 kilometers (0.4 miles) south of the WDA in a snag at the base of Sage Creek Rim (the same location as observed in 2011, 2012 and 2013). This nest is approximately 3.9 kilometers (2.4 miles) from the nearest Phase I turbine location, and is located immediately south of a Turbine No-Build Area surrounding Rasmussen Reservoir that was created to protect foraging and use areas associated with this nest.

Follow-up ground surveys were completed to document nest activity and fledging success for all eagle nests in the CCSM Project Site and associated 5-mile buffer between May 22 and July 21 (Table 2). During this time, flight path mapping surveys were also initiated at 7 golden eagle nests located along the Bolten Rim, Interior Chokecherry Rim, and Sage Creek Rim in order to determine how eagles from those nests were using the surrounding habitat, and whether they were utilizing the Phase I Wind Turbine Development Site for their activities. These specific nests were selected due to their proximity to the Chokecherry and Sierra Madre WDAs, and results and analysis from these surveys may be found in Appendix A. Flight path mapping documented that patterns of use surrounding these 7 nests was consistent with observations made in previous years. The majority of use occurred south of the Bolten Rim over the Sage Creek Basin in a designated Turbine No-Build Area. The limited time spent north of the Bolten Rim occurred in designated Turbine No-Build Areas and associated setback and did not occur within the Phase I Wind Turbine Development Site.

Of the 17 active golden eagle nests documented during 2014 nest surveys, 7 were determined to have failed and 6 were determined to have fledged by the end of July. The statuses of the remaining nests were unable to be determined because of private land access issues or lack of evidence of fledging or failure. With regards to the 7 active bald eagle nests, 1 was confirmed to have failed, and 6 were determined to have fledged by the end of July 2014.

In addition to the 43 active raptor nests, 241 inactive and historic nests were surveyed and assessed during the helicopter nest flights and other nest searching activities. These nests were located across the CCSM Project Site and associated buffer; however, the highest concentrations were located along the Bolten Rim, the North Platte River corridor, and along the Atlantic Rim. While all nests observed during the helicopter nest flights were documented, it is possible that nests of certain species (e.g., American kestrel, prairie falcon, common raven, etc.) were not located due to the nature of aerial surveys, and because of the way their

nests are structured (i.e., oftentimes built in cavities or tight crevasses along cliff bands). All of the inactive nests observed were large in size and were considered potential raptor nests; however, as these nests were inactive, it is not possible to know exactly which species built and/or used the nest in the past.

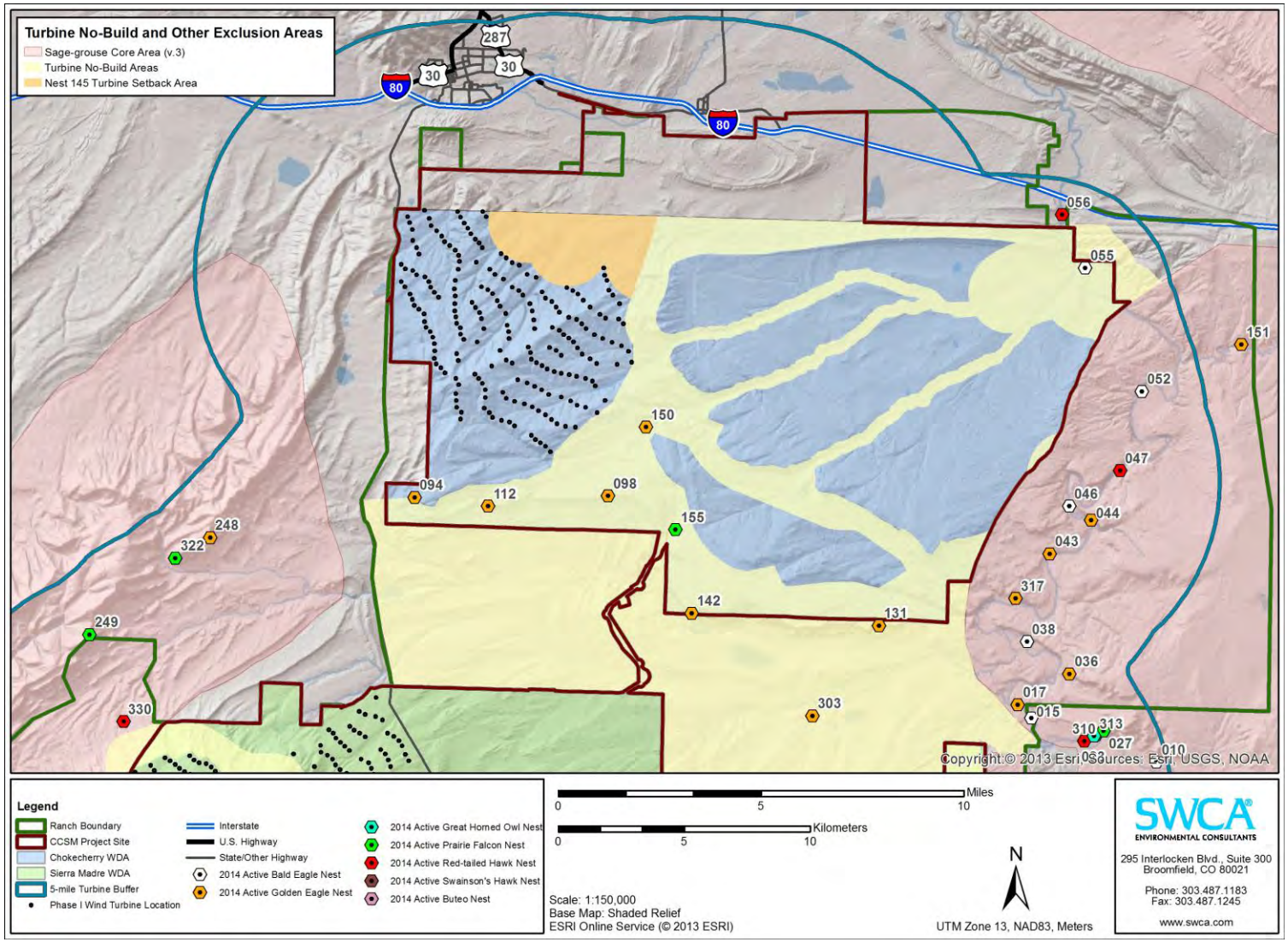

Figure 2. All active nests, Turbine No-Build Areas, and other avoidance and minimization areas located in the vicinity of the Chokecherry WDA.

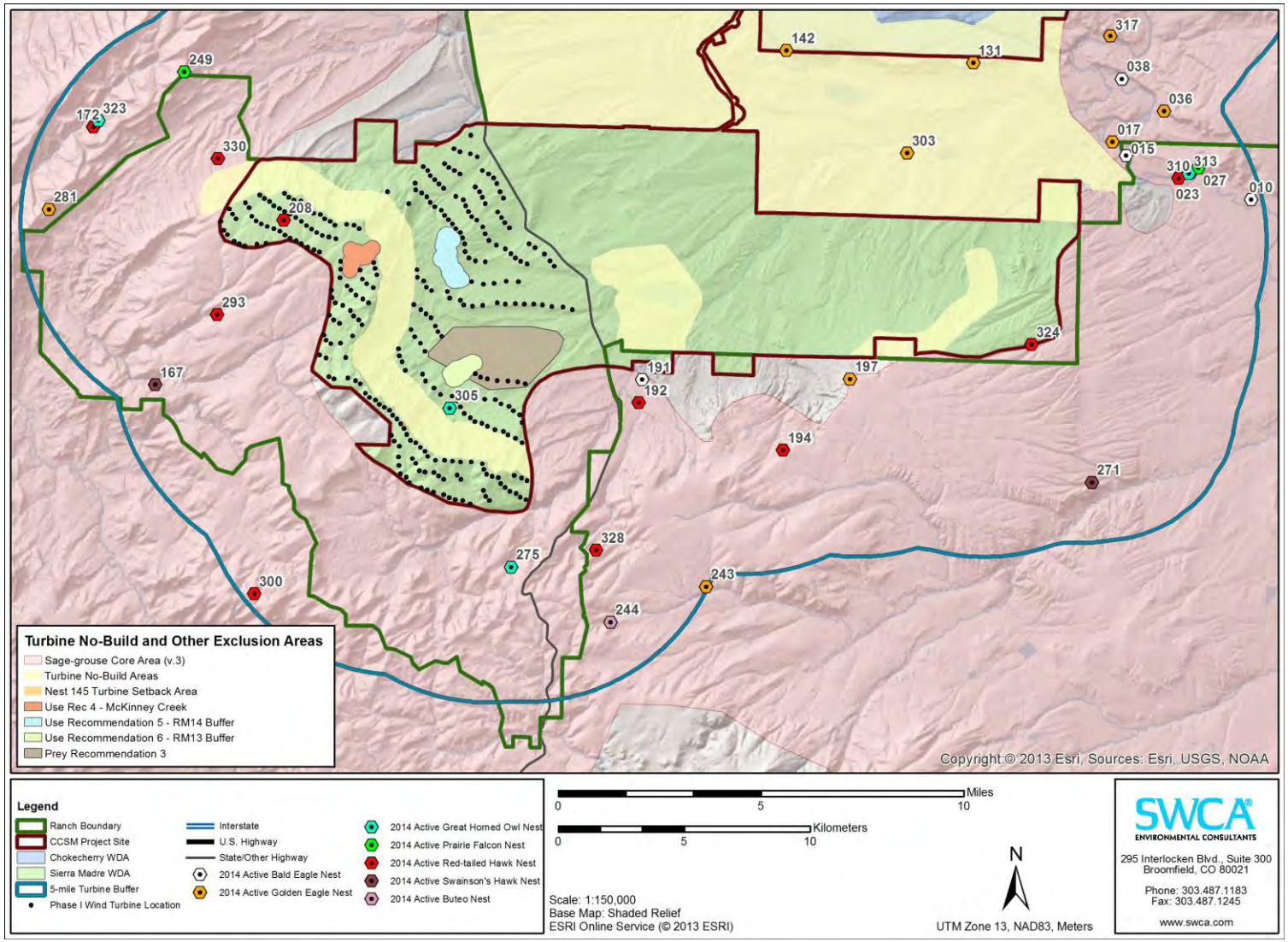

Figure 3. All active nests, Turbine No-Build Areas, and other avoidance and minimization areas located in the vicinity of the Sierra Madre WDA.

Table 2. Nest Status Assessments for All Active Bald and Golden Eagle Nests within the CCSM Project Site and Associated Buffer.

Species	Nest ID	Substrate	Easting	Northing	Status at Flight	1st Check	2nd Check	3rd Check
Bald eagle	010	Cottonwood	341820	4601564	5/1: incubating	not checked	7/2: 1 adult perched on nest	7/20: fledged
Bald eagle	015	Cottonwood	336852	4603315	5/1: incubating	6/12: brooding	7/1: 2 adults perched on nest	7/24: 1 nestling fledged
Bald eagle	038	Cottonwood	336682	4606344	5/1: incubating	6/13: no activity detected	7/1: 1 nestling	7/20: 1 nestling fledged
Bald eagle	046	Cottonwood	338352	4611712	5/13: incubating	6/10: 1 nestling	6/30: 1 nestling	7/18: 1 nestling fledged
Bald eagle	052	Cottonwood	341240	4616259	5/13: 2 adults perched on nest	6/10: 1 adult perched on nest	6/30: 2 nestlings	7/18: 1 nestling fledged
Bald eagle	055	Cottonwood	338988	4621149	5/13: eggs in nest, adult perched nearby	6/10: no activity detected	6/30: no activity detected	7/23: failed
Bald eagle	191	Snag	317657	4594433	5/14: incubating	6/26: 1 nestling	7/3: 1 nestling	7/21: 1 nestling fledged
Golden eagle	017	Cliff	336319	4603846	5/13: incubating	6/12: no activity detected	7/1: no activity detected	7/20: failed
Golden eagle	036	Cliff	338361	4605066	5/13: 2 nestlings	6/13: no activity detected	7/2: 1 adult perched on nest	7/18: 1 nestling fledged
Golden eagle	043	Cliff	337586	4609820	5/13: 1-2 nestlings	6/10: 1 adult perched on nest	6/30: 2 eagles of perched on nest, unknown age	7/18: status unknown
Golden eagle	044	Cliff	339223	4611152	5/13: 1 nestling	6/10: no activity detected	6/30: 1 nestling	7/18: 1 nestling fledged
Golden eagle	094	Cliff	312378	4612056	5/1: incubating	6/11: 1 adult flying nearby	6/23: no activity detected	7/17: failed
Golden eagle	098	Cliff	320060	4612115	5/1: incubating	6/5: 1 adult flying nearby	7/15: no activity detected	7/17: failed
Golden eagle	112	Cliff	315305	4611707	5/1: incubating	6/4: 1 adult flying nearby	6/23: 1 adult flying nearby	7/16: fledged

Species	Nest ID	Substrate	Easting	Northing	Status at Flight	1st Check	2nd Check	3rd Check
Golden eagle	131	Cliff	330801	4606975	5/1: incubating	6/20: 1 adult sitting on nest	7/1: 1 nestling	7/15: 1 nestling fledged
Golden Eagle	142	Cliff	323377	4607473	5/1: incubating	6/3: 1 adult flying nearby	6/25: 1 adult flying nearby	7/15: unknown fledging status
Golden Eagle	150	Cliff	321562	4614839	5/1: incubating	5/28: no activity detected	6/11: failed	N/A
Golden Eagle	151	Rock Outcrop	345183	4618108	5/13: incubating	not checked	7/2: 1 nestling	7/18: 1 nestling fledged
Golden Eagle	197	Cliff	325910	4594457	5/14: incubating	6/2: no activity detected	6/24: 1 adult flying nearby	7/14: failed
Golden Eagle	303	Cliff	328174	4603405	4/18: incubating	4/30: failed, nest collapsed from cliff	N/A	N/A
Golden Eagle	317	Cliff	336235	4608056	5/13: 1-2 nestlings	not checked	6/30: 1 nestling	7/18: 1 nestling fledged
Golden Eagle	248	Cliff	304266	4610464	5/13: incubating	6/26: 1 nestling	7/3: 1 nestling	7/21: 1 nestling fledged
Golden Eagle	281	Cliff	294128	4601180	5/14: incubating	6/25: 1 adult perched on nest	7/3: failed	N/A
Golden Eagle	243	Conifer	294128	4601180	5/14: incubating	NA – Private land	NA – Private land	NA – Private land

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Appendix A: Results of Flight Path Monitoring Surrounding Select Active Golden Eagle Nests

INTRODUCTION

During May, June and July of 2013 and 2014, SWCA Environmental Consultants (SWCA) conducted flight path mapping surveys for the Chokecherry and Sierra Madre Wind Energy Project (CCSM Project) Site at select active golden eagle nest locations. The active nests surveyed were located along the Bolten Rim and Sage Creek Rim, which generally follow the southern boundaries of the Chokecherry and Sierra Madre Wind Development Areas (WDAs), respectively. In 2013, 2 active golden eagle nests (nests 143 and 197) were located along these rims, and in 2014, 7 nests (nests 094, 098, 112, 131, 142, 150, and 197) were located along these rims. All of the active golden eagle nests surveyed were between 2 and 14 kilometers (1.2 and 8.7 miles) of Phase I turbine locations.

FLIGHT PATH SURVEYS

For flight path surveys, biologists selected survey locations on top of the Bolten and Sage Creek rims with views of the nests and surrounding landscape. Surveys locations were sites at least 400 meters from nest locations to reduce the likelihood of disturbing nesting activities. Surveys were generally conducted once per week for 2 to 4 hours at each nest, and survey start times were rotated each week to provide coverage of all daylight hours at each nest location. During surveys, biologists would scan the landscape around them with the assistance of binoculars to detect any golden eagles utilizing the airspace around the active nest locations. Once an eagle was detected, biologists would track the eagle and record its flight path to capture its use of the surrounding topographic features and habitat. Golden eagle flight paths were mapped out to approximately 4,000 meters from the observer, and data collected during these surveys focused primarily on accurate recording of golden eagle flight paths and identification of the active nest the flight path was associated with. Flight paths were georeferenced and digitized for analysis purposes.

In 2013, approximately 30 hours were spent mapping flight paths at the 2 active golden eagle nests located on the Bolten and Sage Creek Rims and in 2014, approximately 160 hours were spent mapping flight paths at the 7 active golden eagle nests located on the Bolten and Sage Creek Rims. Survey effort varied between the two years primarily due to changes in the number of active golden eagle nests.

RESULTS

Flight path patterns observed in 2013 and 2014 were consistent with observations made during raptor surveys conducted for the CCSM Project from 2011 through 2013. As was observed during past raptor surveys, the majority of all eagle flight paths mapped during 2013 and 2014 occurred along and south of the Bolten Rim and north of the Sage Creek Rim in the Sage Creek Basin located between these two topographic features (Figure A.1). Almost no flight paths were recorded north of the Bolten Rim and south of the Sage Creek Rim. The few flight paths that occurred north of the Bolten Rim were located within Turbine No-Build Areas and other areas specifically addressed in redesigning the Phase I Wind Turbine Development to avoid and minimize risks to eagles and other avian species. Several nests (nest numbers 094, 098, 150, and 197) failed early in the flight path survey effort; therefore, few or no flight paths were recorded for these nests.

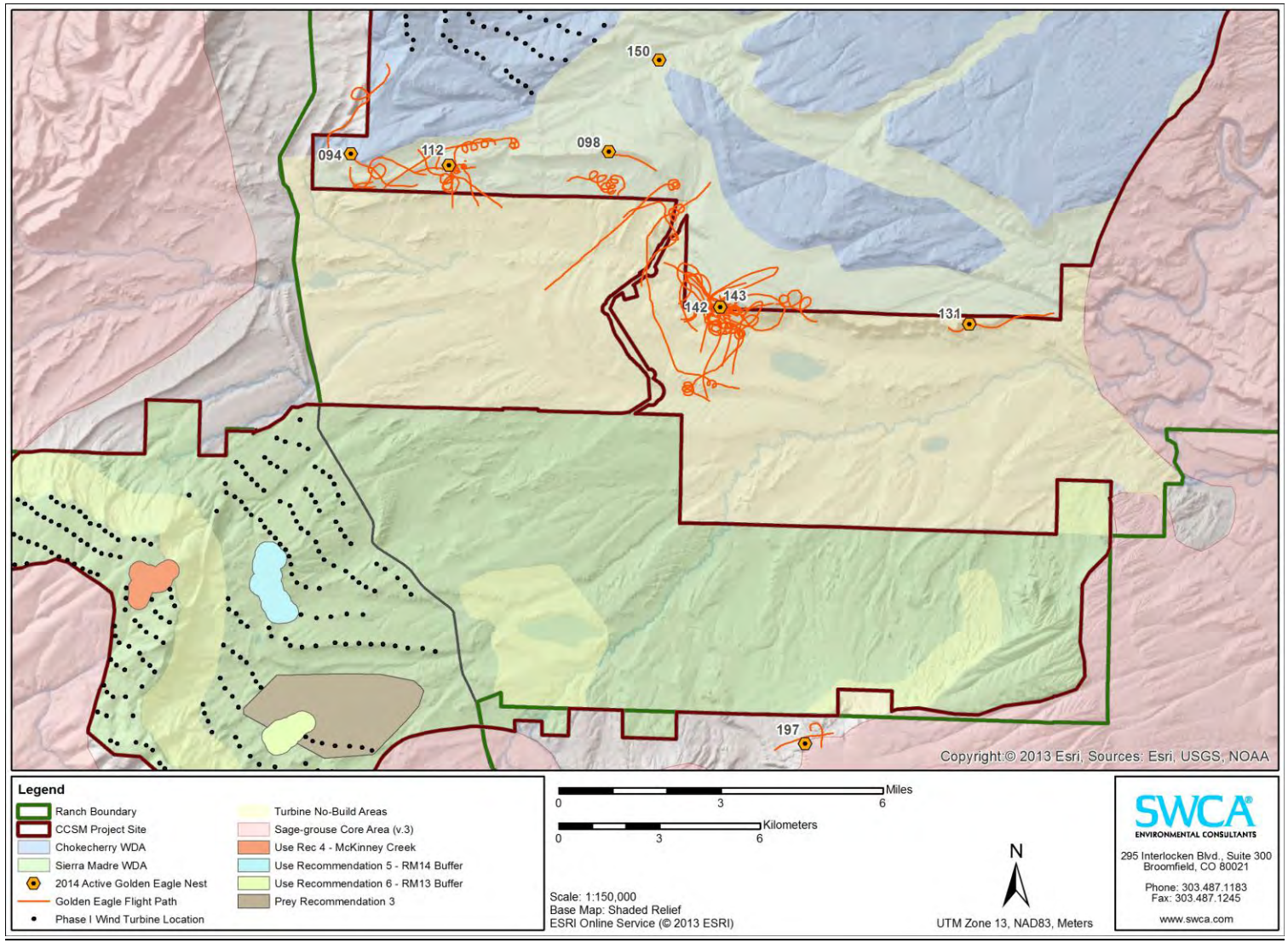

Figure A.1. Golden eagle nests and flight paths, Turbine No-Build Areas, and other avoidance and minimization areas located in the CCSM Project Site

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APPENDIX G

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MERLIN™ Avian Radar Survey for the Power Company of Wyoming

Graphical Data Report for March – November, 2011

Prepared for:

Power Company of Wyoming, LLC
555 Seventeenth St, Suite 2400
Denver, Colorado 80202
USA

Prepared by:

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April 6, 2012

DeTect

Notice

This graphical data report was prepared by DeTect, Inc. (DeTect) in the course of performing work for the Power Company of Wyoming, LLC (PCW) under DeTect's contract with PCW. The data and information developed as a result of this study and presented herein are the property of the client and are not to be disclosed to third parties without the express written consent of PCW.

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MERLIN™ Avian Radar Survey
Graphical Data Report for 2011

1 INTRODUCTION

This report presents radar data collected at a PCW's proposed wind energy site during three seasons: Spring 2011 (April 1 – June 30, 2011), Summer 2011 (July 1 – August 15, 2011), and Fall 2011 (August 16 – November 16, 2011), as well as five sites: Site 5 (March 16 – April 23, 2011), Site 2 (April 28 – June 27, 2011), Site 3 (July 1 – August 22, 2011), Site 1 (August 26 – September 20, 2011), and Site 4 (September 24 – November 16, 2011). As can be noted by the date ranges of radar data collected at each site, Spring 2011 includes data from Sites 2 and 5, Summer 2011 includes data from Site 3, and Fall 2011 includes data from Sites 1 and 4.

2 METHODS

2.1 Radar Equipment and Data Collection

2.1.1 MERLIN Avian Radar System

Two MERLIN Avian Radar Systems were used for this radar survey. The first was an XS10200 which ran from March 13 – April 26, 2011. This system used dual marine radar sensors: a 10-kW power, magnetron, X-band frequency (3 cm wavelength), vertical-scanning radar (VSR) sensor, and a 200-W power, solid state, S-band (10 cm wavelength), horizontal surveillance radar (HSR) sensor. The solid state sensor uses a solid state transmitter instead of a magnetron which allows for a more focused transmission and requires less voltage. The second system was another XS10200 unit but with Doppler in the HSR sensor. This system ran from April 27 – May 11, 2011 after which the 10kw X-band sensor was replaced with a 25kw sensor.

The HSR coverage had a radius of 3.0 nautical miles (nm) March 16 – April 23, 2011 and 4.0 nm April 29 – November 16, 2011. The HSR data provided directional information on targets. The VSR coverage had a radius of 2.0 nm and provided both count and altitudinal information on targets (Figure 2.1).

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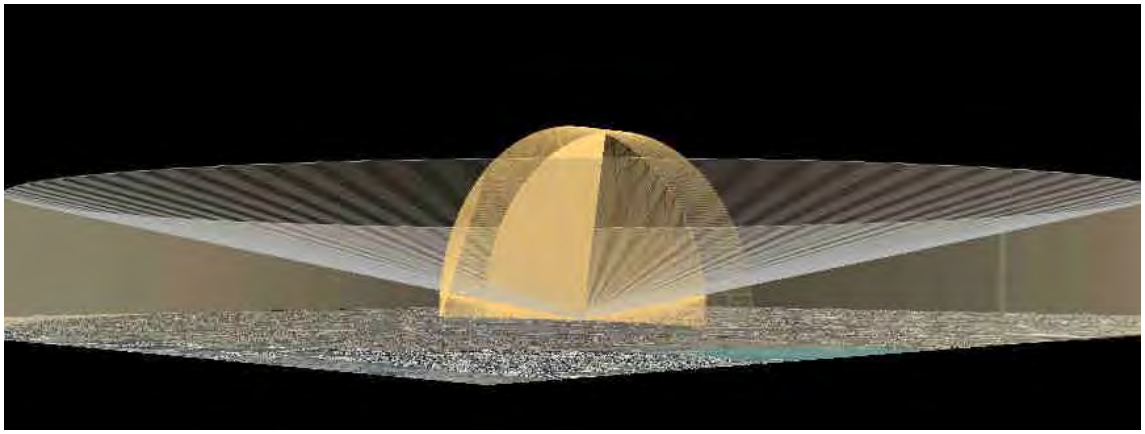

Figure 2-1. Illustration of beam coverage of the horizontal surveillance radar (HSR) and the vertical scanning radar (VSR).

2.1.2 MERLIN Avian Radar Processing Software

The detection and tracking algorithms in the MERLIN software locate plot sequences of biological targets in the raw radar data that fit together into a linear sequence over time as the radar scans (each radar scan updates approximately every 2.5 seconds). When a target meeting the criteria of a bird-like target is tracked for a minimum of three sequential scans or plots, it is identified as a bird target by the radar system, enumerated, and recorded to the system database. A target continues to track as long as it is detected three out of the last four scans or plots. Although the criteria for identifying bird targets has been developed to only track targets that are most likely birds, these are not separable from bats, and targets such as insects or clutter will occasionally be falsely identified and tracked as bird targets. However, the inclusion of non-bird / bat targets was minimized through optimization of the operational settings in the software, visual ground-truthing, and application of custom database queries.

The Merlin Avian Radar System uses modern, marine-grade radar signal processing technology to collect, process, and store 12-bit digitized radar data from both the VSR and HSR. Target data from both radars is processed in real-time by the MERLIN software at the radar with all data and system parameters recorded to compact, internal system databases for target and track processing, analysis, and reporting.

It must be noted that an individual radar echo does not necessarily represent an individual bird or bat, as individuals moving in and out of the radar beam (e.g. circling) would be “counted” by the radar system multiple times. Similarly, a target that is tracked but drops out of the radar line-of-sight (e.g. drops below a tree or brush line) is recorded as a “new” target once it “reappears” and is tracked again (within the MERLIN system, each target is assigned a unique, 64-digit, identification number which facilitates analysis of extended surveys). Therefore, an individual radar echo is referred to as a biological “target” in this

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study, and when counted together they represent an index of bird / bat activity or exposure level for any given period of time, and not necessarily a count of individuals.

2.2 Data Analysis

2.2.1 Radar Data

Data was processed using standard and custom database queries developed by DeTect on a SQL server data network in DeTect's Radar Lab located in Panama City, Florida. In order to filter out false tracks in both the horizontal and vertical data (insects, ground clutter, interference, etc.), targets that were only plotted once after they were defined as a target (leaving only one entry in the database) were eliminated from the database. Masks were also applied to areas that exhibited false tracking as indicated by PCW and/or SWCA.

HSR and VSR data were reviewed by PCW and/or SWCA Environmental Consultants staff. Rain and insect events were noted and excluded from both the VSR and HSR data. Database analysis of the filtered radar data was conducted in DeTect's Data Lab in Panama City, Florida. The Data Lab uses Microsoft Windows® based computer systems, networks, and SQL (structured query language) servers for database processing and analysis.

2.2.2 Vertical Radar Data - Target Counts and Altitudes

As targets passed along or through the VSR beam, the altitude of the target was recorded with each scan of the radar. 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. For the purposes of this graphical analysis a rotor swept zone of 0-154.2 m (0-500 ft) AGL was considered.

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 analyses. 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, 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 each season, or time period at each site. 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.

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2.2.3 Horizontal Radar Data - Target Directions

The horizontal radar data collected was used to develop information on the movement of targets throughout the project area. As targets were detected on the HSR, their bearings were recorded on each scan of the radar. The average bearing of each target was then generated from all the scans as the target passed through the HSR beam.

The horizontal radar data were queried and the average target directions were generated for each dawn, day, dusk, and night. The overall distribution was also plotted for all dawns, days, dusks, and nights in each season by developing a frequency table of target numbers occurring in 45° increments: eight groups centered on north, northeast, east, southeast, south, southwest, west, and northwest. This provided a directional assessment of the target movements throughout the survey area.

Calculations of mean direction and angular concentration (r) for these time periods were calculated using SQL and formulas based on Zar 1999. The value of r is a measure of concentration; it has no units and varies from 0 (no concentration, all values very dispersed) to 1.0 (all data concentrated in the same direction), whereas $1-r$ is a measure of angular dispersion (Zar 1999).

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3 RESULTS for the Spring 2011 Season

3.1 Level of Effort

The MERLIN Avian Radar System operated at Sites 2 and 5 during the Spring 2011 season (April 1 – June 30, 2011).

Table 3-1. Effort of radar monitoring during the spring 2011 season.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	2184	1967.8	216.2	713.6	1254.2
Horizontal Radar (hrs)	2184	1958.9	225.1	90.5	1868.4

3.2 Vertical Radar Data

3.2.1 Target Passage Rates Over Time

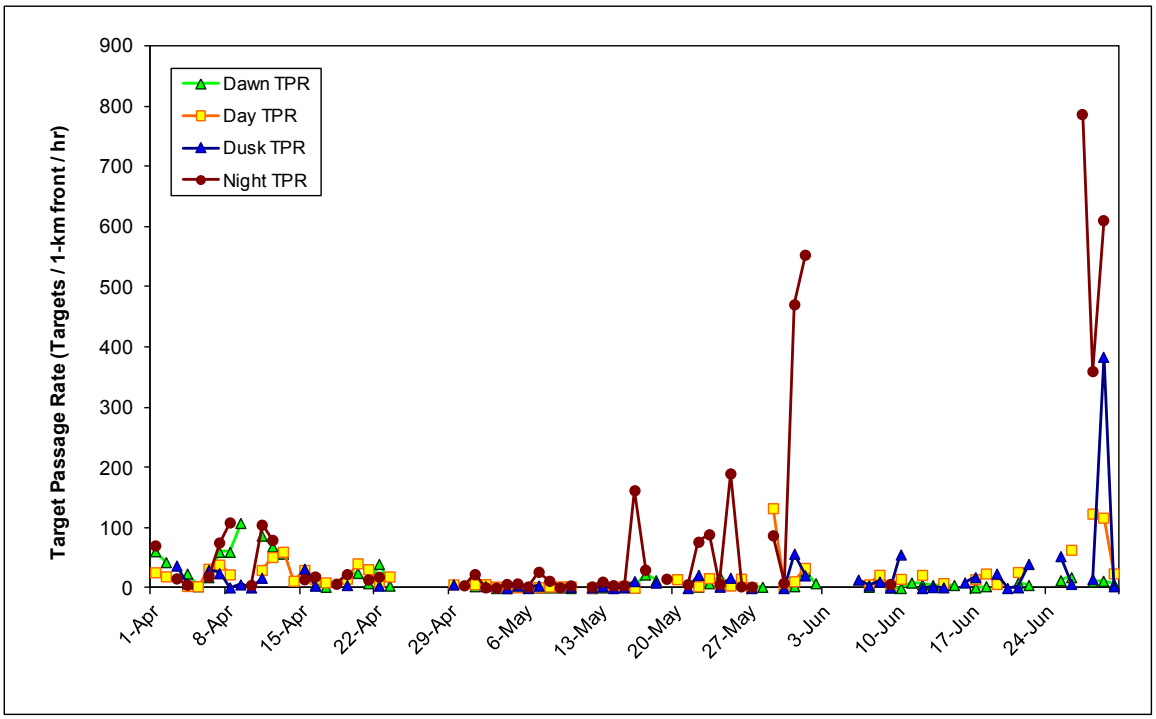

Figure 3-1. Target passage rates during dawns, days, dusks, and nights of the spring 2011 season.

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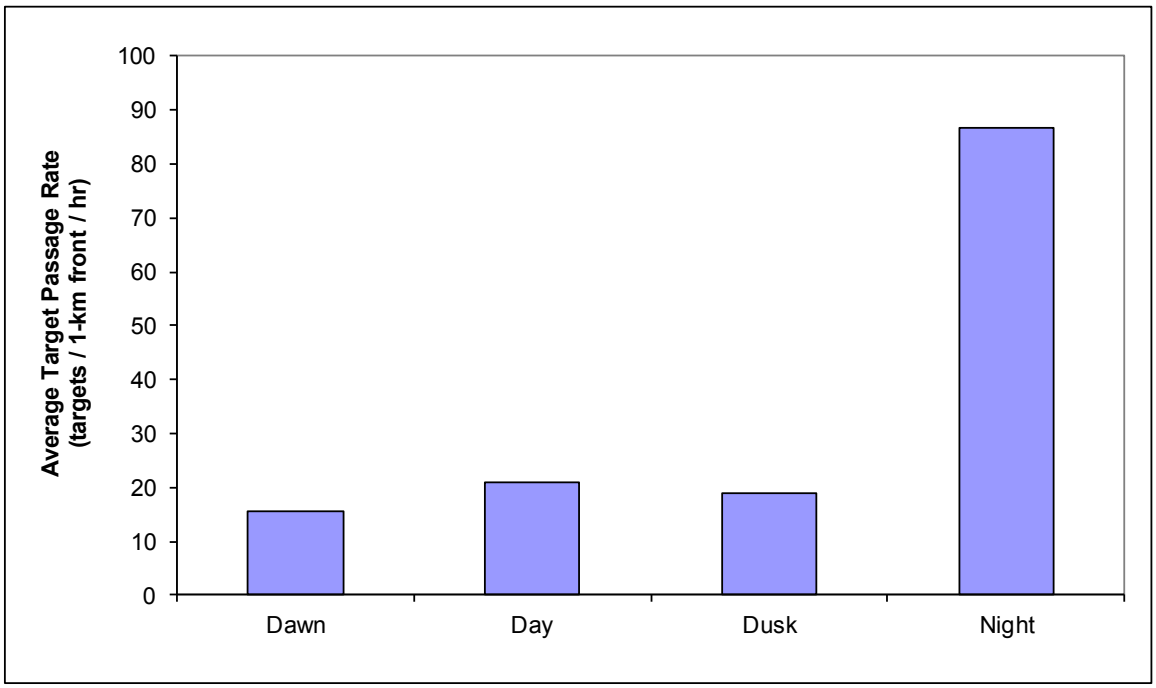

Figure 3-2. Average target passage rates for dawns, days, dusks, and nights of the spring 2011 season.

Table 3-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods during the spring 2011 season.

	Dawn	Day	Dusk	Night
Average	15.6	20.8	18.8	86.7
Standard Deviation	22.7	28.3	53.8	173.8
Median	5.5	12.0	4.6	15.0
Minimum	0.0	0.4	0.0	0.6
Maximum	108.0	132.6	384.0	787.0
Range	108.0	132.3	384.0	786.4

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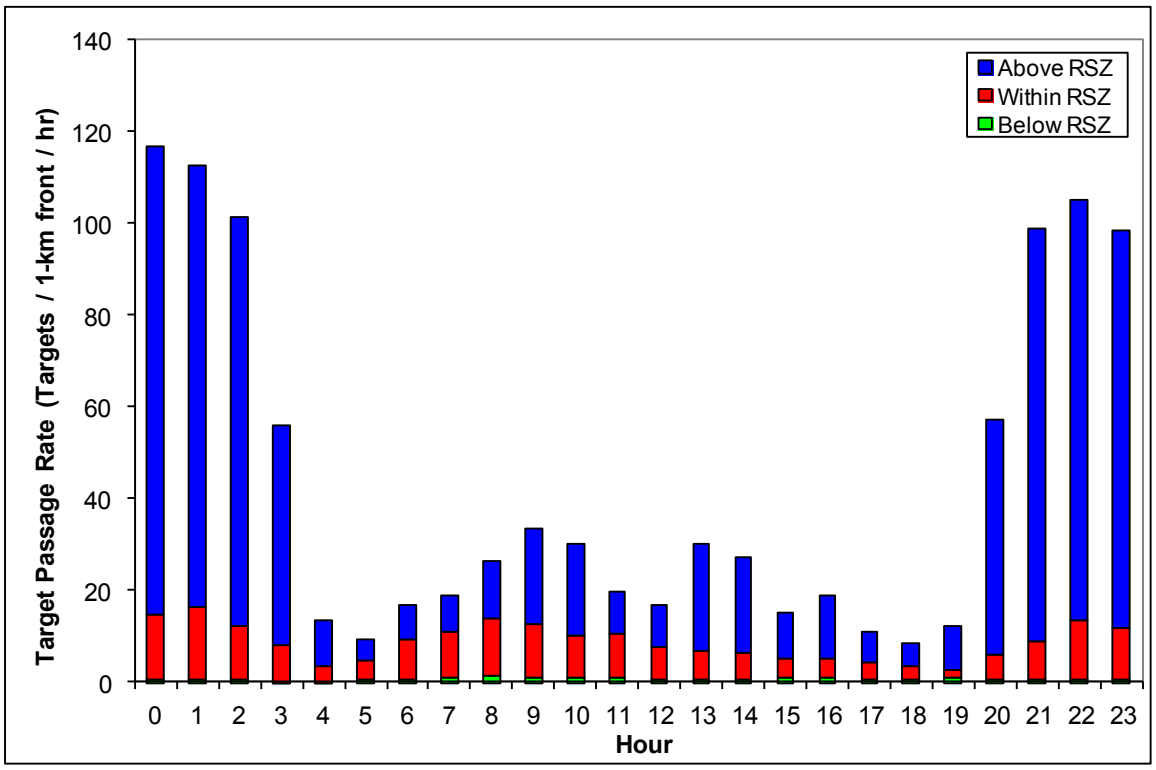

Figure 3-3. Hourly activity (average target passage rates) during the spring 2011 season.

3.2.2 Altitudinal Distribution of Targets

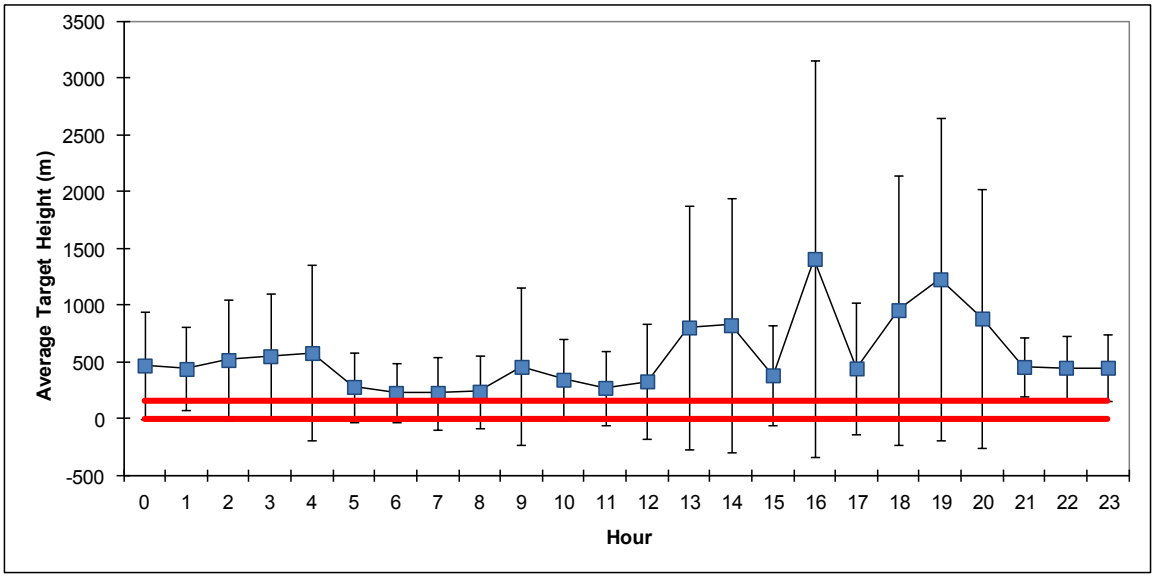

Figure 3-4. Average hourly target heights AGL during the spring 2011 season. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

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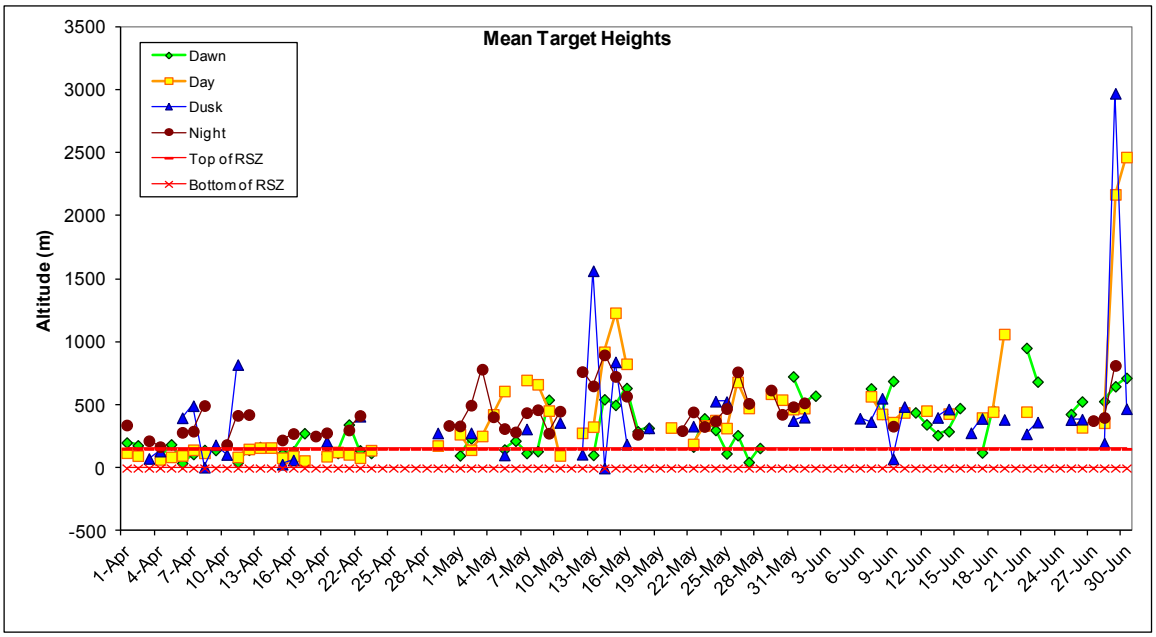

Figure 3-5. Mean target heights during four biological periods of the spring 2011 season.

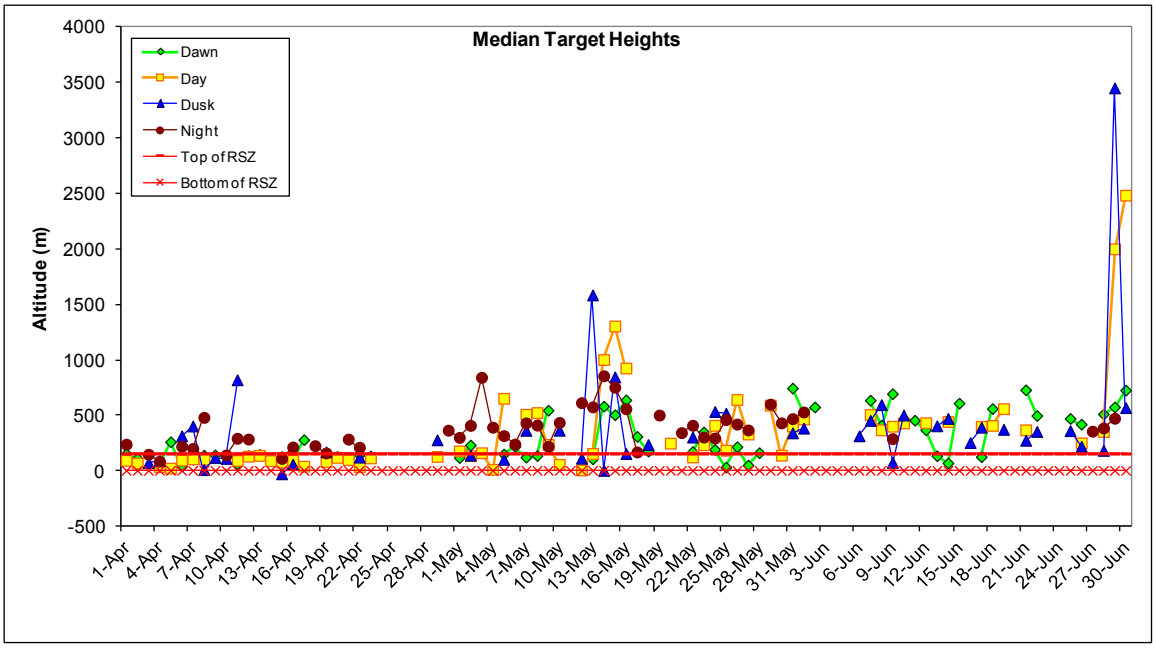

Figure 3-6. Median target heights during four biological periods of the spring 2011 season.

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Table 3-3. Summary of mean and median target heights during four biological periods of the spring 2011 season. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	315.3	417.8	416.6	432.2
Average median target height	290.9	349.9	401.0	368.2
All targets for season combined				
Mean target height	222.5	539.9	1392.3	484.5
Median target height	135.3	251.2	555.3	415.4

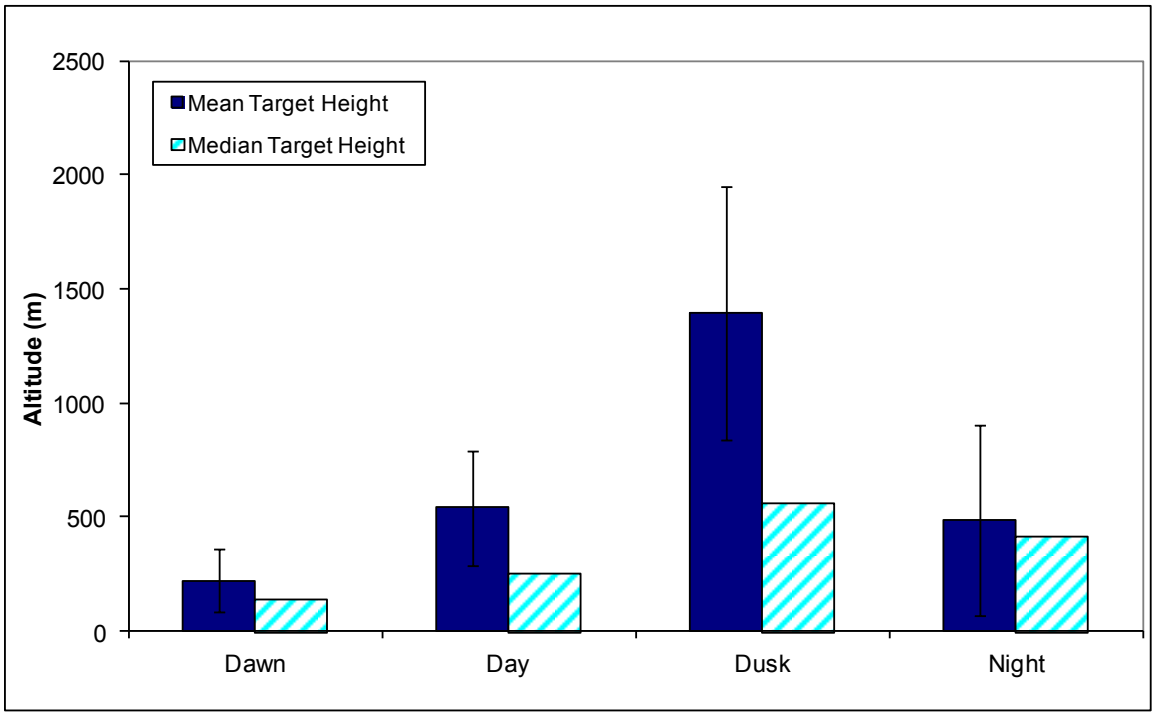

Figure 3-7. Overall mean and median target heights when all targets in each of the four biological periods were combined during the spring 2011 season. Error bars represent one standard deviation.

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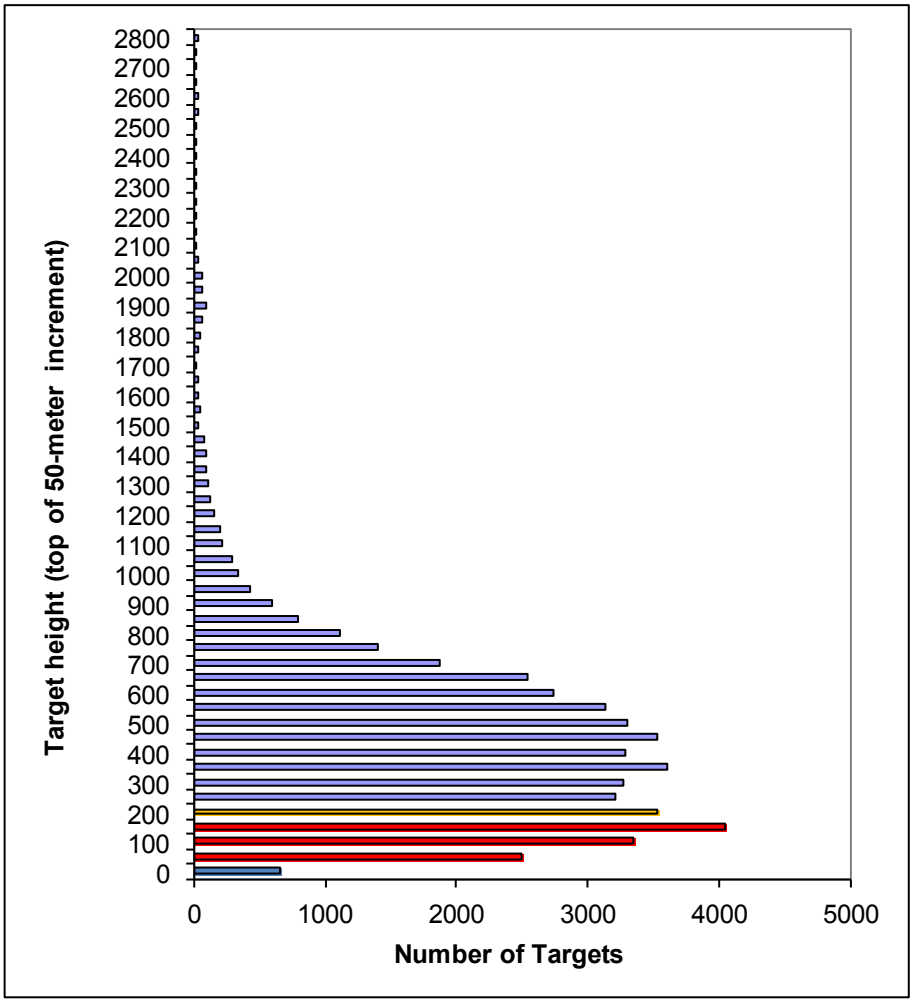

Figure 3-8. Number of targets occurring in each 50-meter increment during the spring 2011 season. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 3-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods of the spring 2011 season.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	42.0%	60.7%	85.7%	86.7%
% targets within RSZ	53.9%	35.4%	11.0%	12.7%
% targets below RSZ	4.1%	3.9%	3.2%	0.6%
% targets below turbine height	58.0%	39.3%	14.3%	13.3%
Target data calculated for each date				
Average % of targets in RSZ	41.1%	40.0%	26.6%	22.9%
Min target percentage within RSZ	0.0%	0.0%	0.0%	1.1%
Max target percentage within RSZ	100.0%	86.6%	100.0%	50.0%
Average target passage rate above RSZ	6.6	12.6	15.9	75.5
Average target passage rate within RSZ	8.4	7.5	2.3	10.7
Average target passage rate below RSZ	0.6	0.8	0.6	0.5

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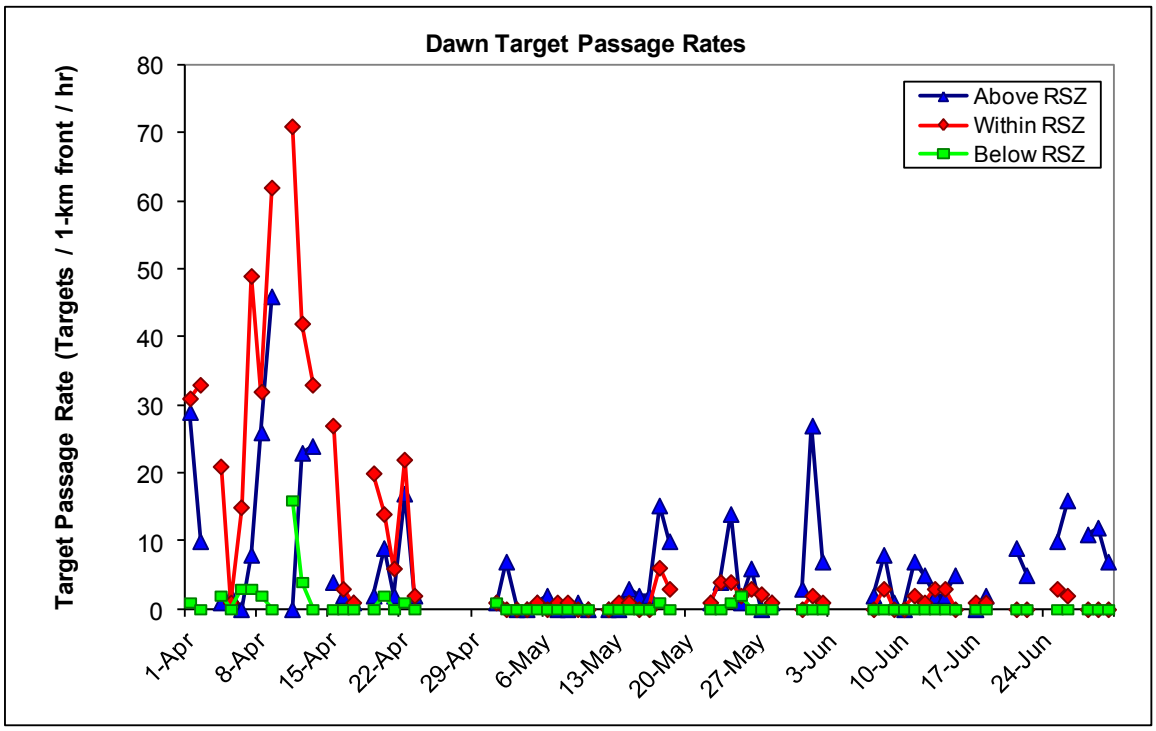

Figure 3-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns of the spring 2011 season.

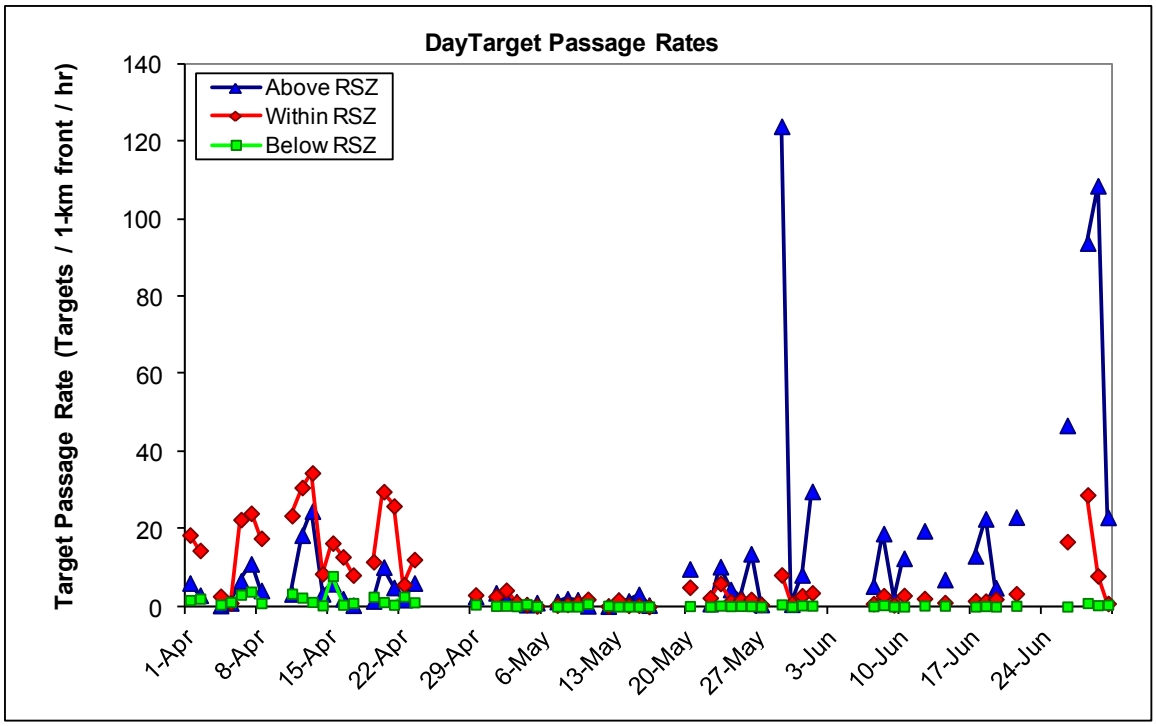

Figure 3-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days of the spring 2011 season.

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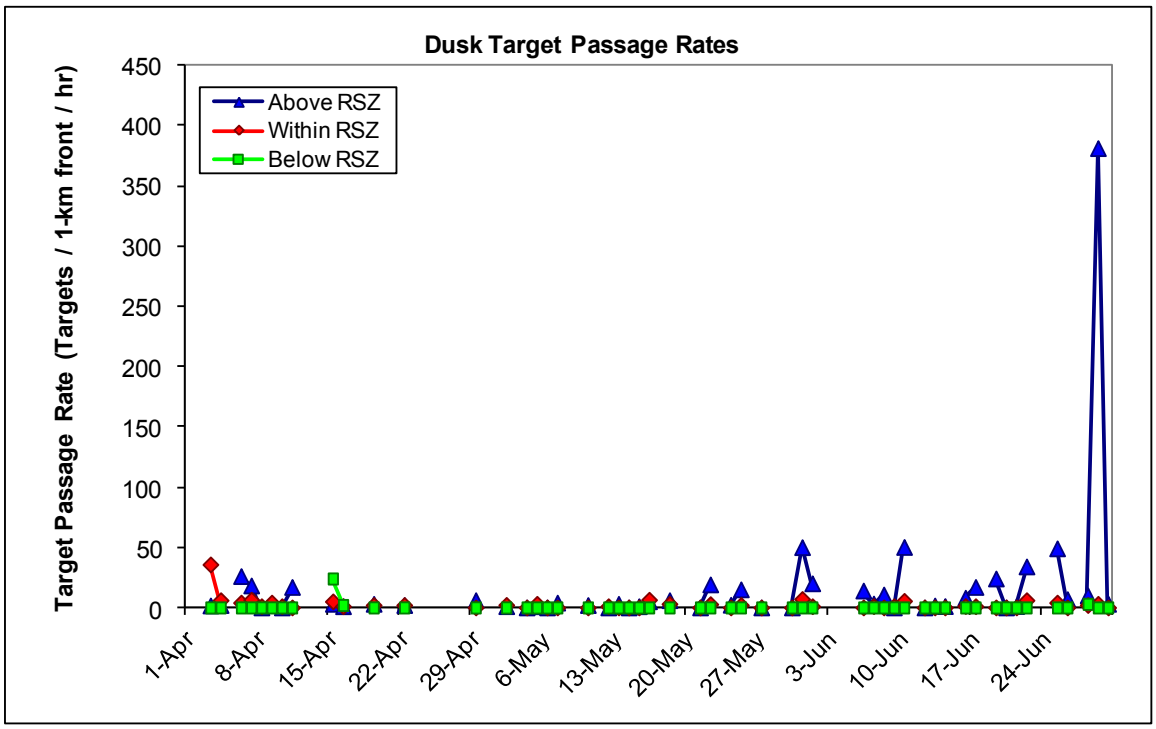

Figure 3-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks of the spring 2011 season.

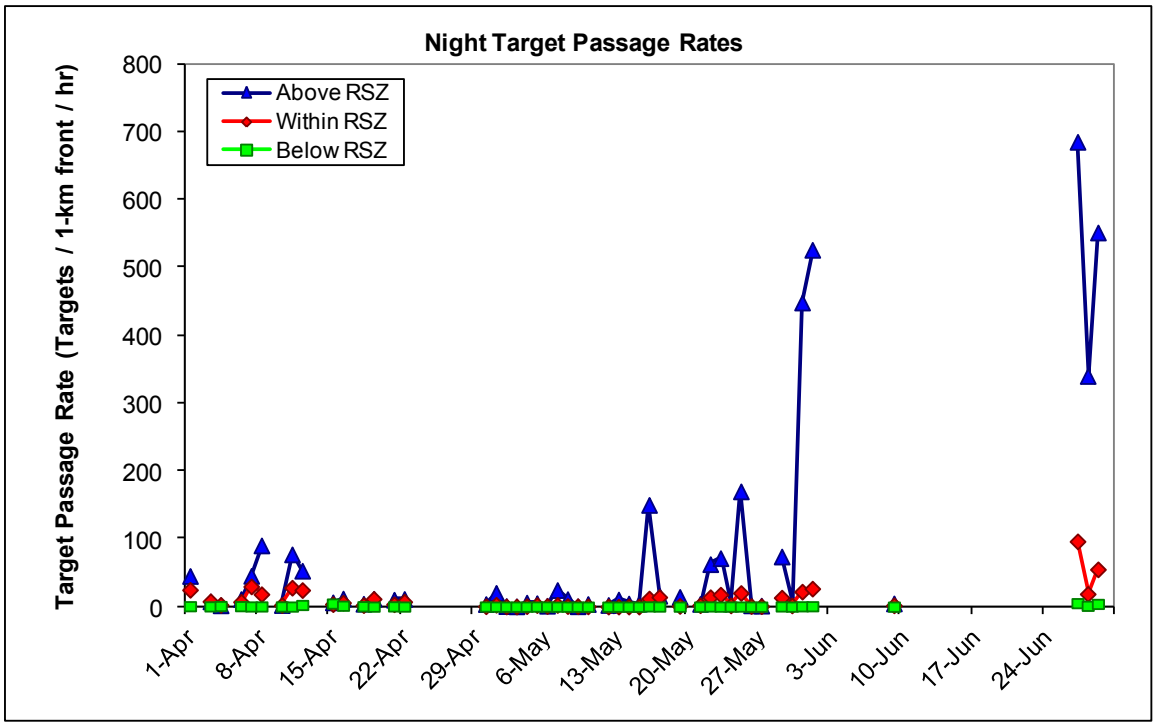

Figure 3-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights of the spring 2011 season.

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3.3 Horizontal Radar Data

3.3.1 Target Directions

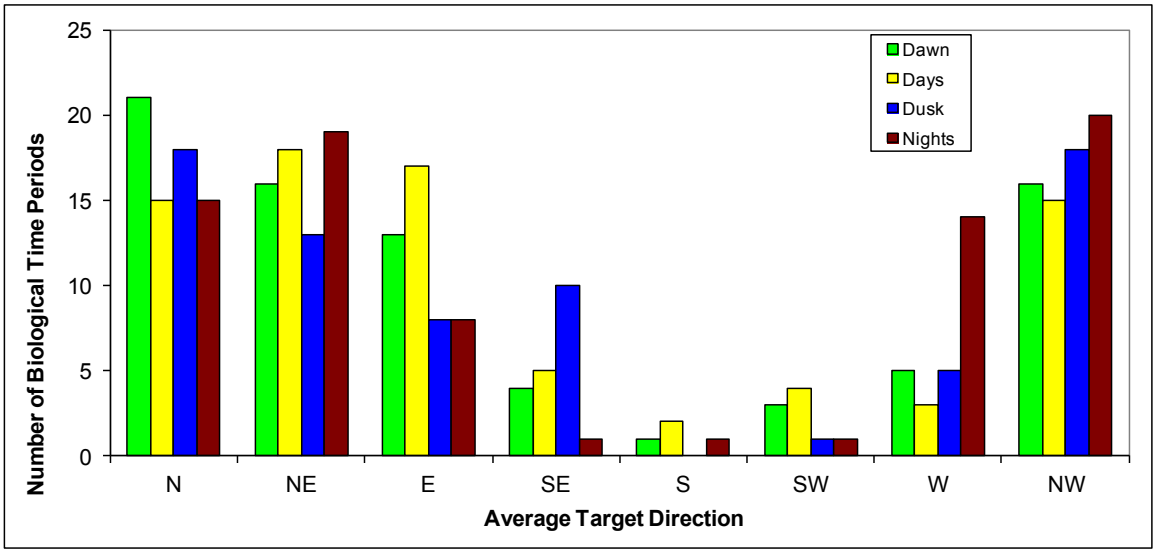

Figure 3-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights during the spring 2011 season.

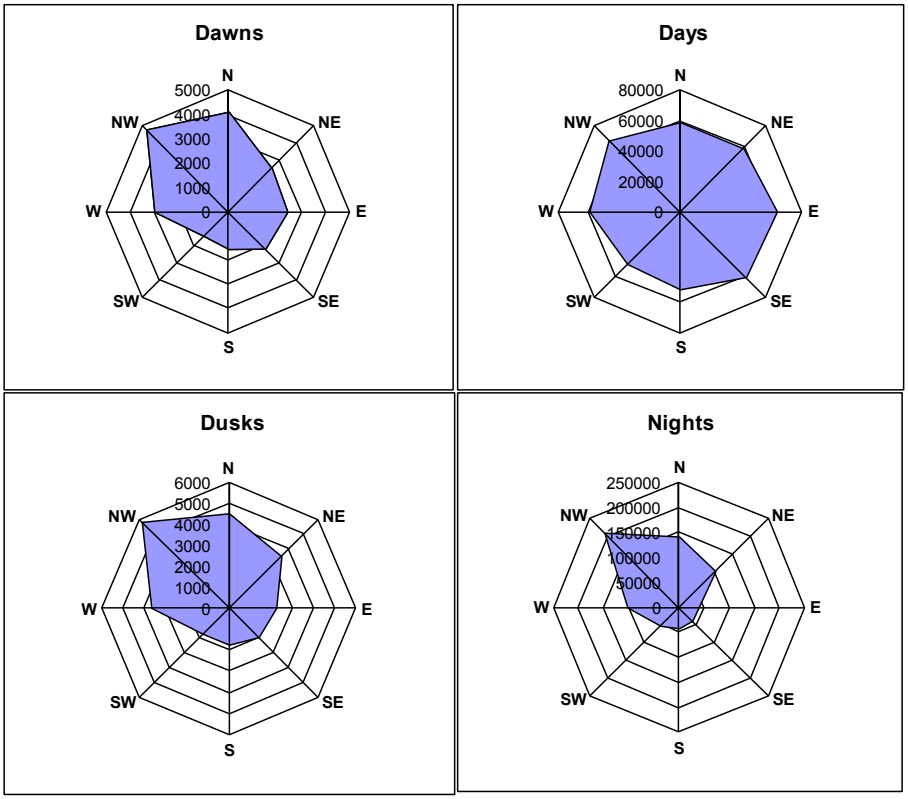

Figure 3-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights during the spring 2011 season.

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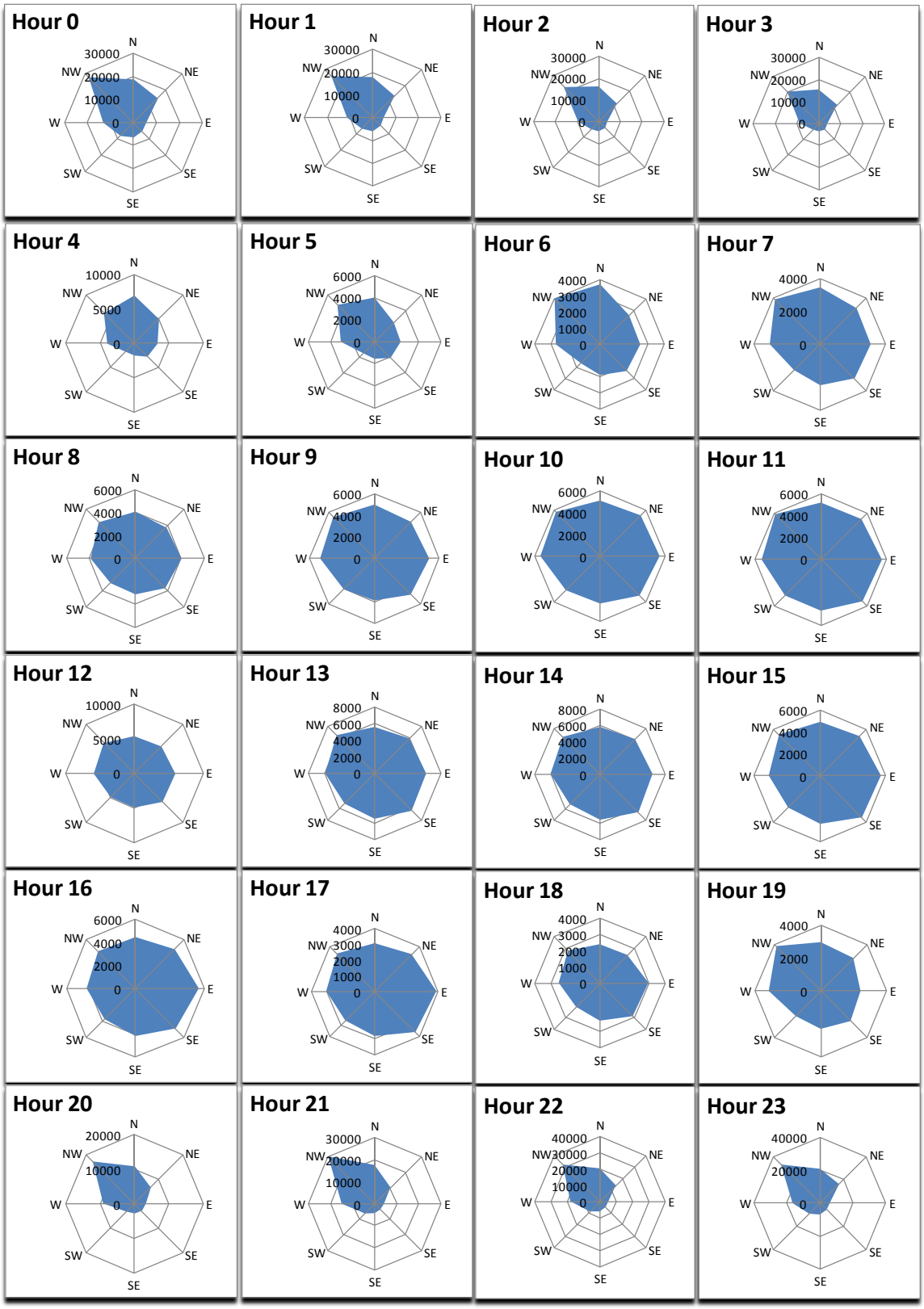

Figure 3-15. Directional distributions for targets during four biological periods of the spring 2011 study period.

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4 RESULTS for the Summer 2011 Season

4.1 Level of Effort

The MERLIN Avian Radar System operated at Site 3 during the Summer 2011 season (July 1 – August 15, 2011).

Table 4-1. Effort of radar monitoring during the summer 2011 season.

Radar	Time in reporting period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical radar (hrs)	1104	1103.7	0.3	538.1	565.6
Horizontal radar (hrs)	1104	983.8	120.2	13.8	970

4.2 Vertical Radar Data

4.2.1 Target Passage Rates Over Time

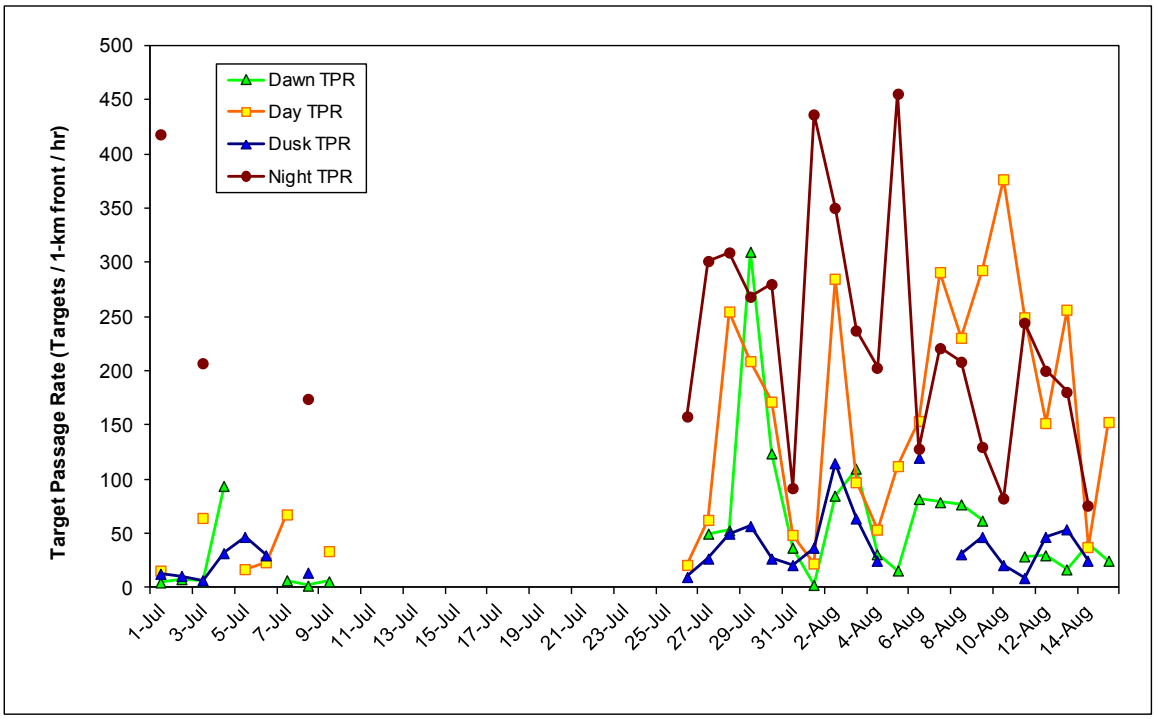

Figure 4-1. Target passage rates during dawns, days, dusks, and nights of the summer 2011 season.

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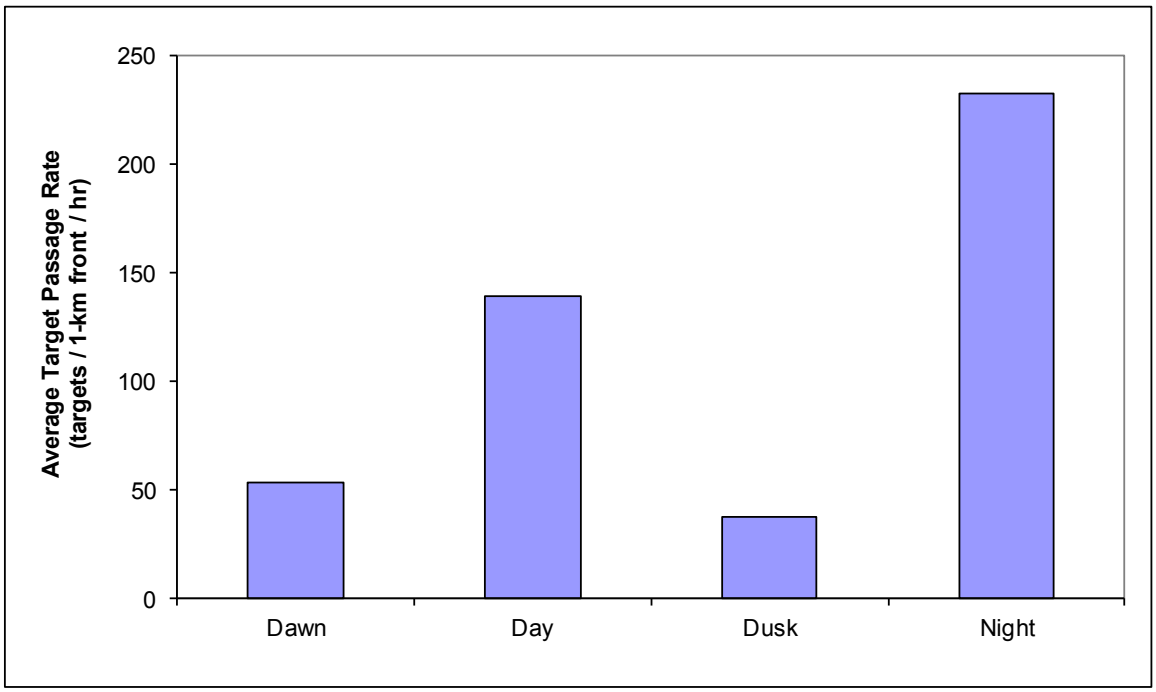

Figure 4-2. Average target passage rates for dawns, days, dusks, and nights of the summer 2011 season.

Table 4-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods during the summer 2011 season.

	Dawn	Day	Dusk	Night
Average	53.4	139.1	37.6	233.2
Standard Deviation	63.5	108.4	29.0	108.2
Median	34.0	112.3	30.0	208.5
Minimum	2.0	15.9	7.0	75.9
Maximum	310.0	376.9	120.0	455.8
Range	308.0	361.0	113.0	380.0

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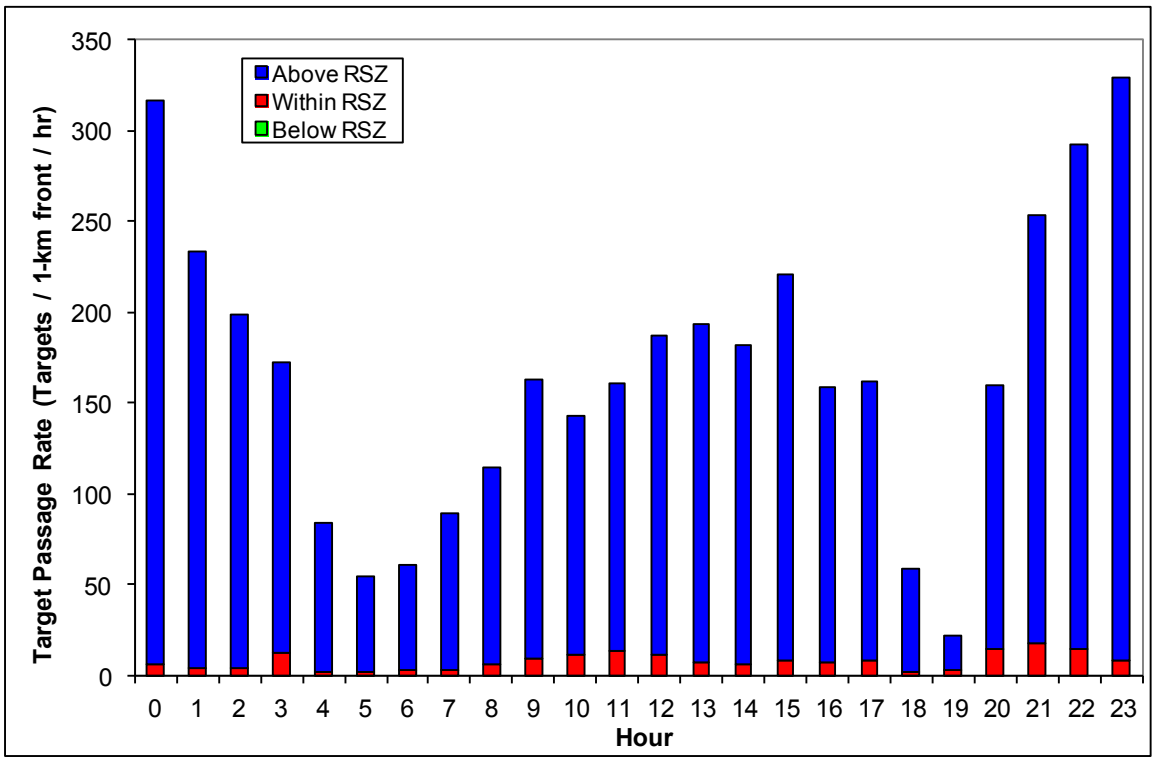

Figure 4-3. Hourly activity (average target passage rates) during the summer 2011 season.

4.2.2 Altitudinal Distribution of Targets

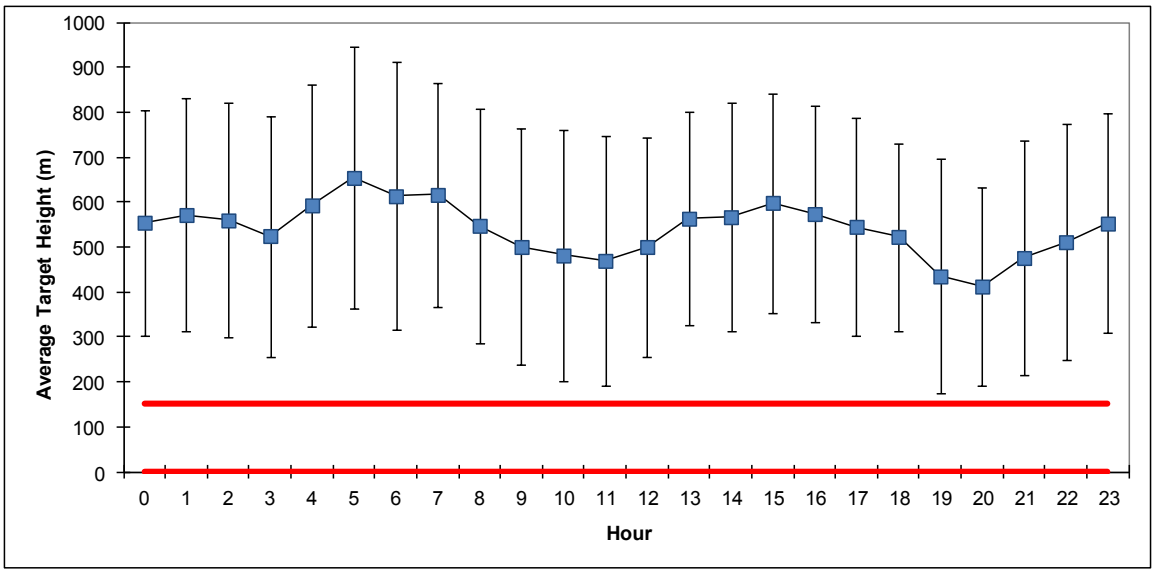

Figure 4-4. Average hourly target heights AGL during the summer 2011 season. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

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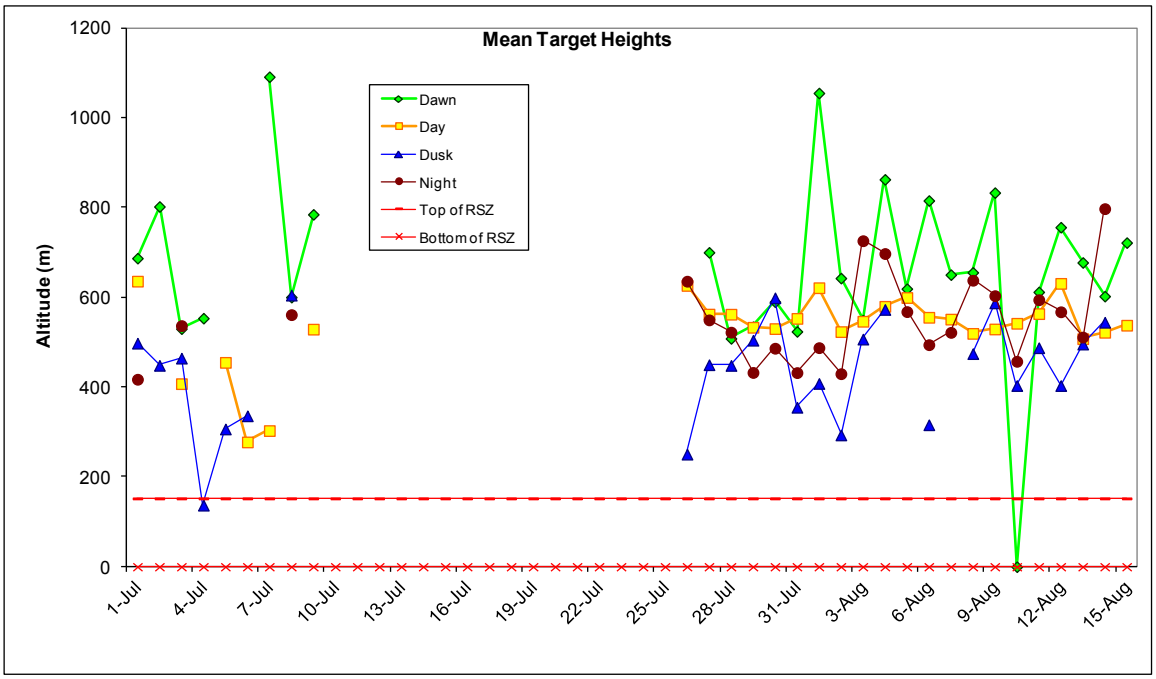

Figure 4-5. Mean target heights during four biological periods of the summer 2011 season.

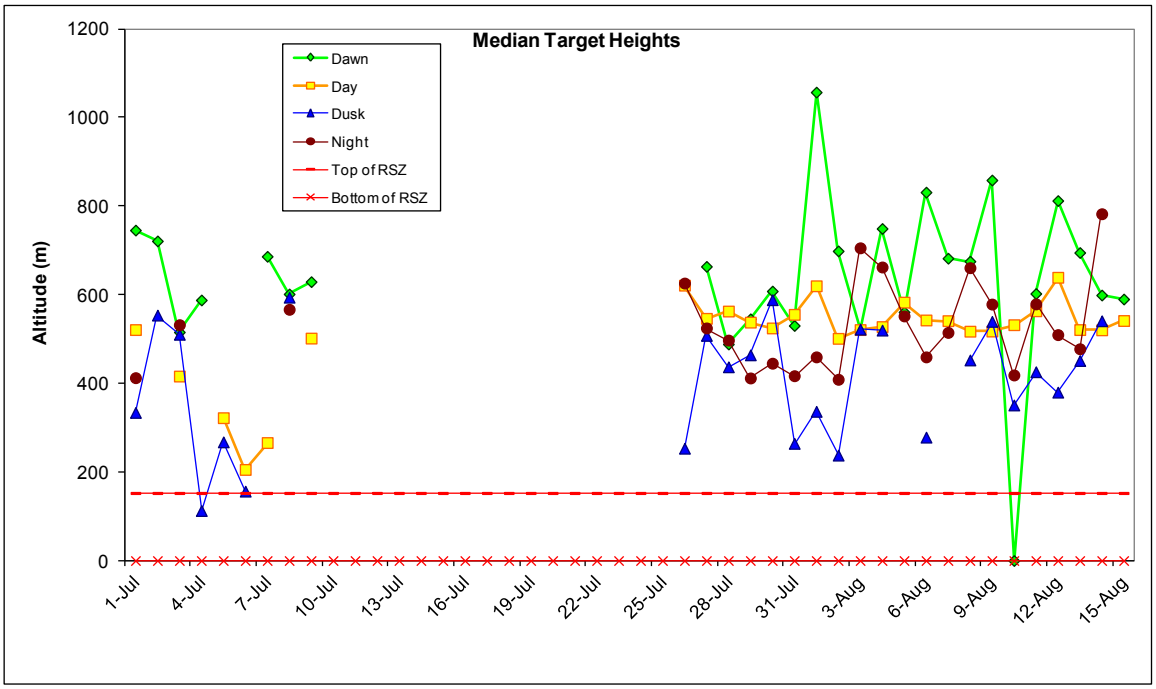

Figure 4-6. Median target heights during four biological periods of the summer 2011 season.

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Table 4-3. Summary of mean and median target heights during four biological periods of the summer 2011 season. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	691.7	530.7	436.5	551.7
Average median target height	663.4	509.9	403.1	530.4
All targets for season combined				
Mean target height	640.1	538.6	417.6	530.8
Median target height	613.0	531.9	372.8	499.9

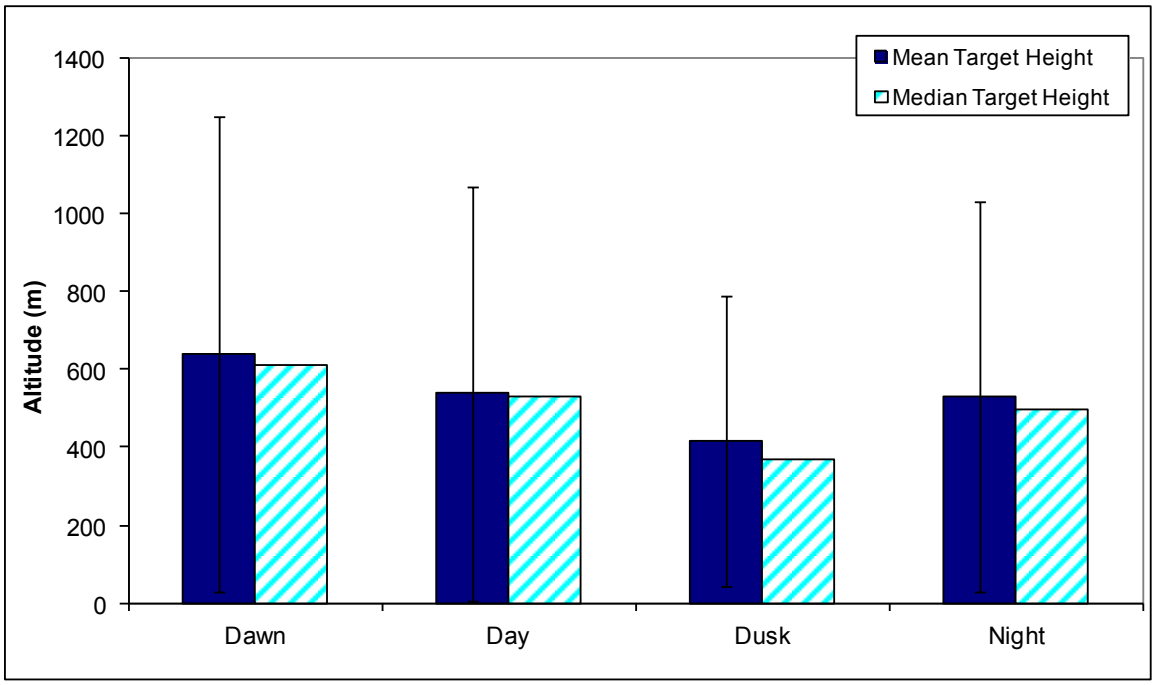

Figure 4-7. Overall mean and median target heights when all targets in each of the four biological periods were combined during the summer 2011 season. Error bars represent one standard deviation.

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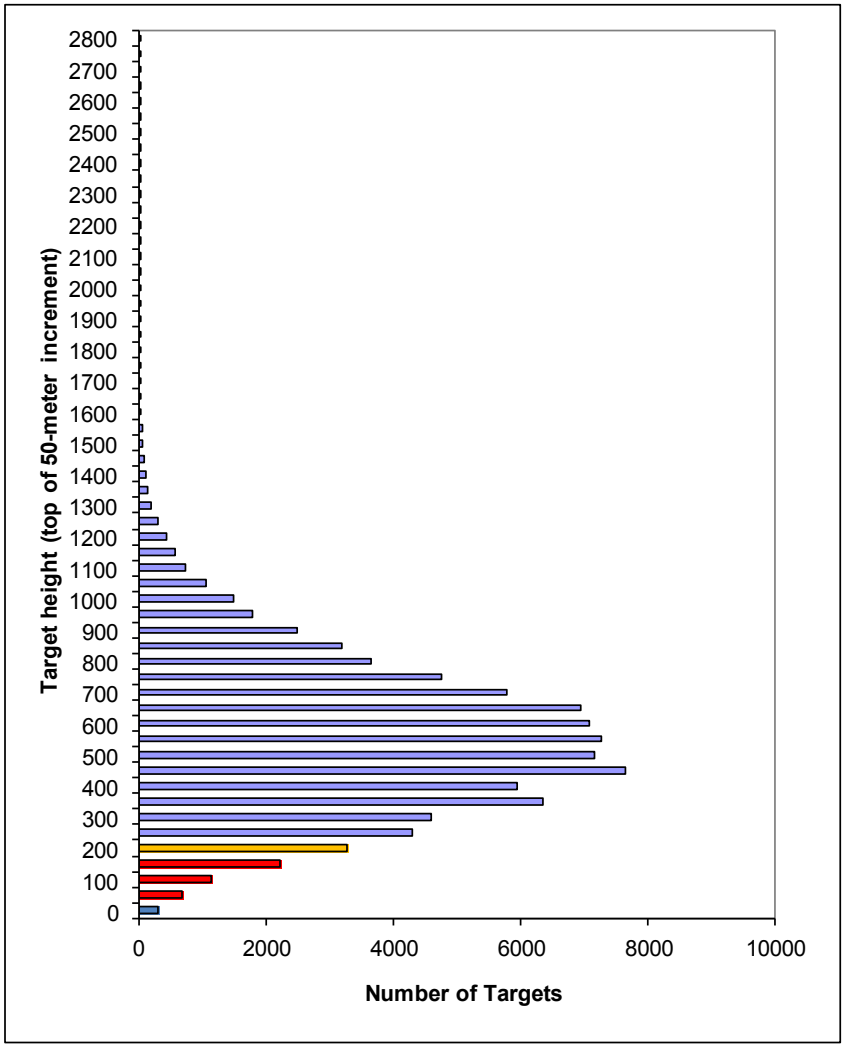

Figure 4-8. Number of targets occurring in each 50-meter increment during the summer 2011 season. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 4-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods of the summer 2011 season.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	95.4%	94.9%	87.3%	96.6%
% targets within RSZ	3.7%	4.6%	12.3%	3.3%
% targets below RSZ	0.9%	0.4%	0.5%	0.1%
% targets below turbine height	4.6%	5.1%	12.7%	3.4%
Target data calculated for each date				
Average % of targets in RSZ	3.3%	6.4%	11.2%	3.1%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.1%
Max target percentage within RSZ	14.3%	33.3%	75.0%	9.9%
Average target passage rate above RSZ	50.9	131.9	32.6	225.0
Average target passage rate within RSZ	2.0	6.6	4.9	7.8
Average target passage rate below RSZ	0.5	0.6	0.2	0.4

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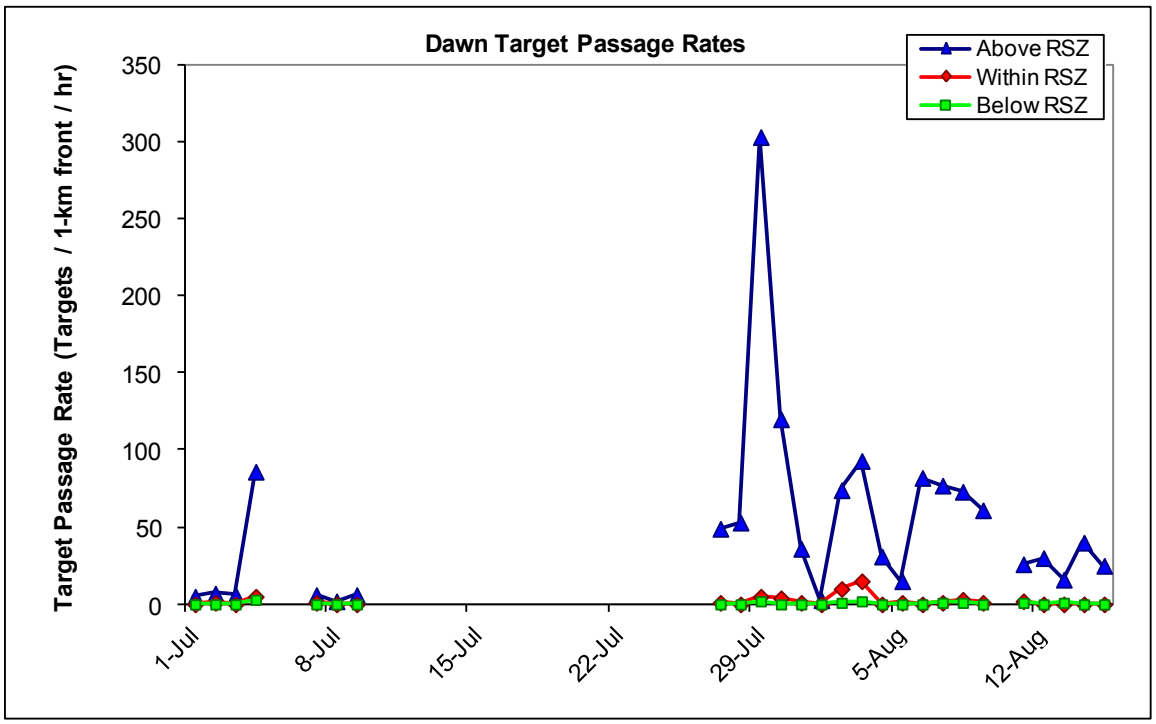

Figure 4-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns of the summer 2011 season.

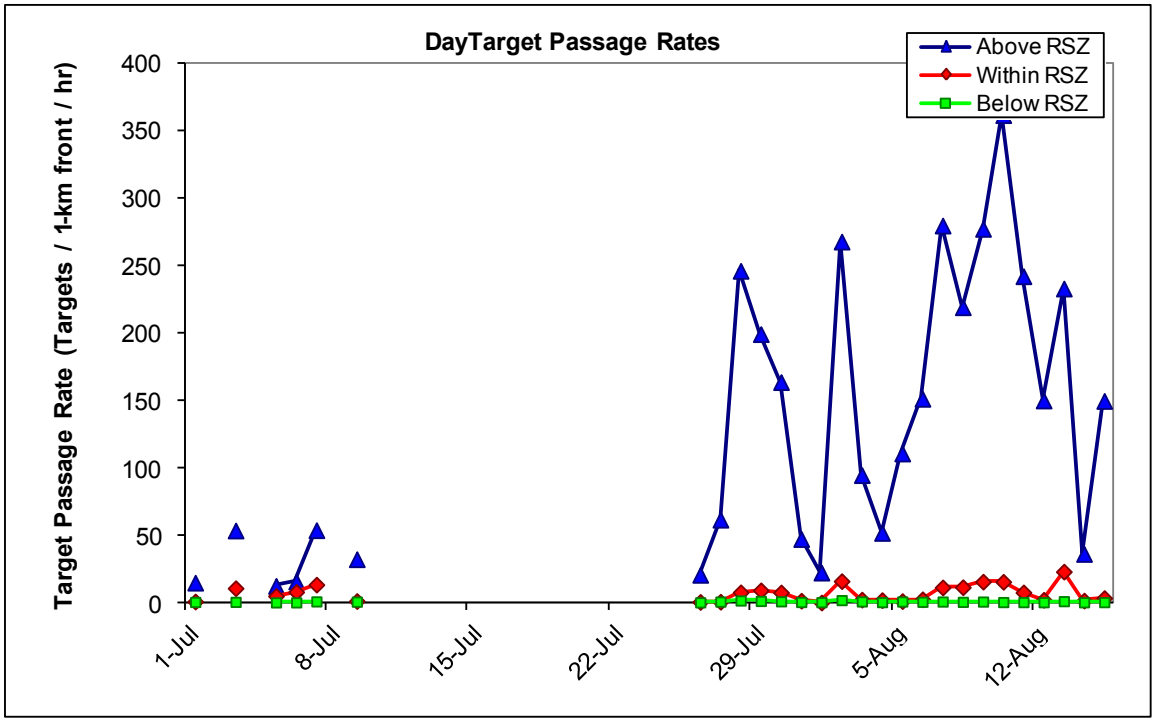

Figure 4-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days of the summer 2011 season.

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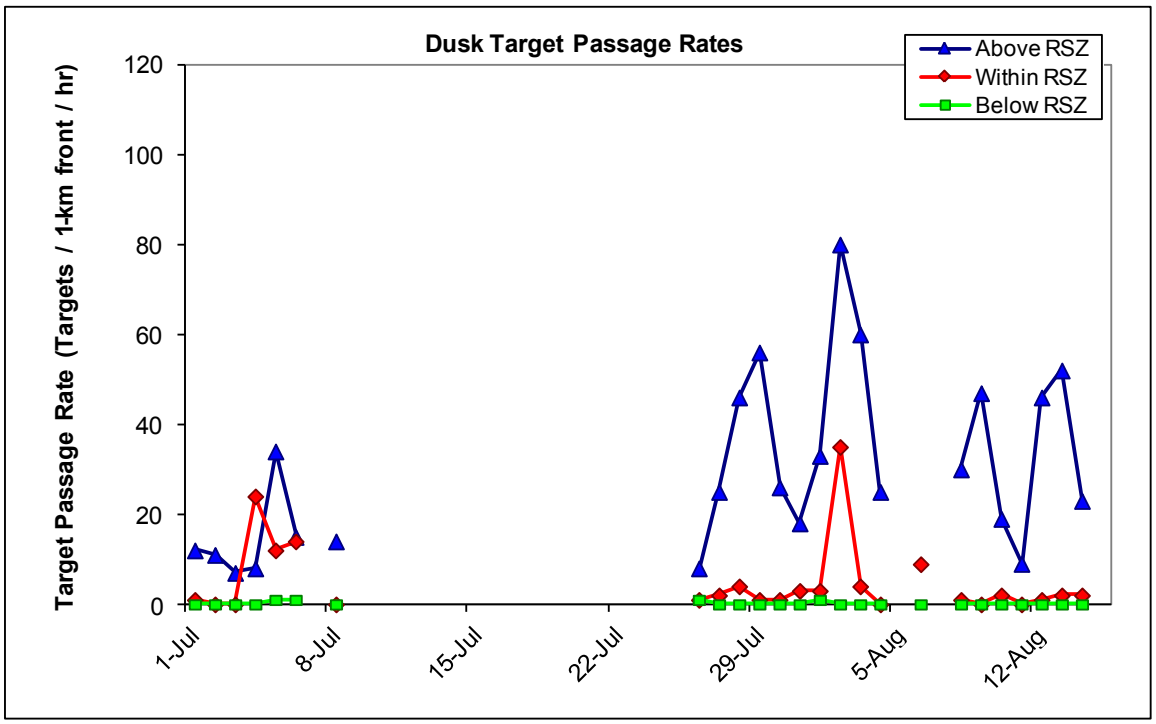

Figure 4-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks of the summer 2011 season.

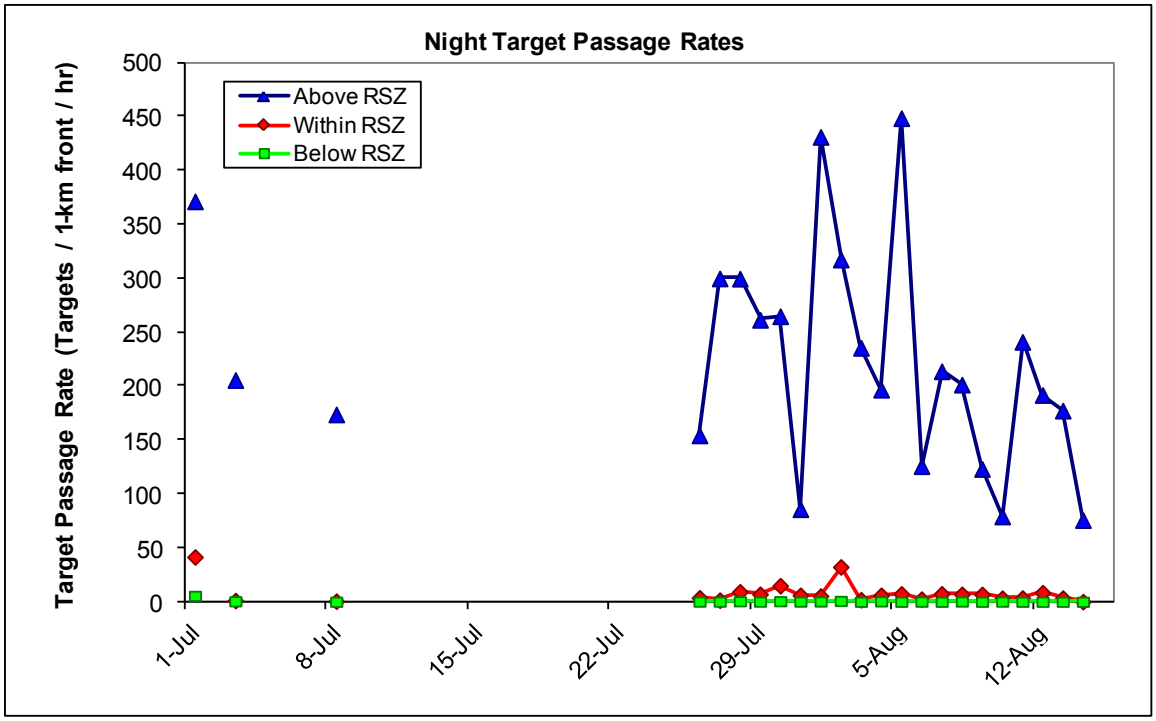

Figure 4-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights of the summer 2011 season.

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4.3 Horizontal Radar Data

4.3.1 Target Directions

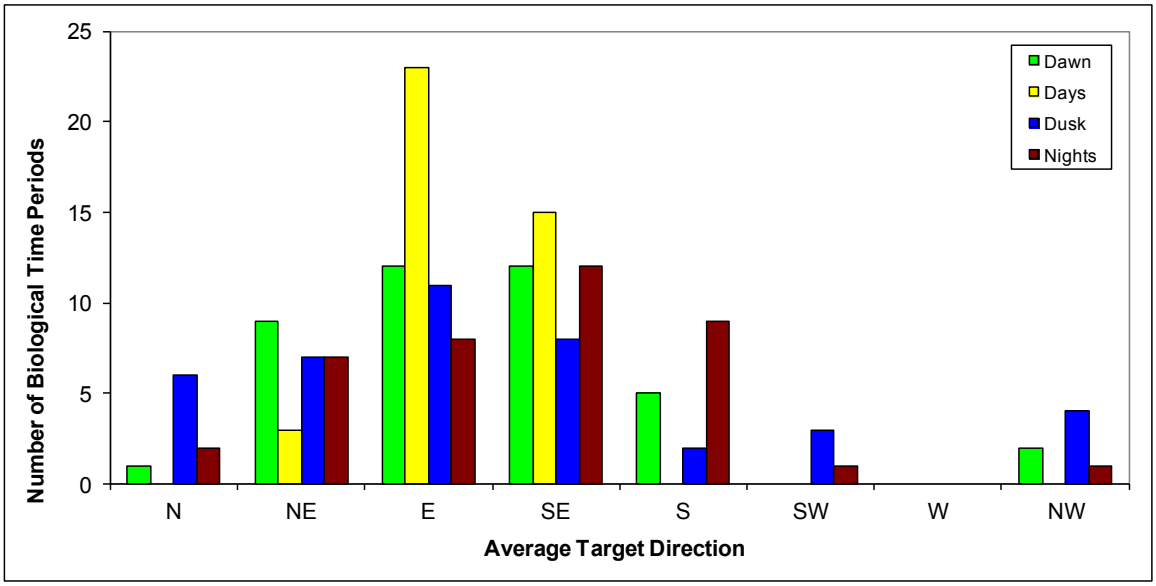

Figure 4-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights during the summer 2011 season.

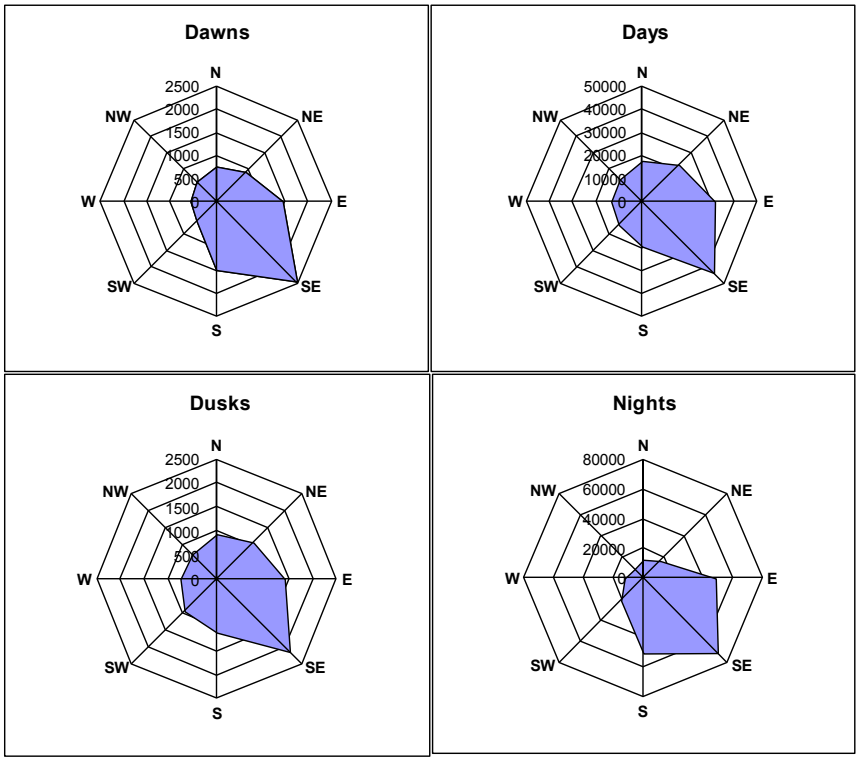

Figure 4-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights during the summer 2011 season.

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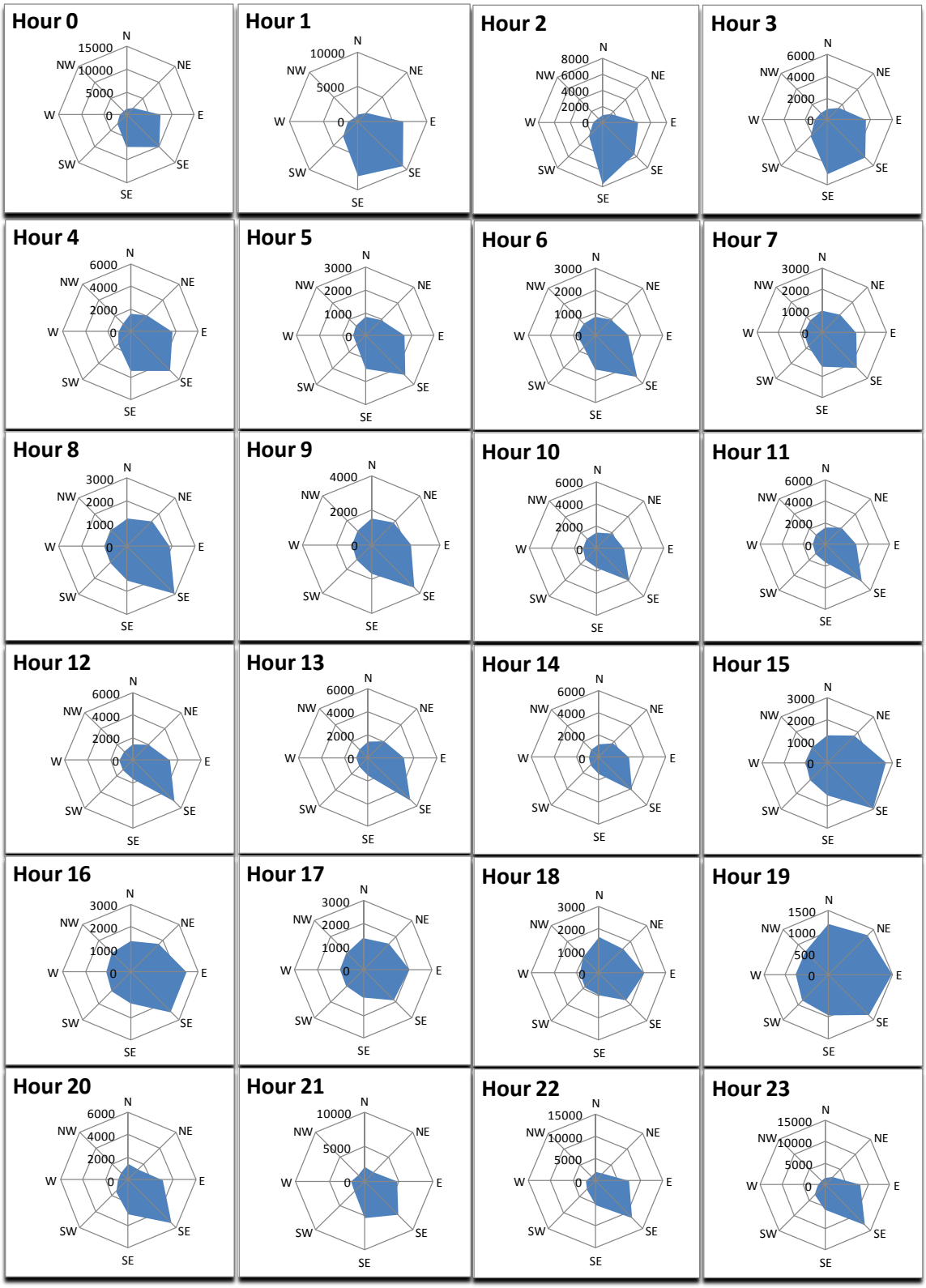

Figure 4-15. Directional distributions for targets during four biological periods of the summer 2011 study period.

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5 RESULTS for the Fall 2011 Season

5.1 Level of Effort

The MERLIN Avian Radar System operated at Sites 1 and 4 during the Fall 2011 season (August 16 – November 16, 2011).

Table 5-1. Effort of radar monitoring during the fall 2011 season.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	2232	1938.9	293.1	282.5	1656.4
Horizontal Radar (hrs)	2232	1710.7	521.3	139.7	1571

5.2 Vertical Radar Data

5.2.1 Target Passage Rates Over Time

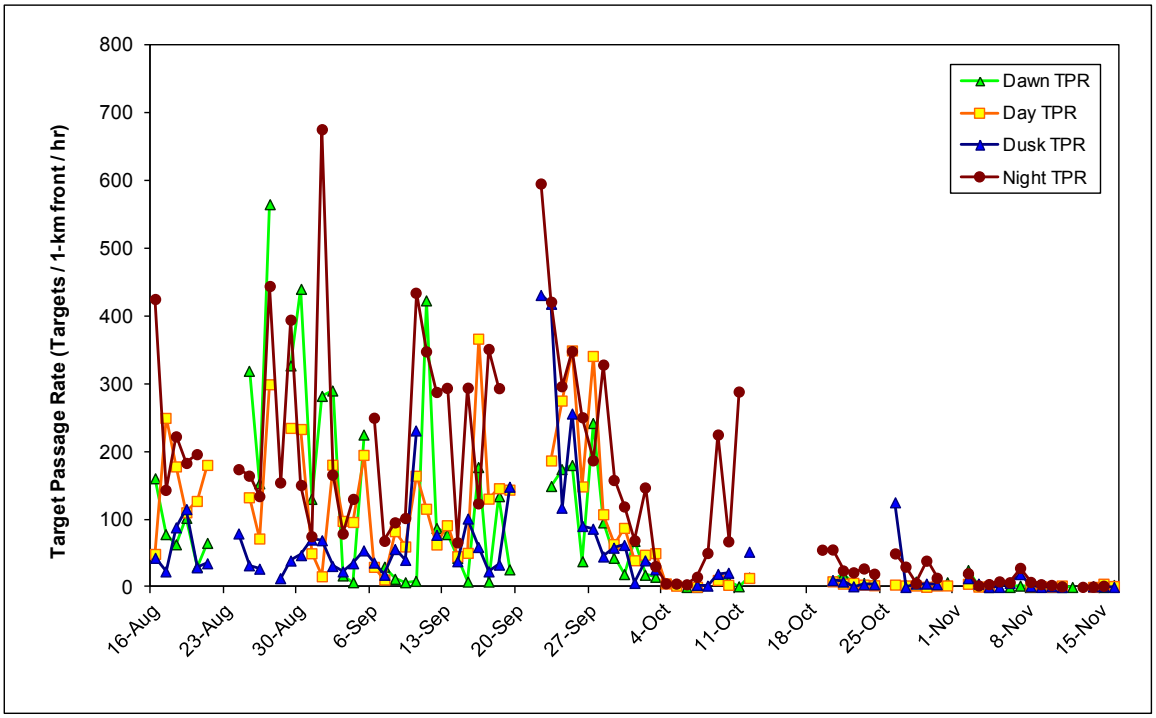

Figure 5-1. Target passage rates during dawns, days, dusks, and nights of the fall 2011 season.

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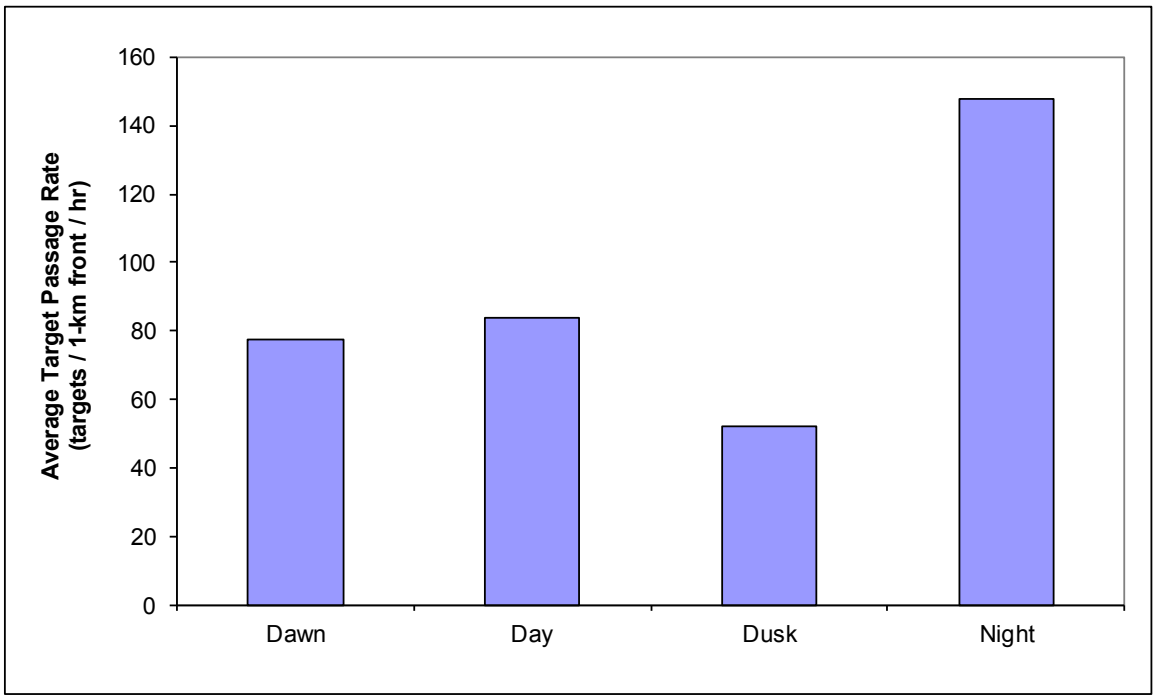

Figure 5-2. Average target passage rates for dawns, days, dusks, and nights of the fall 2011 season.

Table 5-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods during the fall 2011 season.

	Dawn	Day	Dusk	Night
Average	77.3	83.8	52.2	148.1
Standard Deviation	120.3	97.7	81.0	154.3
Median	17.0	49.7	30.0	98.6
Minimum	0.0	0.1	0.0	0.2
Maximum	565.0	366.5	431.0	675.7
Range	565.0	366.4	431.0	675.5

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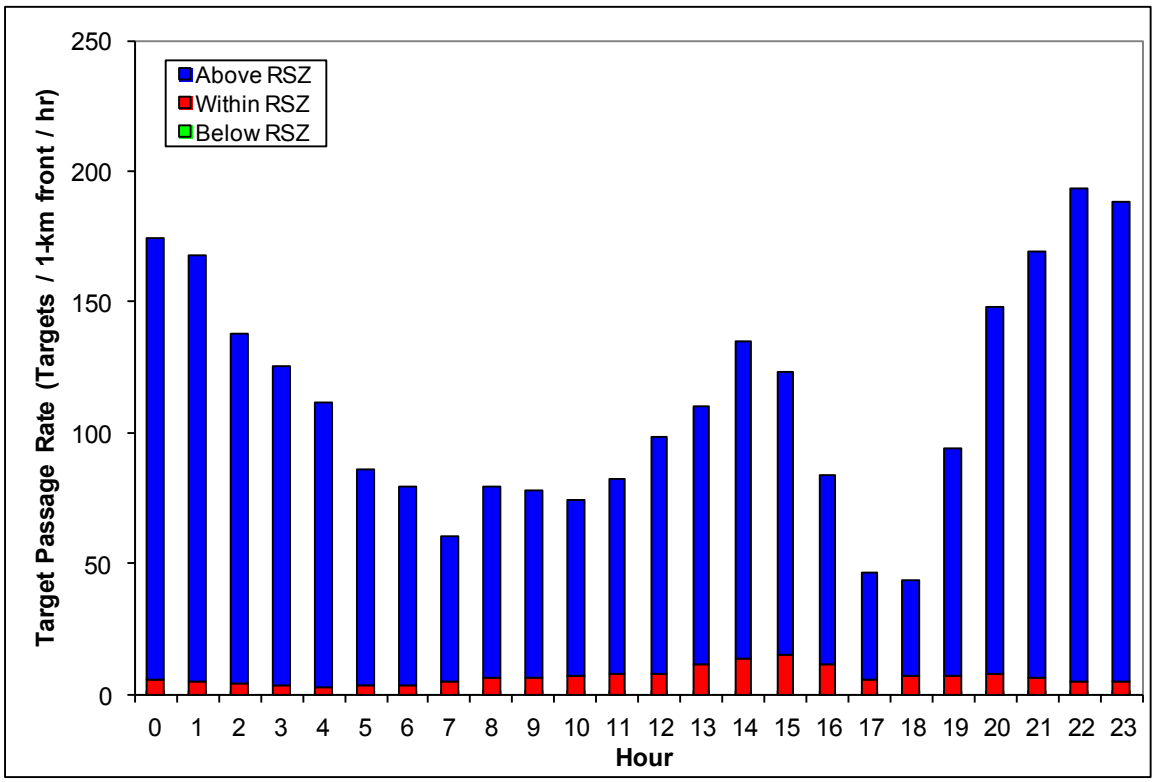

Figure 5-3. Hourly activity (average target passage rates) during the fall 2011 season.

5.2.2 Altitudinal Distribution of Targets

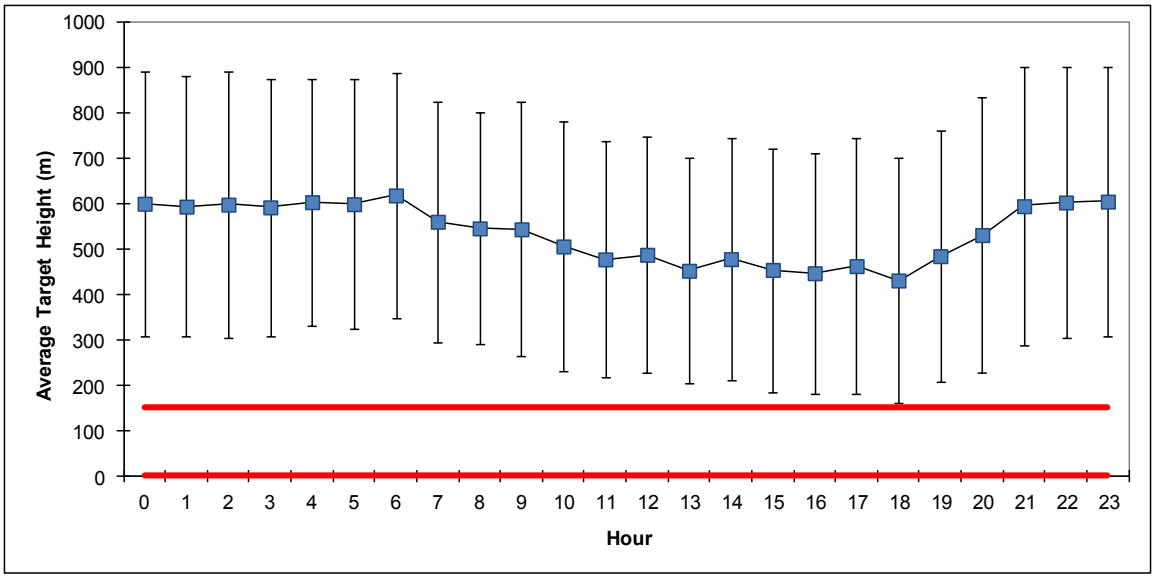

Figure 5-4. Average hourly target heights AGL during the fall 2011 season. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

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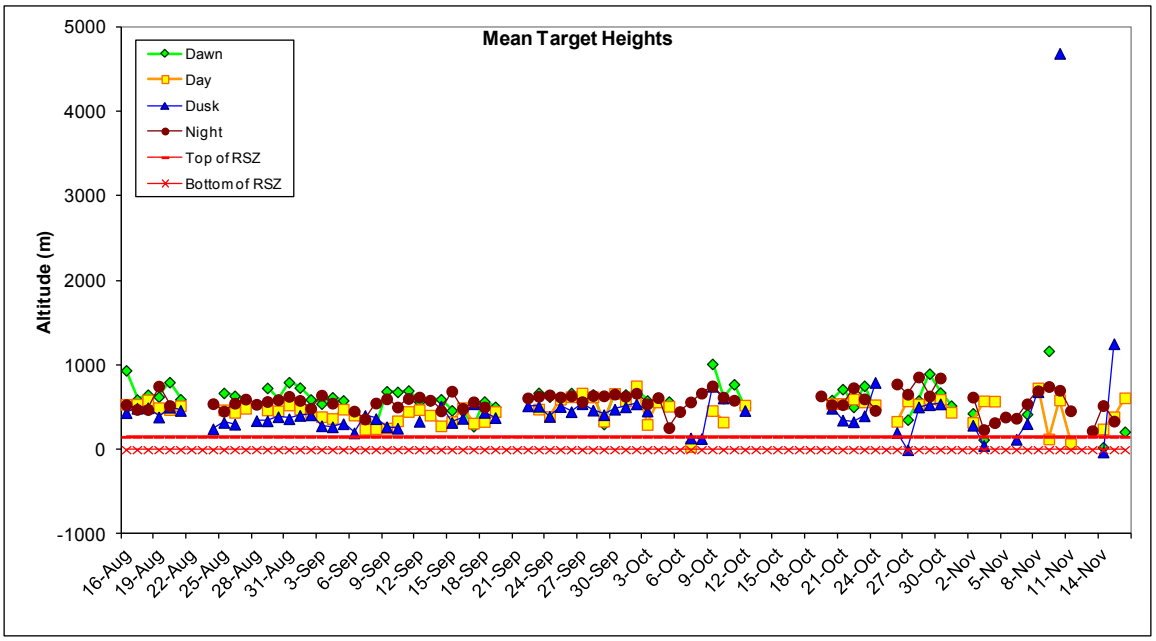

Figure 5-5. Mean target heights during four biological periods of the fall 2011 season.

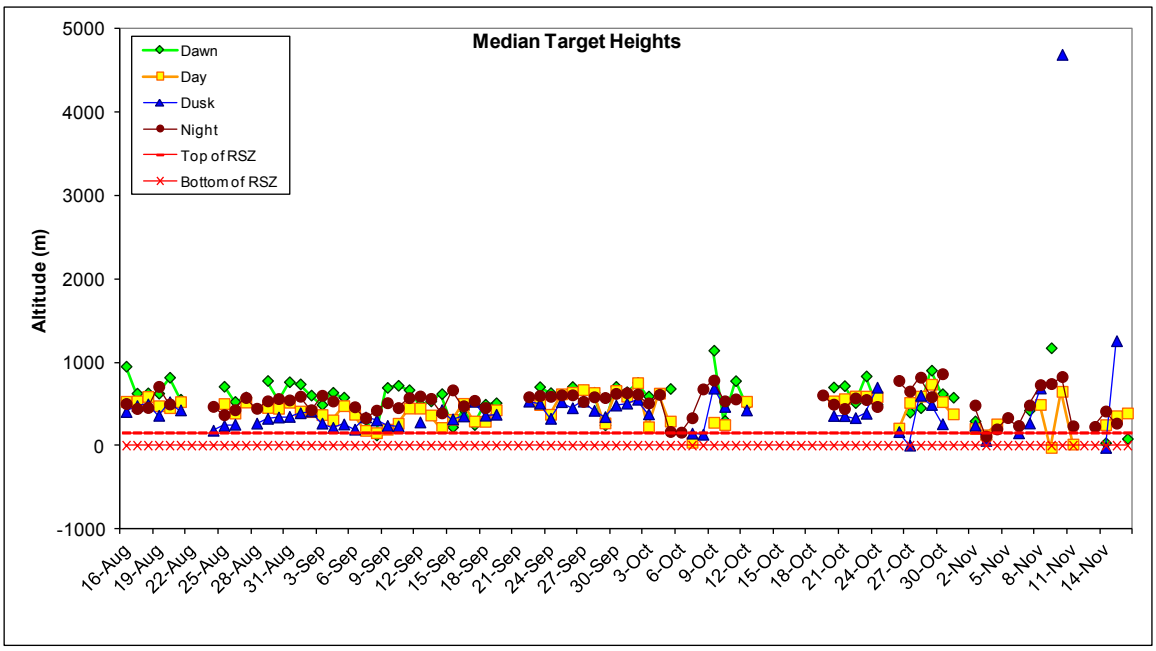

Figure 5-6. Median target heights during four biological periods of the fall 2011 season.

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Table 5-3. Summary of mean and median target heights during four biological periods of the fall 2011 season. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	592.2	461.0	478.1	567.4
Average median target height	575.0	415.0	443.5	512.2
All targets for season combined				
Mean target height	631.7	488.3	421.4	587.8
Median target height	610.1	481.3	404.2	547.7

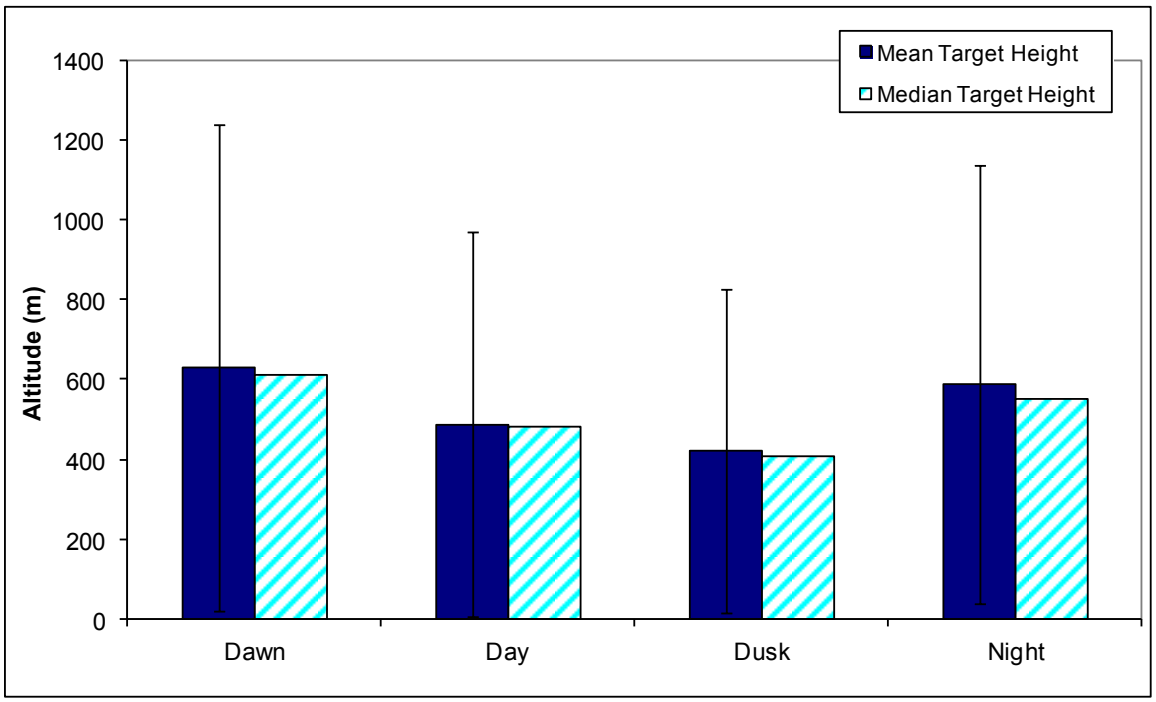

Figure 5-7. Overall mean and median target heights when all targets in each of the four biological periods were combined during the fall 2011 season. Error bars represent one standard deviation.

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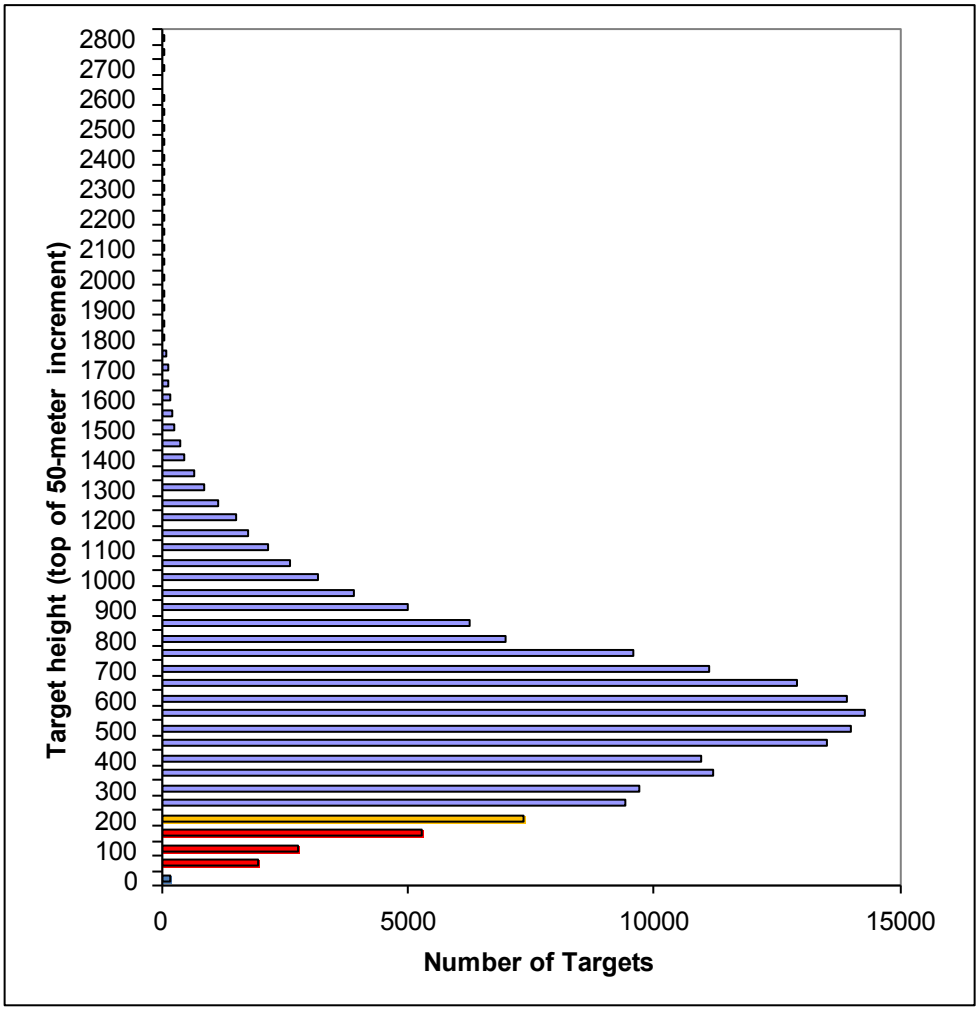

Figure 5-8. Number of targets occurring in each 50-meter increment during the fall 2011 season. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 5-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods of the fall 2011 season.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	96.2%	90.2%	89.2%	97.0%
% targets within RSZ	3.8%	9.6%	10.7%	3.0%
% targets below RSZ	0.1%	0.2%	0.1%	0.0%
% targets below turbine height	3.8%	9.8%	10.8%	3.0%
Target data calculated for each date				
Average % of targets in RSZ	9.8%	16.5%	13.9%	9.2%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.3%
Max target percentage within RSZ	100.0%	100.0%	100.0%	57.1%
Average target passage rate above RSZ	74.4	75.2	46.6	143.4
Average target passage rate within RSZ	2.9	8.4	5.6	4.6
Average target passage rate below RSZ	0.0	0.2	0.1	0.0

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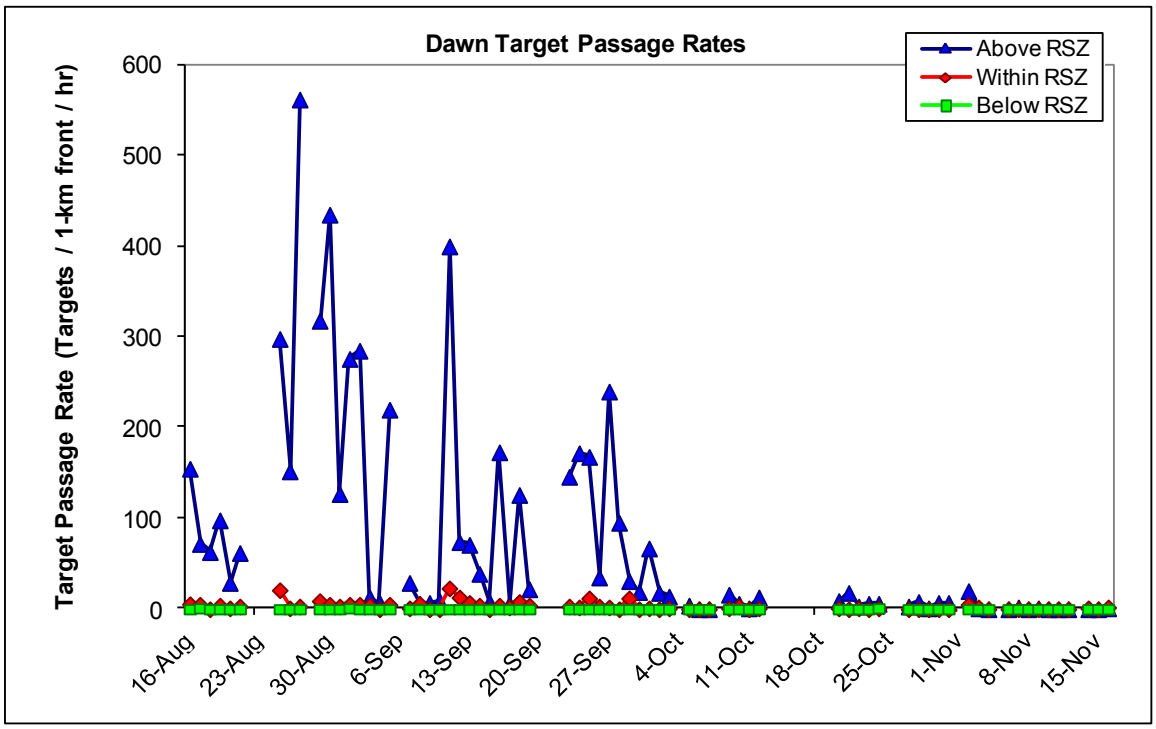

Figure 5-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns of the fall 2011 season.

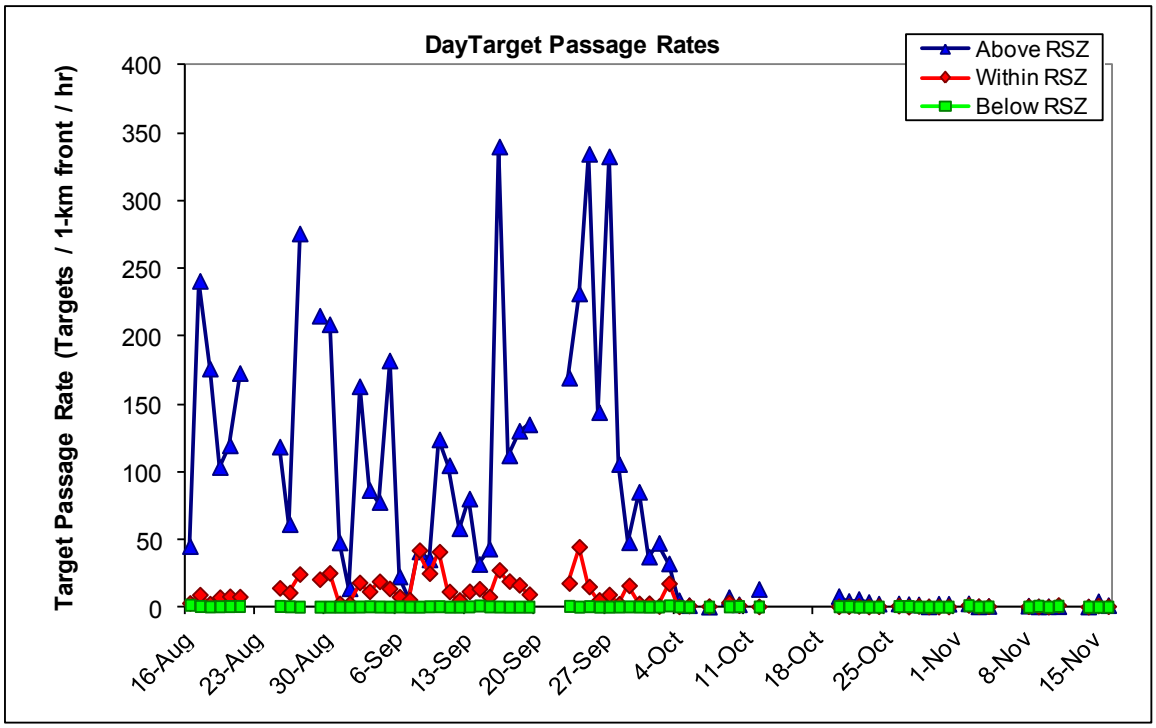

Figure 5-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days of the fall 2011 season.

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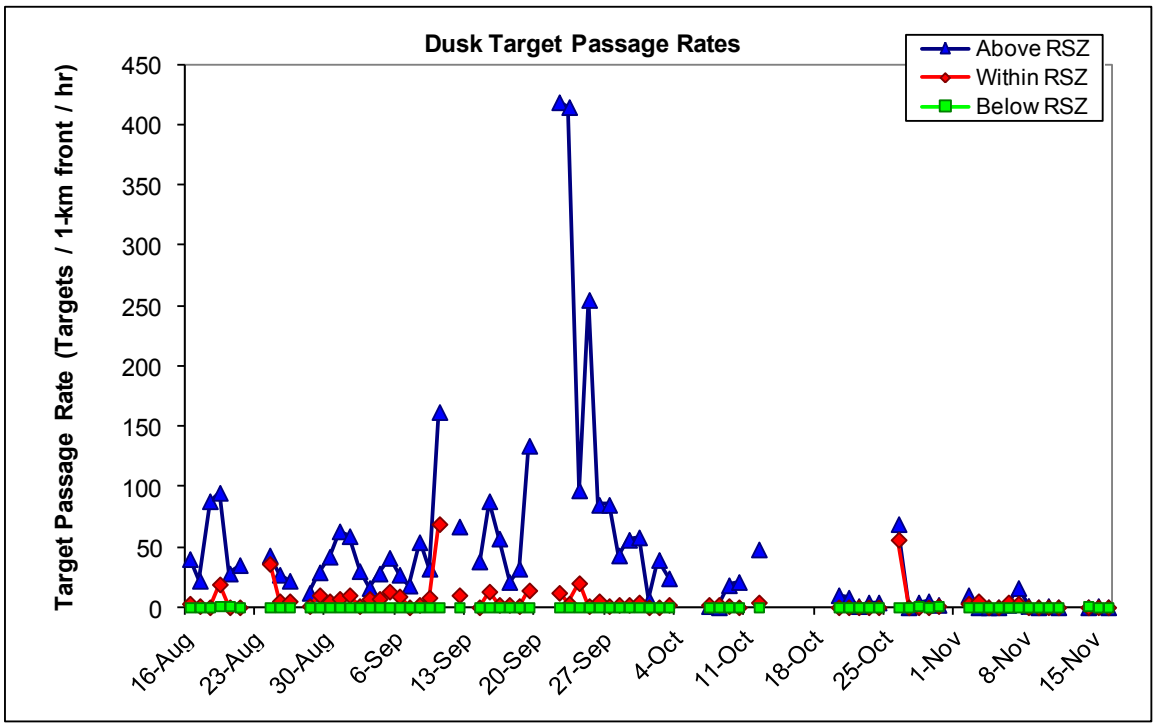

Figure 5-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks of the fall 2011 season.

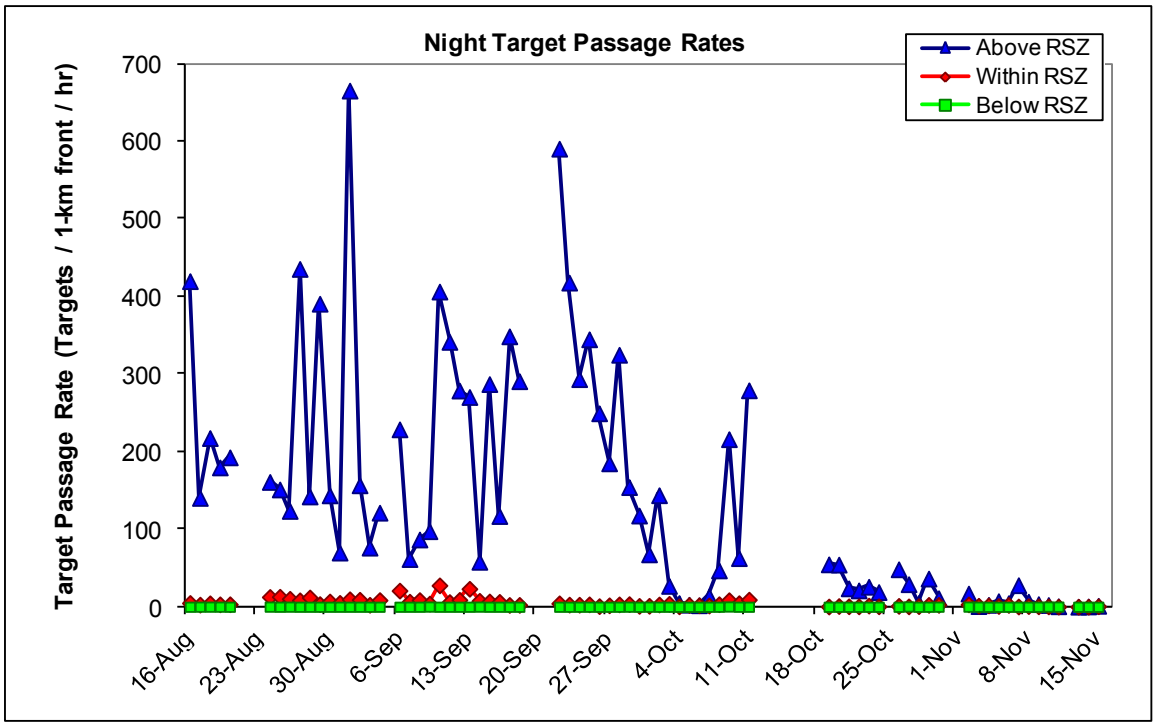

Figure 5-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights of the fall 2011 season.

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5.3 Horizontal Radar Data

5.3.1 Target Directions

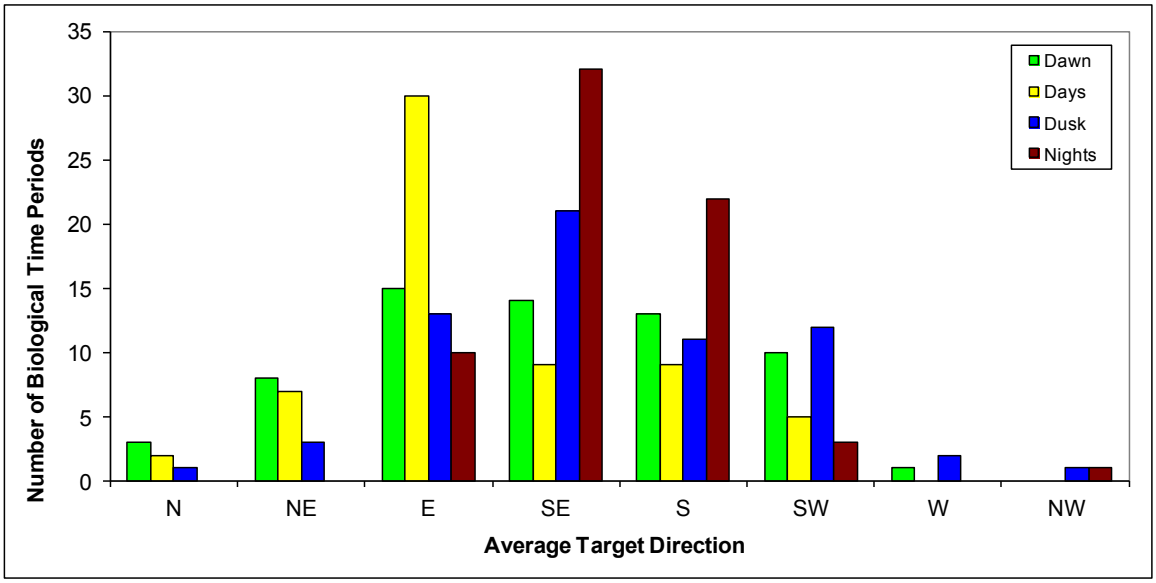

Figure 5-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights during the fall 2011 season.

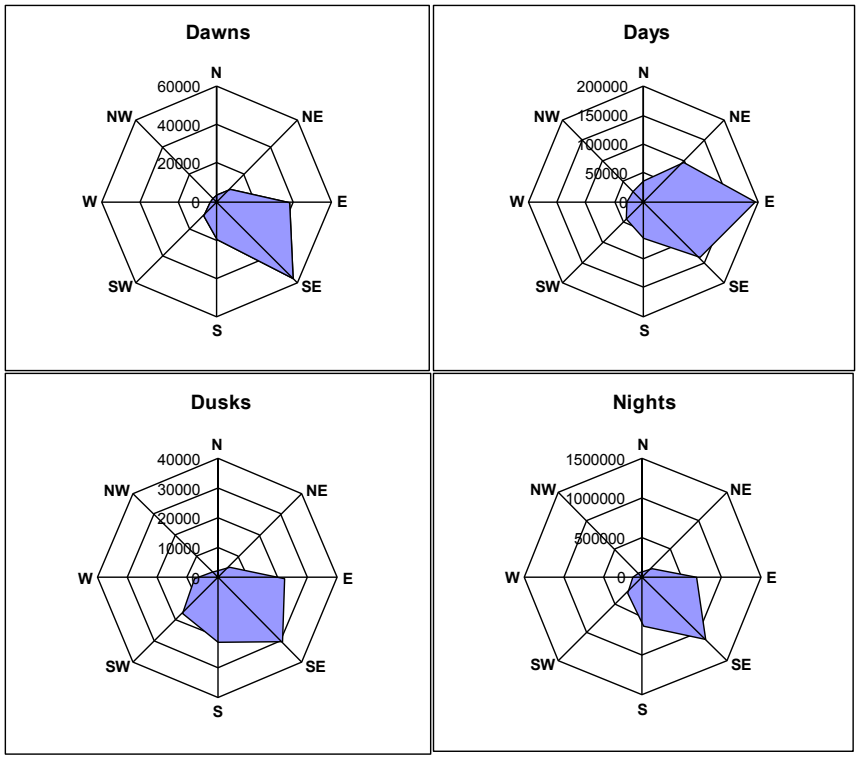

Figure 5-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights during the fall 2011 season.

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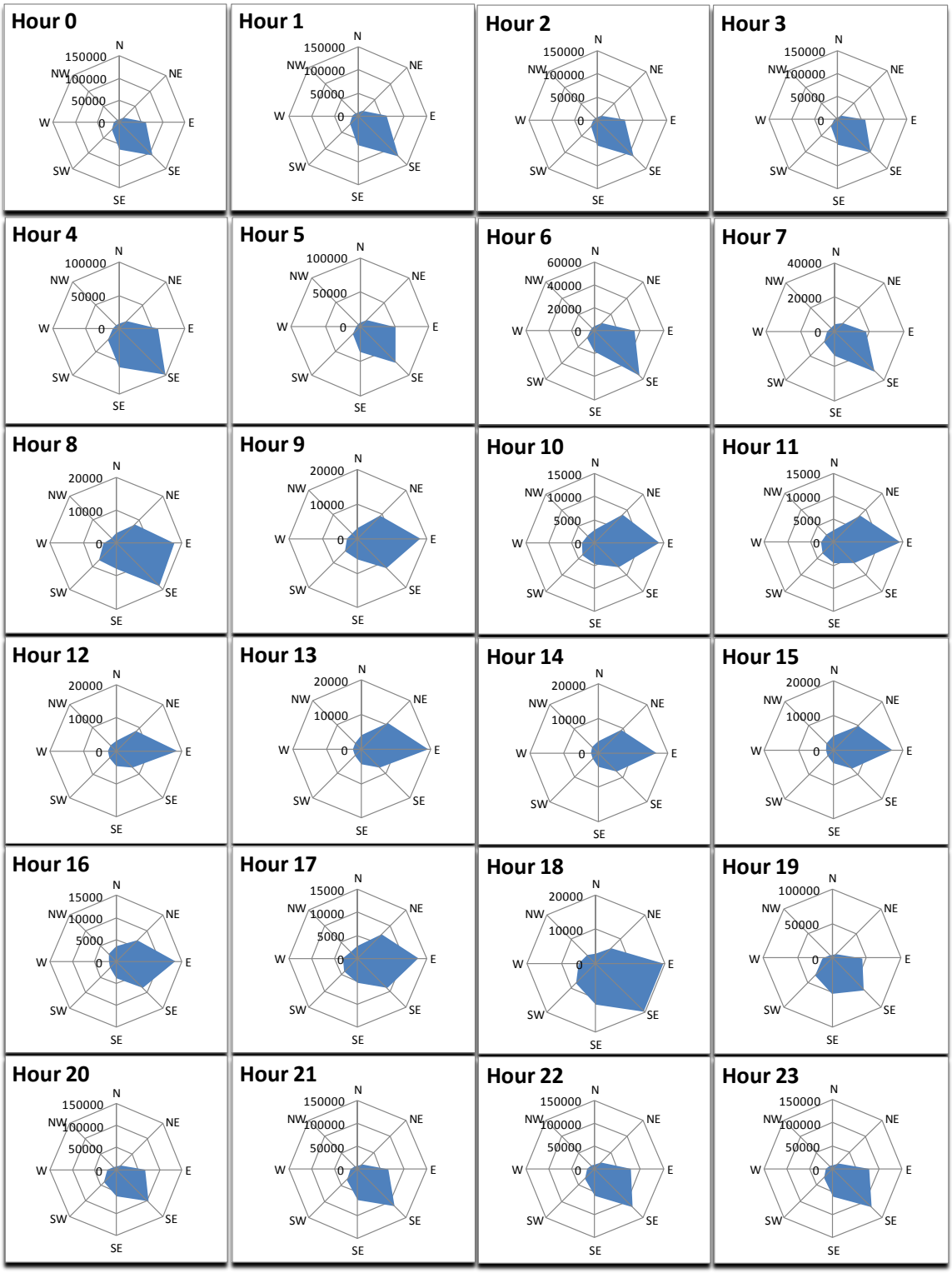

Figure 5-15. Directional distributions for targets during four biological periods of the fall 2011 study period.

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6 RESULTS for Site 1 (August 26 – September 20, 2011)

6.1 Level of Effort

The MERLIN Avian Radar System operated at Site1 August 26 – September 20, 2011.

Table 6-1. Effort of radar monitoring at site 1.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	624	598.4	25.6	77	521.4
Horizontal Radar (hrs)	624	520.3	103.7	57	463.3

6.2 Vertical Radar Data

6.2.1 Target Passage Rates Over Time

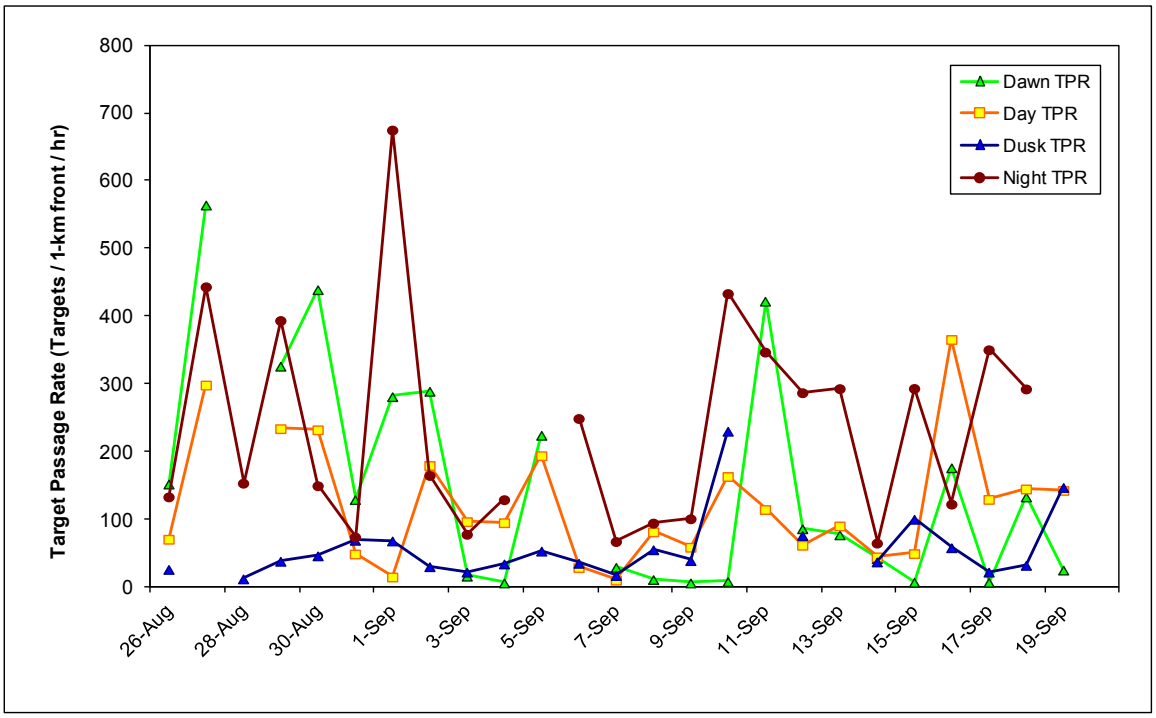

Figure 6-1. Target passage rates during dawns, days, dusks, and nights at site 1.

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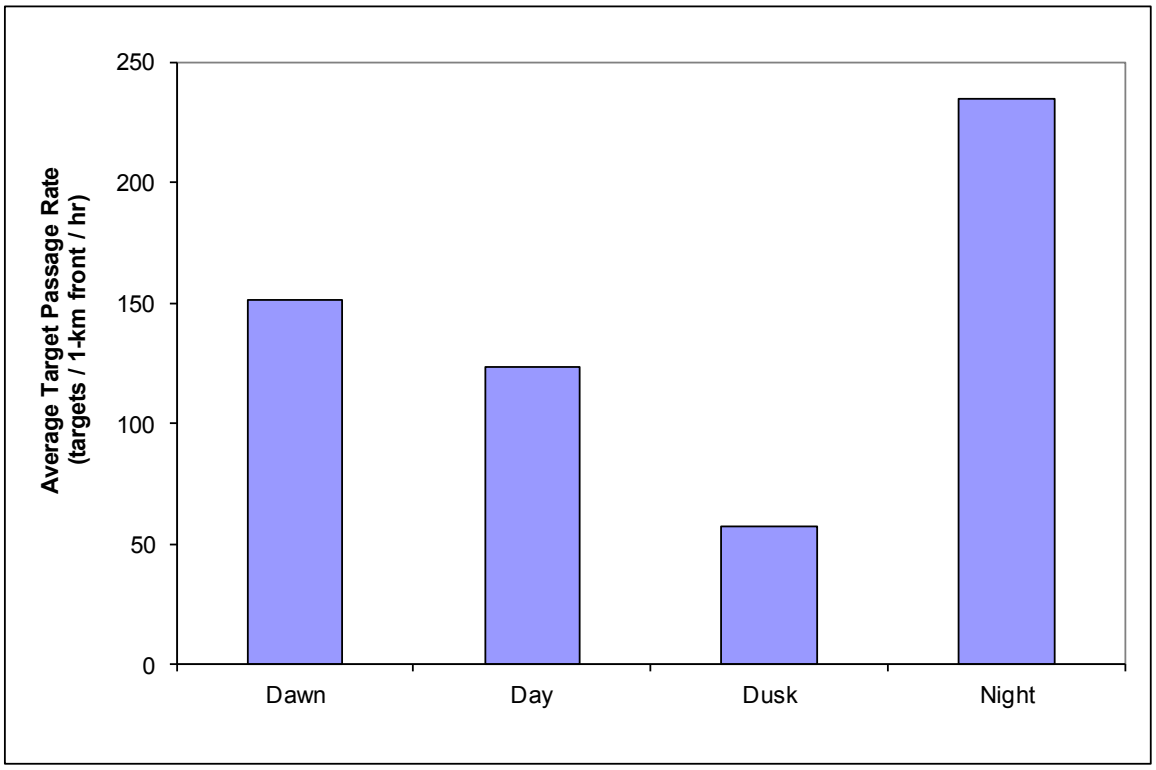

Figure 6-2. Average target passage rates for dawns, days, dusks, and nights at site 1.

Table 6-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods at site 1.

	Dawn	Day	Dusk	Night
Average	151.2	123.8	57.6	235.2
Standard Deviation	164.4	90.9	49.3	156.5
Median	87.0	96.7	39.5	165.8
Minimum	7.0	11.1	13.0	65.8
Maximum	565.0	366.5	231.0	675.7
Range	558.0	355.4	218.0	609.8

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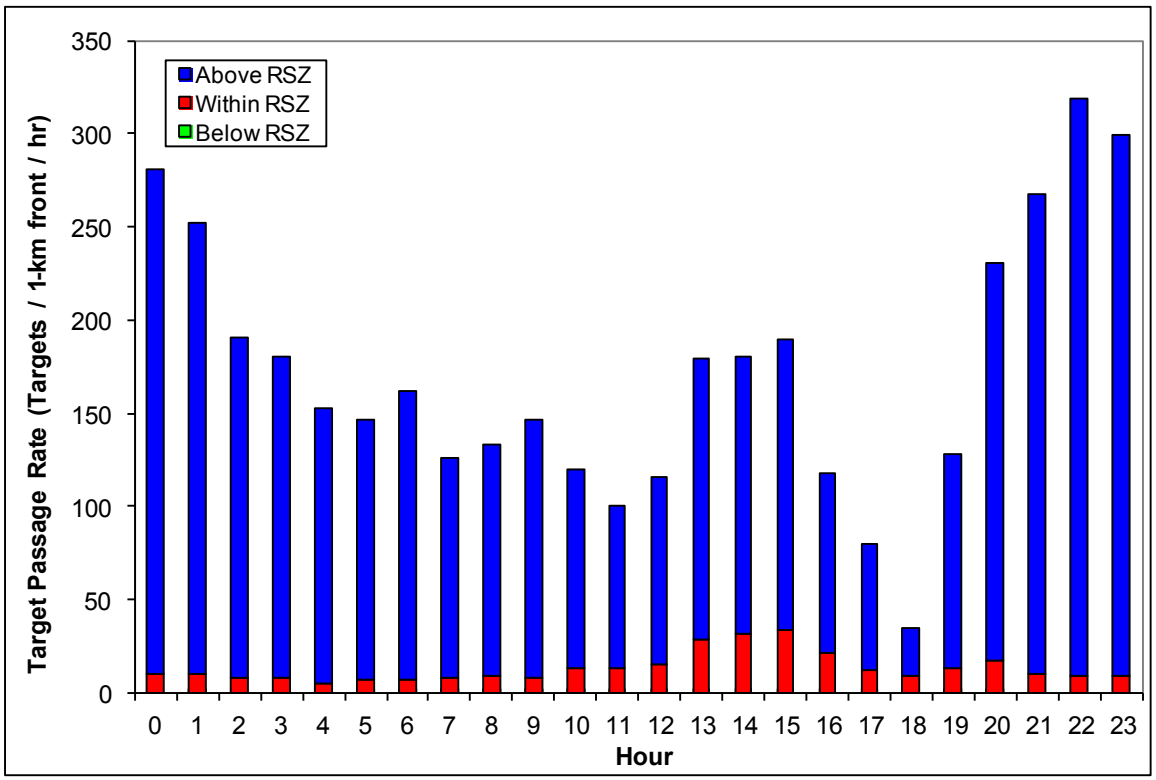

Figure 6-3. Hourly activity (average target passage rates) at site 1.

6.2.2 Altitudinal Distribution of Targets

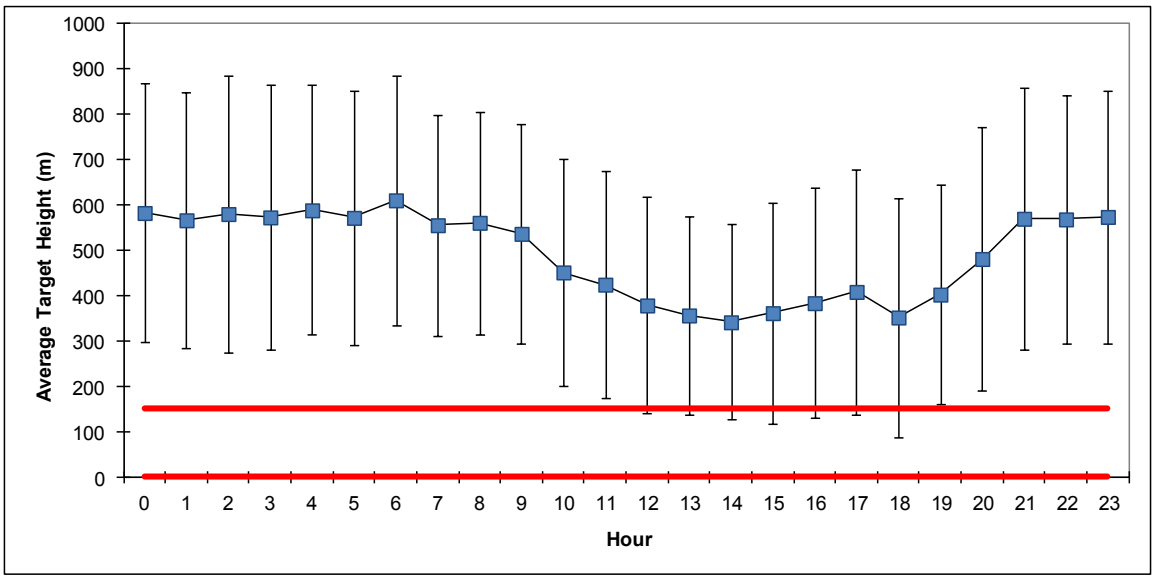

Figure 6-4. Average hourly target heights AGL at site 1. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

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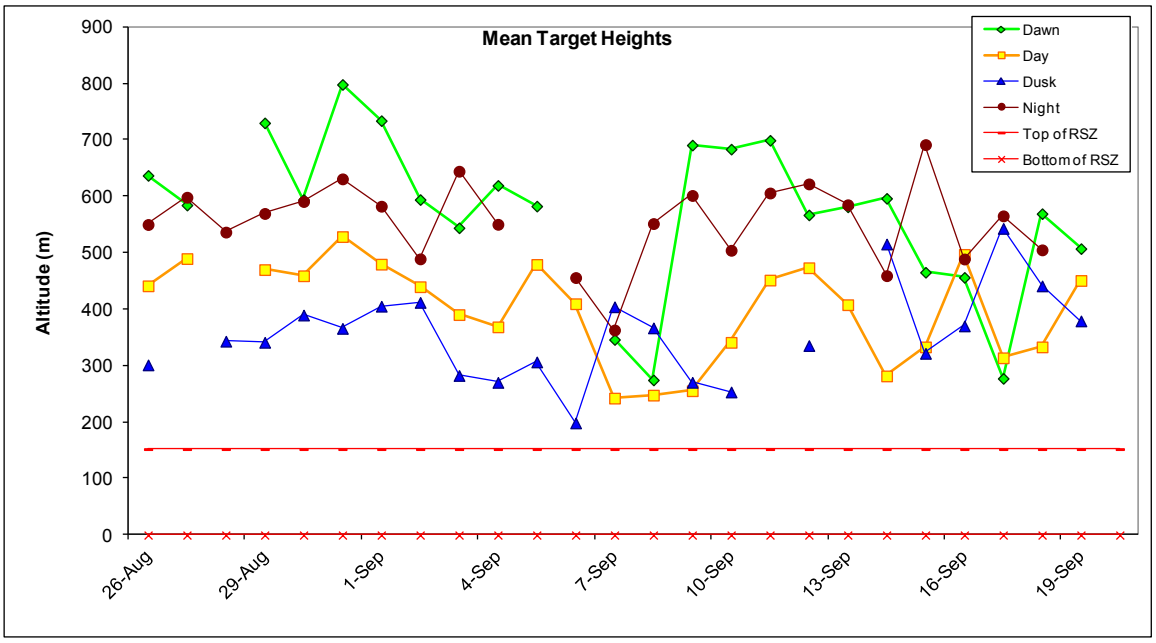

Figure 6-5. Mean target heights during four biological periods at site 1.

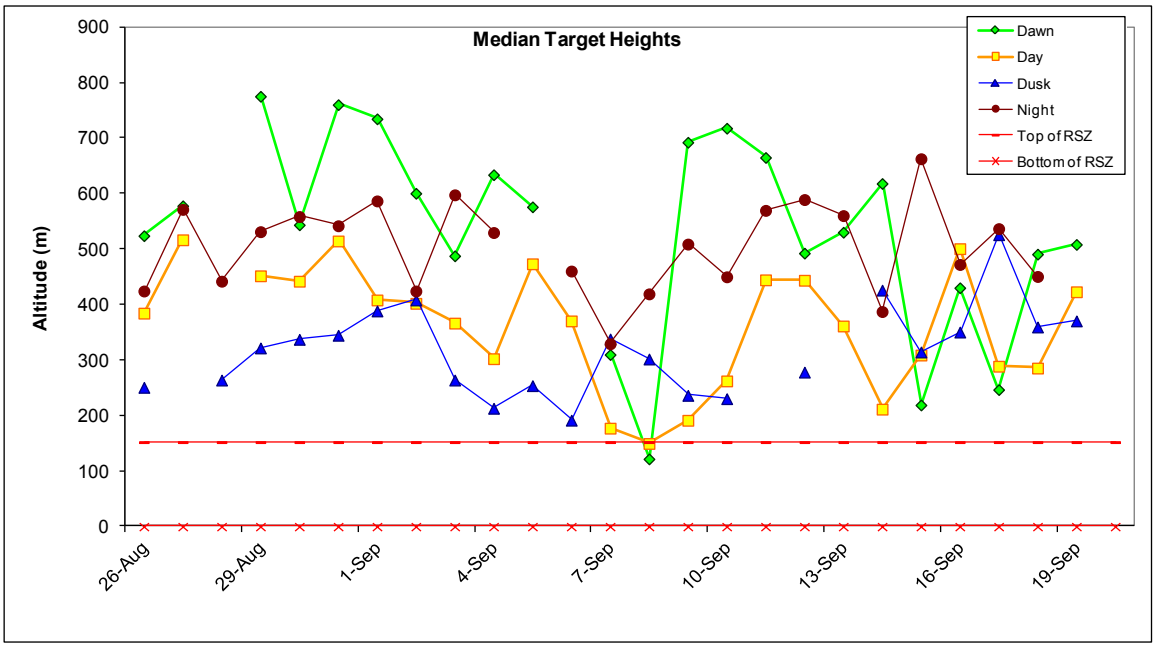

Figure 6-6. Median target heights during four biological periods at site 1.

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Table 6-3. Summary of mean and median target heights during four biological periods at site 1. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	571.5	399.8	355.7	554.5
Average median target height	533.5	362.2	317.2	505.1
All targets for season combined				
Mean target height	622.4	432.3	340.0	559.5
Median target height	586.1	408.7	303.0	524.6

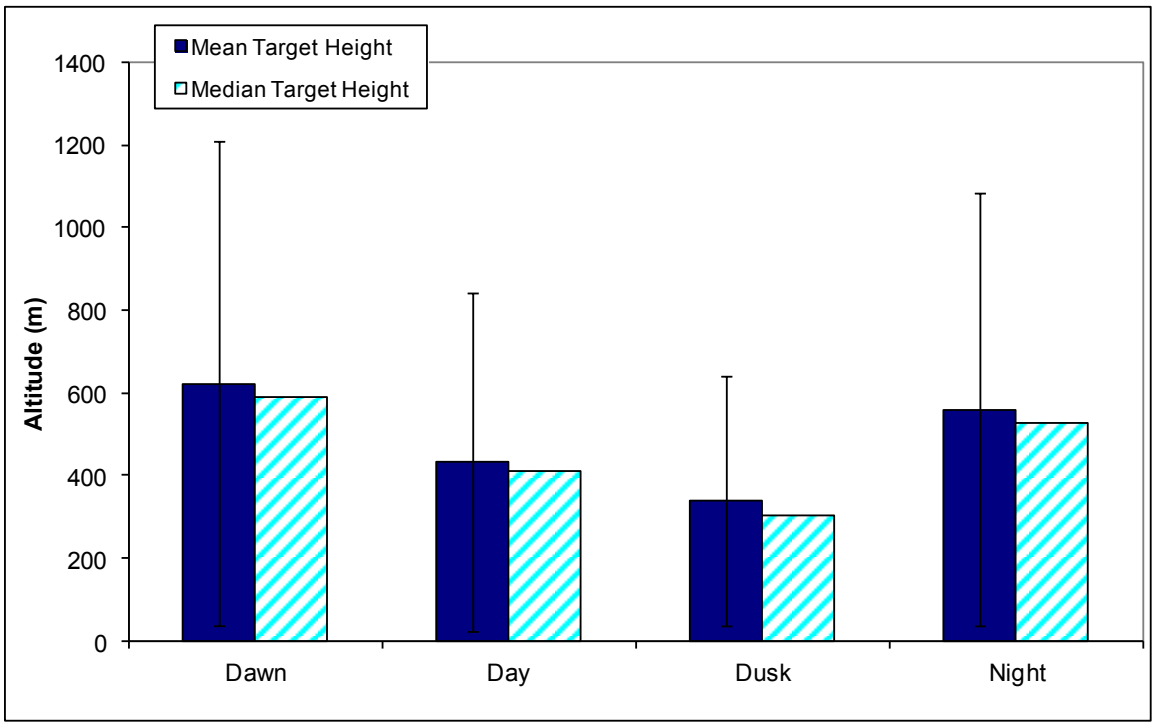

Figure 6-7. Overall mean and median target heights when all targets in each of the four biological periods were combined at site 1. Error bars represent one standard deviation.

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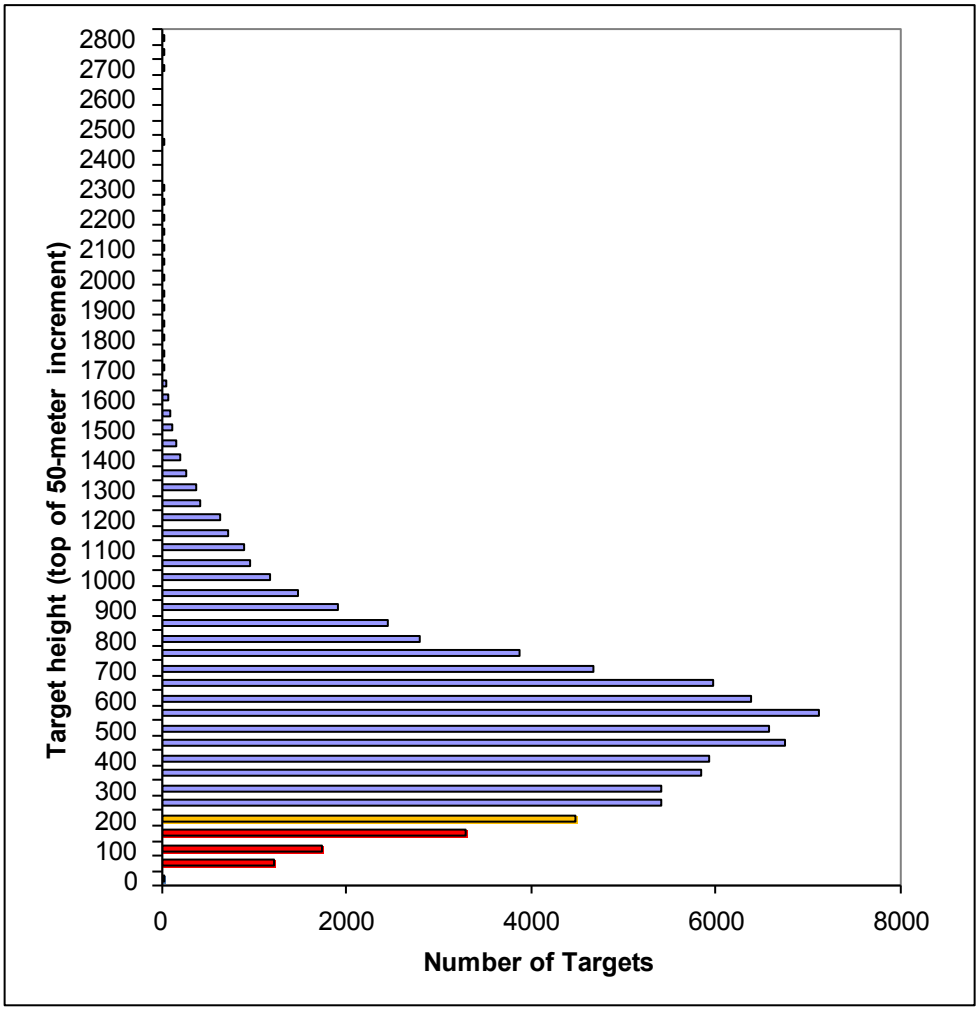

Figure 6-8. Number of targets occurring in each 50-meter increment at site 1. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 6-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods at site 1.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	96.8%	87.2%	84.5%	96.2%
% targets within RSZ	3.2%	12.7%	15.5%	3.8%
% targets below RSZ	0.0%	0.1%	0.0%	0.0%
% targets below turbine height	3.2%	12.8%	15.5%	3.8%
Target data calculated for each date				
Average % of targets in RSZ	7.7%	17.1%	13.3%	5.1%
Min target percentage within RSZ	0.0%	4.8%	0.0%	0.7%
Max target percentage within RSZ	50.0%	50.5%	30.4%	11.7%
Average target passage rate above RSZ	146.3	107.7	48.7	226.2
Average target passage rate within RSZ	4.9	16.0	8.9	9.0
Average target passage rate below RSZ	0.0	0.1	0.0	0.0

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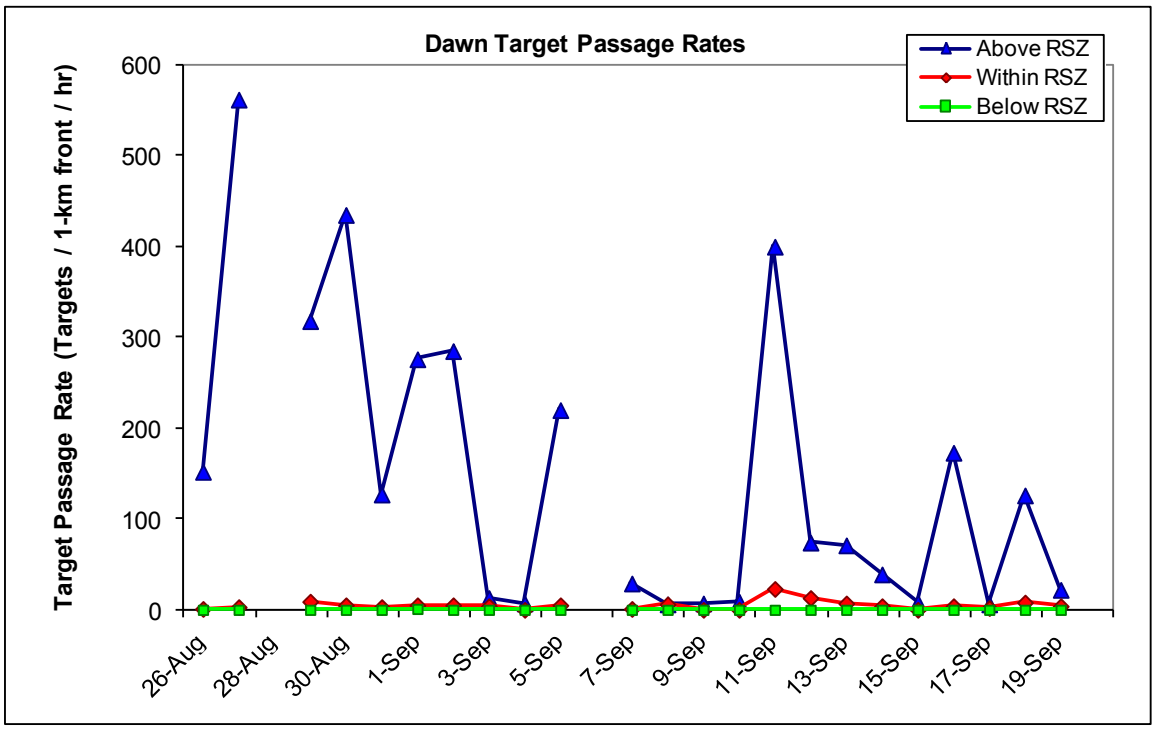

Figure 6-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns at site 1.

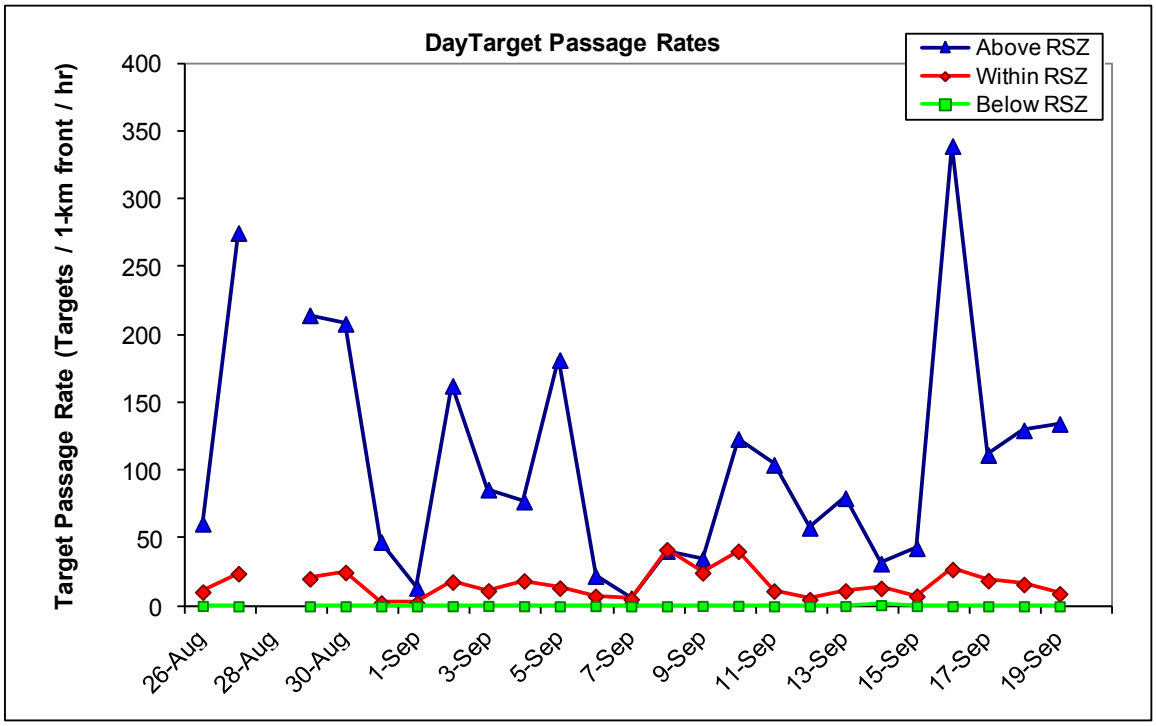

Figure 6-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days at site 1.

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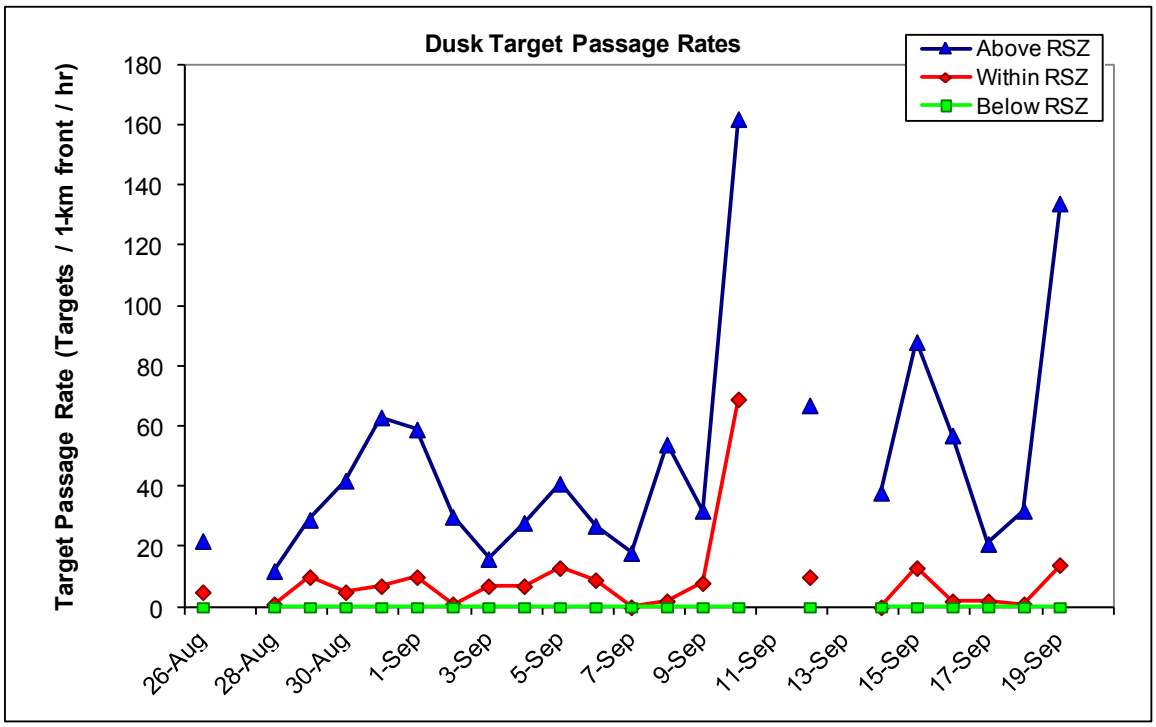

Figure 6-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks at site 1.

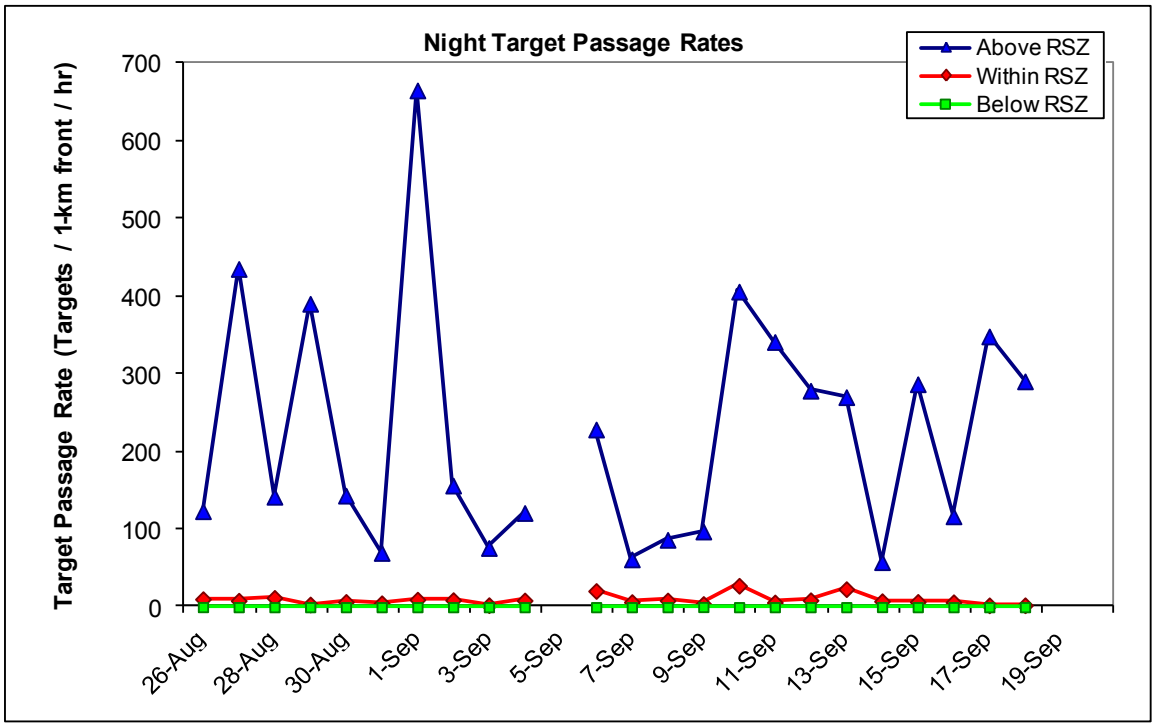

Figure 6-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights at site 1.

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6.3 Horizontal Radar Data

6.3.1 Target Directions

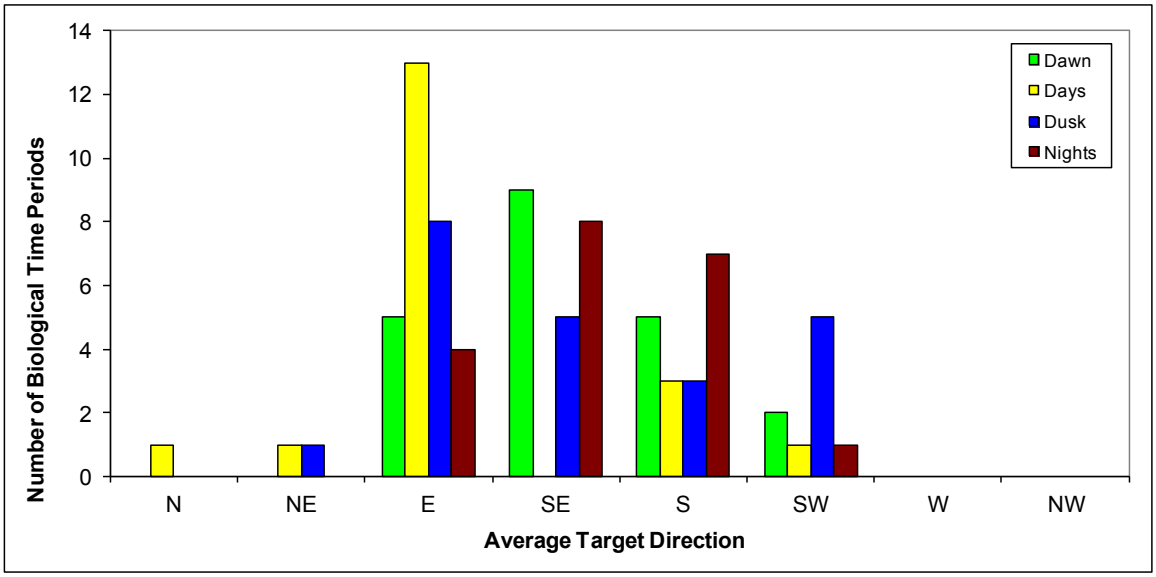

Figure 6-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at site 1.

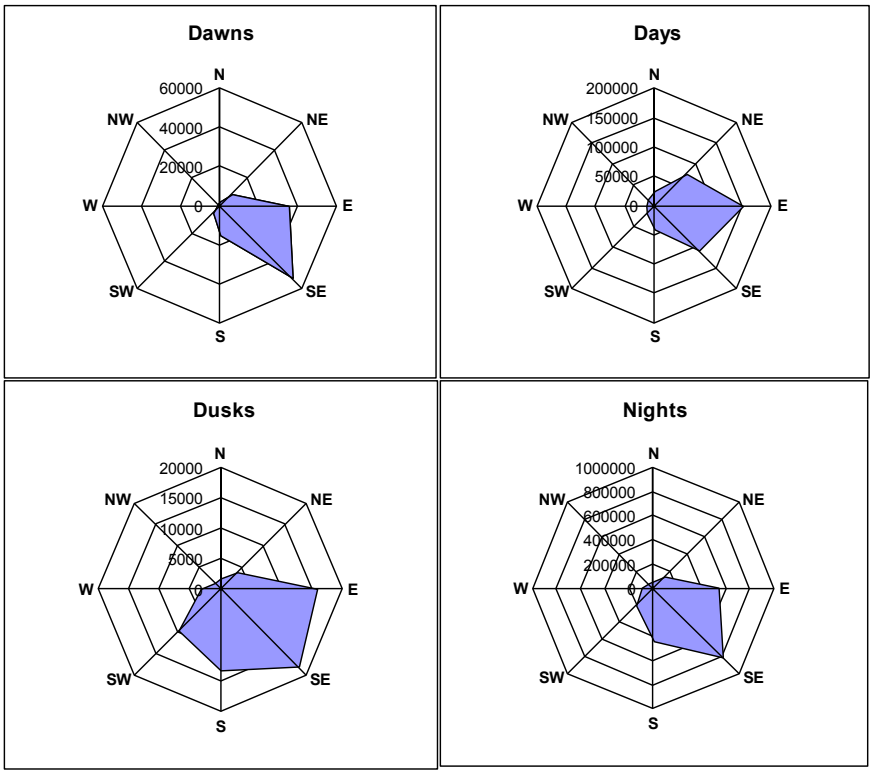

Figure 6-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights at site 1.

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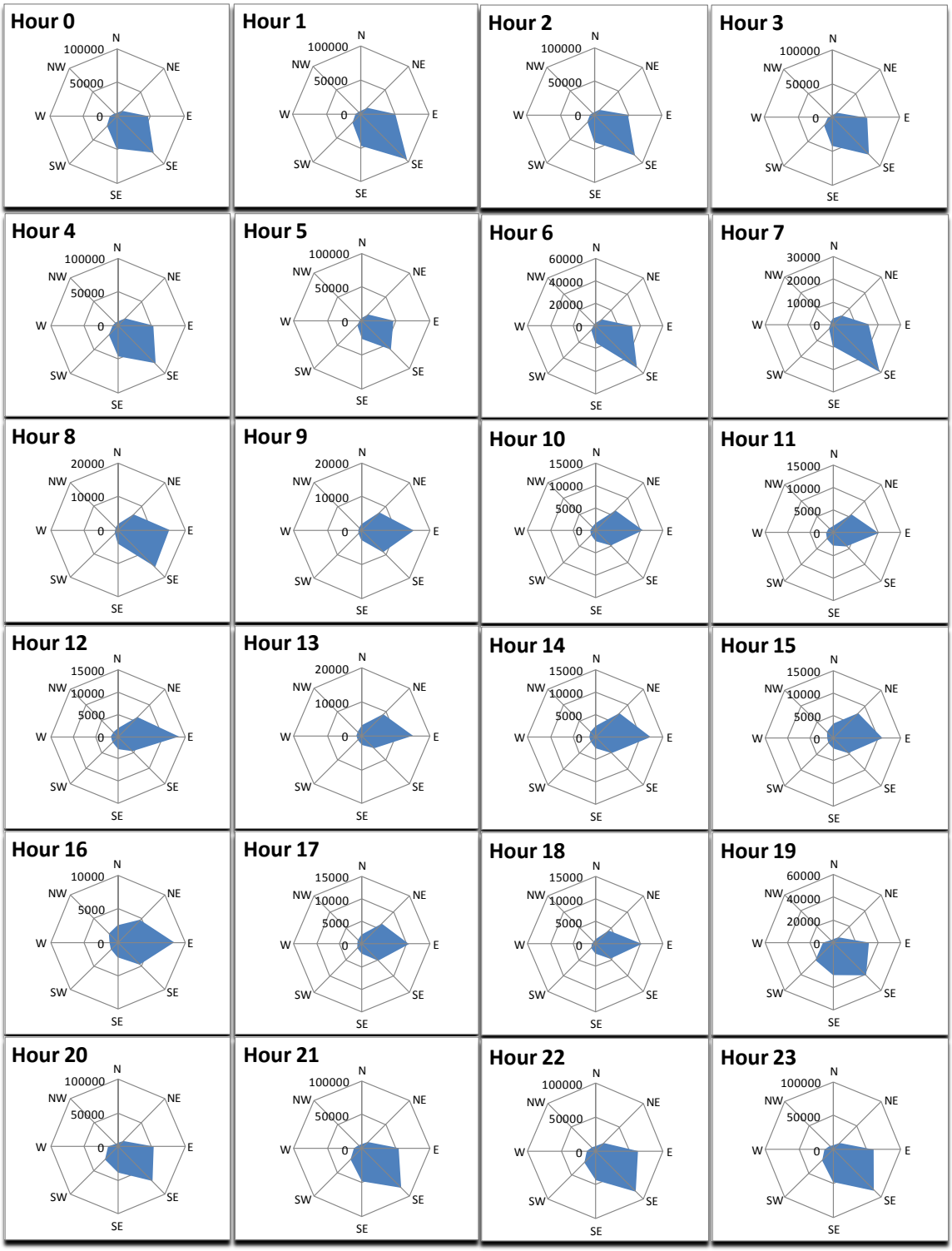

Figure 6-15. Directional distributions for targets during four biological periods at site 1.

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7 RESULTS for Site 2 (April 28 – June 27, 2011)

7.1 Level of Effort

The MERLIN Avian Radar System operated at Site 2 from April 28 to June 27, 2011.

Table 7-1. Effort of radar monitoring at site 2.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	1464	1349.9	114.1	549.3	800.6
Horizontal Radar (hrs)	1464	1359.9	104.1	48	1311.9

7.2 Vertical Radar Data

7.2.1 Target Passage Rates Over Time

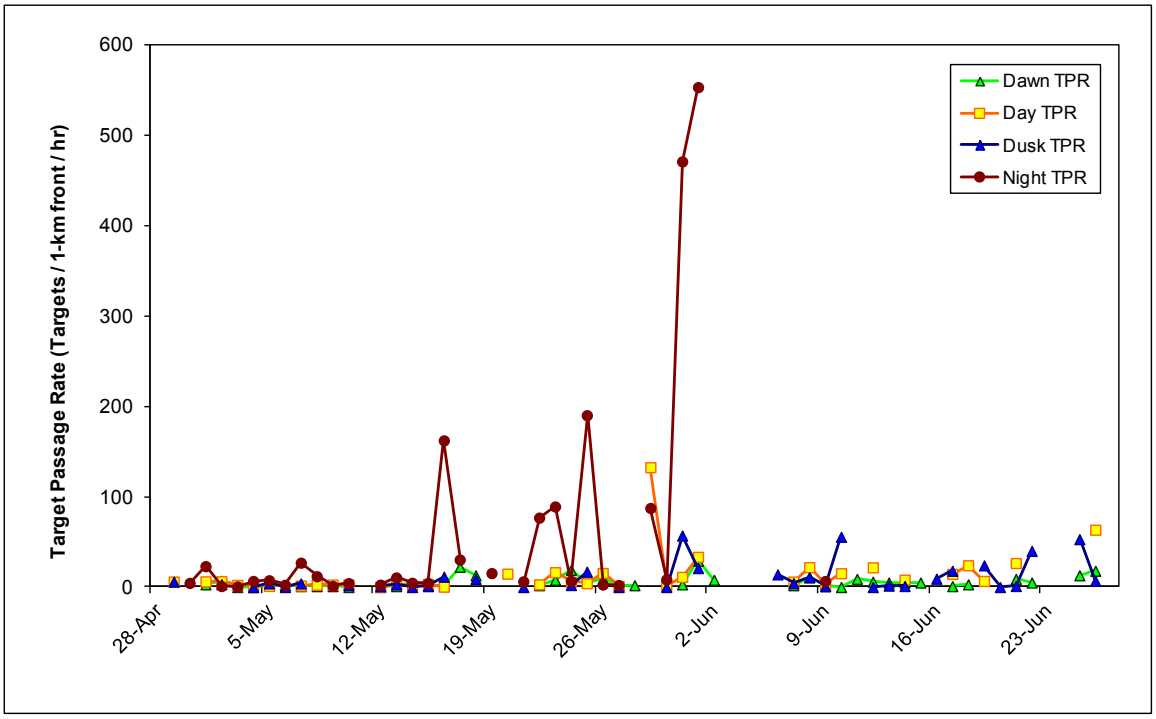

Figure 7-1. Target passage rates during dawns, days, dusks, and nights at site 2.

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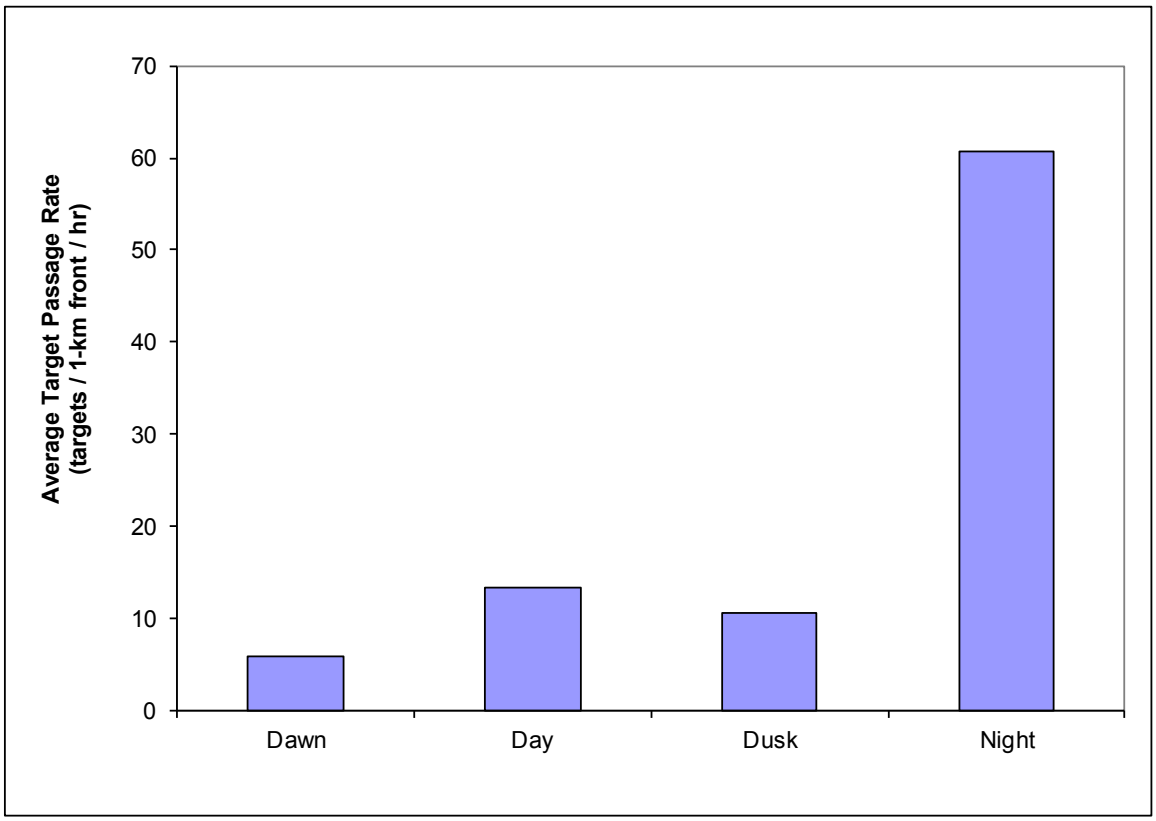

Figure 7-2. Average target passage rates for dawns, days, dusks, and nights at site 2.

Table 7-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods at site 2.

	Dawn	Day	Dusk	Night
Average	5.8	13.3	10.6	60.7
Standard Deviation	6.5	23.6	16.1	131.9
Median	3.0	6.1	3.6	7.1
Minimum	0.0	0.4	0.0	0.6
Maximum	29.0	132.6	57.0	553.4
Range	29.0	132.3	57.0	552.8

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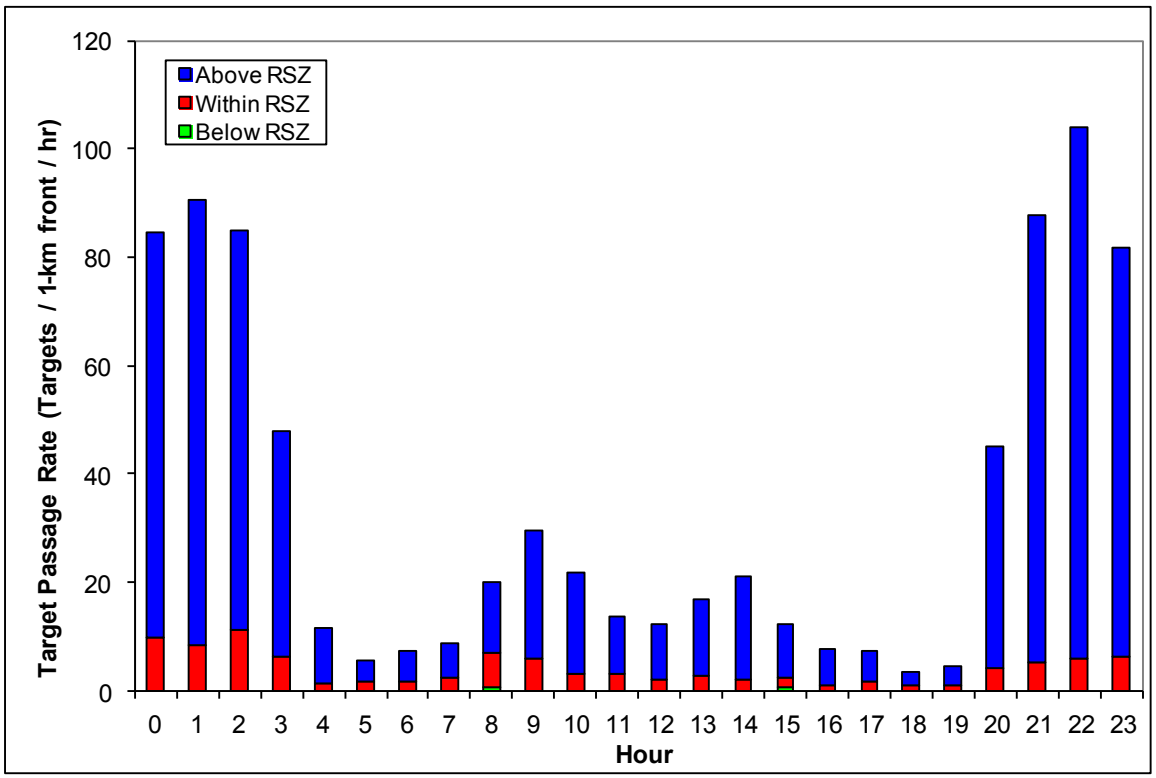

Figure 7-3. Hourly activity (average target passage rates) at site 2.

7.2.2 Altitudinal Distribution of Targets

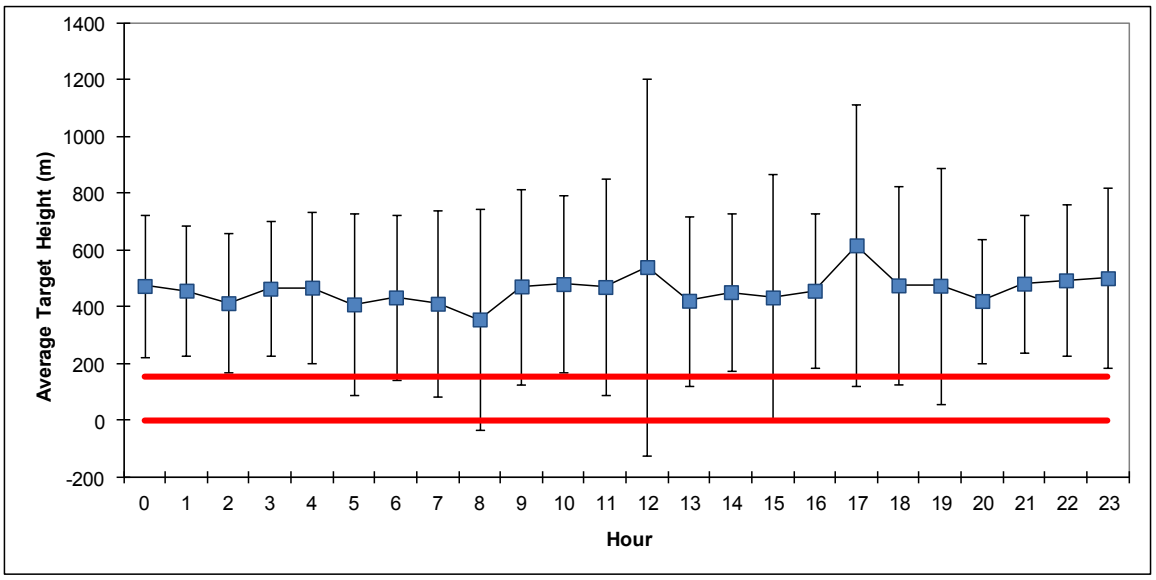

Figure 7-4. Average hourly target heights AGL at site 2. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

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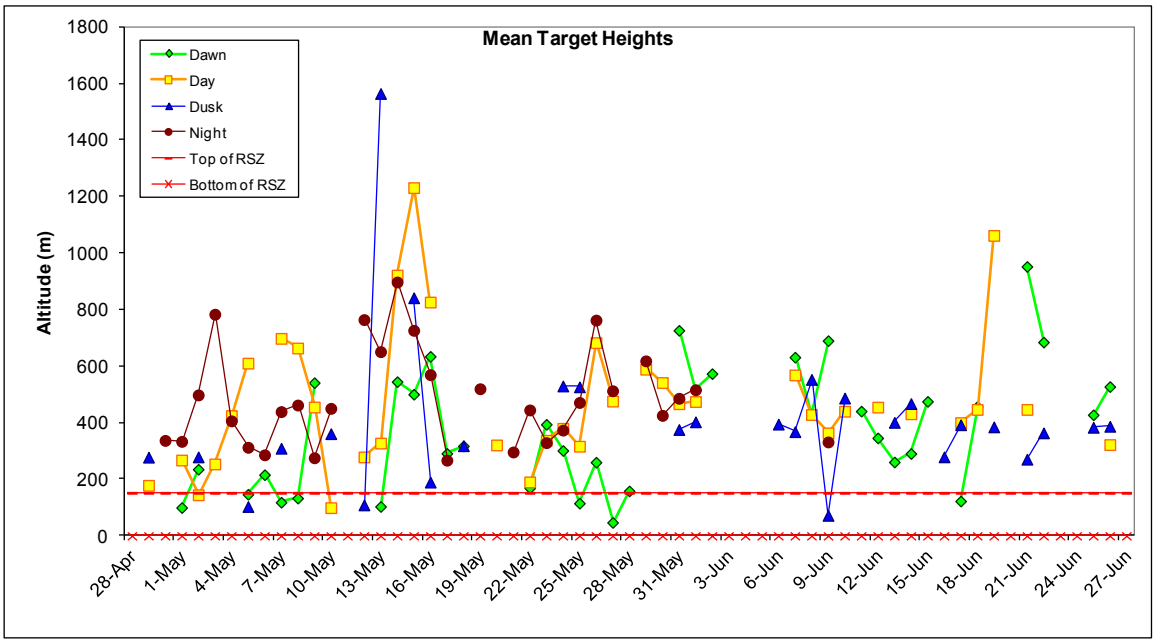

Figure 7-5. Mean target heights during four biological periods at site 2.

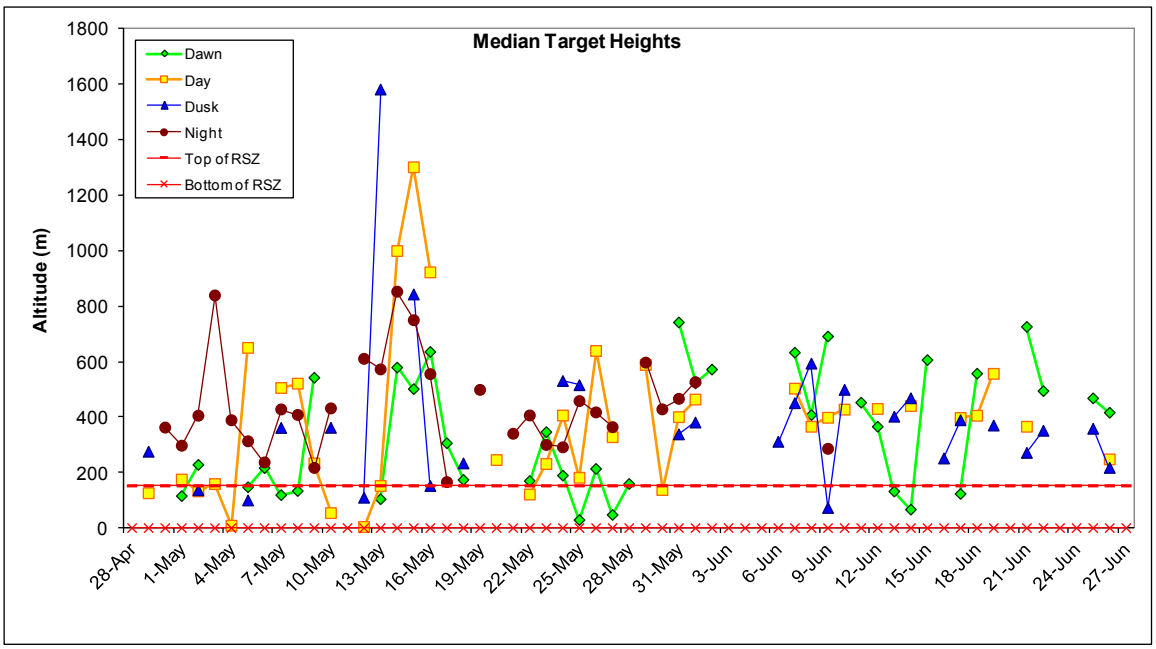

Figure 7-6. Median target heights during four biological periods at site 2.

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Table 7-3. Summary of mean and median target heights during four biological periods at site 2. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	375.8	474.5	407.6	485.8
Average median target height	349.4	384.3	390.1	440.4
All targets for season combined				
Mean target height	415.3	451.5	412.9	466.5
Median target height	371.1	407.5	372.8	446.5

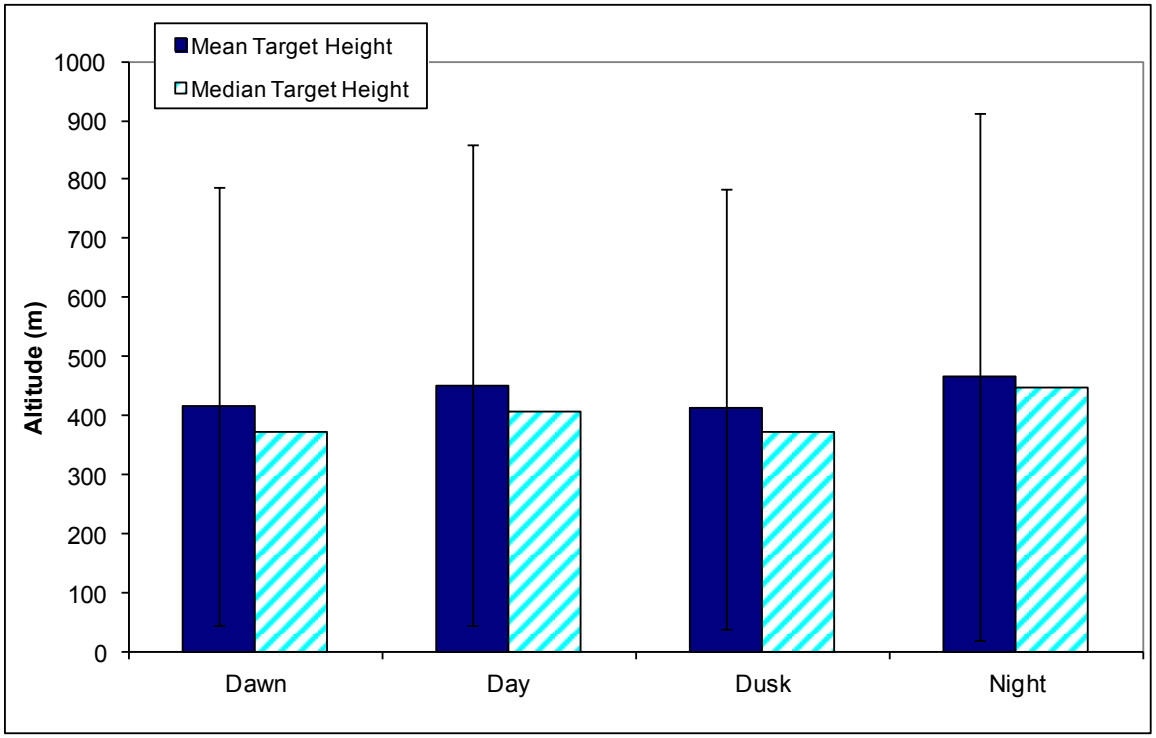

Figure 7-7. Overall mean and median target heights when all targets in each of the four biological periods were combined at site 2. Error bars represent one standard deviation.

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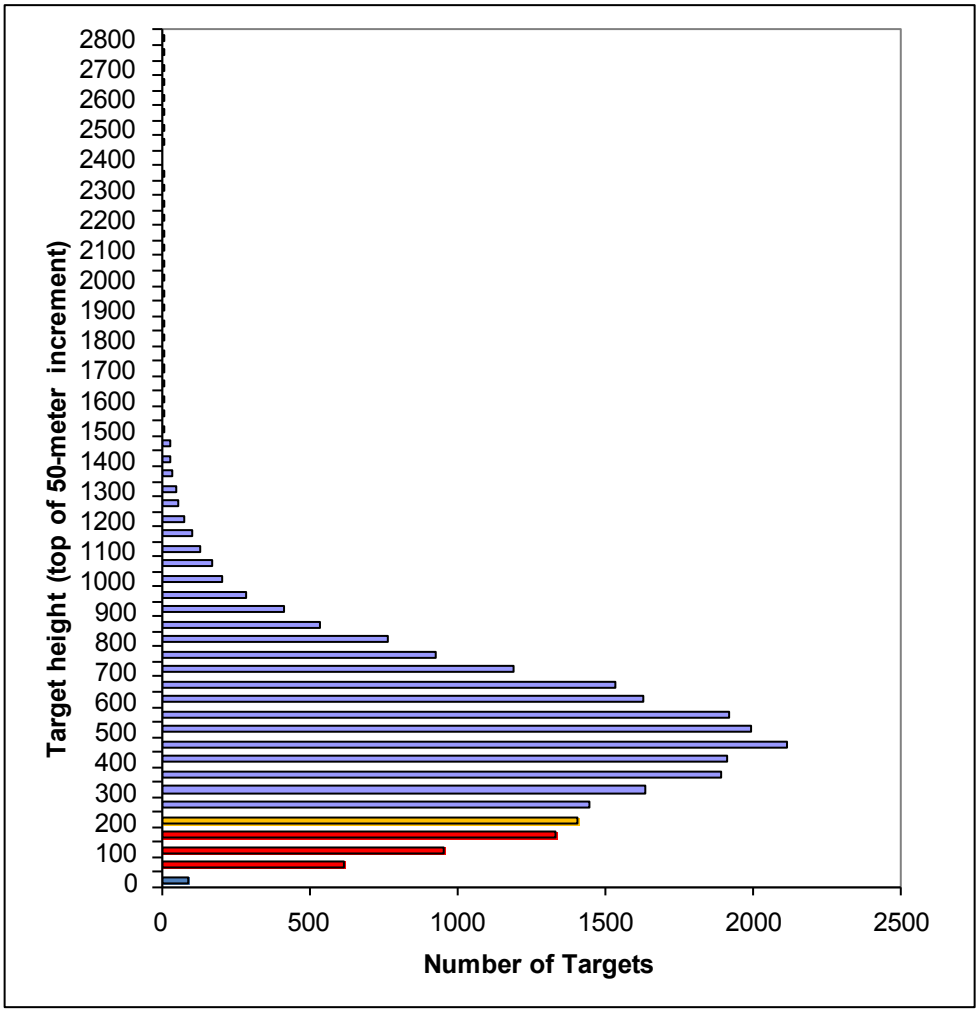

Figure 7-8. Number of targets occurring in each 50-meter increment at site 2. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 7-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods at site 2.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	75.4%	81.0%	88.3%	91.0%
% targets within RSZ	22.5%	17.8%	11.7%	8.9%
% targets below RSZ	2.1%	1.2%	0.0%	0.2%
% targets below turbine height	24.6%	19.0%	11.7%	9.0%
Target data calculated for each date				
Average % of targets in RSZ	31.8%	27.7%	19.1%	18.1%
Min target percentage within RSZ	0.0%	0.0%	0.0%	1.1%
Max target percentage within RSZ	100.0%	75.0%	100.0%	50.0%
Average target passage rate above RSZ	4.3	10.9	9.4	55.2
Average target passage rate within RSZ	1.3	2.3	1.3	5.4
Average target passage rate below RSZ	0.1	0.1	0.0	0.1

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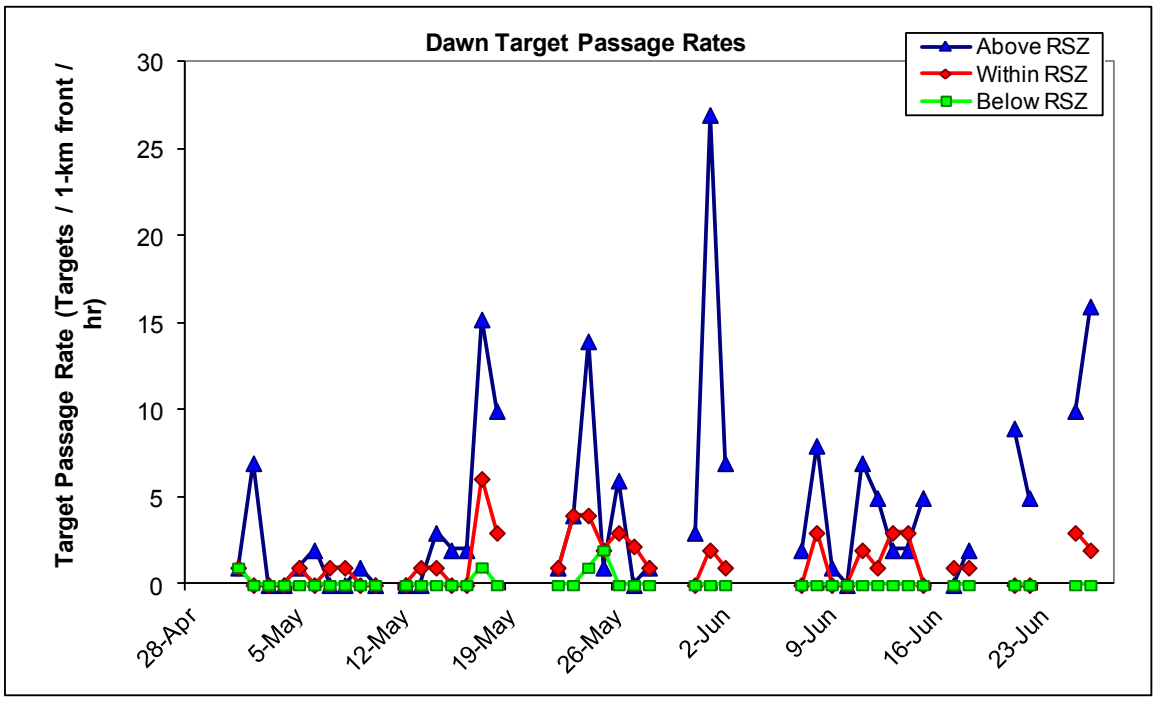

Figure 7-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns at site 2.

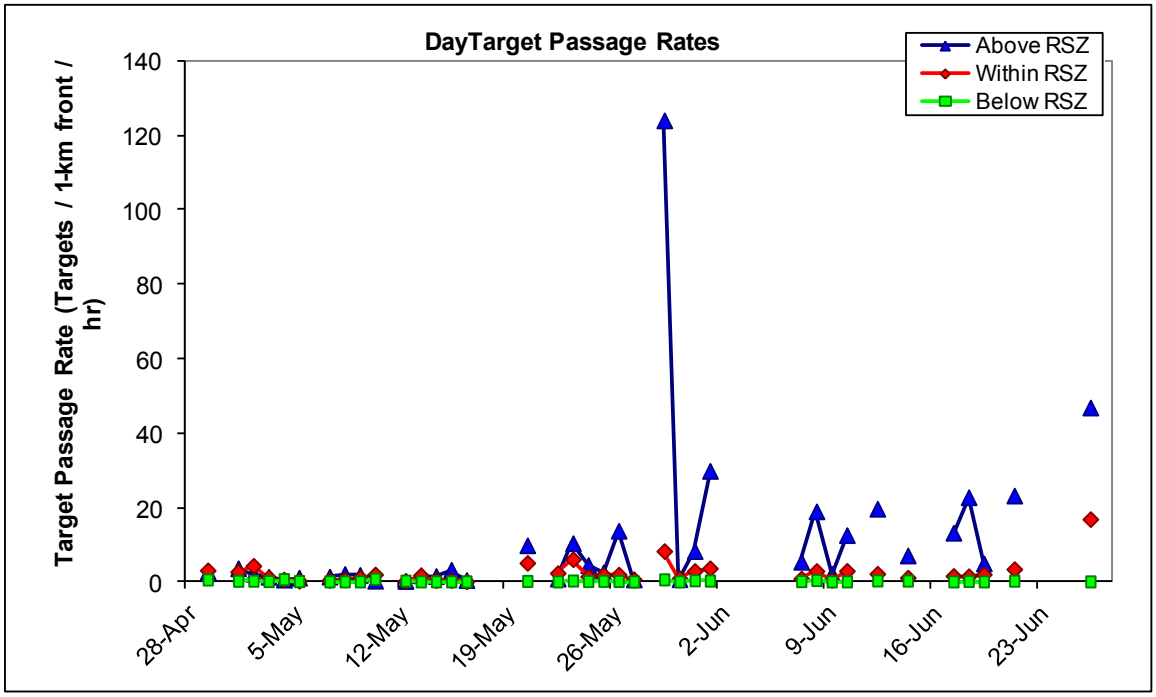

Figure 7-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days at site 2.

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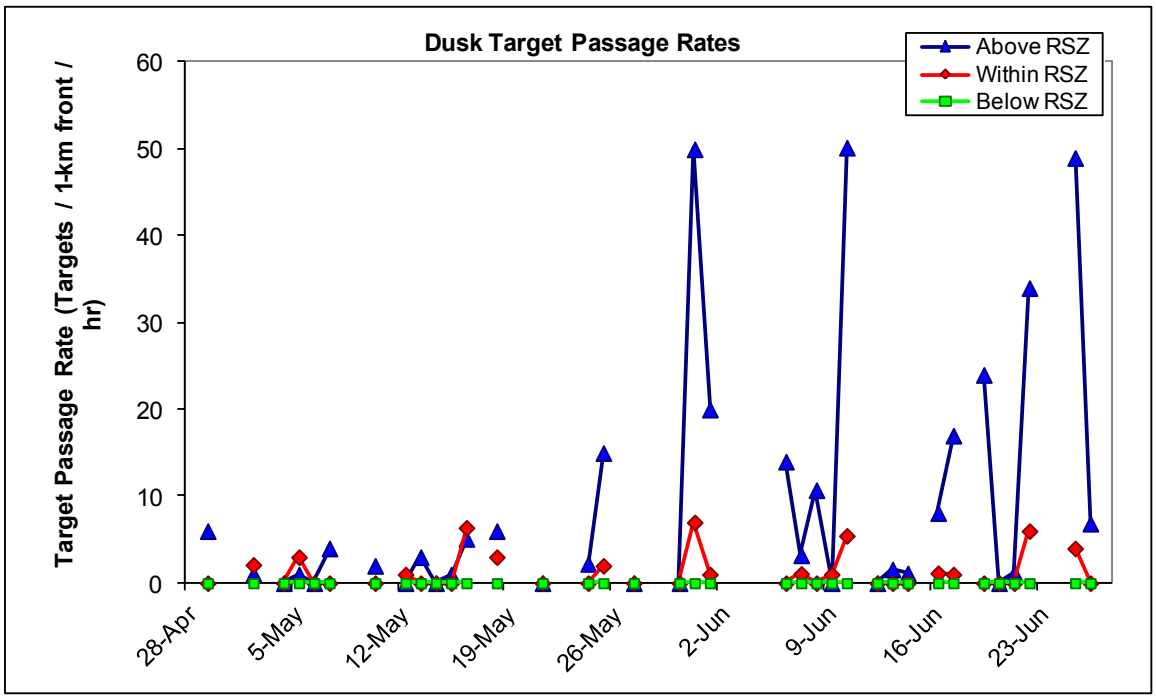

Figure 7-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks at site 2.

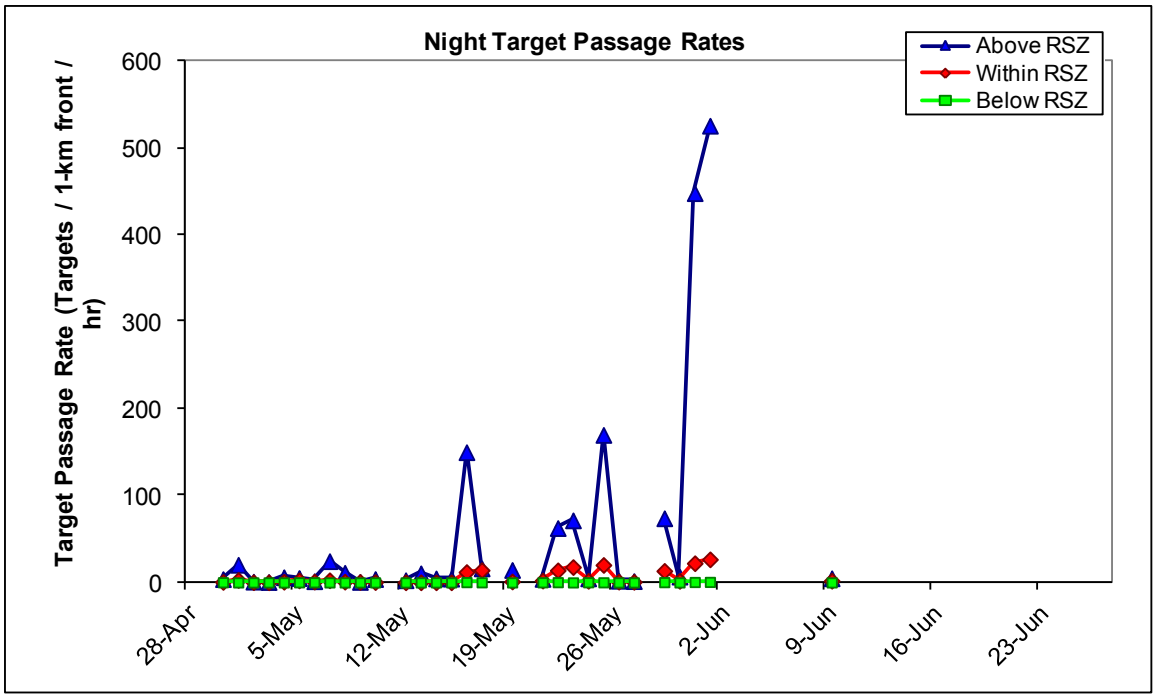

Figure 7-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights at site 2.

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7.3 Horizontal Radar Data

7.3.1 Target Directions

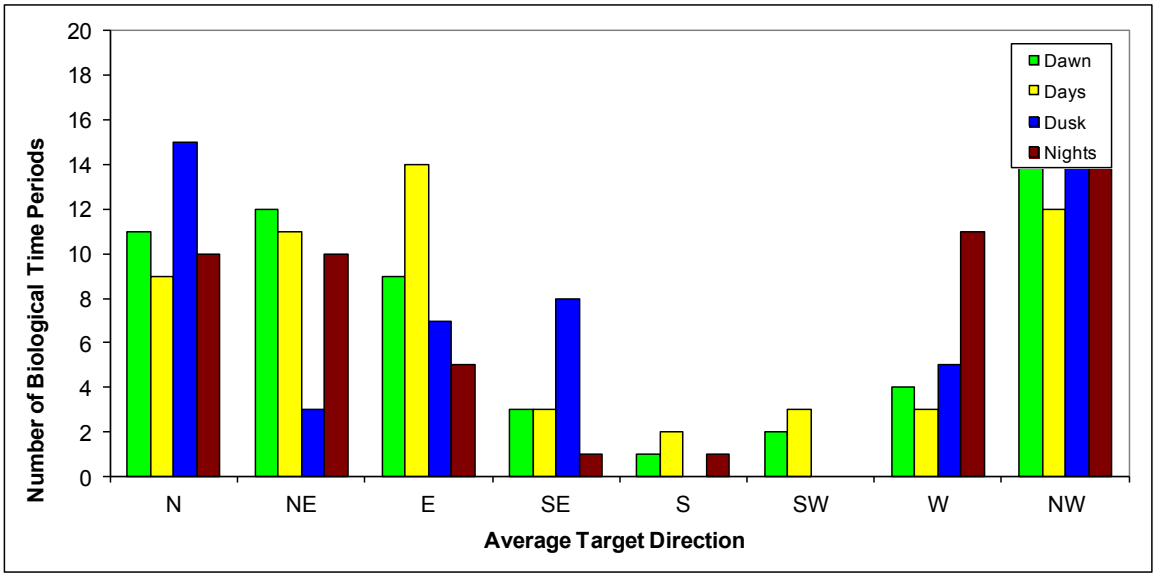

Figure 7-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at site 2.

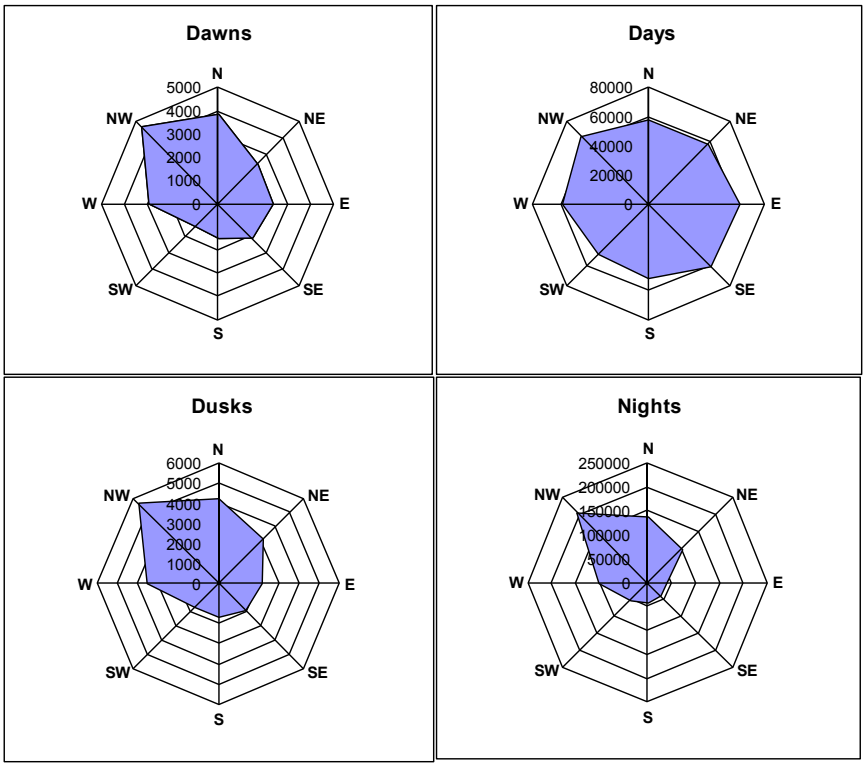

Figure 7-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights at site 2.

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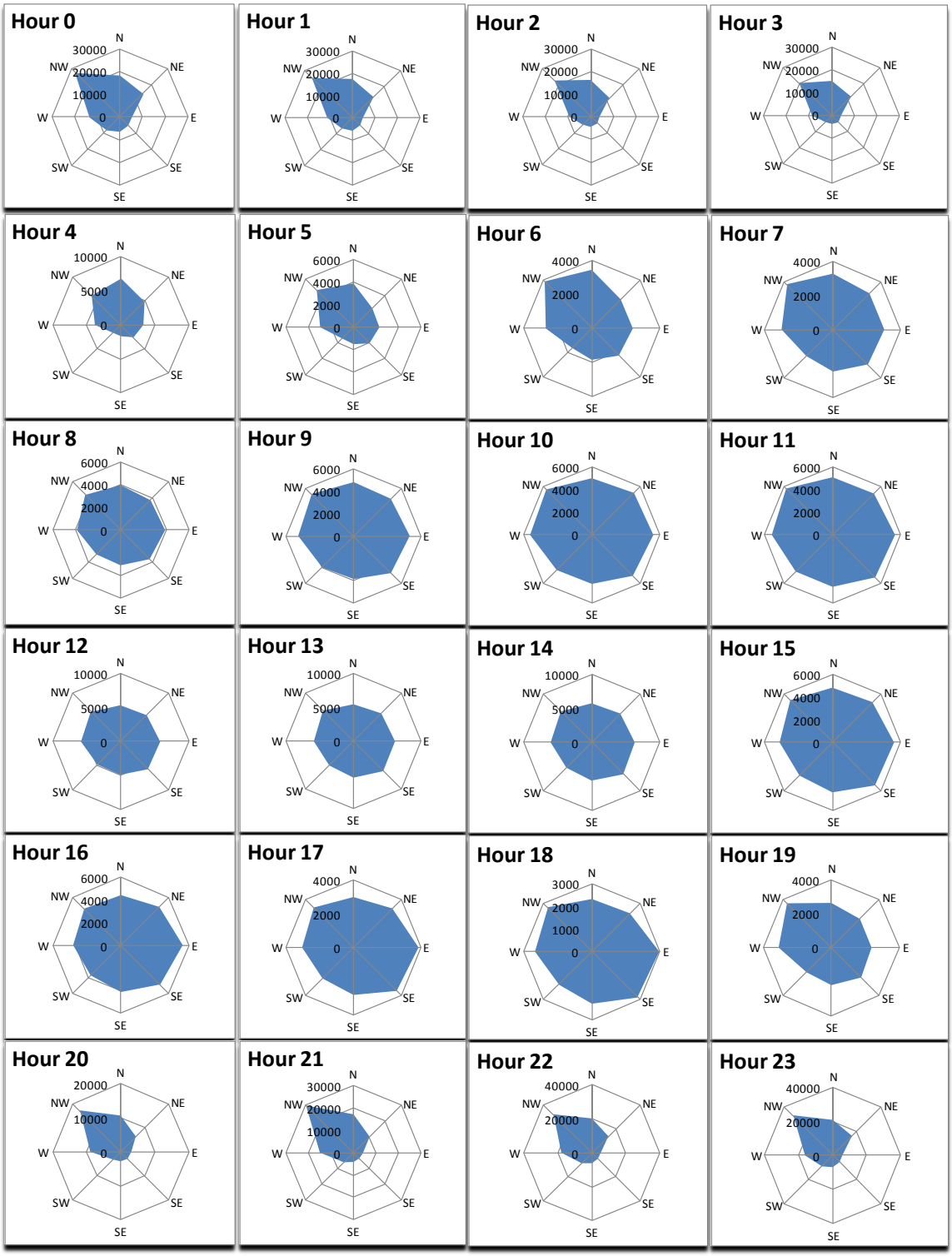

Figure 7-15. Directional distributions for targets during four biological periods at site 2.

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8 RESULTS for Site 3 (July 1 – August 22, 2011)

8.1 Level of Effort

The MERLIN Avian Radar System operated at Site 3 from July 1 to August 22, 2011.

Table 8-1. Effort of radar monitoring at site 3.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	1272	1247.7	24.3	555.4	692.3
Horizontal Radar (hrs)	1272	983.8	288.2	13.8	970

8.2 Vertical Radar Data

8.2.1 Target Passage Rates Over Time

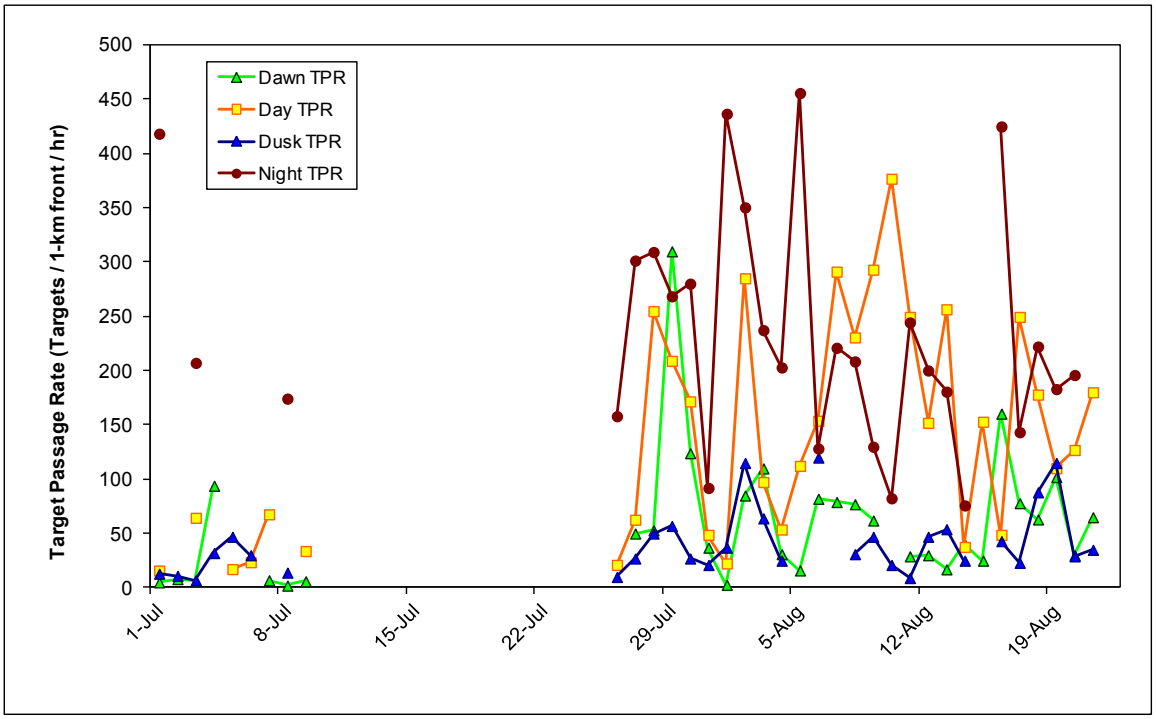

Figure 8-1. Target passage rates during dawns, days, dusks, and nights at site 3.

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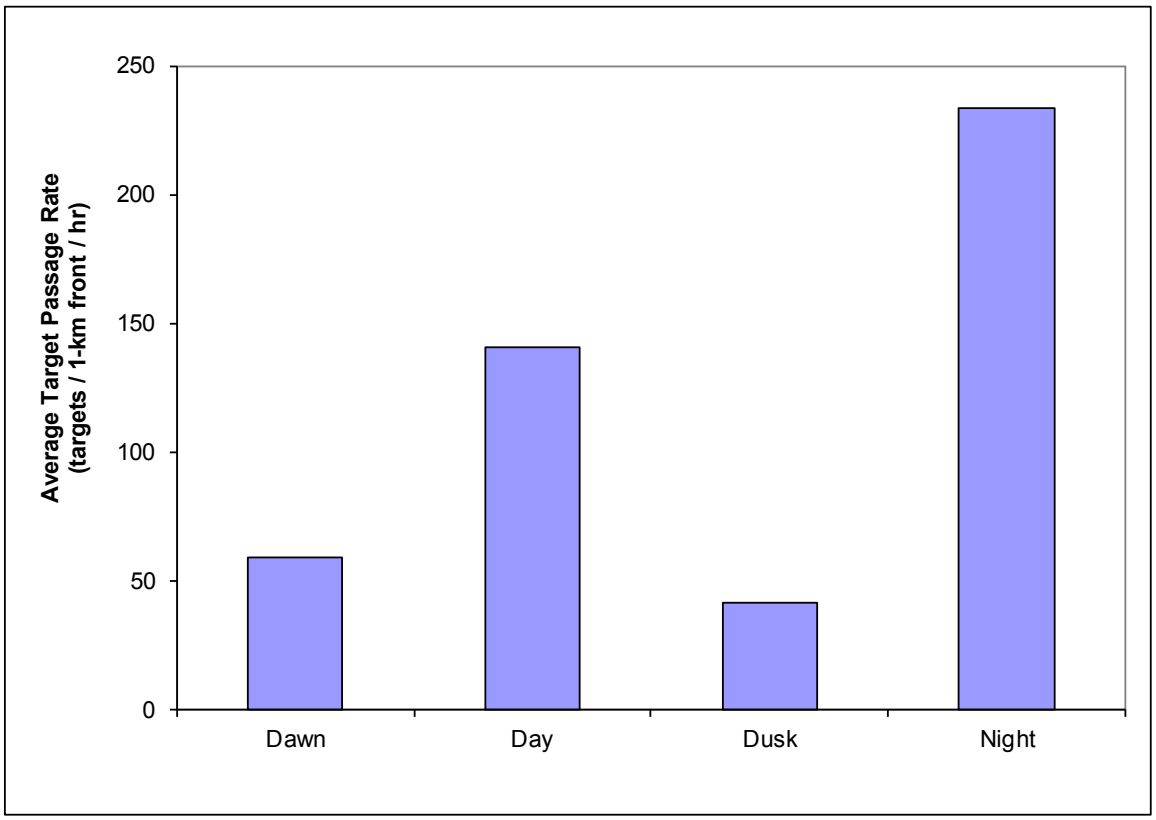

Figure 8-2. Average target passage rates for dawns, days, dusks, and nights at site 3.

Table 8-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods at site 3.

	Dawn	Day	Dusk	Night
Average	58.9	140.9	41.1	233.4
Standard Deviation	60.9	101.6	30.9	106.5
Median	45.0	127.0	31.0	207.9
Minimum	2.0	15.9	7.0	75.9
Maximum	310.0	376.9	120.0	455.8
Range	308.0	361.0	113.0	380.0

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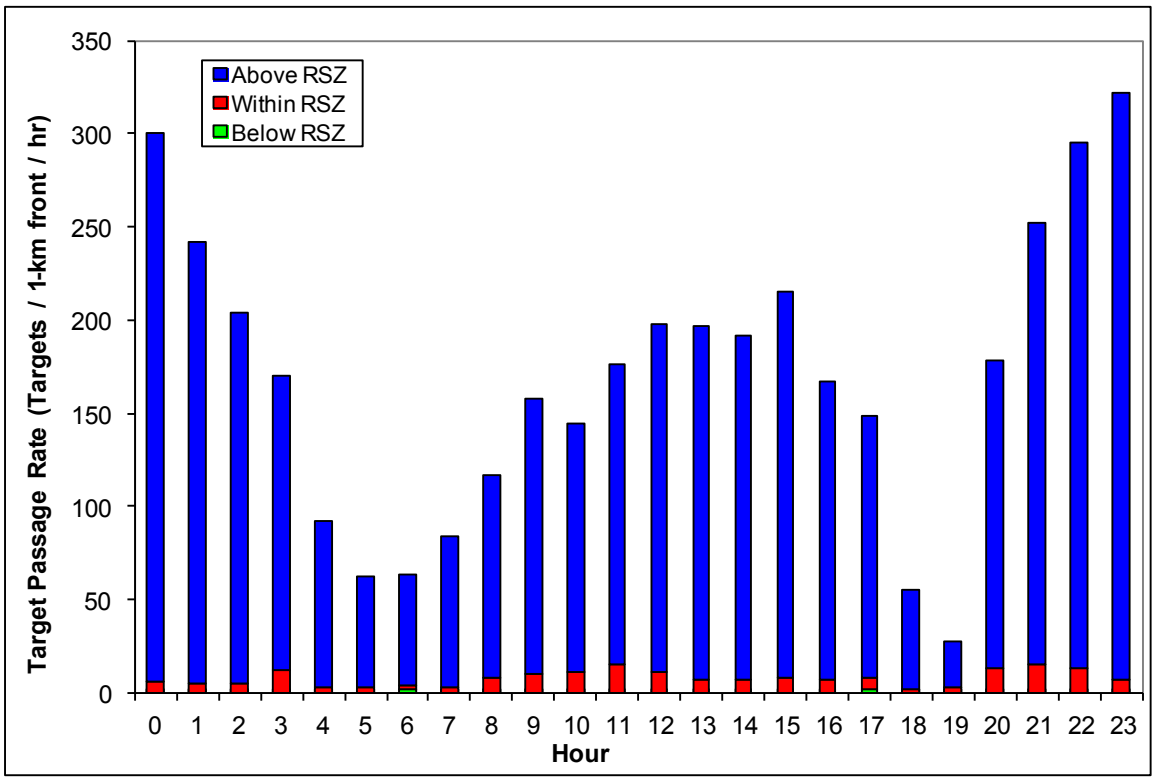

Figure 8-3. Hourly activity (average target passage rates) at site 3.

8.2.2 Altitudinal Distribution of Targets

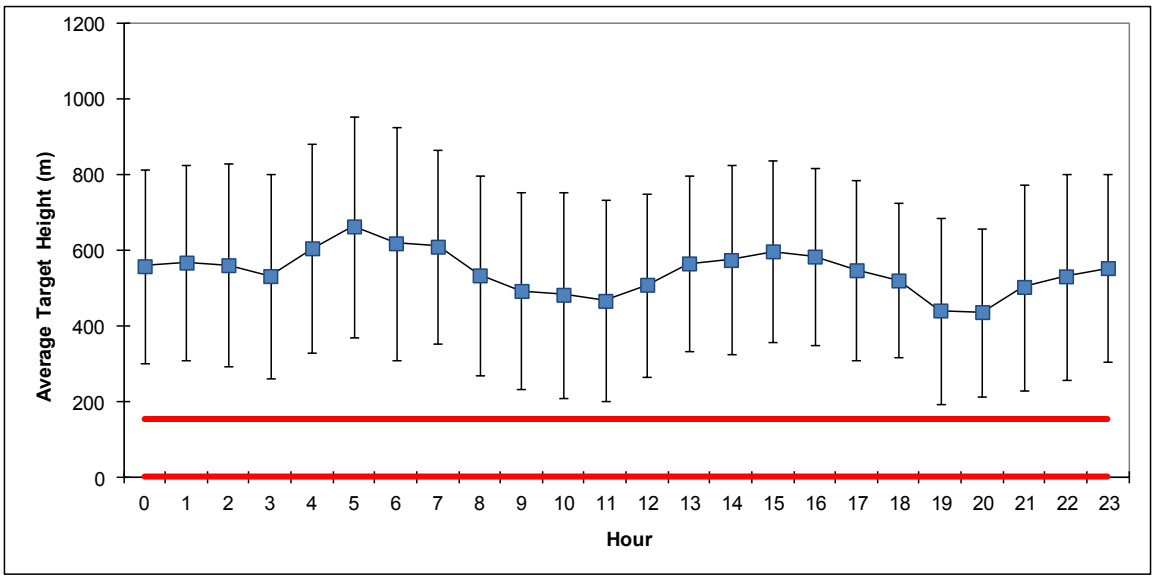

Figure 8-4. Average hourly target heights AGL at site 3. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

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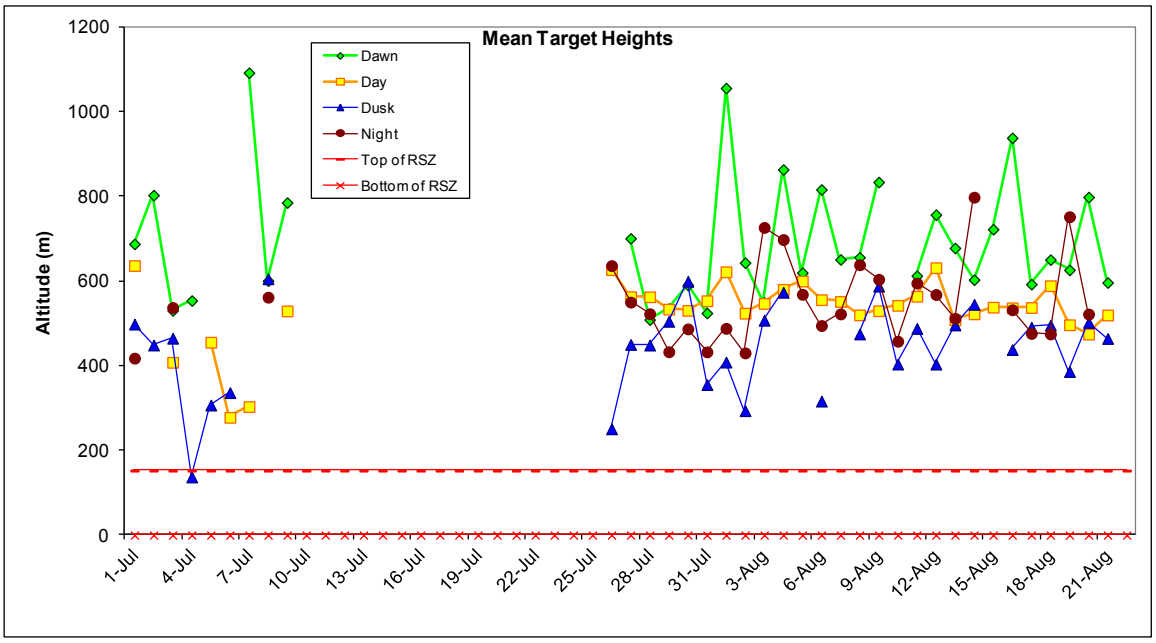

Figure 8-5. Mean target heights during four biological periods at site 3.

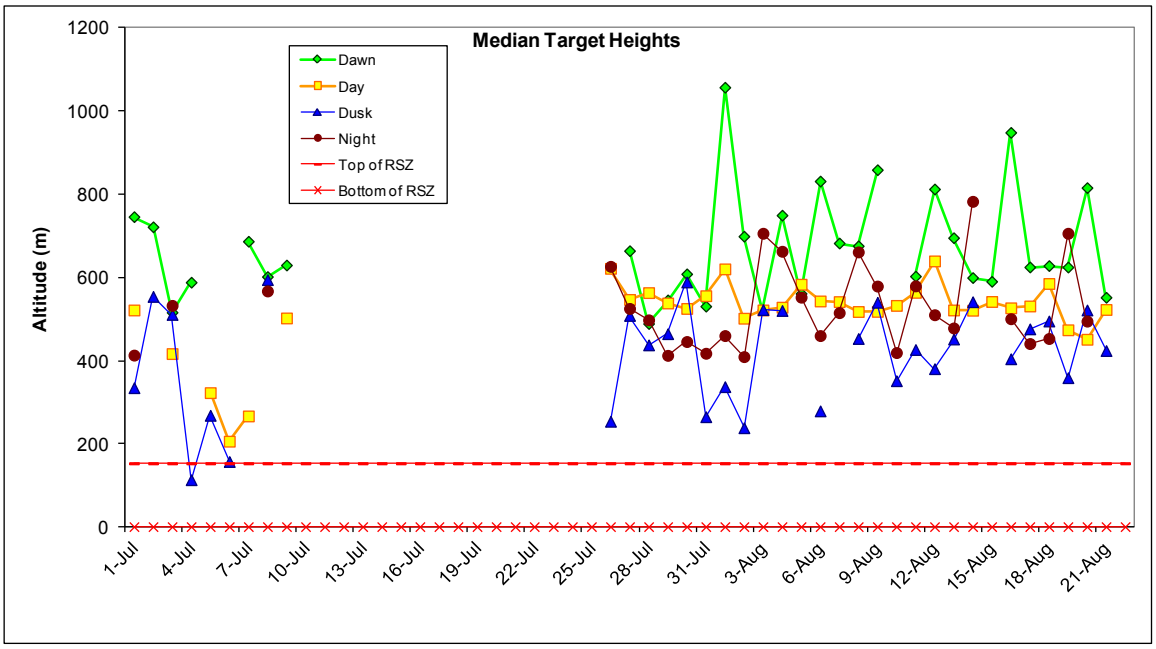

Figure 8-6. Median target heights during four biological periods at site 3.

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Table 8-3. Summary of mean and median target heights during four biological periods of the spring 2011 season. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	693.4	529.9	441.7	551.7
Average median target height	670.0	510.7	411.4	528.2
All targets for season combined				
Mean target height	657.0	537.6	425.8	539.0
Median target height	627.0	531.9	394.4	506.0

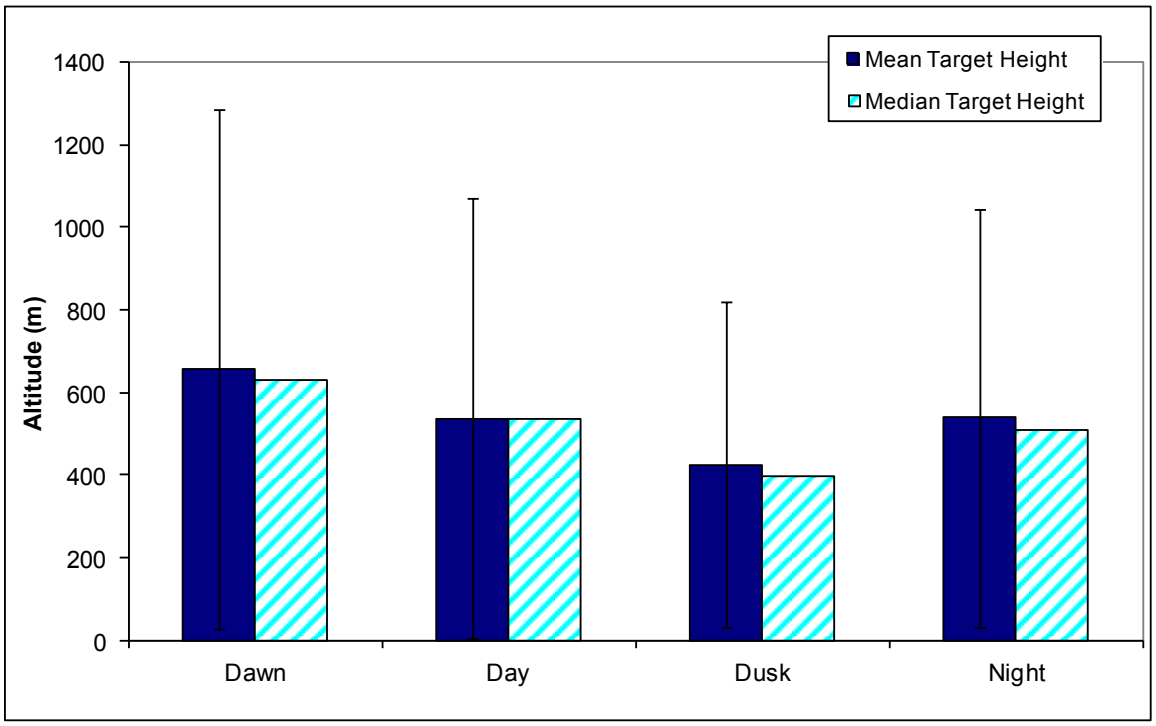

Figure 8-7. Overall mean and median target heights when all targets in each of the four biological periods were combined at site 3. Error bars represent one standard deviation.

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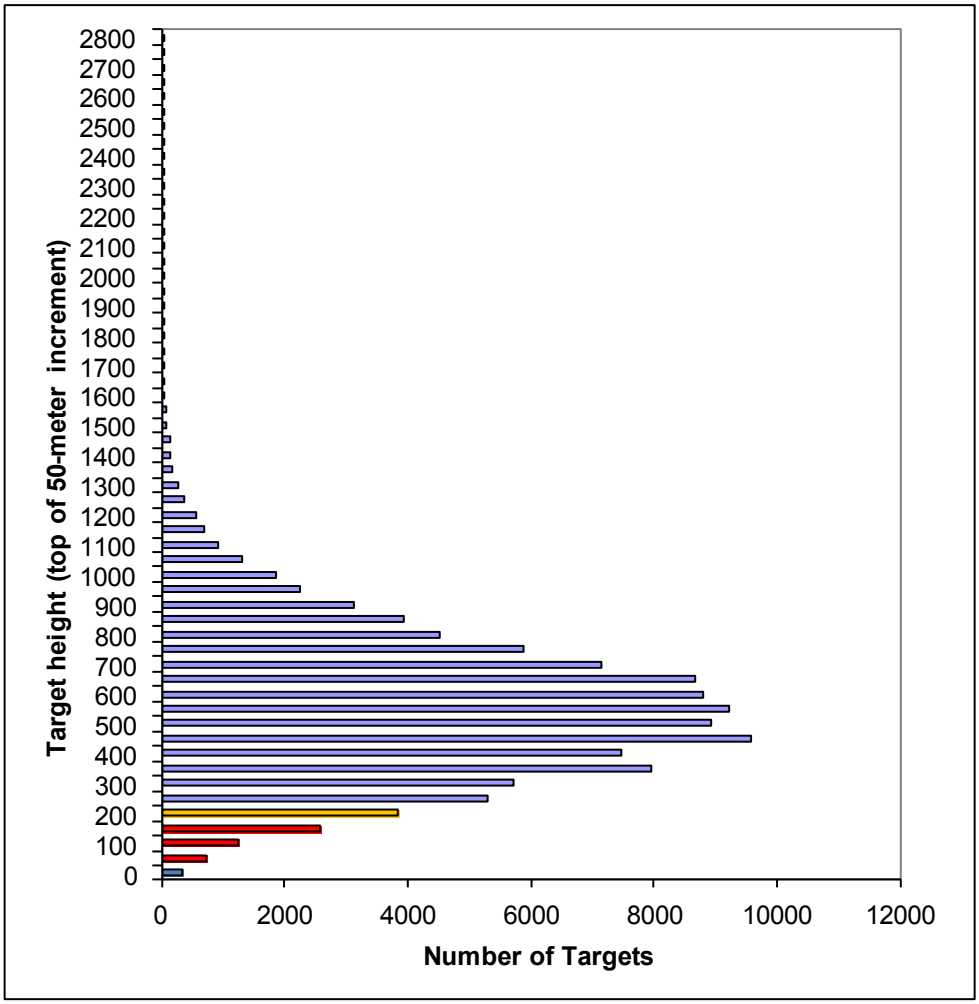

Figure 8-8. Number of targets occurring in each 50-meter increment at site 3. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 8-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods at site 3.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	95.5%	95.1%	88.7%	96.9%
% targets within RSZ	3.7%	4.5%	10.8%	3.0%
% targets below RSZ	0.7%	0.4%	0.5%	0.1%
% targets below turbine height	4.5%	4.9%	11.3%	3.1%
Target data calculated for each date				
Average % of targets in RSZ	3.4%	6.1%	9.9%	2.9%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.1%
Max target percentage within RSZ	14.3%	33.3%	75.0%	9.9%
Average target passage rate above RSZ	56.4	133.8	36.2	225.9
Average target passage rate within RSZ	2.2	6.5	4.7	7.1
Average target passage rate below RSZ	0.4	0.6	0.2	0.3

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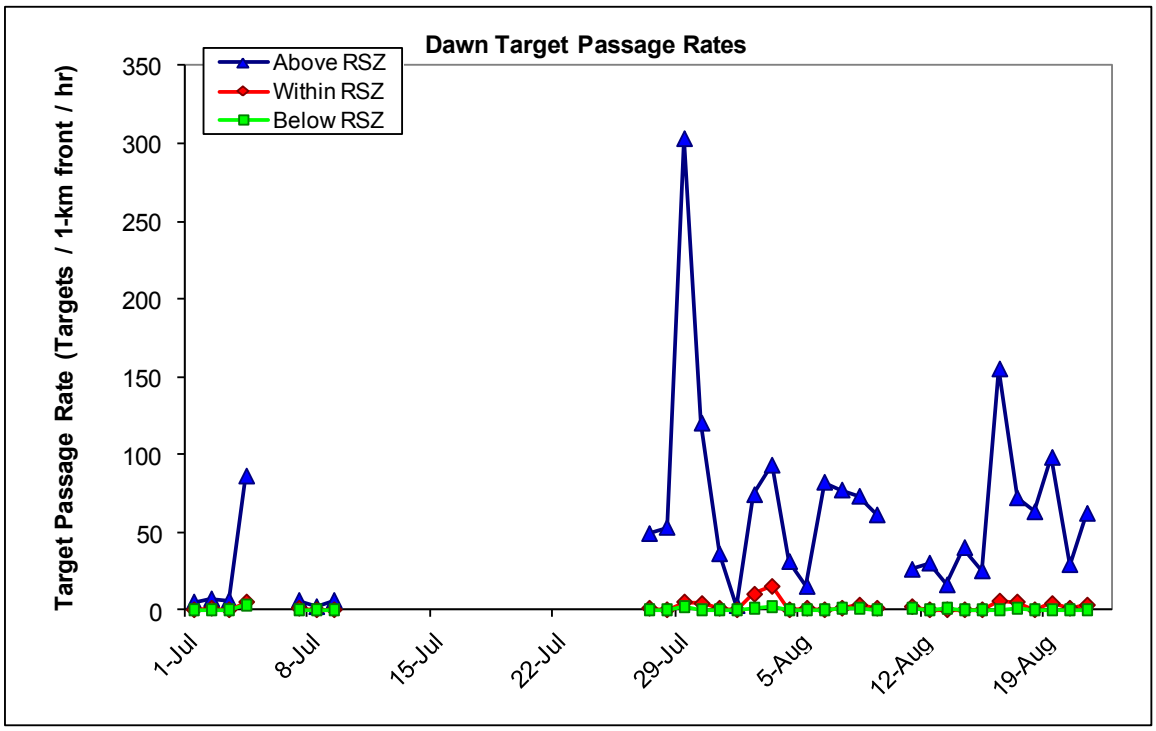

Figure 8-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns at site 3.

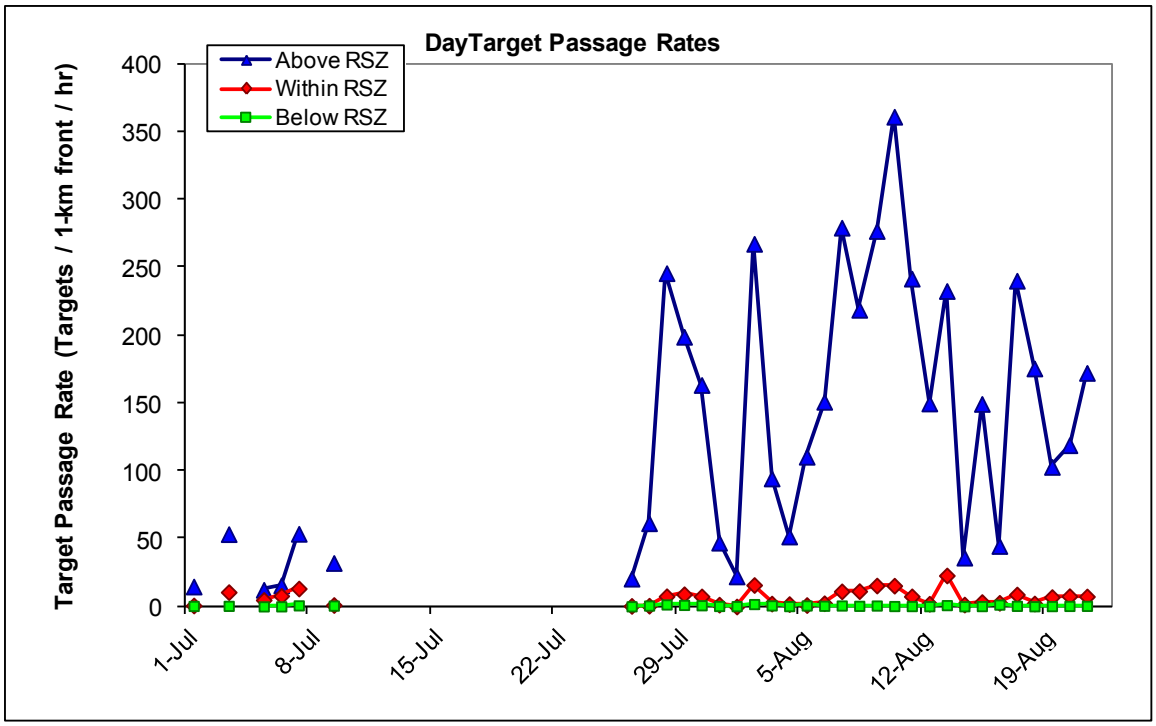

Figure 8-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days at site 3.

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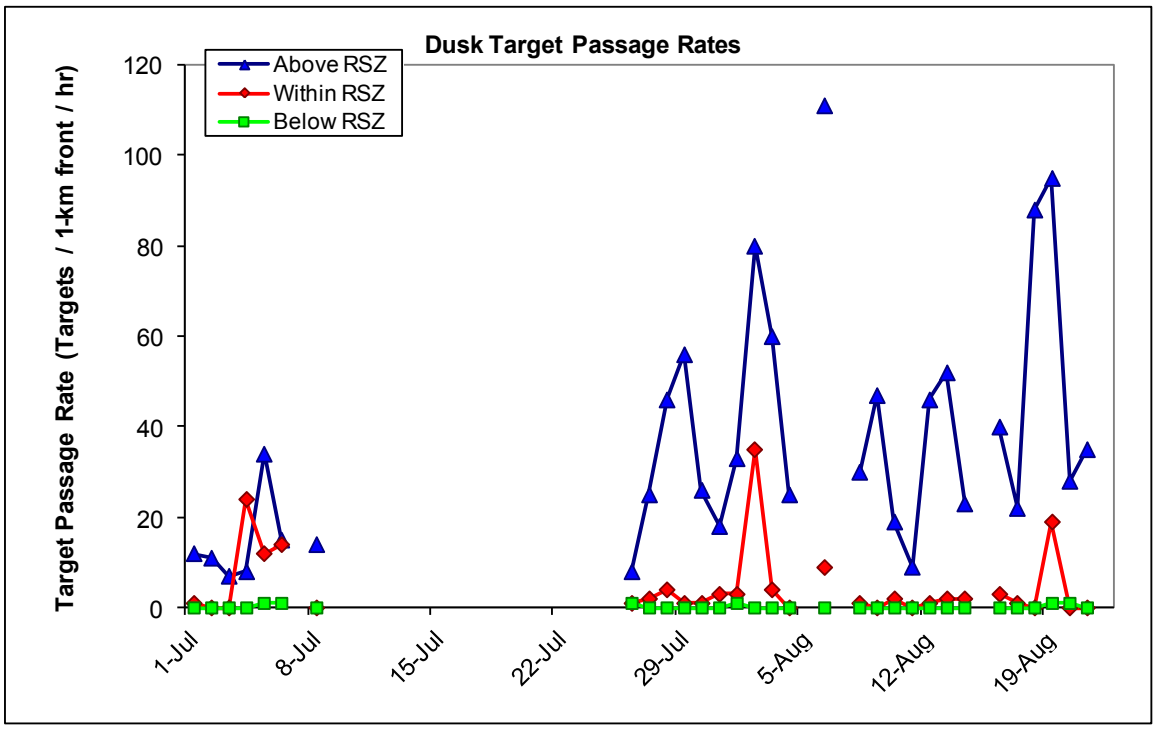

Figure 8-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks at site 3.

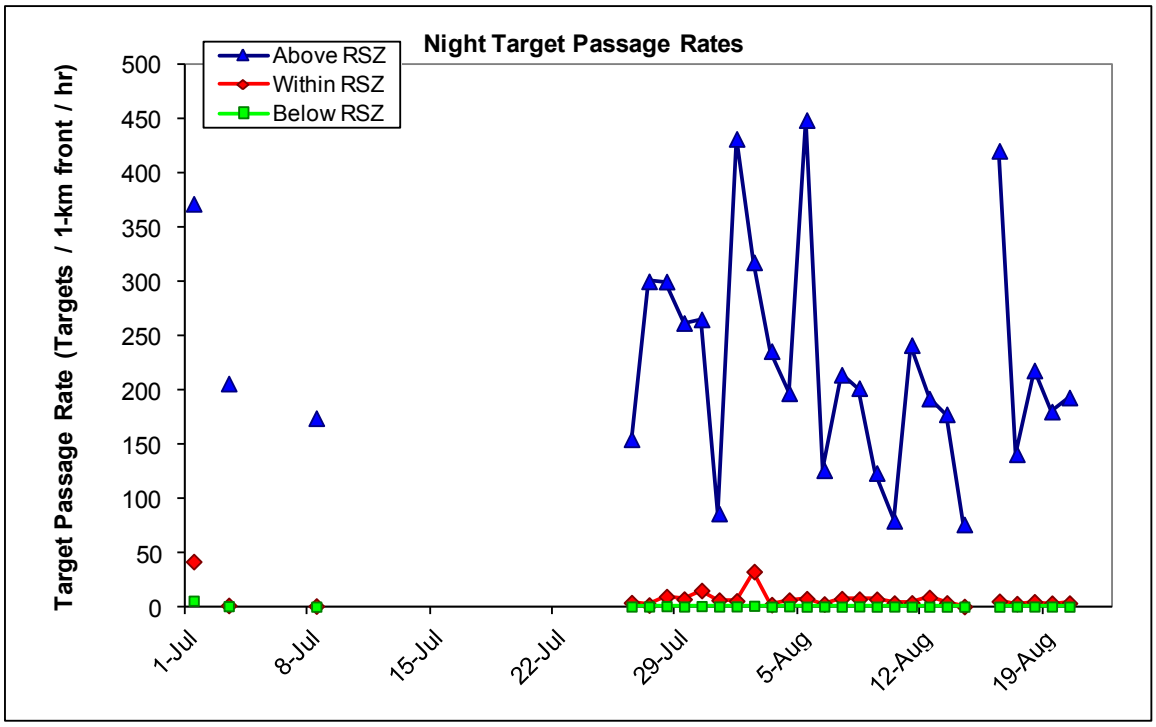

Figure 8-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights at site 3.

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8.3 Horizontal Radar Data

8.3.1 Target Directions

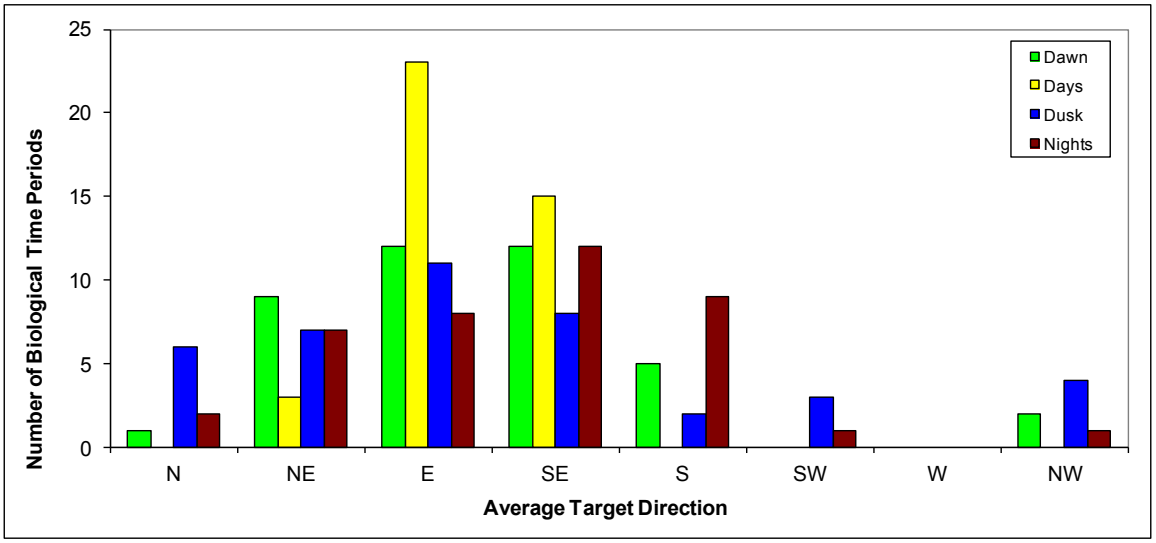

Figure 8-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at site 3.

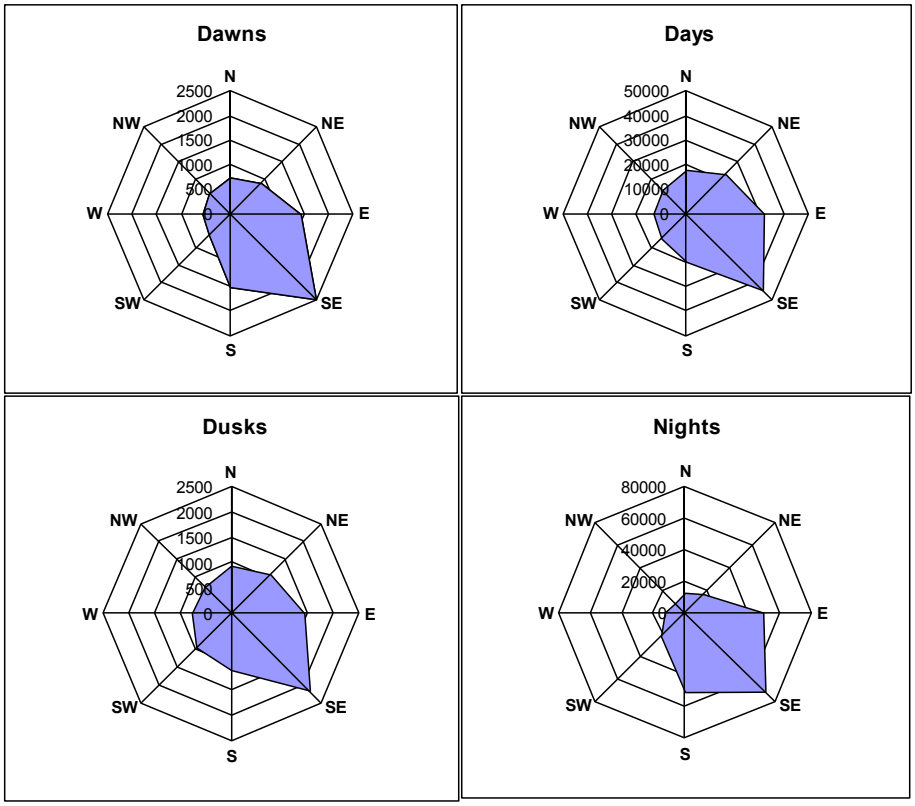

Figure 8-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights at site 3.

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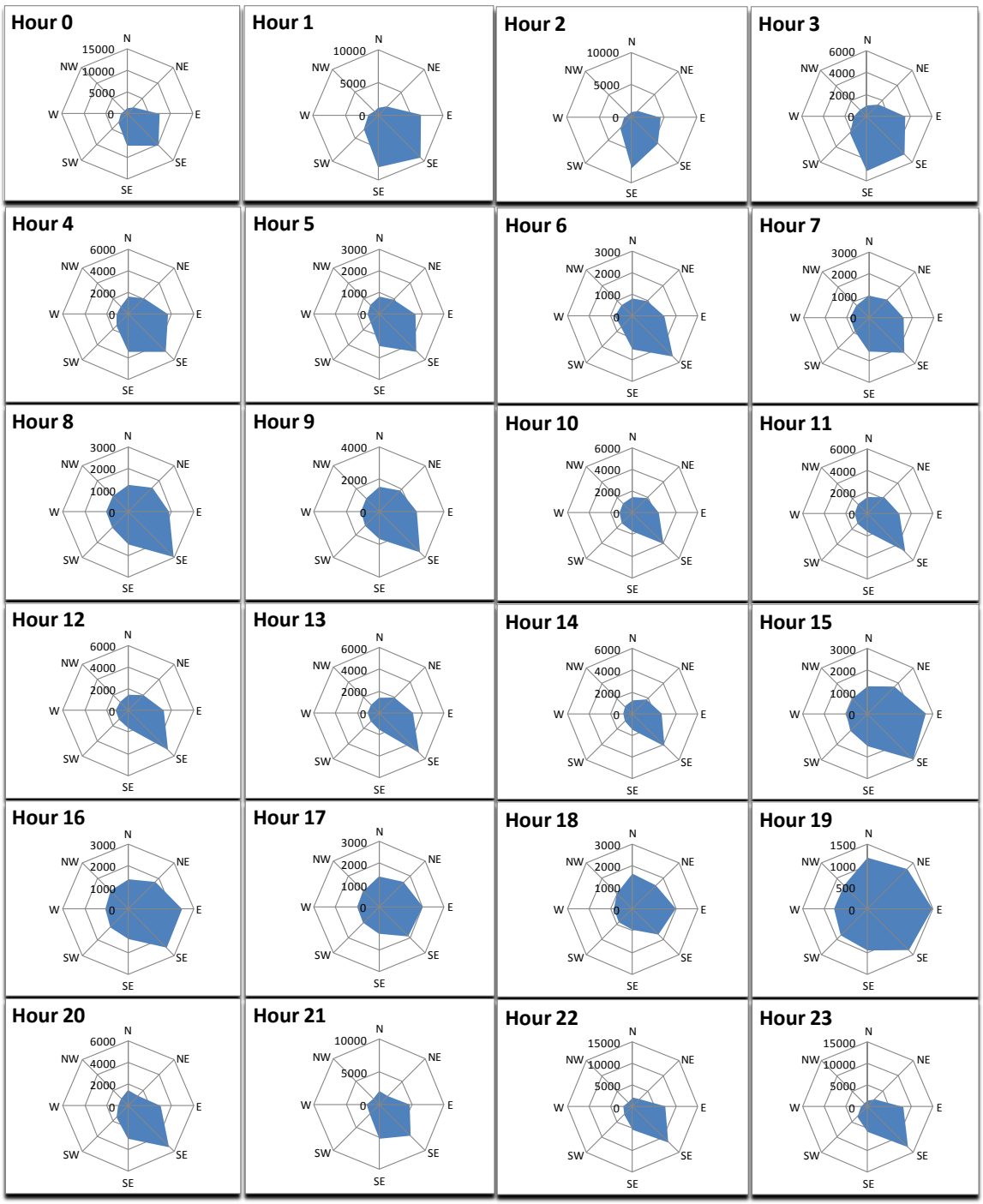

Figure 8-15. Directional distributions for targets during four biological periods at site 3.

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9 RESULTS for Site 4 (September 24 – November 16, 2011)

9.1 Level of Effort

The MERLIN Avian Radar System operated at Site 4 from September 24 to November 16, 2011.

Table 9-1. Effort of radar monitoring at site 4.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	1296	1127.6	168.4	185	942.6
Horizontal Radar (hrs)	1296	1127.7	168.3	82	1045.7

9.2 Vertical Radar Data

9.2.1 Target Passage Rates Over Time

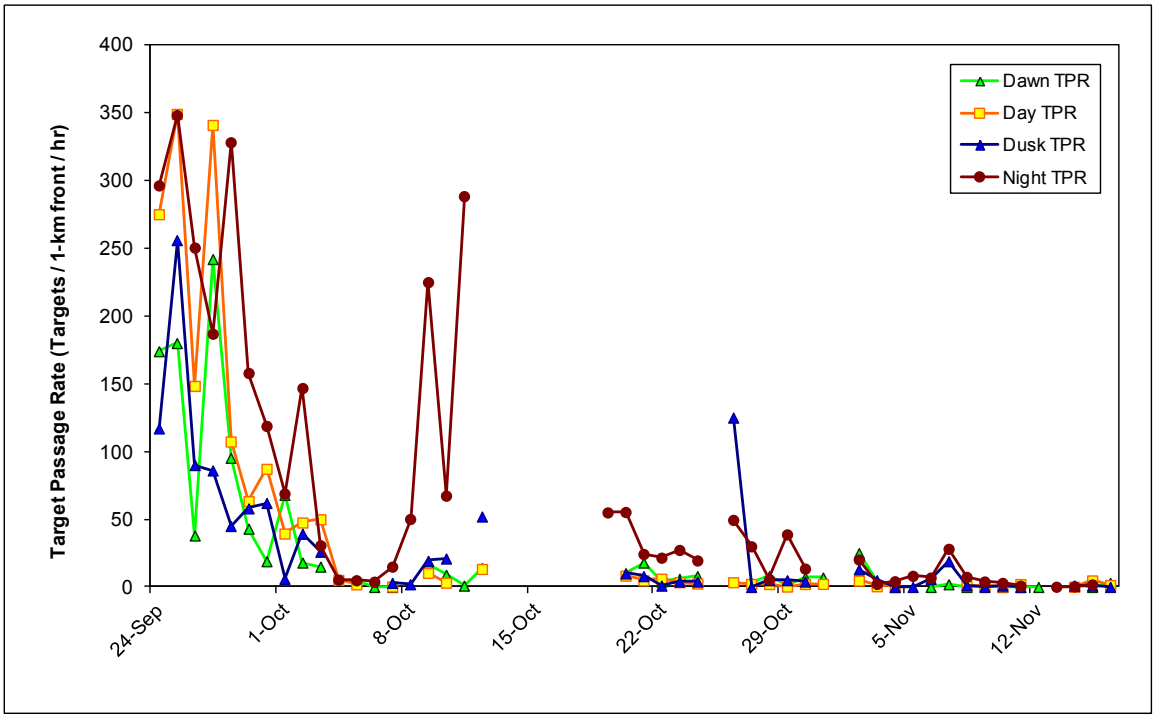

Figure 9-1. Target passage rates during dawns, days, dusks, and nights at site 4.

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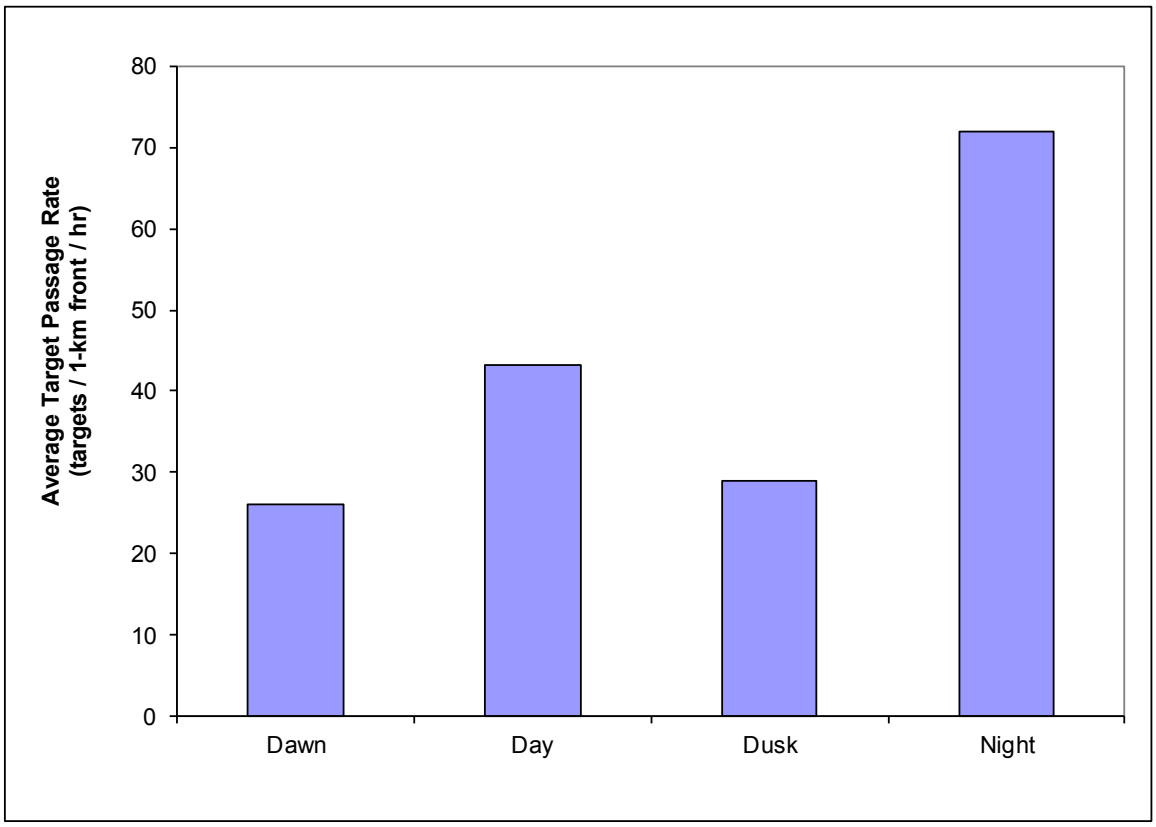

Figure 9-2. Average target passage rates for dawns, days, dusks, and nights at site 4.

Table 9-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods at site 4.

	Dawn	Day	Dusk	Night
Average	26.1	43.2	28.8	72.0
Standard Deviation	54.0	90.8	50.6	101.1
Median	6.5	3.5	5.5	25.8
Minimum	0.0	0.1	0.0	0.2
Maximum	242.0	349.1	256.0	348.2
Range	242.0	349.0	256.0	348.0

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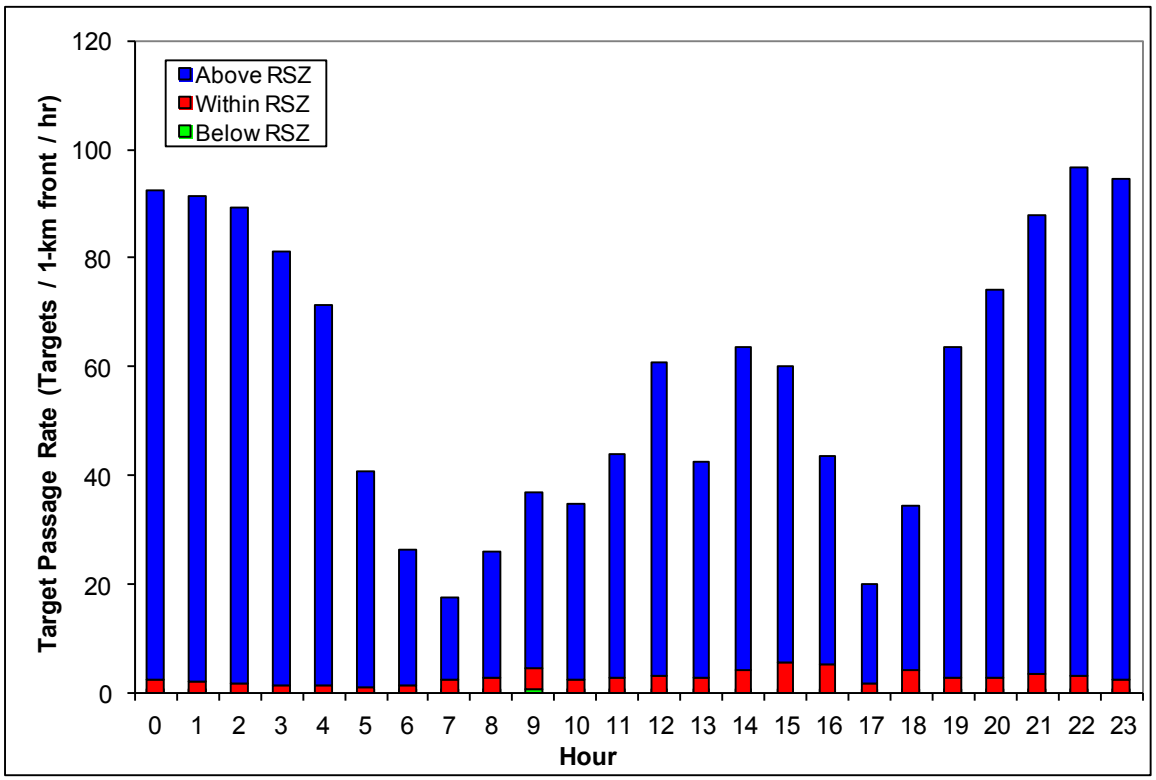

Figure 9-3. Hourly activity (average target passage rates) at site 4.

9.2.2 Altitudinal Distribution of Targets

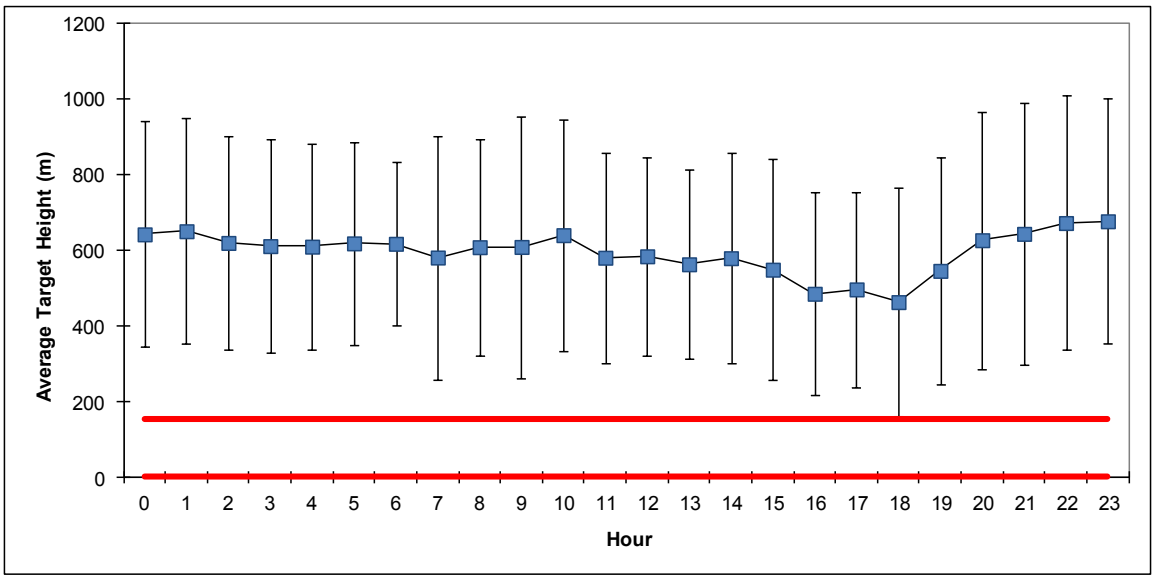

Figure 9-4. Average hourly target heights AGL at site 4. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

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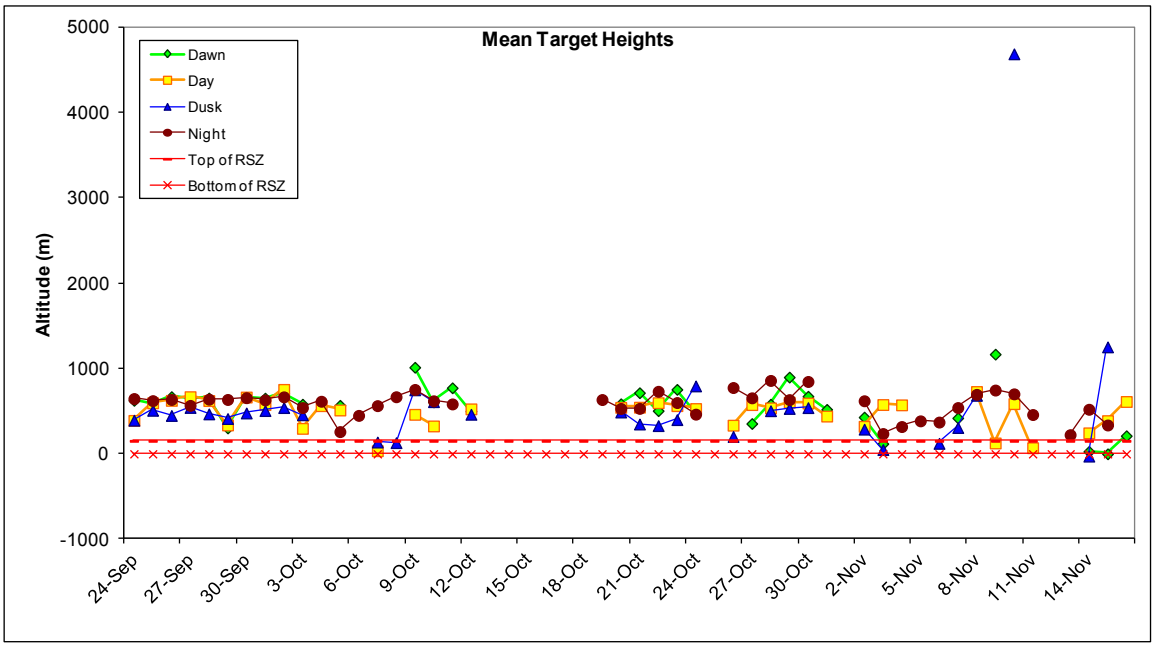

Figure 9-5. Mean target heights during four biological periods at site 4.

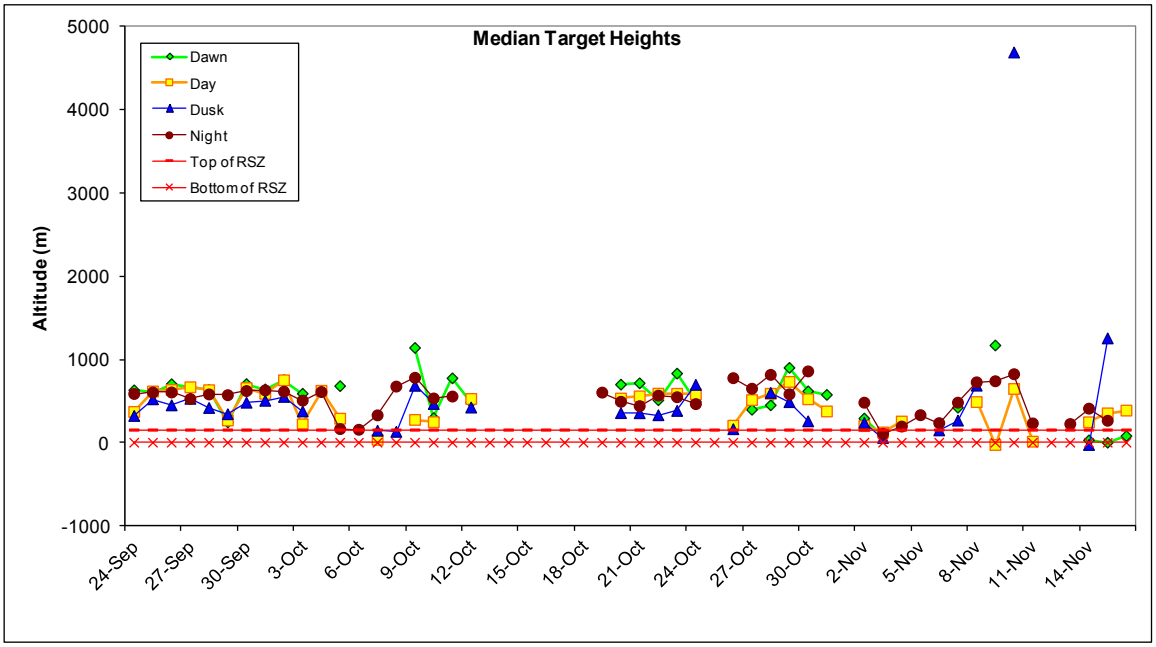

Figure 9-6. Median target heights during four biological periods at site 4.

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Table 9-3. Summary of mean and median target heights during four biological periods at site 4. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	581.4	489.3	574.6	577.0
Average median target height	573.6	428.8	540.2	516.3
All targets for season combined				
Mean target height	611.0	571.6	450.0	632.0
Median target height	625.8	582.5	428.1	588.3

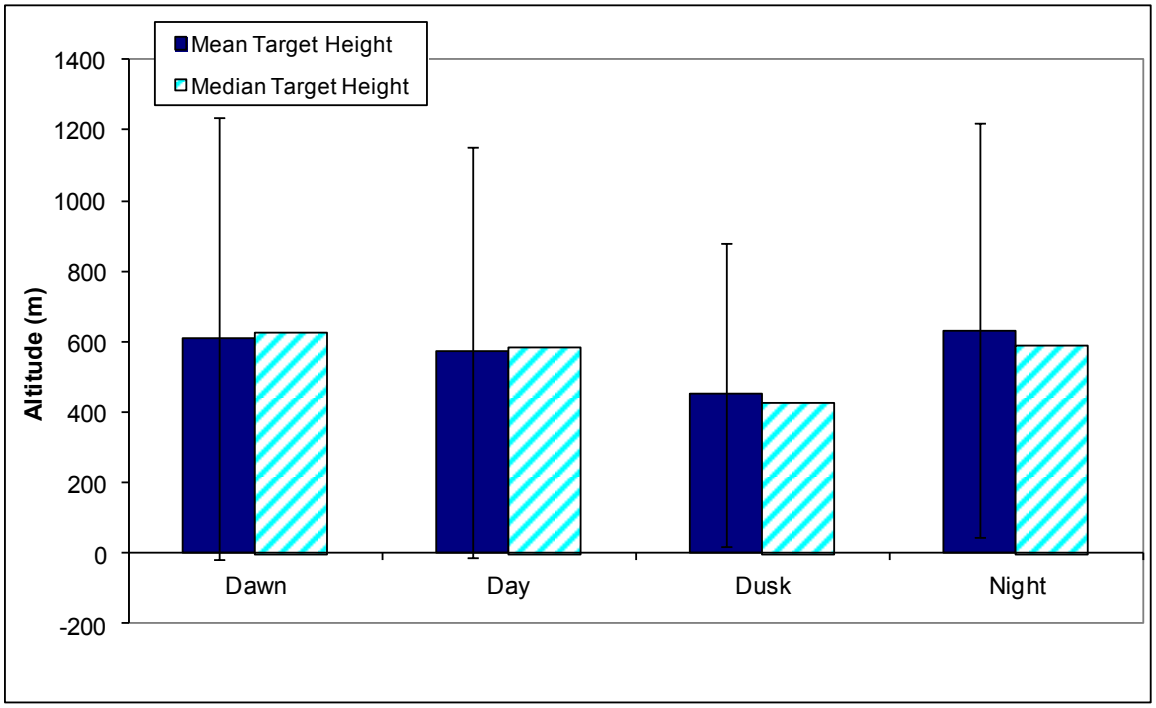

Figure 9-7. Overall mean and median target heights when all targets in each of the four biological periods were combined at site 4. Error bars represent one standard deviation.

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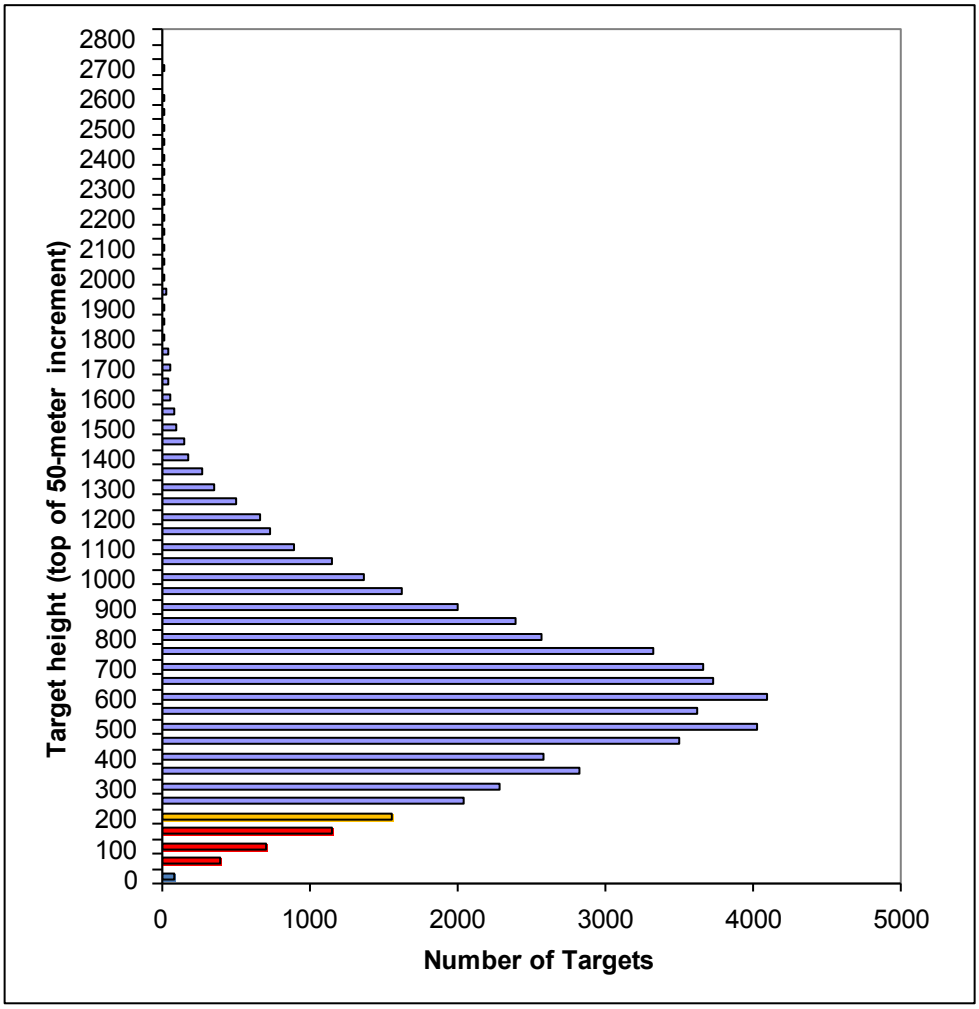

Figure 9-8. Number of targets occurring in each 50-meter increment at site 4. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 9-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods at site 4.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	95.0%	92.3%	89.2%	97.4%
% targets within RSZ	5.0%	7.3%	10.6%	2.5%
% targets below RSZ	0.1%	0.4%	0.3%	0.1%
% targets below turbine height	5.0%	7.7%	10.8%	2.6%
Target data calculated for each date				
Average % of targets in RSZ	12.9%	18.5%	15.7%	12.8%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.3%
Max target percentage within RSZ	100.0%	100.0%	100.0%	57.1%
Average target passage rate above RSZ	24.8	39.6	25.7	70.0
Average target passage rate within RSZ	1.3	3.4	3.1	1.9
Average target passage rate below RSZ	0.0	0.2	0.1	0.0

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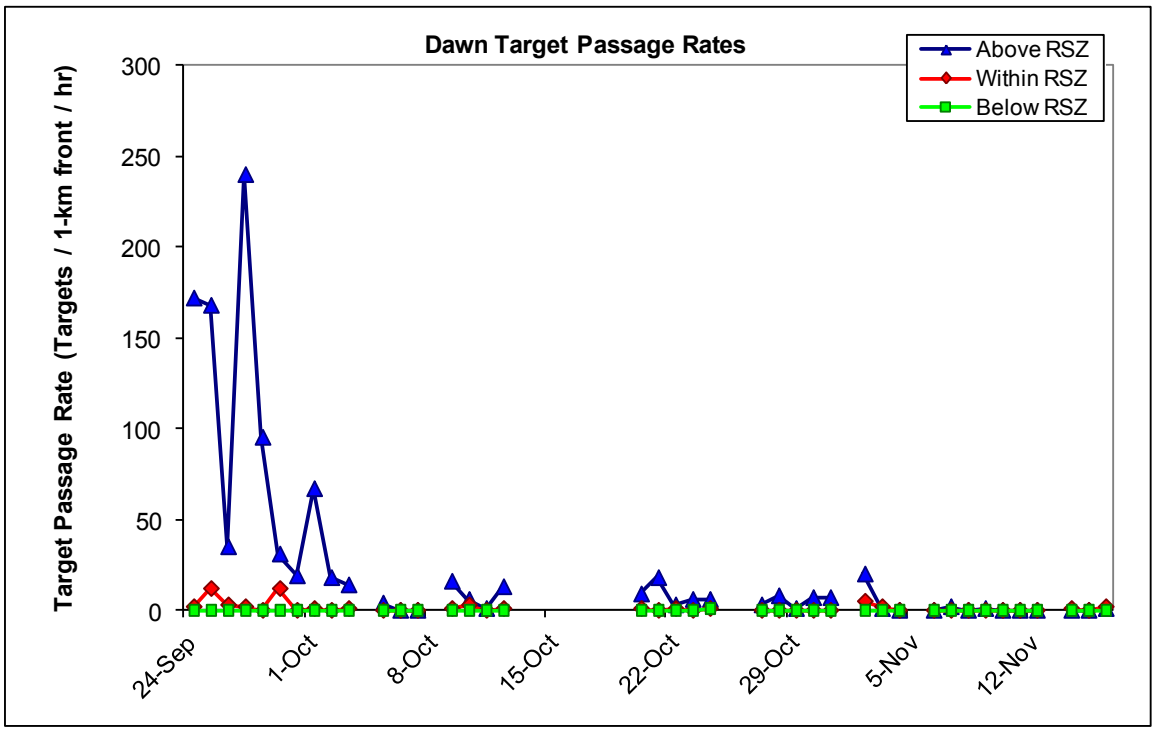

Figure 9-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns at site 4.

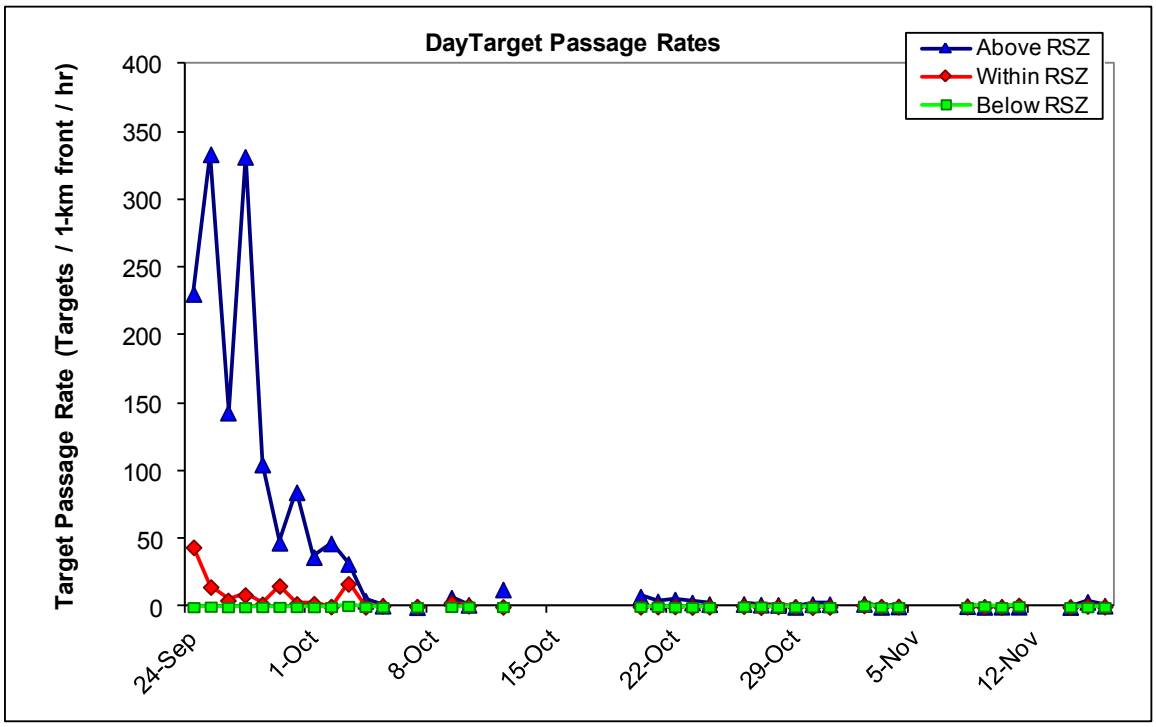

Figure 9-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days at site 4.

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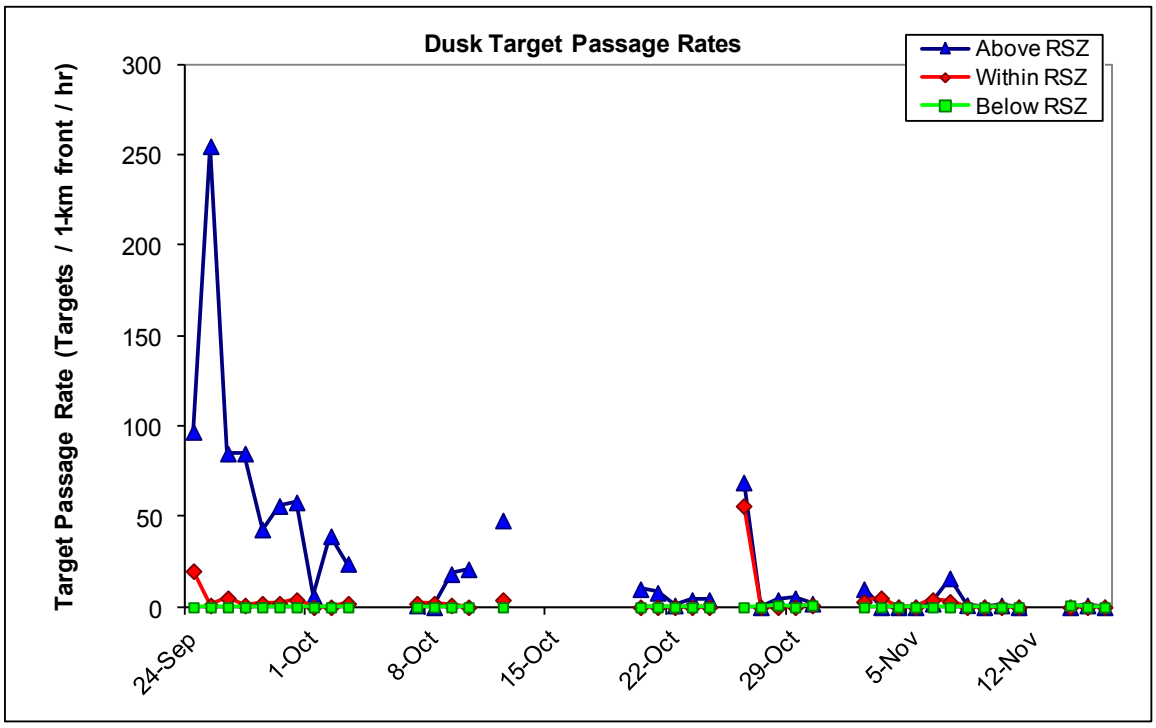

Figure 9-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks at site 4.

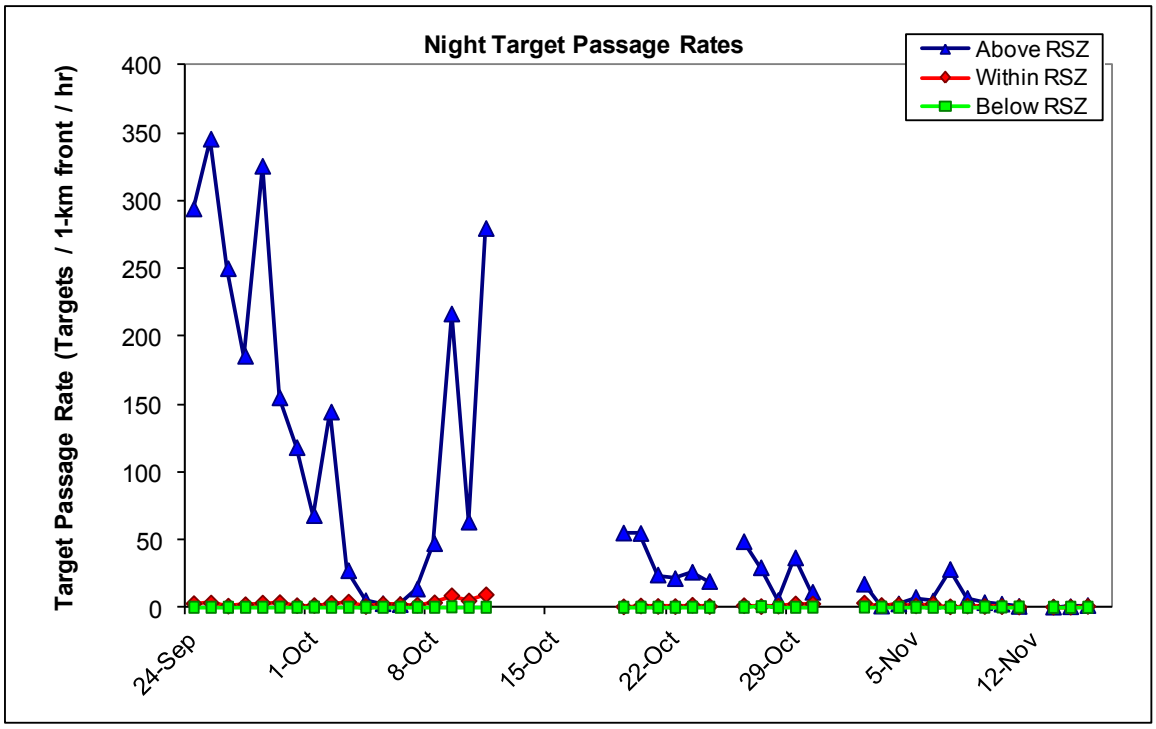

Figure 9-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights at site 4.

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9.3 Horizontal Radar Data

9.3.1 Target Directions

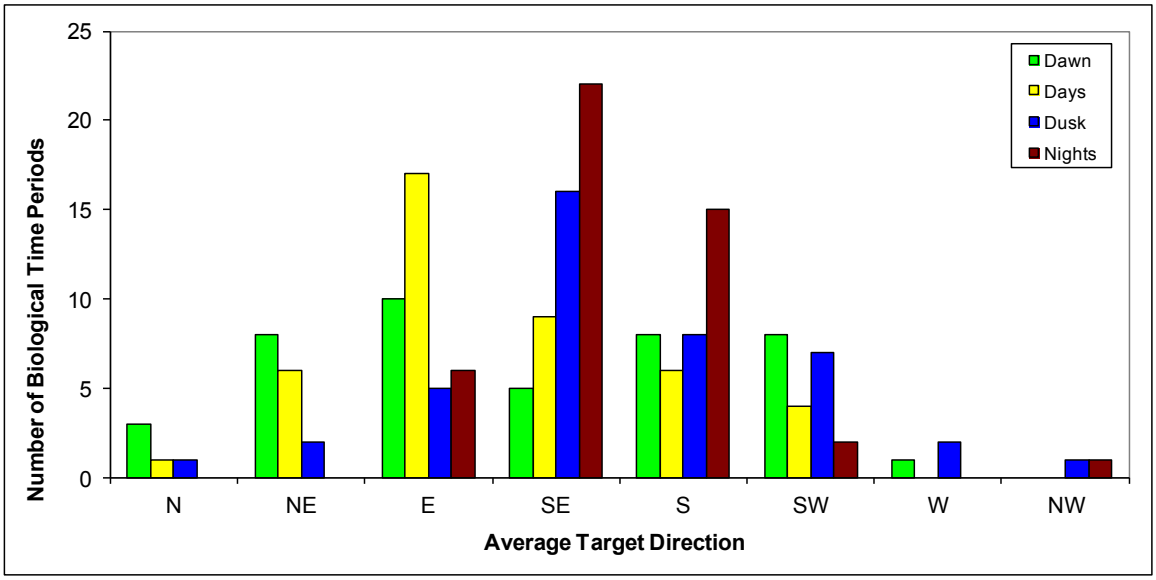

Figure 9-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at site 4.

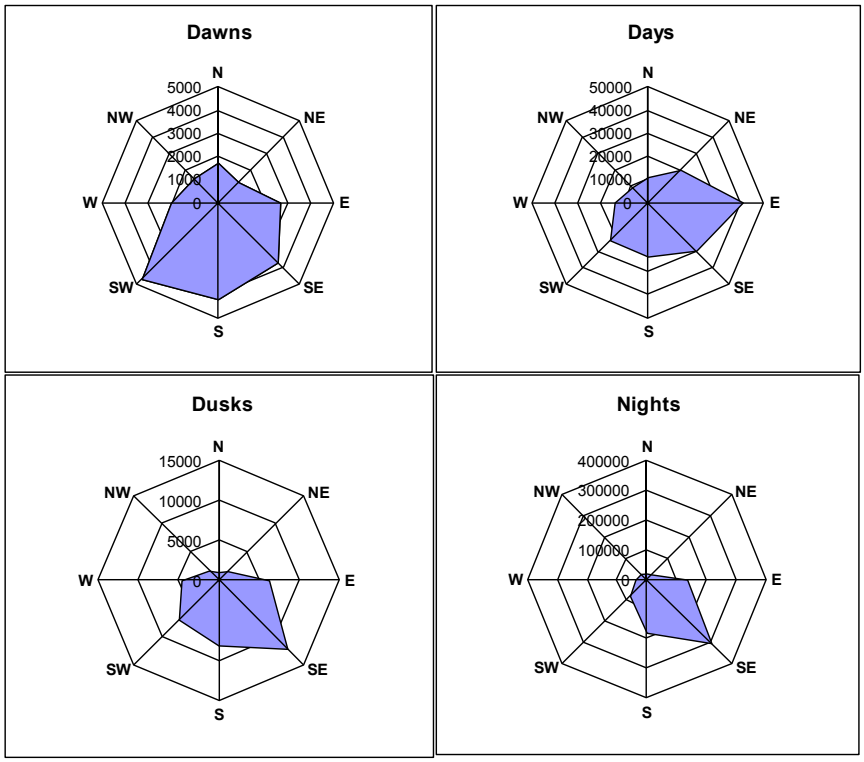

Figure 9-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights at site 4.

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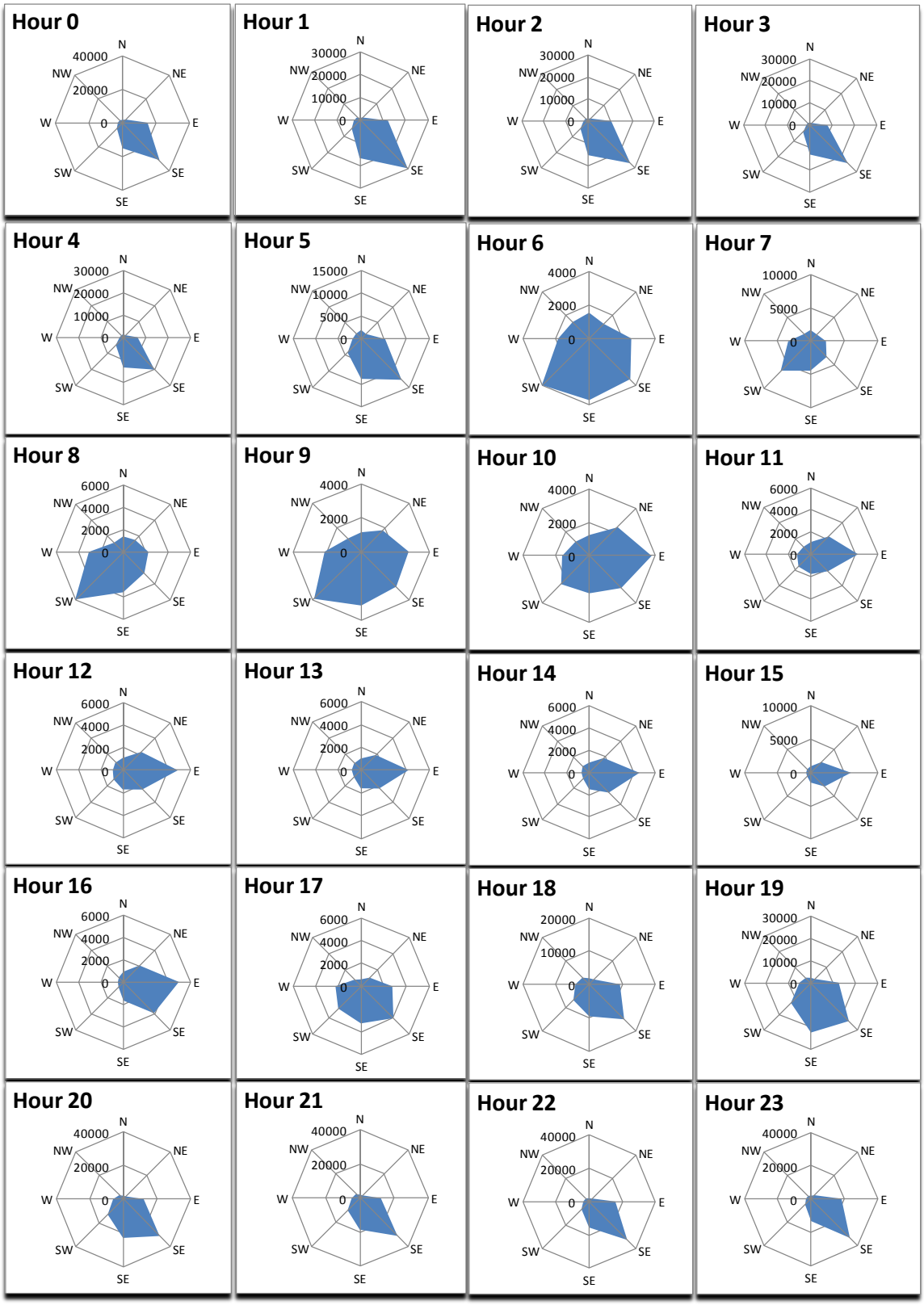

Figure 9-15. Directional distributions for targets during four biological periods at site 4.

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10 RESULTS for Site 5 (March 16 – April 23, 2011)

10.1 Level of Effort

The MERLIN Avian Radar System operated at Site 5 from March 16 – April 23, 2011.

Table 10-1. Effort of radar monitoring at site 5.

Radar	Time In Reporting Period	Time radar collected data	Radar downtime	Radar data with rain and/or insects	Useable radar data
Vertical Radar (hrs)	936	897.2	38.8	223.6	673.6
Horizontal Radar (hrs)	936	878.5	57.5	49.5	829

10.2 Vertical Radar Data

10.2.1 Target Passage Rates Over Time

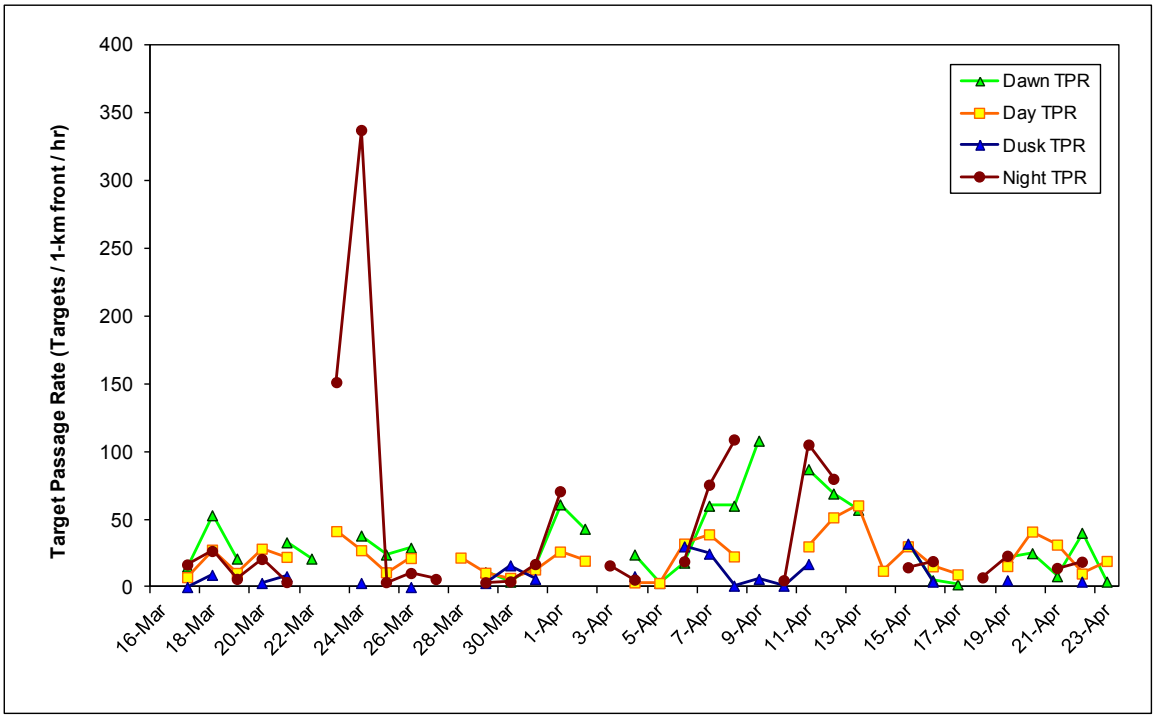

Figure 10-1. Target passage rates during dawns, days, dusks, and nights at site 5.

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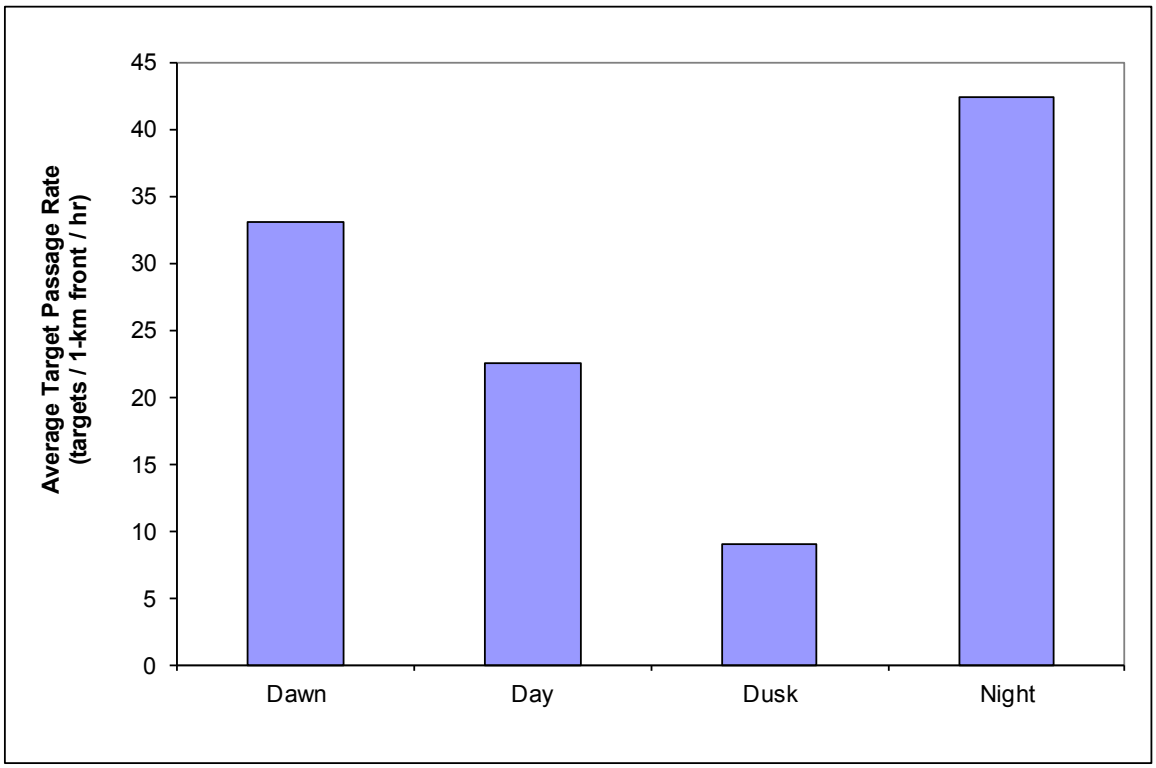

Figure 10-2. Average target passage rates for dawns, days, dusks, and nights at site 5.

Table 10-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for four biological periods at site 5.

	Dawn	Day	Dusk	Night
Average	33.1	22.5	9.0	42.5
Standard Deviation	26.4	13.8	9.8	69.5
Median	24.5	21.6	5.5	16.8
Minimum	2.0	3.0	0.0	3.4
Maximum	108.0	60.3	32.0	337.3
Range	106.0	57.3	32.0	333.9

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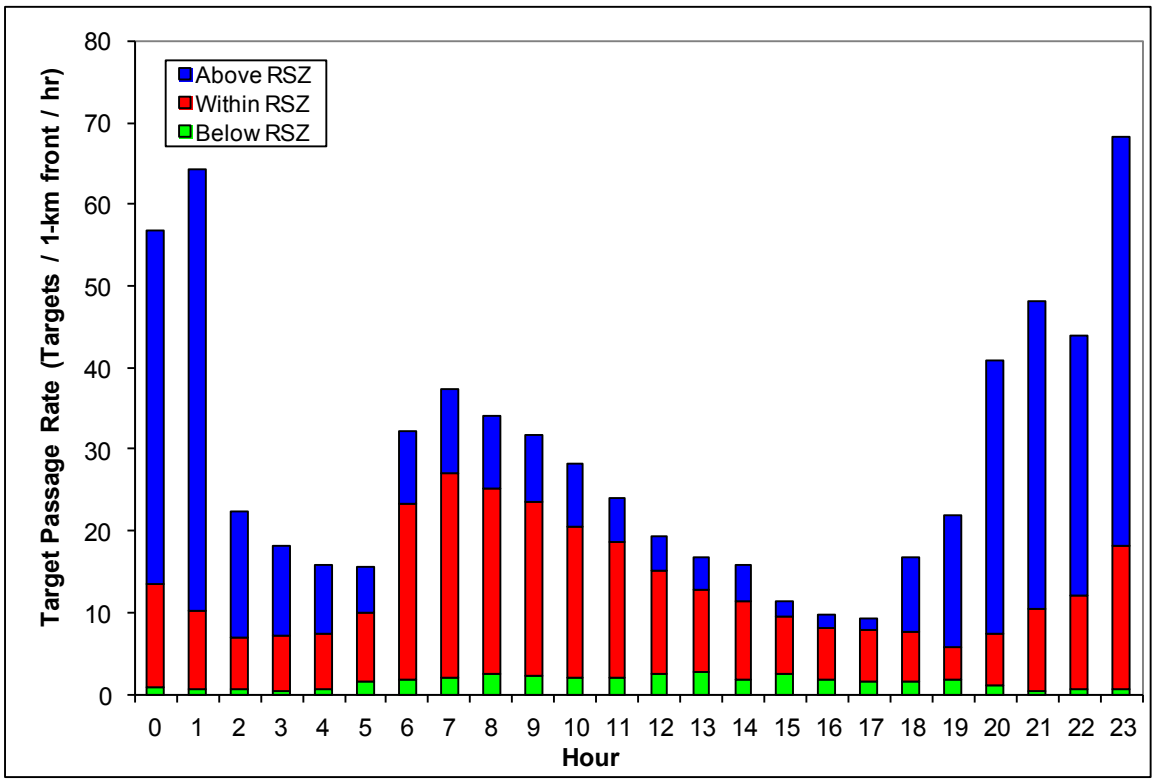

Figure 10-3. Hourly activity (average target passage rates) at site 5.

10.2.2 Altitudinal Distribution of Targets

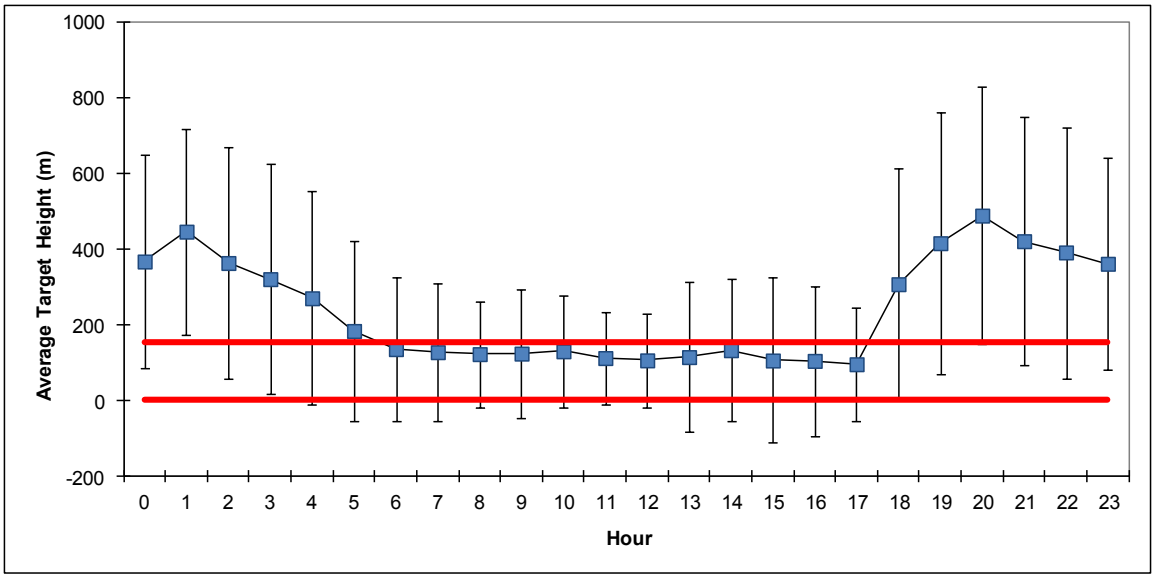

Figure 10-4. Average hourly target heights AGL at site 5. Error bars represent standard deviation for each hour and red lines represent the top and bottom of the rotor swept zone (0 – 152.4 m AGL).

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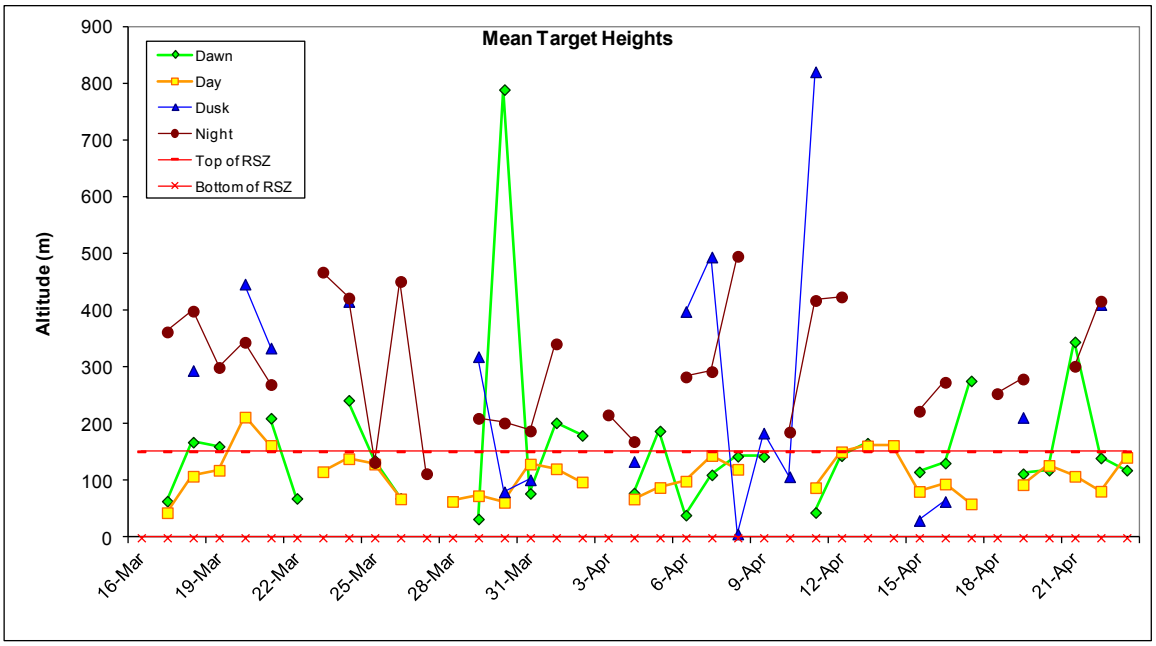

Figure 10-5. Mean target heights during four biological periods at site 5.

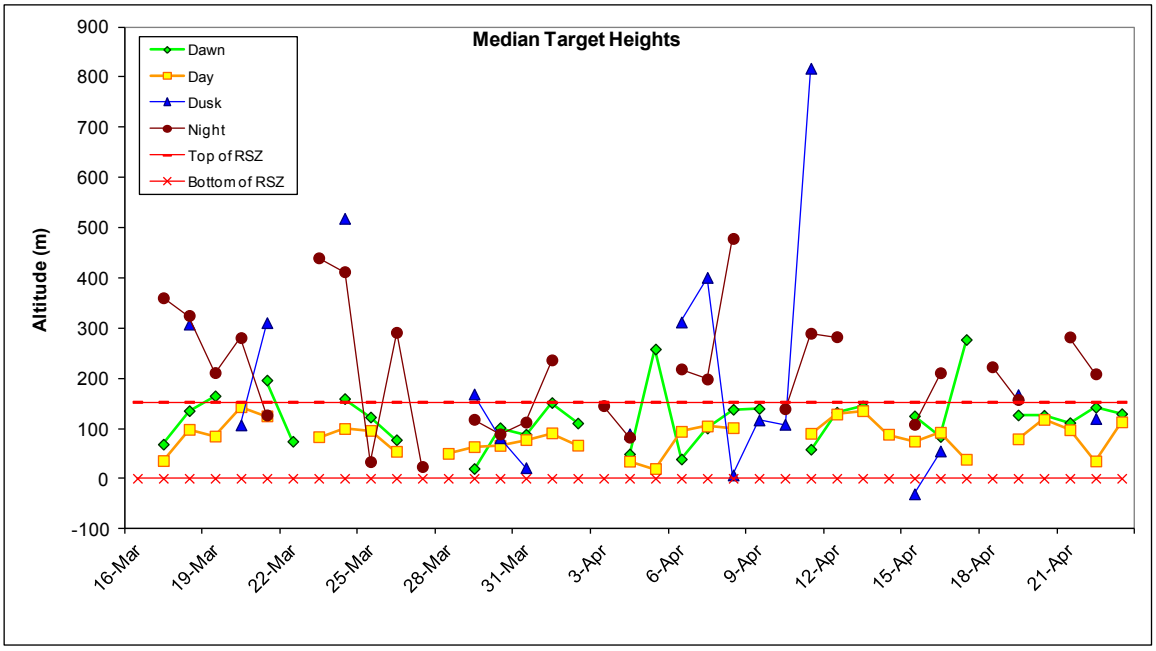

Figure 10-6. Median target heights during four biological periods at site 5.

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Table 10-3. Summary of mean and median target heights during four biological periods at site 5. The top presents averages of mean and median target heights calculated during each biological period having at least 50% data in that time period; the bottom presents the overall mean and median target heights when all targets in each of the four biological periods were combined.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average mean target height	160.9	110.2	270.0	301.6
Average median target height	121.2	83.2	203.8	216.8
All targets for season combined				
Mean target height	138.2	120.7	408.9	391.7
Median target height	112.5	96.9	336.0	327.1

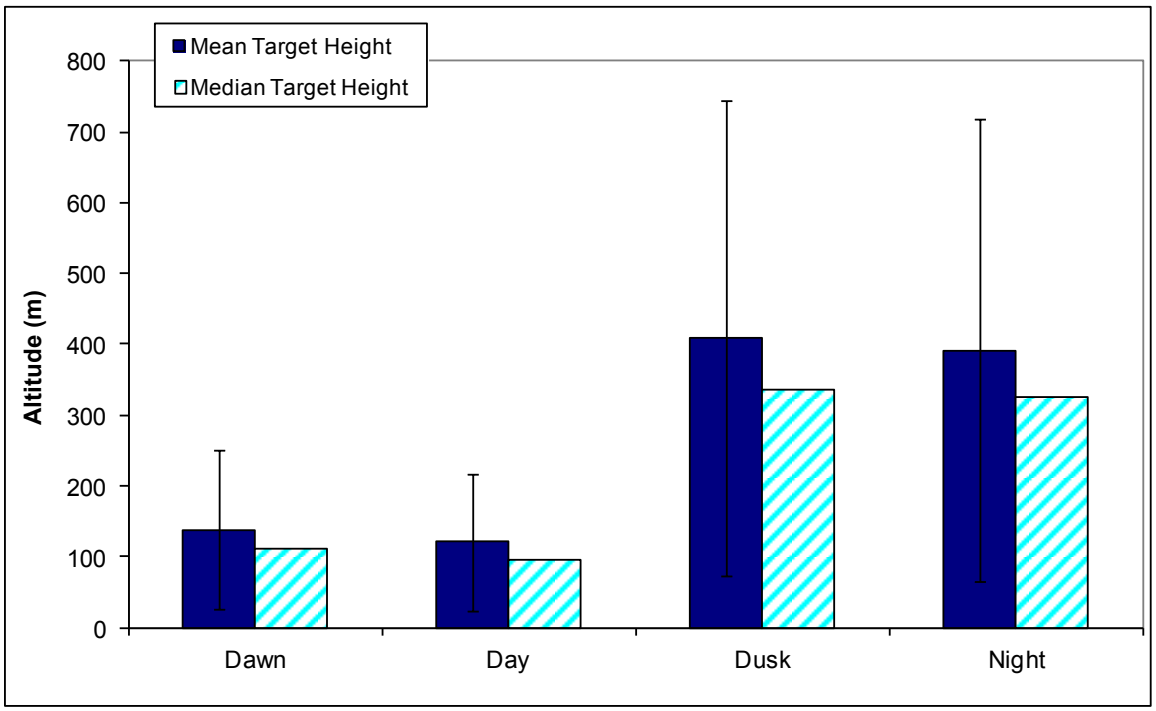

Figure 10-7. Overall mean and median target heights when all targets in each of the four biological periods were combined at site 5. Error bars represent one standard deviation.

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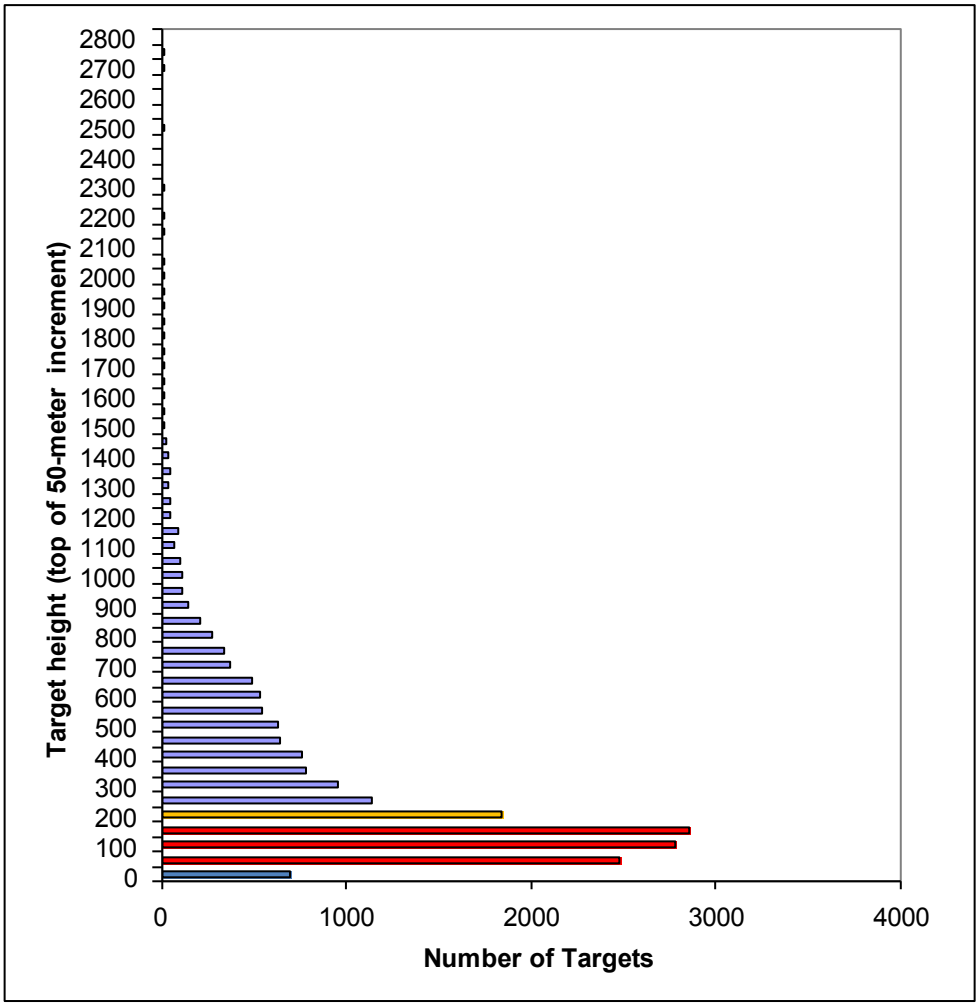

Figure 10-8. Number of targets occurring in each 50-meter increment at site 5. Red indicates rotor swept heights, and orange indicates altitudes partially within rotor swept heights.

Table 10-4. Summary of target passage rates and percent of targets above, within and below the RSZ during four biological periods at site 5.

	Dawn	Day	Dusk	Night
All targets for season combined				
% targets above RSZ	28.9%	24.8%	52.5%	74.5%
% targets within RSZ	66.3%	66.1%	27.9%	23.9%
% targets below RSZ	4.8%	9.1%	19.6%	1.5%
% targets below turbine height	71.1%	75.2%	47.5%	25.5%
Target data calculated for each date				
Average % of targets in RSZ	67.0%	68.1%	41.0%	36.3%
Min target percentage within RSZ	33.3%	30.8%	0.0%	10.6%
Max target percentage within RSZ	95.2%	86.6%	100.0%	64.0%
Average target passage rate above RSZ	9.8	5.6	4.8	32.1
Average target passage rate within RSZ	21.8	15.0	2.5	9.7
Average target passage rate below RSZ	1.5	1.9	1.8	0.7

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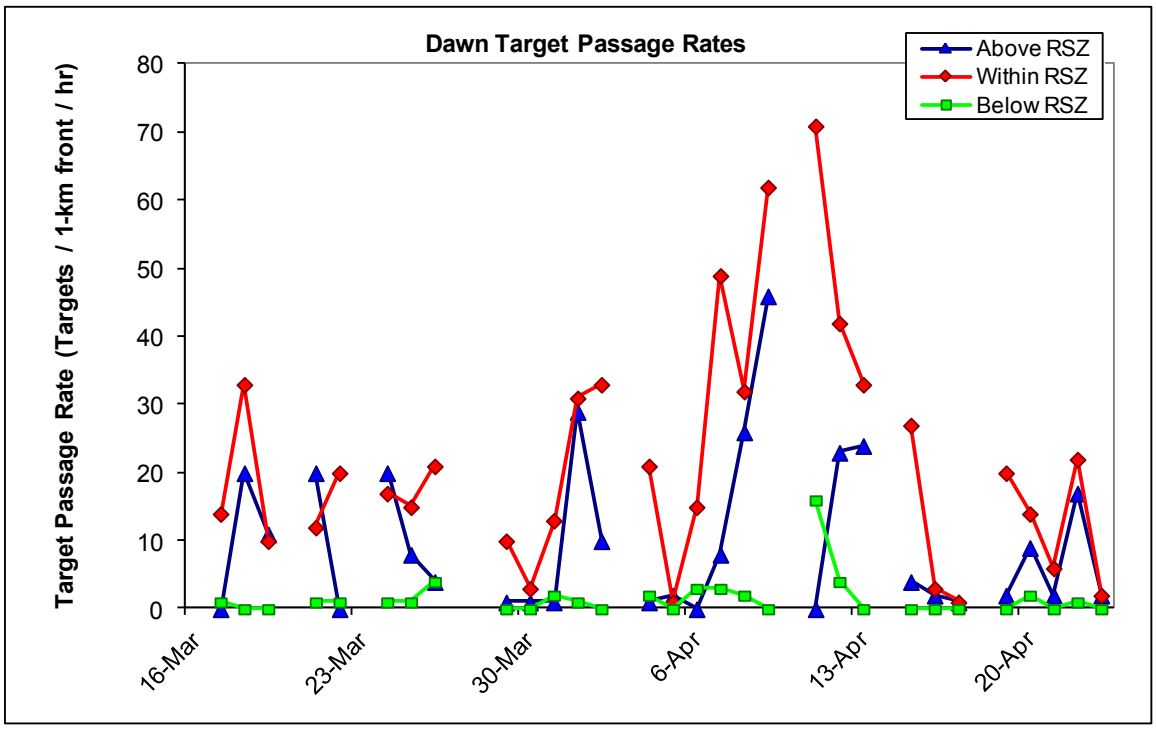

Figure 10-9. Target passage rates below, at, and above the rotor swept zone (RSZ) during dawns at site 5.

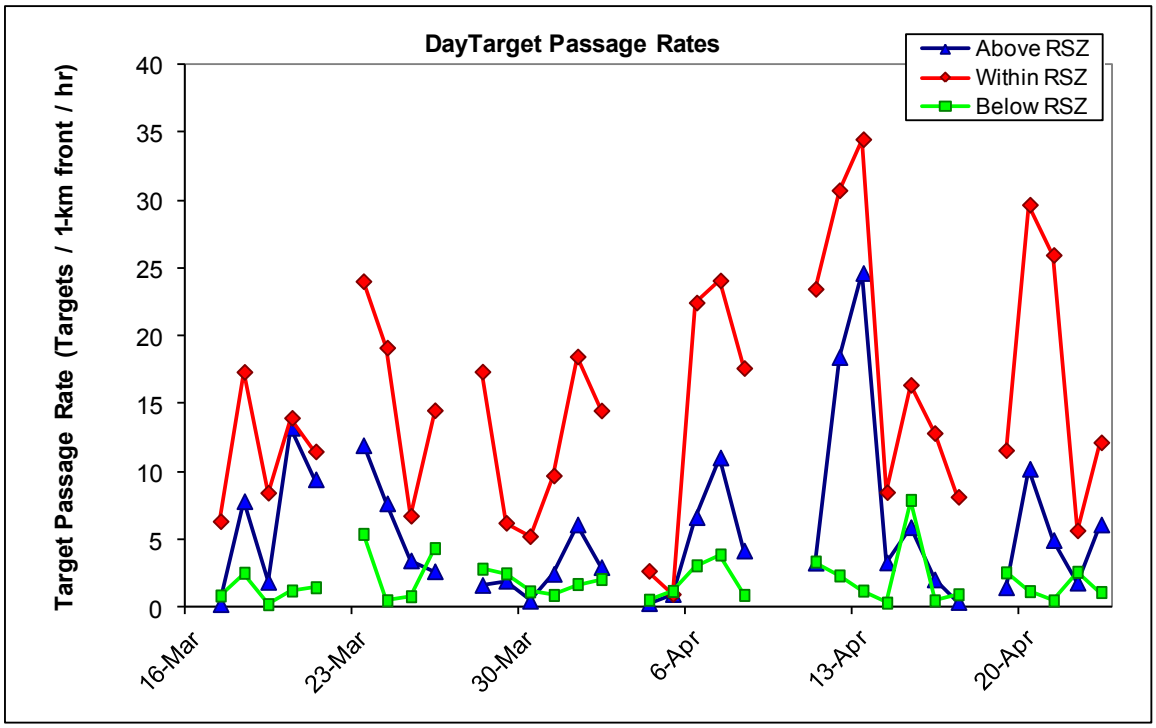

Figure 10-10. Target passage rates below, at, and above the rotor swept zone (RSZ) during days at site 5.

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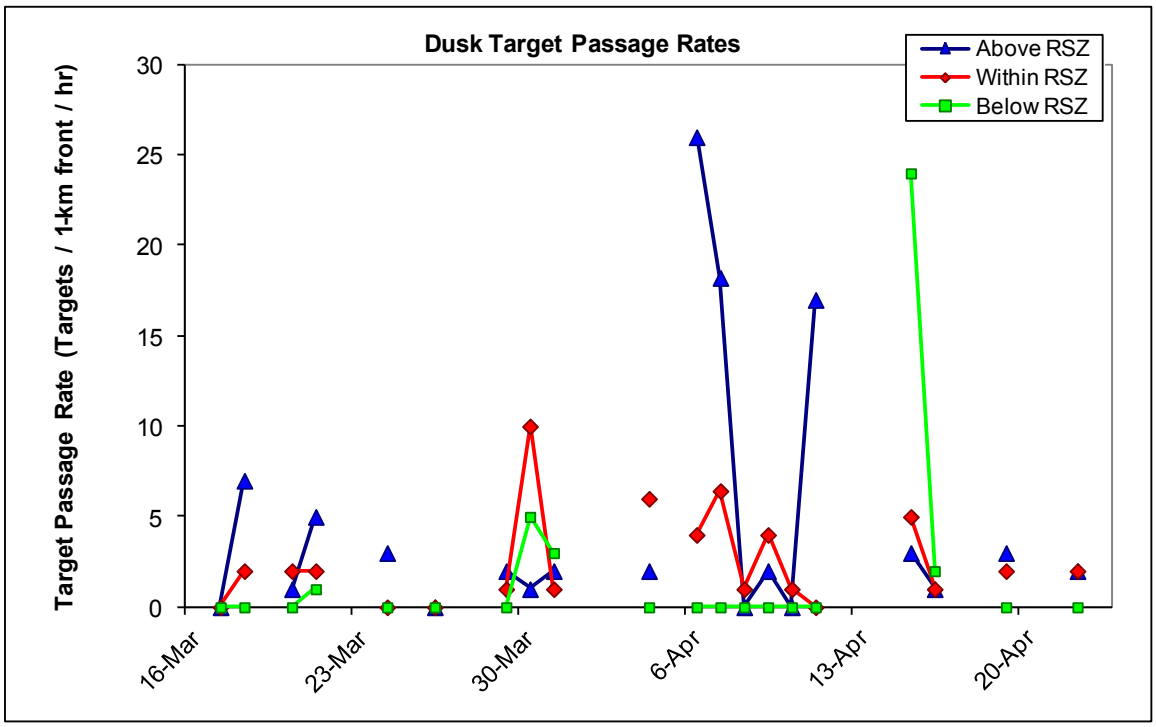

Figure 10-11. Target passage rates below, at, and above the rotor swept zone (RSZ) during dusks at site 5.

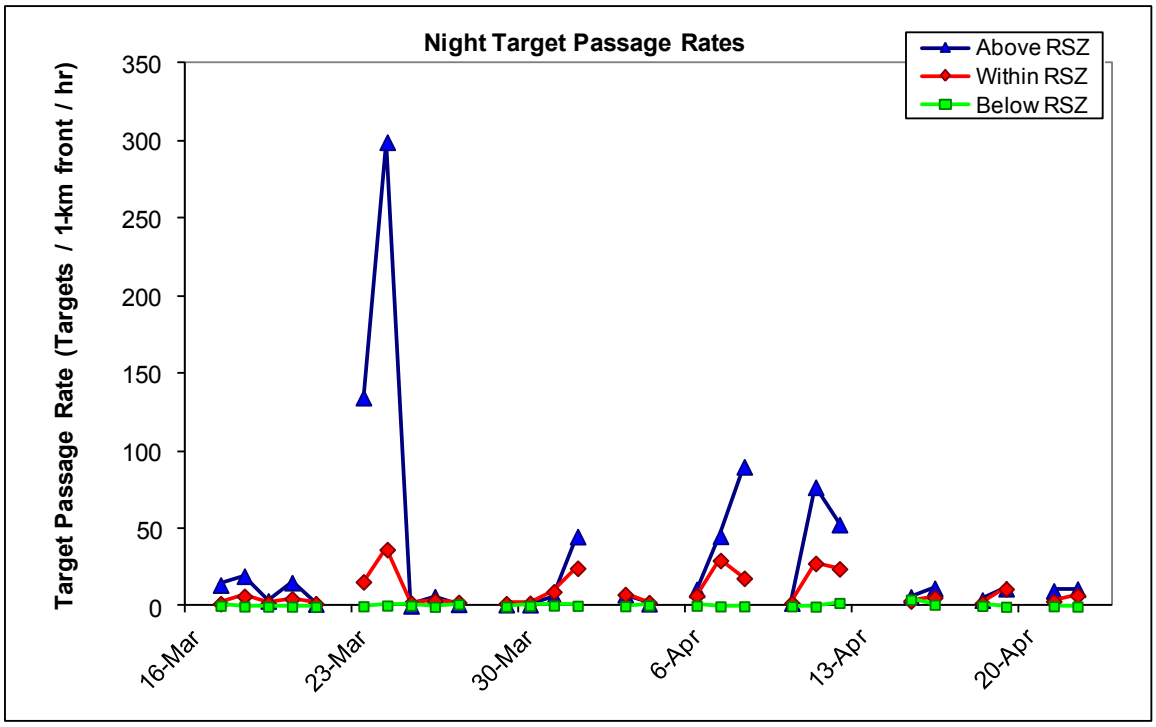

Figure 10-12. Target passage rates below, at, and above the rotor swept zone (RSZ) during nights at site 5.

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10.3 Horizontal Radar Data

10.3.1 Target Directions

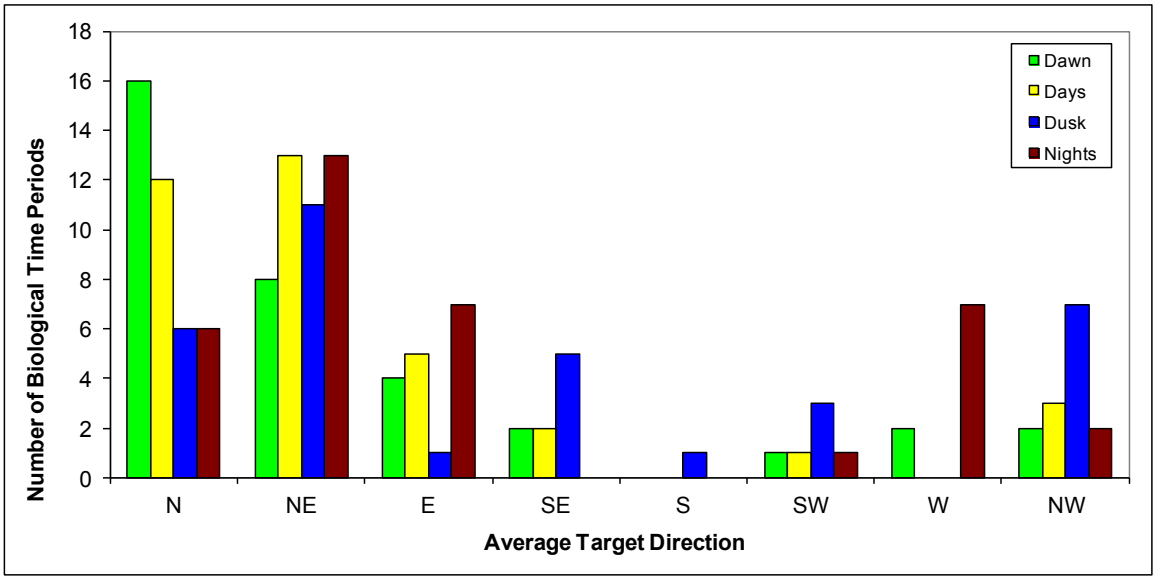

Figure 10-13. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at site 5.

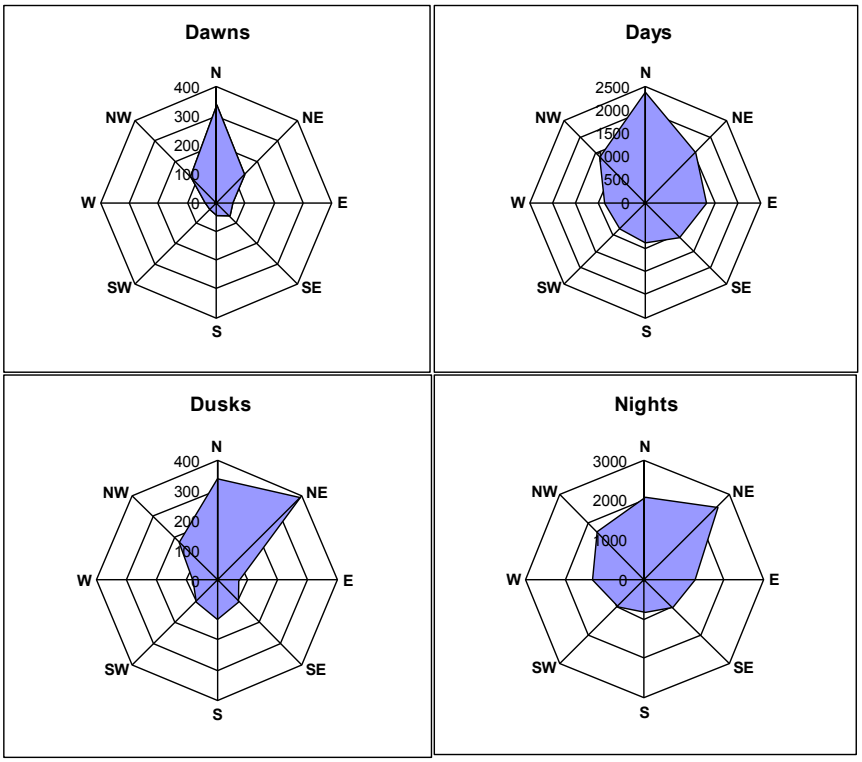

Figure 10-14. Cumulative target direction of all targets during all dawns, days, dusks, and nights at site 5.

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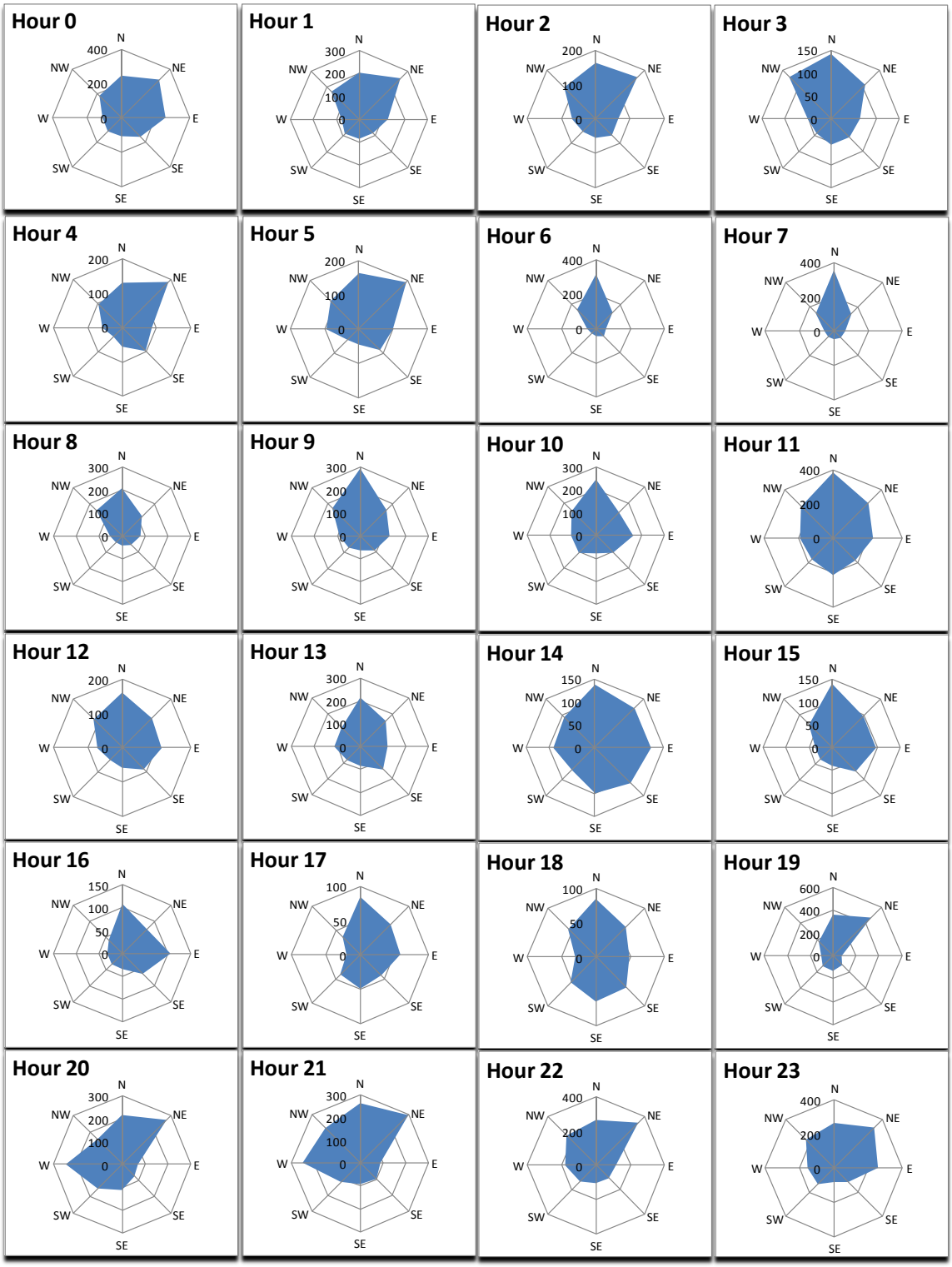

Figure 10-15. Directional distributions for targets during four biological periods at site 5.

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Literature Cited

Zar, J. H. 1999. Biostatistical Analysis. Fourth edition. Prentice-Hall, Englewood Cliffs, New Jersey, USA.

Appendix A - Glossary

1-km Front – Area extending 0.5 km on either side of the VSR, or 1 km on one side of the VSR, forming a 1 km^2 area through which target passage rates are quantified. This area occurs entirely within the radar scanned zone.

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.

Night – 30 minutes after sunset to 30 minutes before sunrise the next day.

Rotor Swept Area (RSA) - The circular area "swept" by the blades during operation of a wind turbine, specific to type of wind turbine.

Rotor Swept Zone (RSZ) – The 1-km wide band within the 1-km front that encompasses the lowest and highest points swept by a wind turbine's blades (RSA). Specific to each project and calculated using the manufacturer's specifications for the wind turbine proposed for the project.

Plot – A single scan of a target or other objects.

Target Passage Rate – Number of specified targets passing through a 1-km wide front during 1 hour. This rate is standardized for effort, or the proportion of minutes radar data was recorded during a given time period.

Target - Object detected by MERLIN Radar and identified by MERLIN software as a biological object (e.g. bird, bat, insect) based on scanned size, speed, and other characteristics.

Track – The entire sequence of target plots that are recorded as long as an object still fits the definition of a target.

Tracking – The MERLIN software begins to track a target after it has met the criteria of a biological target for three scans. The target continues to be tracked until either the target is lost, or target fails to meet the criteria for three of the last four scans.

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Appendix B - Abbreviations

AGL – Above Ground Level

HSR – Horizontal Surveillance Radar

km – kilometer

m – meter

mi – mile

nm – Nautical miles (approximately 1.15 miles)

RSA – Rotor Swept Area

RSZ – Rotor Swept Zone

VSR – Vertical Scanning Radar

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MERLIN™ Avian Radar Survey for the Chokecherry and Sierra Madre Wind Energy Project

Graphical Data Report for November, 2011 – March, 2013

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August 1, 2013

DeTect APPLIED RADAR TECHNOLOGIES | RAPTOR™ RADAR WIND PROFILERS | Merlin™ AVIAN RADAR SYSTEMS | HARRIER™ SECURITY & SURVEILLANCE RADARS

Notice

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MERLIN™ Avian Radar Survey
Graphical Data Report for Nov 2011 – Mar 2013

1 INTRODUCTION

This report presents radar data collected at the proposed Chokecherry and Sierra Madre Wind Project site during five seasons:

- Winter 2011-12 (November 16, 2011 – March 31, 2012),
- Spring 2012 (April 1 – June 30, 2012),
- Summer 2012 (July 1 – August 15, 2012),
- Fall 2012 (August 16 – November 15, 2012),
- Winter 2012-13 (November 16, 2012 – March 31, 2013)

as well as five sites:

- Site 4 (November 16, 2011 – January 26, 2012)
- Site 6 (February 2 – April 29, 2012)
- Site 8 (May 19 – July 17, 2012)
- Site 9 (July 21 – September 29, 2012)
- Site 10 (October 3, 2012 – March 31, 2013)

As can be noted by the date ranges of radar data collected at each site, Winter 2011-12 includes data from Sites 4 and 6, Spring 2012 includes data from Site 6 and 8, Summer 2012 includes data from Site 9, Fall 2012 includes data from Sites 9 and 10, and Winter 2012-13 includes data from Site 10.

2 METHODS

2.1 Radar Equipment, Software, and Data Collection

2.1.1 MERLIN Avian Radar System

The MERLIN avian radar system is an advanced, automated radar system used for remote detection and tracking of bird and bat activity. A remote data uplink allowed remote system monitoring, access to recorded data, and system administration. The MERLIN system collected radar data continuously (24 hours a day, 7 days a week), with the exception of limited periods of system maintenance or downtime.

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A model XS25200e MERLIN avian radar system was used to survey this site during November 2011 through March 2013. This system used dual marine radar sensors: a 25-kW power, magnetron, X-band frequency (3 cm wavelength), vertical-scanning radar (VSR) sensor, and a 200-W power, solid state, S-band (10 cm wavelength), horizontal surveillance radar (HSR) sensor with Doppler. The solid state sensor uses a solid state transmitter instead of a magnetron which allows for a more focused transmission and requires less voltage. This HSR also used high pulse compression of short- and medium--pulsed radar energy.

The VSR operates in the vertical plane transmitting a 20°, wedge-shaped beam from horizon-to-horizon using the vertical scanning technique (Harmata et al. 1999) (Fig. 2-1) at a scan rate of 24 RPM's, or 1 scan every 2.5 seconds, and a range setting of 2.0 nm to either side and above the radar. The X-band used for this VSR is a short wavelength radar (3 cm) and is susceptible to interference from very small targets such as precipitation. The VSR data is used to determine target altitudes, as well as target counts and passage rates.

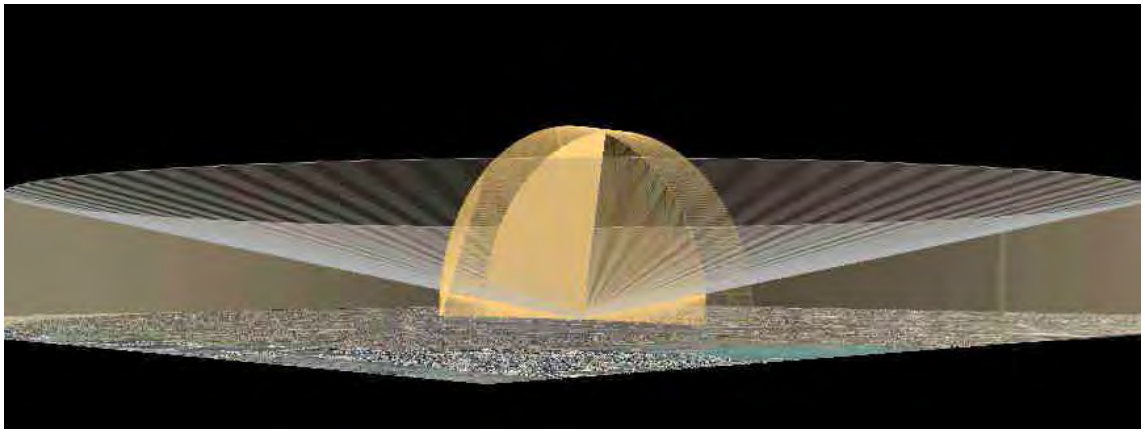

Figure 2-1. Illustration of beam coverage of the horizontal surveillance radar (HSR) and the vertical scanning radar (VSR).

The HSR radar scans 360° in the horizontal plane transmitting a 25°, wedge-shaped beam relatively perpendicular to the VSR (Fig. 2-1) at a scan rate of 24 RPM's, or 1 scan every 2.5 seconds, and a range setting of 4.0 nm radius. The S-band used for the HSR has the advantage of greater detection range and less interference from ground clutter and precipitation. It is also less sensitive to insect contamination. The HSR data is used to determine directional movement of targets over and through the project area.

2.1.2 MERLIN Avian Radar Processing Software

The Merlin avian radar system uses modern, marine-grade radar signal processing technology to collect, process, and store 12-bit digitized radar data

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from both the VSR and HSR. Target data from both radars is processed in real-time by the MERLIN software at the radar with all data on targets, tracks, and system parameters recorded to internal system databases.

The MERLIN avian radar processing software uses automated clutter suppression in conjunction with biological target detection, tracking, and data recording to identify and track targets in the survey area. The software also identifies noise (undesired signals such as ground clutter and interference) within a given radar environment and applies a statistical approach to suppressing the noise while still allowing targets within the noise to be detected, tracked, and recorded. This maximizes the probability of detecting moving targets in high clutter environments (such as over vegetation). The application of CFAR (constant false alarm rate) algorithms and ground clutter mapping techniques are also included in the MERLIN software, and provide automated, high resolution data while minimizing the amount of display lost to ground clutter.

The detection and tracking algorithms in the MERLIN software locate plot sequences of biological targets in the raw radar data that fit together into a sequence over time as the radar scans. When a target meeting the criteria of a bird-like target is tracked for a minimum of three out of four sequential scans or plots, a track is written to the system database. A target continues to track as long as it is detected three out of the last four scans or plots. Although the criteria for identifying bird targets has been developed to only track targets that are most likely birds, these are not separable from bats which are included within the targets tracks, and targets such as insects or clutter that will occasionally be falsely identified and tracked as bird targets. However, the inclusion of non-bird / bat targets is minimized through optimization of operational settings in the software, visual ground-truthing, and application of custom database queries.

It must also be noted that an individual radar echo does not necessarily represent an individual bird or bat, as individuals moving in and out of the radar beam (e.g. circling, flying behind a large obstacle) would be “counted” by the radar system multiple times. Similarly, some flocks of birds may be recorded as a single target if individuals cannot be distinguished. Within the MERLIN system, each target is assigned a unique, 128-digit, identification number which facilitates analysis of extended surveys. Therefore, an individual radar echo is referred to as a biological “target” in this study, and when counted together they represent an index of bird / bat activity or exposure level for a given period of time, and not necessarily a count of individuals.

2.2 Data Analysis

2.2.1 Radar Data

HSR and VSR data were reviewed by SWCA Environmental Consultants staff. Rain and insect events were marked in both the VSR and HSR data. Final data analysis was conducted in DeTect’s Data Center in Panama City, Florida.

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TrackPlot images (15-minute increments) of the radar data were manually reviewed, and previously marked events were separated into either insect events or rain / other contamination events. Any missed contamination events were also marked. All 15-min increments containing contamination were removed from the final datasets and noted in the level of effort metrics. Level of effort queries were run on both data with, and without, time periods marked as insect contamination. This allowed us to derive the amount of time containing insect activity. Graphical output however, was produced using only data without the time periods marked as insect contamination. This matches methods used on data from this site presented in the 2011 report.

The Data Center uses Microsoft Windows® based computer systems, networks, and SQL (structured query language) servers for database processing and analysis. In order to minimize false tracks (insects, ground clutter, interference, etc.) in both the horizontal and vertical data, targets that were only plotted once after they were defined as a target (leaving only one row in the database) were considered low quality and eliminated from the database. Masks were also applied to areas that exhibited false tracking as indicated by SWCA.

The cleaned radar data was analyzed during dawns (30 minutes before to 30 minutes after sunrise), days (30 minutes after sunrise to 30 minutes before sunset), dusks (30 minutes before sunset to 30 minutes after sunset), and nights (30 minutes after sunset to 30 minutes before sunrise the next day). Hourly time periods and seasonal summaries were also used for some analyses.

2.2.2 Vertical Radar Data - Target Counts and Altitudes

The VSR data collected was used to develop information on target passage rates and heights within the project area. As targets passed along or through the VSR beam, the position and altitude above ground level (AGL) of the target was recorded with each scan of the radar. The position and altitude reported for a target is taken from the scan producing the greatest target area as that is the scan most likely having the best “look” at the target. Theoretically, that is also the scan closest to the center of the beam and therefore would have the least slant range error in the altitude measurement. Each target’s altitudes were then used to derive mean and median target heights, as well as to group targets into one of three categories: below rotor swept zone, within rotor swept zone, or above rotor swept zone. For the purposes of this graphical analysis a rotor swept zone of 0-152.4 m (0-500 ft) AGL was considered.

The VSR data were standardized to a 1-km front per hour, generally the industry standard for most migratory and wind energy avian studies and risk analyses. For this report, target passage rates are further defined as the number of targets detected within a standard 1-km front of the radar during a one hour period. Target passage rates were standardized into an hourly rate by dividing the target count by the number of minutes of radar data within a given time period, minus

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any time lost or contaminated, and multiplied by 60. Target passage rates (below, within, and above the rotor swept zone, as well as total), and mean and median target heights, were calculated for each biological period and hour during this survey. Target passage rates were also averaged by biological period and hour. Comprehensive target passage rates, in which all targets were grouped by a given time period regardless of date, were also calculated hourly. Both grand and comprehensive mean target heights were calculated; the former being the average of the average target heights for a period of time across the season, and the latter being the average height of all targets within a given time period regardless of date. Median target heights were both averaged across biological periods and hours, and calculated by biological period. The distribution of targets within 50-m increments is also presented.

2.2.3 Horizontal Radar Data - Target Directions

The HSR data collected was used to develop information on the movement of targets within the project area. As targets were detected by the HSR, their bearings were recorded on each scan of the radar. The average bearing of each target was then generated from all the scans as the target passed through the HSR beam. Date-time information was derived using the last plot of the track.

The HSR data were queried and an average target direction was generated for each biological period and hour; target (angular) concentrations were also calculated for each biological period. The comprehensive directional distribution of all targets was illustrated by biological period and hour in Microsoft Office Excel by developing frequency tables of target numbers occurring in 45° increments: eight groups centered on north, northeast, east, southeast, south, southwest, west, and northwest.

Calculations of mean direction and angular concentration (*r*) for these time periods were calculated using SQL and formulas based on Zar 1999. The value of *r* is a measure of concentration; it has no units and varies from 0 (no concentration, all values very dispersed) to 1.0 (all data concentrated in the same direction), whereas 1-*r* is a measure of angular dispersion (Zar 1999).

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3 RESULTS for the Winter 2011-12 Season

3.1 Level of Effort

Table 3-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, during the Winter 2011-12 Season (November 16, 2011 – March 31, 2012). The MERLIN avian radar system operated at Site 4 until January 26, 2012 and at Site 6 after February 2, 2012.

Table 3-1. Radar monitoring effort during the Winter 2011-12 season.

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	3287.0		3287.0	
Time radar down	169.6	5.2%	168.5	5.1%
Time radar collected data	3117.4	94.8%	3118.6	94.9%
Unuseable radar data[1] due to rain or other contamination	566.7	18.2%	2.0	0.1%
Unuseable radar data[2] due to insects	0.0	0.0%	-	-
Useable radar data[3]	2550.7	77.6%	3116.6	94.8%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

3.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

3.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 3-1) and as an average by biological period (Fig. 3-2) and hour (Fig. 3-3). Summary statistics are presented in table 3-2.

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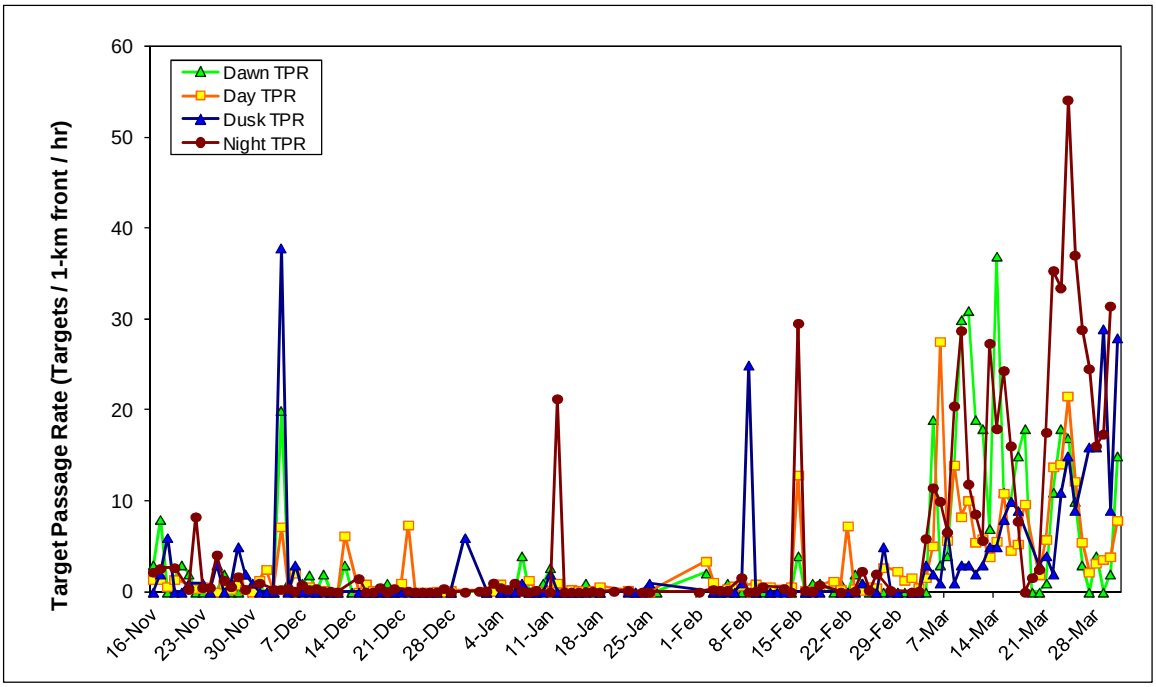

Figure 3-1. Target passage rates (TPR) during biological periods of the Winter 2011-12 season.

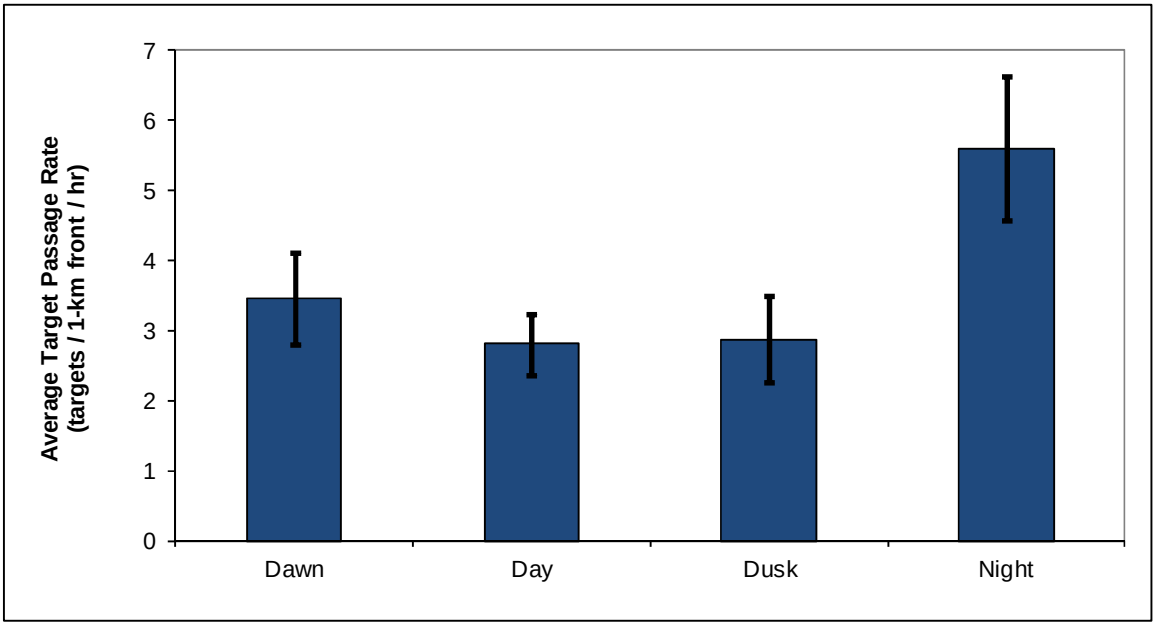

Figure 3-2. Average target passage rates (TPR) by biological period during the Winter 2011-12 season. Error bars represent one standard error.

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Table 3-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods during the Winter 2011-12 season.

	Dawn	Day	Dusk	Night
Average	3.5	2.8	2.9	5.6
Standard Deviation	7.1	4.6	6.4	10.6
Standard Error	0.7	0.4	0.6	1.0
Median	0.0	0.7	0.0	0.4
Minimum	0.0	0.0	0.0	0.0
Maximum	37.0	27.6	37.9	54.2

Both average and comprehensive hourly target passage rates are presented in Fig 3-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

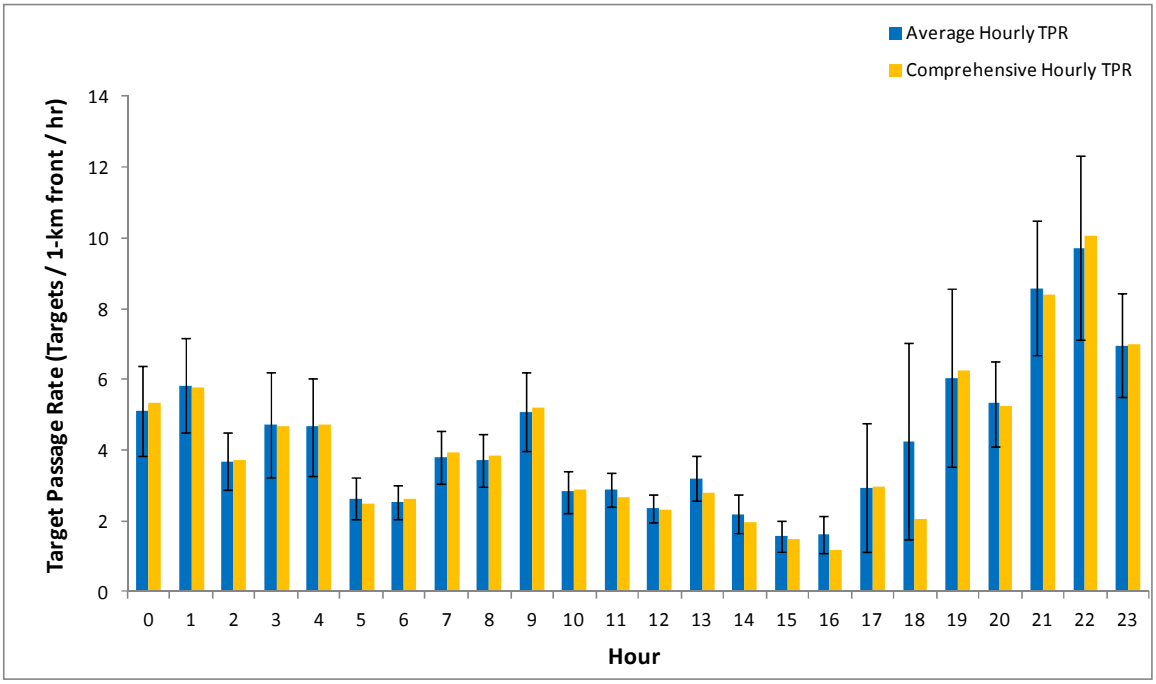

Figure 3-3. Average and comprehensive hourly target passage rates during the Winter 2011-12 season. Error bars represent one standard error.

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3.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 3-4 and Fig. 3-5, respectively) of the Winter 2011-12 season.

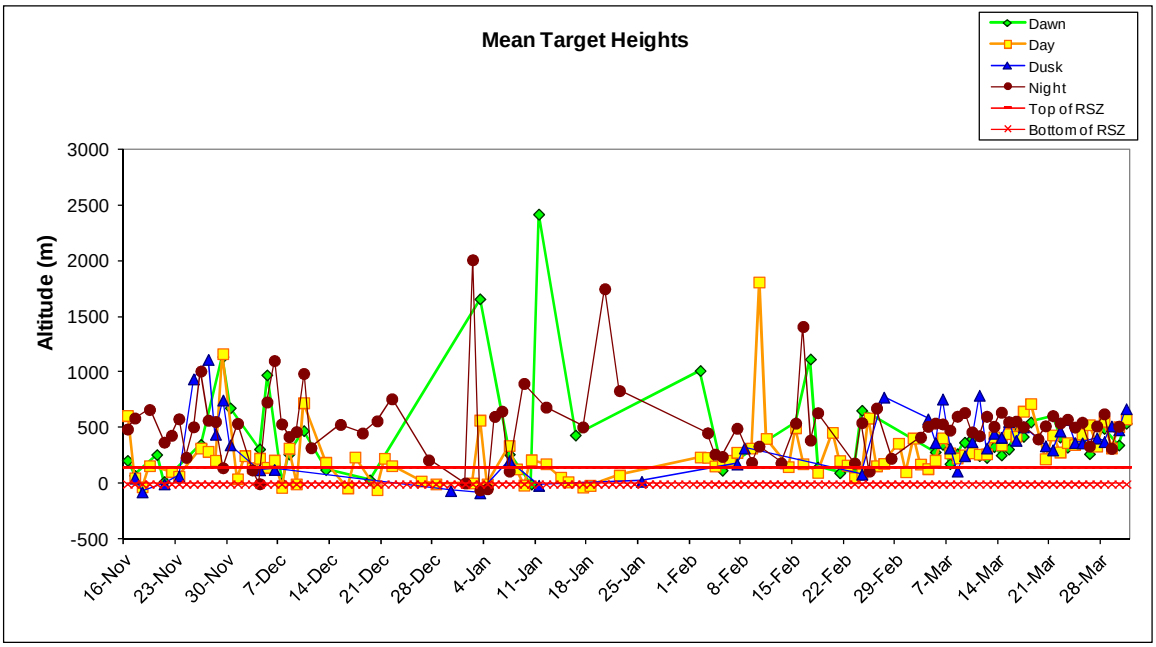

Figure 3-4. Mean target heights during the Winter 2011-12 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

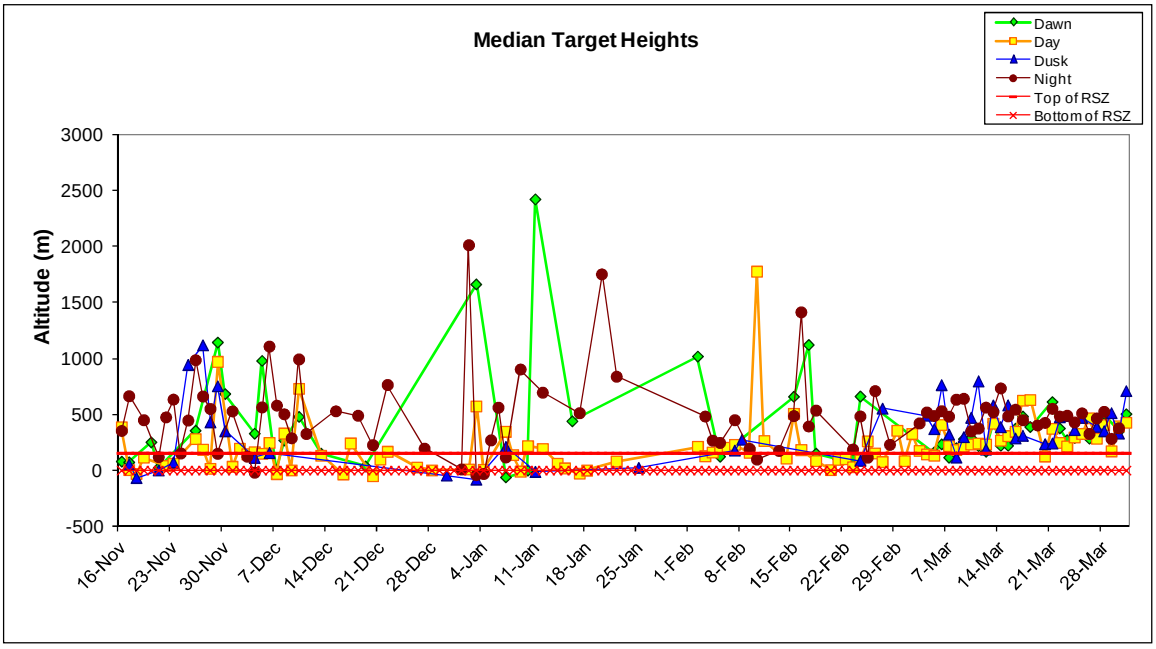

Figure 3-5. Median target heights during the Winter 2011-12 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

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The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 3-3 (top) and illustrated in Figure 3-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 3-3 (bottom) and illustrated in Figure 3-6 (green bars).

Table 3-3. Summary of mean and median target heights during biological periods of the Winter 2011-12 season. Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	442.0	274.8	366.9	524.8
Average median target height	410.9	219.6	347.1	486.0
All targets for season combined				
Comprehensive mean target height	366.3	360.3	433.6	540.7
Comprehensive median target height	272.2	257.9	359.1	482.5

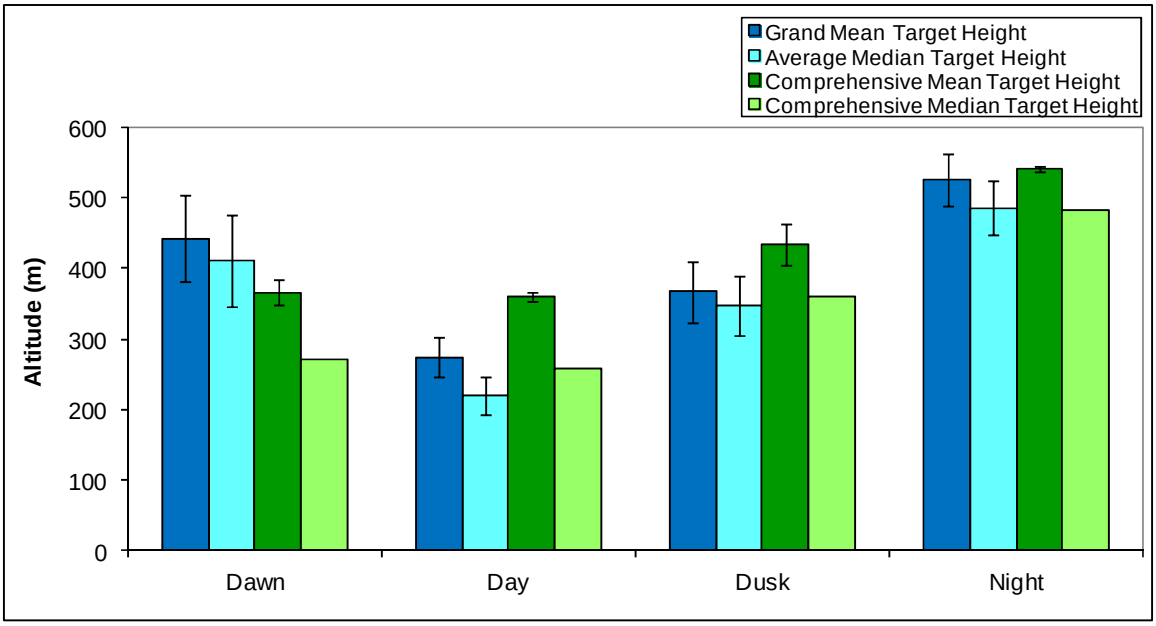

Figure 3-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), during the Winter 2011-12 season. Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 3-7).

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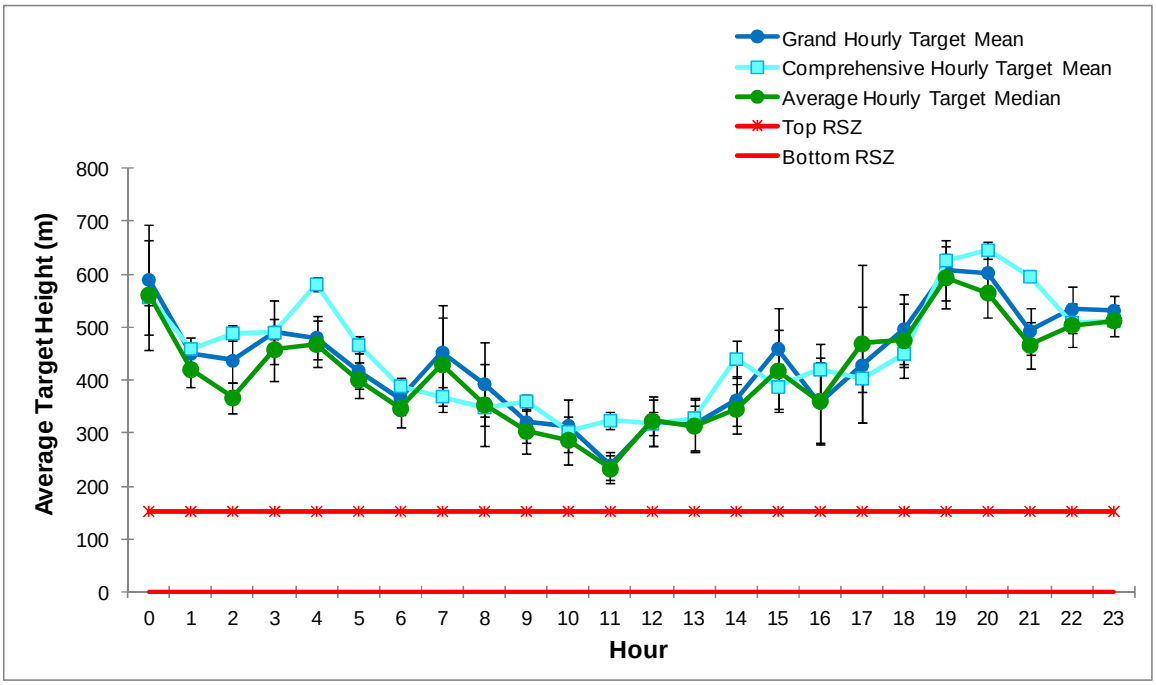

Figure 3-7. Hourly target heights during the Winter 2011-12 season. Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights of the Winter 2011-12 season are shown using 50-meter increments (Fig. 3-8).

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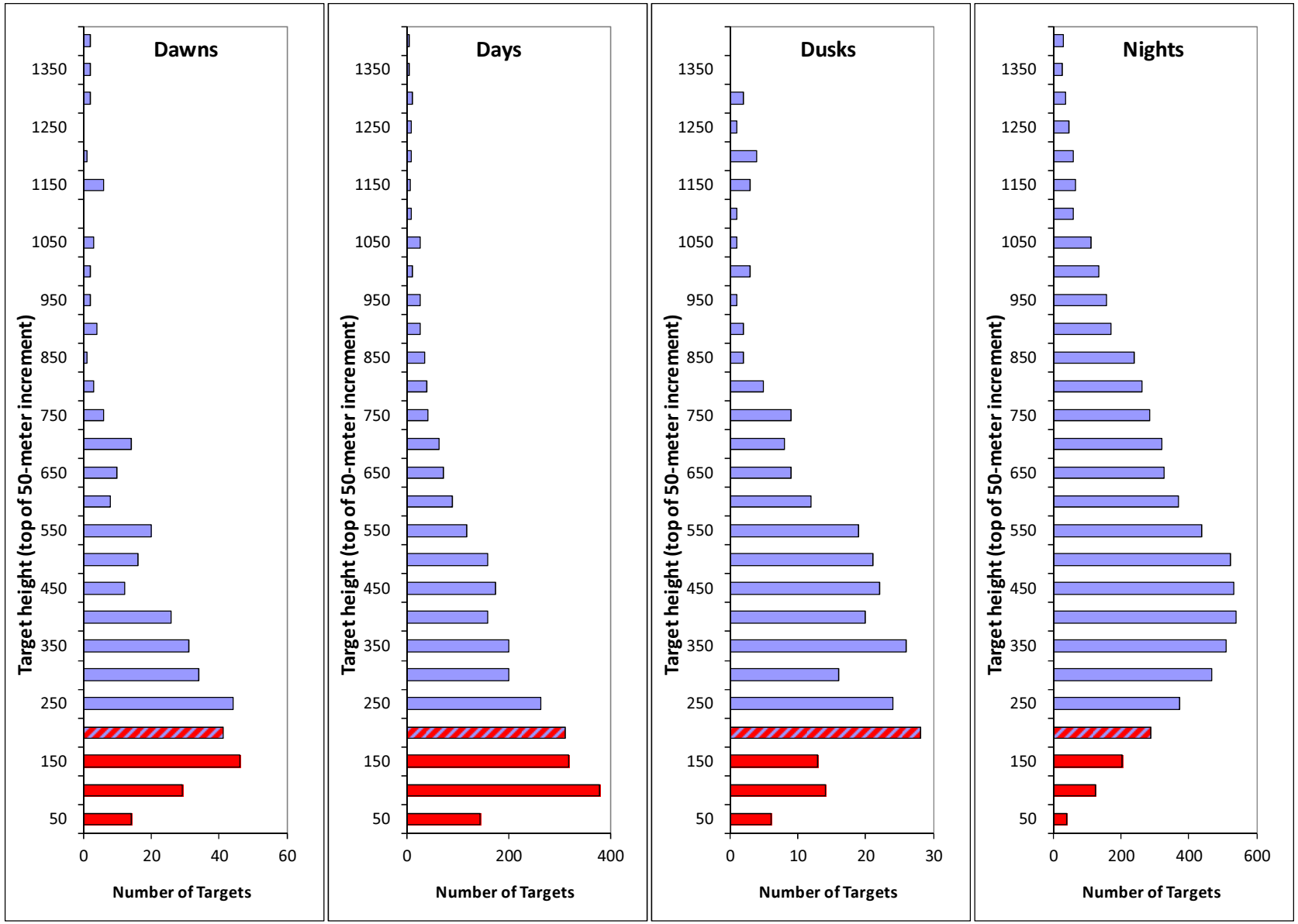

Figure 3-8. Number of targets occurring in each 50-meter increment during biological periods of the Winter 2011-12 season. Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

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Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 3-10) days (Fig. 3-11), dusks (Fig 3-12), and nights (Fig. 3-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period of the Winter 2011-12 season combined together (Table 3-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 3-9).

Table 3-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods of the Winter 2011-12 season. Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	2.6	1.9	2.3	5.3
Average target passage rate within RSZ	0.8	0.8	0.4	0.3
Average target passage rate below RSZ	0.1	0.1	0.2	0.0
Average % of targets in RSZ	28.7%	37.6%	19.2%	13.8%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.0%
Max target percentage within RSZ	100.0%	100.0%	100.0%	100.0%
All targets for season combined				
% targets above RSZ	75.1%	70.0%	82.0%	95.1%
% targets within RSZ	23.4%	27.2%	11.5%	4.5%
% targets below RSZ	1.5%	2.8%	6.4%	0.4%
% targets below turbine height	24.9%	30.0%	18.0%	4.9%

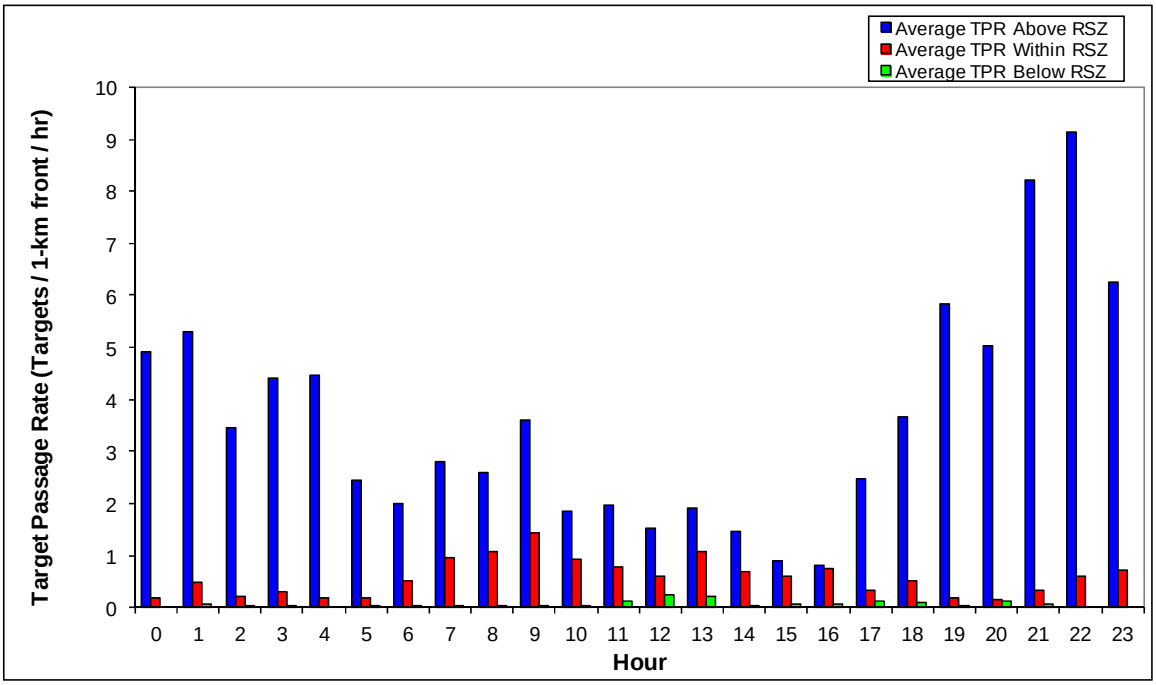

Figure 3-9. Average hourly target passage rates during the Winter 2011-12 season.

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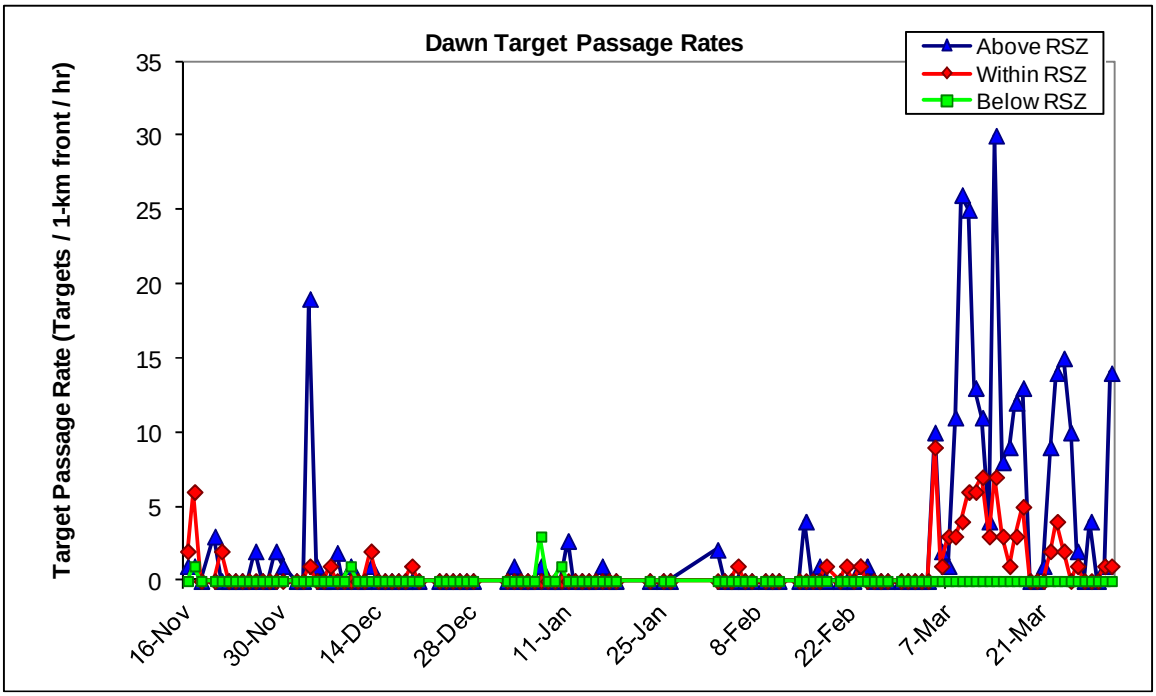

Figure 3-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns of the Winter 2011-12 season.

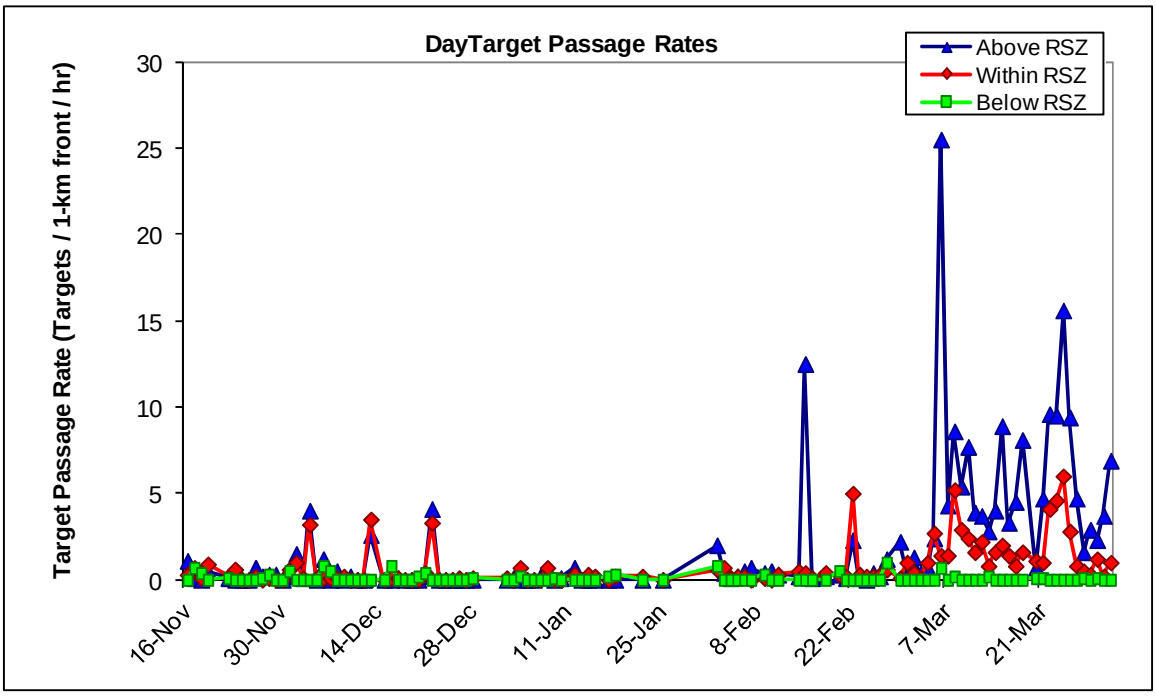

Figure 3-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days of the Winter 2011-12 season.

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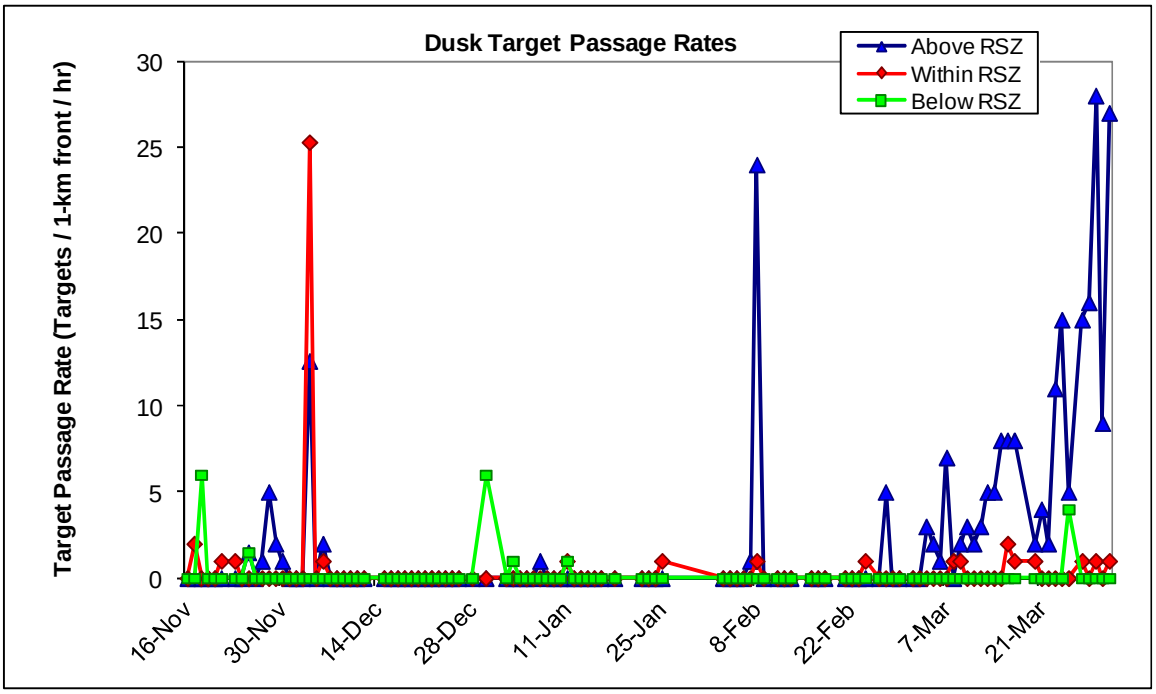

Figure 3-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks of the Winter 2011-12 season.

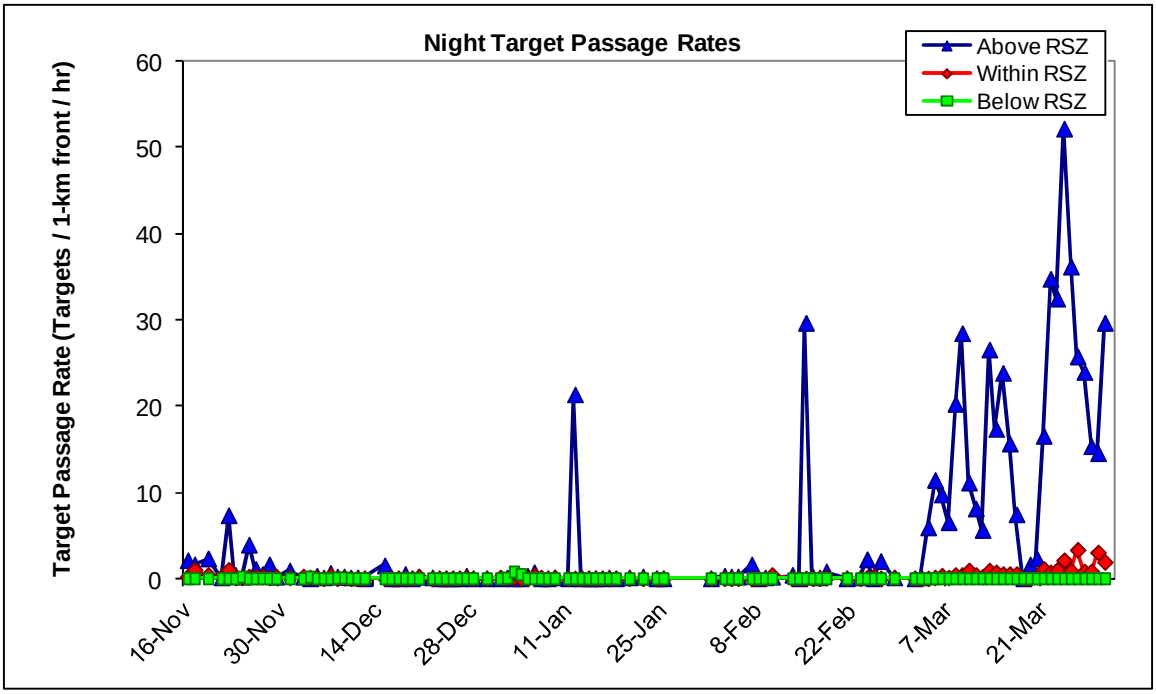

Figure 3-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights of the Winter 2011-12 season.

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3.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods of the Winter 2011-12 season.

3.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 3-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected during the Winter 2011-12 season combined together by biological period (Fig. 3-15) and hour (Fig. 3-16).

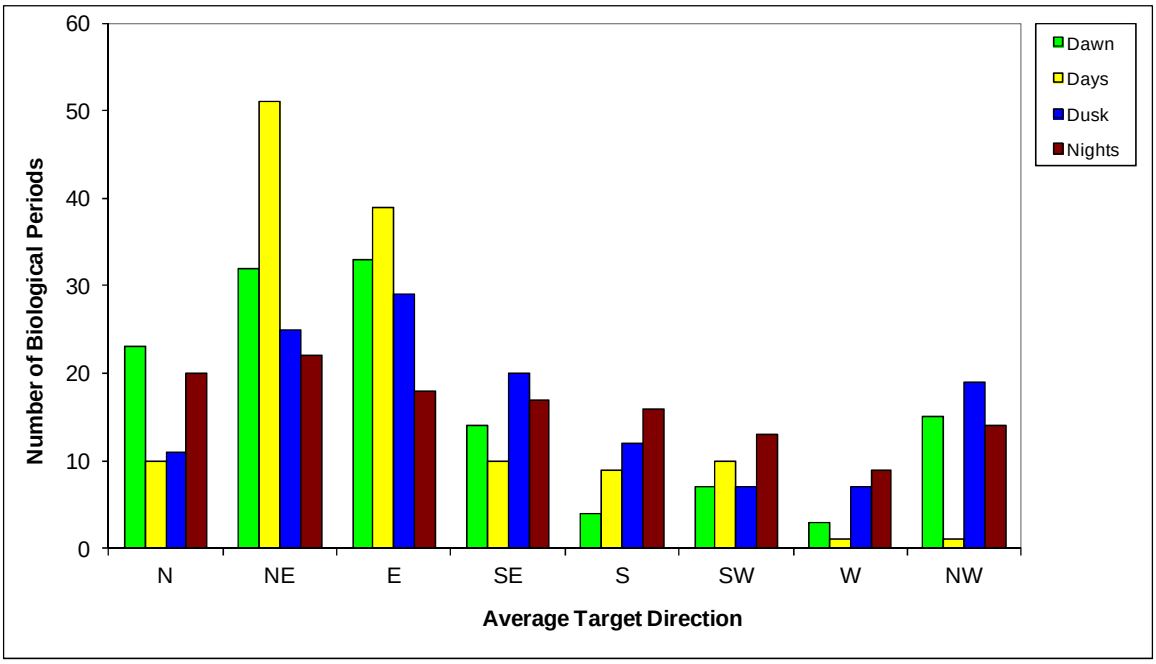

Figure 3-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights of the Winter 2011-12 season.

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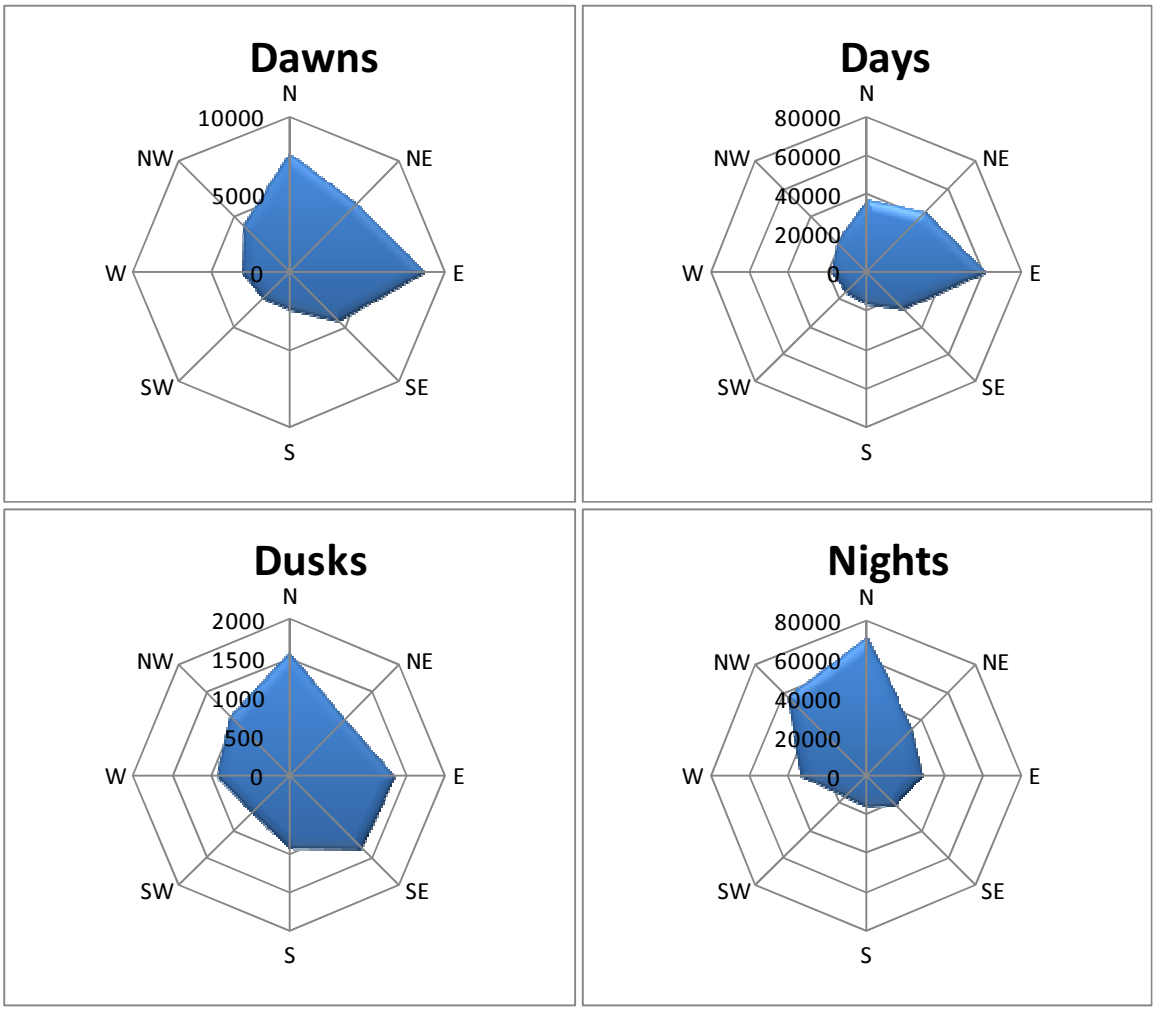

Figure 3-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights of the Winter 2011-12 season.

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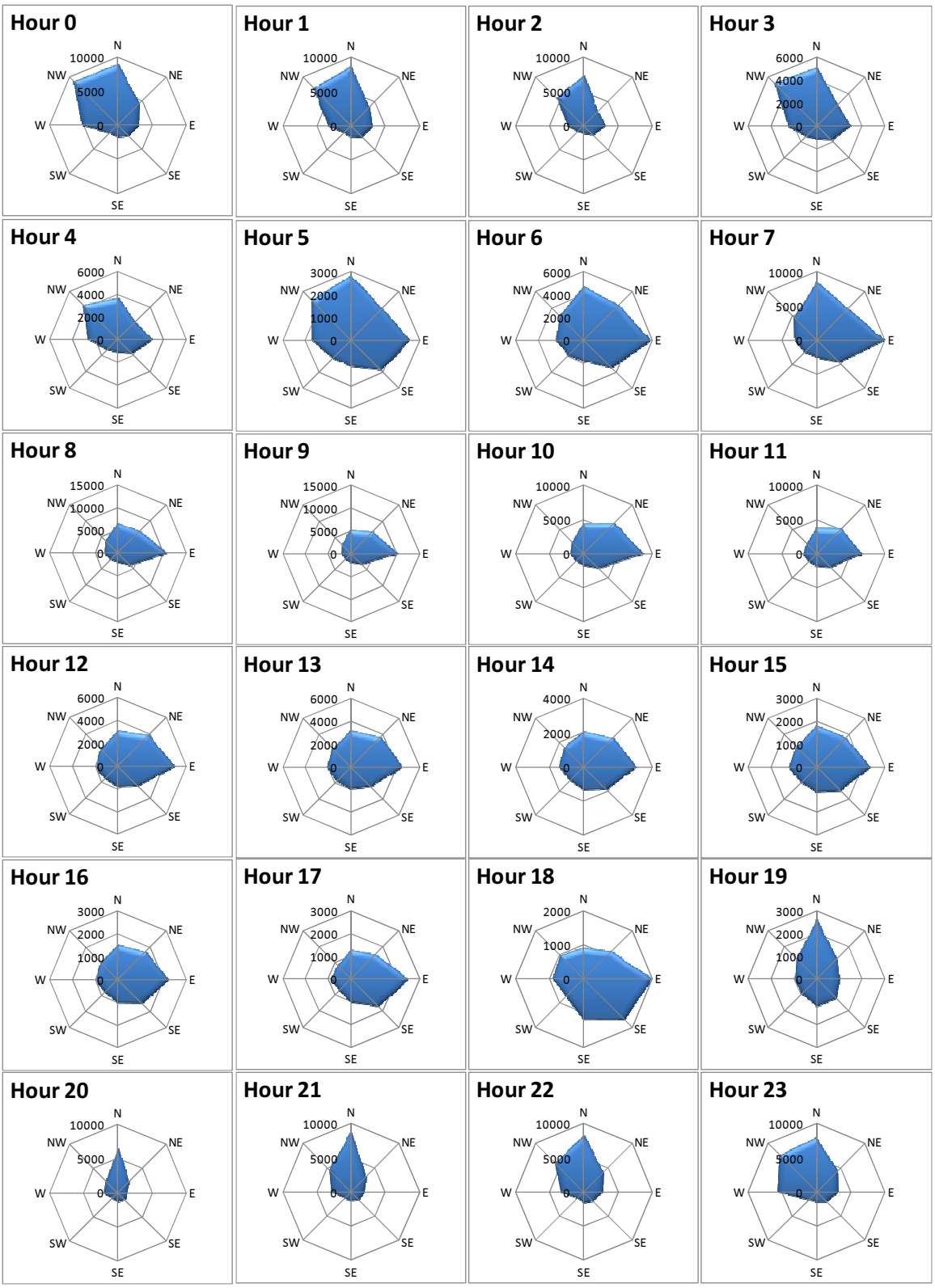

Figure 3-16. Comprehensive distribution of all target's directions by hour during the Winter 2011-12 season.

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4 RESULTS for the Spring 2012 Season

4.1 Level of Effort

Table 4-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, during the Spring 2012 Season (April 1 – June 30, 2012). The MERLIN avian radar system operated at Site 6 until February 2, 2012 and at Site 8 after May 19, 2012.

Table 4-1. Radar monitoring effort during the Spring 2012 season.

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	2183.0		2183.0	
Time radar down	473.2	21.7%	473.1	21.7%
Time radar collected data	1709.8	78.3%	1709.9	78.3%
Unuseable radar data[1] due to rain or other contamination	274.4	16.0%	8.8	0.5%
Unuseable radar data[2] due to insects	231.3	13.5%	-	-
Useable radar data[3]	1204.2	55.2%	1701.2	77.9%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

4.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

4.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 4-1) and as an average by biological period (Fig. 4-2) and hour (Fig. 4-3). Summary statistics are presented in table 4-2.

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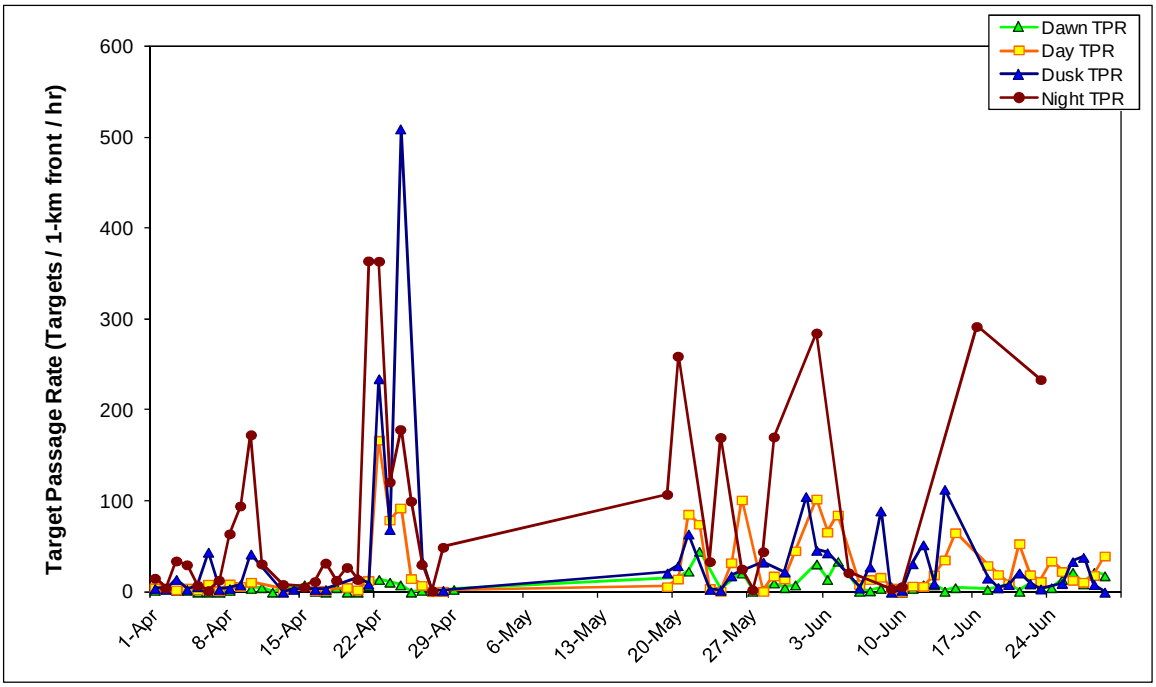

Figure 4-1. Target passage rates (TPR) during biological periods of the Spring 2012 season.

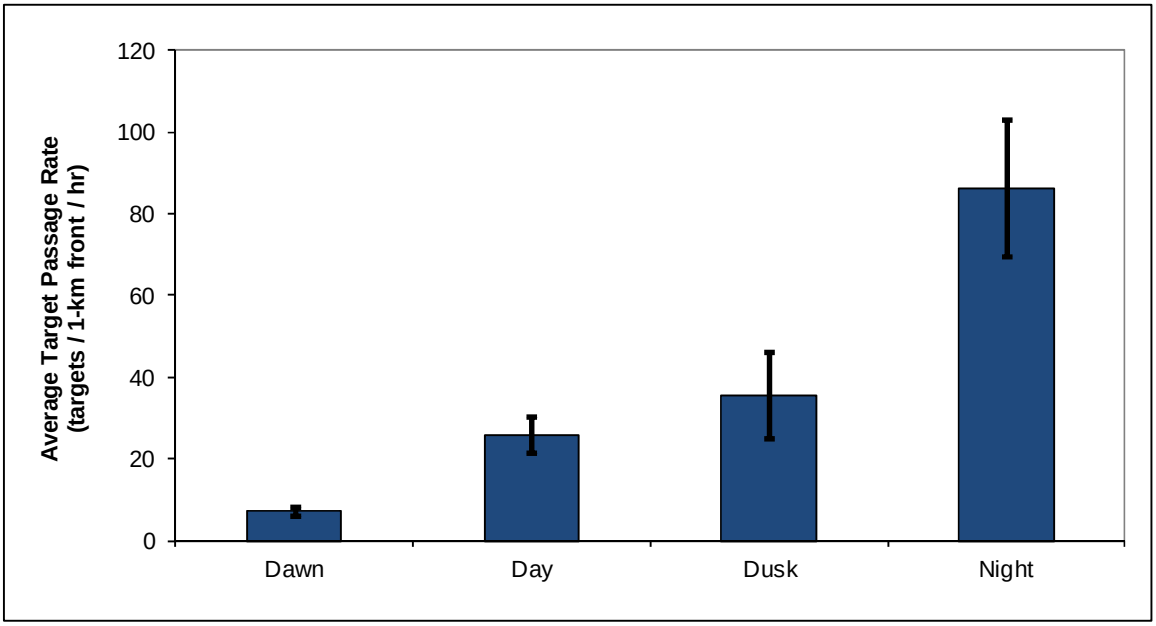

Figure 4-2. Average target passage rates (TPR) by biological period during the Spring 2012 season. Error bars represent one standard error.

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Table 4-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods during the Spring 2012 season.

	Dawn	Day	Dusk	Night
Average	7.4	26.0	35.6	86.3
Standard Deviation	9.1	33.9	77.2	106.3
Standard Error	1.2	4.4	10.6	16.8
Median	5.0	12.4	9.6	31.6
Minimum	0.0	0.3	0.0	1.4
Maximum	45.0	167.3	510.0	364.7

Both average and comprehensive hourly target passage rates are presented in Fig 4-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

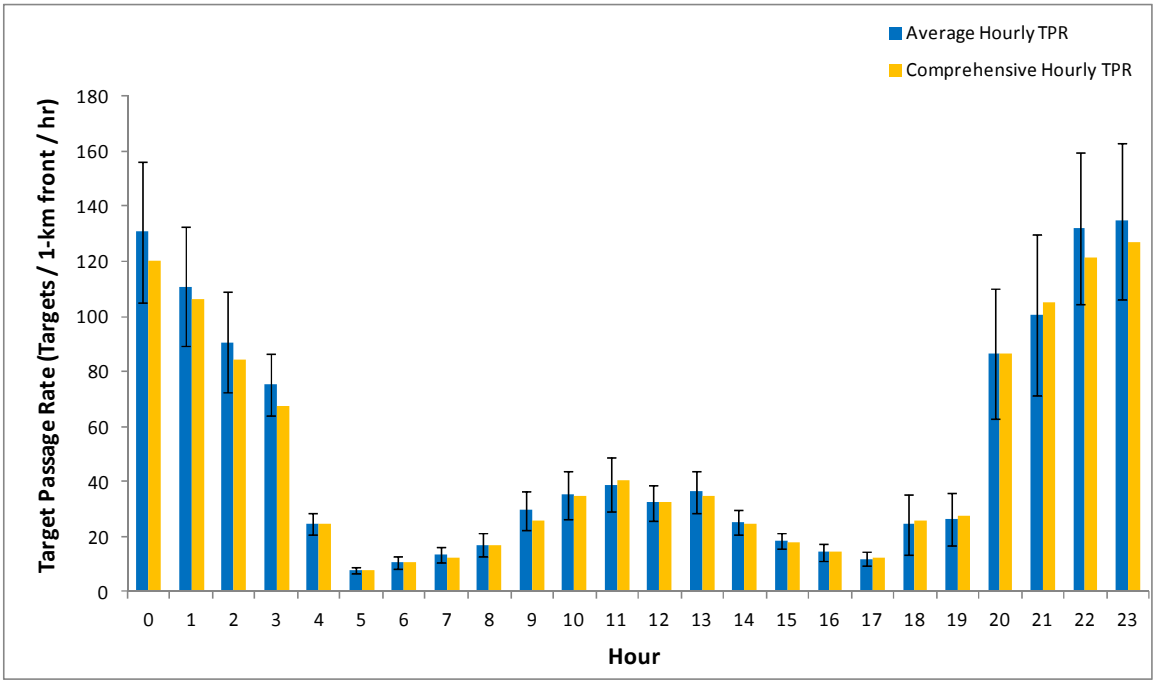

Figure 4-3. Average and comprehensive hourly target passage rates during the Spring 2012 season. Error bars represent one standard error.

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4.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 4-4 and Fig. 4-5, respectively) of the Spring 2012 season.

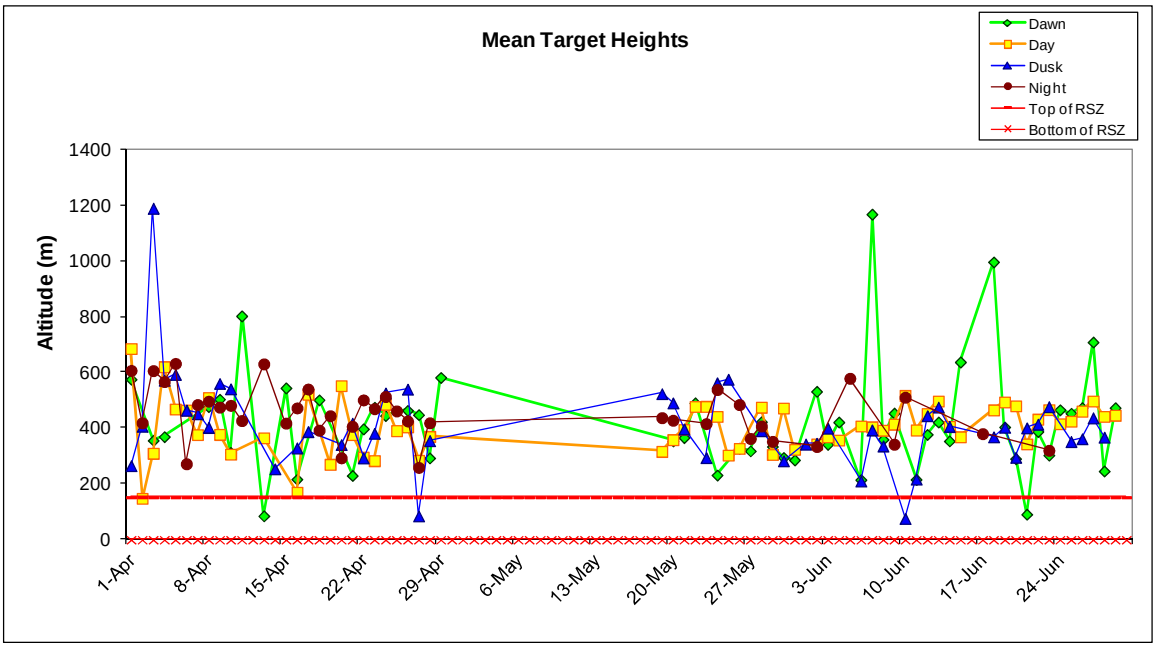

Figure 4-4. Mean target heights during the Spring 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

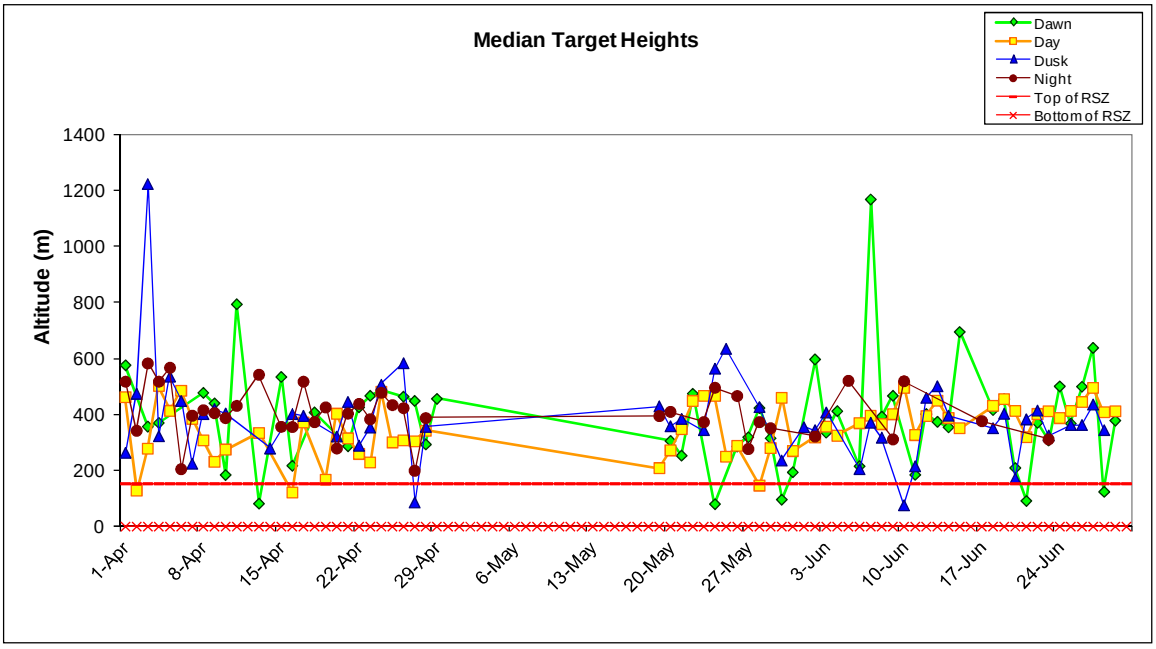

Figure 4-5. Median target heights during the Spring 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

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The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 4-3 (top) and illustrated in Figure 4-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 4-3 (bottom) and illustrated in Figure 4-6 (green bars).

Table 4-3. Summary of mean and median target heights during biological periods of the Spring 2012 season. Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	421.0	407.0	408.2	450.6
Average median target height	386.0	353.8	386.0	406.3
All targets for season combined				
Comprehensive mean target height	423.7	388.9	428.2	437.5
Comprehensive median target height	396.2	353.6	392.9	401.7

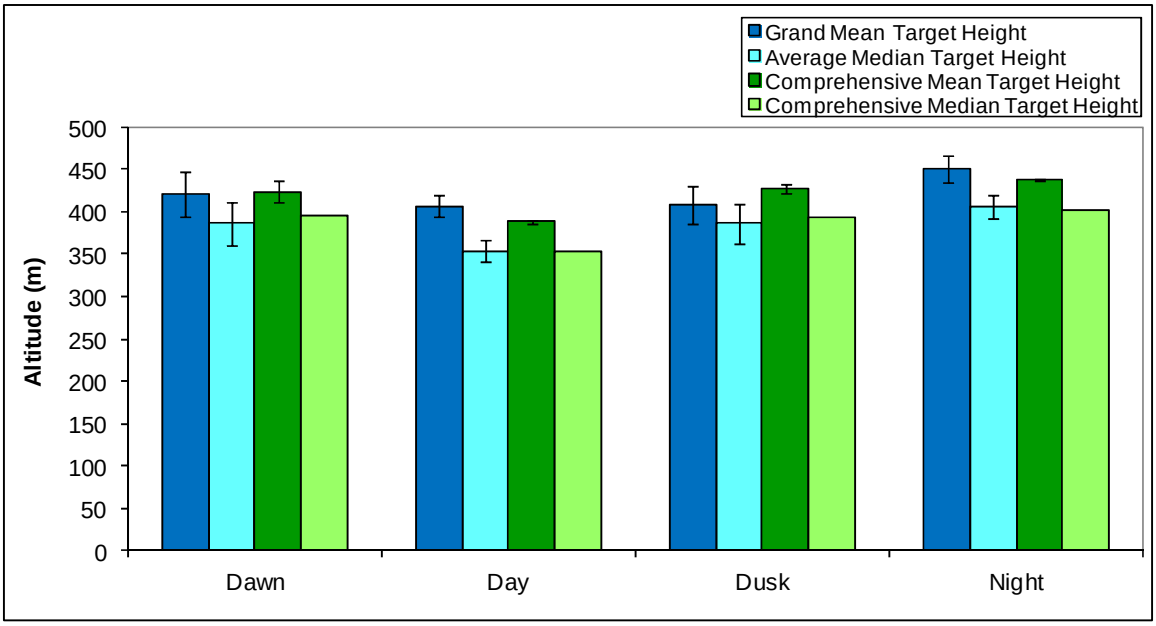

Figure 4-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), during the Spring 2012 season. Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 4-7).

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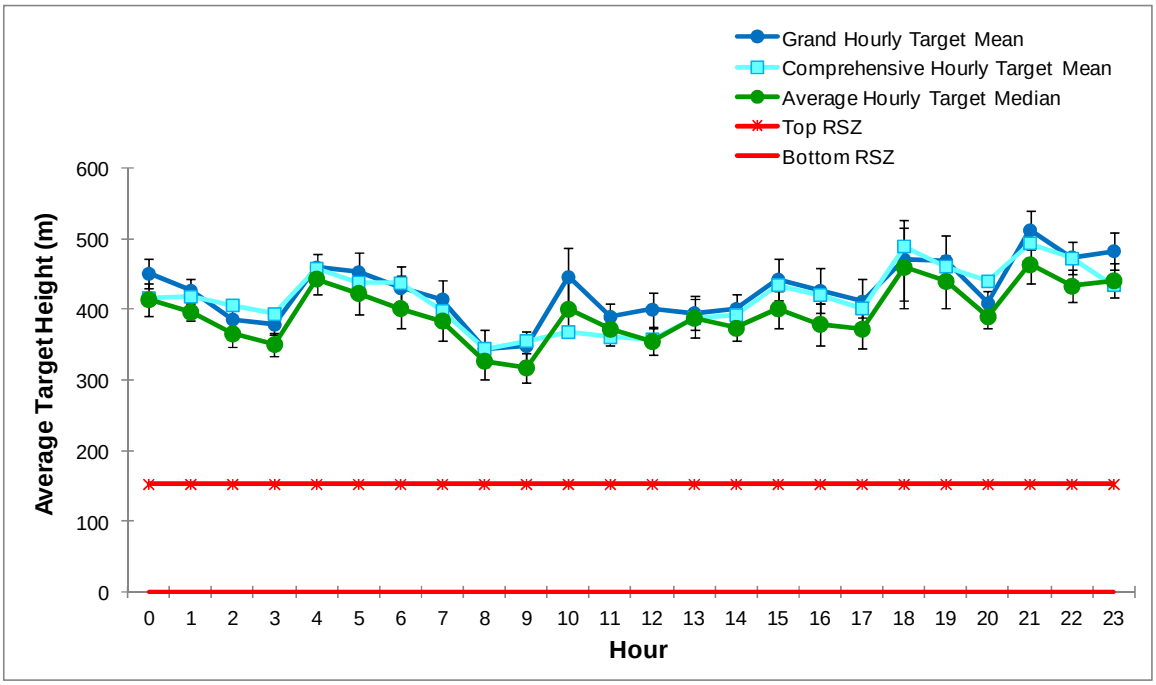

Figure 4-7. Hourly target heights during the Spring 2012 season. Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights of the Spring 2012 season are shown using 50-meter increments (Fig. 4-8).

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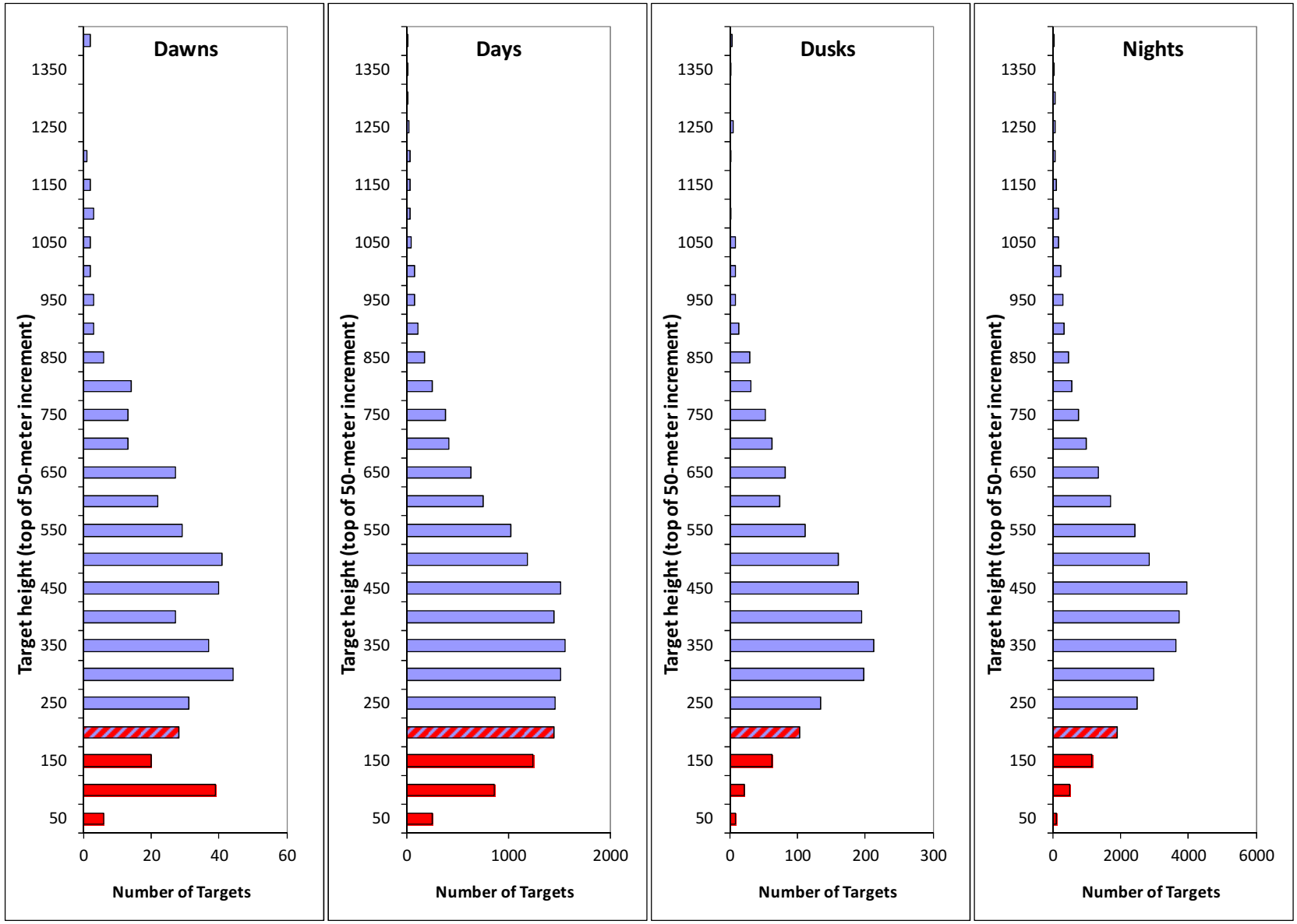

Figure 4-8. Number of targets occurring in each 50-meter increment during biological periods of the Spring 2012 season. Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

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Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 4-10) days (Fig. 4-11), dusks (Fig 4-12), and nights (Fig. 4-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period of the Spring 2012 season combined together (Table 4-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 4-9).

Table 4-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods of the Spring 2012 season. Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	6.4	22.0	33.7	81.0
Average target passage rate within RSZ	1.1	3.9	1.9	5.3
Average target passage rate below RSZ	0.0	0.0	0.0	0.0
Average % of targets in RSZ	16.8%	16.9%	9.2%	7.7%
Min target percentage within RSZ	0.0%	1.8%	0.0%	0.3%
Max target percentage within RSZ	100.0%	67.9%	100.0%	35.3%
All targets for season combined				
% targets above RSZ	85.7%	85.8%	94.8%	94.4%
% targets within RSZ	14.3%	14.2%	5.2%	5.6%
% targets below RSZ	0.0%	0.1%	0.0%	0.0%
% targets below turbine height	14.3%	14.2%	5.2%	5.6%

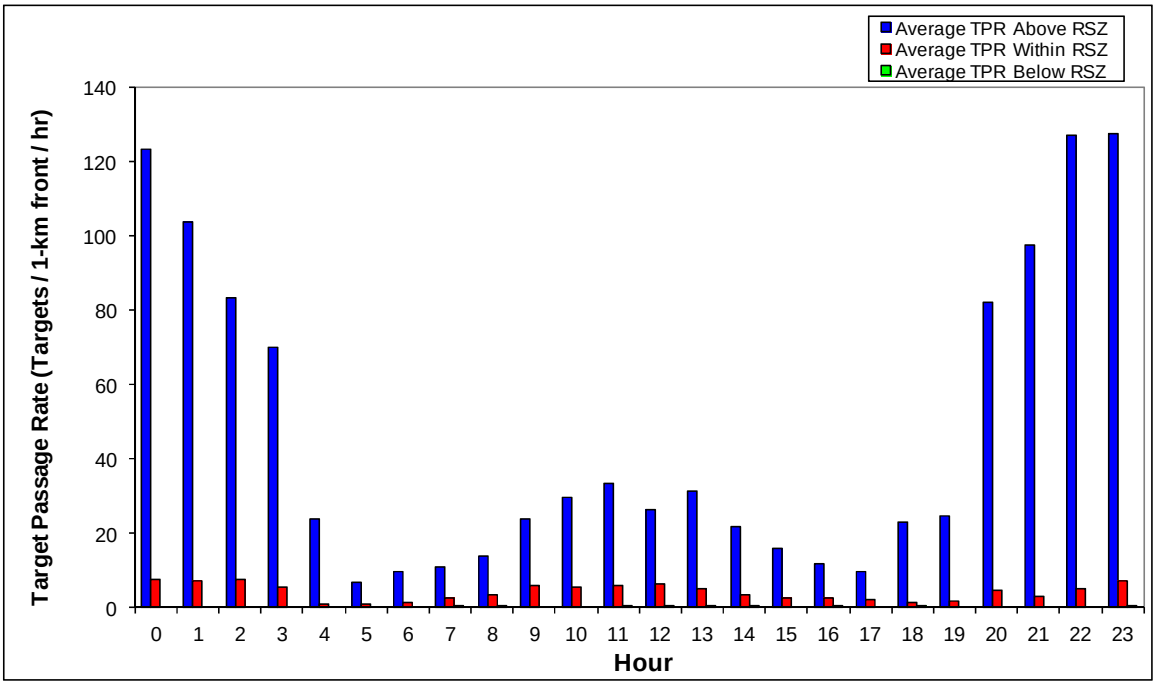

Figure 4-9. Average hourly target passage rates during the Spring 2012 season.

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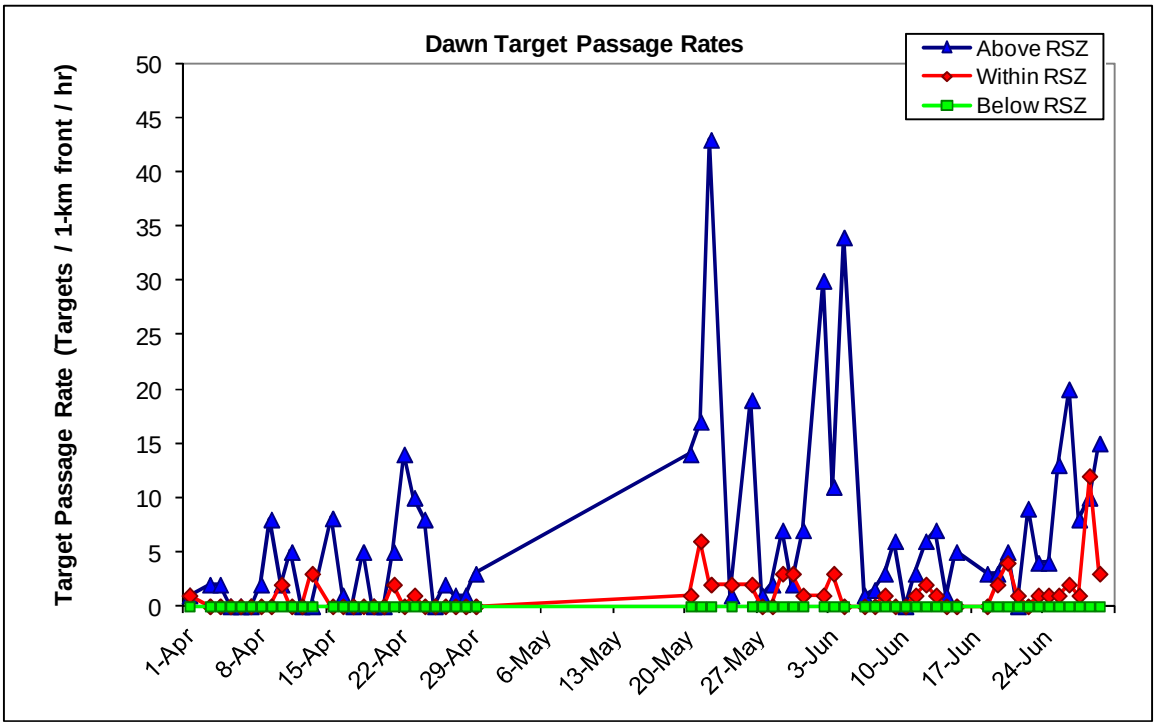

Figure 4-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns of the Spring 2012 season.

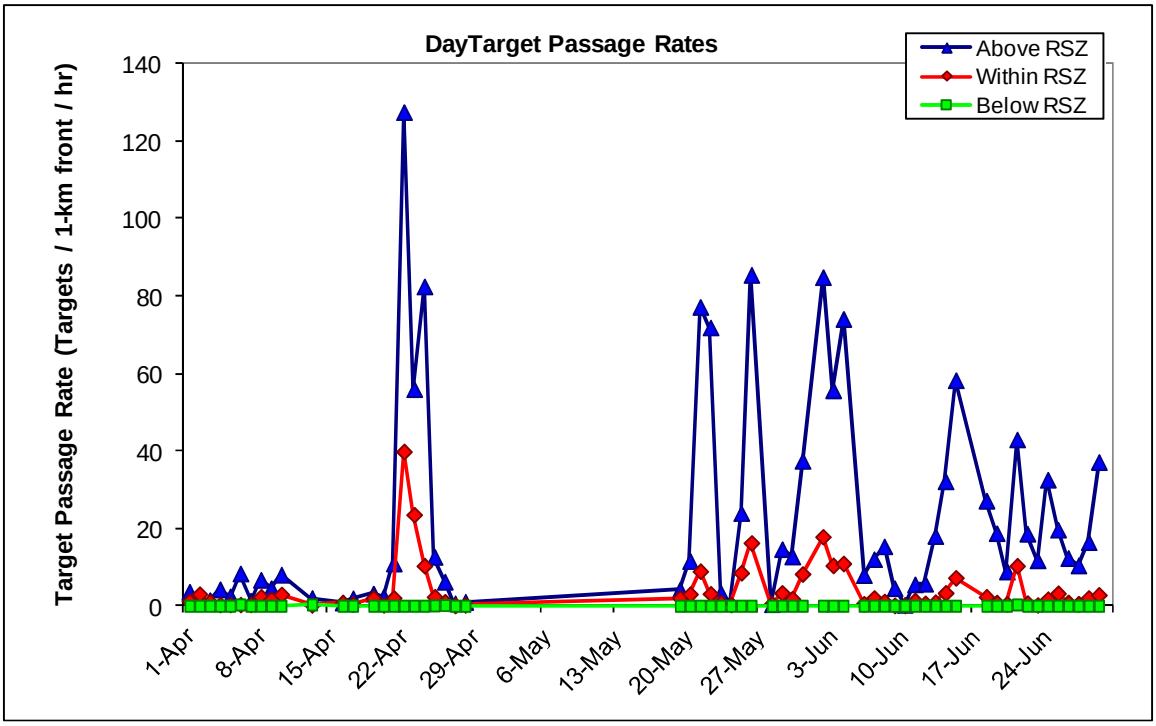

Figure 4-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days of the Spring 2012 season.

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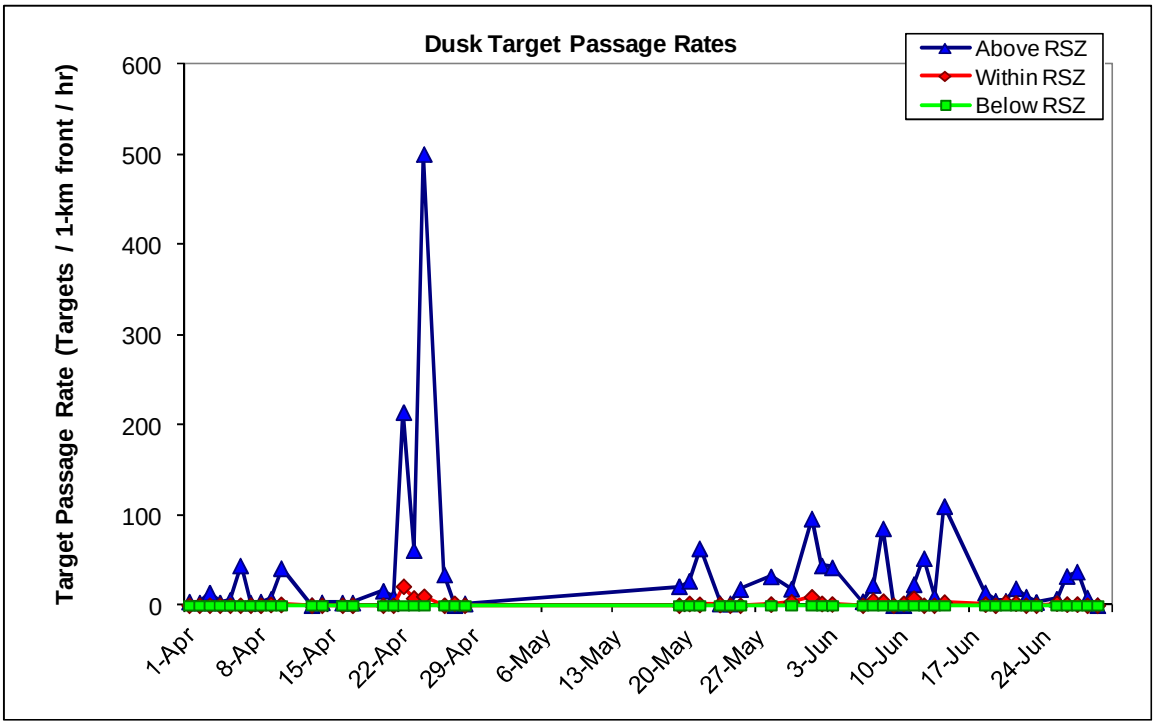

Figure 4-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks of the Spring 2012 season.

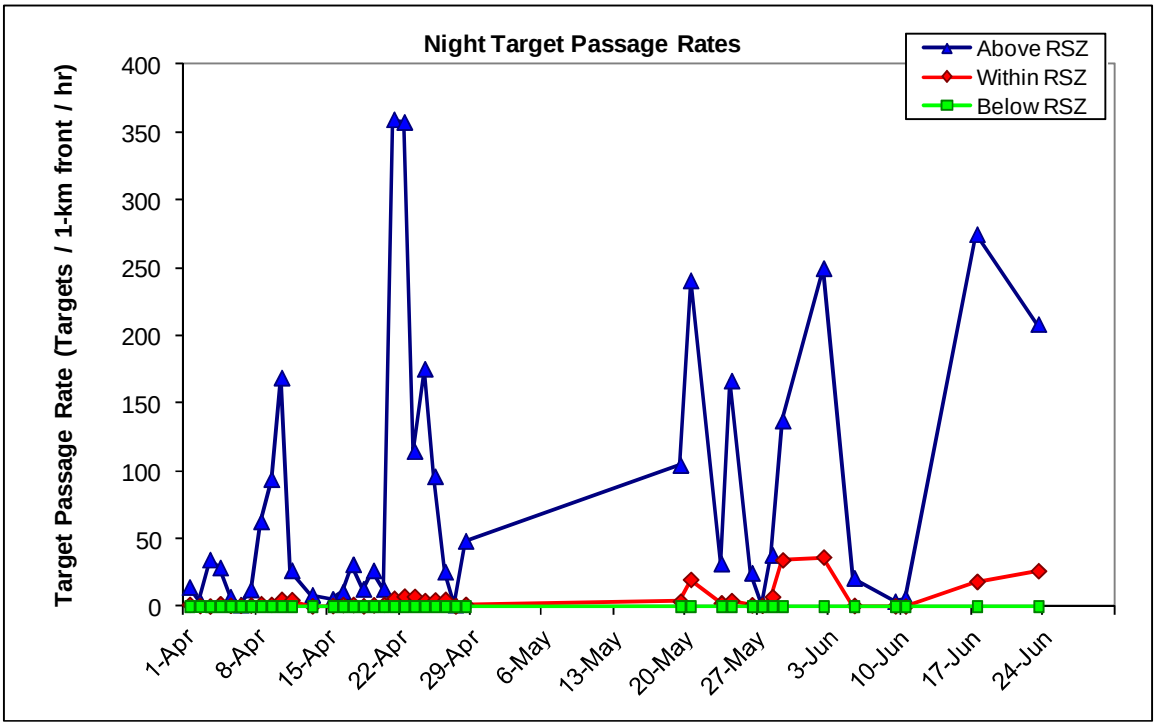

Figure 4-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights of the Spring 2012 season.

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4.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods of the Spring 2012 season.

4.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 4-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected during the Spring 2012 season combined together by biological period (Fig. 4-15) and hour (Fig. 4-16).

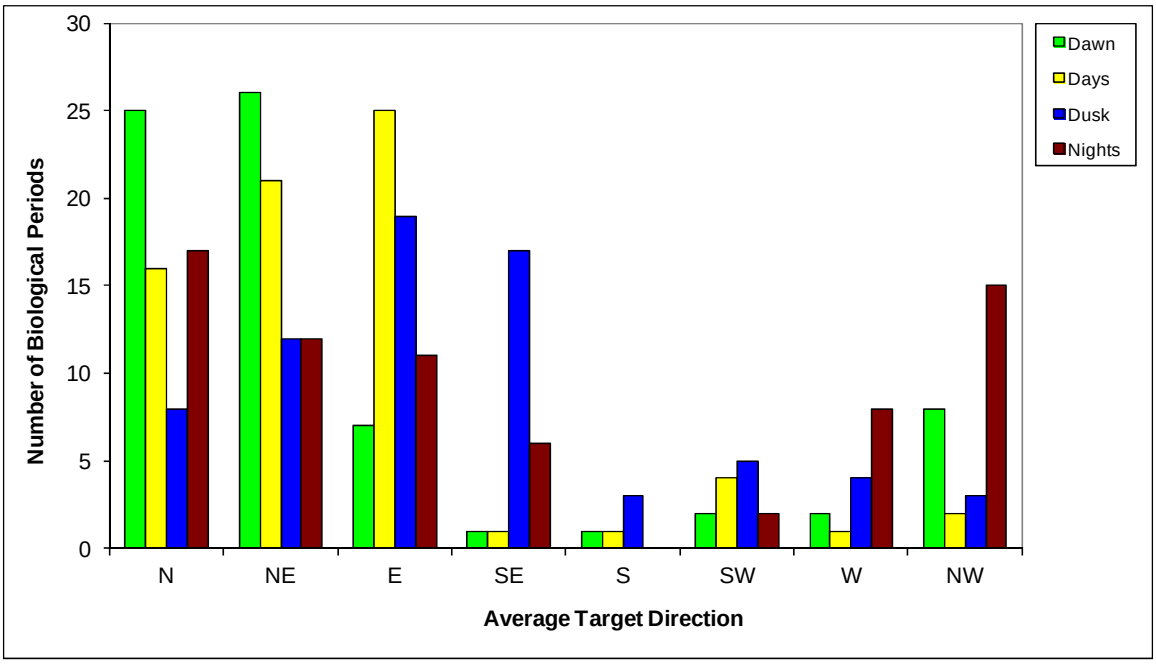

Figure 4-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights of the Spring 2012 season.

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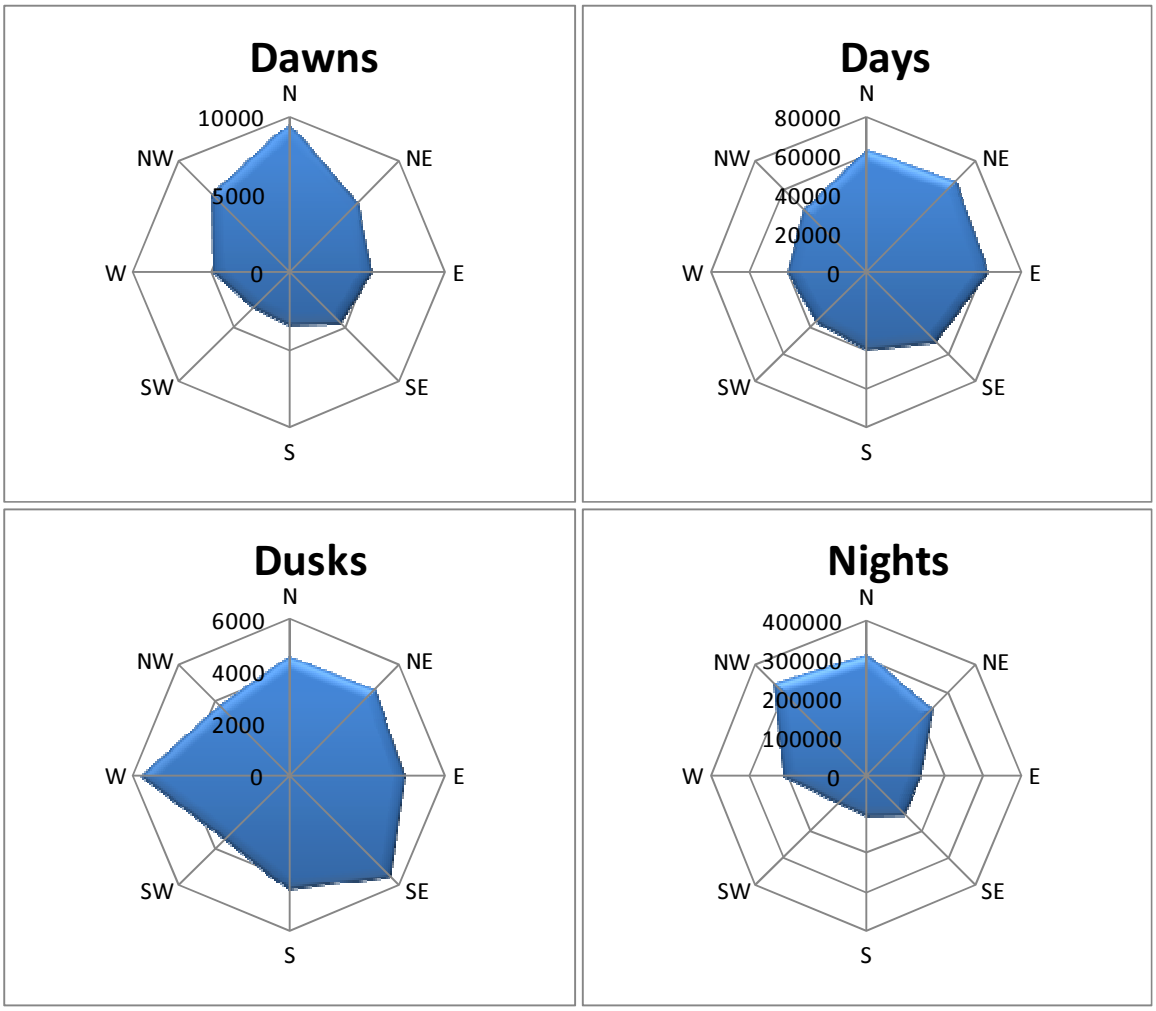

Figure 4-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights of the Spring 2012 season.

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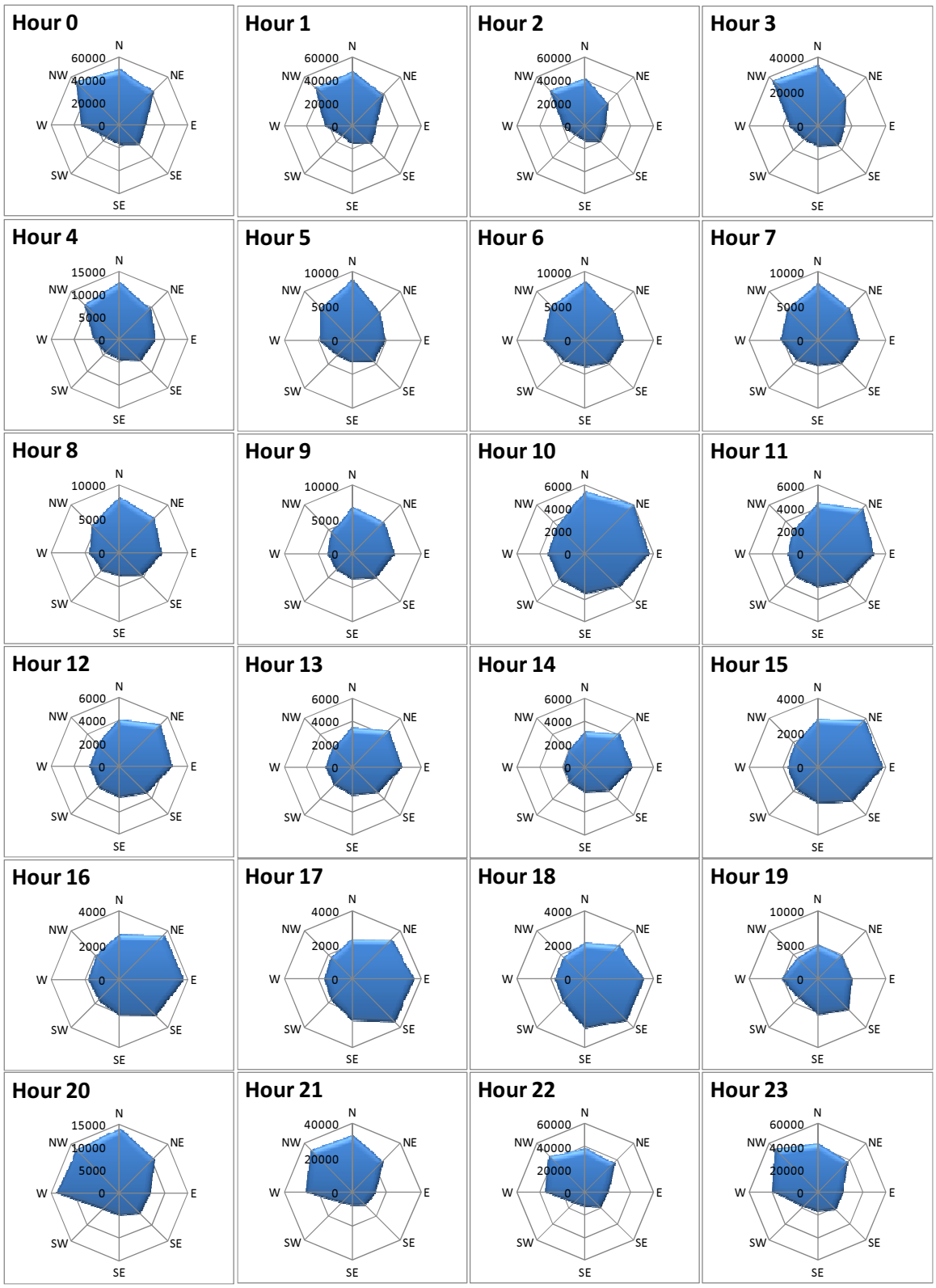

Figure 4-16. Comprehensive distribution of all target's directions by hour during the Spring 2012 season.

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5 RESULTS for the Summer 2012 Season

5.1 Level of Effort

Table 5-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, during the Summer 2012 Season (July 1 – August 15, 2012). The MERLIN avian radar system operated at Site 8 until July 17, 2012 and at Site 9 after July 21, 2012.

Table 5-1. Radar monitoring effort during the Summer 2012 season.

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	1104.6		1104.6	
Time radar down	88.7	8.0%	88.6	8.0%
Time radar collected data	1015.9	92.0%	1016.0	92.0%
Unuseable radar data[1] due to rain or other contamination	104.5	10.3%	13.5	1.3%
Unuseable radar data[2] due to insects	0.0	0.0%	-	-
Useable radar data[3]	911.4	82.5%	1002.5	90.8%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

5.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

5.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 5-1) and as an average by biological period (Fig. 5-2) and hour (Fig. 5-3). Summary statistics are presented in table 5-2.

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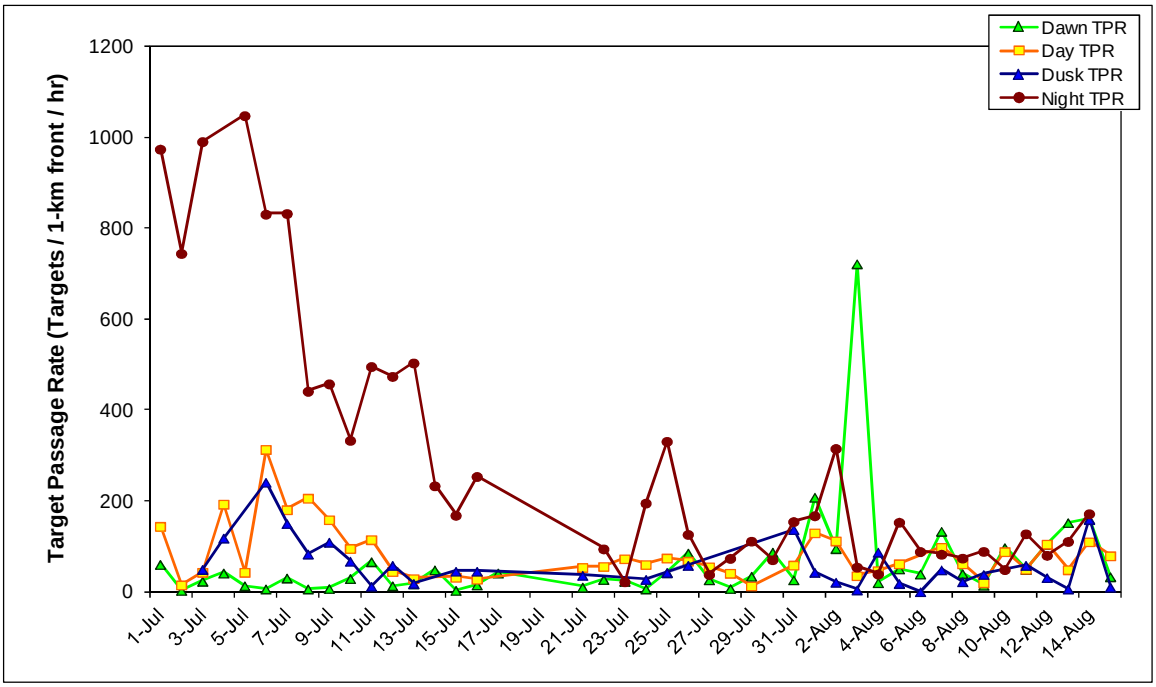

Figure 5-1. Target passage rates (TPR) during biological periods of the Summer 2012 season.

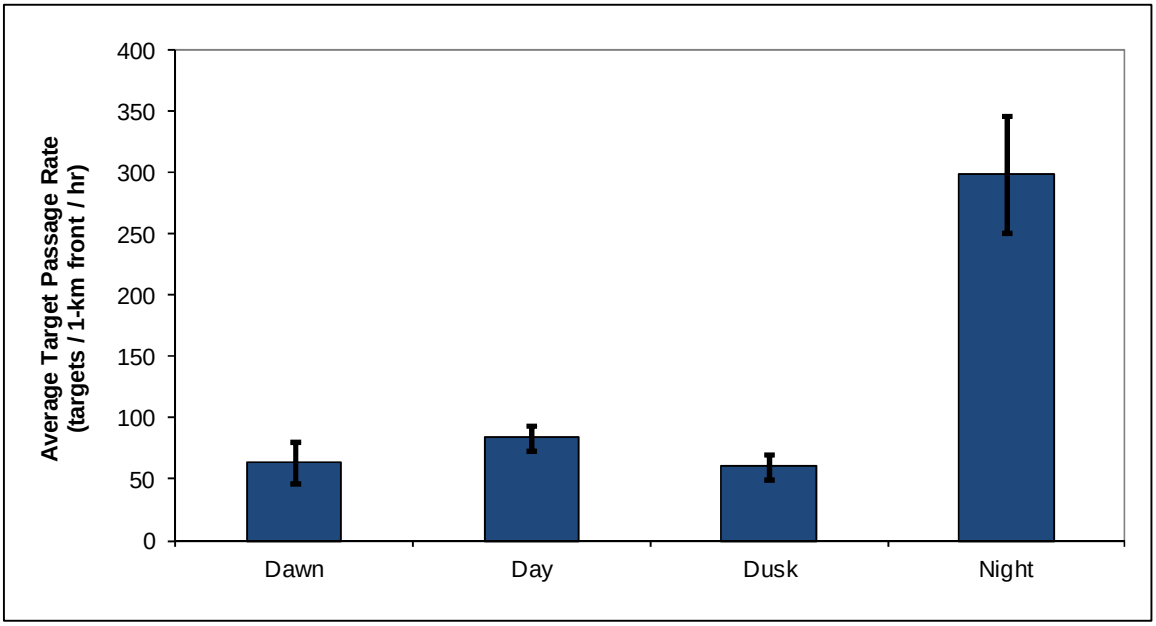

Figure 5-2. Average target passage rates (TPR) by biological period during the Summer 2012 season. Error bars represent one standard error.

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Table 5-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods during the Summer 2012 season.

	Dawn	Day	Dusk	Night
Average	64.0	83.8	60.3	298.5
Standard Deviation	113.0	61.6	54.4	298.1
Standard Error	17.2	9.9	9.8	47.7
Median	34.0	62.2	46.0	168.4
Minimum	4.0	13.7	1.0	23.0
Maximum	723.0	314.2	242.0	1049.2

Both average and comprehensive hourly target passage rates are presented in Fig 5-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

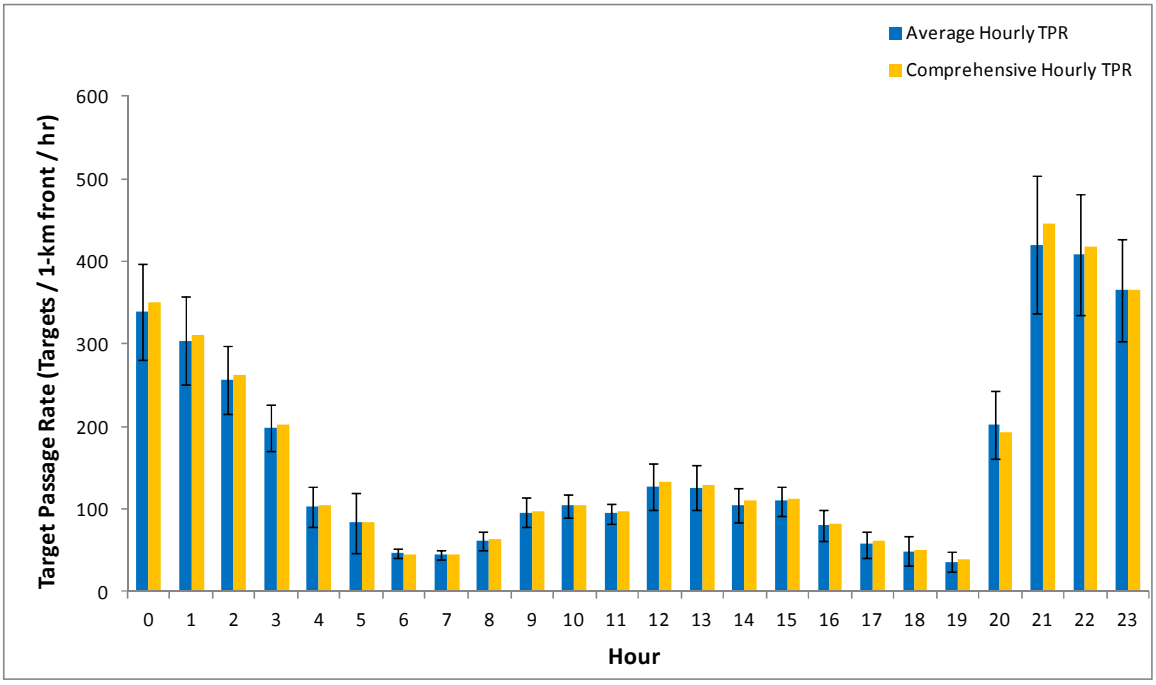

Figure 5-3. Average and comprehensive hourly target passage rates during the Summer 2012 season. Error bars represent one standard error.

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5.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 5-4 and Fig. 5-5, respectively) of the Summer 2012 season.

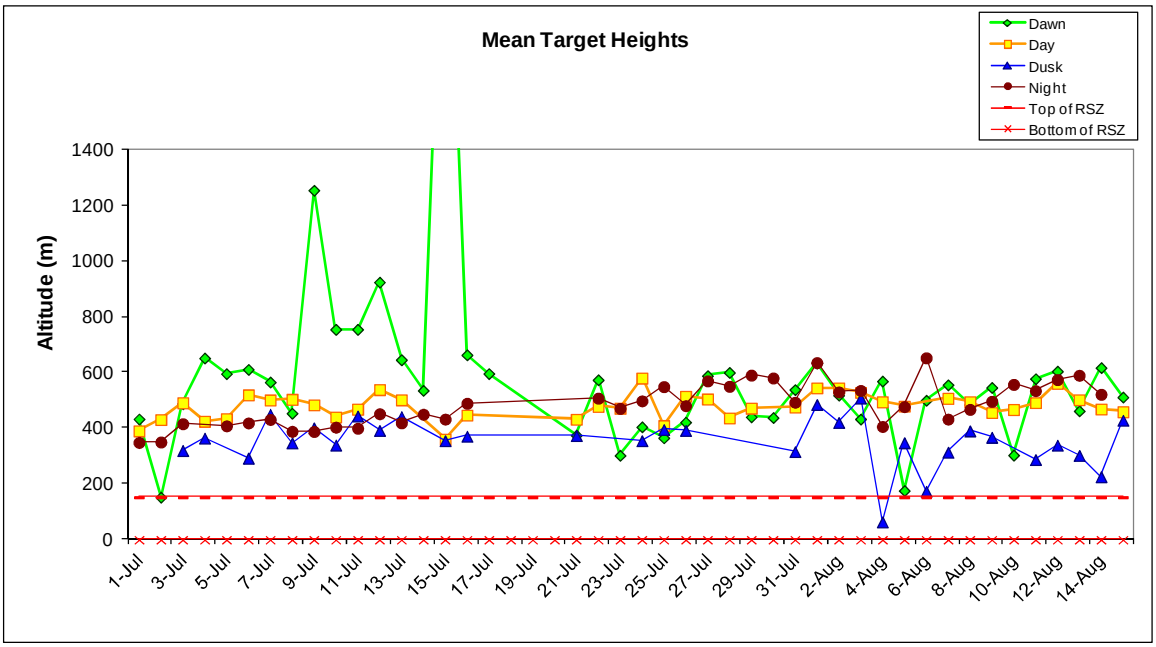

Figure 5-4. Mean target heights during the Summer 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL). July 15th dawn value is 2,610 m.

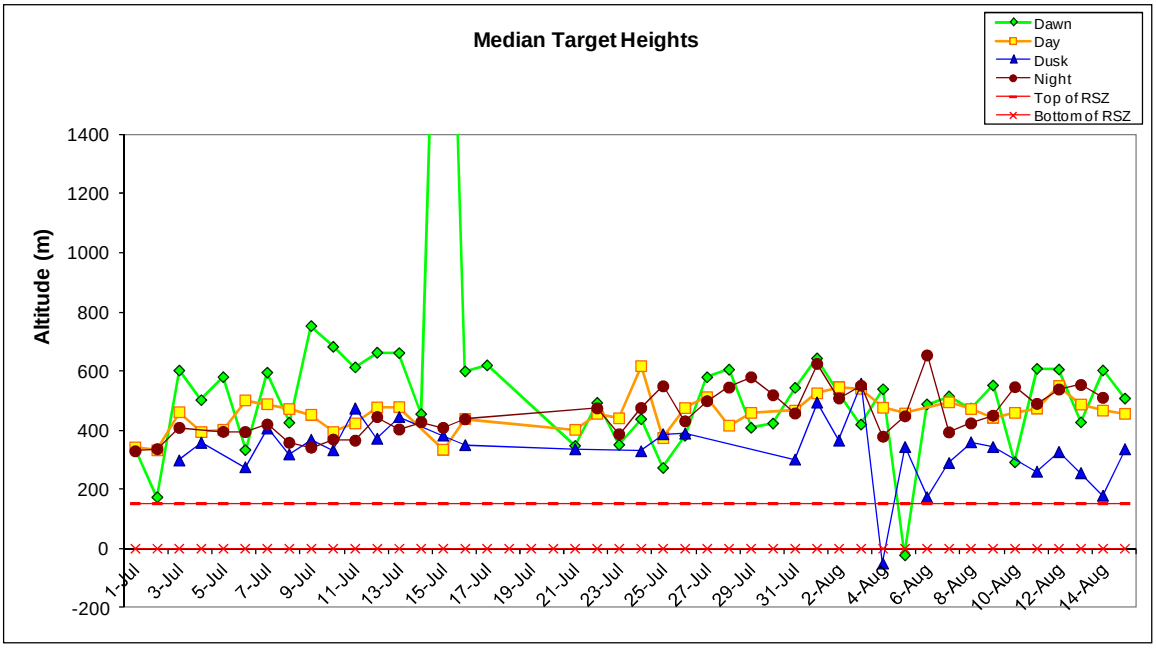

Figure 5-5. Median target heights during the Summer 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL). July 15th dawn value is 3,018 m.

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The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 5-3 (top) and illustrated in Figure 5-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 5-3 (bottom) and illustrated in Figure 5-6 (green bars).

Table 5-3. Summary of mean and median target heights during biological periods of the Summer 2012 season. Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	586.9	479.8	354.9	484.7
Average median target height	549.6	458.0	334.2	457.0
All targets for season combined				
Comprehensive mean target height	509.0	483.3	358.8	433.6
Comprehensive median target height	492.3	459.3	343.8	408.7

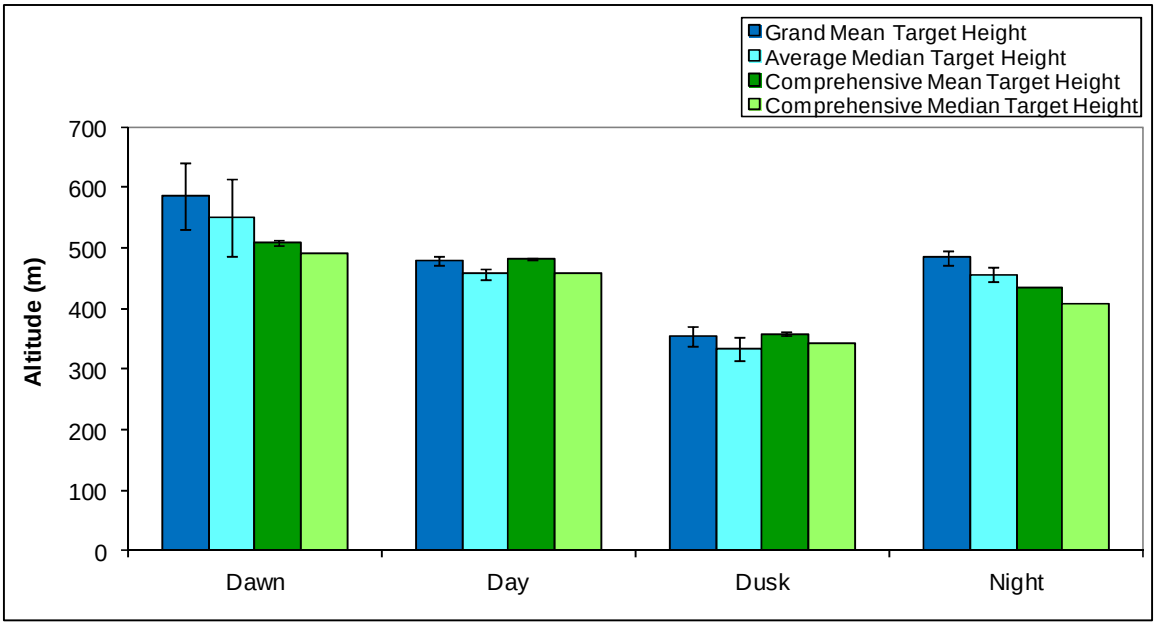

Figure 5-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), during the Summer 2012 season. Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 5-7).

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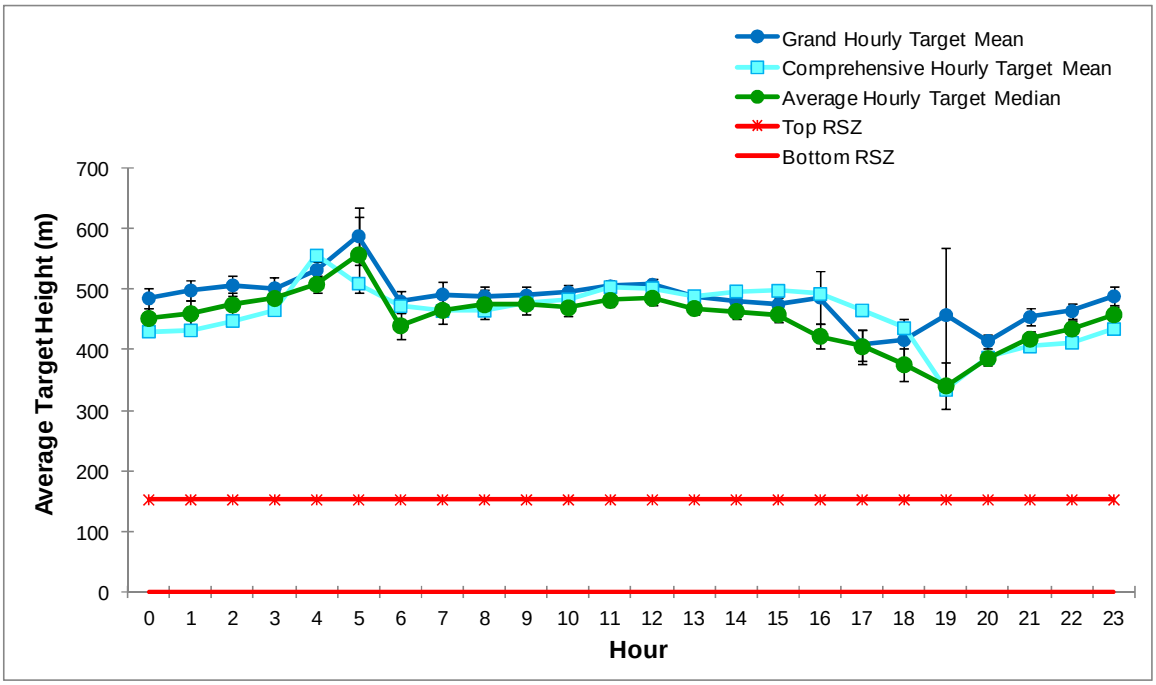

Figure 5-7. Hourly target heights during the Summer 2012 season. Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights of the Summer 2012 season are shown using 50-meter increments (Fig. 5-8).

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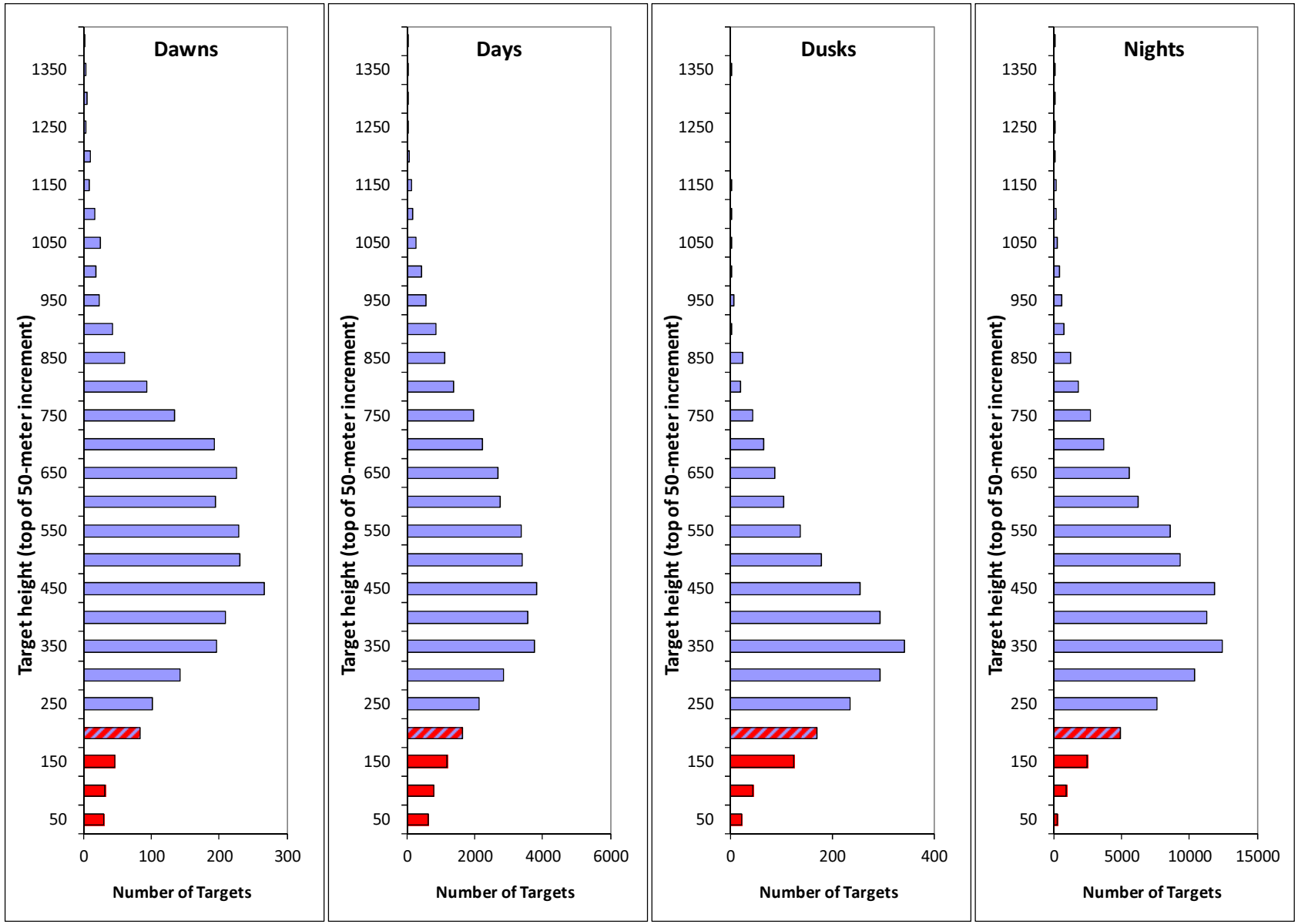

Figure 5-8. Number of targets occurring in each 50-meter increment during biological periods of the Summer 2012 season. Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

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Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 5-10) days (Fig. 5-11), dusks (Fig 5-12), and nights (Fig. 5-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period of the Summer 2012 season combined together (Table 5-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 5-9).

Table 5-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods of the Summer 2012 season. Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	59.7	78.0	52.3	287.7
Average target passage rate within RSZ	2.6	5.3	5.6	10.6
Average target passage rate below RSZ	1.7	0.5	2.5	0.2
Average % of targets in RSZ	6.7%	7.5%	7.3%	2.5%
Min target percentage within RSZ	0.0%	2.2%	0.0%	0.1%
Max target percentage within RSZ	33.3%	25.0%	37.5%	12.7%
All targets for season combined				
% targets above RSZ	93.2%	93.0%	86.6%	96.4%
% targets within RSZ	4.1%	6.4%	9.3%	3.5%
% targets below RSZ	2.7%	0.6%	4.1%	0.1%
% targets below turbine height	6.8%	7.0%	13.4%	3.6%

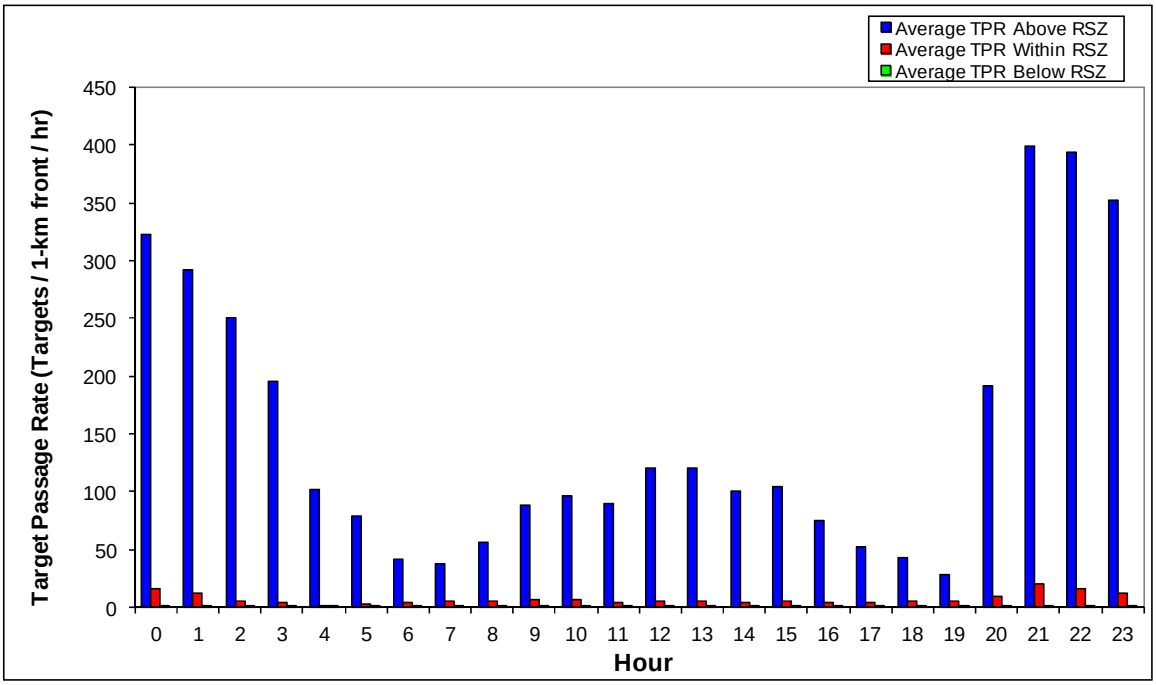

Figure 5-9. Average hourly target passage rates during the Summer 2012 season.

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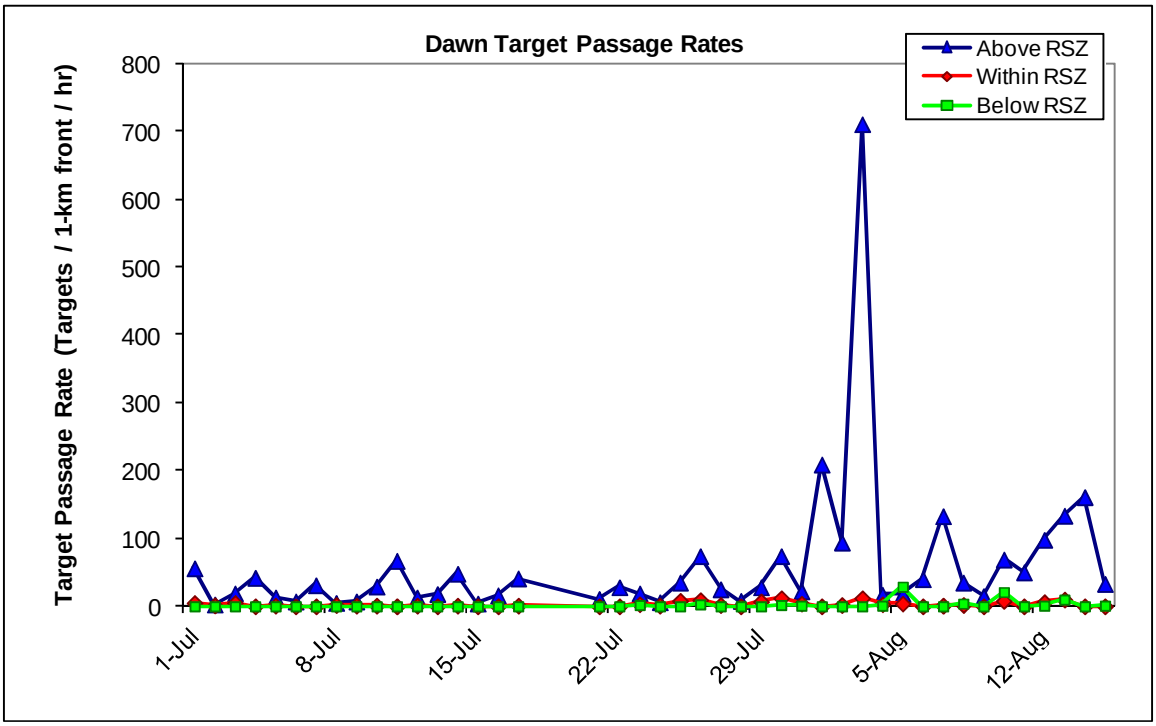

Figure 5-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns of the Summer 2012 season.

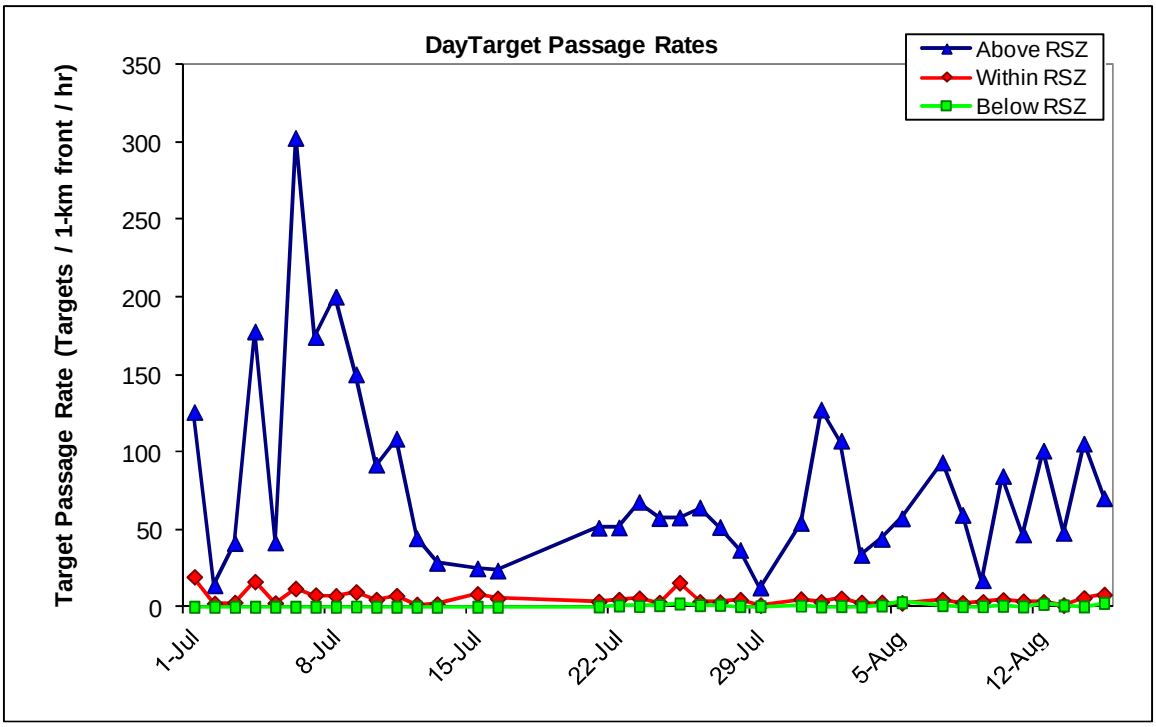

Figure 5-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days of the Summer 2012 season.

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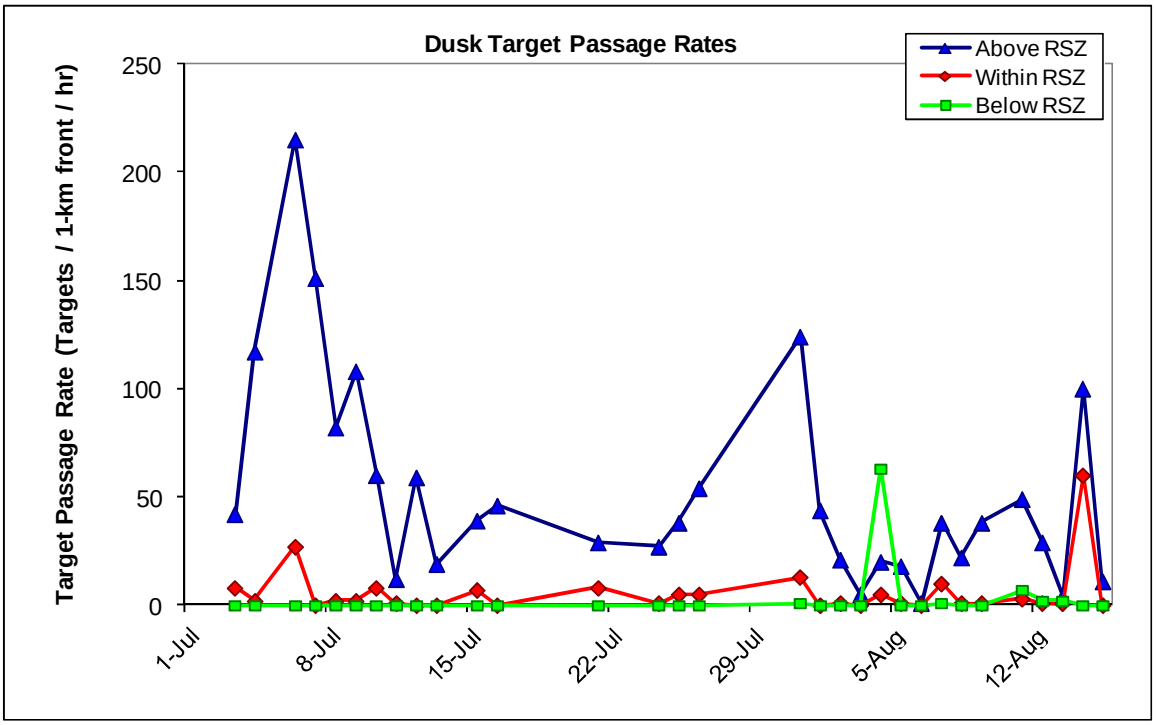

Figure 5-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks of the Summer 2012 season.

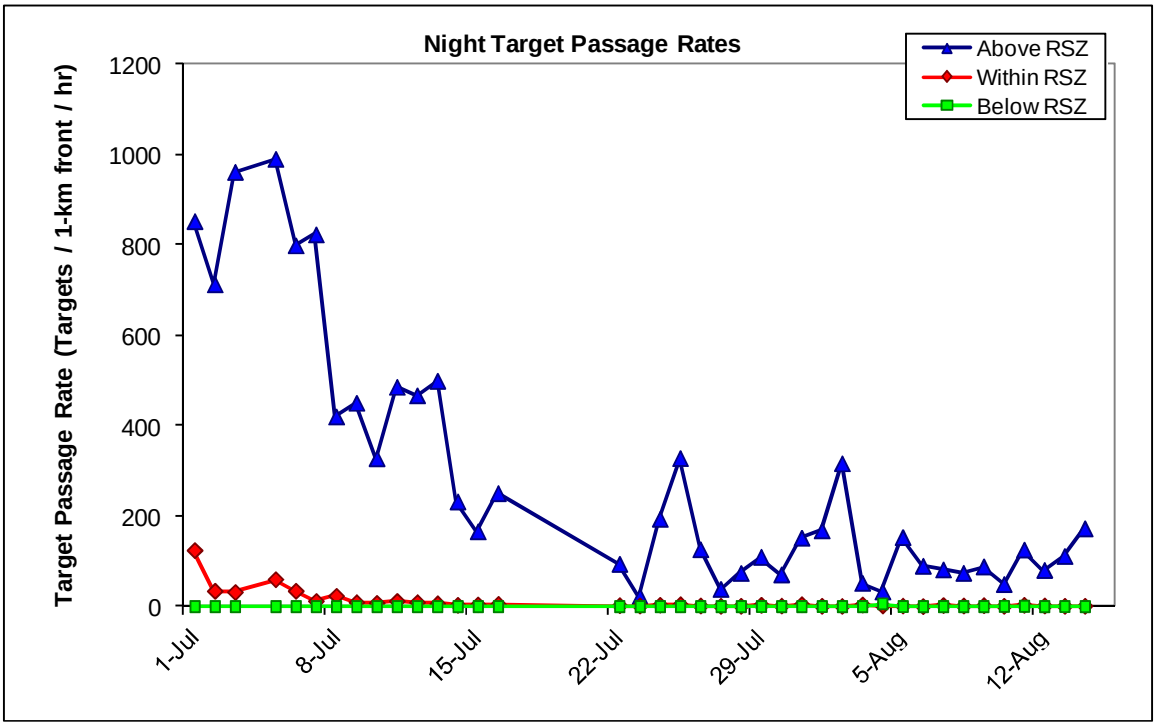

Figure 5-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights of the Summer 2012 season.

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5.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods of the Summer 2012 season.

5.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 5-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected during the Summer 2012 season combined together by biological period (Fig. 5-15) and hour (Fig. 5-16).

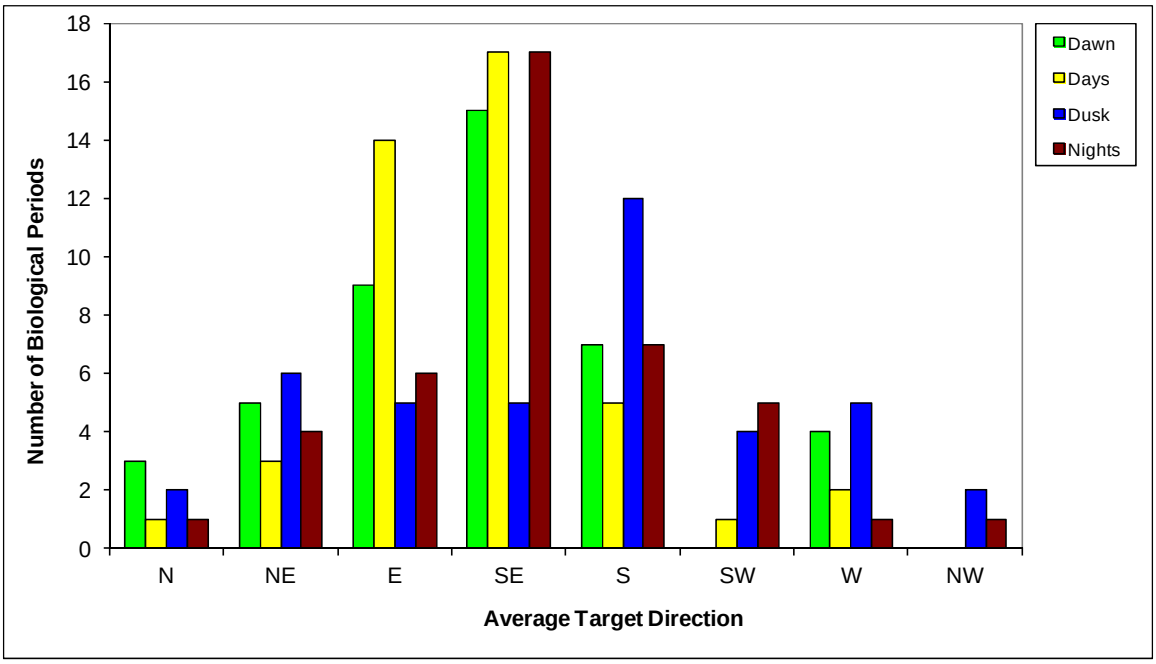

Figure 5-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights of the Summer 2012 season.

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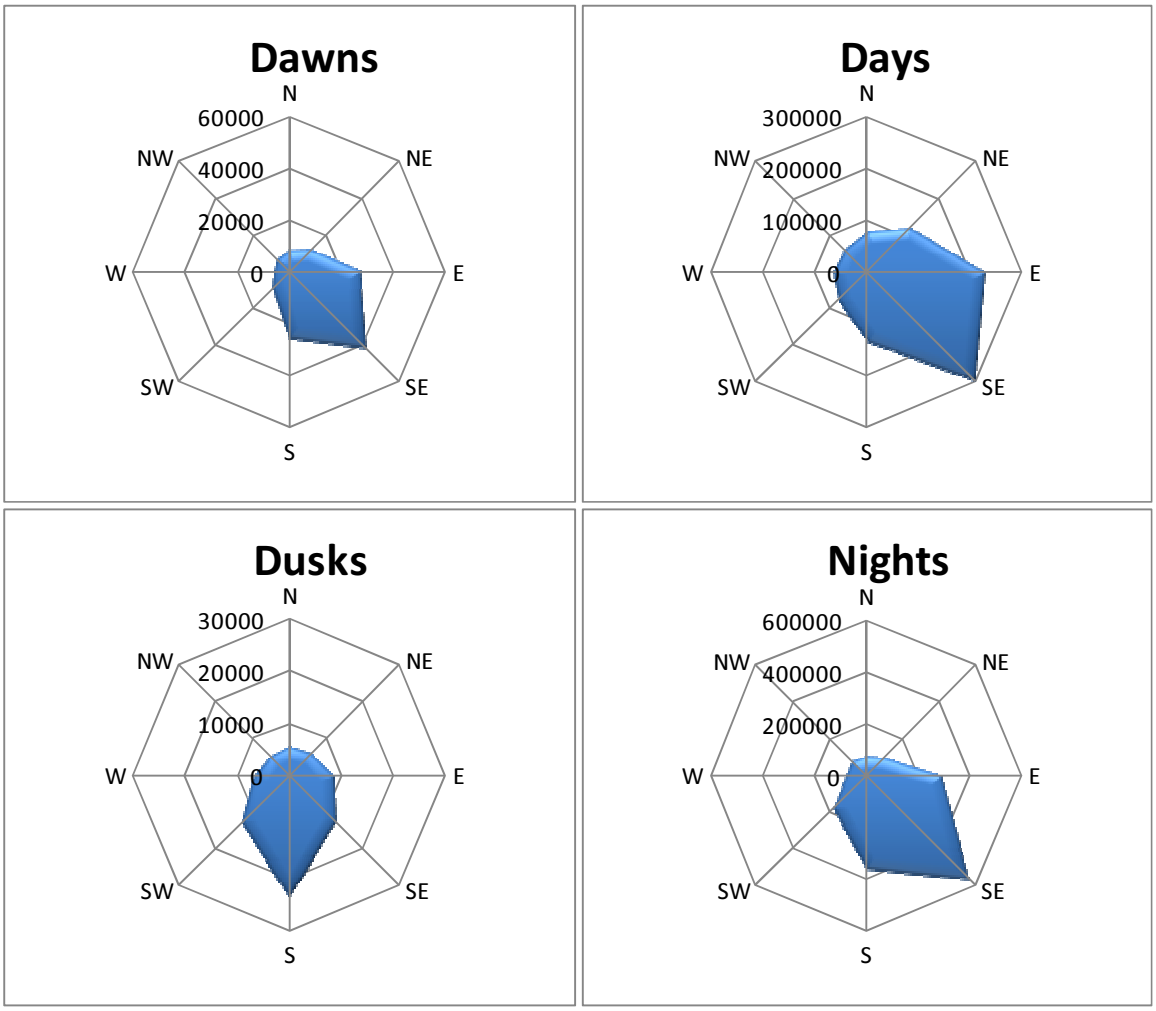

Figure 5-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights of the Summer 2012 season.

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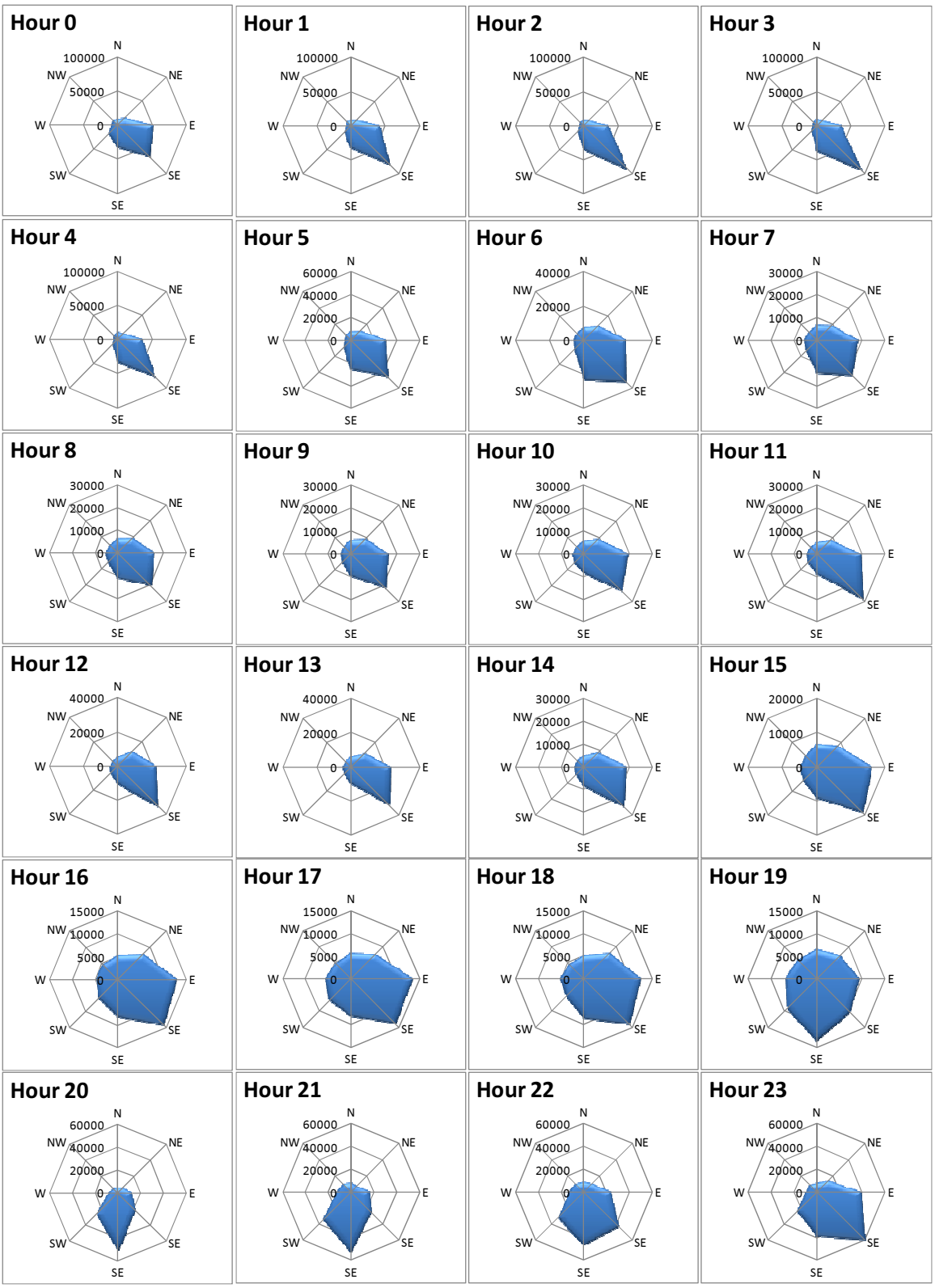

Figure 5-16. Comprehensive distribution of all target's directions by hour during the Summer 2012 season.

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6 RESULTS for the Fall 2012 Season

6.1 Level of Effort

Table 6-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, during the Fall 2012 Season (August 16 – November 15, 2012). The MERLIN avian radar system operated at Site 9 until September 29, 2012 and at Site 10 after October 3, 2012.

Table 6-1. Radar monitoring effort during the Fall 2012 season.

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	2209.4		2209.4	
Time radar down	92.9	4.2%	92.7	4.2%
Time radar collected data	2116.6	95.8%	2116.7	95.8%
Unuseable radar data[1] due to rain or other contamination	215.0	10.2%	15.5	0.7%
Unuseable radar data[2] due to insects	34.8	1.6%	-	-
Useable radar data[3]	1866.9	84.5%	2101.2	95.1%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

6.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

6.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 6-1) and as an average by biological period (Fig. 6-2) and hour (Fig. 6-3). Summary statistics are presented in table 6-2.

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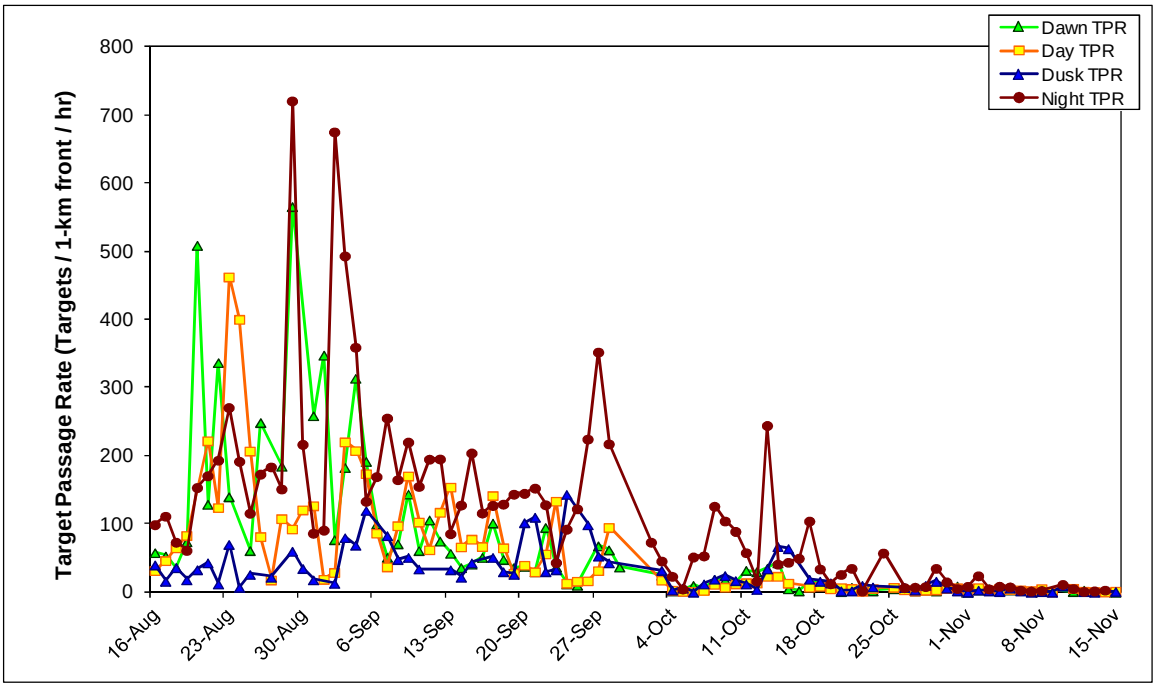

Figure 6-1. Target passage rates (TPR) during biological periods of the Fall 2012 season.

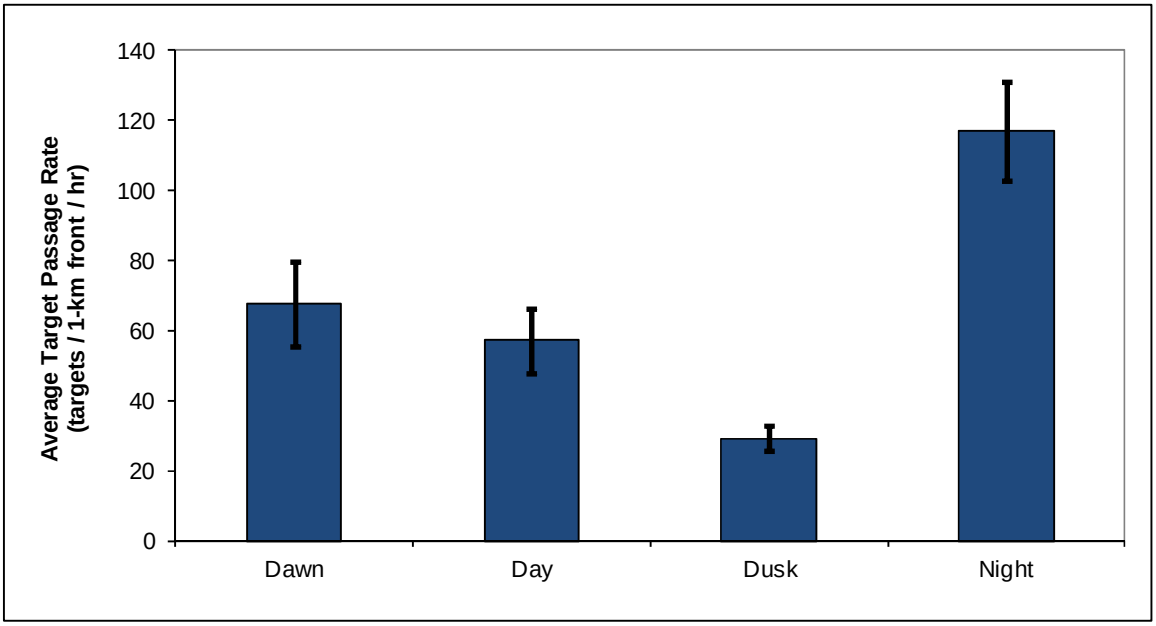

Figure 6-2. Average target passage rates (TPR) by biological period during the Fall 2012 season. Error bars represent one standard error.

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Table 6-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods during the Fall 2012 season.

	Dawn	Day	Dusk	Night
Average	67.7	57.2	29.2	117.1
Standard Deviation	108.7	83.6	31.6	131.2
Standard Error	12.1	9.1	3.6	14.2
Median	32.0	17.7	18.0	91.1
Minimum	0.0	0.2	0.0	1.1
Maximum	566.0	462.8	143.5	721.1

Both average and comprehensive hourly target passage rates are presented in Fig 6-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

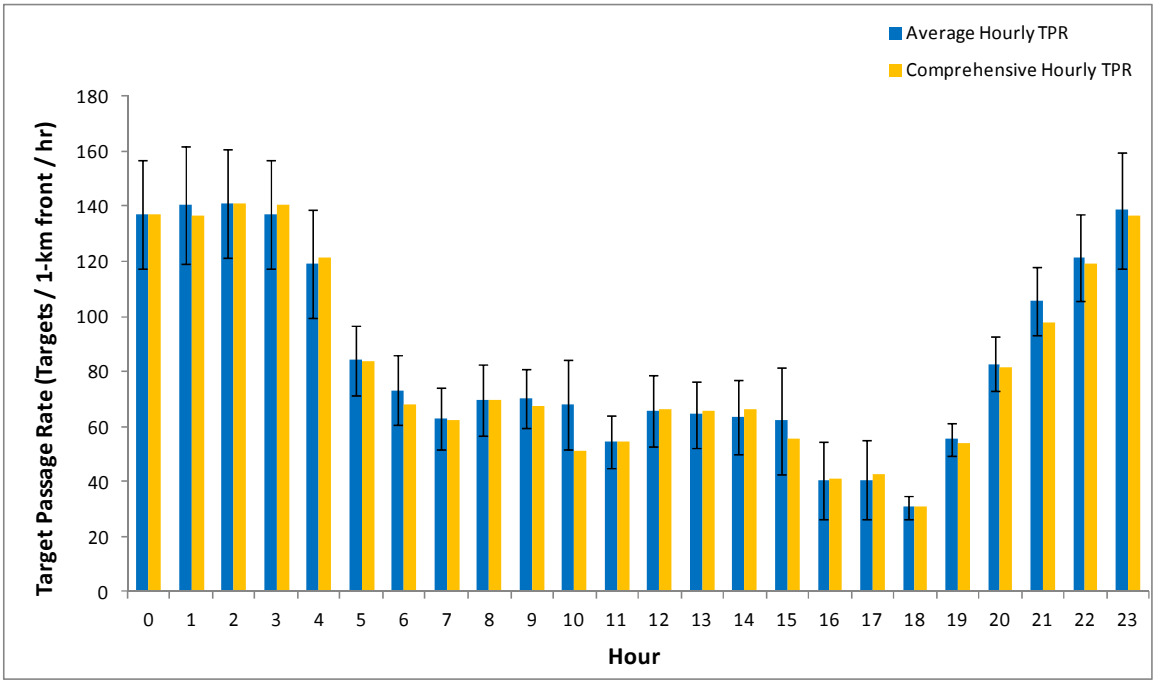

Figure 6-3. Average and comprehensive hourly target passage rates during the Fall 2012 season. Error bars represent one standard error.

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6.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 6-4 and Fig. 6-5, respectively) of the Fall 2012 season.

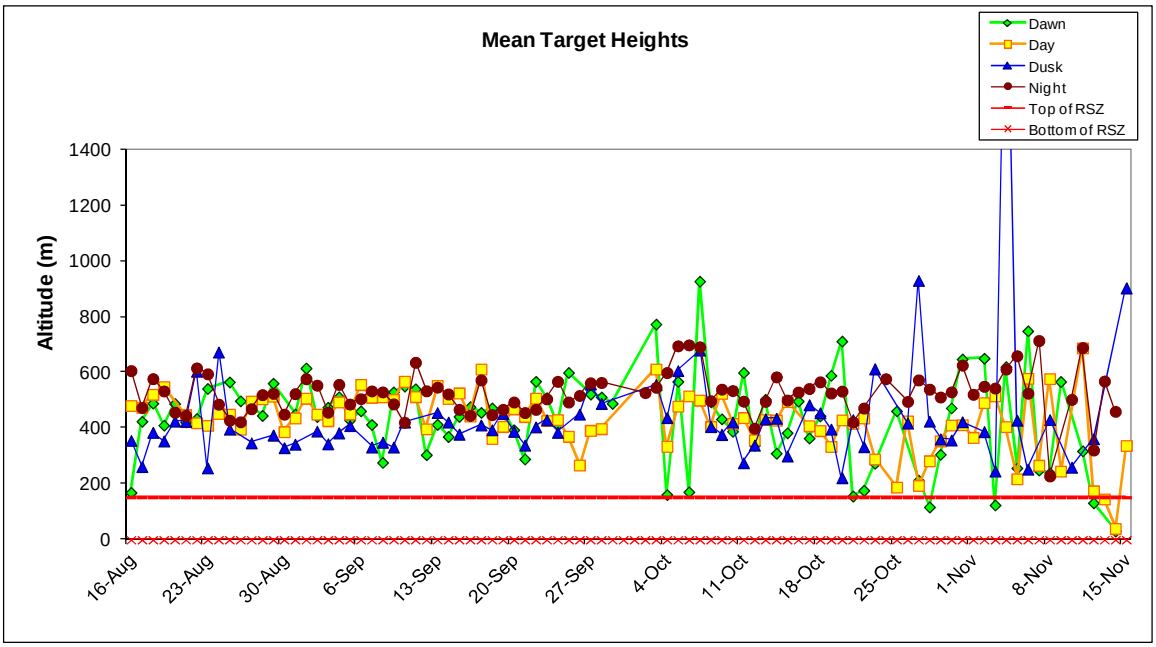

Figure 6-4. Mean target heights during the Fall 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL). November 4th dusk value is 2,285 m.

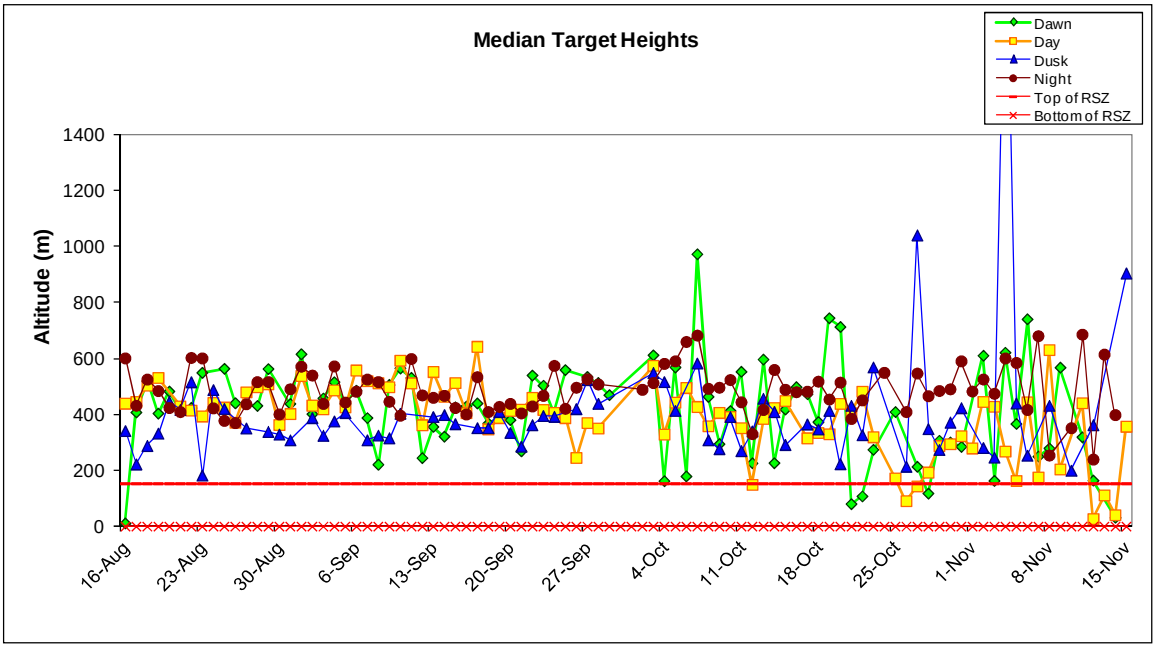

Figure 6-5. Median target heights during the Fall 2012 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL). November 4th dusk value is 2,285 m.

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The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 6-3 (top) and illustrated in Figure 6-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 6-3 (bottom) and illustrated in Figure 6-6 (green bars).

Table 6-3. Summary of mean and median target heights during biological periods of the Fall 2012 season. Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	434.1	427.8	444.8	525.7
Average median target height	412.4	387.6	410.8	486.4
All targets for season combined				
Comprehensive mean target height	484.9	464.2	393.3	520.2
Comprehensive median target height	482.5	445.0	358.1	488.3

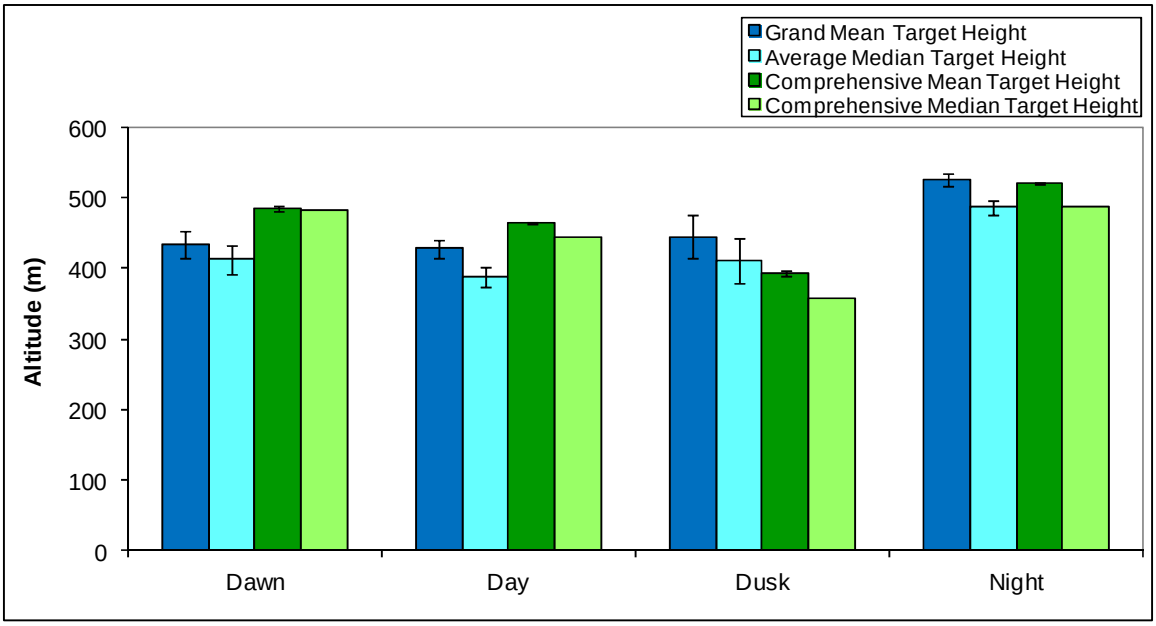

Figure 6-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), during the Fall 2012 season. Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 6-7).

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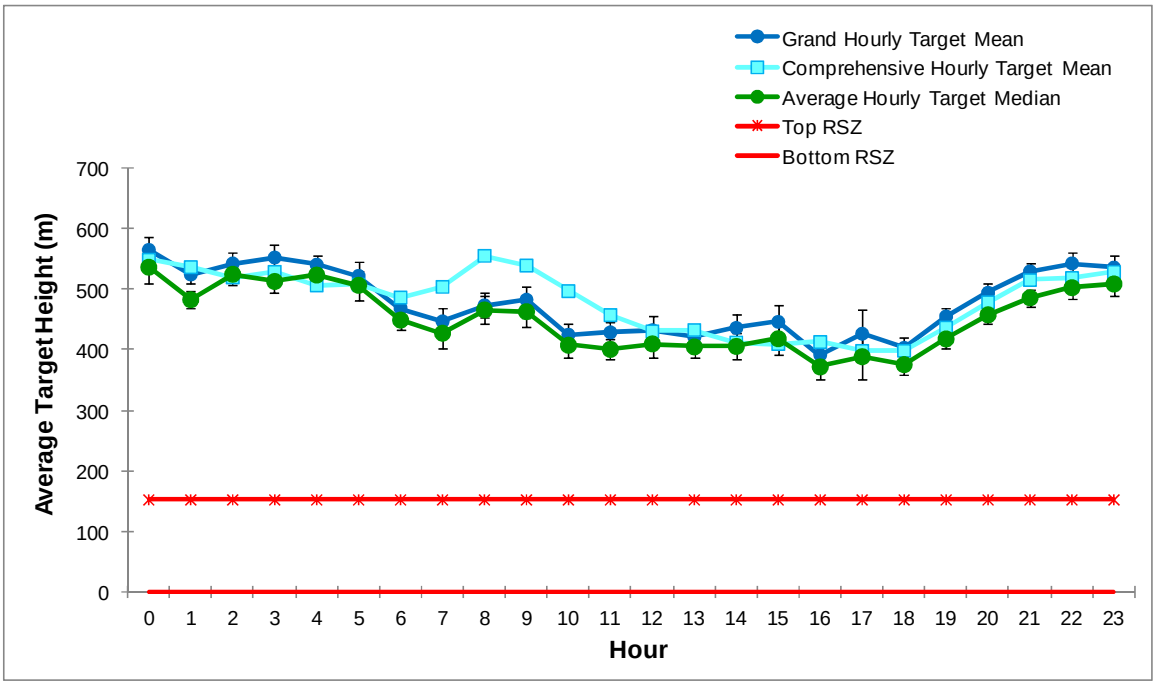

Figure 6-7. Hourly target heights during the Fall 2012 season. Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights of the Fall 2012 season are shown using 50-meter increments (Fig. 6-8).

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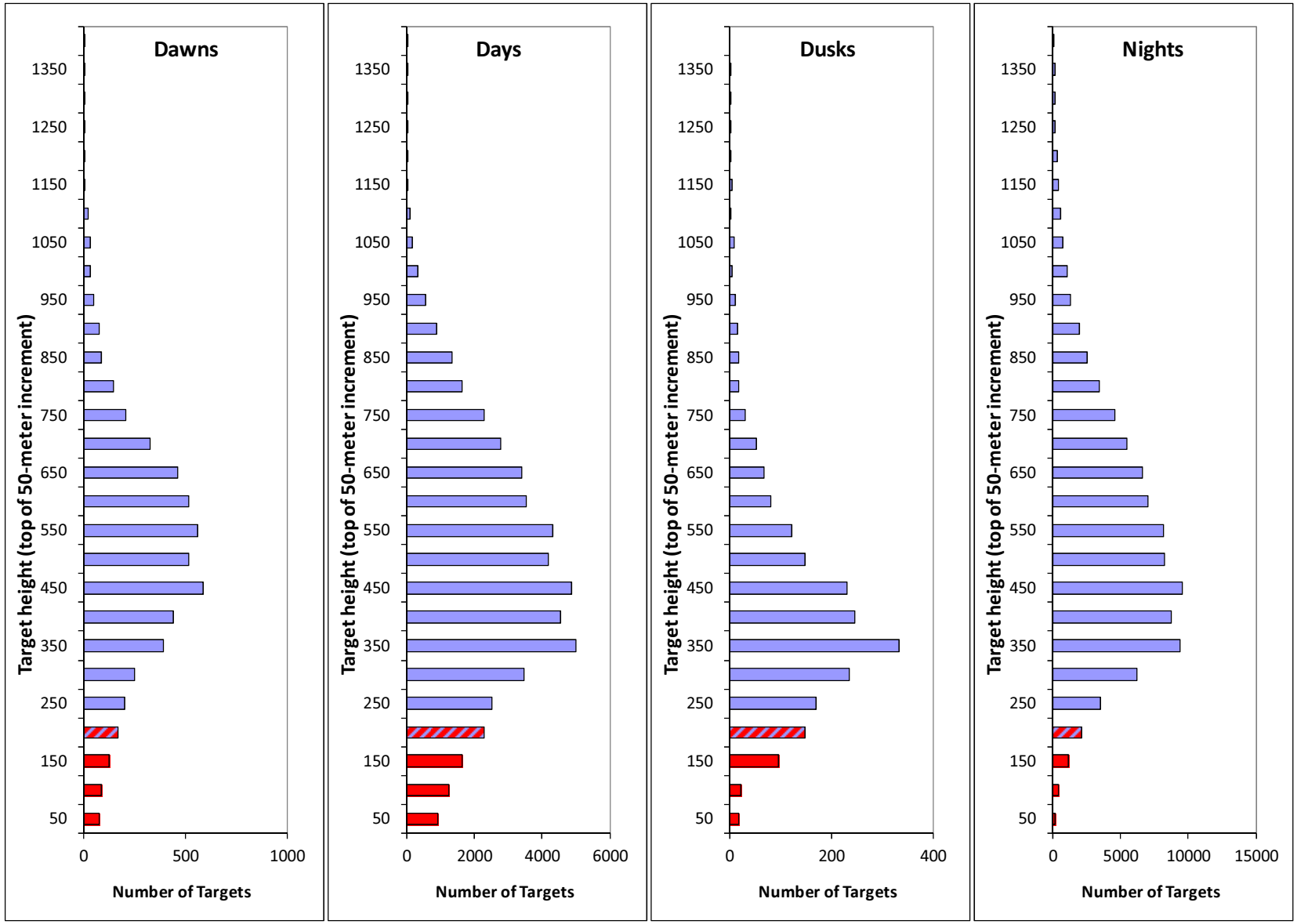

Figure 6-8. Number of targets occurring in each 50-meter increment during biological periods of the Fall 2012 season. Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

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Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 6-10) days (Fig. 6-11), dusks (Fig 6-12), and nights (Fig. 6-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period of the Fall 2012 season combined together (Table 6-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 6-9).

Table 6-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods of the Fall 2012 season. Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	63.3	52.4	27.2	114.8
Average target passage rate within RSZ	3.7	4.4	1.9	2.3
Average target passage rate below RSZ	0.7	0.3	0.1	0.1
Average % of targets in RSZ	16.3%	16.1%	6.5%	4.5%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.3%
Max target percentage within RSZ	100.0%	100.0%	50.0%	44.4%
All targets for season combined				
% targets above RSZ	93.4%	91.9%	93.1%	98.0%
% targets within RSZ	5.6%	7.5%	6.7%	2.0%
% targets below RSZ	1.0%	0.6%	0.2%	0.1%
% targets below turbine height	6.6%	8.1%	6.9%	2.0%

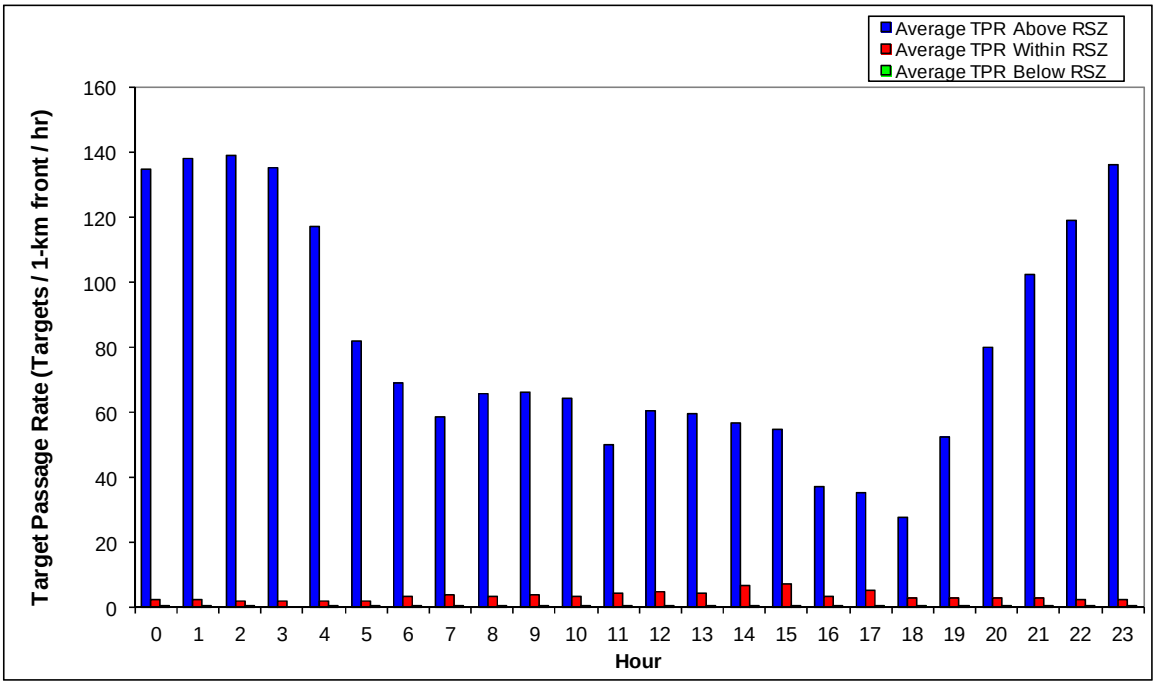

Figure 6-9. Average hourly target passage rates during the Fall 2012 season.

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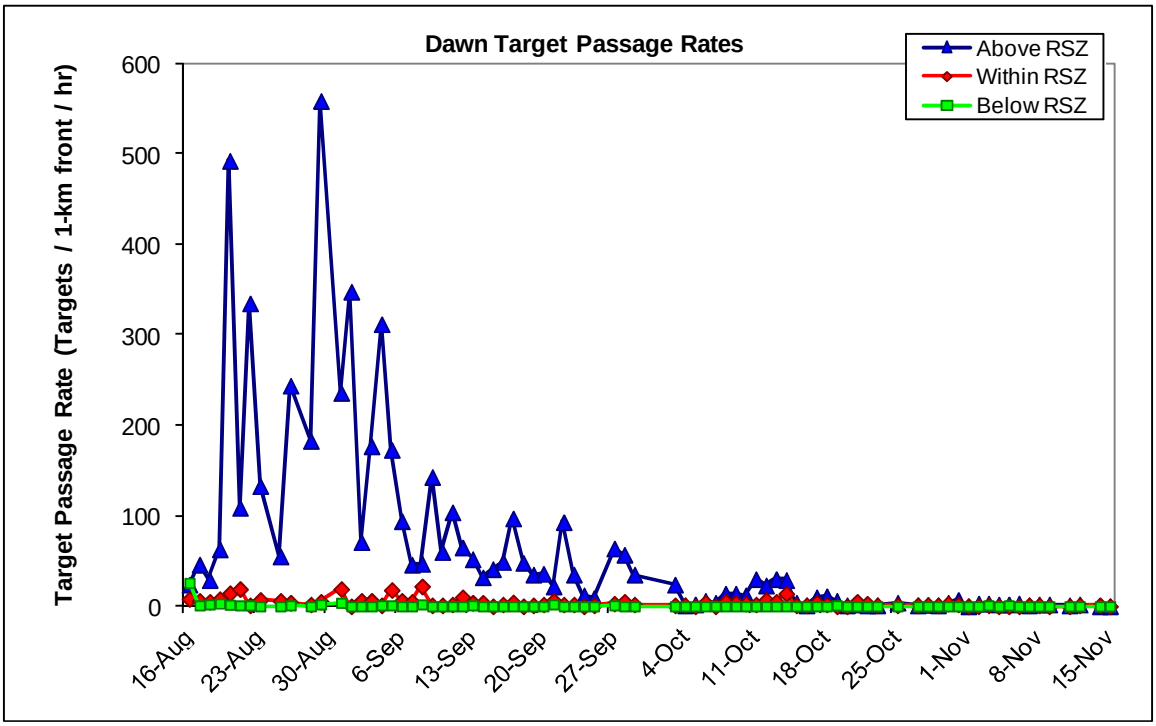

Figure 6-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns of the Fall 2012 season.

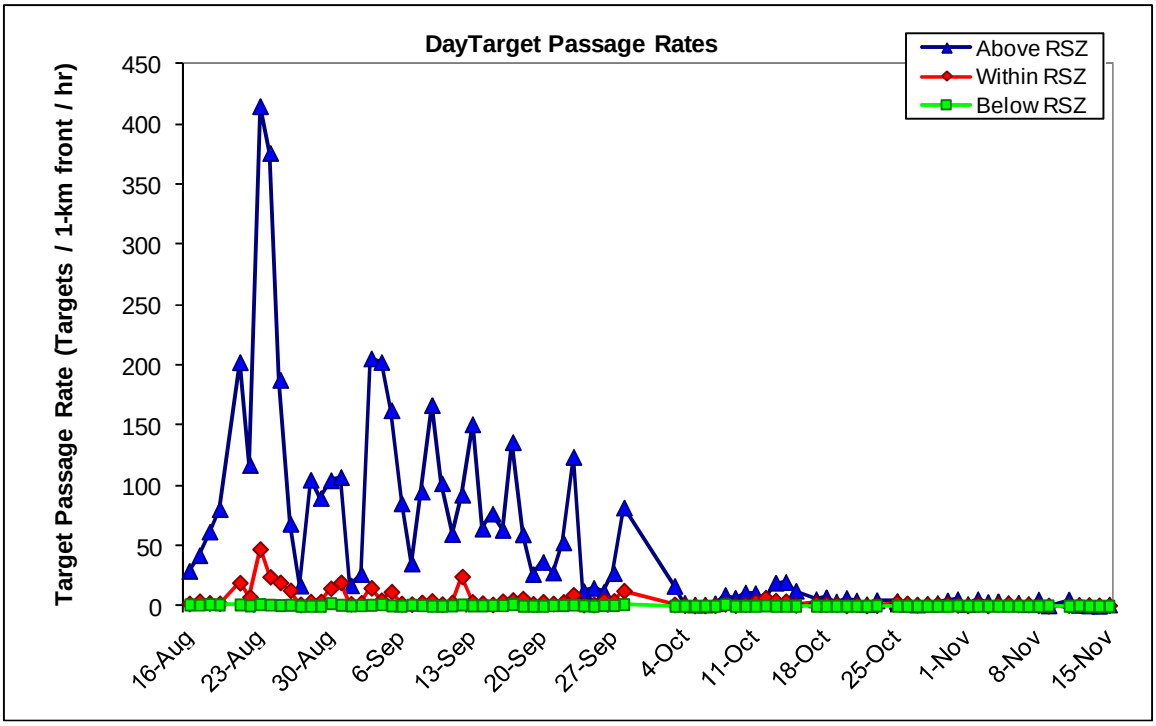

Figure 6-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days of the Fall 2012 season.

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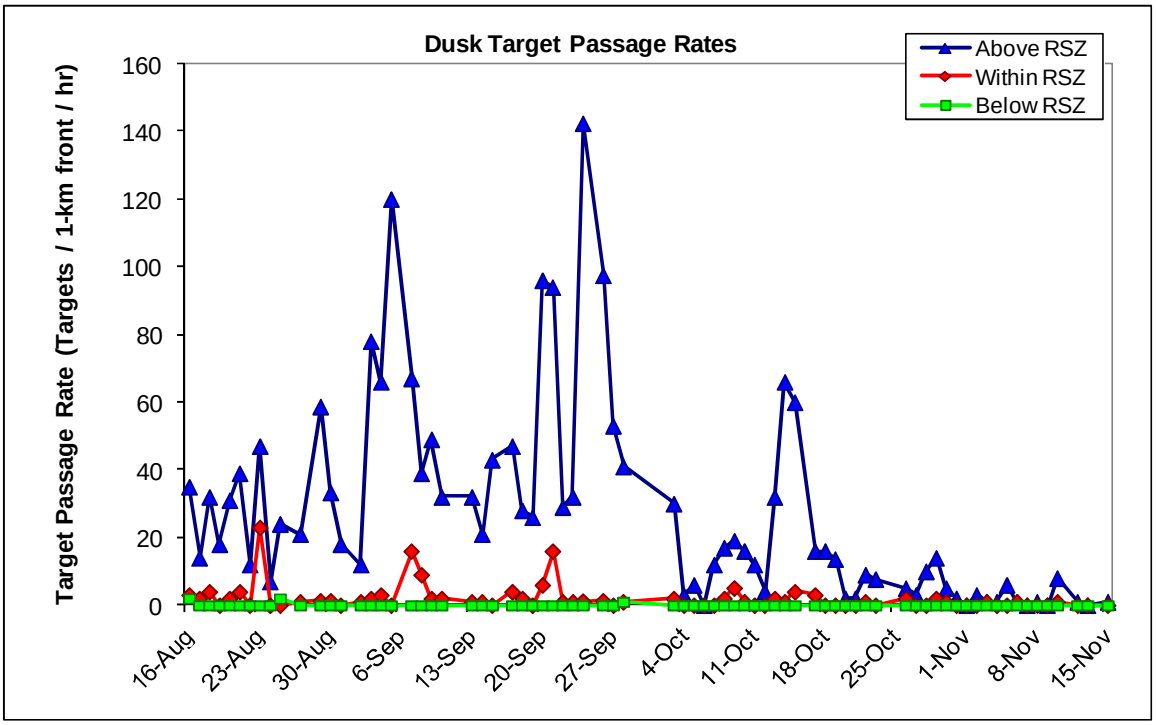

Figure 6-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks of the Fall 2012 season.

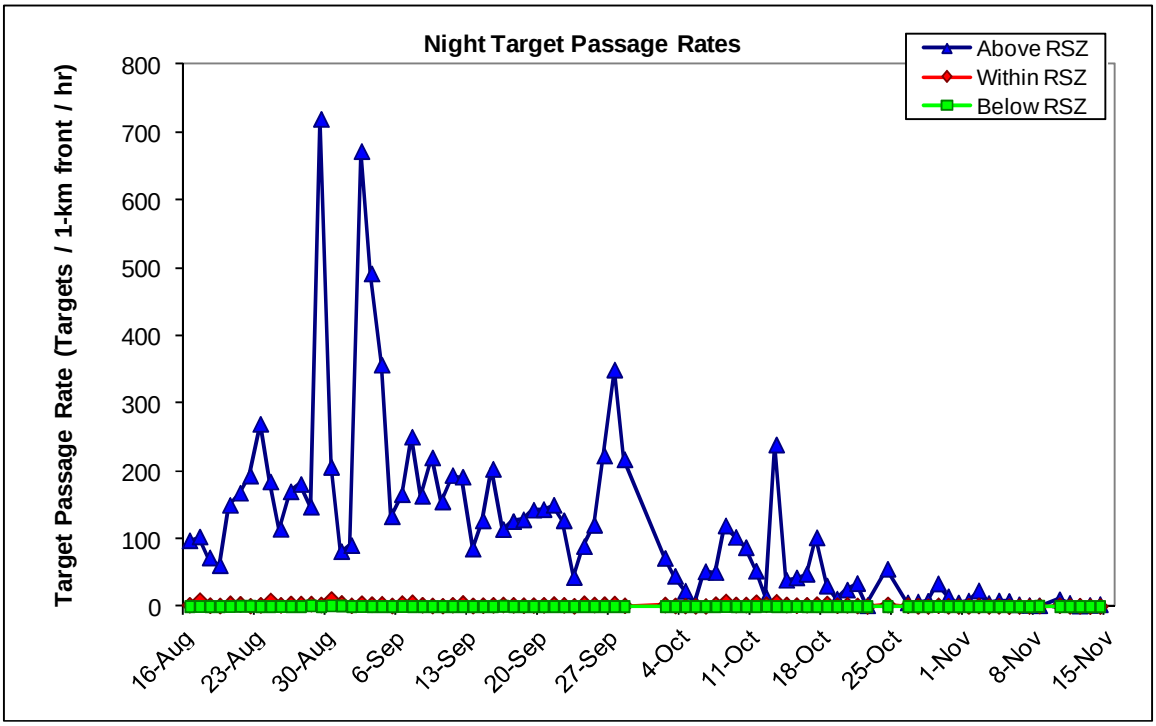

Figure 6-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights of the Fall 2012 season.

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6.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods of the Fall 2012 season.

6.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 6-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected during the Fall 2012 season combined together by biological period (Fig. 6-15) and hour (Fig. 6-16).

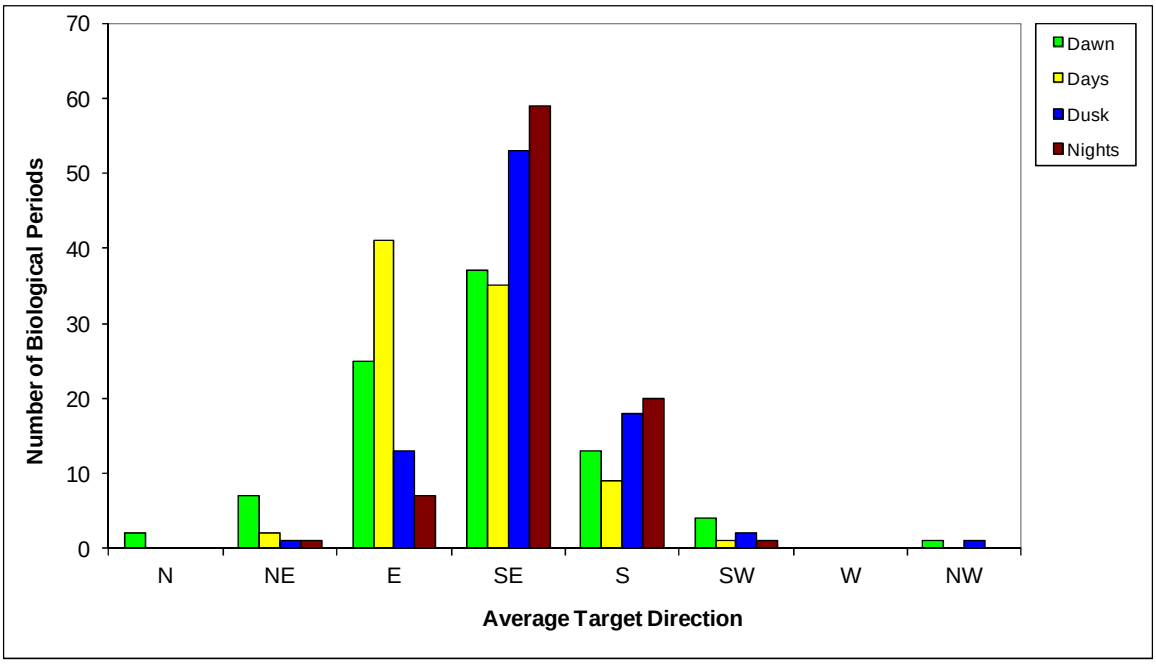

Figure 6-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights of the Fall 2012 season.

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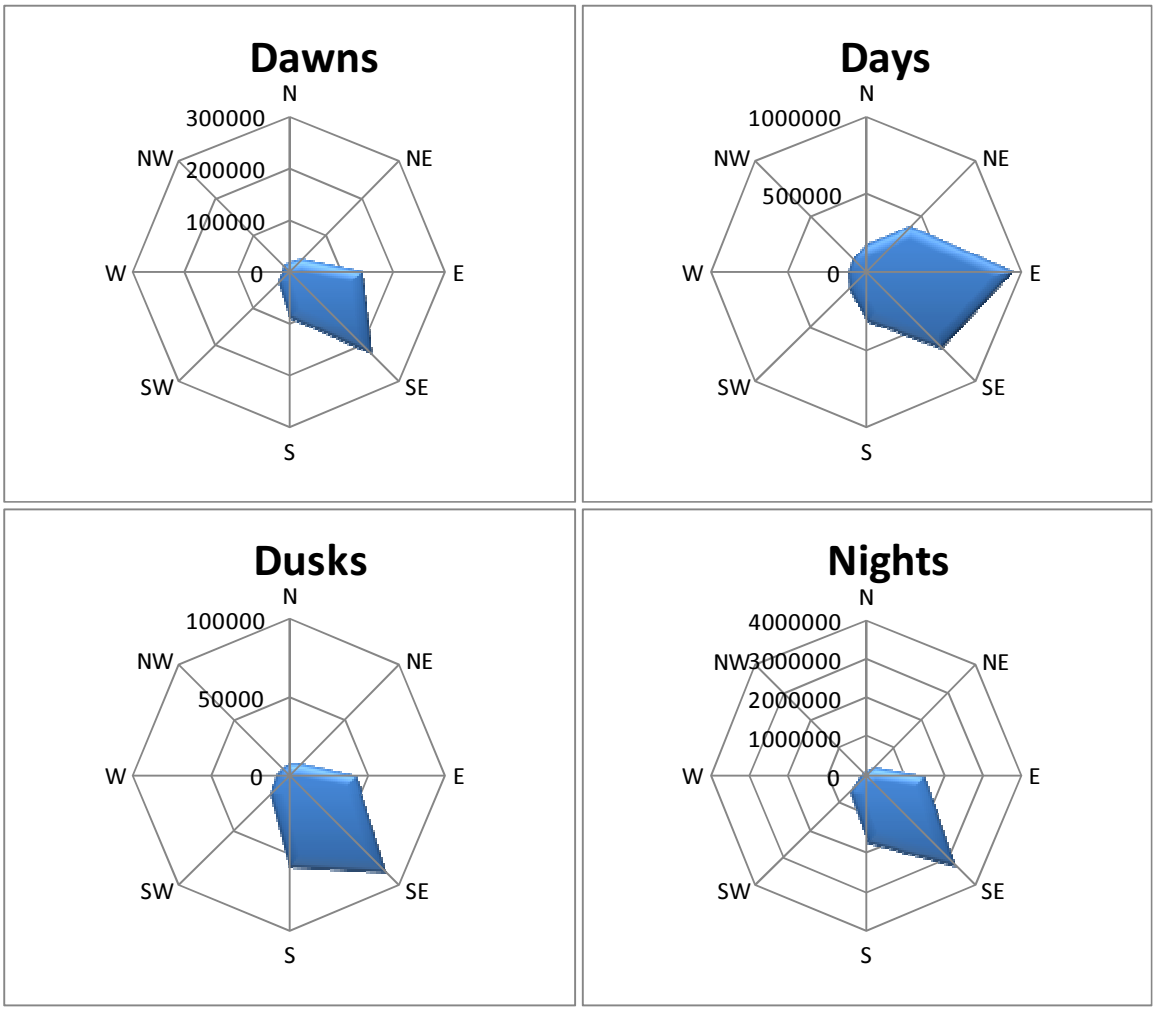

Figure 6-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights of the Fall 2012 season.

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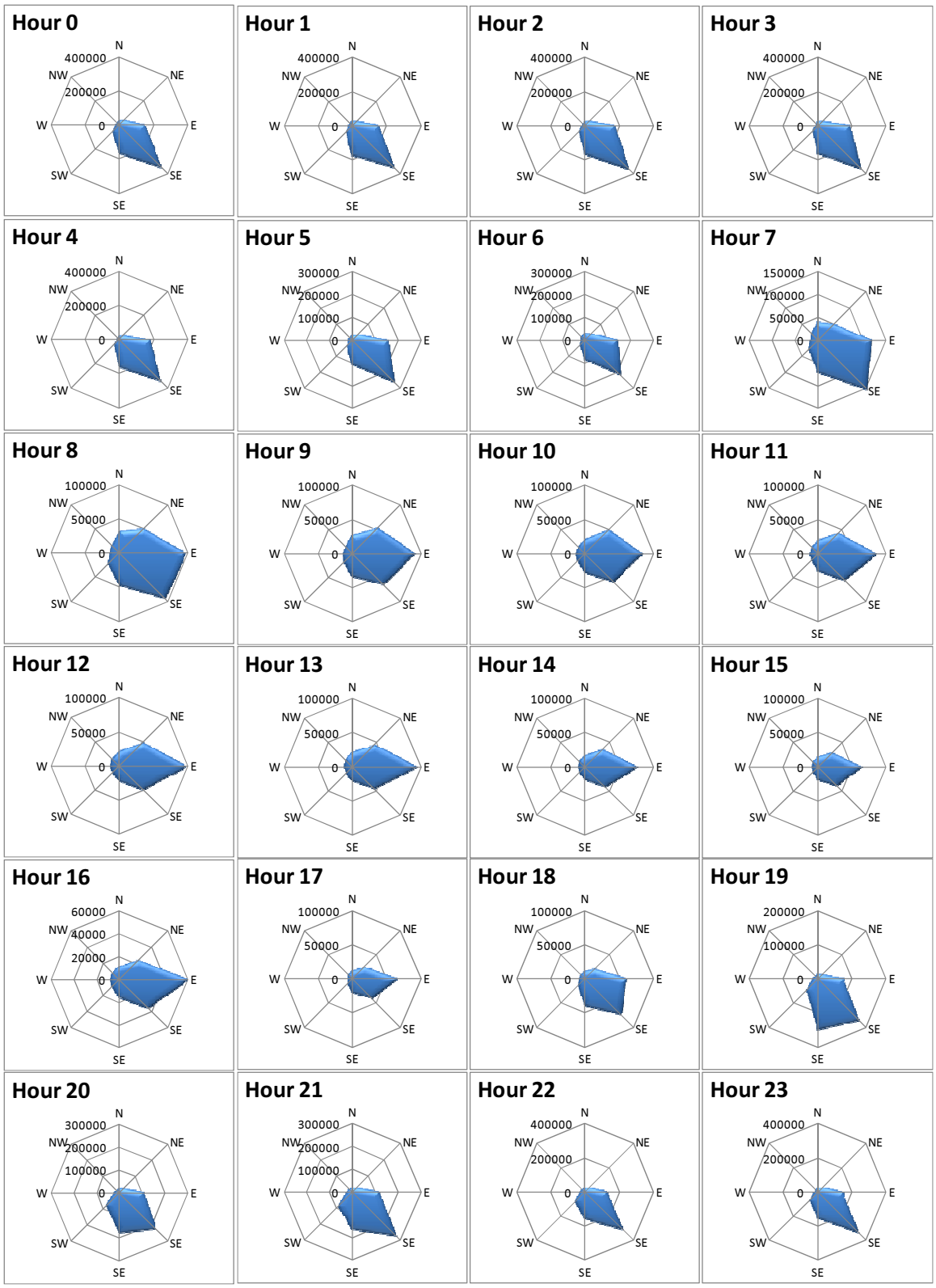

Figure 6-16. Comprehensive distribution of all target's directions by hour during the Fall 2012 season.

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7 RESULTS for the Winter 2012-13 Season

7.1 Level of Effort

Table 7-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, during the Winter 2012-13 Season (November 16, 2012 – March 31, 2013). The MERLIN avian radar system operated at Site 10 during this entire season.

Table 7-1. Radar monitoring effort during the Winter 2012-13 season.

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	3262.8		3262.8	
Time radar down	579.7	17.8%	14.8	0.5%
Time radar collected data	2683.1	82.2%	3248.1	99.5%
Unuseable radar data[1] due to rain or other contamination	469.1	17.5%	6.5	0.2%
Unuseable radar data[2] due to insects	16.8	0.6%	-	-
Useable radar data[3]	2197.3	67.3%	3241.6	99.3%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

7.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

7.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 7-1) and as an average by biological period (Fig. 7-2) and hour (Fig. 7-3). Summary statistics are presented in table 7-2.

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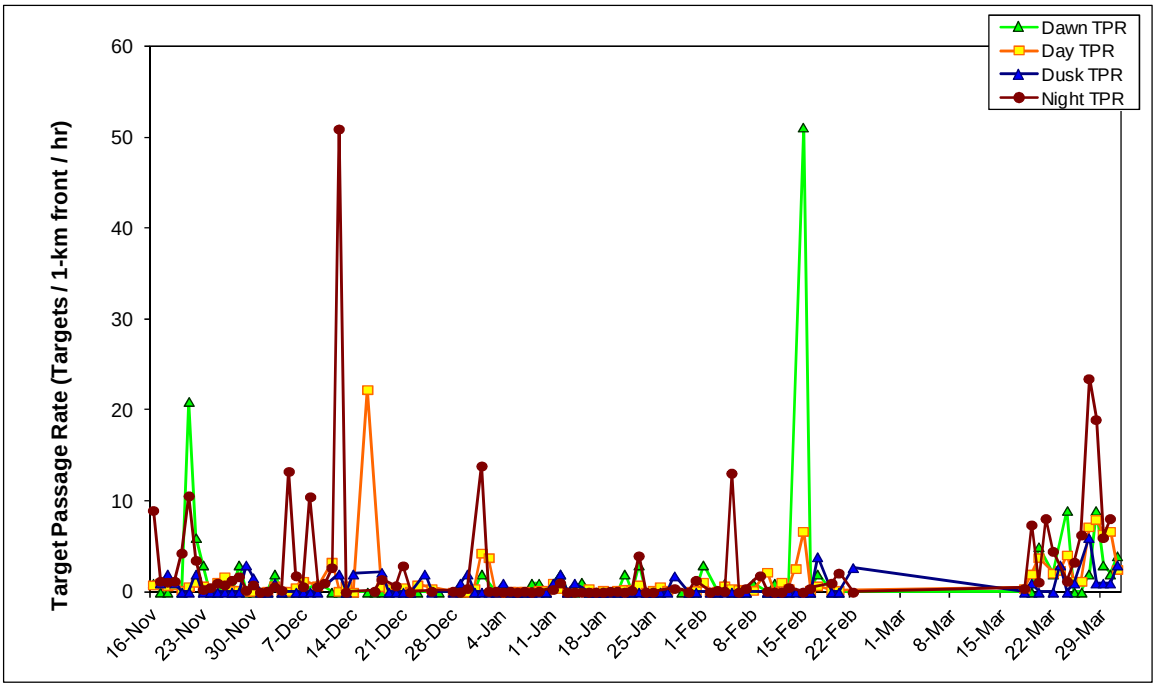

Figure 7-1. Target passage rates (TPR) during biological periods of the Winter 2012-13 season.

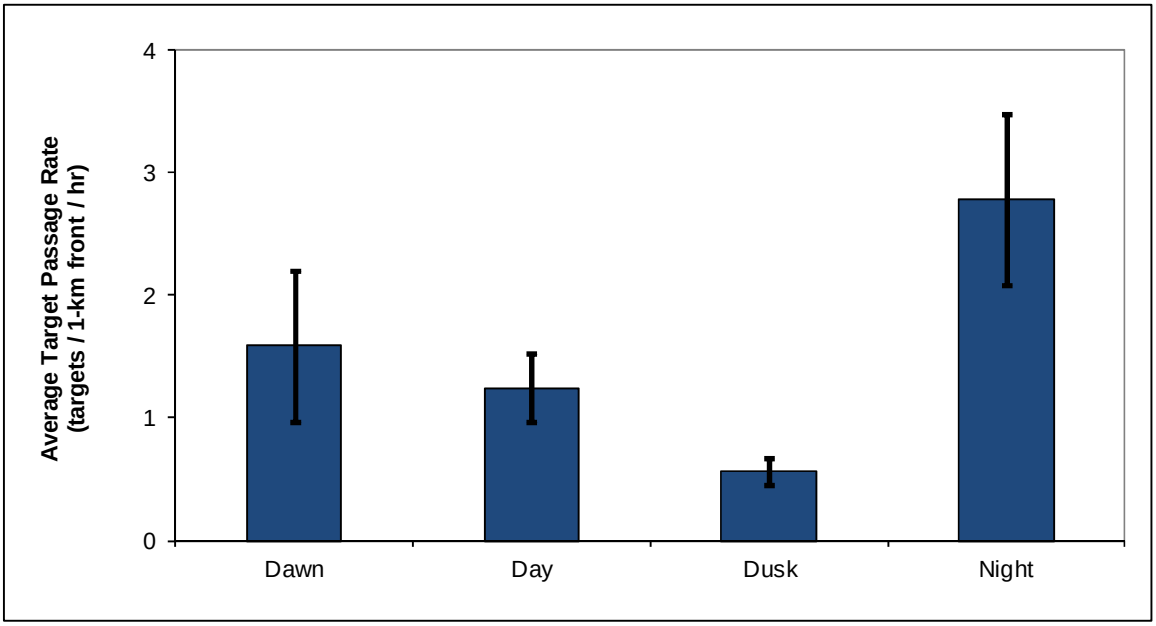

Figure 7-2. Average target passage rates (TPR) by biological period during the Winter 2012-13 season. Error bars represent one standard error.

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Table 7-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods during the Winter 2012-13 season.

	Dawn	Day	Dusk	Night
Average	1.6	1.2	0.6	2.8
Standard Deviation	5.9	2.7	1.1	6.7
Standard Error	0.6	0.3	0.1	0.7
Median	0.0	0.4	0.0	0.4
Minimum	0.0	0.0	0.0	0.0
Maximum	51.2	22.3	6.0	51.0

Both average and comprehensive hourly target passage rates are presented in Fig 7-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

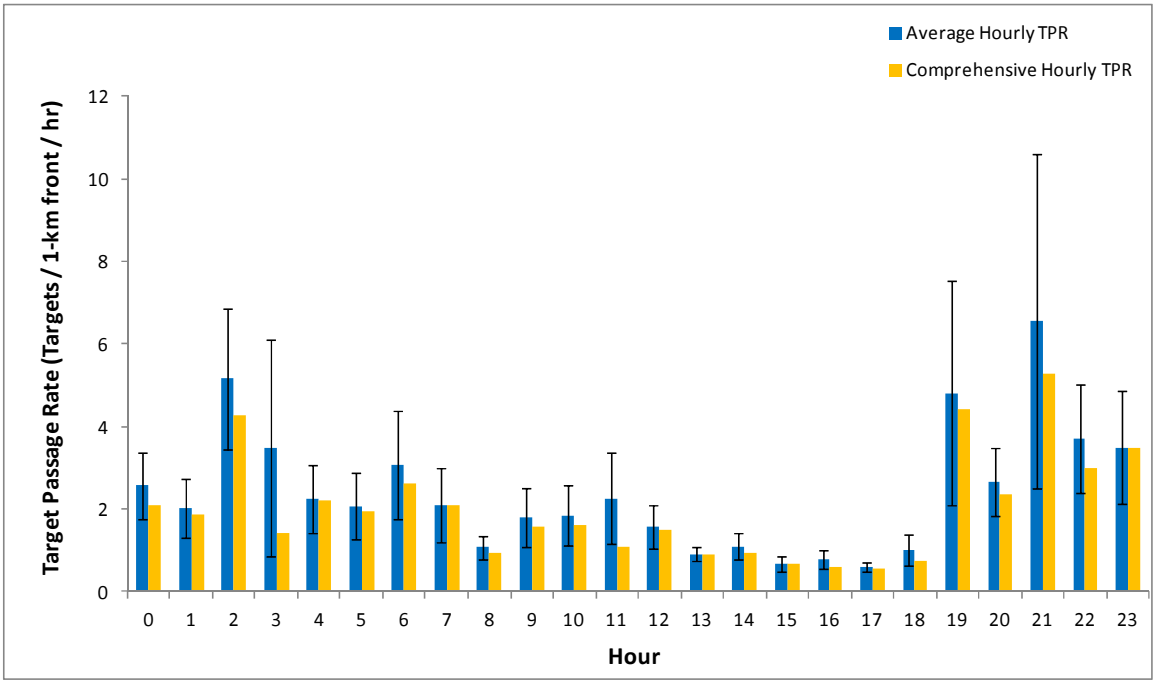

Figure 7-3. Average and comprehensive hourly target passage rates during the Winter 2012-13 season. Error bars represent one standard error.

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7.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 7-4 and Fig. 7-5, respectively) of the Winter 2012-13 season.

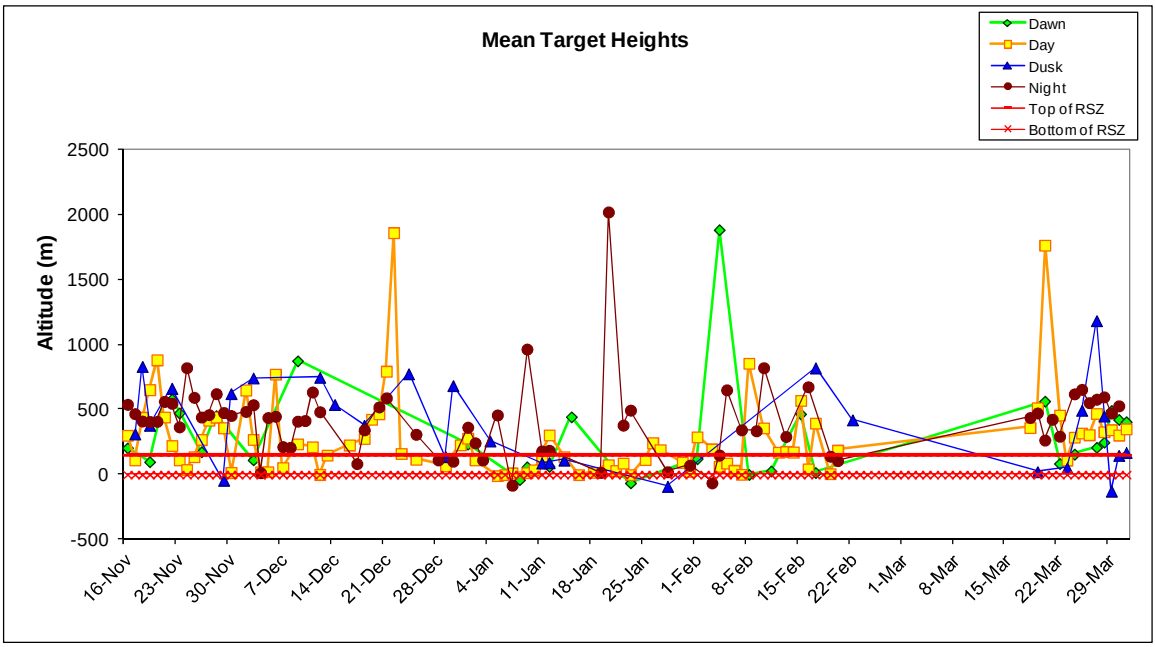

Figure 7-4. Mean target heights during the Winter 2012-13 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

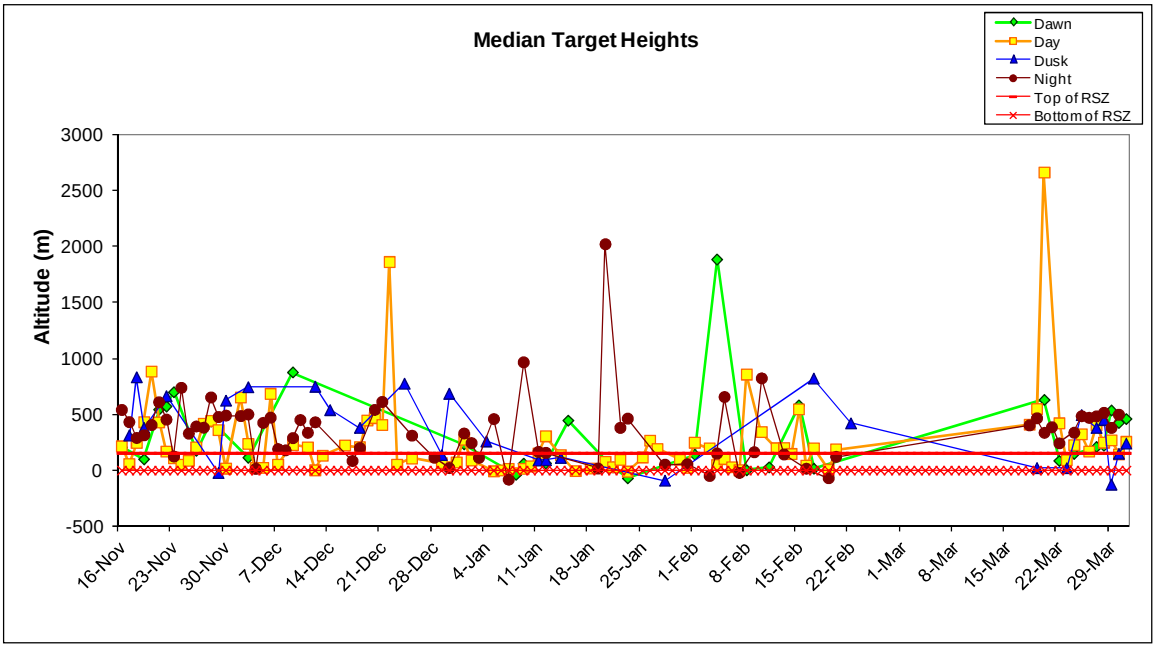

Figure 7-5. Median target heights during the Winter 2012-13 season. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

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The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 7-3 (top) and illustrated in Figure 7-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 7-3 (bottom) and illustrated in Figure 7-6 (green bars).

Table 7-3. Summary of mean and median target heights during biological periods of the Winter 2012-13 season. Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	312.8	274.8	388.5	417.3
Average median target height	326.9	255.3	361.9	356.3
All targets for season combined				
Comprehensive mean target height	374.3	344.7	464.0	502.3
Comprehensive median target height	345.5	221.1	286.1	437.8

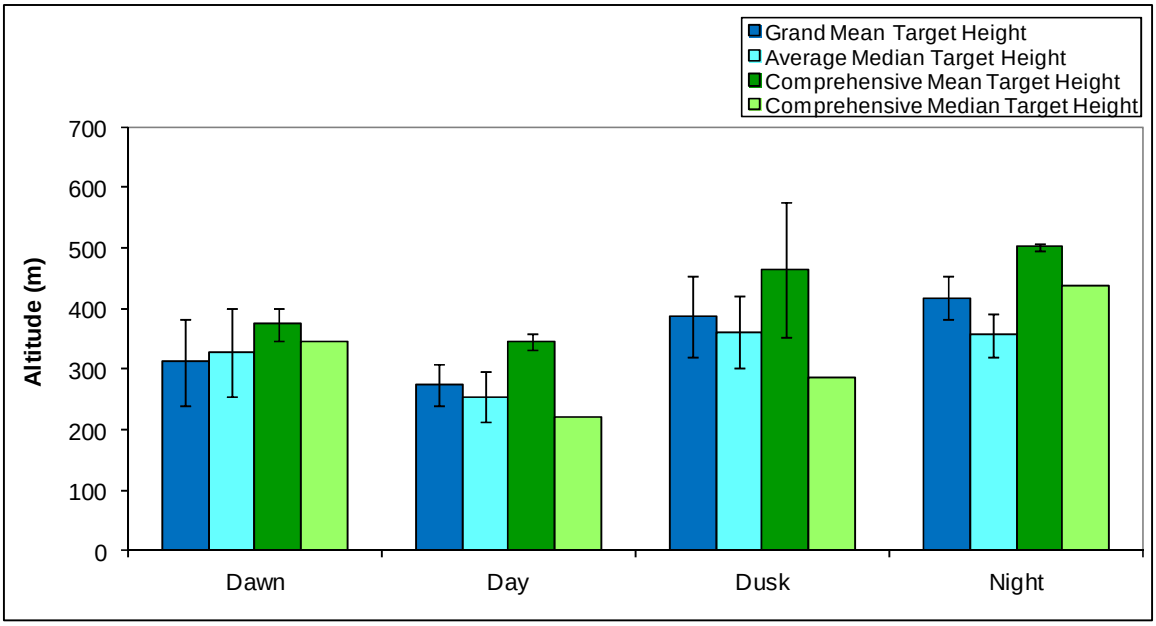

Figure 7-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), during the Winter 2012-13 season. Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 7-7).

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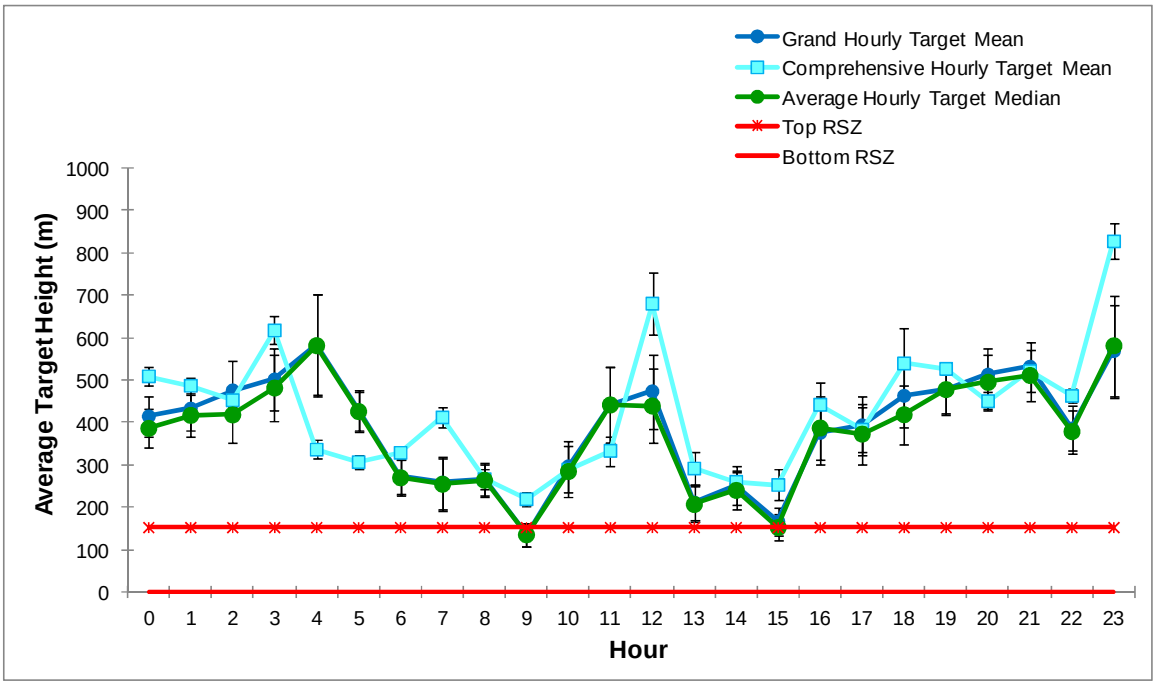

Figure 7-7. Hourly target heights during the Winter 2012-13 season. Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights of the Winter 2012-13 season are shown using 50-meter increments (Fig. 7-8).

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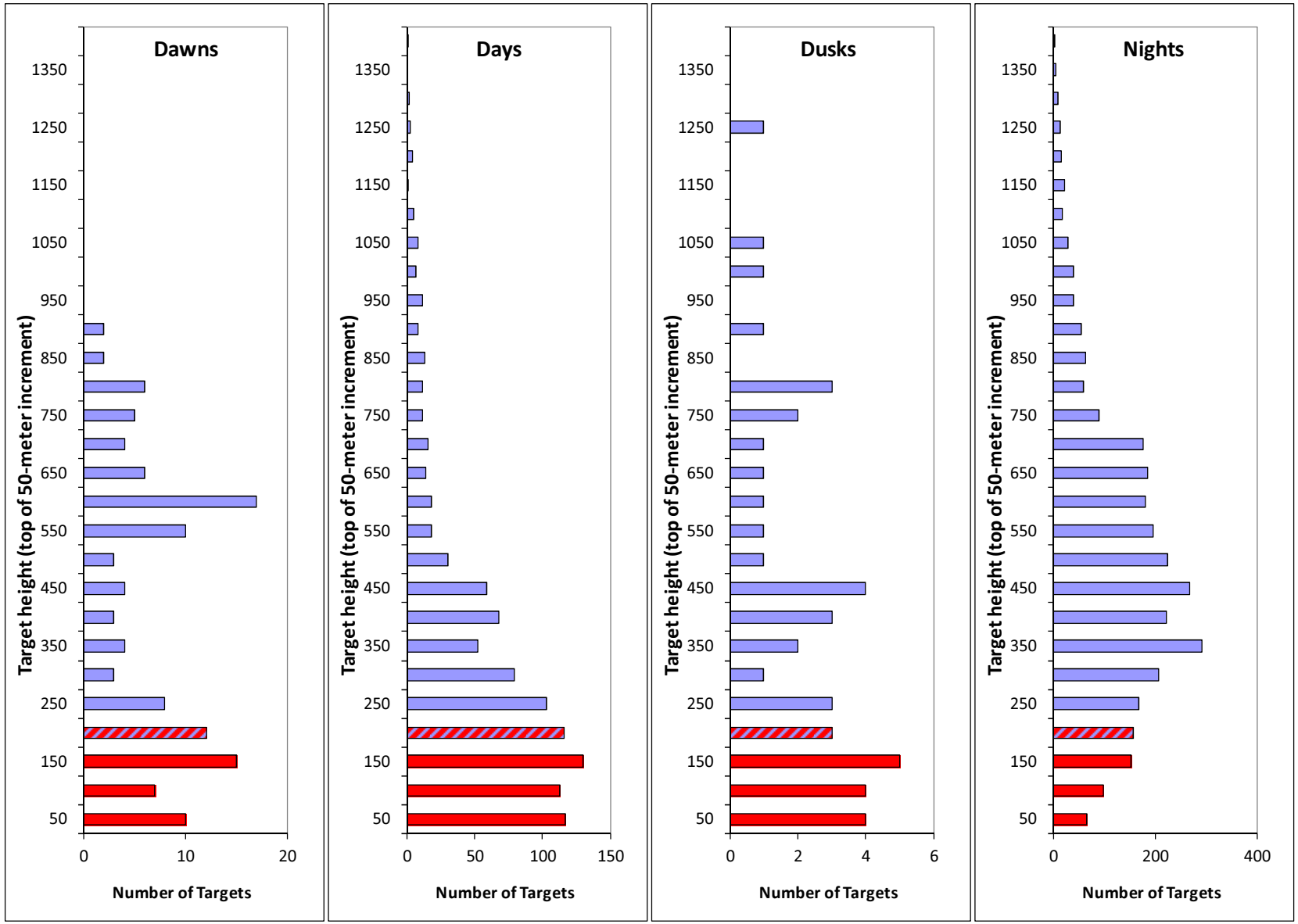

Figure 7-8. Number of targets occurring in each 50-meter increment during biological periods of the Winter 2012-13 season. Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

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Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 7-10) days (Fig. 7-11), dusks (Fig 7-12), and nights (Fig. 7-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period of the Winter 2012-13 season combined together (Table 7-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 7-9).

Table 7-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods of the Winter 2012-13 season. Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	1.2	0.8	0.4	2.5
Average target passage rate within RSZ	0.4	0.4	0.1	0.2
Average target passage rate below RSZ	0.1	0.0	0.1	0.0
Average % of targets in RSZ	37.0%	46.8%	26.8%	22.3%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.0%
Max target percentage within RSZ	100.0%	100.0%	100.0%	100.0%
All targets for season combined				
% targets above RSZ	72.4%	64.5%	65.3%	90.5%
% targets within RSZ	23.6%	33.5%	24.5%	8.3%
% targets below RSZ	4.1%	2.0%	10.2%	1.2%
% targets below turbine height	27.6%	35.5%	34.7%	9.5%

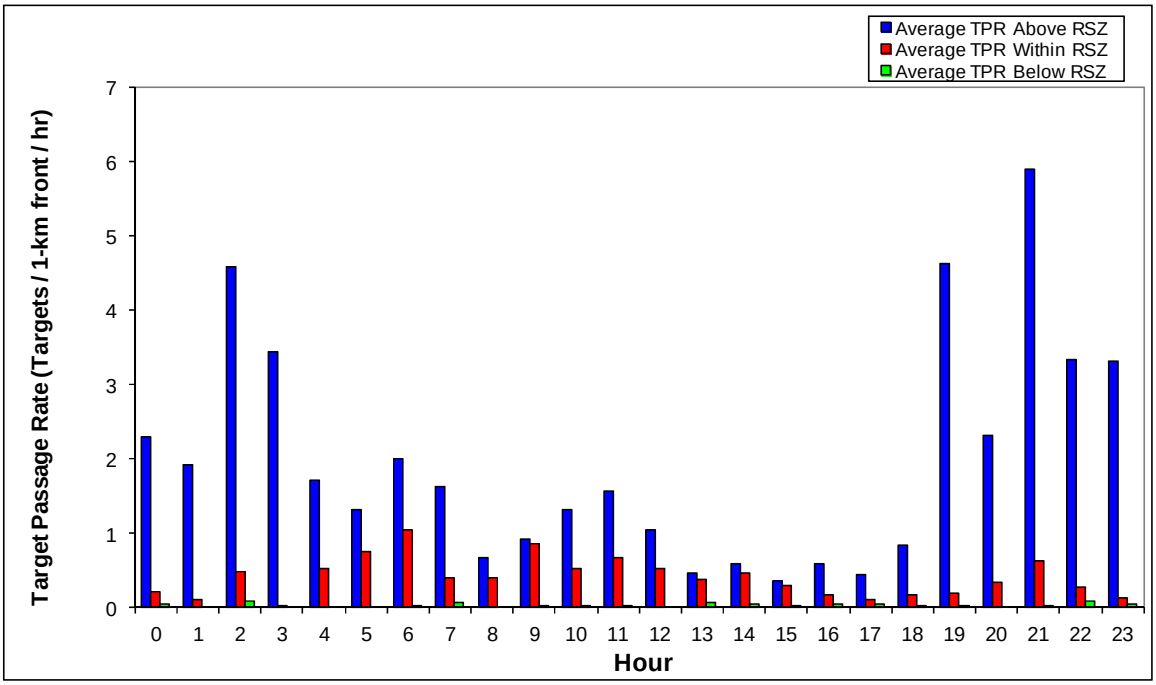

Figure 7-9. Average hourly target passage rates during the Winter 2012-13 season.

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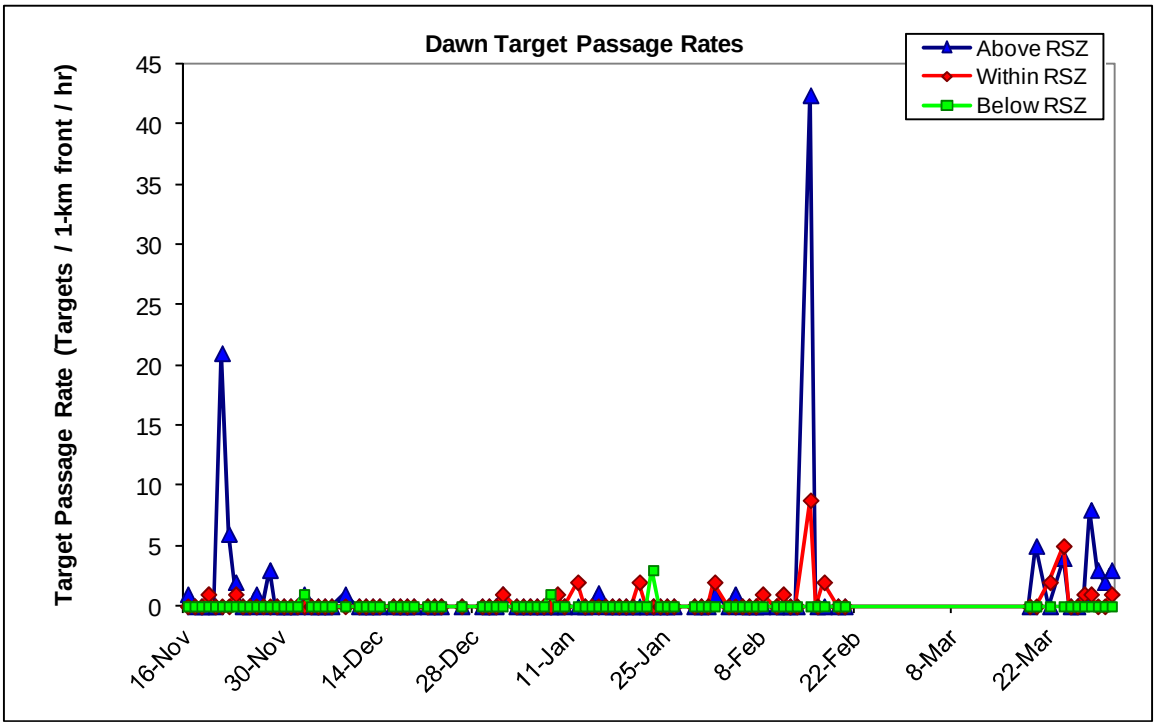

Figure 7-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns of the Winter 2012-13 season.

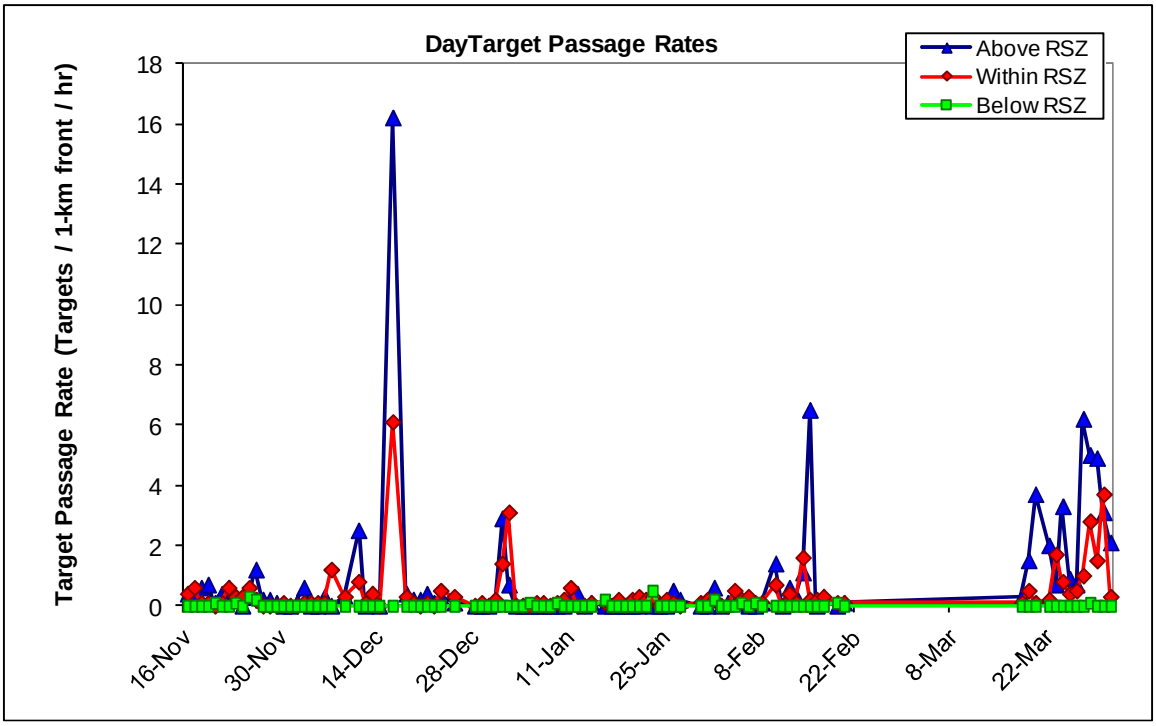

Figure 7-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days of the Winter 2012-13 season.

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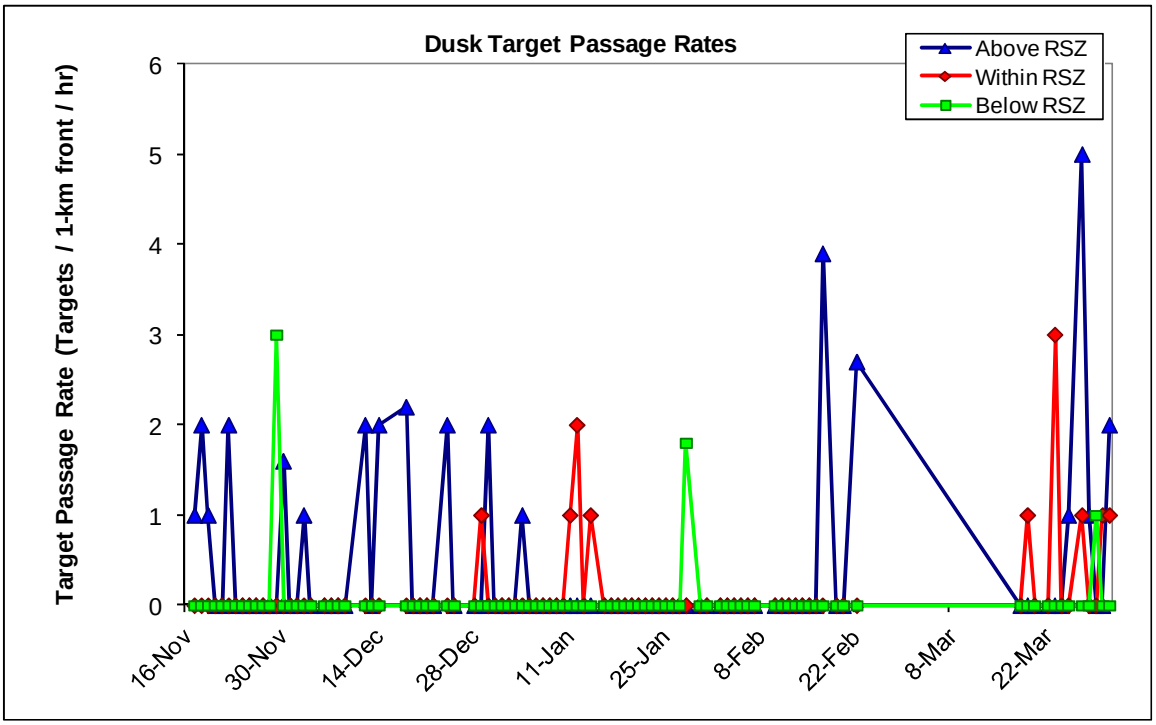

Figure 7-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks of the Winter 2012-13 season.

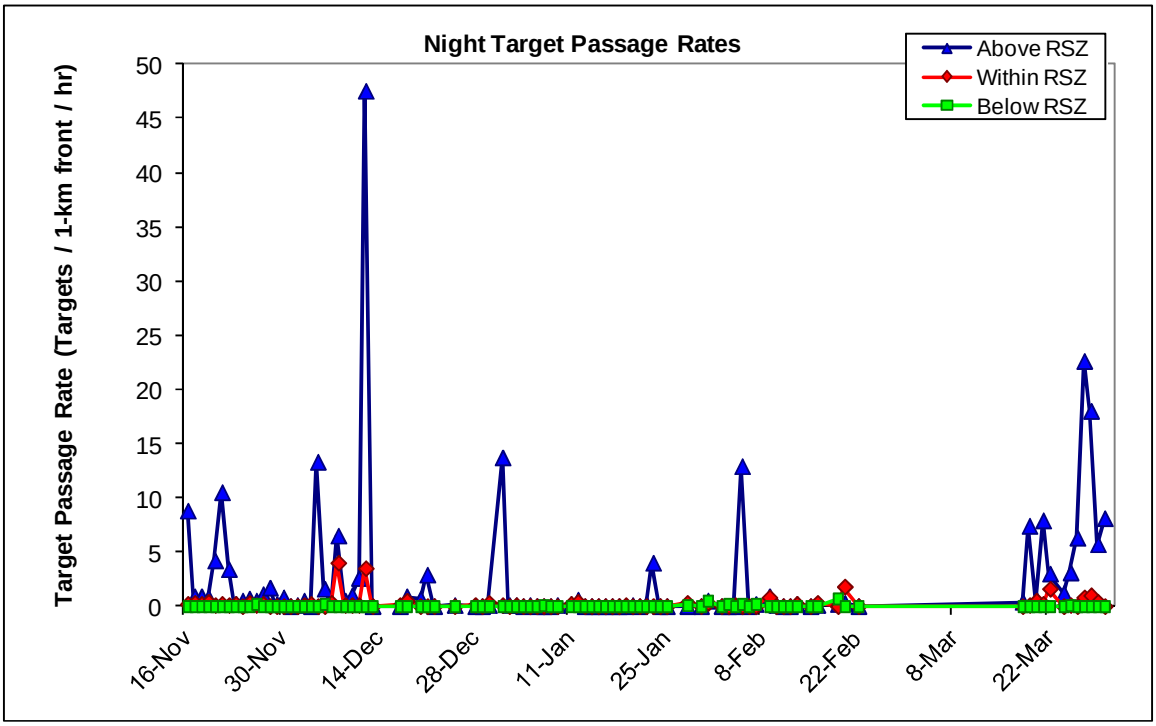

Figure 7-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights of the Winter 2012-13 season.

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7.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods of the Winter 2012-13 season.

7.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 7-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected during the Winter 2012-13 season combined together by biological period (Fig. 7-15) and hour (Fig. 7-16).

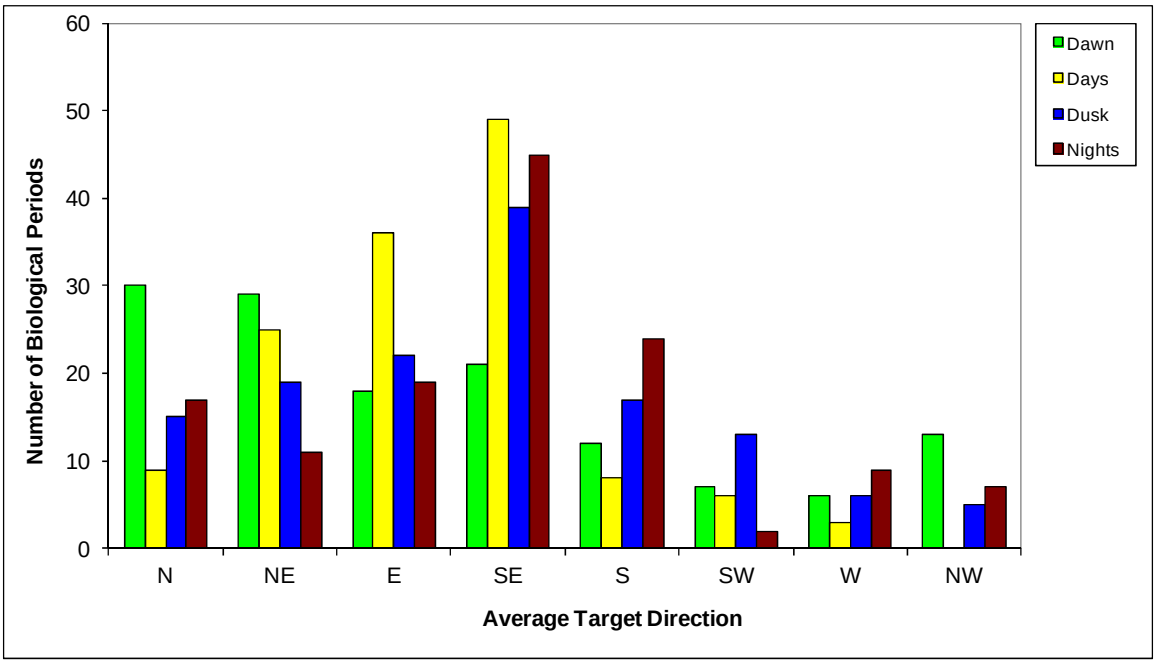

Figure 7-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights of the Winter 2012-13 season.

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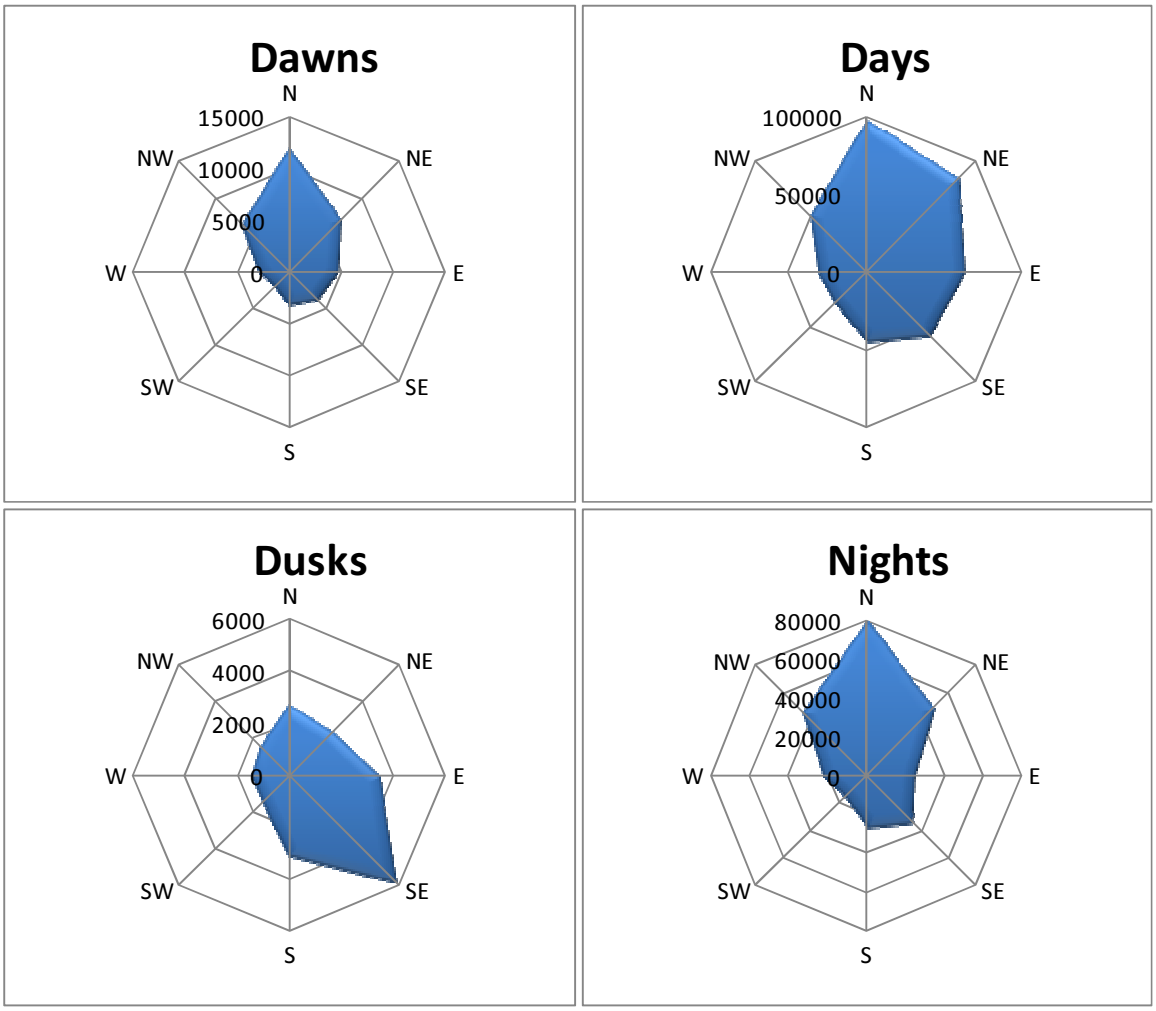

Figure 7-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights of the Winter 2012-13 season.

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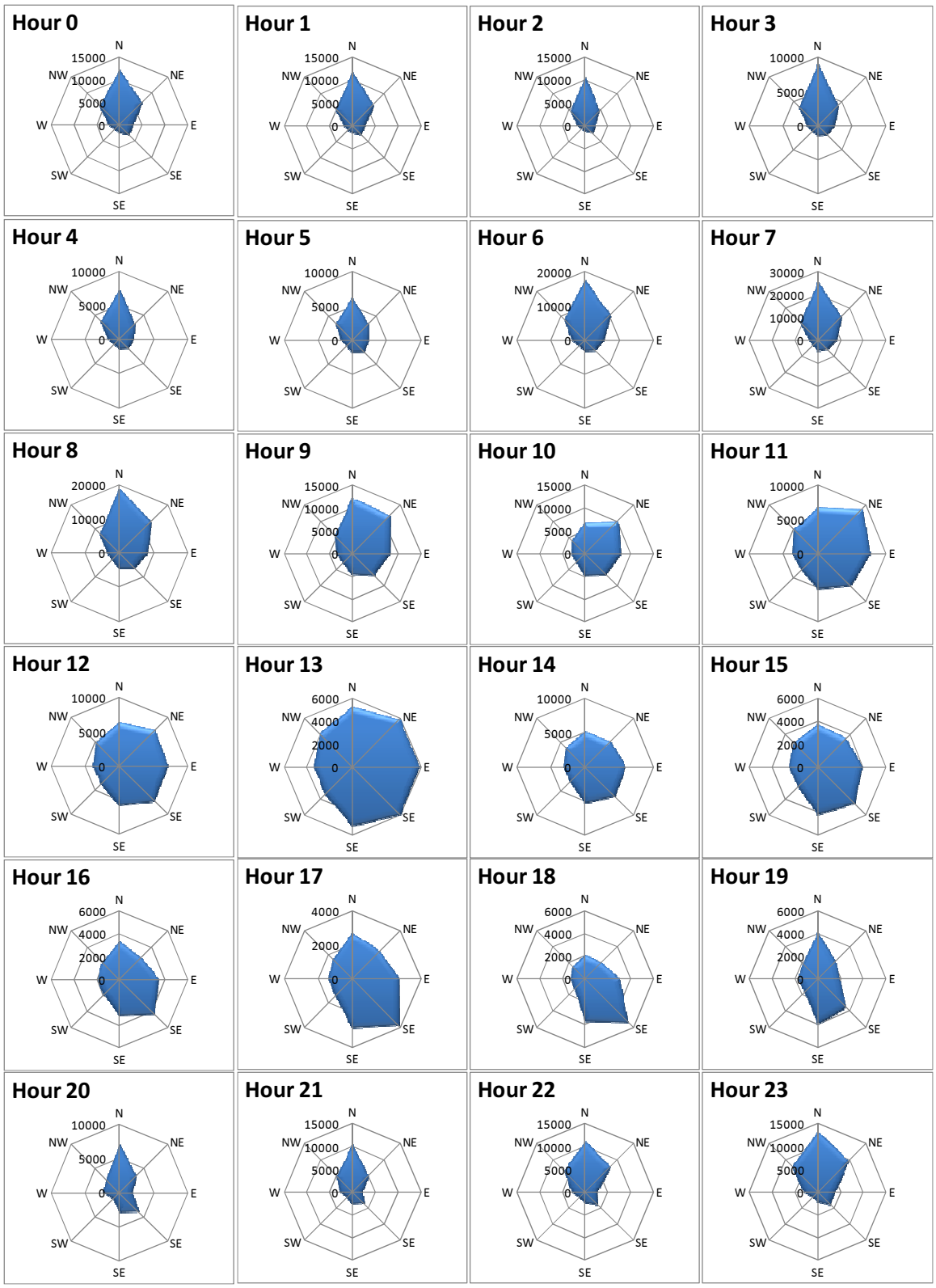

Figure 7-16. Comprehensive distribution of all target's directions by hour during the Winter 2012-13 season.

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8 RESULTS for Site 4 (Nov 16, 2011 – Jan 26, 2012)

8.1 Level of Effort

Table 8-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, for Site 4 (November 16, 2011 – January 26, 2012).

Table 8-1. Radar monitoring effort at Site 4 (November 16, 2011 – January 26, 2012).

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	1728.5		1728.5	
Time radar down	26.4	1.5%	25.8	1.5%
Time radar collected data	1702.0	98.5%	1702.7	98.5%
Unuseable radar data[1] due to rain or other contamination	341.5	20.1%	0.5	0.0%
Unuseable radar data[2] due to insects	0.0	0.0%	-	-
Useable radar data[3]	1360.5	78.7%	1702.2	98.5%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

8.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

8.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 8-1) and as an average by biological period (Fig. 8-2) and hour (Fig. 8-3). Summary statistics are presented in table 8-2.

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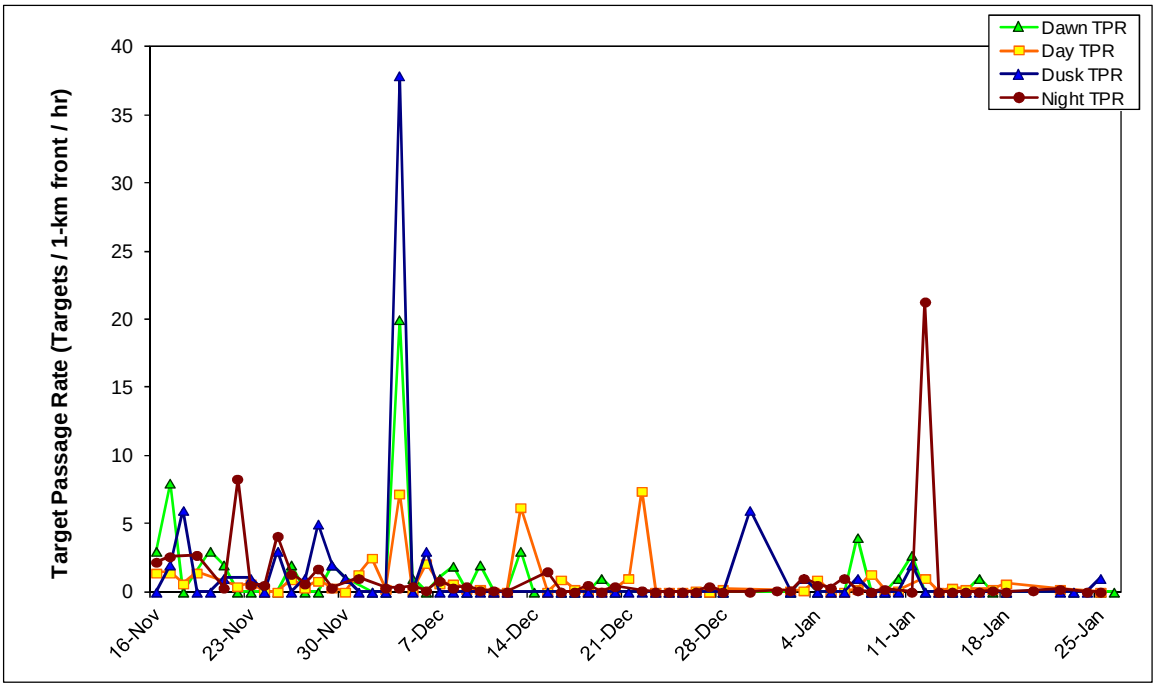

Figure 8-1. Target passage rates (TPR) during biological periods at Site 4 (November 16, 2011 – January 26, 2012).

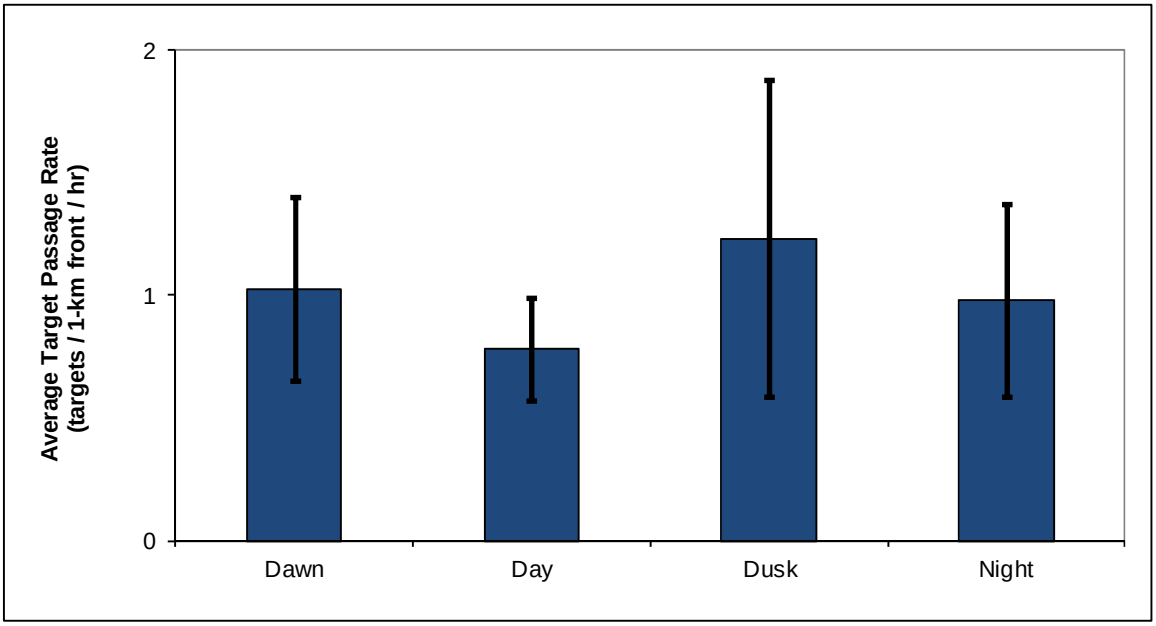

Figure 8-2. Average target passage rates (TPR) by biological period at Site 4 (November 16, 2011 – January 26, 2012). Error bars represent one standard error.

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Table 8-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods at Site 4 (November 16, 2011 – January 26, 2012).

	Dawn	Day	Dusk	Night
Average	1.0	0.8	1.2	1.0
Standard Deviation	2.9	1.6	5.0	3.0
Standard Error	0.4	0.2	0.6	0.4
Median	0.0	0.2	0.0	0.2
Minimum	0.0	0.0	0.0	0.0
Maximum	20.0	7.4	37.9	21.3

Both average and comprehensive hourly target passage rates are presented in Fig 8-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

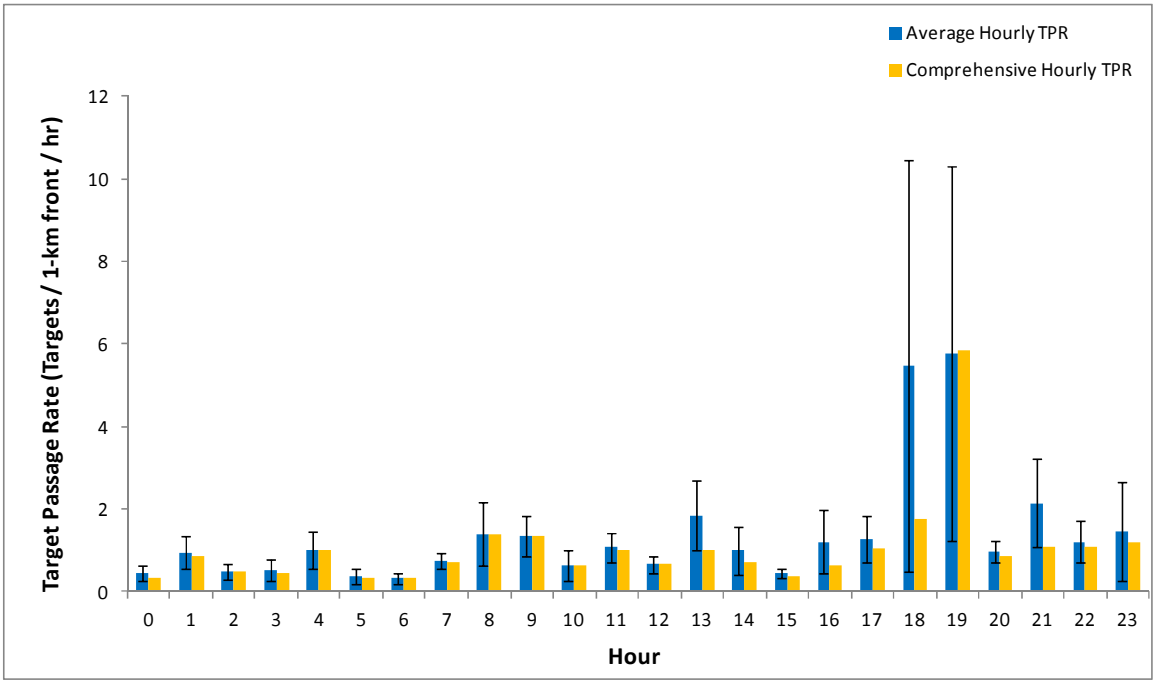

Figure 8-3. Average and comprehensive hourly target passage rates at Site 4 (November 16, 2011 – January 26, 2012). Error bars represent one standard error.

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8.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 8-4 and Fig. 8-5, respectively) at Site 4 (November 16, 2011 – January 26, 2012).

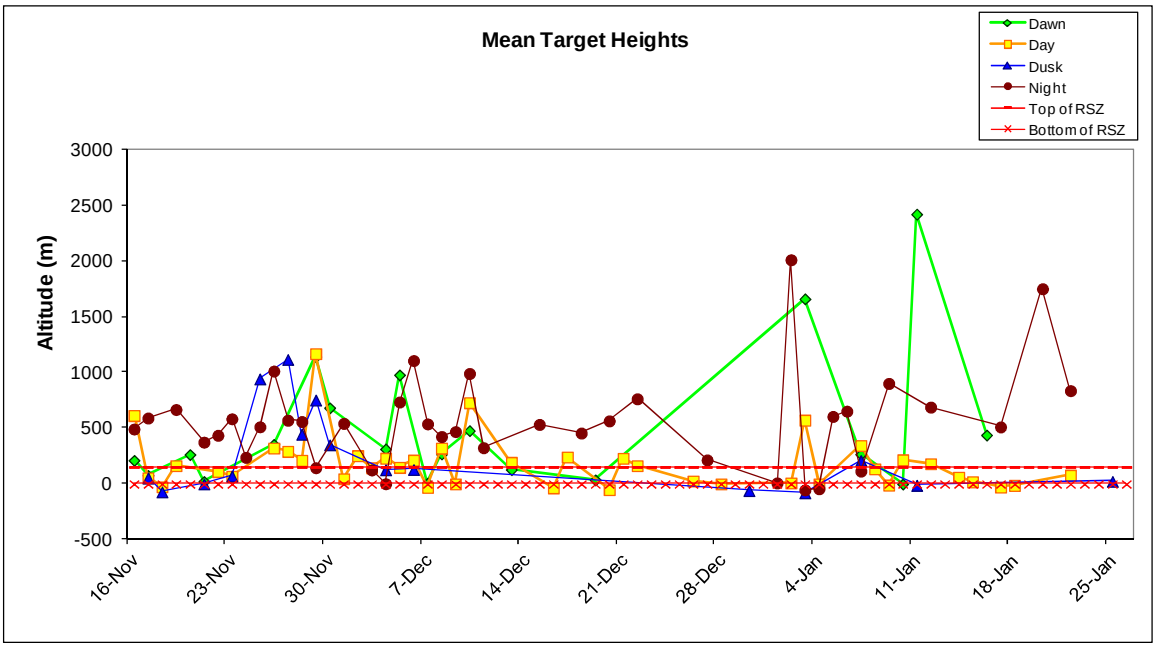

Figure 8-4. Mean target heights at Site 4 (November 16, 2011 – January 26, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

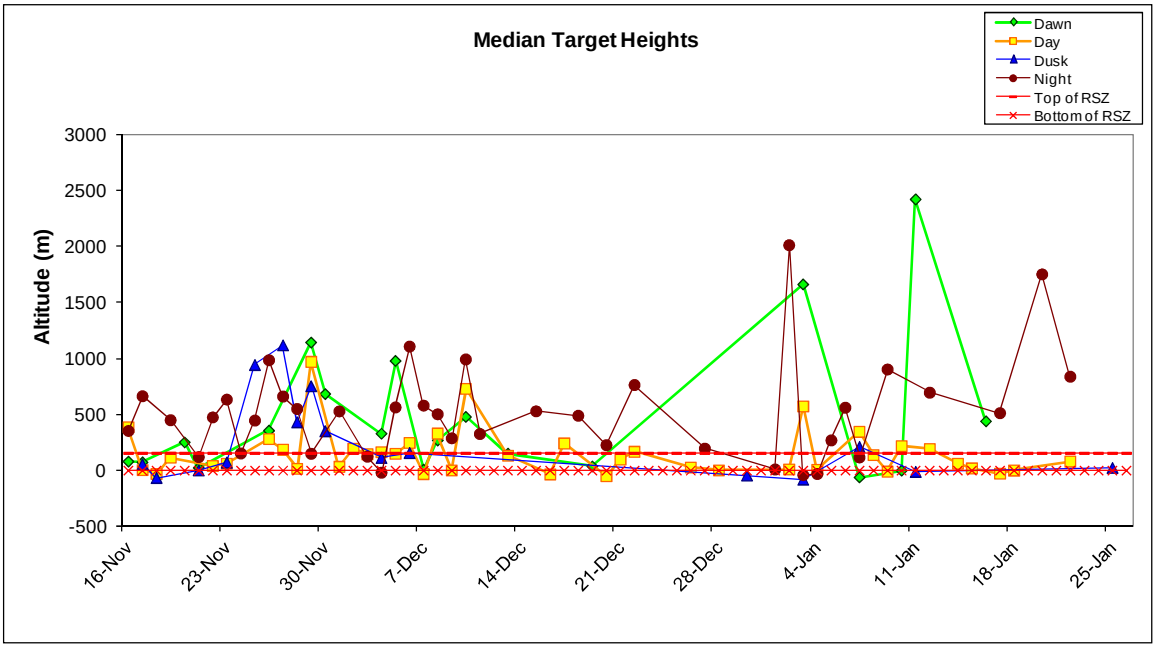

Figure 8-5. Median target heights at Site 4 (November 16, 2011 – January 26, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

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The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 8-3 (top) and illustrated in Figure 8-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 8-3 (bottom) and illustrated in Figure 8-6 (green bars).

Table 8-3. Summary of mean and median target heights during biological periods at Site 4 (November 16, 2011 – January 26, 2012). Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	513.3	179.8	249.8	563.6
Average median target height	490.0	150.1	250.9	523.4
All targets for season combined				
Comprehensive mean target height	384.3	224.2	334.1	535.0
Comprehensive median target height	233.5	137.8	90.5	517.2

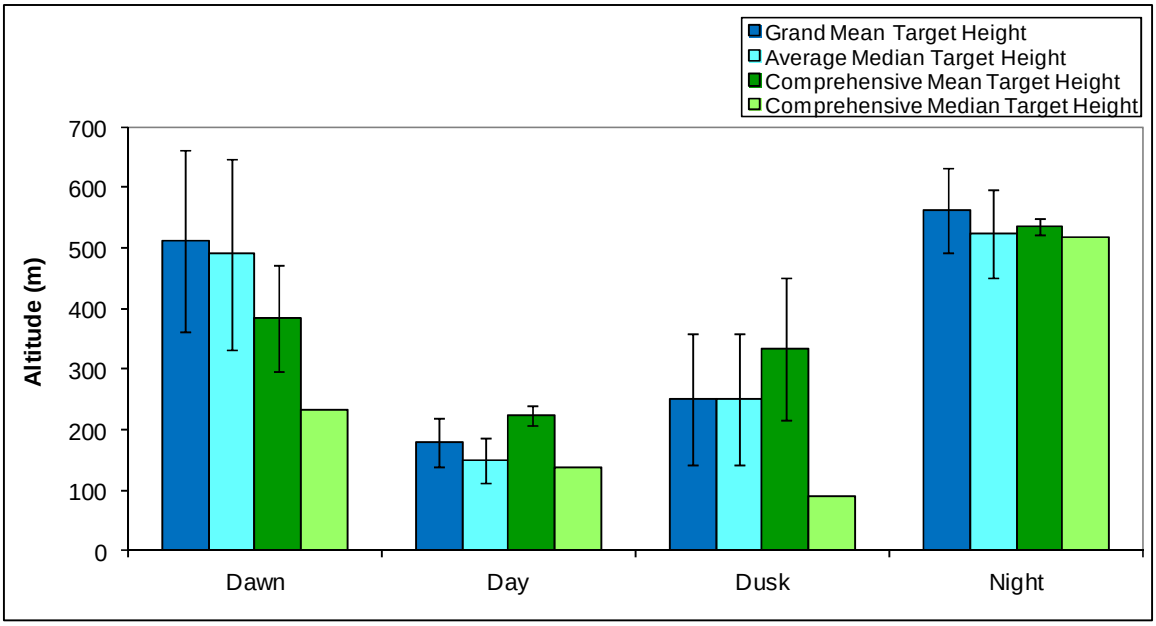

Figure 8-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), at Site 4 (November 16, 2011 – January 26, 2012). Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 8-7).

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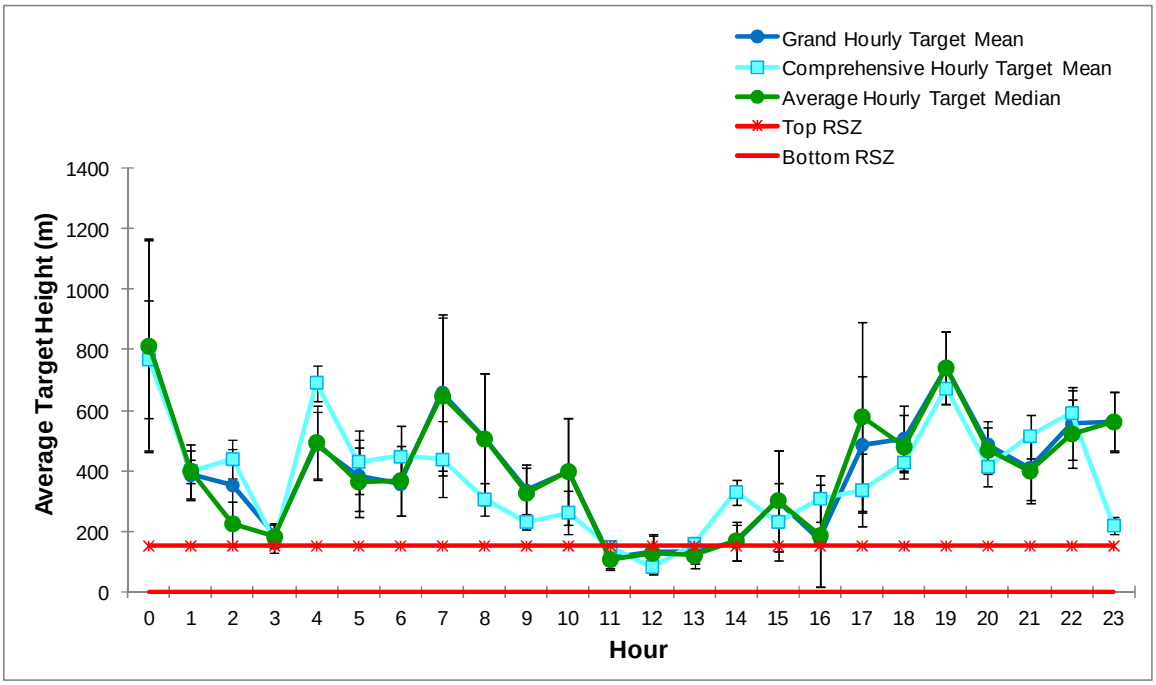

Figure 8-7. Hourly target heights at Site 4 (November 16, 2011 – January 26, 2012). Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights at Site 4 (November 16, 2011 – January 26, 2012) are shown using 50-meter increments (Fig. 8-8).

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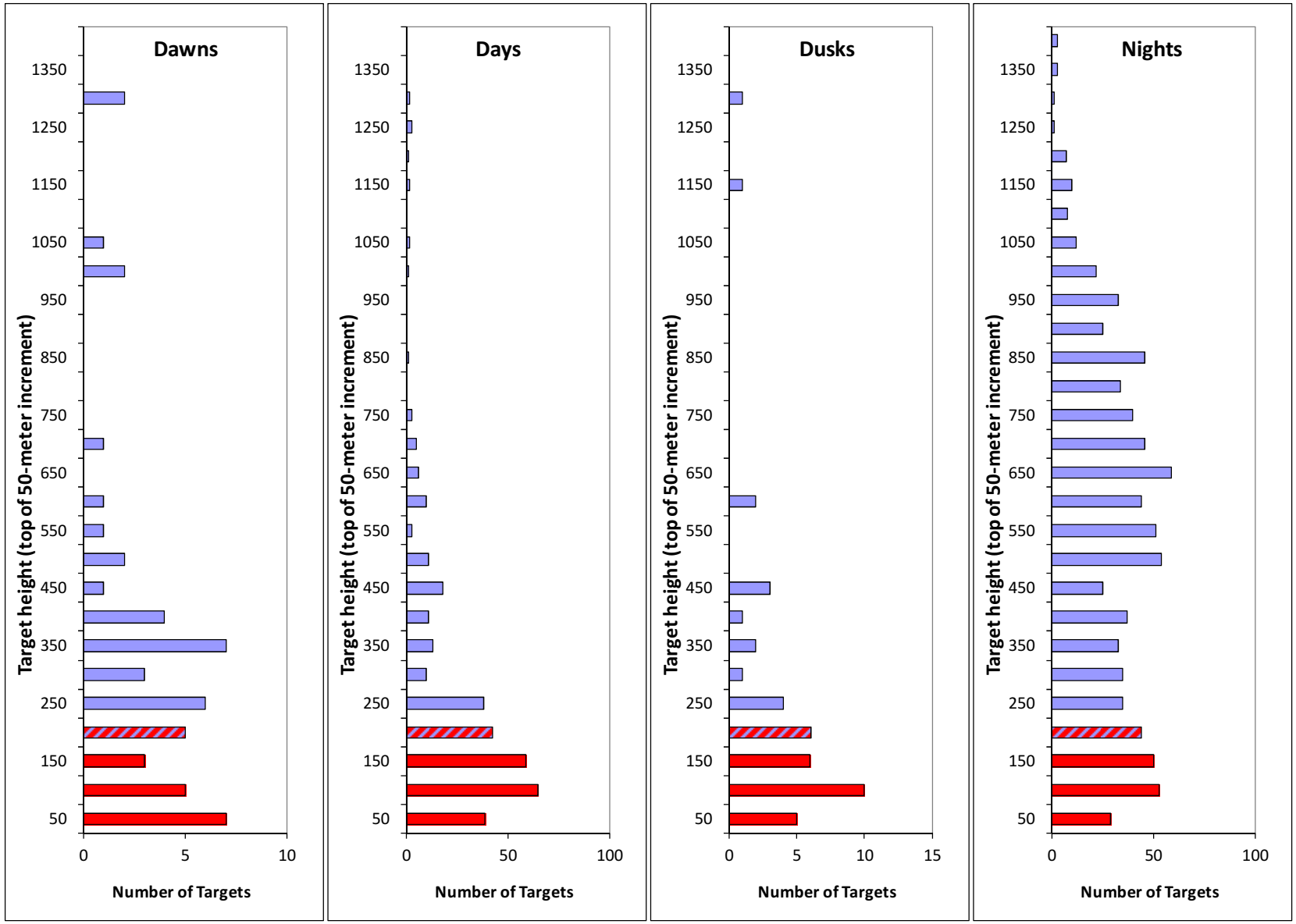

Figure 8-8. Number of targets occurring in each 50-meter increment during biological periods at Site 4 (November 16, 2011 – January 26, 2012). Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

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Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 8-10) days (Fig. 8-11), dusks (Fig 8-12), and nights (Fig. 8-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period at Site 4 (November 16, 2011 – January 26, 2012) combined together (Table 8-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 8-9).

Table 8-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods at Site 4 (November 16, 2011 – January 26, 2012). Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	0.7	0.3	0.4	0.9
Average target passage rate within RSZ	0.3	0.3	0.5	0.1
Average target passage rate below RSZ	0.1	0.1	0.3	0.0
Average % of targets in RSZ	27.0%	42.2%	34.4%	20.4%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.0%
Max target percentage within RSZ	100.0%	100.0%	100.0%	100.0%
All targets for season combined				
% targets above RSZ	64.4%	43.3%	35.6%	87.1%
% targets within RSZ	25.4%	41.8%	39.0%	9.1%
% targets below RSZ	10.2%	14.8%	25.4%	3.8%
% targets below turbine height	35.6%	56.7%	64.4%	12.9%

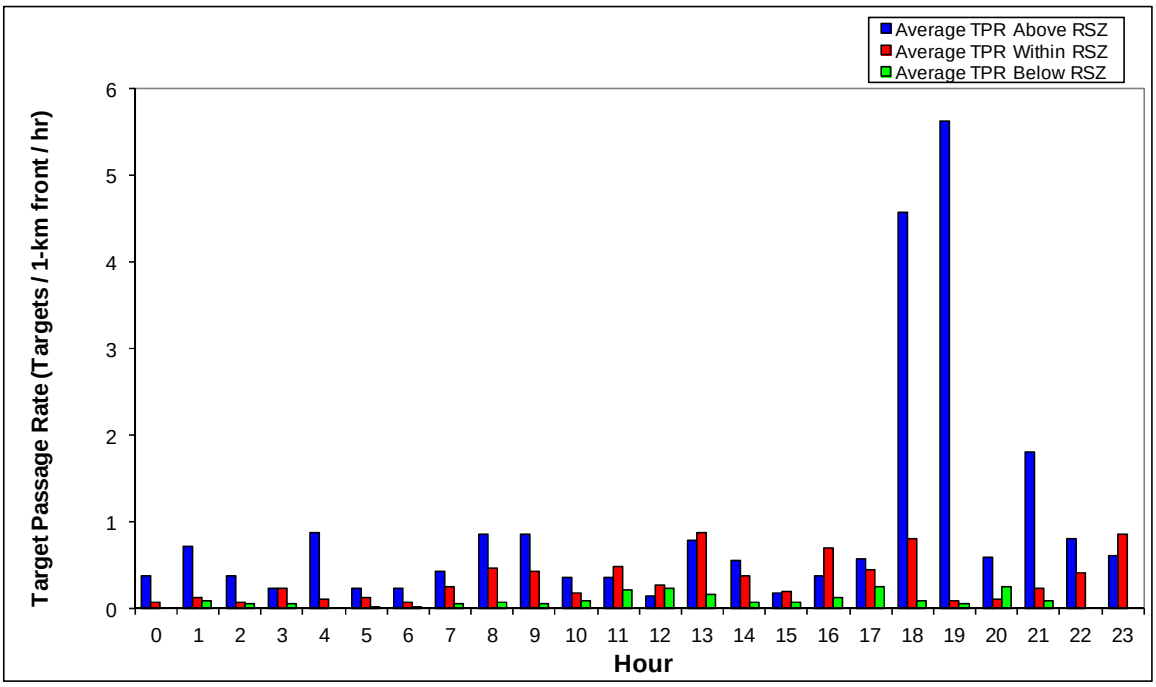

Figure 8-9. Average hourly target passage rates at Site 4 (November 16, 2011 – January 26, 2012).

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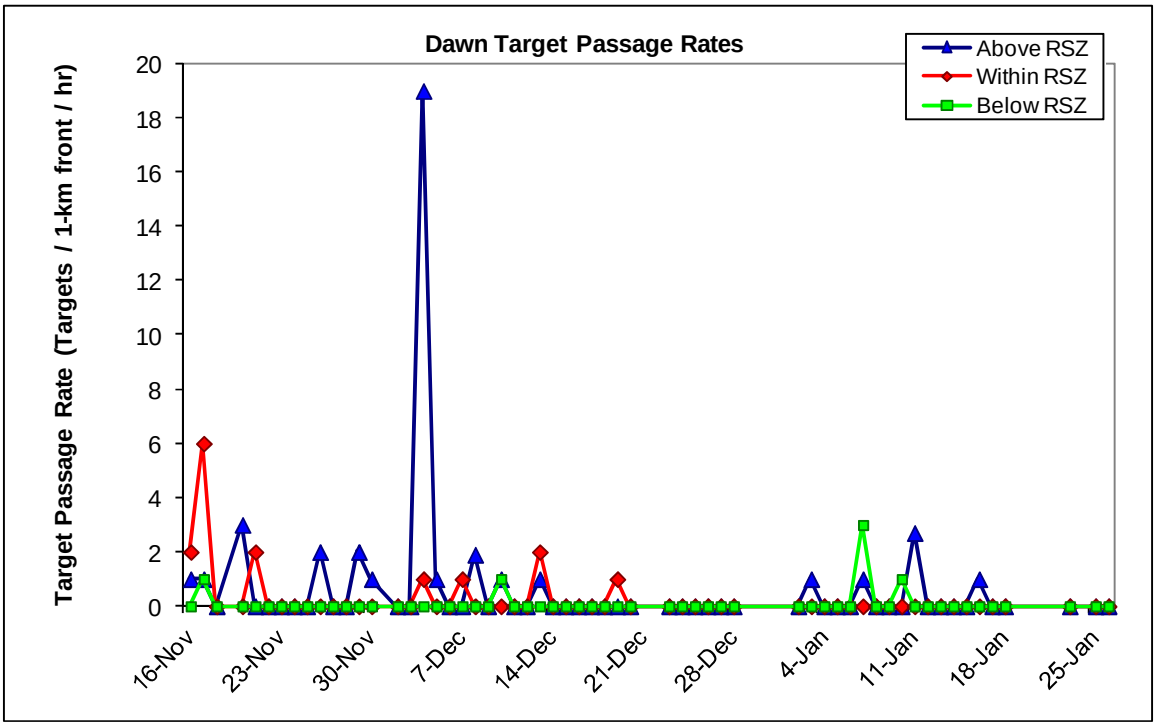

Figure 8-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns at Site 4 (November 16, 2011 – January 26, 2012).

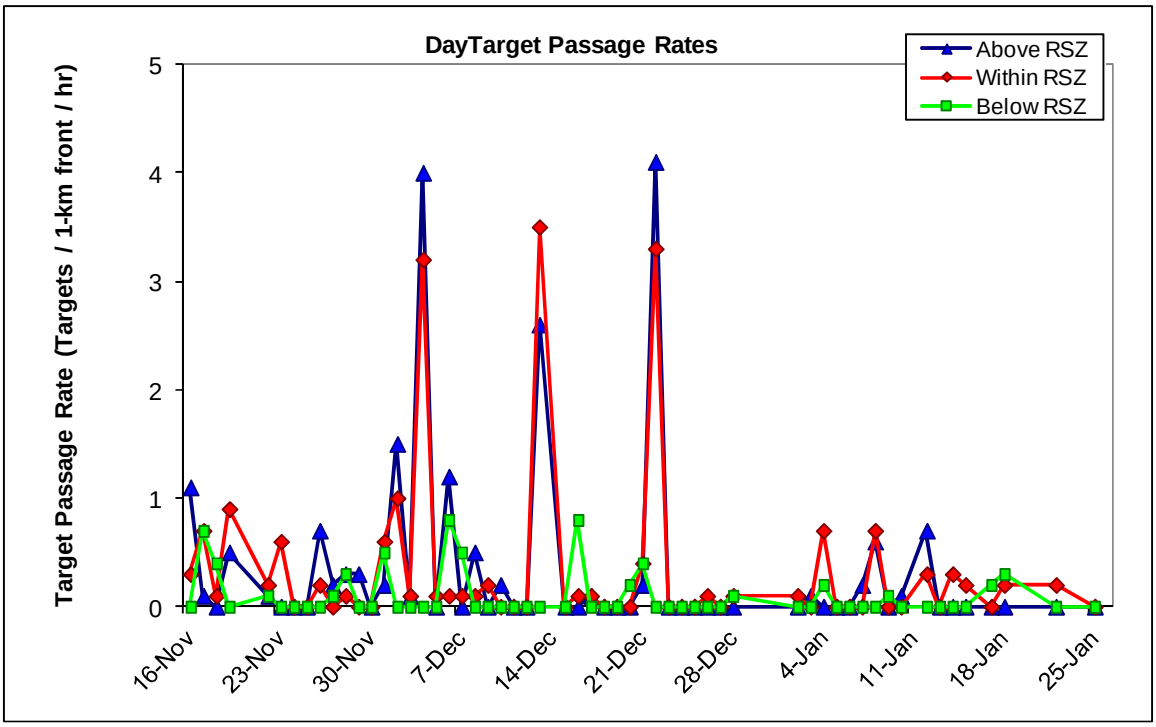

Figure 8-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days at Site 4 (November 16, 2011 – January 26, 2012).

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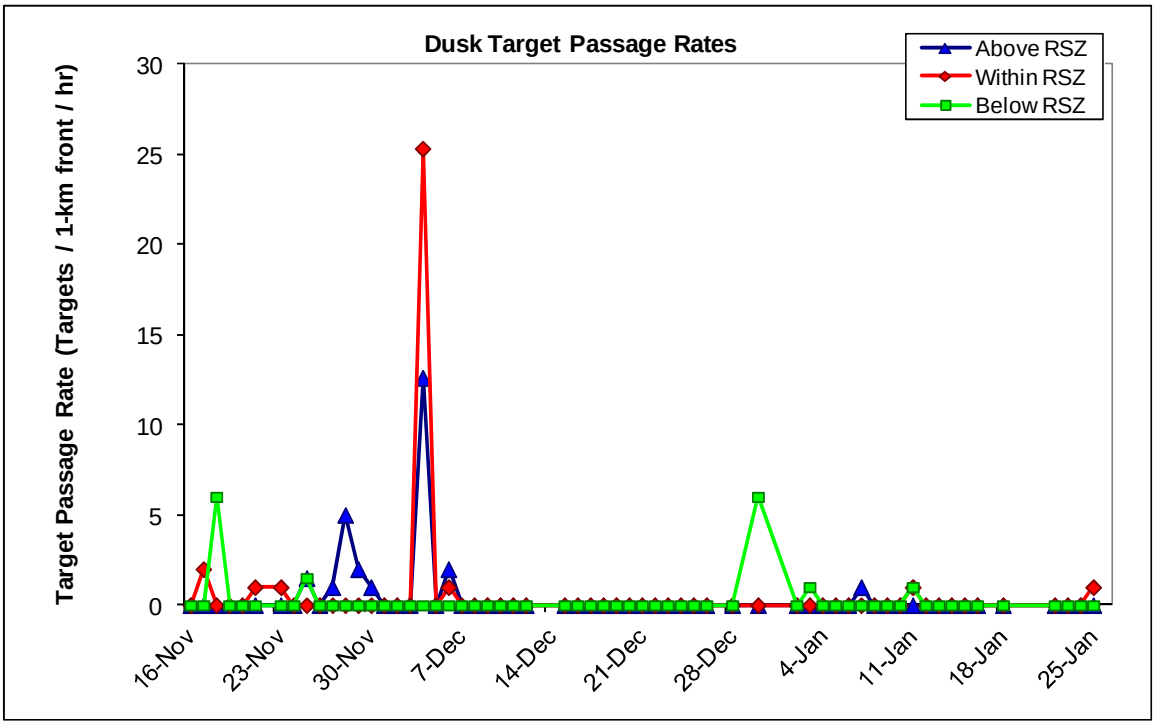

Figure 8-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks at Site 4 (November 16, 2011 – January 26, 2012).

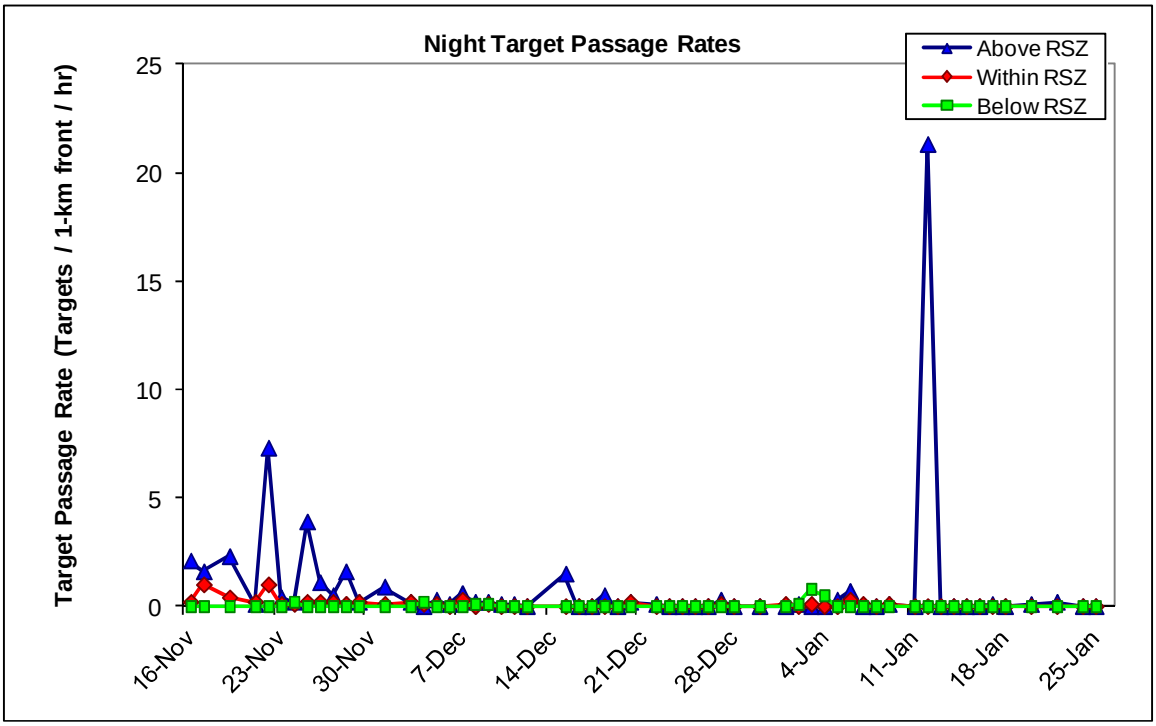

Figure 8-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights at Site 4 (November 16, 2011 – January 26, 2012).

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8.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods at Site 4 (November 16, 2011 – January 26, 2012).

8.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 8-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected at Site 4 (November 16, 2011 – January 26, 2012) combined together by biological period (Fig. 8-15) and hour (Fig. 8-16).

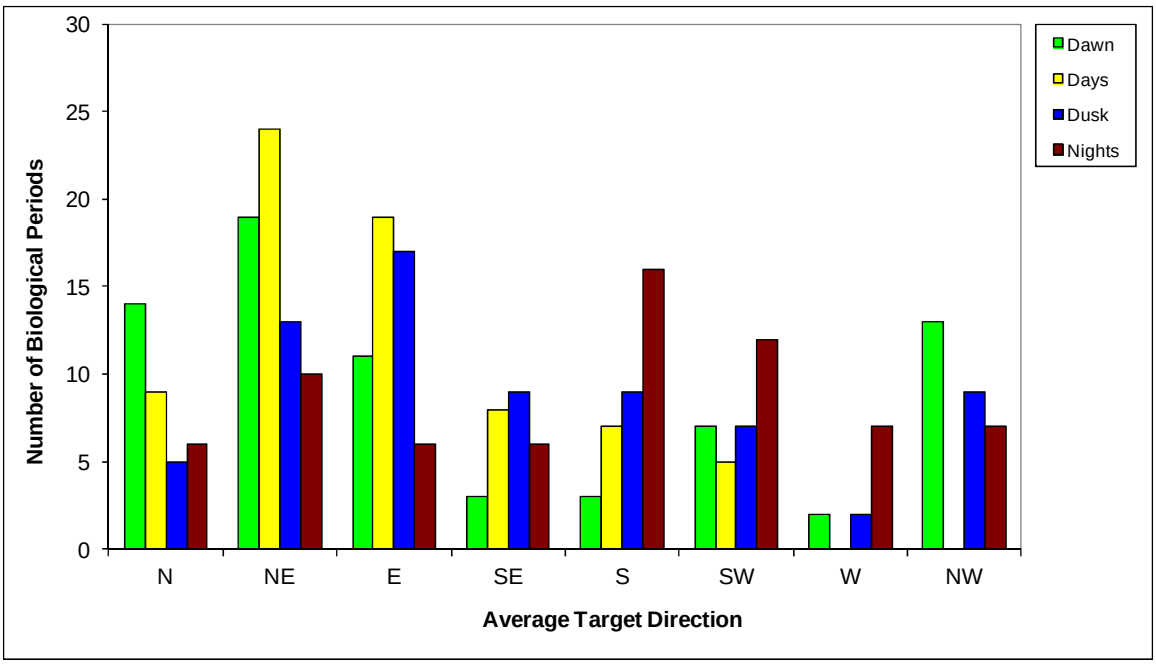

Figure 8-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at Site 4 (November 16, 2011 – January 26, 2012).

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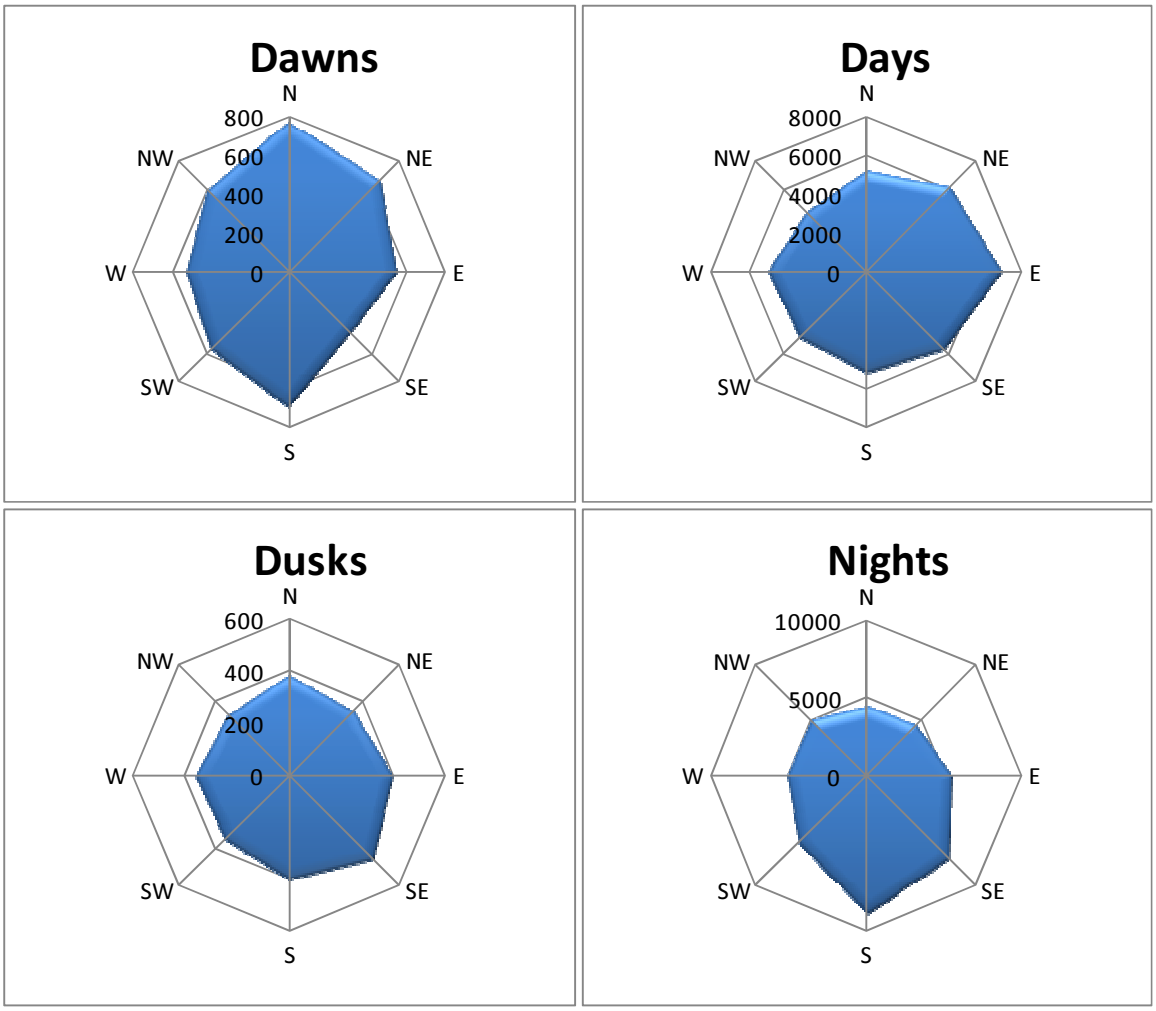

Figure 8-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights at Site 4 (November 16, 2011 – January 26, 2012).

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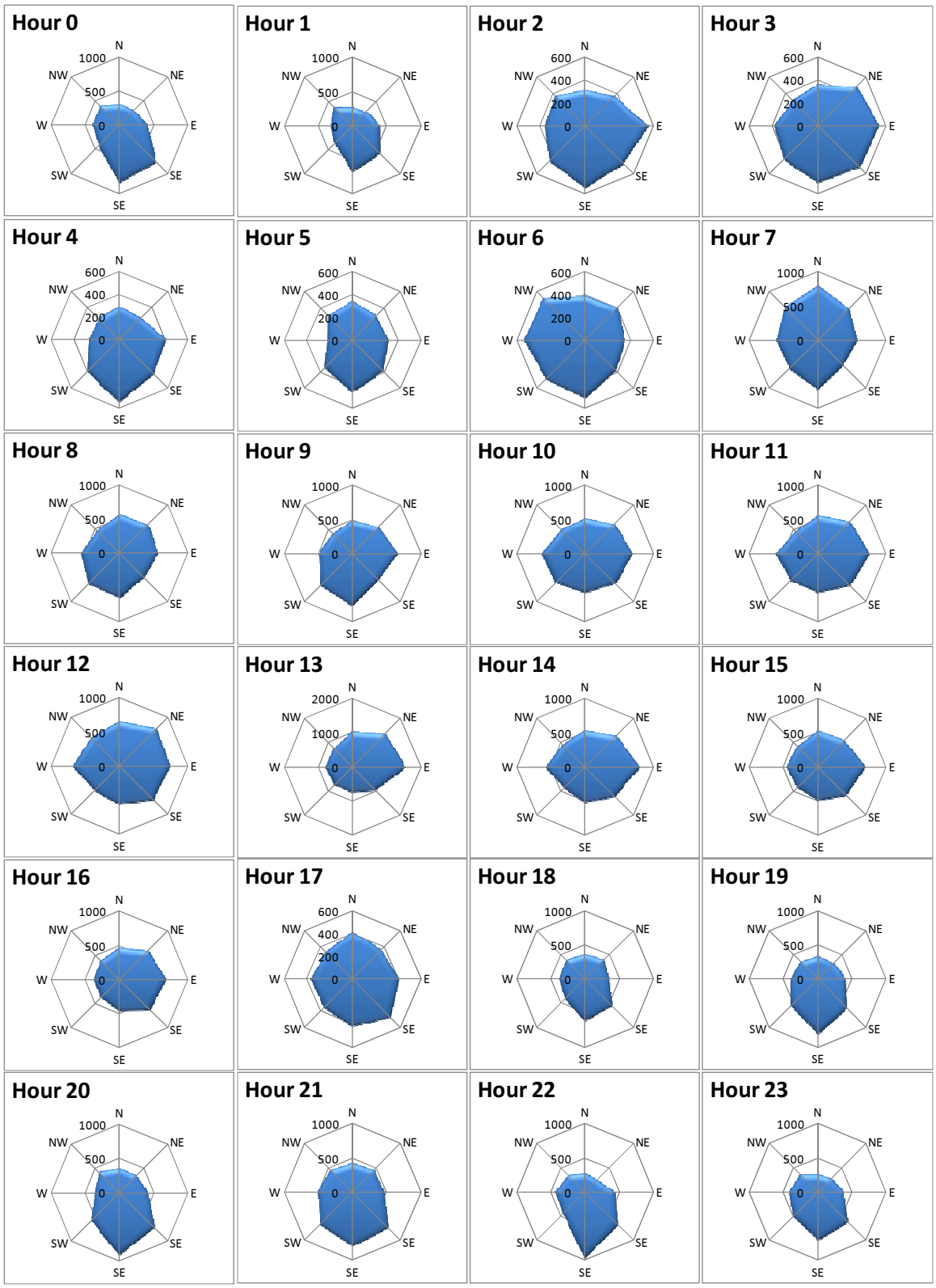

Figure 8-16. Comprehensive distribution of all target's directions by hour at Site 4 (November 16, 2011 – January 26, 2012).

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9 RESULTS for Site 6 (February 2 – April 29, 2012)

9.1 Level of Effort

Table 9-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, for Site 6 (February 2 - April 29, 2012).

Table 9-1. Radar monitoring effort at Site 6 (February 2 - April 29, 2012).

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	2110.0		2110.0	
Time radar down	18.1	0.9%	17.5	0.8%
Time radar collected data	2091.9	99.1%	2092.5	99.2%
Unuseable radar data[1] due to rain or other contamination	297.3	14.2%	6.0	0.3%
Unuseable radar data[2] due to insects	49.5	2.4%	-	-
Useable radar data[3]	1745.1	82.7%	2086.5	98.9%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

9.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

9.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 9-1) and as an average by biological period (Fig. 9-2) and hour (Fig. 9-3). Summary statistics are presented in table 9-2.

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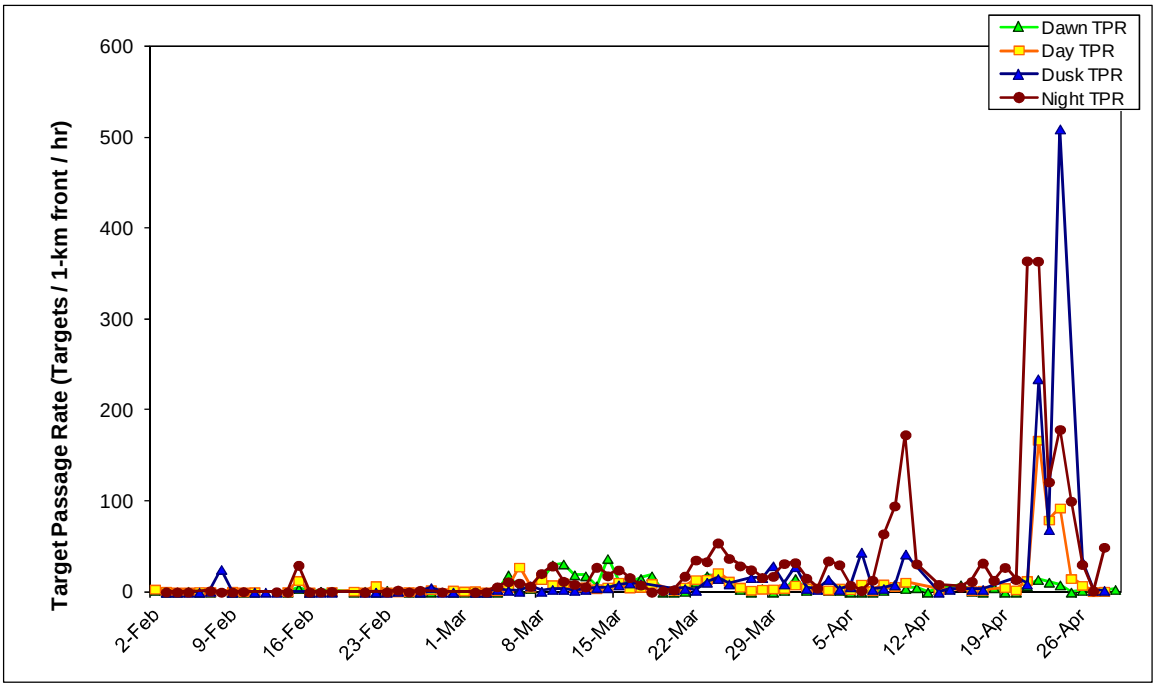

Figure 9-1. Target passage rates (TPR) during biological periods at Site 6 (February 2 - April 29, 2012).

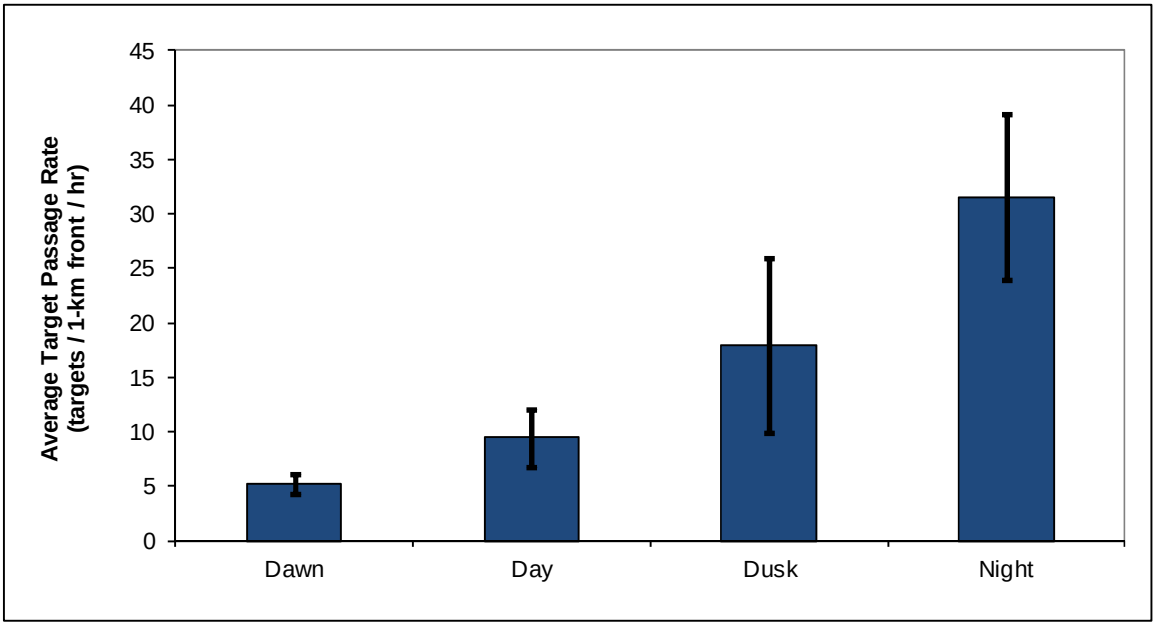

Figure 9-2. Average target passage rates (TPR) by biological period at Site 6 (February 2 - April 29, 2012). Error bars represent one standard error.

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Table 9-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods at Site 6 (February 2 - April 29, 2012).

	Dawn	Day	Dusk	Night
Average	5.2	9.4	17.9	31.6
Standard Deviation	7.9	23.3	66.7	65.4
Standard Error	0.9	2.7	8.0	7.5
Median	2.0	3.9	3.0	11.9
Minimum	0.0	0.2	0.0	0.0
Maximum	37.0	167.3	510.0	364.7

Both average and comprehensive hourly target passage rates are presented in Fig 9-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

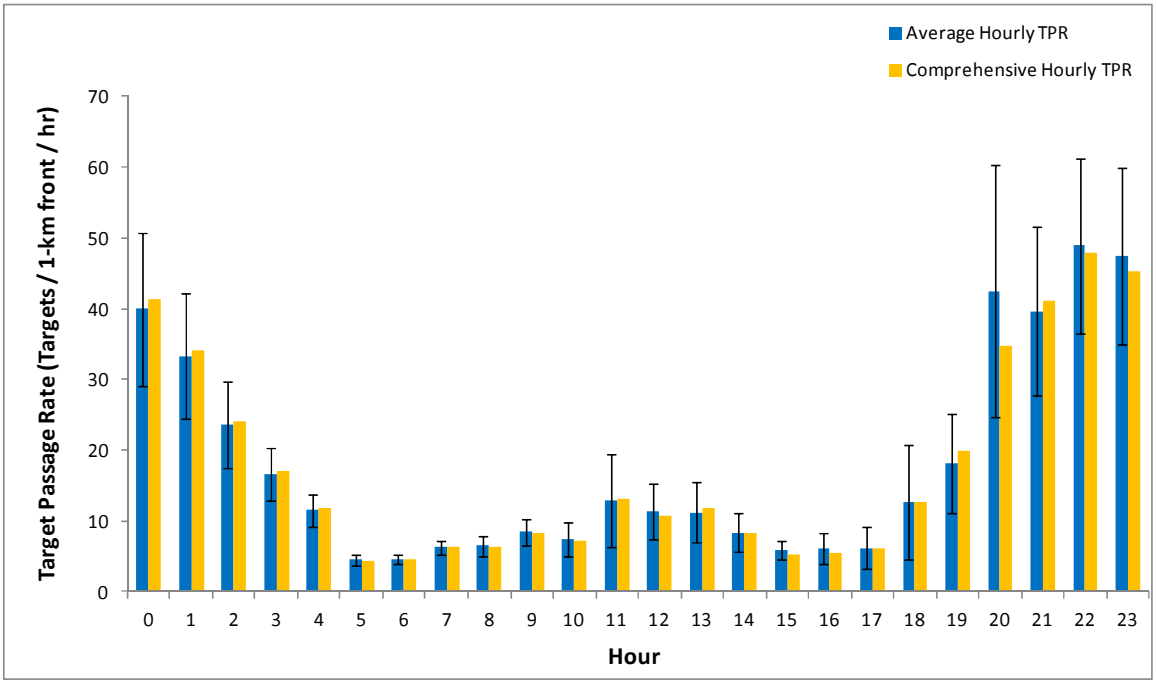

Figure 9-3. Average and comprehensive hourly target passage rates at Site 6 (February 2 - April 29, 2012). Error bars represent one standard error.

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9.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 9-4 and Fig. 9-5, respectively) at Site 6 (February 2 - April 29, 2012).

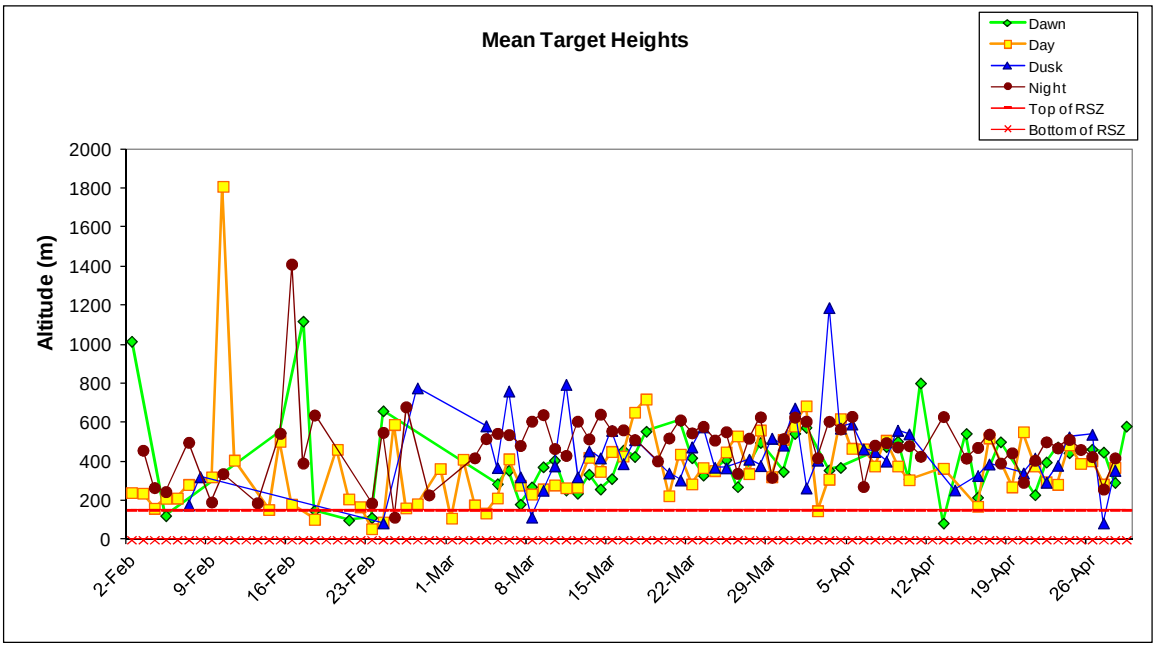

Figure 9-4. Mean target heights at Site 6 (February 2 - April 29, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

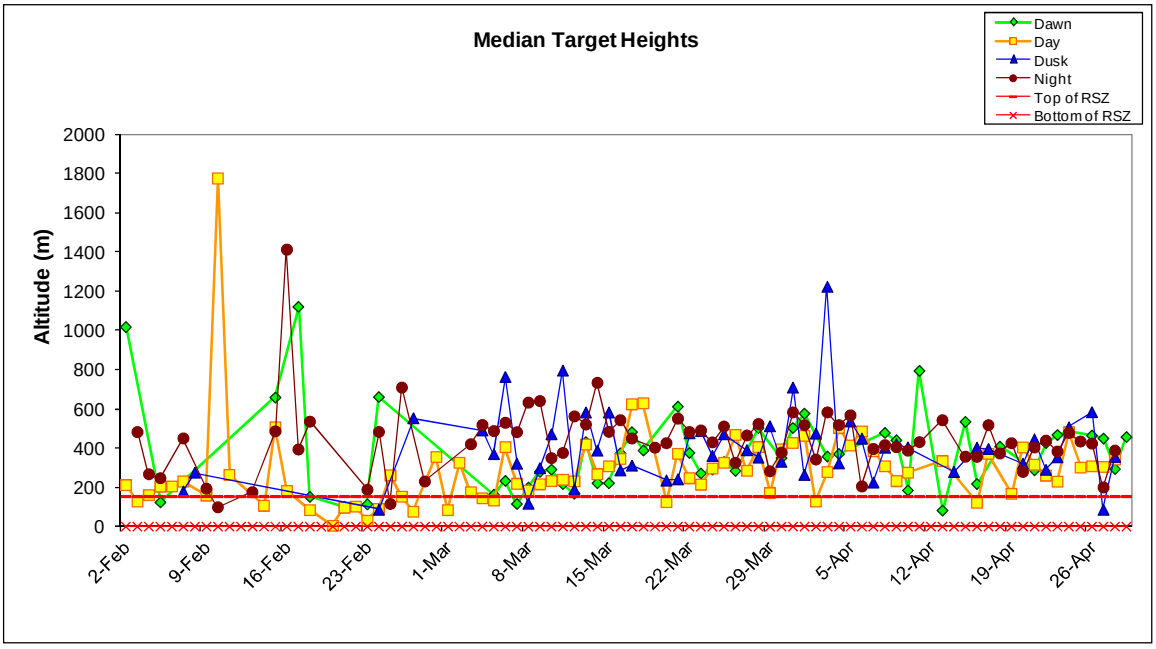

Figure 9-5. Median target heights at Site 6 (February 2 - April 29, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

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The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 9-3 (top) and illustrated in Figure 9-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 9-3 (bottom) and illustrated in Figure 9-6 (green bars).

Table 9-3. Summary of mean and median target heights during biological periods at Site 6 (February 2 - April 29, 2012). Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	408.7	363.0	437.5	483.0
Average median target height	379.9	288.9	406.7	439.7
All targets for season combined				
Comprehensive mean target height	380.0	373.1	462.1	489.8
Comprehensive median target height	300.2	295.4	414.2	427.0

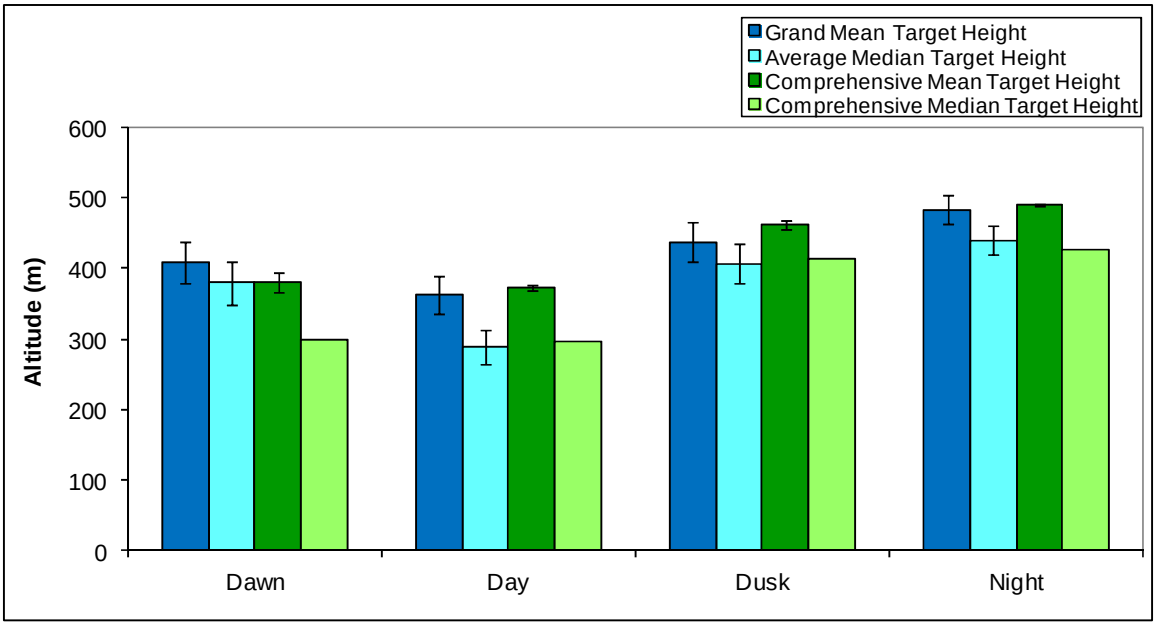

Figure 9-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), at Site 6 (February 2 - April 29, 2012). Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 9-7).

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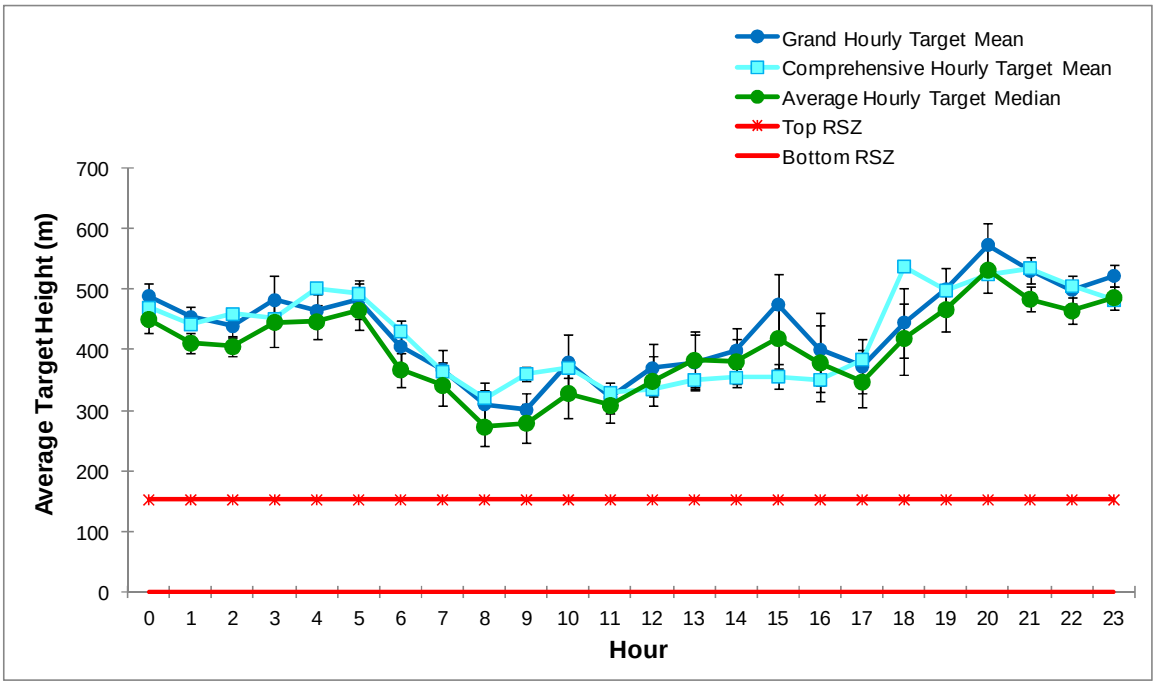

Figure 9-7. Hourly target heights at Site 6 (February 2 - April 29, 2012). Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights at Site 6 (February 2 - April 29, 2012) are shown using 50-meter increments (Fig. 9-8).

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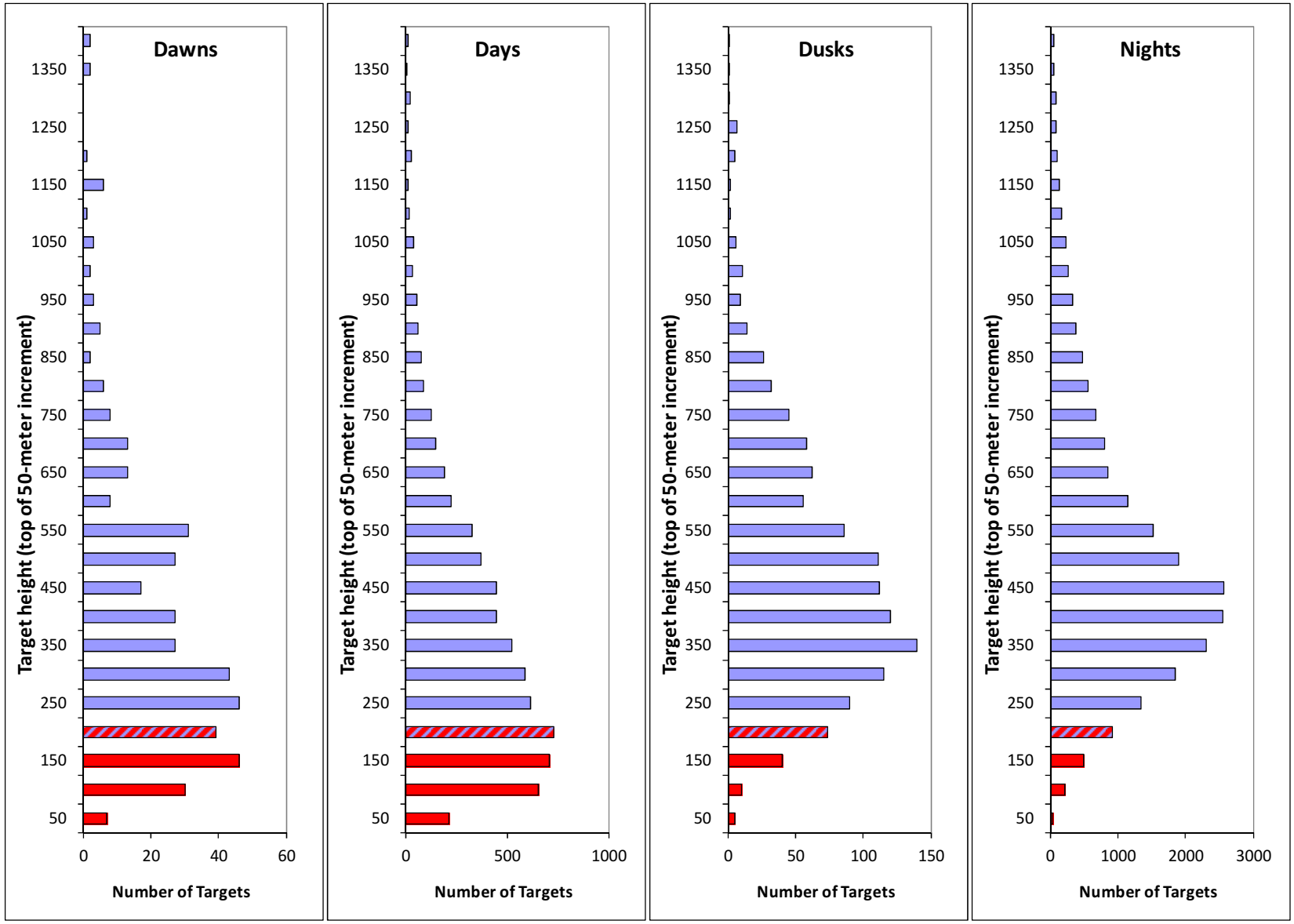

Figure 9-8. Number of targets occurring in each 50-meter increment during biological periods at Site 6 (February 2 - April 29, 2012). Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

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Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 9-10) days (Fig. 9-11), dusks (Fig 9-12), and nights (Fig. 9-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period at Site 6 (February 2 - April 29, 2012) combined together (Table 9-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 9-9).

Table 9-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods at Site 6 (February 2 - April 29, 2012). Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	4.1	7.2	17.1	30.5
Average target passage rate within RSZ	1.0	2.1	0.8	1.1
Average target passage rate below RSZ	0.0	0.1	0.1	0.0
Average % of targets in RSZ	23.1%	30.3%	9.0%	7.5%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.0%
Max target percentage within RSZ	100.0%	100.0%	100.0%	100.0%
All targets for season combined				
% targets above RSZ	79.7%	76.8%	95.4%	96.6%
% targets within RSZ	20.3%	22.6%	4.3%	3.4%
% targets below RSZ	0.0%	0.7%	0.3%	0.0%
% targets below turbine height	20.3%	23.2%	4.6%	3.4%

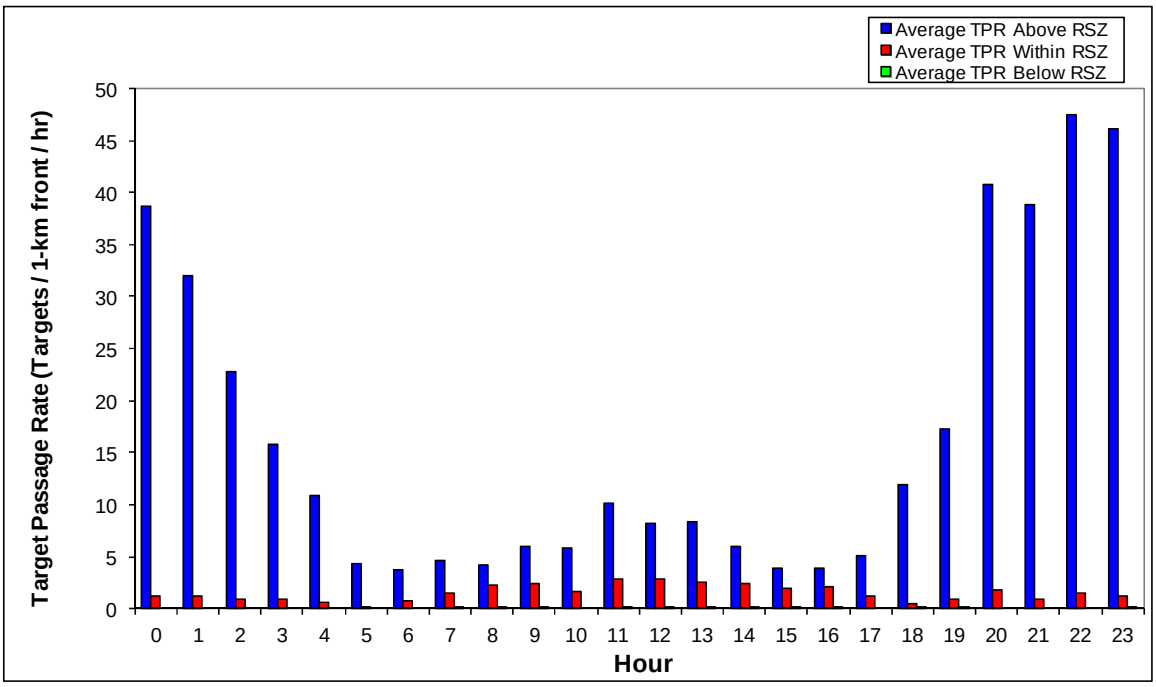

Figure 9-9. Average hourly target passage rates at Site 6 (February 2 - April 29, 2012).

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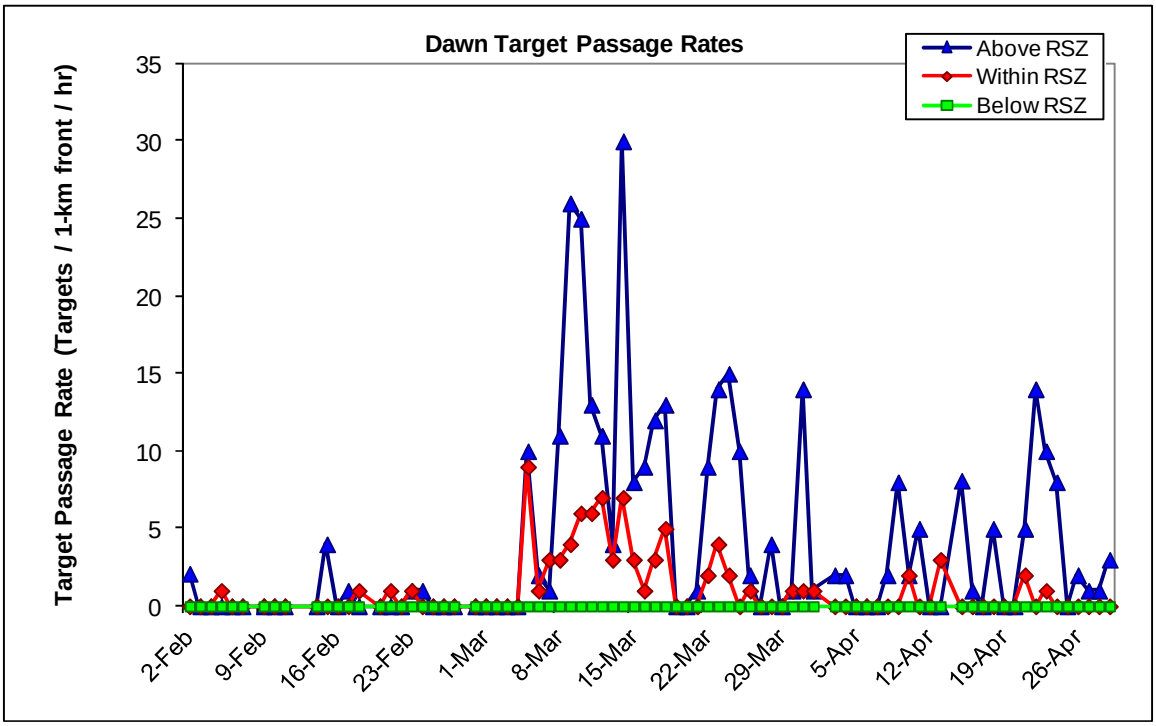

Figure 9-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns at Site 6 (February 2 - April 29, 2012).

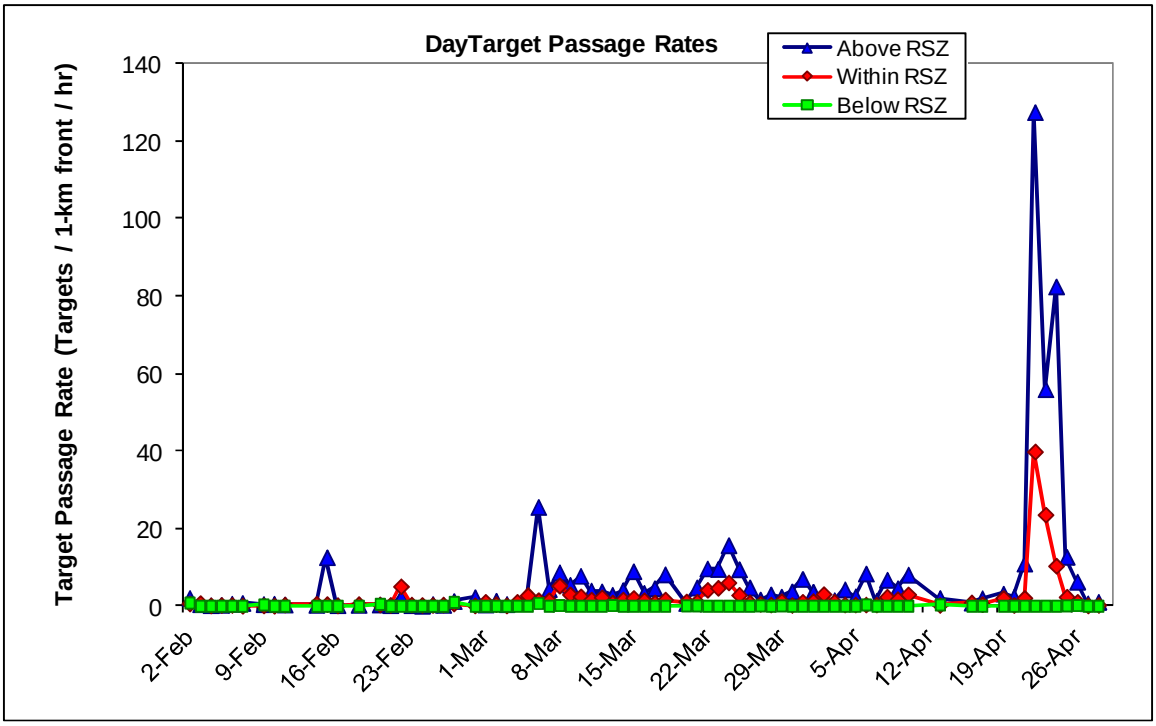

Figure 9-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days at Site 6 (February 2 - April 29, 2012).

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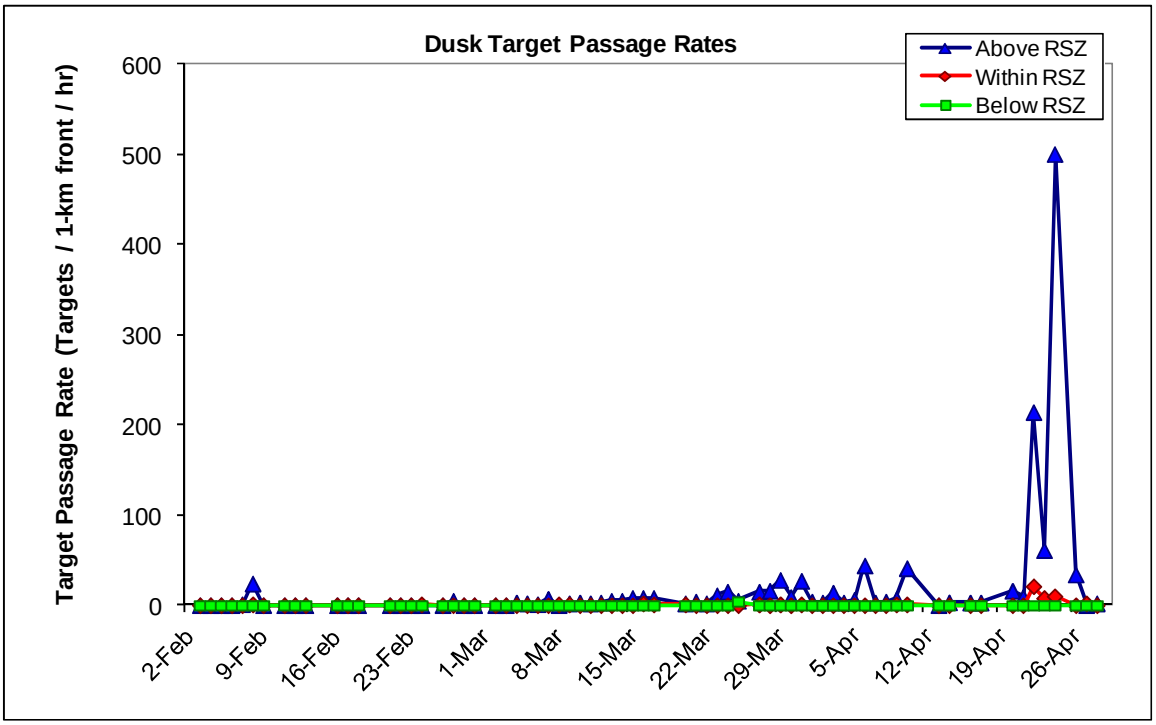

Figure 9-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks at Site 6 (February 2 - April 29, 2012).

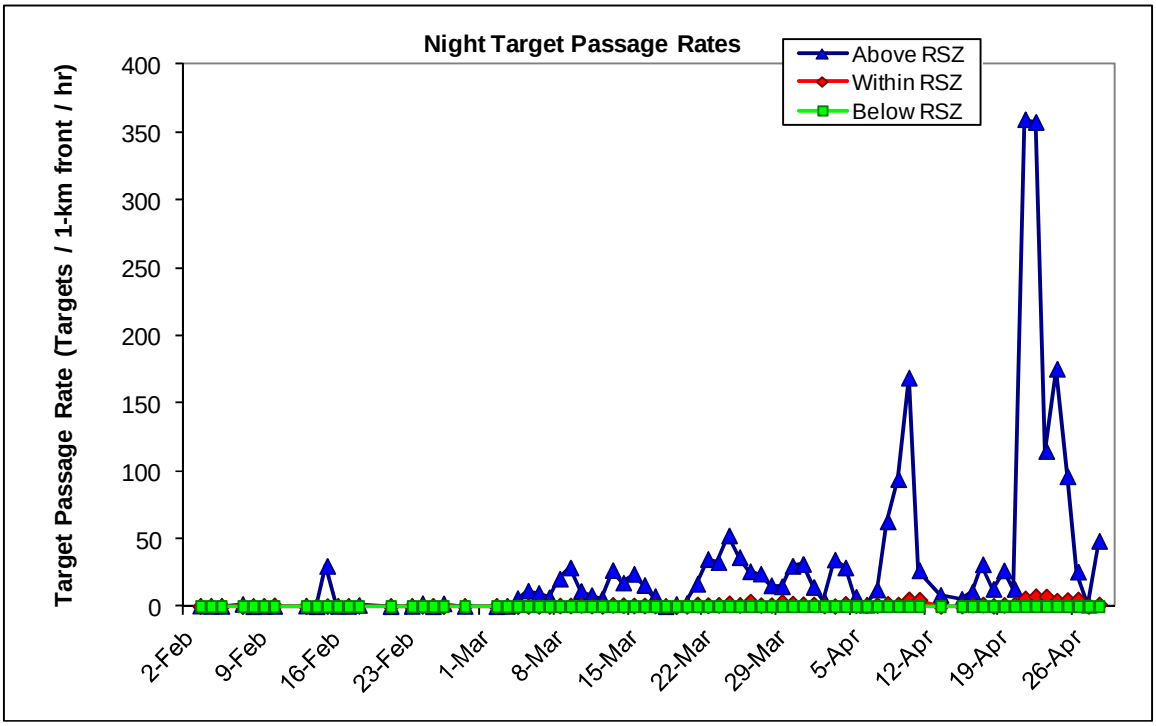

Figure 9-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights at Site 6 (February 2 - April 29, 2012).

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9.3.1 Target Directions

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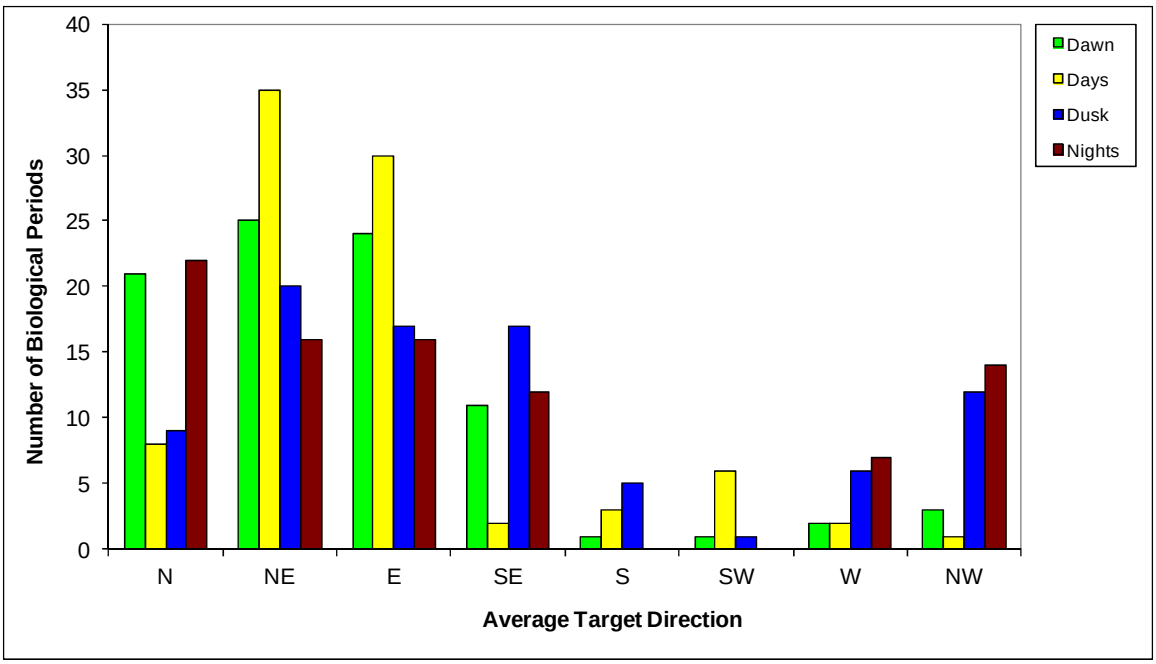

Figure 9-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at Site 6 (February 2 - April 29, 2012).

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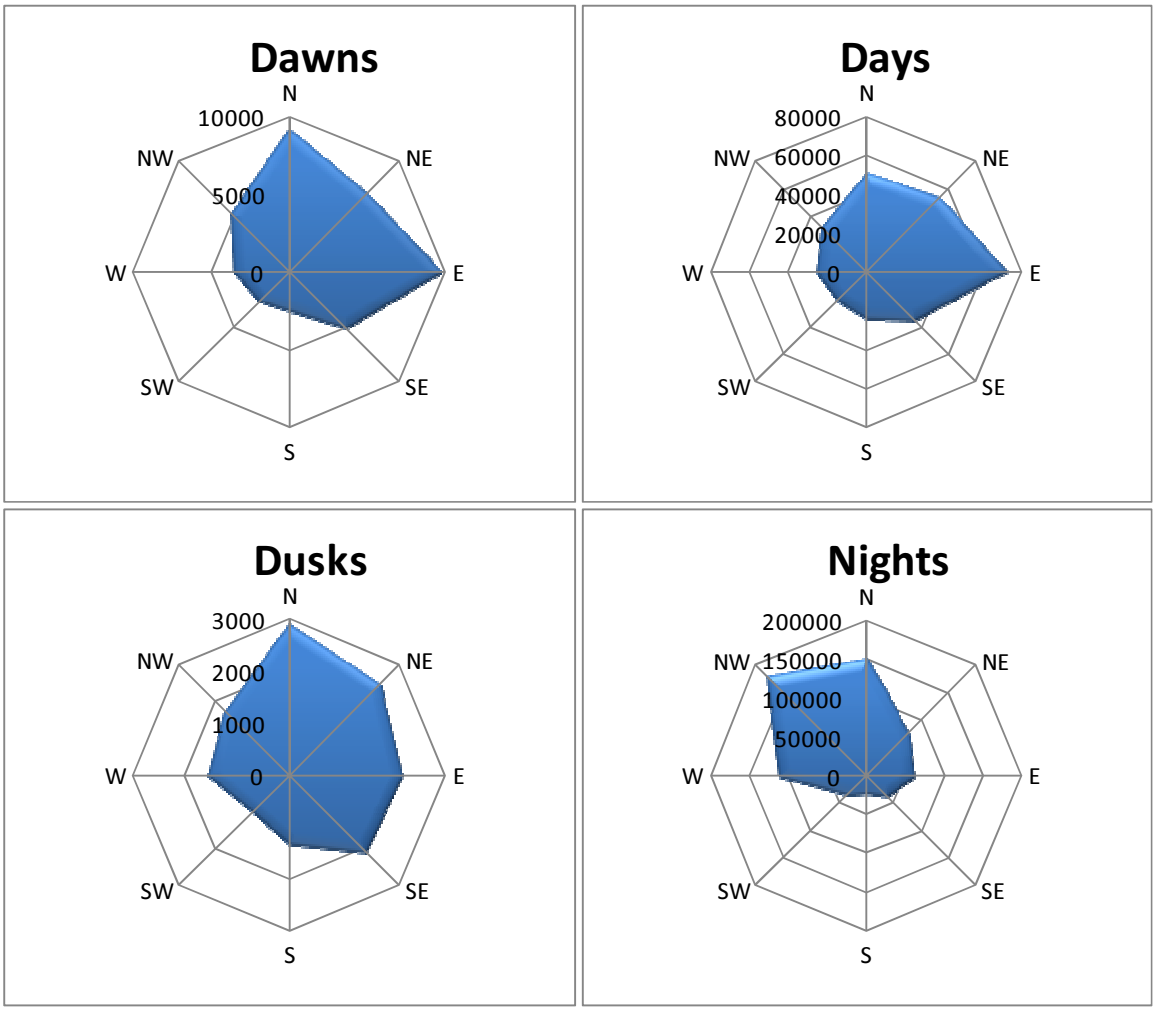

Figure 9-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights at Site 6 (February 2 - April 29, 2012).

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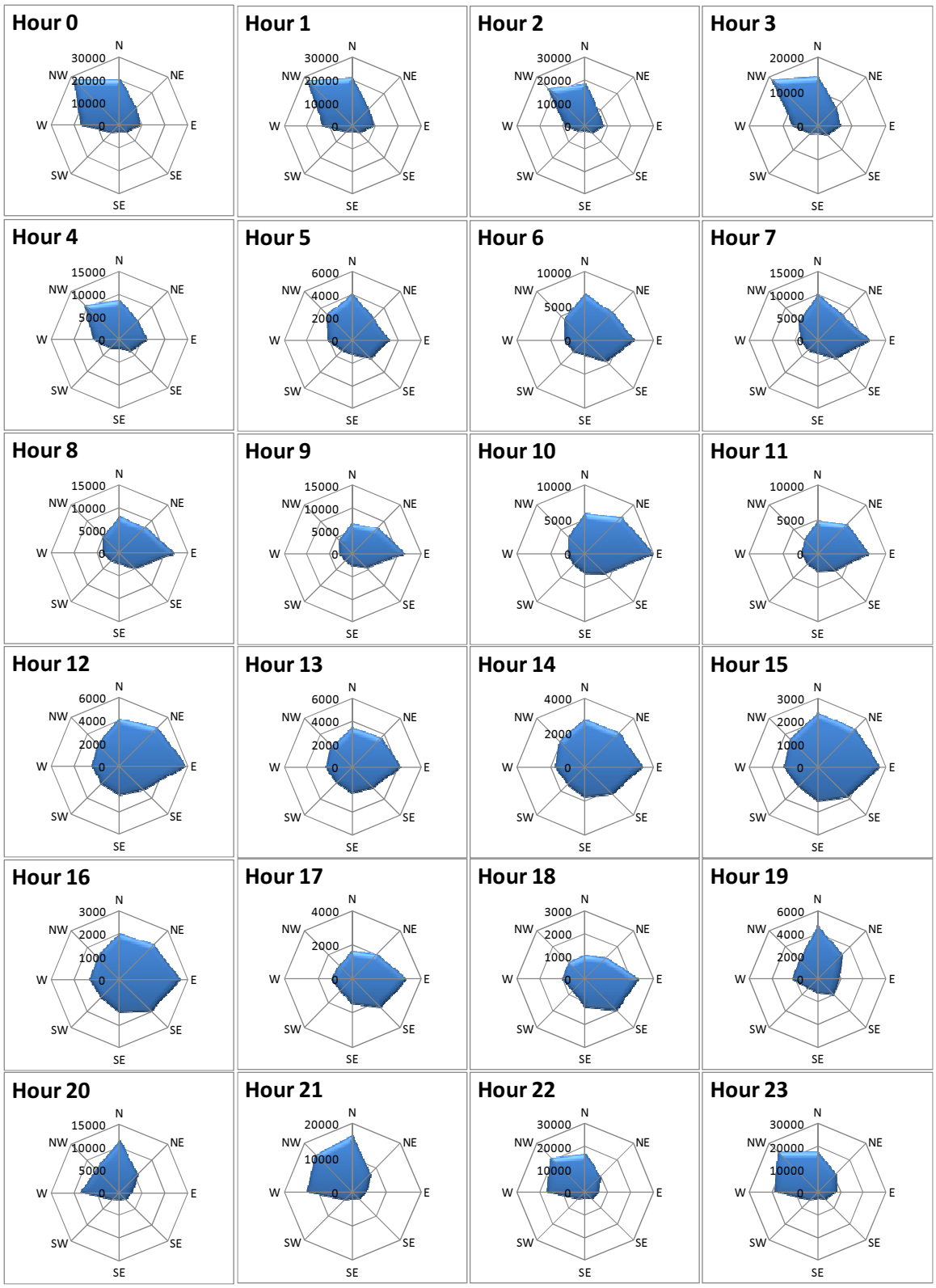

Figure 9-16. Comprehensive distribution of all target's directions by hour at Site 6 (February 2 - April 29, 2012).

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10 RESULTS for Site 8 (May 19 – July 17, 2012)

10.1 Level of Effort

Table 10-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, for Site 8 (May 19 - July 17, 2012).

Table 10-1. Radar monitoring effort at Site 8 (May 19 - July 17, 2012).

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	1440.1		1440.1	
Time radar down	16.3	1.1%	16.2	1.1%
Time radar collected data	1423.8	98.9%	1423.9	98.9%
Unuseable radar data[1] due to rain or other contamination	215.8	15.2%	9.0	0.6%
Unuseable radar data[2] due to insects	294.3	20.7%	-	-
Useable radar data[3]	913.8	63.5%	1414.9	98.3%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

10.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

10.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 10-1) and as an average by biological period (Fig. 10-2) and hour (Fig. 10-3). Summary statistics are presented in table 10-2.

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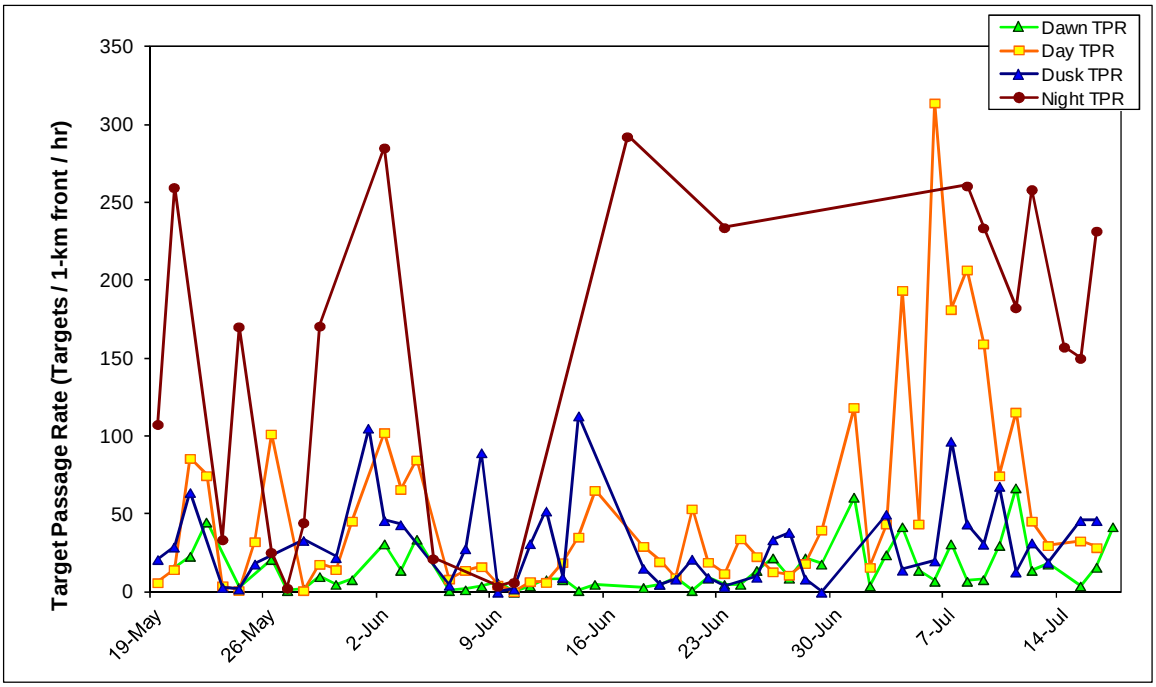

Figure 10-1. Target passage rates (TPR) during biological periods at Site 8 (May 19 - July 17, 2012).

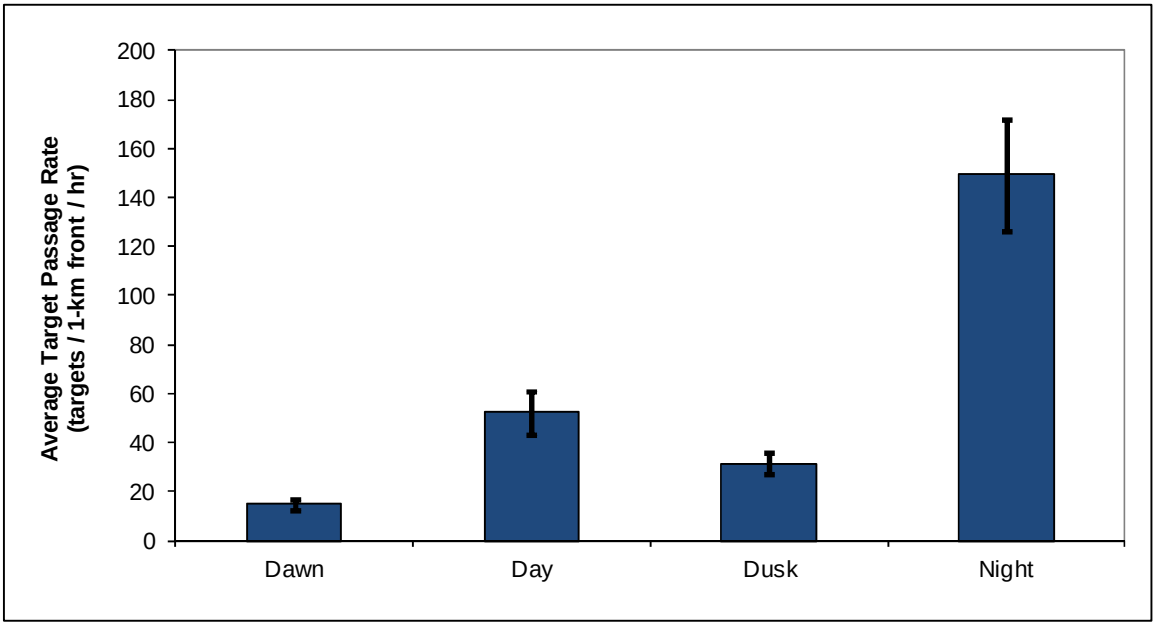

Figure 10-2. Average target passage rates (TPR) by biological period at Site 8 (May 19 - July 17, 2012). Error bars represent one standard error.

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Table 10-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods at Site 8 (May 19 - July 17, 2012).

	Dawn	Day	Dusk	Night
Average	14.9	52.3	31.4	149.2
Standard Deviation	15.3	62.9	28.8	104.8
Standard Error	2.1	8.7	4.4	22.9
Median	9.0	29.7	22.2	170.4
Minimum	0.0	0.3	0.0	2.5
Maximum	67.0	314.2	113.2	292.5

Both average and comprehensive hourly target passage rates are presented in Fig 10-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

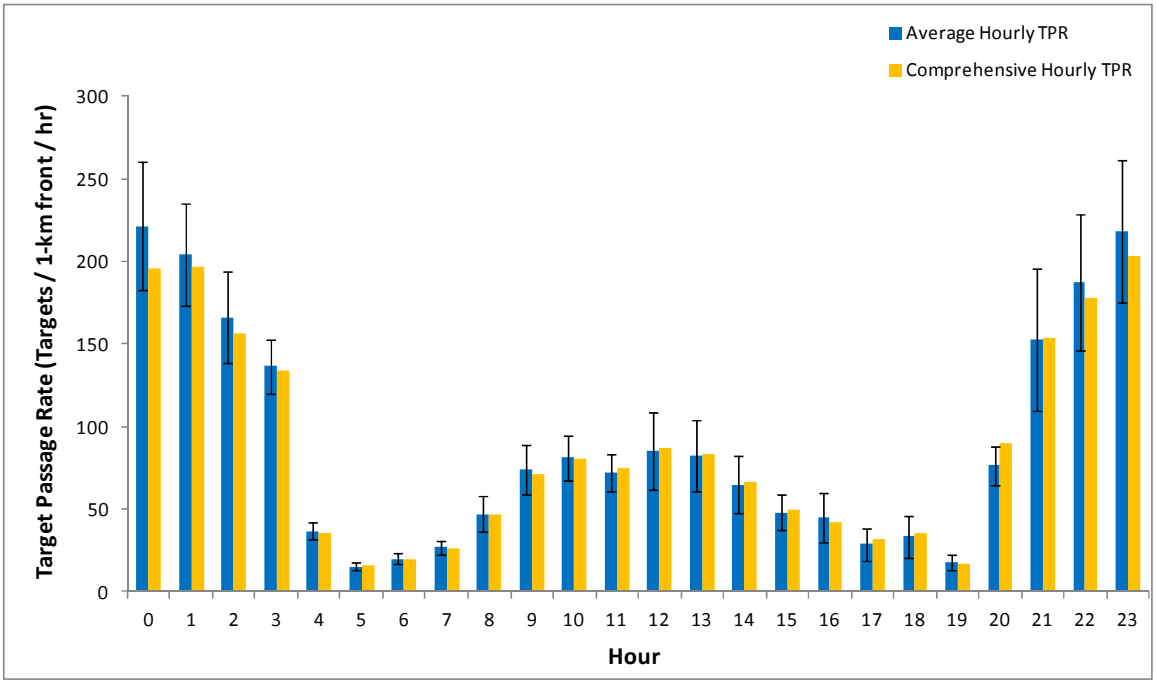

Figure 10-3. Average and comprehensive hourly target passage rates at Site 8 (May 19 - July 17, 2012). Error bars represent one standard error.

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10.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 10-4 and Fig. 10-5, respectively) at Site 8 (May 19 - July 17, 2012).

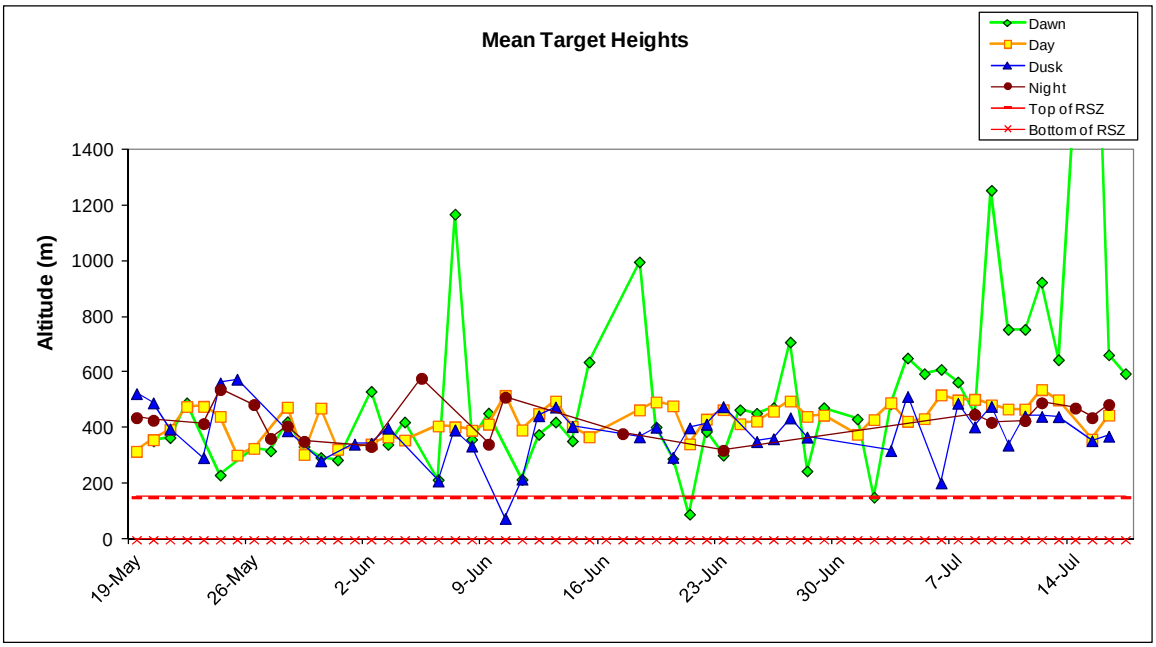

Figure 10-4. Mean target heights at Site 8 (May 19 - July 17, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL). July 15th dawn value is 2,610 m.

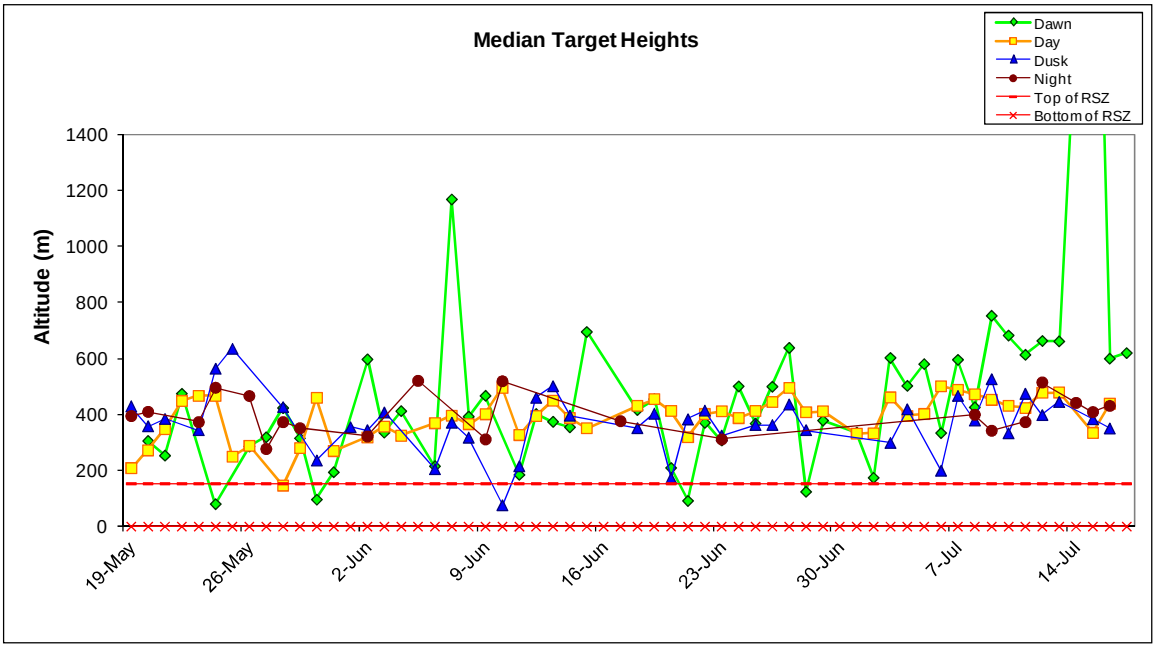

Figure 10-5. Median target heights at Site 8 (May 19 - July 17, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL). July 15th dawn value is 3,018 m.

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The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 10-3 (top) and illustrated in Figure 10-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 10-3 (bottom) and illustrated in Figure 10-6 (green bars).

Table 10-3. Summary of mean and median target heights during biological periods at Site 8 (May 19 - July 17, 2012). Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	527.7	429.4	386.6	432.5
Average median target height	477.0	389.3	371.7	400.4
All targets for season combined				
Comprehensive mean target height	538.2	445.9	388.3	425.5
Comprehensive median target height	470.9	416.1	369.6	398.1

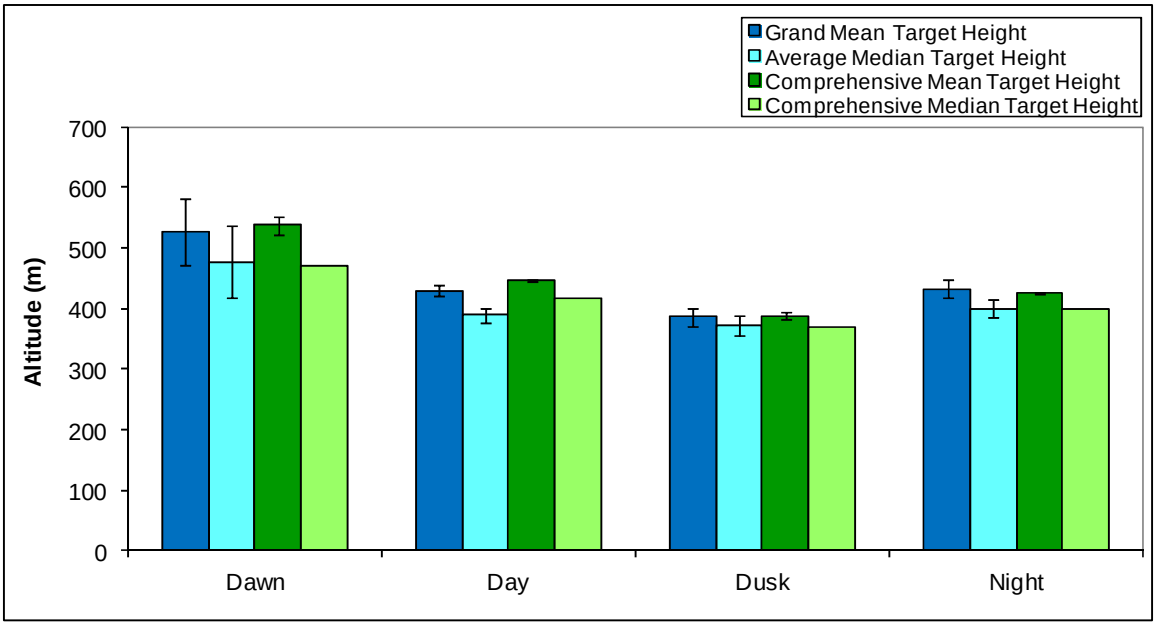

Figure 10-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), at Site 8 (May 19 - July 17, 2012). Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 10-7).

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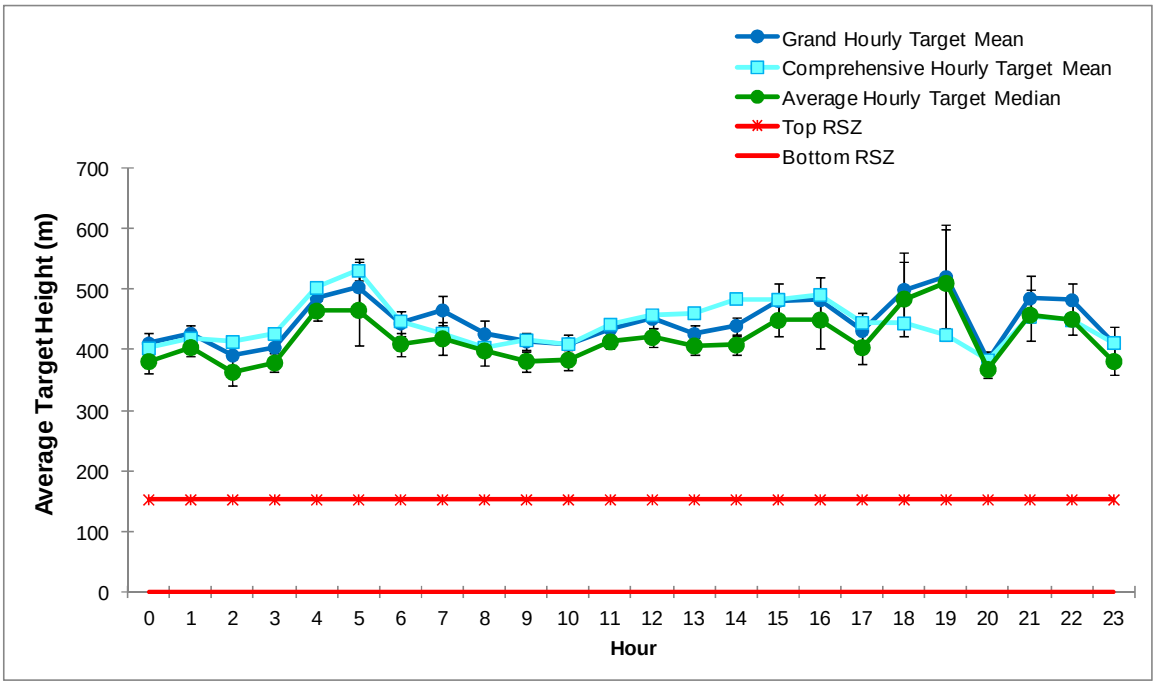

Figure 10-7. Hourly target heights at Site 8 (May 19 - July 17, 2012). Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights at Site 8 (May 19 - July 17, 2012) are shown using 50-meter increments (Fig. 10-8).

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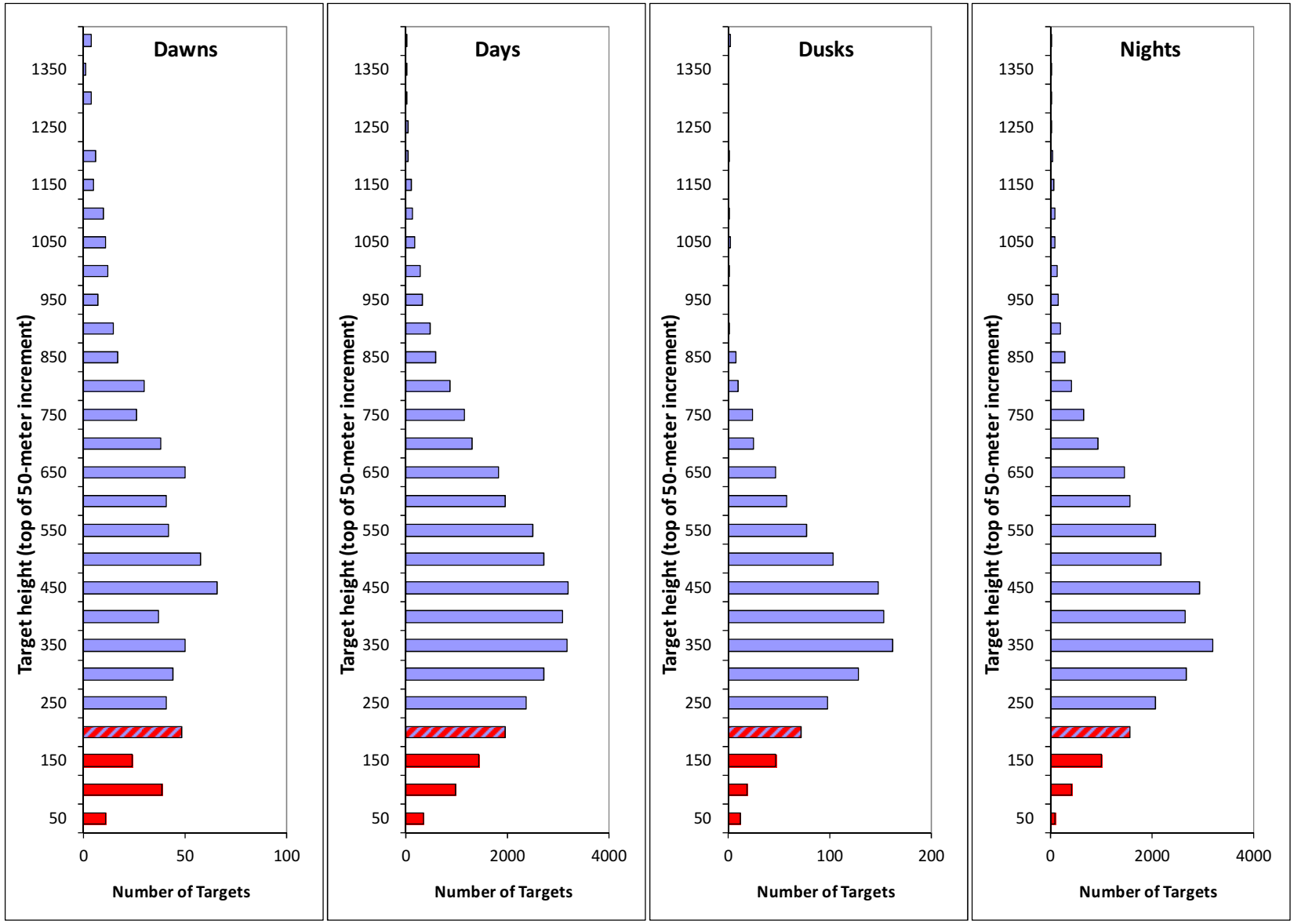

Figure 10-8. Number of targets occurring in each 50-meter increment during biological periods at Site 8 (May 19 - July 17, 2012). Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

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Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 10-10) days (Fig. 10-11), dusks (Fig 10-12), and nights (Fig. 10-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period at Site 8 (May 19 - July 17, 2012) combined together (Table 10-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 10-9).

Table 10-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods at Site 8 (May 19 - July 17, 2012). Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	13.5	47.6	29.4	140.1
Average target passage rate within RSZ	1.5	4.7	2.0	9.1
Average target passage rate below RSZ	0.0	0.0	0.0	0.0
Average % of targets in RSZ	15.5%	12.2%	9.7%	6.7%
Min target percentage within RSZ	0.0%	1.8%	0.0%	1.1%
Max target percentage within RSZ	100.0%	53.8%	100.0%	23.8%
All targets for season combined				
% targets above RSZ	90.1%	91.5%	93.5%	93.9%
% targets within RSZ	9.9%	8.5%	6.5%	6.1%
% targets below RSZ	0.0%	0.0%	0.0%	0.0%
% targets below turbine height	9.9%	8.5%	6.5%	6.1%

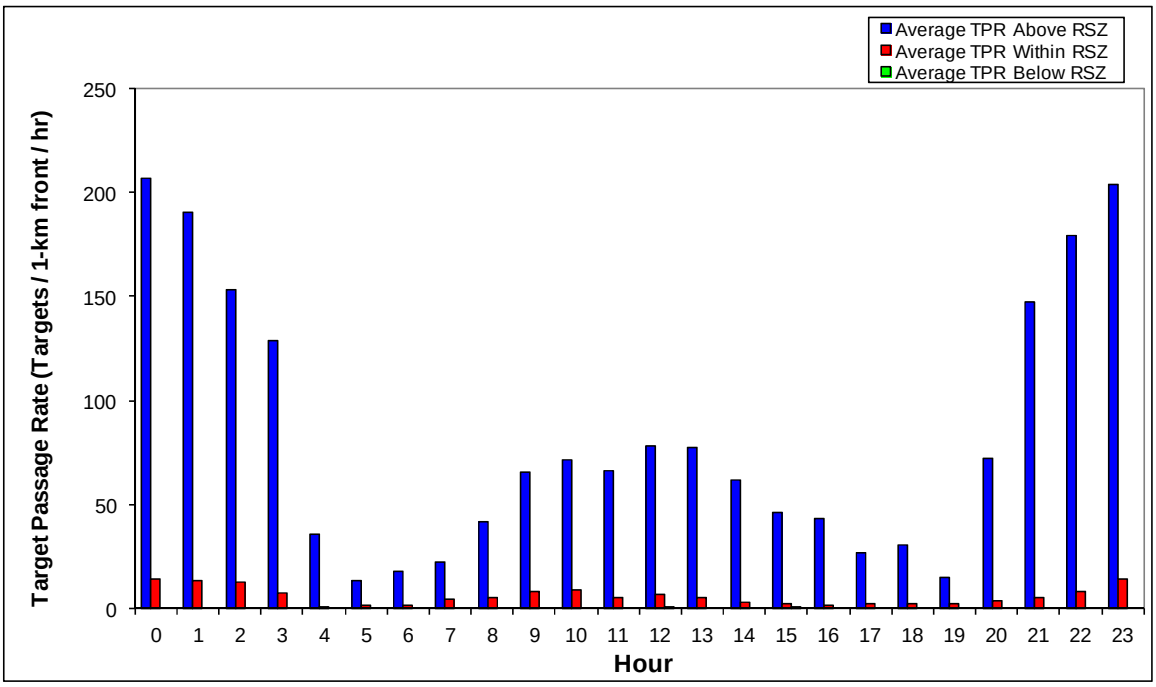

Figure 10-9. Average hourly target passage rates at Site 8 (May 19 - July 17, 2012).

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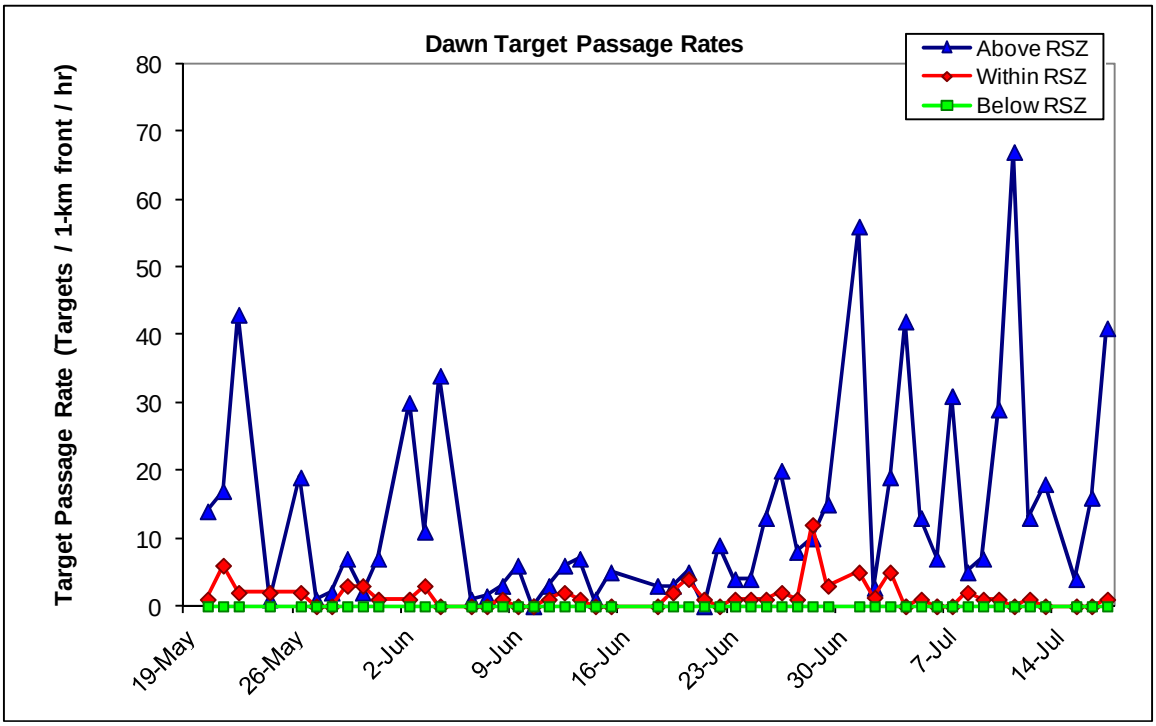

Figure 10-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns at Site 8 (May 19 - July 17, 2012).

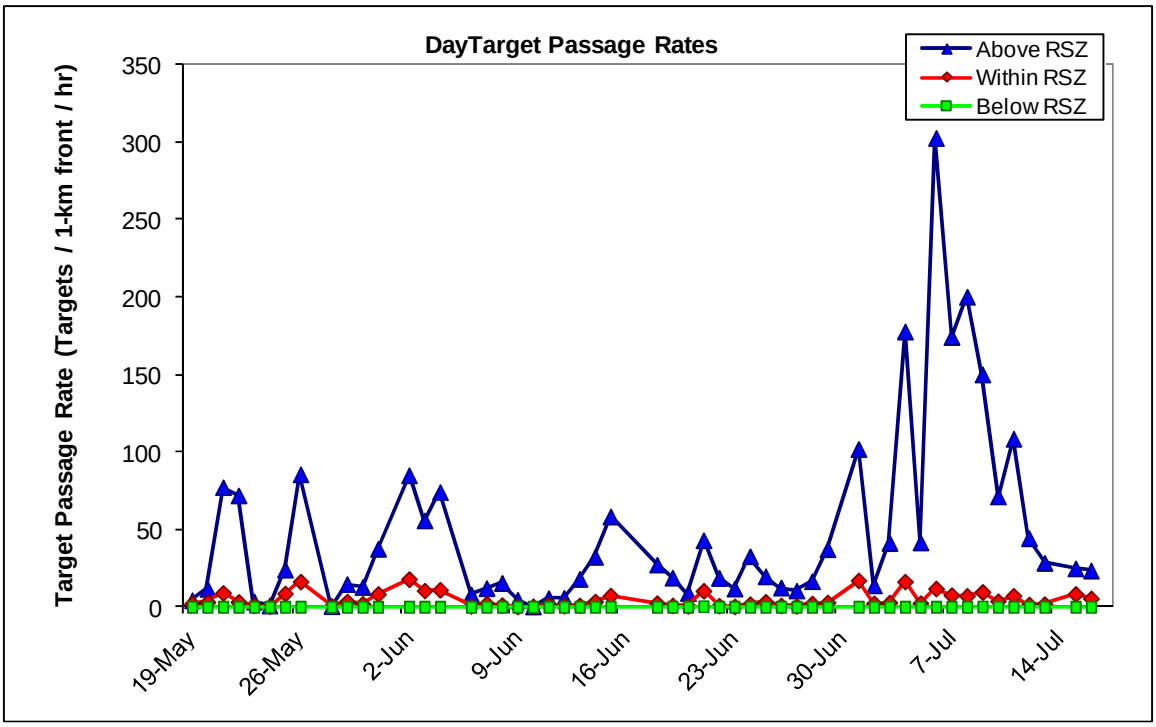

Figure 10-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days at Site 8 (May 19 - July 17, 2012).

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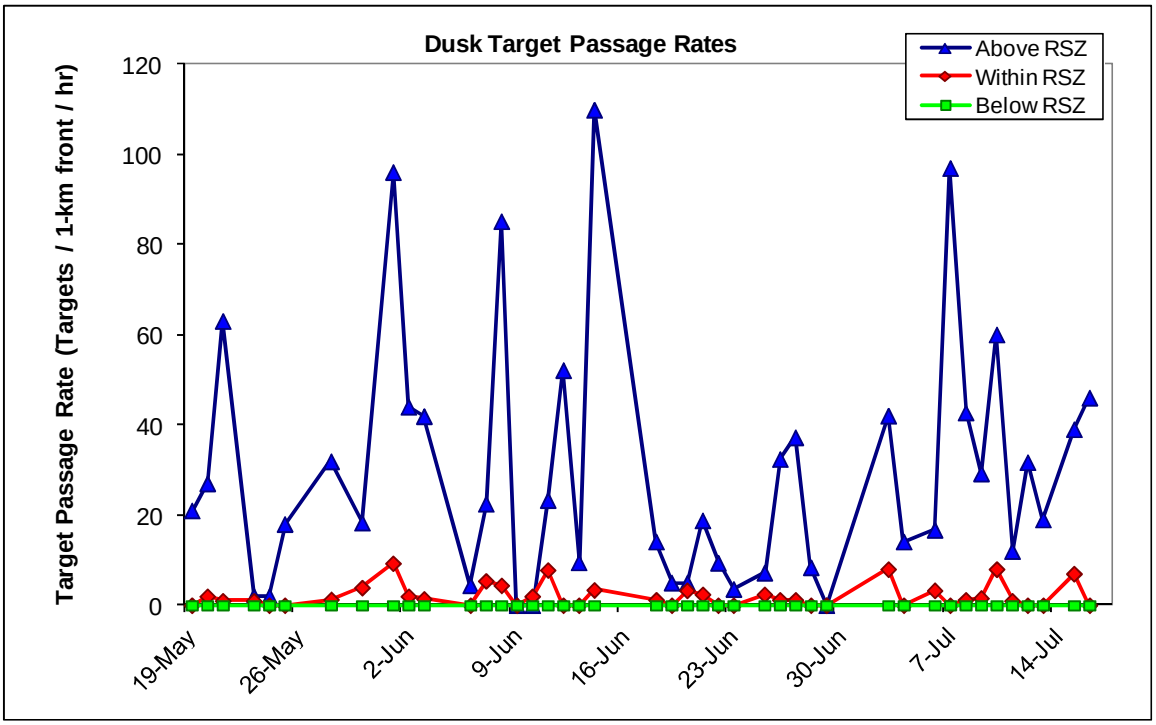

Figure 10-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks at Site 8 (May 19 - July 17, 2012).

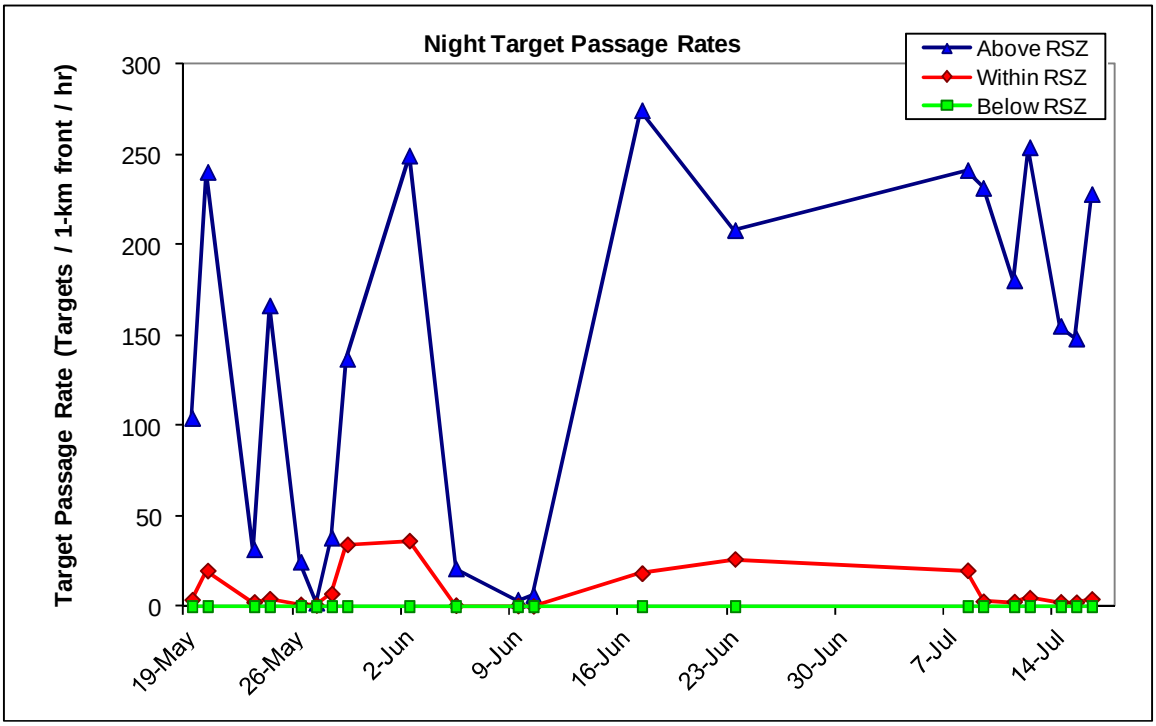

Figure 10-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights at Site 8 (May 19 - July 17, 2012).

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10.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods at Site 8 (May 19 - July 17, 2012).

10.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 10-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected at Site 8 (May 19 - July 17, 2012) combined together by biological period (Fig. 10-15) and hour (Fig. 10-16).

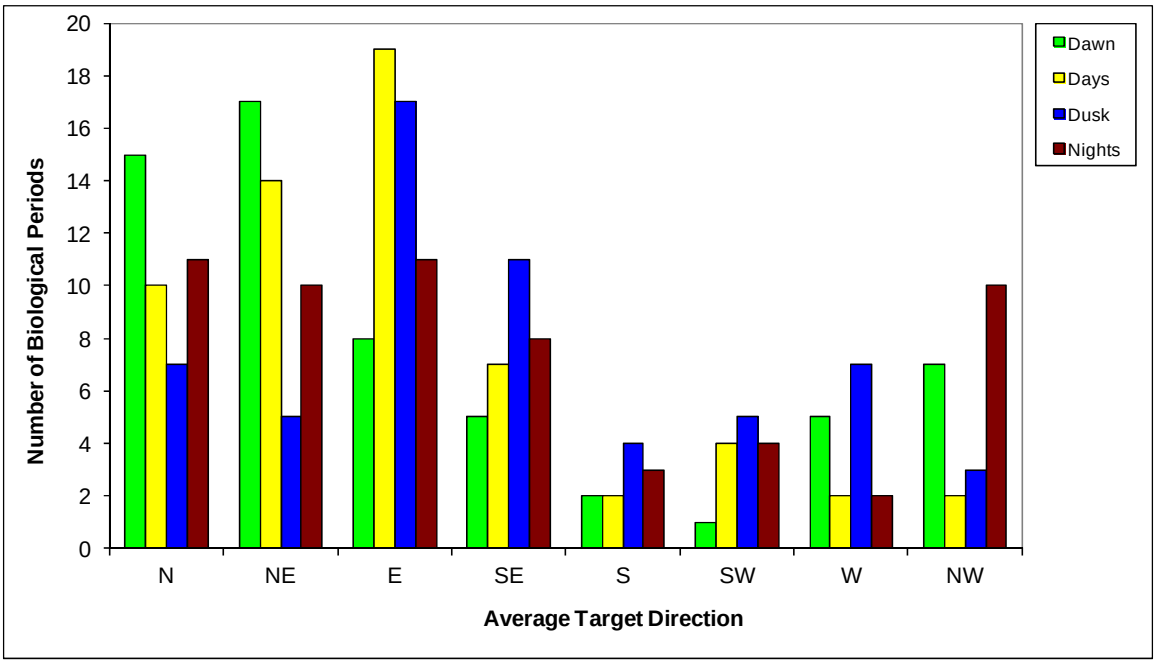

Figure 10-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at Site 8 (May 19 - July 17, 2012).

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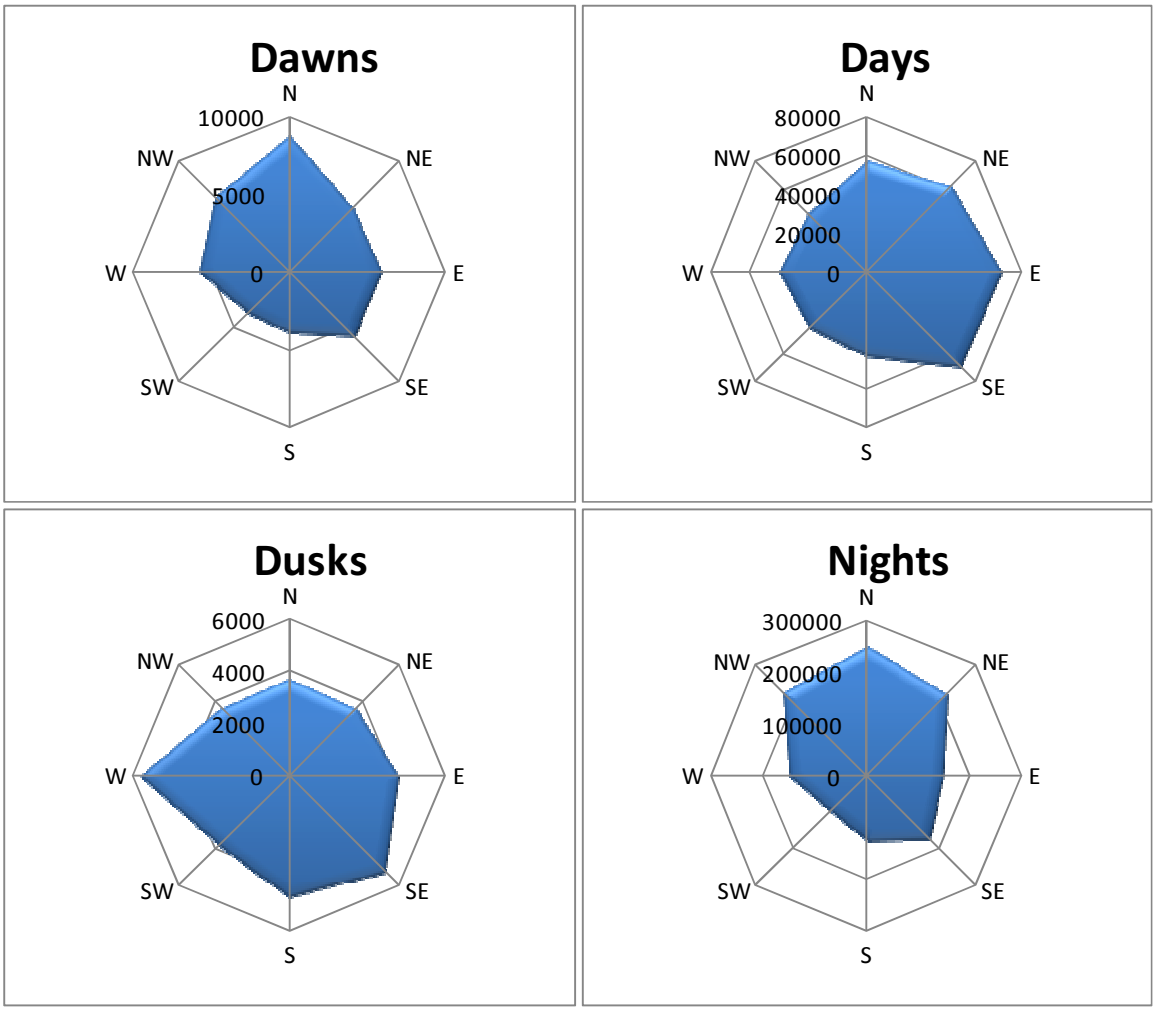

Figure 10-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights at Site 8 (May 19 - July 17, 2012).

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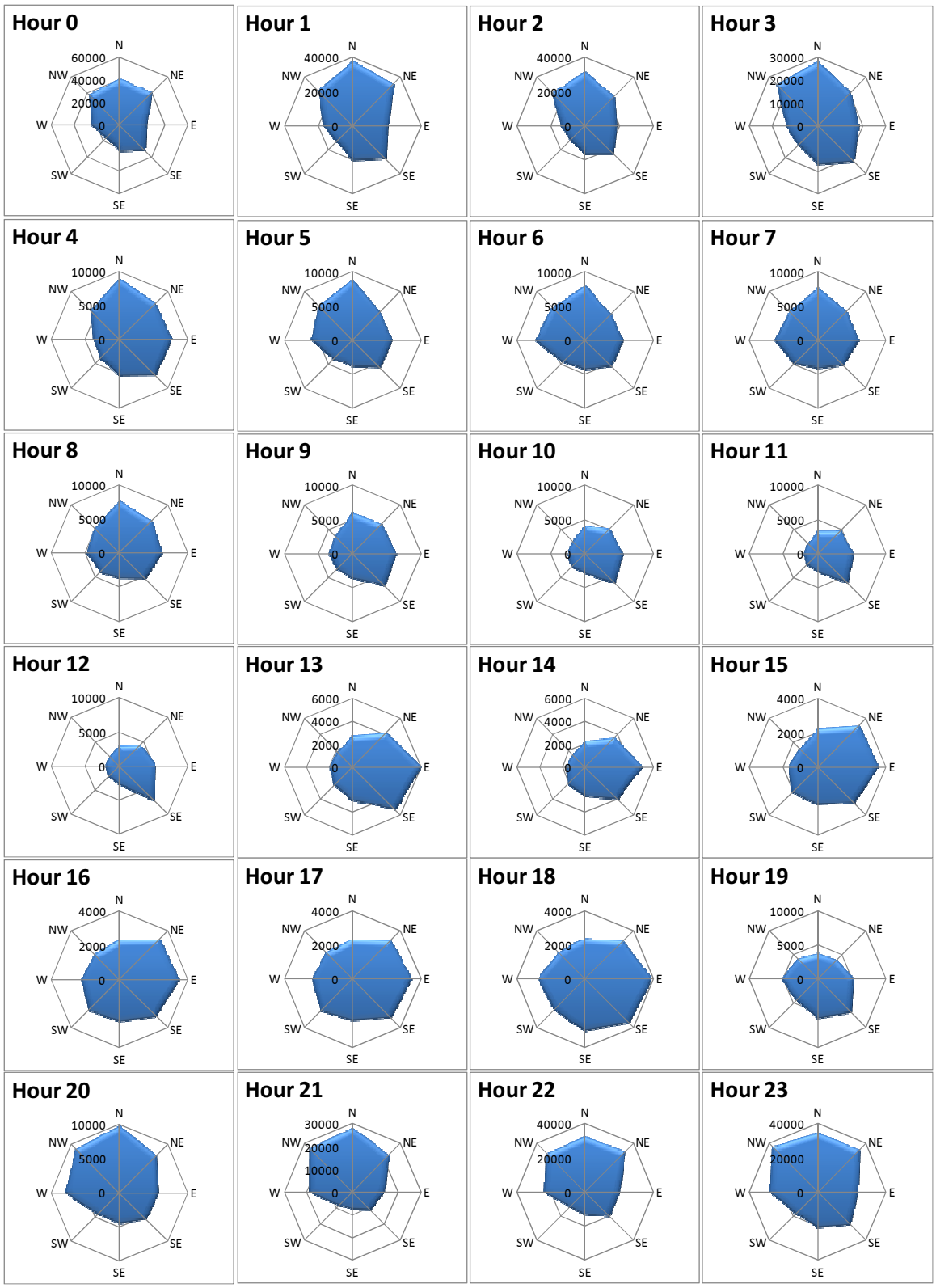

Figure 10-16. Comprehensive distribution of all target's directions by hour at Site 8 (May 19 - July 17, 2012).

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11 RESULTS for Site 9 (July 21 – September 29, 2012)

11.1 Level of Effort

Table 11-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, for Site 9 (July 21 - September 29, 2012).

Table 11-1. Radar monitoring effort at Site 9 (July 21 - September 29, 2012).

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	1705.0		1705.0	
Time radar down	20.0	1.2%	19.9	1.2%
Time radar collected data	1685.0	98.8%	1685.1	98.8%
Unuseable radar data[1] due to rain or other contamination	141.8	8.4%	20.0	1.2%
Unuseable radar data[2] due to insects	33.0	2.0%	-	-
Useable radar data[3]	1510.3	88.6%	1665.1	97.7%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

11.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

11.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 11-1) and as an average by biological period (Fig. 11-2) and hour (Fig. 11-3). Summary statistics are presented in table 11-2.

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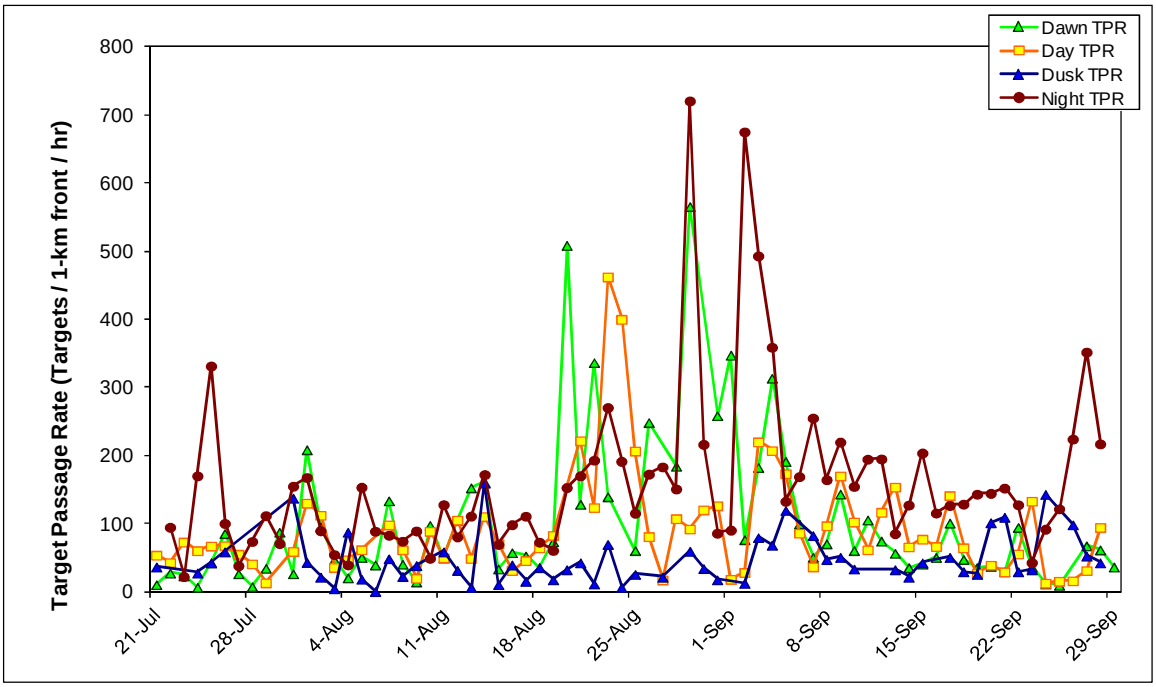

Figure 11-1. Target passage rates (TPR) during biological periods at Site 9 (July 21 - September 29, 2012).

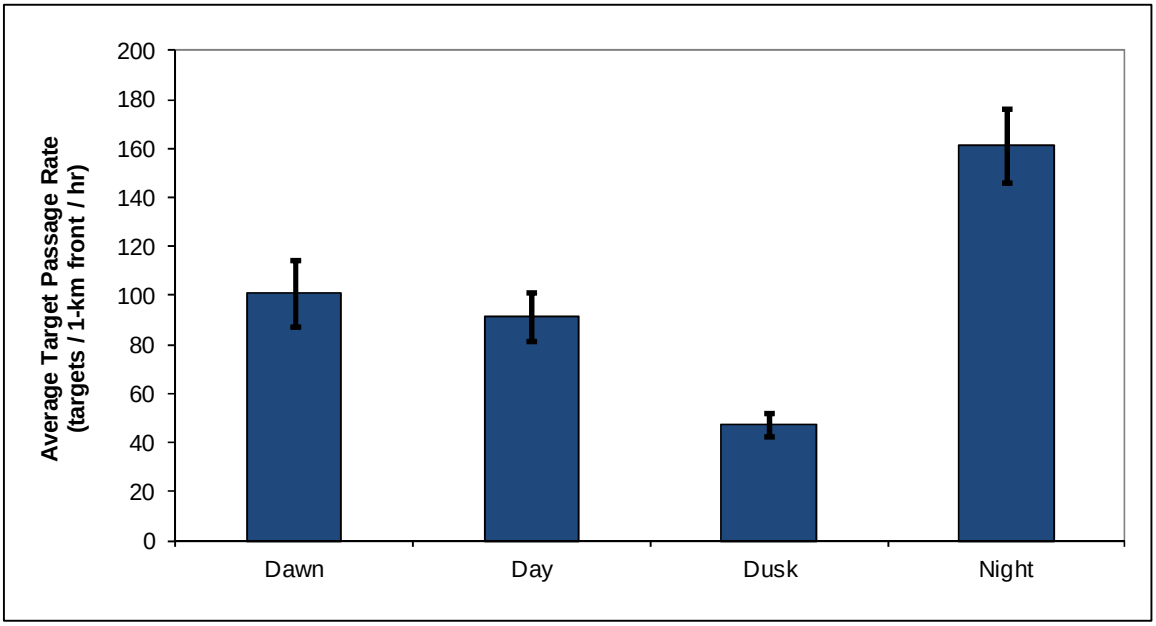

Figure 11-2. Average target passage rates (TPR) by biological period at Site 9 (July 21 - September 29, 2012). Error bars represent one standard error.

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Table 11-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods at Site 9 (July 21 - September 29, 2012).

	Dawn	Day	Dusk	Night
Average	101.1	91.5	47.6	161.4
Standard Deviation	110.0	79.3	36.2	124.4
Standard Error	13.4	9.7	4.9	15.0
Median	61.0	67.6	37.0	129.2
Minimum	7.0	13.2	1.0	23.0
Maximum	566.0	462.8	160.0	721.1

Both average and comprehensive hourly target passage rates are presented in Fig 11-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

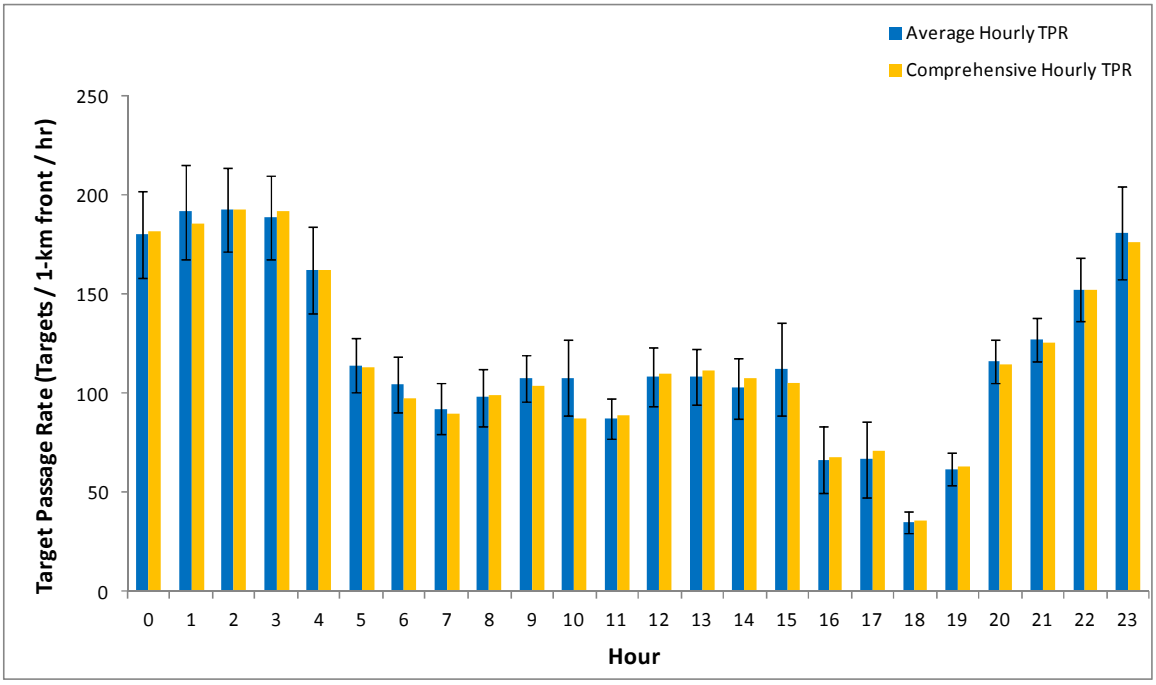

Figure 11-3. Average and comprehensive hourly target passage rates at Site 9 (July 21 - September 29, 2012). Error bars represent one standard error.

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11.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 11-4 and Fig. 11-5, respectively) at Site 9 (July 21 - September 29, 2012).

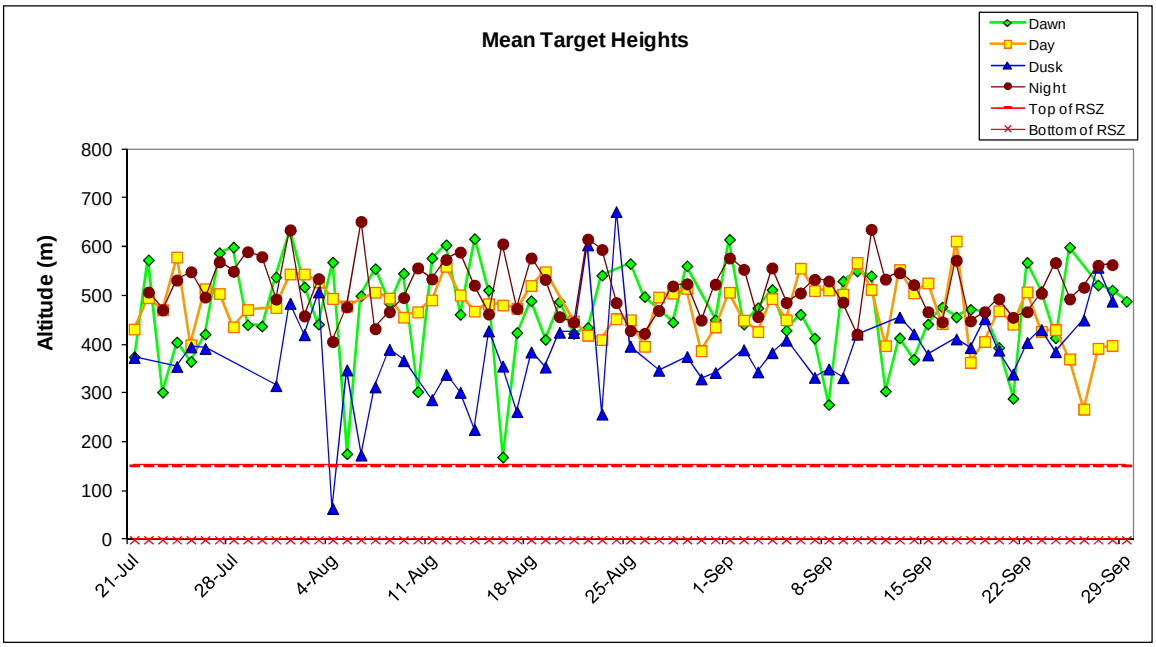

Figure 11-4. Mean target heights at Site 9 (July 21 - September 29, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

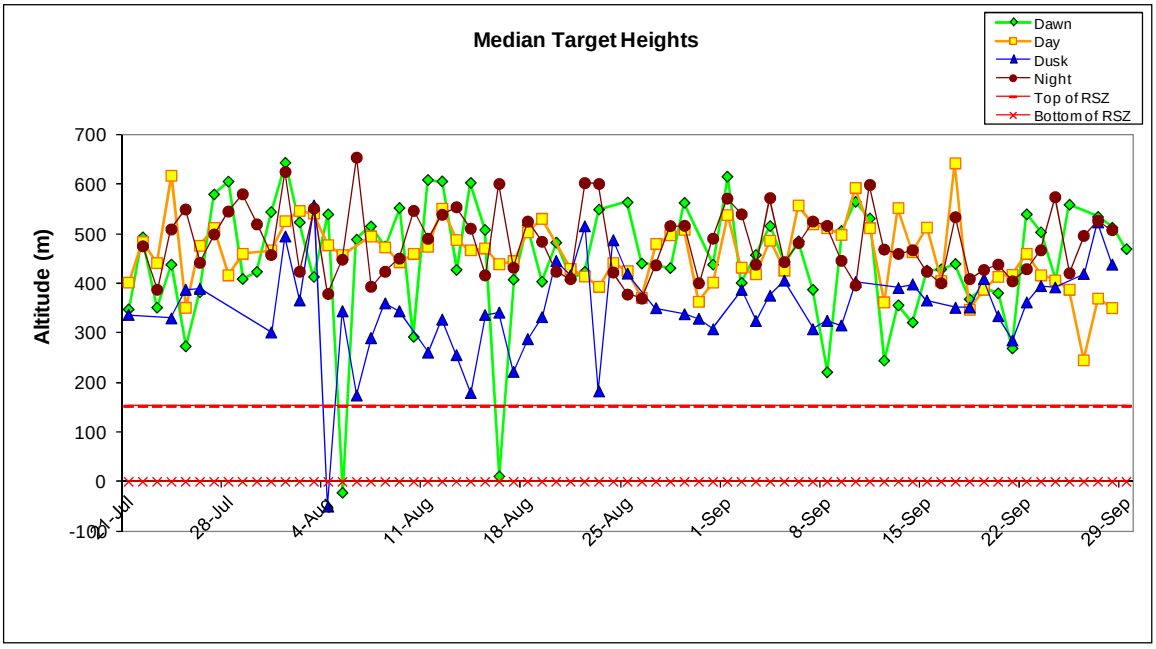

Figure 11-5. Median target heights at Site 9 (July 21 - September 29, 2012). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

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The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 11-3 (top) and illustrated in Figure 11-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 11-3 (bottom) and illustrated in Figure 11-6 (green bars).

Table 11-3. Summary of mean and median target heights during biological periods at Site 9 (July 21 - September 29, 2012). Darker colors in color-coded rows indicate greater values within that row.

Target data calculated for each date				
Grand mean target height	468.9	474.2	380.8	516.9
Average median target height	446.4	458.9	349.1	483.1
All targets for season combined				
Comprehensive mean target height	492.1	474.6	358.8	520.0
Comprehensive median target height	494.1	459.3	338.3	489.8

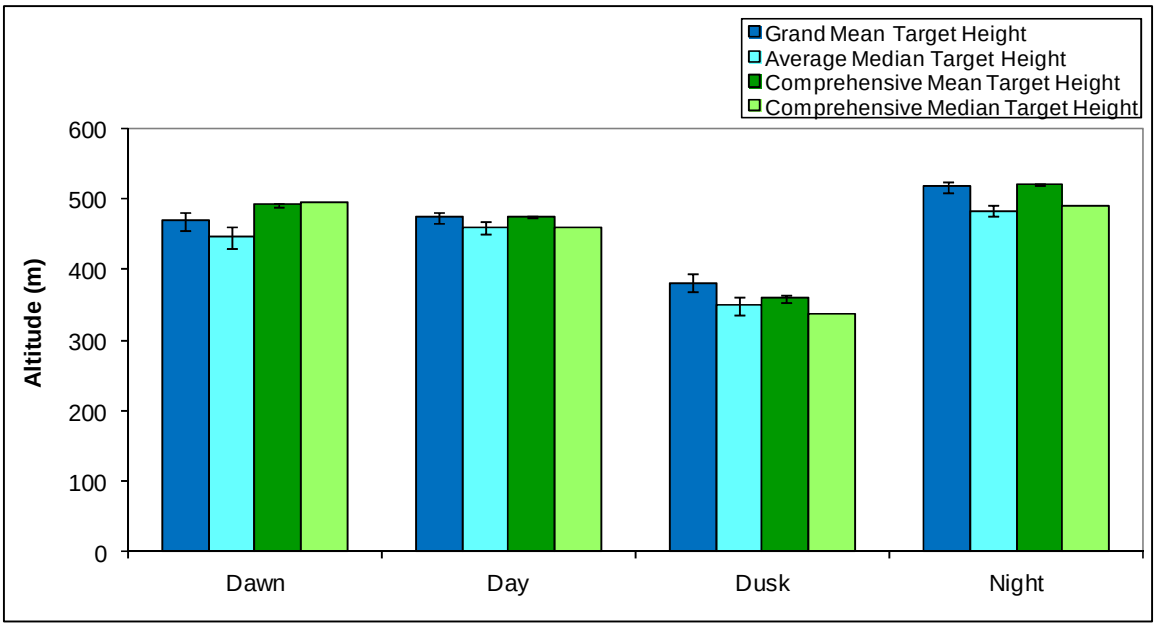

Figure 11-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), at Site 9 (July 21 - September 29, 2012). Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 11-7).

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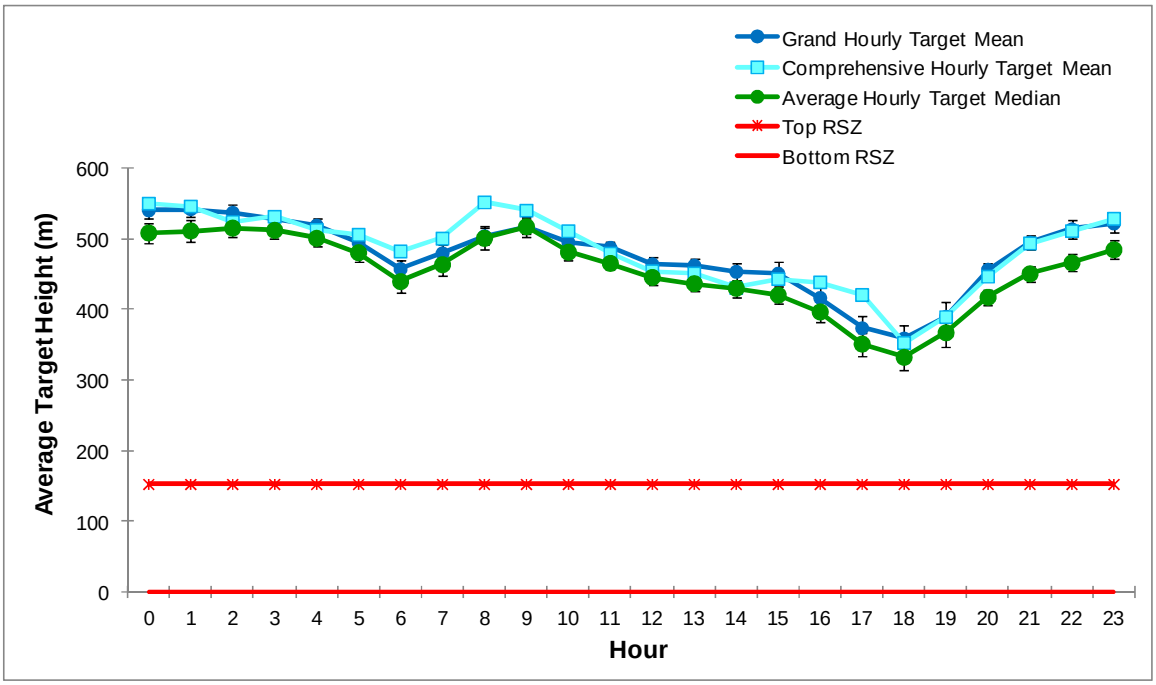

Figure 11-7. Hourly target heights at Site 9 (July 21 - September 29, 2012). Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights at Site 9 (July 21 - September 29, 2012) are shown using 50-meter increments (Fig. 11-8).

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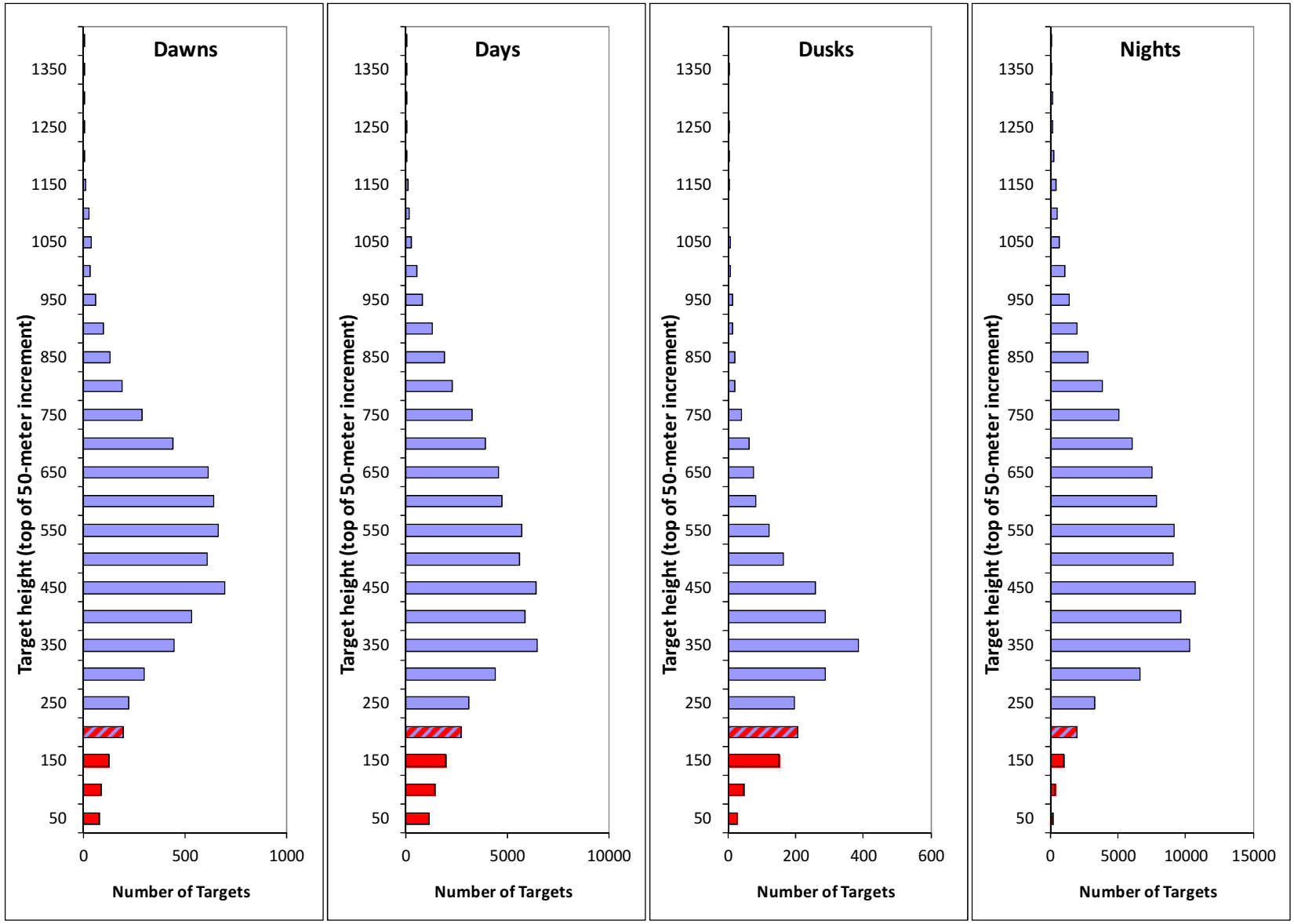

Figure 11-8. Number of targets occurring in each 50-meter increment during biological periods at Site 9 (July 21 - September 29, 2012). Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

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Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 11-10) days (Fig. 11-11), dusks (Fig 11-12), and nights (Fig. 11-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period at Site 9 (July 21 - September 29, 2012) combined together (Table 11-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 11-9).

Table 11-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods at Site 9 (July 21 - September 29, 2012). Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	94.7	84.7	41.9	158.6
Average target passage rate within RSZ	4.6	6.2	4.1	2.5
Average target passage rate below RSZ	1.9	0.7	1.5	0.2
Average % of targets in RSZ	6.6%	7.1%	6.6%	1.9%
Min target percentage within RSZ	0.0%	1.3%	0.0%	0.1%
Max target percentage within RSZ	31.0%	27.7%	37.5%	7.9%
All targets for season combined				
% targets above RSZ	93.5%	92.5%	87.8%	98.3%
% targets within RSZ	4.6%	6.7%	9.0%	1.5%
% targets below RSZ	1.9%	0.8%	3.2%	0.1%
% targets below turbine height	6.5%	7.5%	12.2%	1.7%

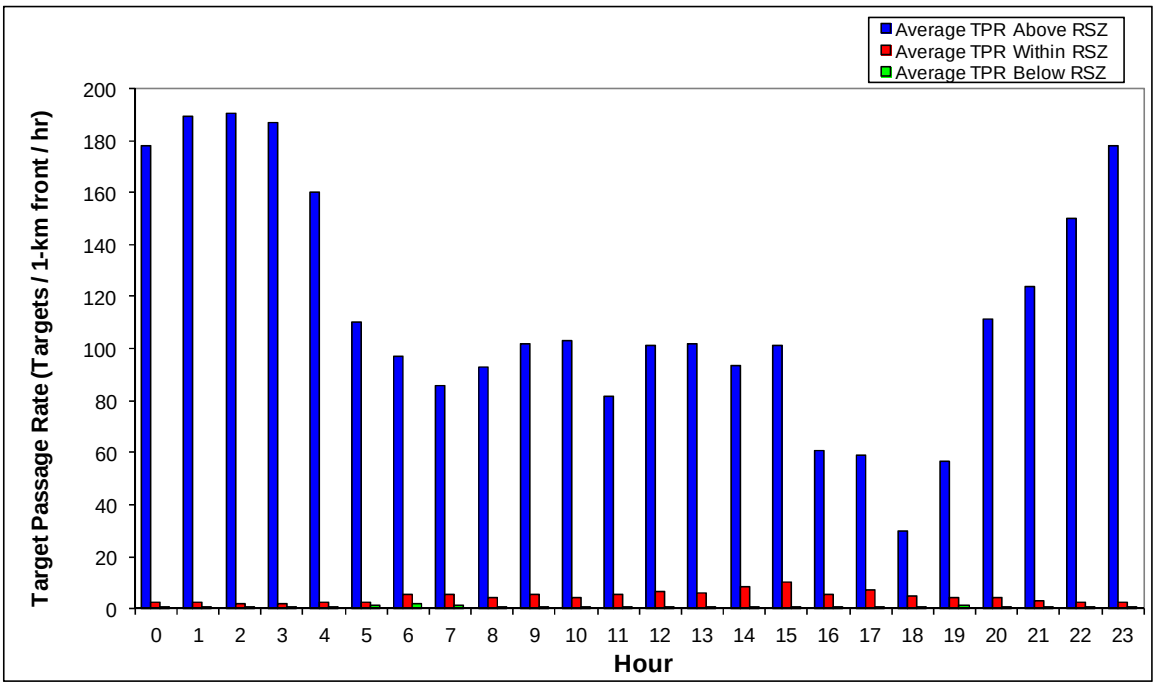

Figure 11-9. Average hourly target passage rates at Site 9 (July 21 - September 29, 2012).

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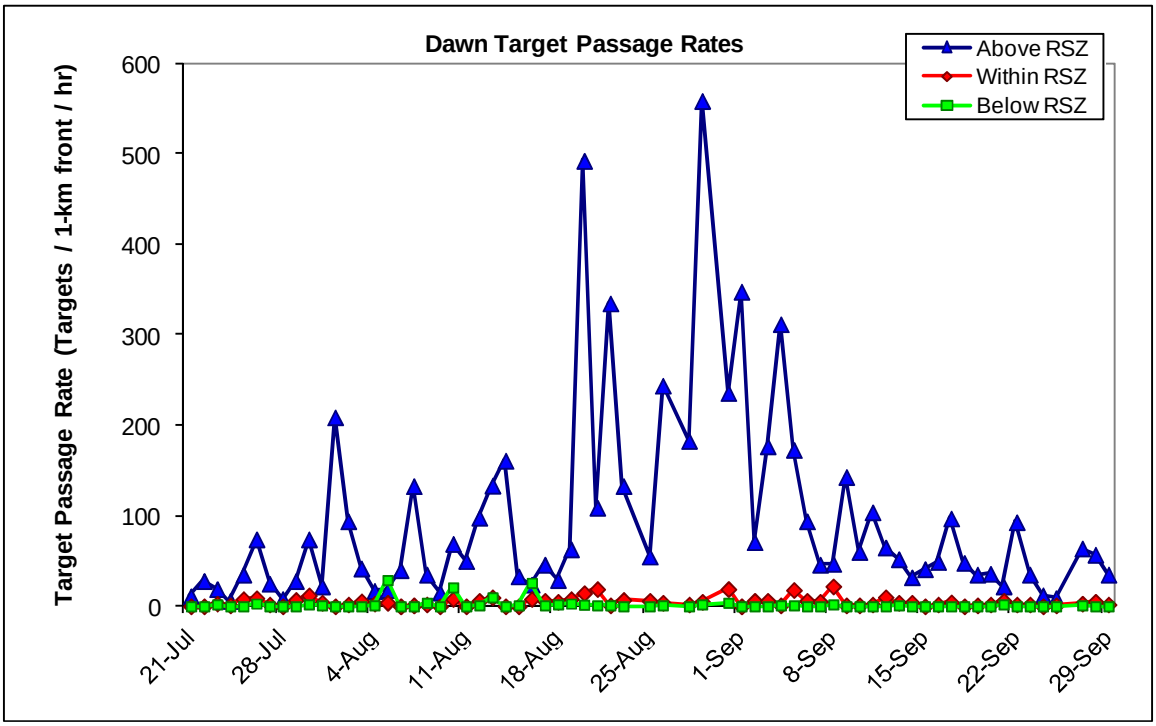

Figure 11-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns at Site 9 (July 21 - September 29, 2012).

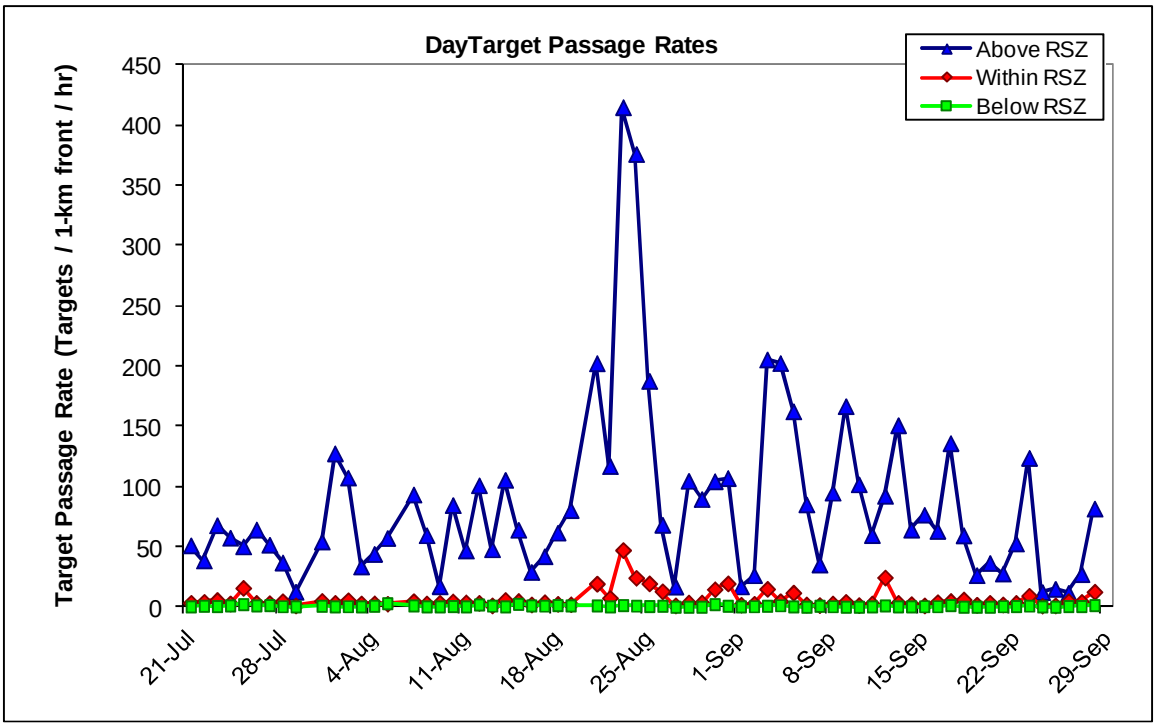

Figure 11-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days at Site 9 (July 21 - September 29, 2012).

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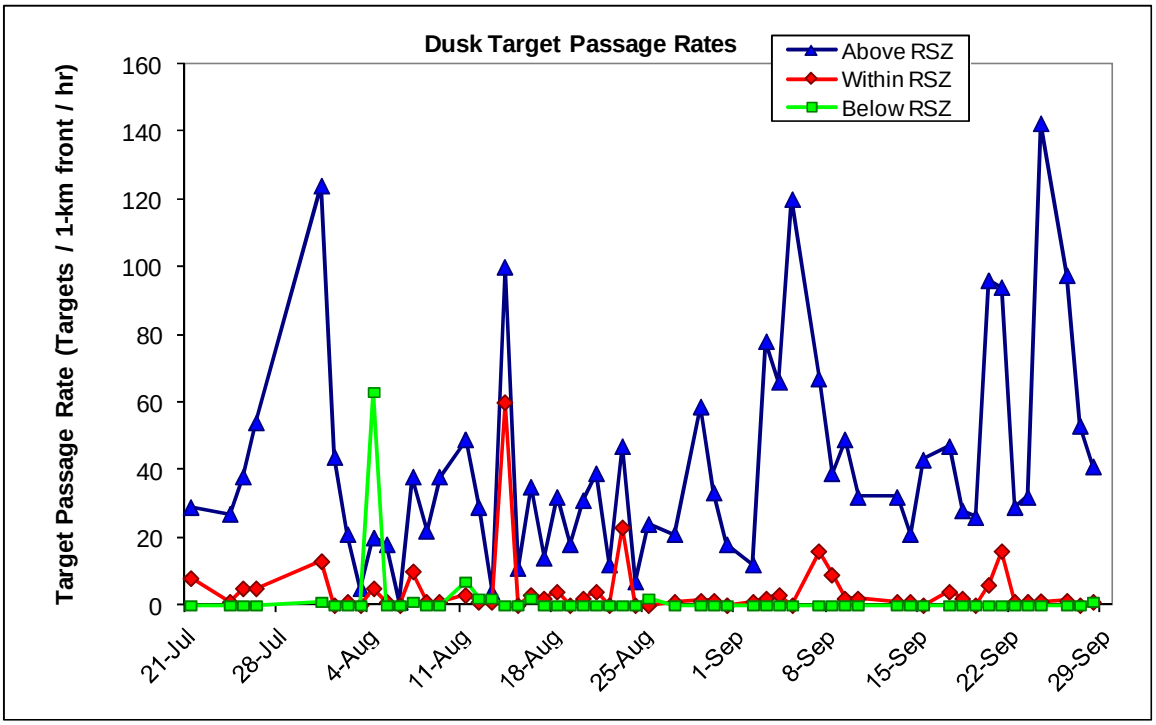

Figure 11-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks at Site 9 (July 21 - September 29, 2012).

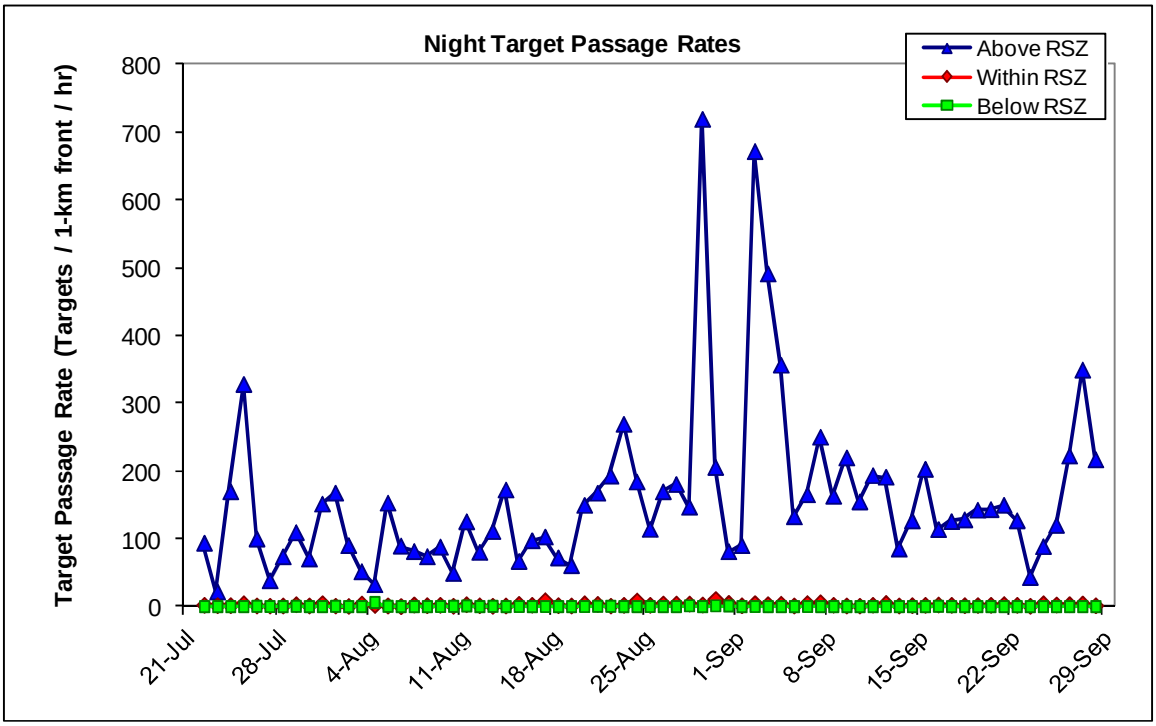

Figure 11-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights at Site 9 (July 21 - September 29, 2012).

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11.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods at Site 9 (July 21 - September 29, 2012).

11.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 11-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected at Site 9 (July 21 - September 29, 2012) combined together by biological period (Fig. 11-15) and hour (Fig. 11-16).

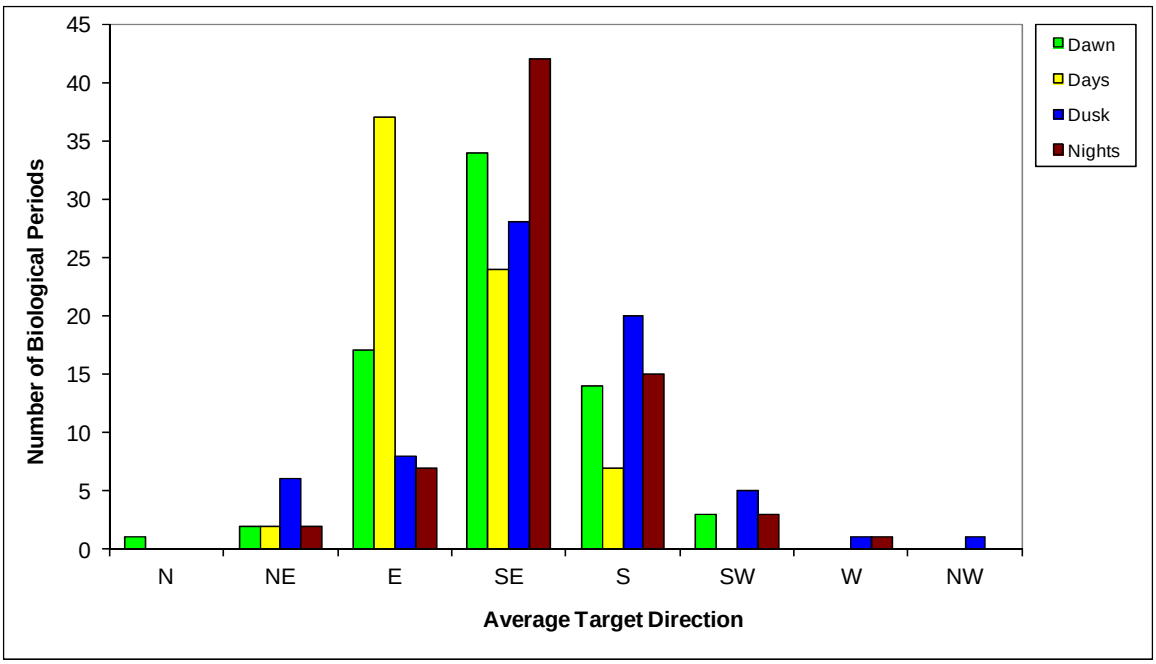

Figure 11-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at Site 9 (July 21 - September 29, 2012).

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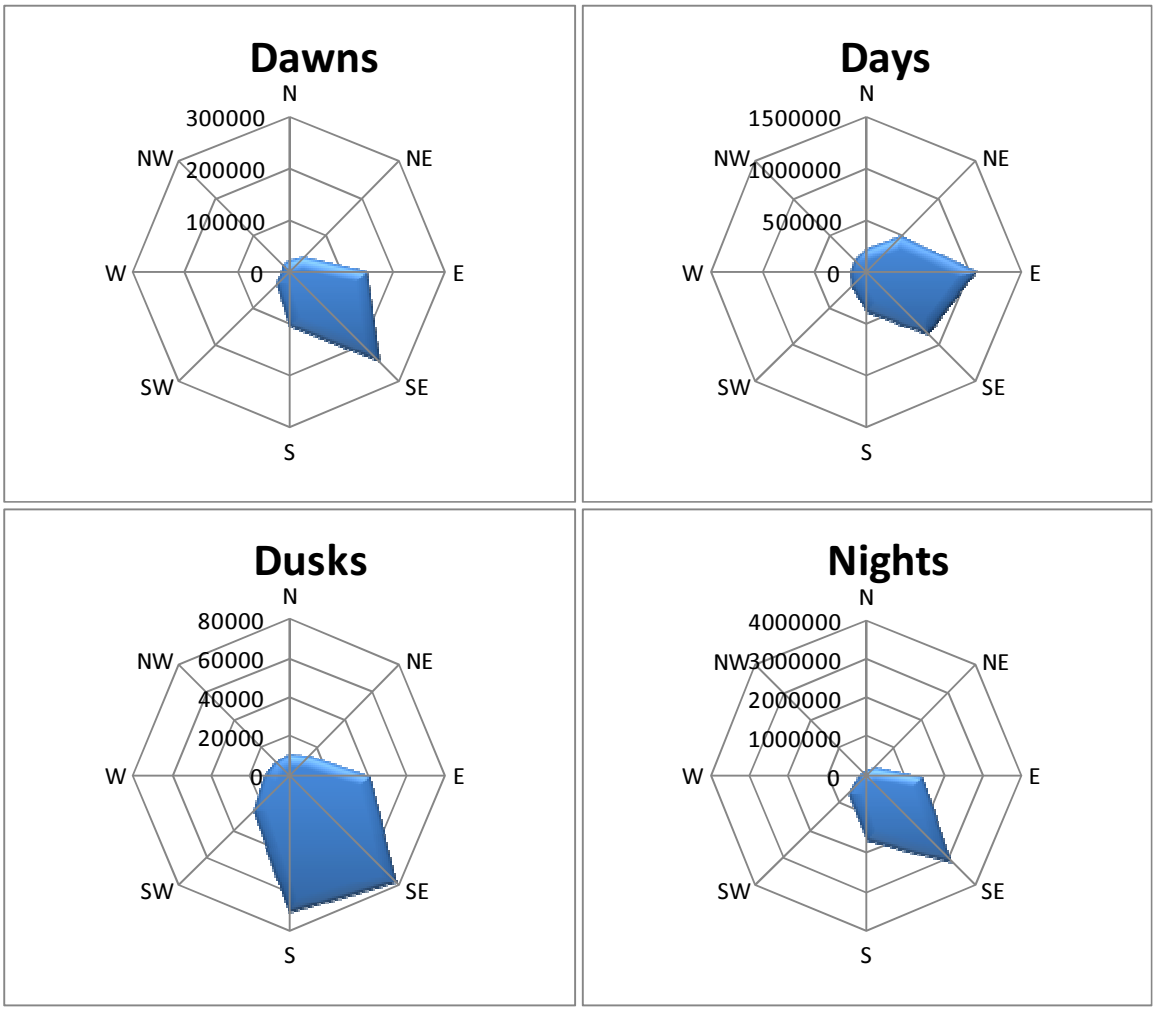

Figure 11-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights at Site 9 (July 21 - September 29, 2012).

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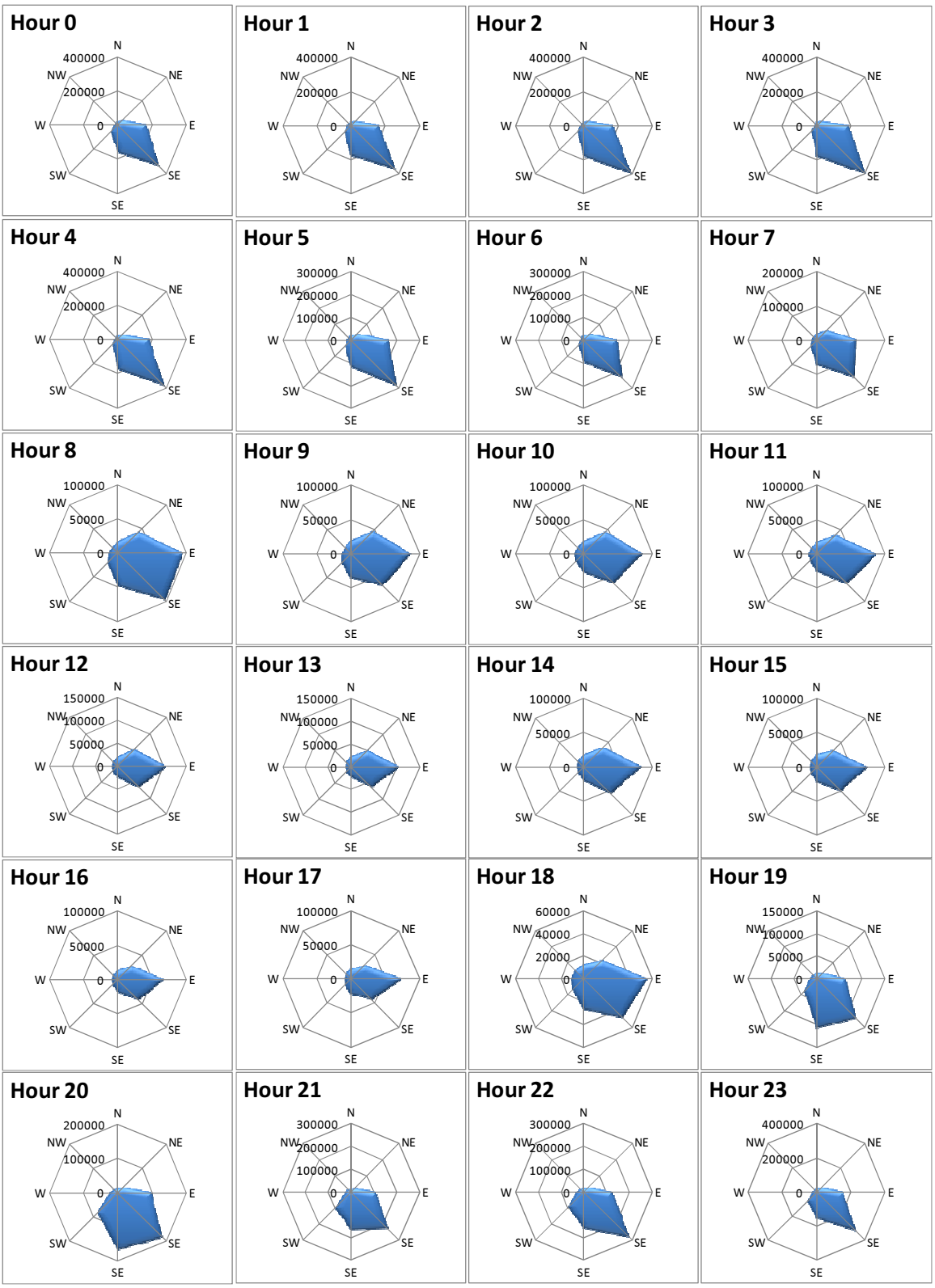

Figure 11-16. Comprehensive distribution of all target's directions by hour at Site 9 (July 21 - September 29, 2012).

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12 RESULTS for Site 10 (October 3, 2012 – March 31, 2013)

12.1 Level of Effort

Table 12-1 presents available time, time radar data were collected, amount of radar data that were removed due to rain, high levels of insect activity, or other contamination, and the resulting time of radar data used for analyses, for Site 10 (October 3, 2012 - March 31, 2013).

Table 12-1. Radar monitoring effort at Site 10 (October 3, 2012 - March 31, 2013).

	Vertical Radar		Horizontal Radar	
	Hours	**%**	**Hours**	**%**
Time in season	4319.6		4319.6	
Time radar down	579.8	13.4%	14.8	0.3%
Time radar collected data	3739.8	86.6%	4304.8	99.7%
Unuseable radar data[1] due to rain or other contamination	606.1	16.2%	10.8	0.2%
Unuseable radar data[2] due to insects	23.3	0.6%	-	-
Useable radar data[3]	3110.4	72.0%	4294.0	99.4%

1 - Percent indicates portion of time with radar data that was lost due to rain or other contamination.
2 - Percent indicates portion of time with radar data that was lost due to high insect activity.
3 - Percent indicates portion of season with useable radar data.

12.2 Vertical Radar Data

Data collected from the vertical scanning radar (VSR) were used to quantify target activity and heights.

12.2.1 Target Passage Rates Over Time

Data is presented as a rate equaling total number of targets / 1-km front / hr for each biological period (Fig. 12-1) and as an average by biological period (Fig. 12-2) and hour (Fig. 12-3). Summary statistics are presented in table 12-2.

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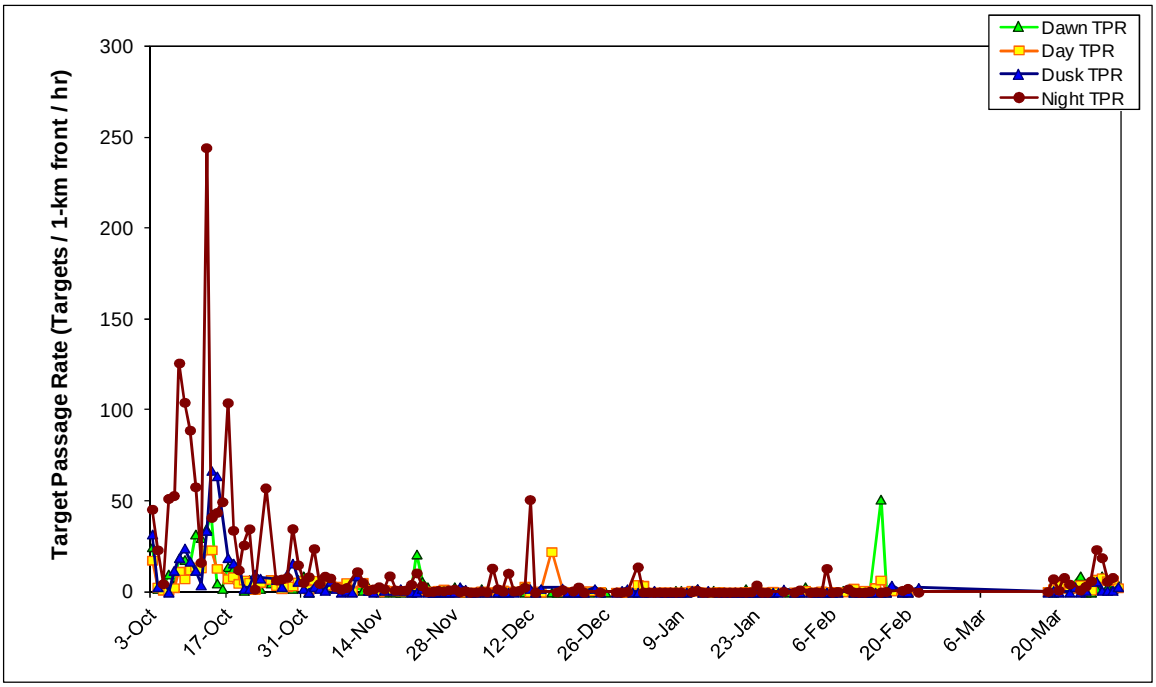

Figure 12-1. Target passage rates (TPR) during biological periods at Site 10 (October 3, 2012 - March 31, 2013).

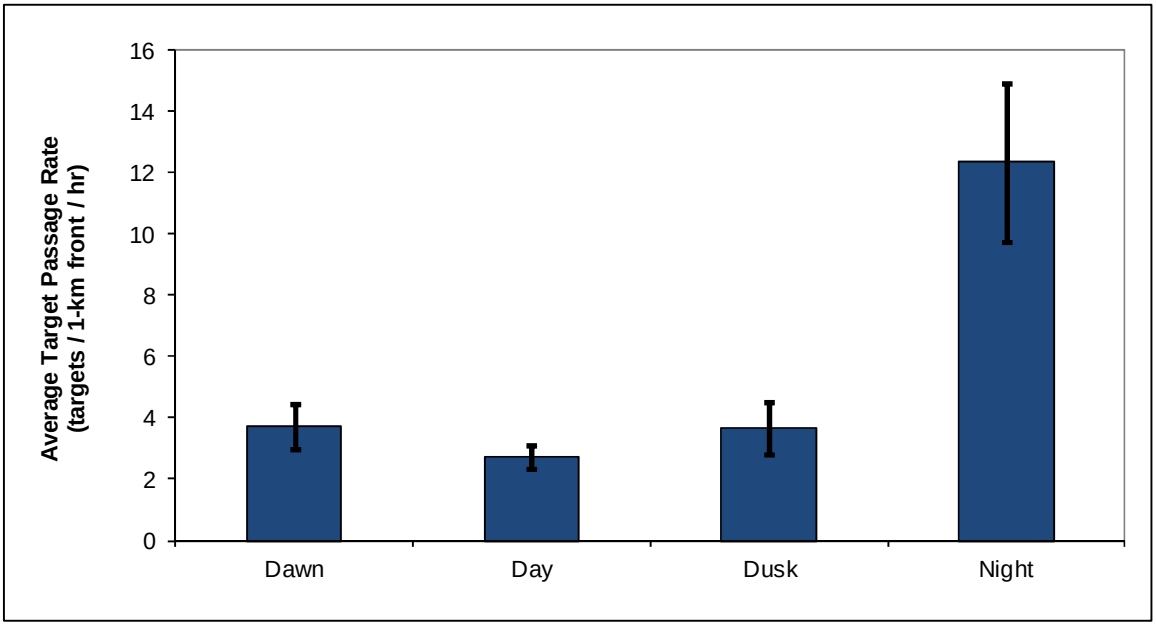

Figure 12-2. Average target passage rates (TPR) by biological period at Site 10 (October 3, 2012 - March 31, 2013). Error bars represent one standard error.

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Table 12-2. Summary statistics for target passage rates (number targets / 1-km front / hour) for biological periods at Site 10 (October 3, 2012 - March 31, 2013).

	Dawn	Day	Dusk	Night
Average	3.7	2.7	3.7	12.3
Standard Deviation	8.3	4.5	9.6	29.8
Standard Error	0.7	0.4	0.8	2.6
Median	1.0	0.8	0.0	1.3
Minimum	0.0	0.0	0.0	0.0
Maximum	51.2	23.3	67.0	244.7

Both average and comprehensive hourly target passage rates are presented in Fig 12-3: average rates are the average of each date's hourly target rate in a given hour, while comprehensive rates use targets grouped by hour, regardless of date.

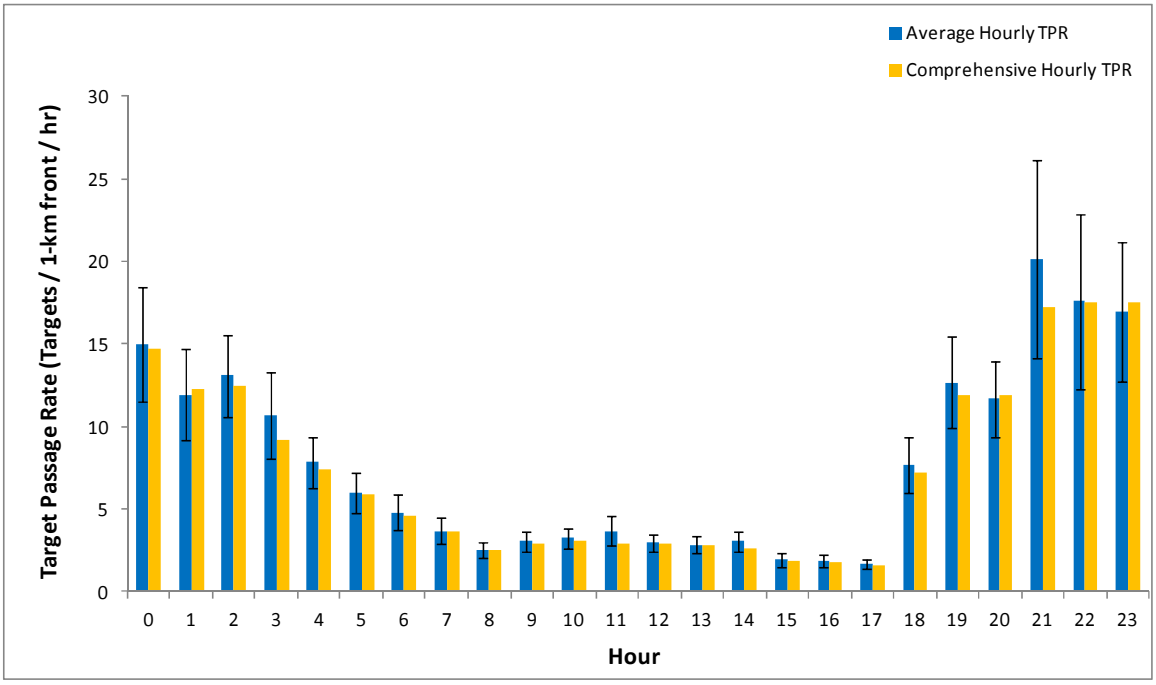

Figure 12-3. Average and comprehensive hourly target passage rates at Site 10 (October 3, 2012 - March 31, 2013). Error bars represent one standard error.

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12.2.2 Altitudinal Distribution of Targets

Mean and median target heights are presented for each biological period (Fig. 12-4 and Fig. 12-5, respectively) at Site 10 (October 3, 2012 - March 31, 2013).

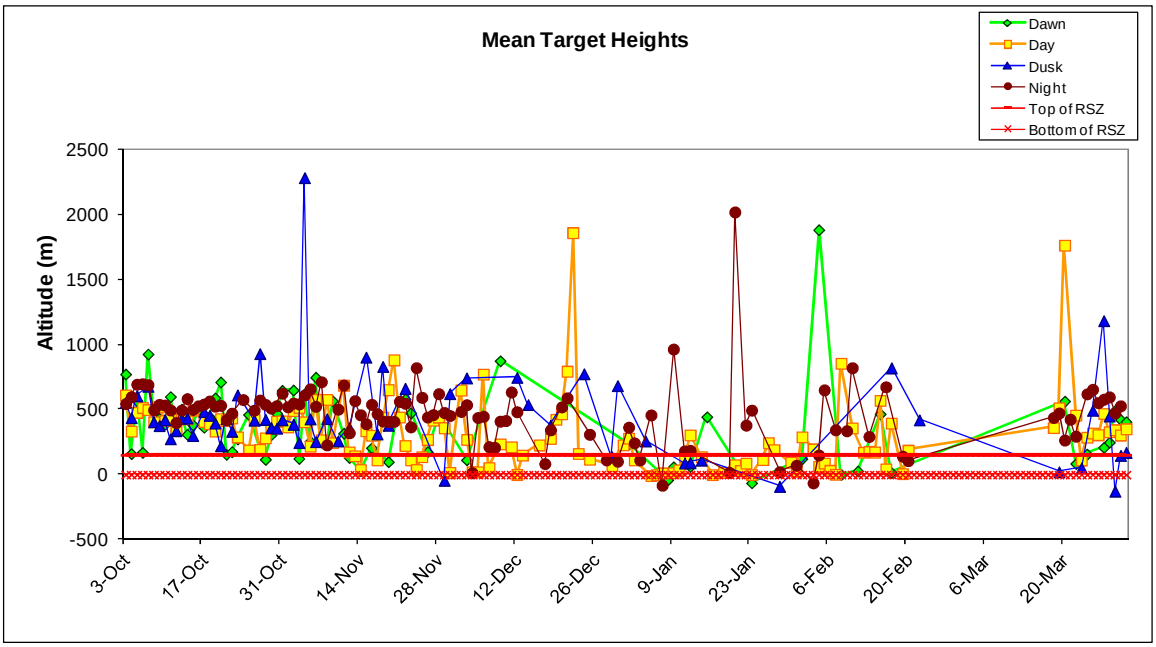

Figure 12-4. Mean target heights at Site 10 (October 3, 2012 - March 31, 2013). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

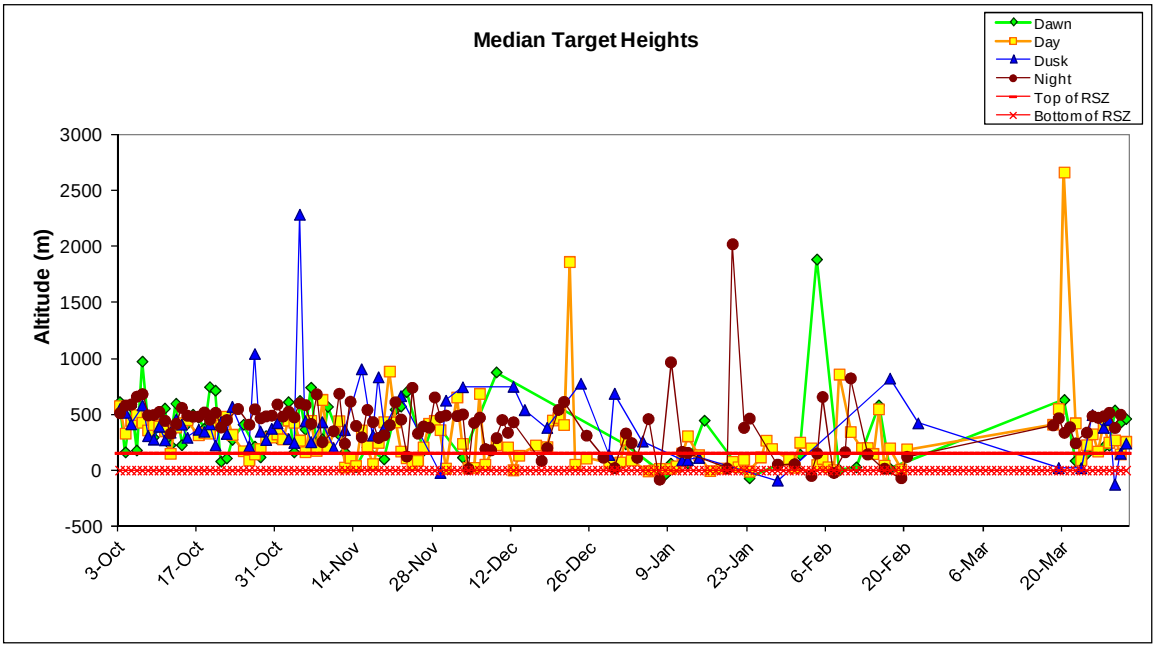

Figure 12-5. Median target heights at Site 10 (October 3, 2012 - March 31, 2013). Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

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The mean and median target heights during each biological period were calculated for all dates with ≥ 50% data for that time period, averaged into a grand mean and average median, and presented in Table 12-3 (top) and illustrated in Figure 12-6 (blue bars). The comprehensive mean and median target heights for each biological period (when all targets were combined regardless of date) are also listed in Table 12-3 (bottom) and illustrated in Figure 12-6 (green bars).

Table 12-3. Summary of mean and median target heights during biological periods at Site 10 (October 3, 2012 - March 31, 2013). Darker colors in color-coded rows indicate greater values within that row.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Grand mean target height	365.0	312.2	444.4	462.0
Average median target height	360.1	277.8	413.9	407.0
All targets for season combined				
Comprehensive mean target height	425.1	408.8	425.7	532.3
Comprehensive median target height	399.3	332.8	359.1	487.1

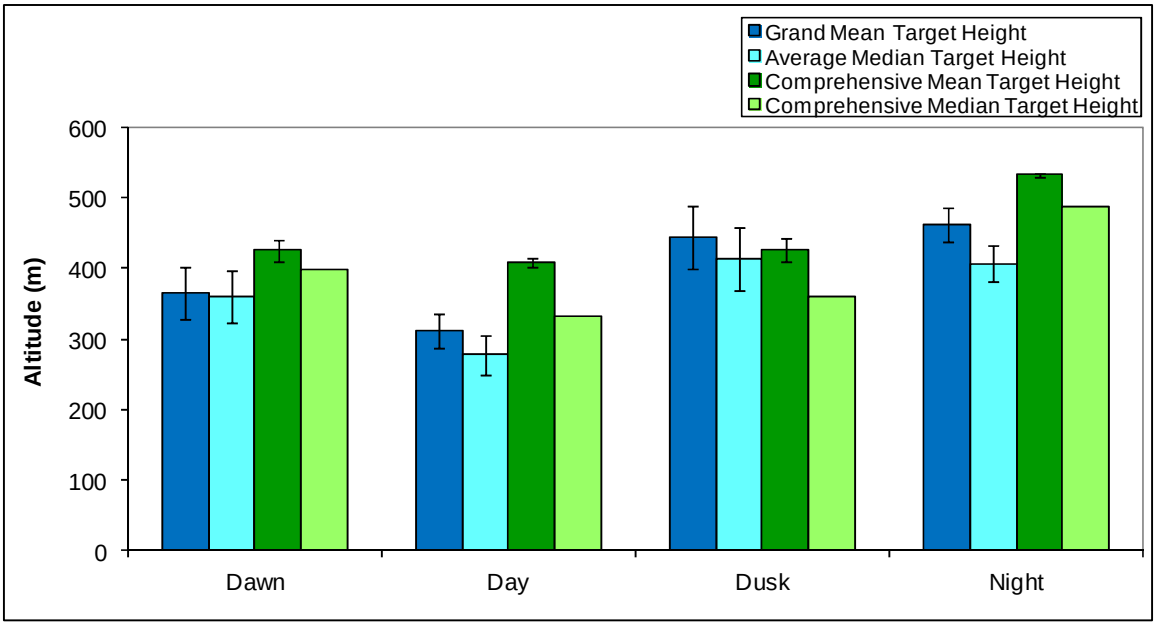

Figure 12-6. Grand mean and average median target heights averaged across individual biological periods (blue bars), and comprehensive mean and median target heights of all targets grouped by biological period (green bars), at Site 10 (October 3, 2012 - March 31, 2013). Error bars represent one standard error.

Hourly target heights were averaged into a grand hourly target mean and an average hourly target median for each of 24 hours; a comprehensive hourly target mean was also calculated by pooling all targets within a given hour together, regardless of date (Fig. 12-7).

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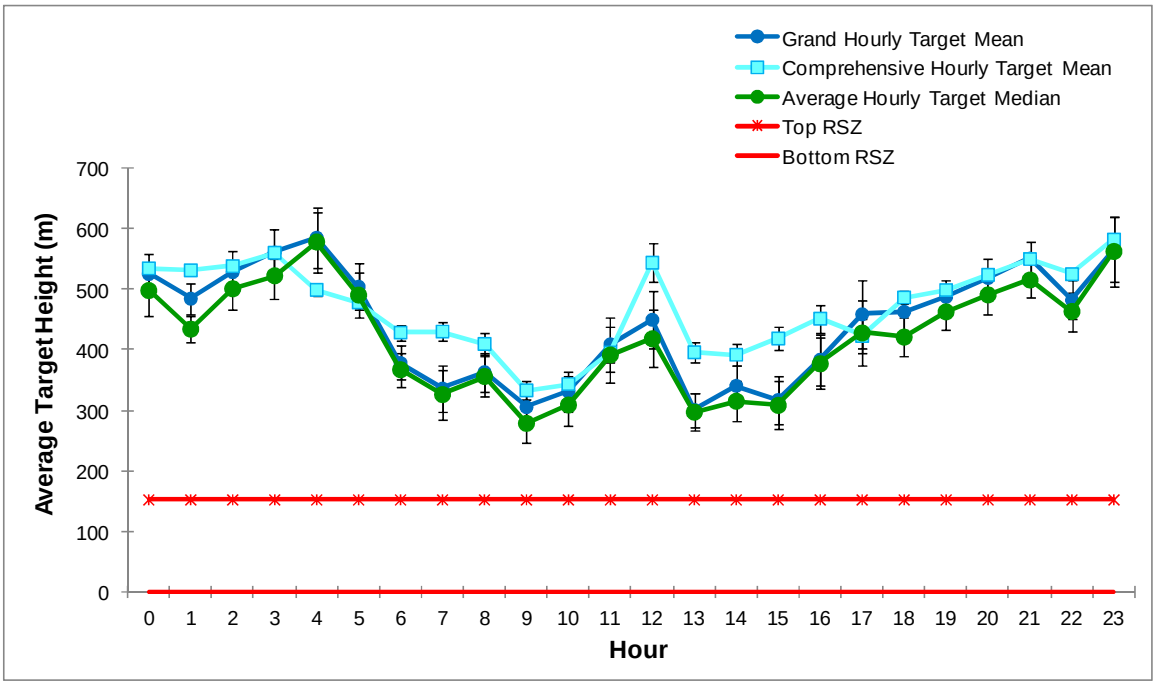

Figure 12-7. Hourly target heights at Site 10 (October 3, 2012 - March 31, 2013). Error bars represent one standard error. Red lines represent top and bottom of the RSZ (0-152.4 m AGL).

The distribution of all targets detected during dawns, days, dusks, and nights at Site 10 (October 3, 2012 - March 31, 2013) are shown using 50-meter increments (Fig. 12-8).

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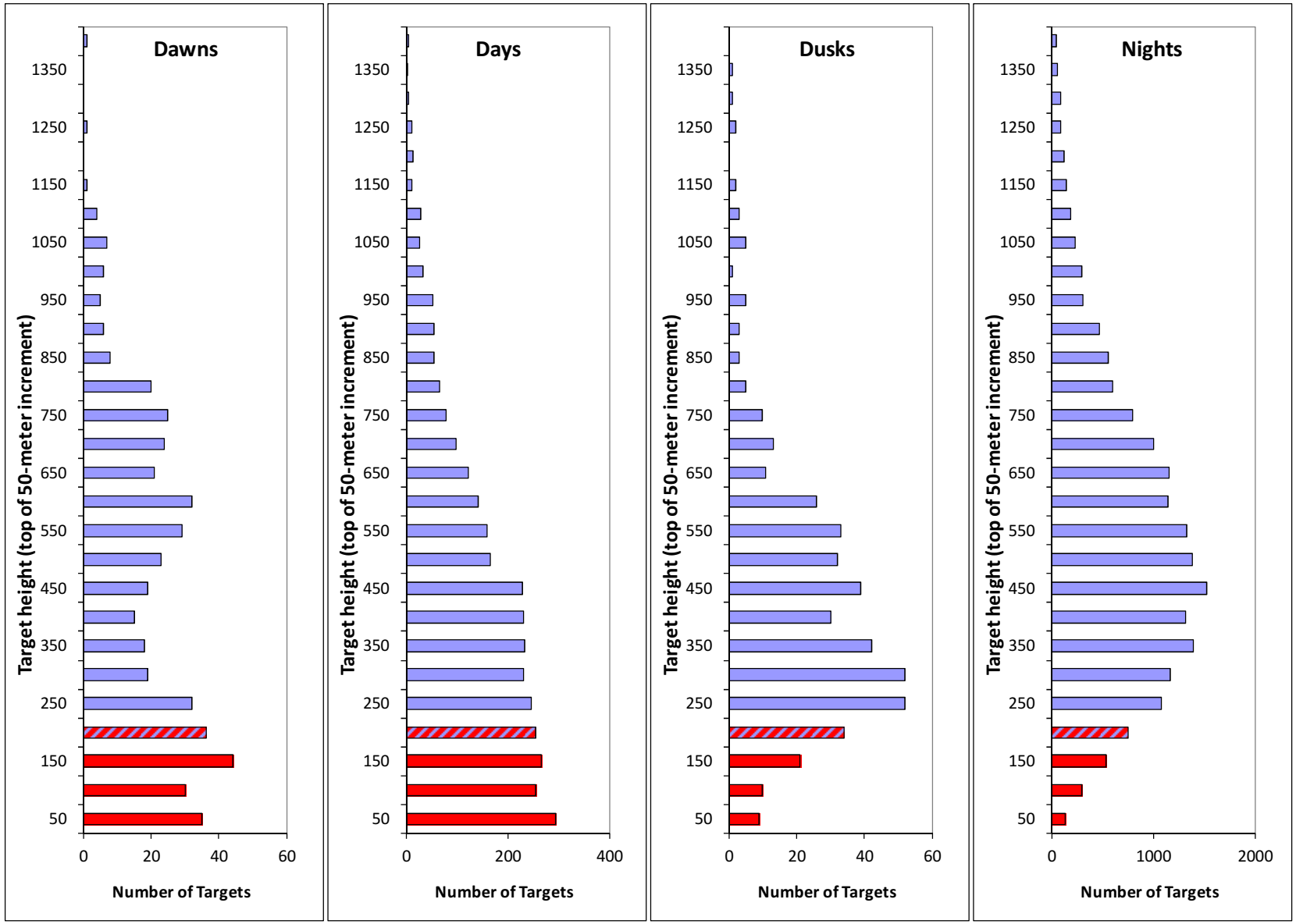

Figure 12-8. Number of targets occurring in each 50-meter increment during biological periods at Site 10 (October 3, 2012 - March 31, 2013). Red indicates rotor swept heights, and red-blue hashed indicates altitudes partially within rotor swept heights.

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Using a RSZ of 0-152.4 m AGL, target passage rates below, within, and above the RSZ were calculated for each date. Individual target passage rates are presented for dawns (Fig. 12-10) days (Fig. 12-11), dusks (Fig 12-12), and nights (Fig. 12-13). Percent targets below, within, and above the RSZ were also calculated seasonally, with all targets detected during each biological period at Site 10 (October 3, 2012 - March 31, 2013) combined together (Table 12-4, bottom). Average hourly target passage rates below, within, and above the rotor swept zone are also given (Fig. 12-9).

Table 12-4. Summary of target passage rates and percent of targets above, within and below the RSZ (0-152.4 m AGL) during biological periods at Site 10 (October 3, 2012 - March 31, 2013). Darker colors indicate greater values.

	Dawn	Day	Dusk	Night
Target data calculated for each date				
Average target passage rate above RSZ	2.8	2.0	3.3	11.7
Average target passage rate within RSZ	0.8	0.7	0.3	0.6
Average target passage rate below RSZ	0.1	0.0	0.0	0.0
Average % of targets in RSZ	31.3%	39.8%	16.2%	16.9%
Min target percentage within RSZ	0.0%	0.0%	0.0%	0.0%
Max target percentage within RSZ	100.0%	100.0%	100.0%	100.0%
All targets for season combined				
% targets above RSZ	75.6%	75.0%	90.3%	94.6%
% targets within RSZ	22.6%	23.6%	8.6%	5.1%
% targets below RSZ	1.7%	1.4%	1.1%	0.3%
% targets below turbine height	24.4%	25.0%	9.7%	5.4%

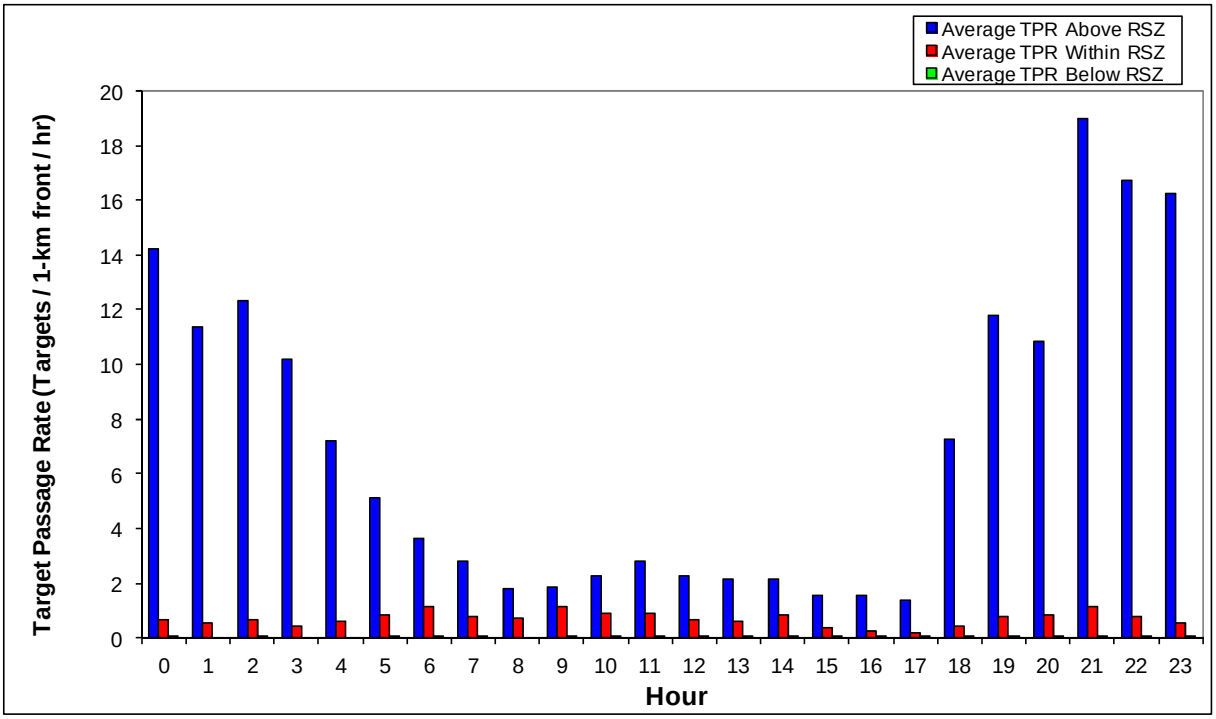

Figure 12-9. Average hourly target passage rates at Site 10 (October 3, 2012 - March 31, 2013).

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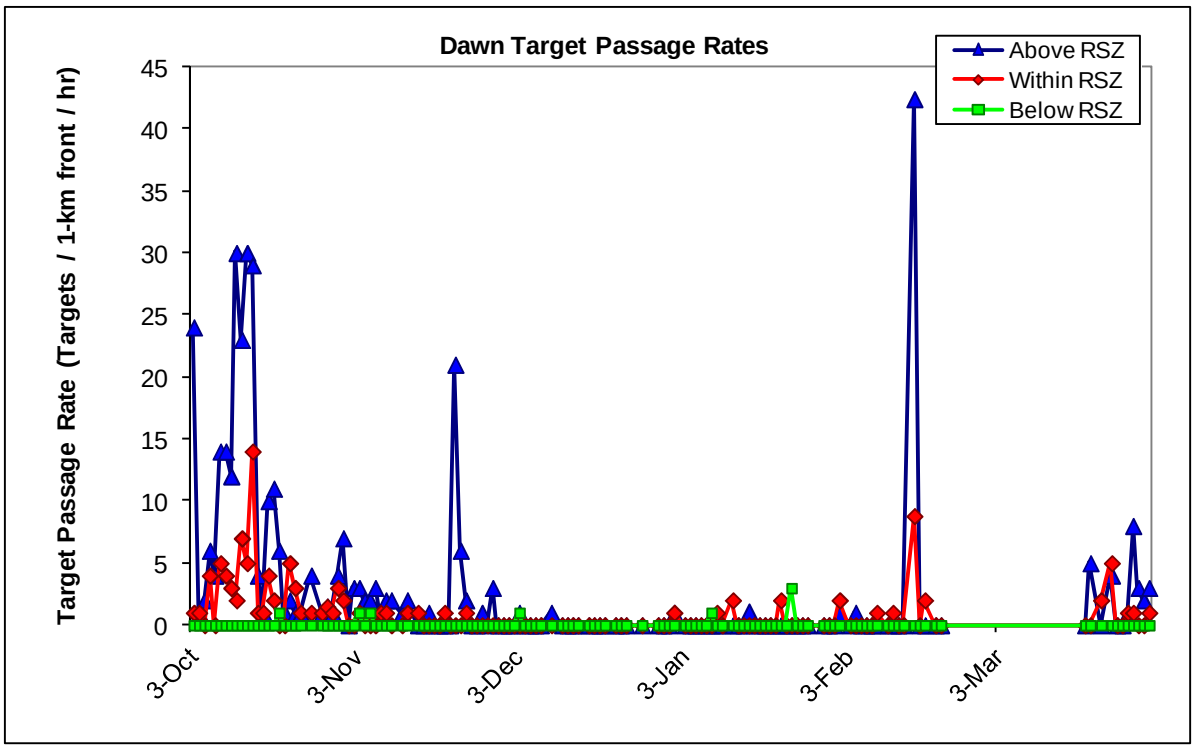

Figure 12-10. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dawns at Site 10 (October 3, 2012 - March 31, 2013).

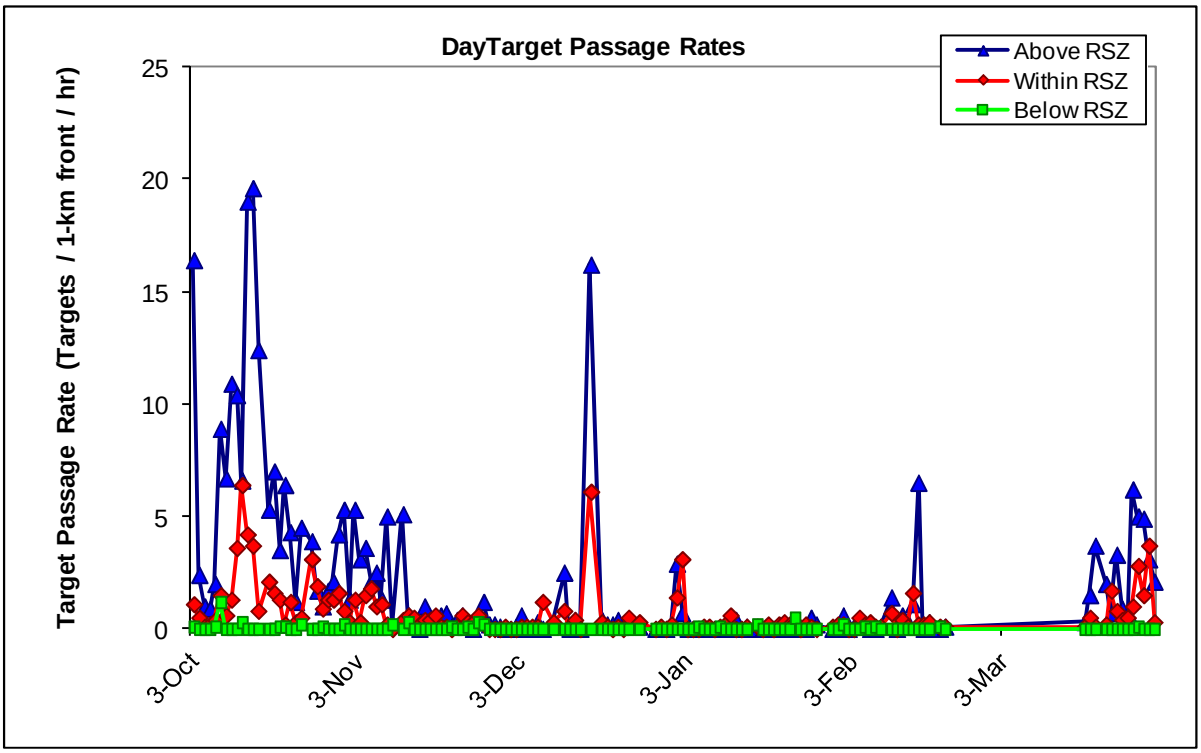

Figure 12-11. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during days at Site 10 (October 3, 2012 - March 31, 2013).

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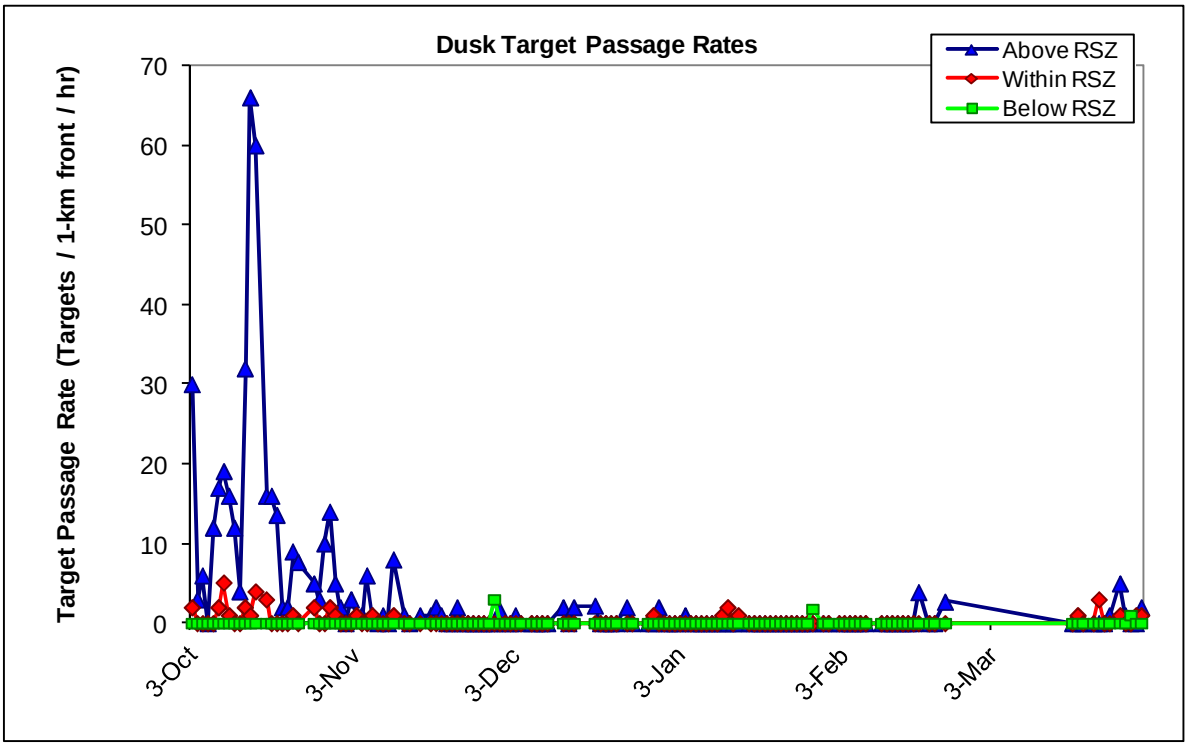

Figure 12-12. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during dusks at Site 10 (October 3, 2012 - March 31, 2013).

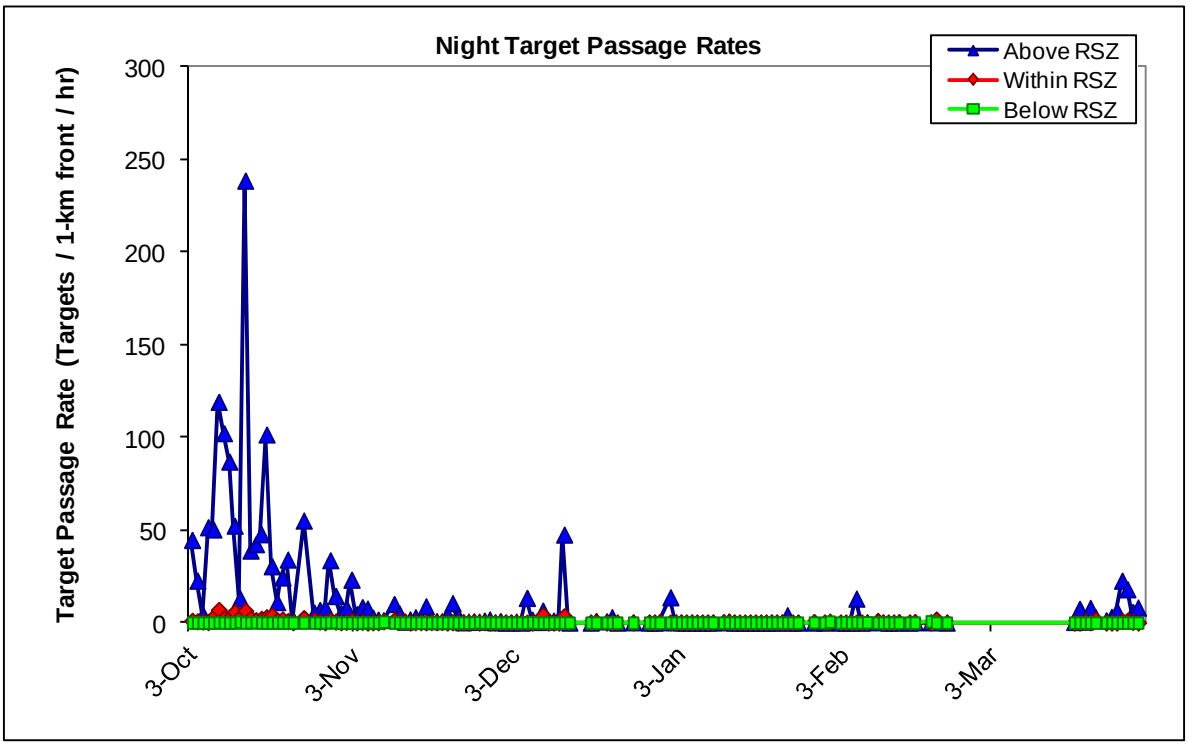

Figure 12-13. Target passage rates below, at, and above the RSZ (0-152.4 m AGL) during nights at Site 10 (October 3, 2012 - March 31, 2013).

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12.3 Horizontal Radar Data

The Horizontal Surveillance Radar (HSR) was used to determine directional movements of targets during biological periods at Site 10 (October 3, 2012 - March 31, 2013).

12.3.1 Target Directions

Average target directions were calculated for each biological period (Fig. 12-14). Average target directions were also calculated seasonally (comprehensive distribution), with all targets detected at Site 10 (October 3, 2012 - March 31, 2013) combined together by biological period (Fig. 12-15) and hour (Fig. 12-16).

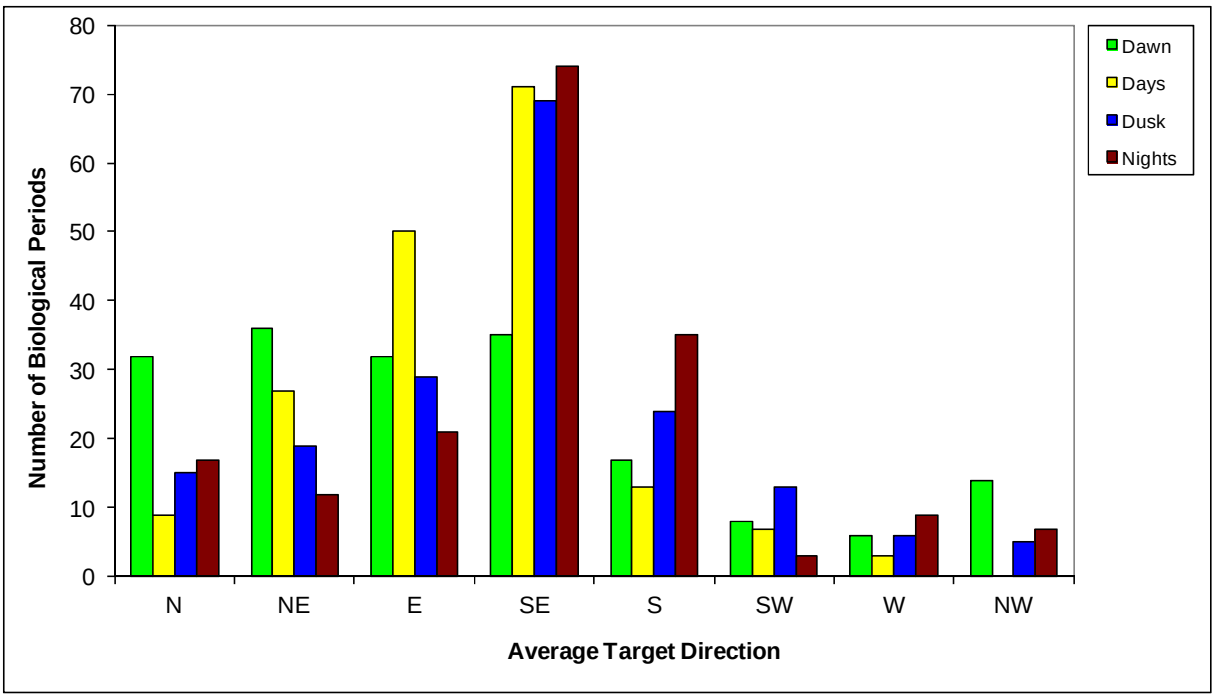

Figure 12-14. Distribution of average target movements among eight directions during dawns, days, dusks, and nights at Site 10 (October 3, 2012 - March 31, 2013).

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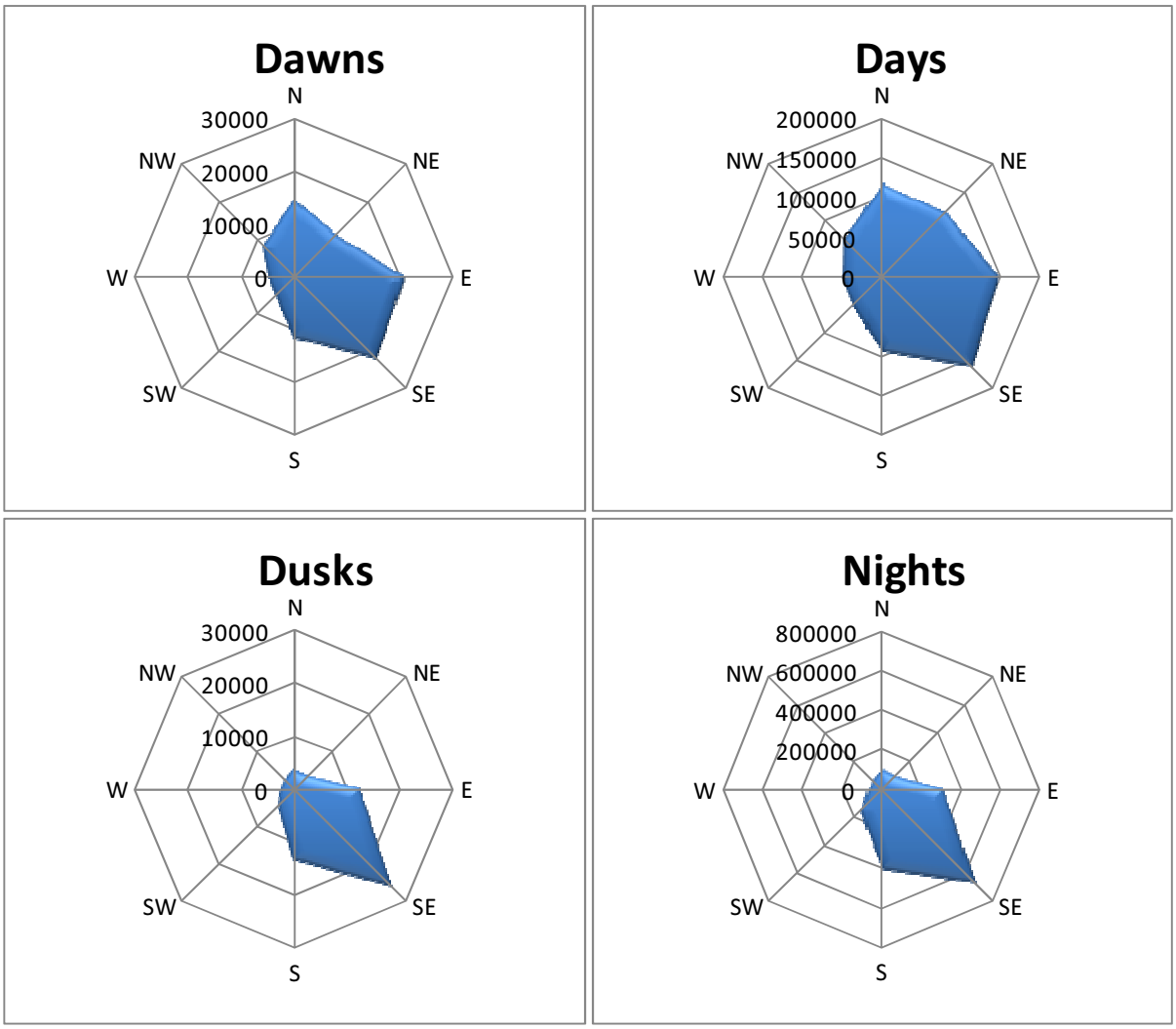

Figure 12-15. Comprehensive distribution of all target's directions during dawns, days, dusks, and nights at Site 10 (October 3, 2012 - March 31, 2013).

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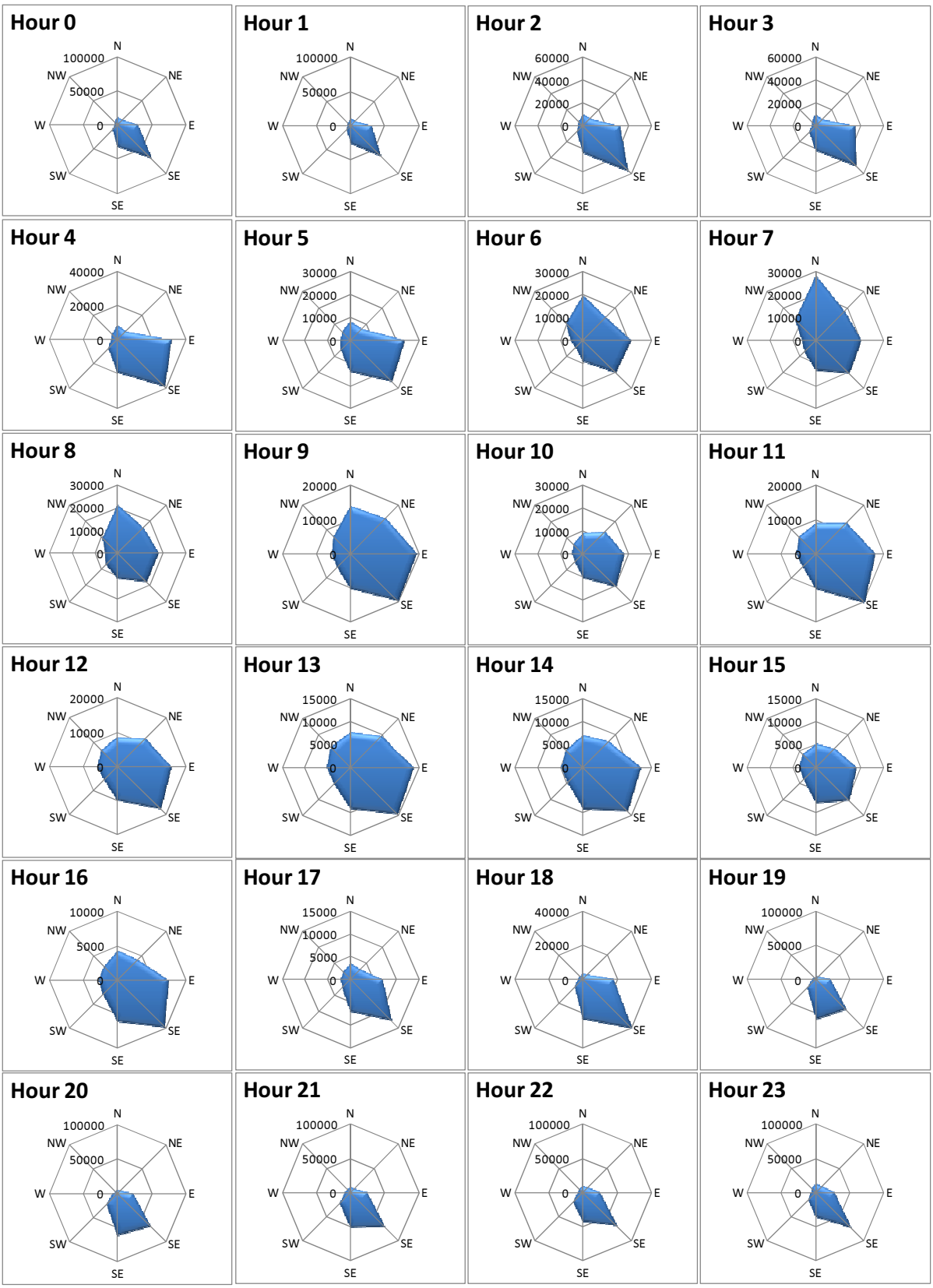

Figure 12-16. Comprehensive distribution of all target's directions by hour at Site 10 (October 3, 2012 - March 31, 2013).

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Literature Cited

Harmata, A. R., K. M. Podruzny, J. R. Zelenak, and M. L. Morrison. 1999. Using marine surveillance radar to study bird movements and impact assessment. Wildlife Society Bulletin 27:44-52.

Zar, J. H. 1999. Biostatistical Analysis. Fourth edition. Prentice-Hall, Englewood Cliffs, New Jersey, USA.

Appendix A - Abbreviations

AGL – Above Ground Level

HSR – Horizontal Surveillance Radar

km – kilometer

m – meter

mi – mile

nm – Nautical miles (approximately 1.15 miles)

RSZ – Rotor Swept Zone

VSR – Vertical Scanning Radar

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Appendix B - Glossary

1-km Front – 0.5 km on either side of the VSR, or 1 km on one side of the VSR, forming a 1-km front through which target passage rates are quantified.

Comprehensive distribution – Frequency distribution of all mean target bearings combined during a season, regardless of date.

Comprehensive mean – Mean of all targets in a time period during an entire season, regardless of the date.

Grand mean – Mean of all period means (e.g. all nights).

Rotor Swept Zone (RSZ) – The 1-km wide band within the 1-km front that encompasses the lowest and highest points swept by a wind turbine's blades. Specific to each project and calculated using the manufacturer's specifications for the wind turbine proposed for the project.

Plot – A single scan of a target.

Target Passage Rate – Number of targets passing through a 1-km wide front during 1 hour. Standardized to an hourly rate using the proportion of minutes radar data was recorded during a given time period.

Target - Object detected by MERLIN Radar and identified by MERLIN software as a biological object (e.g. bird, bat) based on scanned size, speed, and other characteristics.

Track – The entire sequence of plots that make up a target's trail within the radar coverage as long as an object still fits the definition of a target.

TrackPlot – MERLIN program displaying all target or track activity within a specific time period; used for defining time periods of radar data containing rain or other interference.

Tracking – The MERLIN software begins to track a target after it has met the criteria of a biological target for three of four scans. The target continues to be tracked until either the target fails to be detected or to meet the criteria for three of the last four scans.

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APPENDIX H

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THE OVERLAND TRAIL RANCH

CHOKECHERRY AND SIERRA MADRE WIND ENERGY PROJECT

CONSERVATION PLAN AND LANDOWNER AGREEMENT

This Conservation Plan and Landowner Agreement (this "Agreement") is entered into as of July 1, 2014 between **POWER COMPANY OF WYOMING LLC** ("PCW") and **THE OVERLAND TRAIL CATTLE COMPANY LLC** ("TOTCO").

Recitals

A. TOTCO owns and operates a large cattle ranching and agricultural operation known as the Overland Trail Ranch (the "Ranch"), which is located south of Rawlins and Sinclair in Carbon County, and headquartered in Saratoga, the Ranch consists of approximately 320,000 acres. The Ranch is in Wyoming's "checkerboard" country, consisting of about half private land and half federal land managed by the Bureau of Land Management ("BLM"), along with a small percentage of state-owned parcels.

B. PCW is developing a wind farm known as the Chokecherry and Sierra Madre Wind Energy Project ("CCSM Project"). The CCSM Project will be located on approximately 125,000 acres of the Ranch. Total permanent land disturbance, however, for the turbines, access roads and related facilities is estimated to be less than 3% of the CCSM Project area. The CCSM Project will generate 2,000-3,000 megawatts of clean, renewable wind energy.

C. PCW and TOTCO have entered into that certain Grant of Easement and Easement Agreement and Restrictive Covenant by and between TOTCO and PCW dated November 30, 2007, as amended (the "Wind Easement"), which allows PCW to use the Ranch lands to construct and operate the CCSM Project.

D. The Ranch provides habitat for a variety of wildlife species. The BLM released a Final Environmental Impact Statement on July 3, 2012, which describes the CCSM Project in detail and analyzes and discloses the impacts of the CCSM Project, including impacts to wildlife species (the "Final EIS") and subsequently issued a Record of Decision for the CCSM Project on October 9, 2012.

E. PCW, TOTCO and Wyoming Game and Fish Department ("WGFD") have entered into a Memorandum of Understanding ("MOU") dated December 10, 2012 to promote and maintain through collaborative efforts the availability and use of high quality habitat to sustain and enhance terrestrial and aquatic wildlife populations on the Ranch in conjunction with various land uses, including the continuation of ranching and agricultural operations as well as development of the wind energy resource through construction and operation of the CCSM Project.

F. The Wildlife Protection Recommendations for Wind Energy Development in Wyoming approved by the Wyoming Game and Fish Commission on November 17, 2010 (the "Wildlife Protection Recommendations") provide for collaboration with the landowner(s) affected by wind energy development to develop a conservation plan for affected private lands incorporating mutually agreed upon goals and practices.

G. The Wildlife Protection Recommendations provide that the conservation plan shall be incorporated into the wind developer's permit application to the Industrial Siting Council ("ISC") and shall become the WGFD "recommendations" under W.S. 35-12-110 (b) and (c) and the WGFD recommendation to any local government entity.

H. The Wildlife Protection Recommendations provide that the parties shall jointly advocate for the ISC to incorporate the conservation plan into the wind developer's permit.

I. The parties desire to enter into a conservation plan for the Overland Trail Ranch pursuant to the Wildlife Protection Recommendations setting forth the mutually agreed upon goals and practices for the Ranch and the CCSM Project, as set forth more fully below.

AGREEMENT

For good and valuable consideration the parties agree that PCW will support TOTCO's management goals and practices in connection with its livestock operations on the Ranch as set out below:

1. **TOTCO Operations.** TOTCO currently manages the Ranch as an active, year round livestock operation. TOTCO's activities include, but are not limited to, raising cattle as a cow/calf and yearling operation, and growing feed for its livestock operations. Range resources within the Ranch consist of intermingled private, state and public lands administered as grazing allotments. The allotments are managed under an intensive rotation system in which grazing is rotated during the growing season among several different pastures within each allotment to provide complete growing season rest for all pastures on alternate years. As a result, water quality in affected streams has improved through soil stabilization, decreased runoff, increased infiltration, and enhanced riparian vegetation health.

2. **TOTCO Management Goals.** TOTCO's goals and practices for managing livestock operations on the Ranch are:

   a. Manage livestock grazing to meet the Wyoming Standards for Healthy Rangelands;
   b. Maintain and/or increase Animal Unit Month (AUM) levels for livestock grazing when feasible, providing that Wyoming Standards for Healthy Rangelands are met;

c. Work closely with BLM to determine the most appropriate methods for achieving the desired plant community, in addition to meeting the Standards for Healthy Rangelands; and
d. Design grazing systems and range improvements to achieve the management goals for livestock grazing and to achieve and maintain healthy rangelands.

For the avoidance of doubt, TOTCO is not obligated to manage the Ranch as set forth in Section 1 or Section 2 above, nor shall such sections otherwise limit TOTCO's complete discretion in the management of the Ranch.

3. **PCW Agreement to Cooperate and Support TOTCO Management Goals.** To the extent consistent with its goals and objectives for developing the CCSM Project and the terms and conditions of the Wind Easement, PCW agrees to cooperate and support TOTCO in meeting TOTCO's goals and objectives for managing livestock operations on the Ranch through the following actions:

a. By implementing a reclamation plan with the objective of emphasizing eventual ecosystem reconstruction to maintain a safe and stable landscape, which means returning the land to a condition approximate to or better than pre-disturbance conditions. Reclamation objectives include initial stabilization goals and long-term reclamation measures to ensure biophysical conditions are maintained in the short term to achieve long-term goals of revegetation and ecosystem reconstruction.
b. By implementing a weed management plan to prevent, mitigate, and control the spread of noxious and/or invasive plant species during construction and operation of the CCSM Project. The goal of weed management in the CCSM Project area will be to minimize the spread of noxious and/or invasive plant species during the construction and operation of the CCSM Project. PCW will assist federal, state, and local agencies' weed control efforts; comply with appropriate agency requirements designed to prevent the spread of noxious and/or invasive plant species; and implement weed control measures on areas of the CCSM Project that are identified to be of special concern. Success standards will be used to assess whether revegetation requirements for the CCSM Project are being met. Part of successful revegetation includes maintaining native or desirable plant communities with minimal undesirable plant species. Success standards and management goals will be designed to be site-specific to each surface-disturbing activity and the surrounding vegetation.
c. By implementing the Applicant Committed Mitigation Measures set forth in Appendix Table C-2 of the Final EIS. Implementing these measures will avoid, minimize and mitigate impacts to grazing operations, wildlife, aquatic resources and other resources within the Ranch.

d. By controlling dust generated by CCSM Project construction activities through implementation of best management practices (BMPs) as listed in Appendix Table C-2 of the Final EIS. Controlling dust will avoid and minimize potential impacts resulting from reduced palatability of livestock forage and serve to maintain livestock health.

4. **Sage-grouse.** Through The Chokecherry and Sierra Madre Wind Energy Project Sage-Grouse Conservation Plan developed by PCW and dated August 2012 (the "Sage-grouse Conservation Plan"), PCW has committed that the CCSM Project will be developed in a way that complements and furthers federal, state and local goals to conserve the greater sage-grouse (*Centrocercus urophasianus*; hereafter sage-grouse). This Conservation Plan promotes sustainable sage-grouse populations and conservation of habitat through environmentally responsible planning and by incorporating the following principles: (1) protection of un-fragmented habitats (PCW's commitment to no development within sage-grouse core population areas [EO 2011-5, Version 3 map]); (2) minimization of habitat loss and fragmentation (CCSM Project long-term footprint is less than 2,000 acres); and (3) management of habitats to maintain, enhance or restore conditions that meet sage-grouse life history needs (implementation of conservation measures). This conservation program will address threats to sage-grouse and will set the standard for the development of renewable resources in an environmentally responsible manner. This will be achieved by implementing science-based conservation measures for sage-grouse that will reduce or eliminate current threats as well as protect, restore and enhance habitat of sage-grouse and other species of interest on the Ranch and within the CCSM Project site. These conservation measures will insure that vital seasonal and year-long habitats on the Ranch are managed responsibly for the benefit of the sage-grouse. These measures will have ancillary benefits to BLM sensitive species and other species including sagebrush obligates, grassland endemics, avian species, big game species and aquatic species (See Appendix 1 to Sage-grouse Conservation Plan).

In addition, the parties have jointly prepared and submitted an application to the U.S. Fish and Wildlife Service (USFWS) for an Enhancement of Survival Permit under Section 10(a)(1)(A) of the Endangered Species Act. The USFWS is currently reviewing the parties draft Candidate Conservation Agreement with Assurances ("CCAA") for sage-grouse, which will be expanded to include a Candidate Conservation Agreement ("CCA"), which will apply to the federal lands within the Ranch.

The parties agree as follows with respect to the Sage-grouse Conservation Plan and any CCAA and CCA ultimately approved by the USFWS:

a. TOTCO agrees to cooperate with PCW so that PCW and its contractors can implement conservation measures outlined in the Sage-grouse Conservation Plan and any CCAA ultimately approved by the USFWS covering lands within the Ranch. The parties acknowledge that such conservation measures may include, but are not limited to, removing and marking fences, water improvement projects and other habitat improvements, reclamation of unnecessary two-track and other roads, and control of noxious and invasive plants.

b. To the extent that the finalized Sage-grouse Conservation Plan and any CCAA approved by the USFWS provide for actions on the Ranch that affect TOTCO's grazing or other agricultural operations, TOTCO agrees to fully implement all such measures as provided for in the Sage-grouse Conservation Plan and/or CCAA. TOTCO and PCW will allocate the cost of implementation of such measures on an equitable basis between them depending on the particular conservation measure involved.

c. TOTCO agrees that where it controls public access to the Ranch, access will not be permitted for the purpose of hunting sage-grouse unless otherwise agreed to by TOTCO, PCW and WGFD.

d. The parties agree to each make available appropriate staff as necessary for implementation of the conservation measures outlined in the Sage-grouse Conservation Plan and any approved CCAA as well as to make available appropriate management level employees as may be needed to attend meetings with the BLM, WGFD, and USFWS or other applicable wildlife agencies with respect to implementation and monitoring of the Sage-grouse Conservation Plan and any approved CCAA.

5. **Mule Deer.** TOTCO and PCW agree to cooperate with WGFD and BLM in developing conservation and mitigation measures related to the Baggs Mule Deer Herd and the Platte Valley Mule Deer Herd. Such measures may include: cooperative research with the University of Wyoming; collaring animals to obtain more information on the herd; and monitoring of the habitat. TOTCO has and will continue to cooperate with the WGFD and the University of Wyoming on pronghorn antelope studies by providing access to the Ranch as requested on a case-by-case basis. The CCSM Project is not expected to have an impact on either the Sierra Madre or the Elk Mountain elk herds because the majority of the high quality elk habitat is located within Sage-Grouse Core Population Areas, where no wind development activities will occur.

6. **Birds and Bats.** PCW is developing an avian and bat protection plan for those species under the jurisdiction of the WGFD as directed by the Wildlife Protection

Recommendations. PCW is working with the USFWS on a Bird and Bat Conservation Strategy ("BBCS") and an Eagle Conservation Plan ("ECP") that address conservation measures that will avoid, minimize and mitigate potential impacts of the CCSM Project on Avian and Bat Trust Species. TOTCO agrees to support PCW in implementation of the BBCS and ECP by providing reasonable access throughout the Ranch for avian and bat surveys and monitoring. TOTCO also agrees to allow PCW access to the Ranch to implement conservation measures required under the USFWS approved BBCS and ECP so long as such conservation measures do not unreasonably interfere with TOTCO's operations and are consistent with TOTCO's livestock management goals and practices as set forth in this Agreement.

7. **Watersheds.** PCW has developed a watershed monitoring plan for the CCSM Project designed to better define current watershed conditions and monitor future conditions of the watersheds. Sites from which channel characteristics and water quality will be monitored are located on TOTCO lands and state and public lands. TOTCO agrees to provide reasonable access to PCW to watershed monitoring sites on the Ranch as currently located or as may be from time to time established or relocated.

8. **Fish.** As set forth in the MOU, TOTCO has agreed to provide access to the Upper Muddy Creek drainage to designated WGFD personnel, or their supervised designees from the BLM or U.S. Forest Service, during the term of the MOU for the purpose of conducting fish surveys, the installation and maintenance of fish migration barriers, and performing mechanical and chemical treatments for habitat enhancement. The goal is to restore native roundtail chub (*Gila robusta*), bluehead sucker (*Catostomus discobolus*), flannelmouth sucker (*Catostomus latipinnis*), mountain sucker (*Catostomus platyrhynchus*), Colorado River cutthroat (*Oncorhynchus clarkii pleuriticus*) and speckled dace (*Rhinichthys osculus*) ("Upper Muddy Creek Fish Species") through improvement and enhancement of habitat.

9. **Reporting and Technical Committee.** Prior to January 31 of each year, PCW will prepare a report summarizing the previous year's wildlife monitoring program and results, and the effectiveness of PCW's wildlife protection measures and best management practices. This report will be distributed to all members of the wildlife technical advisory committee described below.

   TOTCO, PCW, and WGFD will form a wildlife technical advisory committee (Wildlife TAC). The Wildlife TAC may include other federal, state or local permitting agencies, such as the Industrial Siting Council or its appointed representative, as required by law. The Wildlife TAC will meet at least annually prior to March 15 to review the prior year's wildlife monitoring results,

implementation of wildlife protection measures and best management practices. Based upon prior year's results, the Wildlife TAC may recommend modification, addition or removal of monitoring protocols, wildlife protection measures or best management practices. PCW will consider the Wildlife TAC's recommendations and notify the Wildlife TAC which recommendations it will implement, consistent with PCW's federal permits for the CCSM Project.

The Wildlife TAC will meet each year during CCSM Project construction and for the first three years post-construction. Thereafter, the Wildlife TAC will determine how often to meet, but it shall be at least once every five years. The Wildlife TAC may also modify the schedule for reports to the Wildlife TAC.

10. **Post-Construction Monitoring.** PCW has agreed to post-construction monitoring as set out in Attachment A. TOTCO agrees to support PCW in implementation of its post-construction monitoring commitments by providing reasonable access throughout the Ranch as required for PCW to comply with its commitments.

11. **Reimbursement of Expenses.** Except as expressly provided otherwise in this Agreement, PCW shall reimburse TOTCO for all costs and expenses reasonably and directly incurred by TOTCO in its performance of its obligations under this Agreement.

12. **No Third-party Beneficiaries.** TOTCO and PCW are the only intended beneficiaries of this Agreement and no rights are hereby created for the benefit of any third party, including without limitation any government agency. WGFD is not a party to or an intended beneficiary of this Agreement.

13. **Breach and Remedies.** In the event of TOTCO's or PCW's material breach of this Agreement, the other party's sole remedy shall be to require specific performance of the breaching party's obligations under this Agreement. There shall be no other remedy in law or in equity other than specific performance of this Agreement, including a claim for damages of any kind. The parties shall endeavor to settle any dispute, controversy or claim arising out of or relating to this Agreement, or its breach, termination or validity, which has not been resolved by negotiation by the parties, by mediation under the then current Center for Public Resources ("CPR") Model Procedure for Mediation of Business Disputes. The neutral third party will be selected from the CPR Panel of Neutrals, with the assistance of CPR, unless the parties agree otherwise. If the matter has not been resolved within 10 days of the appointment of the neutral third party, then either party may bring an action related to the matter in any state court in Wyoming. PCW's breach of this Agreement shall not give rise to any claim of PCW's breach of (a) the MOU or (b) the Wind Easement.

14. **Covenants Running with Lands.** The provisions of this Agreement shall be covenants running with the Ranch lands and shall be binding upon and inure to the benefit of the successors and assigns of the parties hereto.

15. **No Representations or Warranties.** No representations or warranties of any kind are made by any party to this Agreement.

16. **Entire Agreement; Modification.** This agreement comprises the entire agreement between TOTCO and PCW with regard to the subject matter herein. The agreement shall not be modified, deleted or added to, except in writing signed by an authorized representative of TOTCO and PCW.

17. **Waiver.** The delay or failure of any party to enforce any of its rights under this Agreement shall not constitute a waiver of any such rights, unless such waiver is signed by an authorized representative of the waiving party and delivered to the other party. No custom or practice that may arise between the parties in the course of operating under this Agreement will be construed to waive any party's rights to either ensure the other party's strict performance with the terms and conditions of this Agreement, or to exercise any rights granted to it under this Agreement. Neither party shall be deemed to have waived any right conferred by this Agreement or under any applicable law unless such waiver is set forth in a written document signed by the party to be bound, and delivered to the other party. No express waiver by either party shall be construed as a continuing waiver of any future rights, including as a result of future breaches or defaults or defaults by the other party.

18. **Severability.** If any of the terms of this Agreement are in conflict with any applicable rule, regulation, order or law of a federal, state, county or municipal body, the terms so in conflict shall not apply and the applicable rule, regulation, order or law shall prevail. The provisions of this Agreement shall be deemed severable and the invalidity of any provision hereof shall not affect the validity of the remaining provisions.

19. **Choice of Law.** This Agreement shall be governed by and construed in accordance with the law of the State of Wyoming, excluding its conflict of laws provisions.

20. **Term.** This Agreement shall remain in effect for the life of the CCSM Project, including decommissioning and reclamation.

21. **Execution.** This Agreement may be executed and delivered in one or more counterparts, each of which when executed and delivered shall be an original, and all of which when executed shall constitute one and the same instrument. The exchange of copies of this Agreement and of signature pages by facsimile or by electronic

transmission in .pdf format shall constitute effective execution and delivery of this Agreement as to the parties, and shall be deemed to be their original signatures for all purposes. Any party that delivers an executed counterpart signature page by facsimile or in .pdf format shall promptly thereafter deliver a manually executed counterpart signature page to each of the other parties; provided, however, that the failure to do so shall not affect the validity, enforceability or binding effect of this Agreement.

22. **Recording**. This Agreement shall not be recorded.

[*Signature page follows*]

The Parties have executed this Agreement as of the date first written above.

THE OVERLAND TRAIL CATTLE COMPANY LLC

By: _____

Name: William J. Miller
Title: President

POWER COMPANY OF WYOMING LLC

By: _____

Name: Garry L. Miller
Title: Vice President, Land and Environmental Affairs

By its signature below, the Wyoming Game and Fish Department acknowledges that it has reviewed this Agreement and concurs with the terms and conditions applicable to the parties set forth above, and further acknowledges that this Agreement satisfies the applicable requirements of the Wildlife Protection Recommendations.

Wyoming Game and Fish Department

By: _____

Name:
Title:

The Parties have executed this Agreement as of the date first written above.

THE OVERLAND TRAIL CATTLE COMPANY LLC

By: _____

Name: William J. Miller
Title: President

POWER COMPANY OF WYOMING LLC

By: _____

Name: Garry L. Miller
Title: Vice President, Land and Environmental Affairs

By its signature below, the Wyoming Game and Fish Department acknowledges that it has reviewed this Agreement and concurs with the terms and conditions applicable to the parties set forth above, and further acknowledges that this Agreement satisfies the applicable requirements of the Wildlife Protection Recommendations.

Wyoming Game and Fish Department

By: _____

Name: John Kennedy
Title: Deputy Director

ATTACHMENT A

Chokecherry and Sierra Madre Wind Energy Project

Wyoming Game and Fish Department Wildlife Protection Recommendations for Wind Energy Development in Wyoming
Implementation of Post-Construction Monitoring Recommendations

Wildlife Resource	Citation[1]	WGFD Recommendations			CCSM Project Implementation
		Survey Type	Survey Objective and Use	WGFD Post-Construction Survey Duration Recommendation	
Bats	App. B, pp. 38 - 44	Habitat Evaluation	The results of habitat evaluations can be used to identify potential roosting and foraging areas for bats within project sites to prioritize surveys. A post-construction habitat evaluation is recommended following development of the project site. Compare pre- and post-construction habitat evaluations to quantify changes in habitats within the project site.	One-time	No sensitive bat habitats were identified in the CCSM Project Site; in addition, the CCSM Project design avoids placing wind turbines near the Bolten Rim, forested areas and reservoirs where bat habitat may exist. The location of the CCSM Project components precludes the need to re-evaluate bat habitat.
		Passive Acoustic	Identify and quantify bat species and relative abundance near the rotor sweep zone. Results can be used to identify bat species presence and describe bat behavior (e.g., spatial and temporal use, etc.) likely to occur near rotor sweep zone.	Three years	Should bat mortality exceed thresholds that will be identified with concurrence from the USFWS[4], the Wildlife TAC will provide recommendations for additional monitoring.[3]
		Carcass Search	Identify and quantify bat species mortality after construction of turbines. The results of post-construction carcass searches are used to estimate mortality rates of bats at wind energy development sites.	Three years	PCW will conduct monitoring for two years post-construction as recommended by the U.S. Fish and Wildlife Service Land-based Wind Energy Guidelines (Wind Energy Guidelines)[5] or as agreed upon with USFWS through concurrence on the BBCS[6] for the CCSM Project. PCW will conduct a third year of post-construction monitoring using protocols agreed upon by the Wildlife TAC.[8]
Passerines and Raptors	App. B, pp. 45 - 48	Fixed-radius 20 minute Point Count Surveys	Detect resident and migrant passerines, and other localized birds.	Three years	PCW will conduct monitoring for two years post-construction as recommended by the Wind Energy Guidelines[5] and Eagle Conservation Plan (ECP) Guidance[7] or as agreed upon with USFWS through concurrence on the BBCS and ECP for the CCSM Project. PCW will conduct a third year of post-construction monitoring using protocols agreed upon by the Wildlife TAC.[8]
		Fixed-radius Day-long Point Count Surveys	Document the species and number of birds observed, their movements and distribution, the proportion of birds occurring within the rotor sweep area, and altitude and orientation of flight during various weather conditions	Three years	PCW will conduct monitoring for two years post-construction as recommended by the Wind Energy Guidelines[5] and ECP Guidance[7] or as agreed upon with USFWS through concurrence on the BBCS and ECP for the CCSM Project. PCW will conduct a third year of post-construction monitoring using protocols agreed upon by the Wildlife TAC.[8]
		Nest Search Surveys	Locate raptor nest structures within suitable habitat	Three years	PCW will conduct monitoring for two years post-construction as recommended by the Wind Energy Guidelines[5] and ECP Guidance[7] or as agreed upon with USFWS through concurrence on the BBCS and ECP for the CCSM Project. PCW will conduct a third year of post-construction monitoring using protocols agreed upon by the Wildlife TAC.[8]

Wyoming Game and Fish Department Wildlife Protection Recommendations for Wind Energy Development in Wyoming
Implementation of Post-Construction Monitoring Recommendations

Wildlife Resource	Citation[1]	WGFD Recommendations			CCSM Project Implementation
		Survey Type	Survey Objective and Use	WGFD Post-Construction Survey Duration Recommendation	
Passerines and Raptors	App. B, pp. 45 - 48	Carcass Search and Collection	Estimate annual fatality rates	Three years	PCW will conduct monitoring for two years post-construction as recommended by the Wind Energy Guidelines[5] and ECP Guidance[7] or as agreed upon with USFWS through concurrence on the BBCS and ECP for the CCSM Project. PCW will conduct a third year of post-construction monitoring using protocols agreed upon by the Wildlife TAC.[8]
Sage-Grouse	App. B, pp. 48 - 49	Lek Counts	Collect research response variables to support multi-state industry supported research programs and identify changes in distribution, movements, and habitat use	Three years	PCW will continue to work with BLM and WGFD to perform annual lek counts within the Ranch for five years post-construction.
Big Game	App. B, pp. 49	Telemetry Study	Collect post-development data in support of multi-state industry supported research programs that will help identify any associated impacts	Three years	PCW will continue to coordinate with WGFD on on-going mule deer monitoring for three years post-construction.
Amphibians	App. B, pp. 49 - 51	Incidental Observations[2]	Incidental observations while performing other wildlife surveys will allow for trend data, which could elucidate possible shifts in species assemblages resulting from energy development.	Three years	Incidental observations will be recorded by wildlife biologists during other wildlife surveys
Reptiles	App. B, pp. 52 - 56	Incidental Observations[2]	Incidental observations while performing other wildlife surveys will allow for trend data, which could elucidate possible shifts in species assemblages resulting from energy development.	Three years	Incidental observations will be recorded by wildlife biologists during other wildlife surveys
Aquatics	App B, pp. 57 - 66	Monitor culverts and roads with 5% or greater slopes	The purpose of monitoring culverts and roads with 5% or greater slope is to determine the presence, absence and/or extent of cumulative impacts resulting from changes to the upland surface hydrology, erosion and deposition, to ensure that culverts are functioning as designed and are being maintained and to ensure that the long-term BMPs that were installed are still functioning and are being maintained.	Two years post SWPPP release	PCW will monitor the CCSM Project Site in accordance with the SWPPP, Erosion Control Plan and the Reclamation Plan. The monitoring provisions of the Erosion Control Plan and Reclamation Plan extend at least two years post SWPPP release.

Chokecherry and Sierra Madre Wind Energy Project

Wyoming Game and Fish Department Wildlife Protection Recommendations for Wind Energy Development in Wyoming
Implementation of Post-Construction Monitoring Recommendations

Wildlife Resource	Citation[1]	WGFD Recommendations			CCSM Project Implementation
		Survey Type	Survey Objective and Use	WGFD Post-Construction Survey Duration Recommendation	
Aquatics	App B, pp. 57 - 66	Geomorphological Monitoring	The purpose of geomorphological monitoring activities is to determine the presence, absence and/or extent of cumulative impacts resulting from changes to upland surface hydrology, erosion and deposition and the potential for impacting habitats important to fish, macroinvertebrates, reptiles and amphibians.	Three years from preconstruction survey	PCW will continue watershed monitoring until three years post-construction, in accordance with the Watershed Monitoring Plan for the CCSM Project.

1. Wyoming Game and Fish Commission. 2010. "Wildlife Protection Recommendations for Wind Energy Development in Wyoming." November 17, 2010. http://wgfd.wyo.gov/web2011/Departments/Wildlife/pdfs/WINDENERGY_WILDLIFEPROTECTION0000703.pdf .
2. No occupied or important habitat for Species of the Greatest Conservation Need (SGCN), as identified by the Wyoming Game and Fish Department in the 2010 State Wildlife Action Plan was identified on the CCSM Project Site.
3. USFWS = United States Fish and Wildlife Service.
4. U.S. Fish and Wildlife Service. 2012. "U.S. Fish and Wildlife Service Land-based wind Energy Guidelines" March 23, 2012.
5. BBCS = Bird and Bat conservation Strategy.
6. U.S. Fish and Wildlife Service. 2013. "Eagle Conservation Plan Guidance, Module 1 – Land-based Wind Energy, Version 2" April 2013.
7. The Wildlife Technical Advisory Committee (Wildlife TAC) membership is described in Section 9 of "The Overland Trail Ranch, Chokecherry and Sierra Madre Wind Energy Project Conservation Plan and Landowner Agreement."

APPENDIX I

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Chokecherry and Sierra Madre Wind Energy Project

Applicability of BLM Environmental Constraints, Applicant Committed Measures, Applicant Committed Best Management Practices, and Proposed Mitigation Measures to Migratory Birds and Bats

Phase I Wind Turbine Development

Prepared by

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August 2015

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Cultural – Historic Trails	Within either 0.25-mile or the visual horizon (whichever is closer) of a cultural property/ historic trails.	No surface disturbing activities. Management actions resulting in visual elements that diminish the integrity of the property's setting will be managed in accordance with the Wyoming State Protocol and BMPs.	Yes[4]	Yes	Yes	1	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines; Wind Energy Programmatic EIS ROD Policies and BMPs.	No applicability to migratory birds and bats
Recreation Sites	Within 0.25-mile of developed and undeveloped recreation sites.	Lands closed to operation of public land laws.	Yes[4]	Yes[4]	Yes[4]	1	2008 Rawlins RMP ROD.	No applicability to migratory birds and bats. There are no developed or undeveloped recreation sites within 0.25 mile of the Phase I Wind Turbine Development Site.
Soils – Slopes	Steep slopes >25 percent.	Surface disturbance will be prohibited. No turbines, staging or substations.	Yes[5]	Yes[5]	Yes[5]	1	Wyoming BLM Mitigation Guidelines.	Measure will reduce erosion and soil loss in steep areas maintaining habitats that are used by migratory birds and bats.
Special Management Areas – Designated Areas	Designated areas part of the National Landscape Conservation System (e.g., Continental Divide National Scenic Trail [CDNST]).	Lands will be excluded from wind energy site monitoring and testing and development on lands on which wind energy development is incompatible with specific resource values. (0.25-mile swath centered on the trail)	n/a	Yes[4]	Yes	1	Wind Energy Programmatic EIS ROD Policies and BMPs.	No applicability to migratory birds and bats. The Phase I Wind Turbine Development is not located within 0.25 mile of areas designated as part of the National Landscape Conservation System.
Water – Ephemeral Channels	Within 100 feet from the inner gorge of ephemeral channels.	Avoidance areas for surface-disturbing and disruptive activities and linear crossings. Only those actions within areas that cannot be avoided and that provide protection for the resource identified will be approved.	No[5]	No[5]	Yes[5]	1	2008 Rawlins RMP ROD.	Measure will maintain vegetation and riparian corridors used by migratory birds and bats.
Water – Floodplains	Identified 100-year floodplains.	Surface disturbing activities will be avoided. Only those actions within areas that cannot be avoided and that provide protection for the resource identified will be approved.	No	No	Yes	1	2008 Rawlins RMP ROD.	Measure will maintain vegetation and riparian corridors used by migratory birds and bats.
Water – Perennial Waters, Springs, Wetlands, Riparian	Within 500 feet of perennial waters, springs, and wetland and riparian areas.	Surface disturbing activities will be avoided. Only those actions within areas that cannot be avoided and that provide protection for the resource identified will be approved.	No[4,5]	No[4,5]	Yes[5]	1	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines; Executive Orders (EOs) 11990 and 11988.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
Water – Unstable Areas	Unstable areas (such as landslides, slopes >25 percent, slumps, and areas exhibiting soil creep).	Surface disturbing activities will be avoided. Reclamation practices and BMPs will be applied as appropriate for surface disturbing activities.	No	No	Yes	1	2008 Rawlins RMP ROD.	Measure will reduce erosion and soil loss in steep areas maintaining habitats that are used by migratory birds and bats.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Water – Wetlands	Wetlands identified on National Wetlands Inventory (NWI) or proper functioning condition (PFC).[6]	No disturbance.	No	No	Yes	1	EOs 11990 and 11988.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
Wildlife – Amphibians	Identified 100-year floodplains; within 500 feet of perennial waters, springs, wells, and wetlands; and within 100 feet of the inner gorge of ephemeral channels.	Surface disturbing and disruptive activities will be avoided.	No	No	Yes	1	2008 Rawlins RMP ROD.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
Wildlife – Fish	Waterbodies that potentially support fish for a portion of the year.	Design road crossings to simulate natural stream processes.	No	No	Yes	1	2008 Rawlins RMP ROD.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
Wildlife – Raptors	825 feet of active raptor nests (ferruginous hawks, 1,200 feet).	Well locations, roads, ancillary facilities, and other surface structures requiring a repeated human presence will not be allowed. Distance may vary depending on factors such as nest activity, species, natural topographic barriers, and line-of-sight distances.	Yes	Yes	Yes	1	2008 Rawlins RMP ROD.	Measure will minimize impacts to active raptor nests.
Wildlife-Columbian Sharp-tailed Grouse	0.25 mile to 1 mile of an occupied or undetermined Columbian sharp-tailed grouse lek.	High-profile structures (e.g., buildings, storage tanks, overhead powerlines, wind turbines, towers, and windmills) would be authorized on a case-by-case basis from one-quarter mile to 1 mile of an occupied greater sage-grouse and sharp-tailed grouse lek.	No	No	Yes	1	2008 Rawlins RMP ROD.	No applicability to migratory birds and bats. Columbian sharp-tailed grouse do not occur within 1-mile of Phase I.
Wildlife – Greater Sage-grouse	Inside Core Areas: 0.60 mile NSU from lek perimeter (includes occupied and undetermined leks). Outside Core Areas: 0.25 mile NSU from lek perimeter (includes occupied and undetermined leks).	Surface disturbing activities or surface occupancy is prohibited or restricted.	Yes	Yes	Yes	1	BLM IM No. WY-2012-019	Measure will minimize impacts to sagebrush habitats that are used by sagebrush obligate bird species and other migratory bird and bat species.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Wildlife – Greater Sage-grouse	Inside Core Areas.	Limit development to one disturbance location per 640 acres. Cumulative value of one location and existing disturbance to not exceed 5 percent of sagebrush habitat within 640 acres	No	No	Yes	1	BLM IM No. WY-2012-019	PCW has committed to site the CCSM Project outside designated greater sage-grouse core areas (Order 2011-5, Attachment A, Sage-Grouse Core Breeding Areas Version 3). Measure will avoid impacts, including fragmentation, to habitats that are used by sagebrush obligate bird species and other migratory bird and bat species.
Wildlife – Greater Sage-Grouse	0.25-mile to 1 mile of an occupied sage-grouse lek.	High-profile structures (e.g., buildings, storage tanks, overhead power lines, wind turbines, towers, and windmills) will be authorized on a case-by-case basis.	No	No	Yes	1	2008 Rawlins RMP ROD.	No applicability to migratory birds and bats.
Wildlife – Greater Sage-grouse	Inside Core Areas: Within 0.60-mile of the perimeter of an occupied or undetermined greater sage-grouse lek. Outside Core Areas: Within 0.25-mile of the perimeter of an occupied or undetermined greater sage-grouse lek.	Disruptive activities are restricted between 6:00 p.m. and 9:00 a.m. from March 1 to May 20.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD; BLM IM No. WY-2012-019.	Measure will reduce disturbance of nocturnal and crepuscular species across Phase I.
Wildlife – Greater Sage-grouse	Inside Core Areas: In suitable greater sage-grouse nesting and early brood-rearing habitat. Outside Core Areas: In suitable greater sage-grouse nesting and early brood-rearing habitat within 1) mapped habitat important for connectivity, or 2) within 2 miles of any occupied or undetermined lek.	Surface disturbing and/or disruptive activities are prohibited or restricted from March 1 – July 15.	No[7]	No[7]	Yes	2	BLM IM No. WY-2012-019; 2008 Rawlins RMP ROD.	Measure will reduce impacts to migrating and nesting migratory birds and bats that use sagebrush habitat and other associated habitats within Phase I.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Wildlife – Greater Sage-grouse	Greater sage-grouse delineated winter concentration areas.	Surface disturbing and/or disruptive activities in mapped or modeled greater sage-grouse winter habitats/concentration areas that support Core Area populations, are prohibited or restricted from November 15 – March 14.	No[7]	No[7]	Yes	2	BLM IM No. WY-2012-019; 2008 Rawlins RMP ROD.	No applicability to migratory birds and bats. There are no delineated greater sage-grouse winter concentration areas in the CCSM Project Site.
Wildlife – Columbian Sharp-tailed Grouse	Within 0.25-mile of the perimeter of an occupied or undetermined Columbian sharp-tailed grouse lek.	Surface disturbing activities or occupancy are prohibited. Disruptive activities are prohibited between 6:00 p.m. and 9:00 a.m. from March 1 to May 20.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No applicability to migratory birds and bats. Columbian sharp-tailed grouse do not occur in CCSM Project Site.
Wildlife – Barn Owl	Within 0.75-mile of barn owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Barn owls are not known to occur in the CCSM Project Site. In the unlikely event that a barn owl nest is discovered, this measure will reduce impacts to the nest when active.
Wildlife – Big Game	Big game crucial winter range.	Surface disturbing and disruptive activities will not be allowed during the period of November 15 to April 30. Disruptive activities will require the use of BMPs designed to reduce the amount of human presence and activity during the winter months.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines.	Limited applicability to migratory birds and bats. No bats and very few migratory birds occur in Phase I during winter. However, measure will reduce impacts and disturbance to migratory bird species using Phase I in winter.
Wildlife – Big Game	Big game parturition areas.	Surface disturbing and disruptive activities will not be allowed during the period of May 1 to June 30.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD; Wyoming BLM Mitigation Guidelines.	No applicability. No big game parturition areas occur in Phase I.
Wildlife – Burrowing Owl	Within 0.75-mile of burrowing owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 15–September 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active burrowing owl nests.
Wildlife – Cooper's Hawk	Within 0.75-mile of Cooper's hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active Cooper's hawk nests.
Wildlife – Ferruginous Hawk	Within 1-mile buffer of ferruginous hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active ferruginous hawk nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active ferruginous hawk nests that may occur in the future.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Wildlife – Golden Eagle	Within 1-mile buffer of golden eagle nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	PCW's Phase I ECP describes the benefits of the avoidance and minimization measures developed for golden eagles.
Wildlife – Goshawk	Within 0.75-mile of Goshawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–August 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active goshawk nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active goshawk nests that may occur in the future.
Wildlife – Great-Horned Owl	Within 0.75-mile of great-horned owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active great horned owl nests.
Wildlife – Kestrel	Within 0.75-mile of kestrel nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active American kestrel nests.
Wildlife – Long-Eared Owl	Within 0.75-mile of long-eared owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active long-eared owl nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active long-eared owl nests that may occur in the future.
Wildlife – Merlin	Within 0.75-mile of Merlin nests.	Seasonal wildlife stipulation April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active merlin nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active merlin nests that may occur in the future.
Wildlife – Mountain Plover	Potential and occupied habitat Mountain plover.	Habitat will be avoided where practical. All surface-disturbing activities will be restricted from April 10 to July 10. Additional protection measures will be applied if this area is later determined to be within occupied habitat. Occupied habitat is defined as areas where broods and adults have been found.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to mountain plovers and other migratory bird and bat species that use occupied mountain plover habitats.
Wildlife – Northern Harrier	Within 0.75-mile of northern harrier nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active northern harrier nests.
Wildlife – Osprey	Within 0.75-mile of osprey nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active osprey nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active osprey nests that may occur in the future.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			
Wildlife – Peregrine Falcon	Within 0.75-mile of peregrine falcon nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active peregrine falcon nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active peregrine falcon nests that may occur in the future.
Wildlife – Prairie Falcon	Within 0.75-mile of prairie falcon nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active prairie falcon nests.
Wildlife – Raptor	Defined raptor and game bird winter concentration areas.	Activities or surface use will not be allowed from November 15 to April 30.	No[7]	No[7]	Yes	2	Wyoming BLM Mitigation Guidelines.	No applicability to migratory birds and bats. No raptor or game bird winter concentration areas occur in the CCSM Project Site.
Wildlife – Raptor	Raptor nesting habitat.	Activities or surface use will not be allowed from February 1 to July 31.	No[7]	No[7]	Yes	2	Wyoming BLM Mitigation Guidelines.	Measure will minimize impacts to active raptor nests.
Wildlife – Raptors	Within 0.75-mile of other raptor nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active raptor nests.
Wildlife – Red-Tailed Hawk	Within 0.75-mile of red-tailed hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited February 1–July 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to active red-tailed hawk nests.
Wildlife – Screech Owl	Within 0.75-mile of screech owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active screech owl nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active screech owl nests that may occur in the future.
Wildlife – Sharp-Shinned Hawk	Within 0.75-mile of sharp-shinned hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to sharp-shinned hawk nests.
Wildlife – Short-Eared Owl	Within 0.75-mile of short-eared owl nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited March 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No active short-eared owl nests have been documented in more than 5 years of monitoring for the CCSM Project. However, measure will minimize impacts to any active short-eared owl nests that may occur in the future.
Wildlife – Swainson's Hawk	Within 0.75-mile of Swainson's hawk nests.	Surface disturbing and disruptive activities potentially disruptive are prohibited April 1–July 31.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	Measure will minimize impacts to sharp-shinned hawk nests.
Wildlife – Western Yellow-billed Cuckoo	Within 0.5 mile radius yellow-billed cuckoo nest.	Seasonal wildlife stipulation April 15–August 15.	No[7]	No[7]	Yes	2	2008 Rawlins RMP ROD.	No suitable western yellow-billed cuckoo habitat is present within the vicinity of the CCSM Project Site.

TABLE 1. SUMMARY OF BLM ENVIRONMENTAL CONSTRAINTS (ROD TABLE D-1)

Resource Area	Resource Concern	Protection Measure	Application to Jurisdiction[1]			Mitigation Type[2]	Authority/Source	Applicability to Migratory Birds and Bats
			Private Land[3]	State Land	Public Land			

Notes:

[1] Sources of information for application of stipulations for private and state lands include *Applicant Proposed Alternative and BLM Response Letter* (April 23, 2010), *PCW Response and Data on BLM Alternatives* (December 2009), and the *Plan of Development for the Chokecherry and Sierra Madre Wind Energy Project* (January 12, 2012).

[2] 1 = Restriction; 2 = Seasonal.

[3] As indicated in PCW's submittal entitled *Applicant Proposed Alternative and BLM Response Letter* (April 23, 2010).

[4] Applicant imposes more restrictive measures or applies measure to a specific area, see summary table of PCW ACMs.

[5] Per the *PCW Response and Data on BLM Alternatives* (December 2009) footnotes to Alternatives Summaries #18, "No Surface Uses (NSUs), as provided by BLM, were avoided to the extent practicable; however, some NSUs could not be completely avoided in a small number of discreet instances (mainly ephemeral streams, slope, and perennial streams/springs/wetlands/riparian). An example of an exception to the NSUs is where a turbine is located in an area that cannot be accessed without crossing an ephemeral stream. If it is determined that the stream is a Water of the U.S., then a Section 404 permit will be obtained thereby allowing an access road to be constructed. Another example is the slope criteria. The accuracy of the digital terrain model used for this analysis is insufficient for micro-siting. Engineering judgment was used to determine in a limited number of cases that it may be possible to grade a resource road to design criteria."

[6] See Chapter 8.0, Glossary.

[7] Per the *PCW Response and Data on BLM Alternatives* (December 2009) footnotes to Alternatives Summaries #10, "seasonal timing restrictions were not applied to construction activities on private land."

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-01	ESA, sensitive species, and other wildlife and fish species	Site-specific surveys and/or monitoring for ESA threatened and endangered species, BLM sensitive species and other wildlife and fish species will take place during each phase of construction. Survey and monitoring approaches will be developed in coordination with USFWS, BLM, and WGFD and will be identified in the site-specific PODs developed for each construction right-of-way grant.	Site-specific survey requirements have identified sensitive habitats and areas of avian use. Data was used to avoid and minimize impacts to migratory birds and bats as documented in Phase I BBCS.
A-1-02	Avian and Bat Species, Golden and Bald Eagles	PCW will develop an Avian Protection Plan (APP), a Bat Protection Plan (BPP) and an Eagle Conservation Strategy (ECS) to identify measures to avoid, minimize, and mitigate project impacts through siting, operations, and monitoring.	The Phase I BBCS identifies measures to avoid, minimize, and mitigate project impacts to migratory birds and bats through siting, operations, and monitoring.
A-1-03	Greater Sage-grouse	PCW will comply with EO 2011-5 and commit to no construction activities within Wyoming's SGCA as they are identified in EO 2011-5 (Core Area Version 3 Map).	PCW has committed to locate the CCSM Project outside designated greater sage-grouse core areas (Order 2011-5, Attachment A, Sage-Grouse Core Breeding Areas Version 3). Measure will avoid impacts, including fragmentation, to habitats that are used by sagebrush obligate bird species and other migratory bird and bat species.
A-1-04	Wildlife Habitat Management Areas	PCW will not construct any facilities within portions of the Red Rim-Grizzly WHMA and Upper Muddy Creek Watershed-Grizzly WHMA that are within the Wyoming Sage-Grouse Core Management Area Version 3 Map (EO 2011-5).	See response to A-1-03.
A-1-05	Mule Deer	PCW will continue to coordinate with WGFD on ongoing mule deer monitoring efforts on the Ranch.	No applicability to migratory birds and bats.

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-06	Colorado River Fishes – bluehead sucker, flannelmouth sucker, roundtail chub, Colorado River cutthroat trout	PCW will continue to work with WGFD and BLM to develop conservation and monitoring strategies for native fish species in the Upper Muddy Creek watershed.	No applicability to migratory birds and bats.
A-1-07	Fish species, amphibian species, other stream obligates; water quality	PCW will monitor watershed and stream conditions throughout the Application Area to document hydrologic conditions and stream channel characteristics (see Appendix F – Watershed Monitoring Plan).	Measure will document any changes to hydrologic conditions and stream channel characteristics that might impact habitats used by migratory birds and bats.
A-1-08	Other wildlife species	PCW will continue to incorporate the outcome of site-specific surveys to microsite infrastructure in order to avoid, minimize, or mitigate impacts to wildlife species.	Site-specific surveys were used to microsite Phase I to avoid, minimize and mitigate impacts to sensitive wildlife species including migratory birds and bats.
A-1-09	Wildlife Stipulations	PCW will adhere to the timing and spatial stipulations and exception processes as they are described in the Project ROD.	Measure benefits migratory birds and bats as documented in this appendix (Appendix I).
A-1-10	Wildlife Stipulations	Timing and spatial stipulations will be used on public lands.	Measure benefits migratory birds and bats as documented in this appendix (Appendix I).
A-1-11	Avian and Bat Monitoring	PCW will develop a project Avian Protection Plan, Bat Protection Plan and Eagle Conservation Strategy that will each describe post-construction monitoring efforts for avian and bat species.	The Phase I BBCS identifies post-construction monitoring and adaptive management processes designed to benefit migratory birds and bats.
A-1-12	Wildlife Monitoring and Survey	PCW will continue to incorporate the outcome of site-specific surveys to microsite infrastructure in order to avoid, minimize, or mitigate impacts to sensitive wildlife species.	Site-specific surveys were used to microsite Phase I to avoid, minimize and mitigate impacts to sensitive wildlife species including migratory birds and bats.

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-13	Vegetation	Vegetation datasets developed by PCW will be used during project design to identify sensitive vegetation types for avoidance, minimization or mitigation and to optimize the reclamation plans for each construction phase.	PCW used its vegetation datasets to avoid and minimize impacts, including fragmentation, to sensitive vegetation within Phase I. The reclamation plan for Phase I identifies appropriate BMPs to minimize and mitigate remaining impacts. These measures will benefit migratory birds and bats that use those habitats.
A-1-14	Colorado butterfly plant and Ute ladies'-tresses orchid	Site-specific surveys for both plant species will be completed prior to surface disturbing activities in suitable habitat.	No applicability to migratory birds and bats.
A-1-15	Revegetation and Reclamation	PCW will develop detailed reclamation plans for each of the construction phases and right-of-way grants. These plans will consider site-specific conditions and design considerations to maximize reclamation success.	The reclamation plan for Phase I identifies BMPs to minimize and mitigate vegetation impacts. These measures will benefit migratory birds and bats that use habitats disturbed by Phase I.
A-1-16	Wetland Resources	Facilities would be sited to avoid and/or minimize impacts.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
A-1-17	Wetland Resources	Any construction that occurs in or adjacent to wetlands and streams would use BMPs to protect surface water quality and minimize impacts to those resources.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
A-1-18	Cultural Resources	Class III inventories of all proposed disturbance areas associated with the site-specific POD will be conducted prior to construction.	No applicability to migratory birds and bats.
A-1-19	Cultural Resources	All cultural resource identification, evaluation, and treatment, including as a result of unexpected discovery at such time that construction has been permitted, will follow the stipulations of the Programmatic Agreement (PA) established for the project.	No applicability to migratory birds and bats.

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-20	Paleontological Resources	In the event that fossils are discovered on public lands during construction activities, PCW will suspend work in that area, have an on-call paleontologist review the fossils, and notify the BLM. PCW expects the significance of the discovery and the resulting course of action to be determined within 48 hours of discovery.	No applicability to migratory birds and bats.
A-1-21	Watershed Resources	PCW has implemented a watershed monitoring program to evaluate potential impacts of project construction and operations. PCW commits to continue watershed monitoring efforts for three years post-construction.	Measure will document any changes to hydrologic conditions and stream channel characteristics that may impact habitats used by migratory birds and bats.
A-1-22	Greater Sage-Grouse	PCW will work cooperatively with BLM and WGFD to perform annual lek monitoring within the Ranch in accordance with approved WGFD protocols during pre-construction, construction and for five years post-construction.	No applicability to migratory birds and bats.
A-1-23	Greater Sage-Grouse	PCW will work with BLM and private landowners to identify fences that pose a significant collision risk to sage-grouse. Identified fences will be removed or marked as practicable. To date PCW and TOTCO have removed over 10 miles of fence and have marked an additional 16 miles of fence with reflective bird diverters.	Removing or marking fences will avoid and minimize risks to migratory birds.

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-24	Greater Sage-Grouse	PCW will work with BLM and private landowners to evaluate proposed new fences and determine the risk of such fences to sage-grouse. If significant risk exists, new fence construction will be deferred where possible; if fences must be constructed they will be marked with reflective bird diverters.	Proper planning of new fences will avoid and minimize risks to migratory birds.
A-1-25	Avian Species including Bald and golden Eagles and Greater Sage-Grouse	Guy wires on meteorological towers will be marked with reflective bird diverters. To date PCW has marked all guy wires on Project meteorological towers with reflective bird diverters.	Phase I meteorological towers do not include guy wires. This avoids the risk of collision for migratory birds and bats.
A-1-26	Wildlife including Greater Sage-Grouse, Other Avian Species and Small Mammals	PCW will work with private landowners to install metal mesh escape ladders in water tanks that pose a risk to wildlife species. To date, PCW and TOTCO have installed metal mesh escape ramps on many Ranch water tanks.	Water tanks are a known source of mortality for migratory birds. Installation of escape ladders will avoid and minimize this risk.
A-1-27	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with BLM and private landowners to stabilize and rehabilitate burned areas to promote the biological integrity of the site and limit expansion of invasive species. In 2010 PCW and TOTCO pursued stabilization and recovery of a burned area in the Chokecherry site with an emphasis on rapid recovery and use of the area by sage-grouse and other species.	Rehabilitation of burned areas will restore native vegetation communities, decrease habitat fragmentation, avoid displacement, and maintain habitat for migratory birds and bats.
A-1-28	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with private landowners and water right owners to pursue water improvement conservation projects to benefit greater sage-grouse and other wildlife species in accordance with all applicable rules and regulations.	Water improvement conservation projects will benefit migratory birds and bats that use those habitats.

TABLE 2. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Environmental Resource	Applicant Committed Measure	Applicability to Migratory Birds and Bats
A-1-29	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with private land owners to enhance fallow agricultural fields on the Ranch located east of the North Platte River. Enhancements include vegetation treatments to improve forage and cover for greater sage-grouse.	Restoration of sagebrush and other associated habitats will benefit sagebrush obligate species and other migratory bird and bat species through the reduction of habitat fragmentation.
A-1-30	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	To minimize habitat fragmentation PCW will work with BLM and private landowners to close unnecessary roadways and reclaim such roads where practicable.	Road closure and reclamation will reduce habitat fragmentation and eliminate vehicle collision risk for migratory birds and bats on those roadways.
A-1-31	Wildlife including Greater Sage-Grouse and Bald and Golden Eagles	PCW will work with BLM and private landowners to control the spread of noxious and invasive plant species.	Noxious weed management will benefit migratory bird and bat species by maintaining habitat functionality and avoiding habitat degradation and species displacement.
A-1-32	Greater Sage-Grouse	PCW will work with private landowners to suspend the hunting of sage-grouse on private lands within the Ranch	Reduction of lead in the environment benefits migratory birds that may ingest or otherwise come in contact with lead.
A-1-33	Greater Sage-Grouse	PCW will cooperate with agencies and private land owners to evaluate and implement predator control techniques to benefit sage-grouse as appropriate.	Reduction of sage-grouse non-avian predators will also decrease predation risks for migratory birds and bats.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To					Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads	Collection	T-Line		
A-2-01	Cultural Historic Trails	1 mile WTGs, 0.25 mile surface of the Overland Trail	Y	Y	Y	Y	Y	No, minimize crossings, cross at right angles			1 mile setback from the center of the Overland Trail as presently mapped (2008 RMP/ROD) in all areas except the following sections, where the BLM's RMP requirement of 0.25 miles were used: T18N R87W S6; T18N R88W S1; T18N R88W S2; T18N R88W S4; T18N R88W S7; T18N R88W S9; T18N R89W S11; T18N R89W S12; T18N R89W S13; T18N R89W S14; and the unmapped Overland Trail alternative route located in T18N R88W S6, T18N R89W S1, T18N R89W S2, T18N R89W S11, and T18N R89W S10.	No applicability to migratory birds and bats.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To					Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads	Collection	T-Line		
A-2-02	Lands and Realty - City/Town Limits	Structure base 0.5 mile setback	Y	Y	Y	Y	Y	No			Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure	No applicability to migratory birds and bats.
A-2-03	Lands and Realty Homes/ Occupied Buildings	Greater of 5.5 times total structure height or 1,000 ft. setback	Y	Y	Y	Y	N	No			Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure	No applicability to migratory birds and bats.
A-2-04	Lands and Realty - ROW Setback	5D from ROW boundary	N	N	Y	Y	N	No			Waiver may be granted	No applicability to migratory birds and bats.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To					Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads	Collection	T-Line		
A-2-05	Lands and Realty - Subdivisions	Greater of 5.5 times total structure height or 1,000 ft. setback	Y	Y	Y	Y	Y	Yes, except underground			Setback applies to all above-ground construction, underground appears permissible within setback	No applicability to migratory birds and bats.
A-2-06	Lands and Realty - WTGs	Tower base 1.1 times total structure height from external property lines	Y	Y	Y	Y	N	No			Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure	No applicability to migratory birds and bats.
A-2-07	Lands and Realty - WTGs	Tower base 1.1 times total structure height from any public ROWs	Y	Y	Y	Y	N	No			Setback only applies to "towers," term not defined in Act; PCW to apply setback to WTGs, overhead collection, and transmission structures based on the height of each structure	No applicability to migratory birds and bats.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To					Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads	Collection	T-Line		
A-2-08	Recreation - T eton Reservoir	1 mile boundary WTGs of Teton Reservoir	Y	Y	Y	Y	N	No			WTG placement would be prohibited within one mile of the Teton Reservoir Recreation Site.	Waterbirds/waterfowl and other migratory birds and bats that use areas within 1-mile of Teton Reservoir benefit from this measure.
A-2-09	Water - North Platte River	1 mile high water mark WTGs of the North Platte River	Y	Y	Y	Y	Y	No, avoid if possible			WTG placement would be prohibited within one mile of the ordinary high water mark of the North Platte River.	Waterbirds/waterfowl and other migratory birds and bats that use the areas within 1-mile of the ordinary high water mark of the North Platte River benefit from this measure.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To					Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads	Collection	T-Line		
A-2-10	Wildlife - Red Rim Grizzly Wildlife Habitat Area (WHMA)	No development within Red Rim-Grizzly WHMA within the Wyoming Sage-Grouse Core Management Areas Version 3 Map (finalized June 29, 2010)	Y	Y	Y	Y	Y	Yes			The Wyoming Game and Fish Department's (WGFD) Red Rim-Grizzly WHMA is approximately 37,630 acres in total, of which approximately 1,200 acres (3%) lie outside Sage-Grouse Core Management Areas Version 3. The area outside Sage-Grouse Core Management Areas Version 3 is located in the northeast corner of the Grizzly WHMA and is a part of or adjacent to Miller Hill. PCW may locate facilities within this area of the Grizzly WHMA.	Phase I is not located within the Red-Rim Grizzly WHMA. Avoidance of this area benefits the migratory bird and bat species that utilize the WHMA.

TABLE 3. SUMMARY OF APPLICANT COMMITTED MEASURES (ROD TABLE D-2)

Item	Resource Concern	Restriction Distance	Jurisdiction			Applies To					Notes	Applicability to Migratory Birds and Bats
			Private	State	BLM	WTGs	Subs	Roads	Collection	T-Line		
A-2-11	Wildlife-Sage-Grouse Core Breeding Area	No facilities within the Wyoming Sage-Grouse Core Management Area Version 3 Map (finalized June 29, 2010)	Y	Y	Y	Y	Y	Yes			No construction of any facilities (WTGs, roads, transmission lines, collector lines, substations, staging areas, etc.) in Wyoming's Sage-Grouse Core Management Areas Version 3 (finalized June 29, 2010).	PCW has committed to site the CCSM Project outside designated greater sage-grouse core areas (Order 2011-5, Attachment A, Sage-Grouse Core Breeding Areas Version 3). Measure will avoid impacts, including fragmentation, to habitats that are used by sagebrush obligate bird species and other migratory bird and bat species.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-01	Air – Dust Control	Water would be applied twice per day, or as deemed necessary by the Environmental Inspector, to all disturbed surfaces (i.e., exposed, dry, and unfrozen) during construction. During operation, dust control would occur twice per day in those areas where vehicular traffic exceeds normal operational needs. If, for example, heavy equipment is brought on site for maintenance or if vehicular traffic exceeds a few vehicles per day, additional dust control watering would be initiated.	Dust control measures decrease impacts to vegetation and benefit migratory birds and bats.
A-3-02	Air – Dust Control	Magnesium chloride may be applied, if necessary, for adequate dust suppression. These treatments would occur on an as-needed basis, depending on weather conditions and the amount of traffic on the road.	Dust control measures decrease impacts to vegetation and benefit migratory birds and bats.
A-3-03	Air – Dust Control	The driving surface of all roads constructed for project access would be surfaced with gravel to further reduce potential dust emissions.	Dust control measures decrease impacts to vegetation and benefit migratory birds and bats.
A-3-04	Air – Dust Control	Dust abatement techniques would be used on unpaved, unvegetated surfaces to minimize airborne dust. Dust abatement techniques would be employed on construction materials and stockpiled soils if they are a source of fugitive dust. Dust abatement techniques would be used before and during surface clearing, excavation, or blasting activities.	Dust control measures decrease impacts to vegetation and benefit migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-05	Air – Dust Control	Speed limits (e.g., 25 miles per hour [mph] [40 kilometers per hour [km/h]) would be posted along all access roads and enforced during construction and maintenance activities and enforced to reduce airborne fugitive dust.	Dust control measures decrease impacts to vegetation and benefit migratory birds and bats. Controlling vehicle speeds will also minimize risks associated with vehicle collision.
A-3-06	Air – Vehicle Emissions	All construction equipment would be maintained in good working condition and would contain appropriate pollution control devices to minimize trace gas emissions.	No direct benefit to migratory birds or bats.
A-3-07	Cultural and Paleontological Resources	Unexpected discovery of cultural or paleontological resources during construction would be brought to the attention of the responsible BLM authorized officer immediately. Work would be halted in the vicinity of the find to avoid further disturbance to the resources while they are being evaluated and appropriate mitigation measures are being developed.	No applicability to migratory birds and bats
A-3-08	General – Decommissioning	Prior to the termination of the right-of-way authorization, a decommissioning plan would be developed and approved by the BLM. The decommissioning plan would include a decommissioning impact analysis, site reclamation plan and monitoring program. All management plans, BMPs, and stipulations developed for the construction phase would be applied to similar activities during the decommissioning phase as agreed to between BLM and PCW.	Development of a decommissioning plan using the decommissioning BMPs described in the Phase I BBCS will minimize risks to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-09	General – Decommissioning	All turbines and ancillary (above-ground) structures would be removed from the site.	Removal of above-ground structures and reclamation of disturbed areas will benefit migratory birds and bats by returning habitat values. Removing above-ground structures will also remove collision risk for migratory birds and bats.
A-3-10	General – Avoidance of sensitive areas	PCW would work with the BLM to mitigate for environmentally sensitive areas. Marshy soils, drainage bottoms, and riparian areas would be avoided to the extent practicable.	Mitigation of environmentally sensitive areas will benefit the migratory bird and bat species that use those areas.
A-3-11	General – Electrical Lines	All underground electrical collector lines would be buried in a manner that minimizes additional surface disturbance (e.g., along roads or other paths of surface disturbance when possible).	Minimizing surface disturbance will benefit migratory birds and bats by retaining habitat value.
A-3-12	General – Environmental Compliance	An Environmental Compliance Plan (ECP) would be developed and implemented to monitor implementation of mitigation measures during project construction. An Environmental Inspector would be on-site to oversee the implementation of the Project ECP.	Implementation of the Environmental Compliance Plan will ensure compliance with the measures described in the Phase I BBCS that benefit migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-13	General – Maintenance	The transmission lines would be inspected two times per year by ground or aerial patrols, and maintenance would be performed as necessary. Substation maintenance activities would include routine, scheduled equipment maintenance and grounds keeping. Once reclamation is complete and vegetation is stable, noxious weed surveys of the Project areas would be conducted on a regular basis. Inspection of the Project access roads and internal resource roads would include weed monitoring and treatment, as outlined in the Weed Management Plan.	Maintenance of transmission lines will ensure compliance with APLIC standards and reduce risks to migratory bird species. Noxious weed management will benefit migratory bird and bat species by maintaining habitat functionality.
A-3-14	General – Maintenance	Inoperative turbines would be repaired, replaced or removed in a timely manner.	No applicability to migratory birds and bats.
A-3-15	General – Mitigation Measures	All control and mitigation measures established for the Project in the POD and the resource-specific management plans that are part of the POD would be maintained and implemented throughout the operational phase, as appropriate. These control and mitigation measures would be reviewed and revised, as needed, based on the mutual agreement of PCW and BLM, to address changing conditions or requirements within the Project area, throughout the operational phase. This dynamic approach would help ensure that impacts from operations are kept to a minimum.	Implementation of the control and mitigation measures in the POD as well as an adaptive management process will benefit migratory birds and bats to the extent the measures apply to migratory birds and bats.
A-3-16	General – Project Disturbance	The number and size/length of roads, temporary fences, lay-down areas, and borrow areas would be minimized.	Minimization of the project footprint has resulted in reduction of habitat impacts and fragmentation which benefits migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-17	General – Project Footprint	The area disturbed by construction-related activities (i.e., footprint) would be kept to a minimum.	Minimization of the project footprint has resulted in reduction in habitat impacts and fragmentation which benefits migratory birds and bats.
A-3-18	General – Project Footprint	The area disturbed by operational-related activities (i.e., footprint) would be kept to a minimum.	Minimization of the project footprint has resulted in reduction in habitat impacts and fragmentation which benefits migratory birds and bats.
A-3-19	Geology – Seismic Considerations	All structures will be built to appropriate seismic requirements for the local geology.	No applicability to migratory birds and bats.
A-3-20	Hazardous Materials – SPCC Plan	A Spill Prevention, Control, and Countermeasures (SPCC) Plan would be implemented during the construction and operation phases of Project. The SPCC would define procedures to be used in the event of an accidental spill from vehicles or other equipment.	Application of the SPCC will reduce potential impacts by preventing migratory bird and bat contact with spilled materials. The SPCC also reduces potential impacts to migratory bird and bat habitat that might be impacted in the unlikely event of an accidental discharge.
A-3-21	Hazardous Materials – Accidental Release	In the event of an accidental release of hazardous materials to the environment, the operator would document the event, including a root cause analysis, appropriate corrective actions taken, and a characterization of the resulting environmental or health and safety impacts. Documentation of the event would be provided to the BLM authorized officer and other federal and state agencies, as required.	See response to item A-3-20.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-22	Hazardous Materials – ESA	A Phase I Environmental Site Assessment would be required prior to the purchase of a property and would be conducted by a trained and experienced environmental professional. If the Phase I Environmental Site Assessment identifies potential hazardous substances, a Phase II Environmental Site Assessment is usually conducted to confirm the presence and extent of contamination.	No applicability to migratory birds and bats.
A-3-23	Hazardous Materials – Handling	Pursuant to the Project's Hazardous Materials Management Plan, all personnel handling hazardous materials would be trained appropriately on the dangers o, and safety precautions to be taken, when working with hazardous materials. Any hazardous materials used on-site would be documented and properly labeled. Material Safety Data Sheets (MSDS) and proper handling procedures would be located on-site. In the event a significant chemical spill occurs, personnel should evacuate the immediate area (as required) and report the release. The Emergency Response Team would be called to the area to assess the extent of the emergency and would determine appropriate response actions based on the Emergency Response Plan.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-24	Hazardous Materials – Secondary Containment	Secondary containment would be provided for all on-site hazardous materials and waste storage, including fuel. In particular, fuel storage (for construction vehicles and equipment) would be a temporary activity occurring only for as long as is needed to support construction activities.	No applicability to migratory birds and bats.
A-3-25	Hazardous Materials – Storage, Handling, and Disposal	Safety measures would be implemented in accordance with Occupational Safety and Health Administration (OSHA) standards and operator requirements. Petroleum products (e.g., lubricating oils and greases) and items such as touch-up paint and fiberglass blade repair materials would be stored on-site for maintenance operations. All such wastes/substances would be handled, stored in a secured location, and disposed of in accordance with applicable federal, state, and local regulations.	No applicability to migratory birds and bats.
A-3-26	Health and Safety – Crane Operation	Crane safety training would be conducted to ensure riggers and ground workers understand the hazards of working around mobile cranes and that they watch for signs of problems at all times, especially if power lines are nearby. Standard operating procedures would be developed and implemented for safely lifting loads. A written engineered lift plan for all critical lifts would be developed and followed.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-27	Health and Safety – Crane Operation	Crane operators would take the following steps to protect themselves and other workers when operating mobile cranes on the Project Sites: 1) the minimum clearance between power lines and the crane or load would be 10 ft. for lines rated 50-kV or below; 2) for lines over 50-kV, the minimum clearance would be 10 ft. plus 0.4 foot for each 1-kV over 50-kV; 3) operation of a crane outside of design limitations, manufacturer's specifications, or without the load charts would be prohibited; 4) cranes would be operated only when wind velocities are under the maximum speeds stipulated for safe operation (these velocities are generally stated in the manufacturer's specifications); 5) cranes would be inspected daily prior to each use, monthly, and annually, and the records of these inspections would be available on the machine; 6) rigging equipment would be inspected daily; 7) all operators of mobile cranes would have, and be familiar with, the additional requirements in the ANSI standard; 8) the latch in the hook throat opening would never be tied back; and 9) employees would not be suspended from the cranes and the use of cranes for suspended personnel platforms would be avoided.	No applicability to migratory birds and bats.
A-3-28	Health and Safety – Crane Operation	Meteorological stations would monitor wind speeds on the job site to support safe crane operating standards.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-29	Lands and Realty – Foreign Lines, Monuments, and Markers	All foreign lines would be marked. Monuments and markers (i.e., General Land Surveys and BLM Cadastral Survey Corners, reference corners, U.S. Coastal and Geodetic benchmarks) would be protected during the construction and operational phases of the Project. In the event that a monument or marker is disturbed, the employee would report the incident in writing to the Authorized Officer. PCW, in consultation with the BLM or other appropriate agency, would be responsible for re-surveying and replacing any markers that are disturbed.	No applicability to migratory birds and bats.
A-3-30	Noise – Blasting and Noisy Activity	If blasting or other noisy activities are required during the construction period, nearby residents would be notified in advance.	No applicability to migratory birds and bats.
A-3-31	Noise – Construction Equipment	All equipment would have sound-control devices no less effective than those provided on the original equipment. All construction equipment used would be adequately muffled and maintained.	Noise control will minimize impacts to migratory birds and bats by reducing potential disturbance and displacement of individuals.
A-3-32	Noise – Construction Equipment	All stationary construction equipment (i.e., compressors and generators) would be located as far as practicable from nearby residences.	No applicability to migratory birds and bats.
A-3-33	Noise – Road Use	Road use specifications designed to keep traffic to a minimum would be implemented to the maximum extent practical.	Minimizing traffic will reduce collision risk, noise, and potential displacement of migratory birds and bats.
A-3-34	Noise – Turbine Noise	All WTGs would be properly maintained to prevent excessive noise.	Noise control will minimize impacts to migratory birds and bats by reducing potential disturbance and displacement of individuals.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-35	Public Health and Safety – Construction Practices	A Project Health and Safety Plan would be implemented in accordance with OSHA standards. Hard hat requirements and "authorized personnel only" signs would be posted at the entrance to the main access points during construction. Permanent signs would be posted at gates on the main access roads. Safety signs (e.g., speed limits, steep grades, etc.) would be placed along the main access roads in accordance with local, state, and federal regulations. Safety signing would be posted on all transformers, at high-voltage facilities, along roads, and around towers (if necessary) in conformance with applicable state and federal regulations.	No applicability to migratory birds and bats

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-36	Public Health and Safety – Construction Practices	A comprehensive and continuous occupational Injury and Illness Prevention Program (IIPP) would be implemented and enforce a code of safe practices (CSP) for all employees. A designated field safety person would be responsible for on-site management and administration of the IIPP and CSP. Occupational safety and health matters would be communicated to employees by written documentation, staff meetings, formal and informal training, weekly safety meetings, and posted information. Communication from employees to supervisors or safety representatives about unsafe or unhealthy conditions would be encouraged and may be verbal or written. Results of investigations of any employee safety suggestion or report of hazard would be distributed to all employees affected by the hazard or posted, as appropriate.	No applicability to migratory birds and bats.
A-3-37	Public Health and Safety – Construction Practices	Each supervisor would conduct an inspection to identify unsafe working conditions and practices, as follows: 1) weekly in all areas; 2) whenever new substances, procedures, or equipment that may represent a new safety or health hazard are introduced to the job site; and 3) whenever a supervisor is made aware of a new or previously unrecognized hazard. A hazard checklist or hazard assessment form would be used to document inspections. Employees may not enter a hazard area without appropriate protective equipment, training, and prior specific approval by the IIPP and CSP administrator.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-38	Public Health and Safety – Fire Management	Fire control would be provided pursuant to the Project's Fire Safety Plan.	Fire control measures will reduce risk to migratory birds and bats including habitat loss and fragmentation, displacement of individuals, and other indirect impacts.
A-3-39	Public Health and Safety – Fire Management	Fire prevention standards would be followed to reduce the risk of a fire, in accordance with 36 CFR 261 and the Wyoming Interagency Fire Restriction Plan. All hot work that is to occur on site would be done in accordance with OSHA Regulation 29 CFR 1910.252(a).	Fire control measures will reduce risk to migratory birds and bats including habitat loss and fragmentation, displacement of individuals, and other indirect impacts.
A-3-40	Reclamation	All areas of disturbed soil would be reclaimed using weed-free native grasses, forbs, and shrubs. Reclamation activities would be undertaken as early as possible on disturbed areas not required for operation.	Reclamation using native species will maintain habitat function for migratory birds and bats.
A-3-41	Reclamation – Roadways	Access roads would be regraded, the topsoil replaced, and all disturbed areas would be re-vegetated. Any roadway damage due to the transport of the heavy equipment would be repaired on the public roadways upon the completion of Project construction and decommissioning.	Re-vegetation will decrease the size and duration of disturbed surfaces, decrease fragmentation, decrease risk for displacement of individuals, and maintain habitat function for migratory birds and bats.
A-3-42	Reclamation – Topsoil	Topsoil from all decommissioning activities would be salvaged and reapplied during final reclamation.	Topsoil salvage will increase reclamation success and benefit migratory birds and bats per item A-3-41
A-3-43	Reclamation – Vegetation	All areas of disturbed soil would be reclaimed using weed-free native shrubs, grasses, and forbs. The vegetation cover, composition, and diversity would be restored to values commensurate with the ecological setting.	Reclamation using weed-free native species will maintain habitat function for migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-44	Recreation – Public Access	Temporary fencing would be installed around staging areas and storage yards during construction to limit public access. Public access to open excavations would be limited by either installation of locked gates at public access points, or utilization of other approved means of limiting public access.	No applicability to migratory birds and bats.
A-3-45	Recreation – Public Access	Permanent fencing would be installed and maintained around electrical substations, and turbine tower access doors would be locked to limit public access during operations.	No applicability to migratory birds and bats.
A-3-46	Roads – General Design	DELETED[1]	
A-3-47	Roads – General Design	Access roads and on-site roads would be surfaced with aggregate materials, wherever appropriate.	No applicability to migratory birds and bats.
A-3-48	Roads – General Design	Access roads would be located to follow natural contours where possible and minimize side hill cuts.	Minimizing side hill cuts and following natural contours will reduce erosion risk and associated impacts to habitats used by migratory birds and bats.
A-3-49	Roads – General Design	DELETED[1]	
A-3-50	Roads – General Design	Roads would be located upwind from WTG rows, where possible, such that drifting caused by towers or transformers is not likely to accumulate on roads.	No applicability to migratory birds and bats.

[1] Power Company of Wyoming (PCW). 2012. Memorandum from G. Miller (PCW) to P. Murdock (BLM) dated April 10, 2012.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-51	Roads – General Design	Roads are designed in accordance with the BLM Gold Book (BLM 2007a) design criteria as well as the BLM Manual 9113: Roads (BLM 1985).	No applicability to migratory birds and bats.
A-3-52	Roads – General Design	Existing roads would be used, but only if in safe and environmentally sound locations. If new roads are necessary, they would be designed and constructed to the appropriate BLM road design standards where practical and be no higher than necessary to accommodate their intended functions (e.g., traffic volume and weight of vehicles).	Use of existing roads, when possible, will decrease fragmentation, displacement of individuals, and surface disturbance in habitats used by migratory birds and bats.
A-3-53	Roads – General Design	Final roadway alignments will include erosion control measures to stabilize steeper slopes and to prevent loss of soil. These measures will include hay bales, shallow swales and ditches, rock/rip rap embankments, and culvert outlet protection. Final alignments will be ground-verified using BLM Rawlins Field Office knowledge of potentially problematic areas for road construction and/or maintenance.	Measure will reduce erosion and soil loss in steep areas maintaining habitats that are used by migratory birds and bats.
A-3-54	Roads – General Design	Where road intersection improvements are required to accommodate extra-long vehicles, potential upgrades could include placement of relocating signs, placement of temporary paving, and use of flaggers, as needed. All intersection improvements would be restored to their original condition upon the completion of construction.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-55	Roads – General Design	Where road-cattle guard intersection improvements are required to accommodate overweight vehicles, potential road profile upgrades may be required to allow travel safely over the cattle guards. All damaged cattle guards would be replaced upon the completion of construction.	No applicability to migratory birds and bats.
A-3-56	Roads – General Design	All existing roads that would be used as primary access locations to the Project area would need to be upgraded to accommodate the anticipated extra traffic generated by the Project. Most of these roads are county roads or two-track roads that would need to be widened to accommodate the construction traffic. All necessary federal, state, and local permits would be obtained to complete this work prior to construction.	No applicability to migratory birds and bats.
A-3-57	Roads – General Design	During the course of construction, if excessive wear and tear to the existing roadway surface is evident, these road surfaces would be restored to their original condition upon the completion of construction. Where necessary, consultation with the UPRR would be required to change the roadway profile at specific at-grade railroad crossings to smooth the existing hump for low-profile vehicles; consultation with various utility companies would be required to elevate the risk of oversized vehicles in relation to low-hanging power lines.	No applicability to migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-58	Roads – General Design	Due to crest and sag vertical curves in the roadway profile, select locations would require re-grading prior to hauling extra-long loads. Any grades greater than 10 percent would require assist vehicles on-hand for the large tractor-trailers hauling WTG components. Any grades greater than 7 percent would require assist vehicles on-hand. These locations would be verified during the final design process. In addition, any construction site with grades ranging from 5 to 7 percent on non-paved roadways would require an assist vehicle on stand-by during adverse weather or road conditions.	No applicability to migratory birds and bats.
A-3-59	Roads – General Use	Traffic would be restricted to the roads developed for the Project. Use of other unimproved roads would be restricted to emergency situations. Signs would be placed along construction roads to identify speed limits, travel restrictions, and other standard traffic control information.	Control of traffic and speeds will reduce collision risks to migratory birds and avoid displacement of individuals sensitive to traffic-related impacts.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-60	Roads – Maintenance	Most road maintenance would be performed on an as-needed basis. The frequency and type of maintenance that would be required would be determined by routine inspections. The inspections would be performed on a regular basis and following snowmelt or heavy or prolonged rainfall. Inspections would identify maintenance needs for reduction of ruts and holes, maintenance of crowns and outslopes to keep water off the road, replacement of surfacing materials, clearing of sediment blocking ditches and culverts, maintenance of interim reclamation, and noxious weed control.	No applicability to migratory birds and bats.
A-3-61	Roads – Maintenance	All roads would be maintained in a safe and environmentally responsible manner.	No applicability to migratory birds and bats.
A-3-62	Roads – Operation Access	Project operation would require the use of the new roads for equipment and personnel to reach the WTGs. In addition, an access road that runs adjacent to each WTG site and the project substations would be used.	No applicability to migratory birds and bats.
A-3-63	Roads – Operation Access	Internal resource roads would be located within the project boundaries and would provide access to each WTG. All internal resource roads would be surfaced with gravel. As part of routine maintenance activities, internal resource roads would be maintained in a condition that allows for continued access to the WTGs.	No applicability to migratory birds and bats.
A-3-64	Roads – Reclamation	Abandoned roads and roads that are no longer needed would be recontoured and revegetated.	Measure will reduce surface disturbance and fragmentation in habitats used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-65	Soils and Geology –Slopes	Operators would identify unstable slopes and local factors that can induce slope instability. Operators also would avoid creating excessive slopes during excavation and blasting operations. Special construction techniques would be used where applicable in areas of steep slopes, erodible soil, and stream channel crossings.	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.
A-3-66	Soils – Erosion Control	Erosion control measures would be employed as described in the Master Reclamation Plan	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.
A-3-67	Soils – Erosion Control	Permanent erosion control devices would be installed during project construction and may include, but are not limited to, waterbars, roadside ditches with subsurface culverts, berms, trash racks on culverts, energy-dissipating structures, mulches, and establishment of permanent vegetation. Erosion controls that comply with county, state, and federal standards would be applied. Practices such as jute netting, silt fences, and check dams would be applied near disturbed areas. The Environmental Inspector would monitor construction to ensure that erosion control devices are functioning properly.	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.
A-3-68	Soils – Erosion Control	Final roadway alignments would include erosion control measures to stabilize steeper slopes and to prevent loss of soil. These measures would include hay bales, shallow swales and ditches, rock/rip rap embankments, and culvert outlet protection.	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-69	Soils – Erosion Control	If, during operation, it is determined that snow accumulation causes significant accelerated erosion, appropriate mitigation measures (e.g., snow fence construction) would be developed and implemented.	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.
A-3-70	Soils – Excavation and Blasting Activities	Foundations and trenches would be backfilled with originally excavated material as much as possible. Excess excavation materials would be disposed of only in approved areas or, if suitable, stockpiled for use in reclamation activities.	No applicability to migratory birds and bats.
A-3-71	Soils – Excavation and Blasting Activities	Borrow material would be obtained only from authorized and permitted sites. Existing sites would be used in preference to new sites when possible.	No applicability to migratory birds and bats.
A-3-72	Soils – Topsoil Handling	Topsoil from all excavations and construction activities would be salvaged and reapplied during reclamation.	Topsoil salvage will increase reclamation success and benefit migratory birds and bats per item A-3-41.
A-3-73	Soils – Topsoil Handling	Topsoil material suitable for site reclamation would be removed in conjunction with clearing and grading and reserved in local stockpiles. Topsoil storage areas would generally be located within staging areas and alongside roadways during construction.	Topsoil salvage will increase reclamation success and benefit migratory birds and bats per item A-3-41.
A-3-74	Soils – Wet Soils During Construction	Construction activities would be suspended when soils are wet. Construction would resume when soils become dry enough to support construction equipment. The Environmental Inspector (EI) would determine when conditions are too wet to continue.	Measure will reduce impacts to soils, increase reclamation success, and maintain habitats that are used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-75	Transportation – Traffic Considerations	To minimize impacts on local commuters, consideration would be given to limiting construction vehicles traveling on public roadways during the morning and late afternoon commute time. Consideration would also be given to opportunities for busing of construction workers to the job site to reduce traffic volumes.	No applicability to migratory birds and bats.
A-3-76	Transportation – Transportation Planning	Ongoing ground transportation planning would be conducted to evaluate road use, minimize traffic volume, and ensure that roads are maintained adequately to minimize associated impacts.	Ongoing transportation management will reduce traffic-related disturbance and potential collision risk to migratory birds.
A-3-77	Transportation – Transportation Planning	Following the finalization of site access locations and proposed roadways, a Traffic Management Plan would be developed for traffic both on and off-site. The Traffic Management Plan would discuss flagging guidelines on and off site, specifics of auxiliary lanes if needed, requirements for signage during construction of the project, passing zone and striping details for the existing public roadways, and other details specific to the individual approved access locations leading to and from, and on, the Project area.	Ongoing traffic management will reduce traffic-related disturbance and potential collision risk to migratory birds.
A-3-78	Vegetation – Noxious Weed	Noxious weed surveys would be conducted to evaluate the presence and aerial extent of noxious weed and invasive species populations within the Project area. Preventative management measures would be applied as warranted pursuant to the Project's Weed Management Plan.	Noxious weed management will benefit migratory bird and bat species by maintaining habitat functionality.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-79	Visual Resources	Operators would reduce visual impacts during construction by clearly delineating construction boundaries and minimizing areas of surface disturbance; preserving vegetation to the greatest extent possible; utilizing undulating surface disturbance edges; stripping, salvaging and replacing topsoil; contoured grading; controlling erosion; using dust suppression techniques as required; and restoring exposed soils as closely as possible to their original contour and vegetation.	No applicability to migratory birds and bats.
A-3-80	Visual Resources	Operators would monitor and maintain visual mitigation measures for the approved project in accordance with a visual monitoring and compliance plan. The operator would maintain revegetated surfaces until a self-sustaining stand of vegetation is reestablished and visually adapted to the undisturbed surrounding vegetation.	No applicability to migratory birds and bats.
A-3-81	Waste Management – Disposal	Wastes would be properly containerized and removed periodically for disposal at appropriate off-site permitted disposal facilities.	Measure will maintain habitats that are used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-82	Waste Management – Wastewater	Any wastewater generated in association with temporary, portable sanitary facilities would be periodically removed by a licensed hauler and introduced into an existing municipal sewage treatment facility or otherwise disposed of in accordance with applicable state and local laws and regulations. Temporary, portable sanitary facilities provided for construction crews would be adequate to support expected on-site personnel and would be removed at completion of construction activities.	No applicability to migratory birds and bats.
A-3-83	Water – SWPPP	The Project's SWPPP would be implemented in accordance with the Wyoming Department of Environmental Quality (WDEQ) requirements to obtain National Pollutant Discharge Elimination System (NPDES) compliance under Wyoming's NPDES permit WYR10-0000. The SWPPP would describe site-specific erosion control and stream crossing measures that would be implemented during the construction and operation phases of the Project. The Environmental Inspector would direct activities to ensure compliance with the SWPPP.	Measure will reduce impacts to soils and water quality, increase reclamation success, and maintain habitats that are used by migratory birds and bats.
A-3-84	Water – Excavation and Blasting Activities	DELETED[2]	

[2] Power Company of Wyoming (PCW). 2012. Memorandum from G. Miller (PCW) to P. Murdock (BLM) dated April 10, 2012.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-85	Water – Excavation and Blasting Activities	Operators would avoid creating hydrologic conduits between two aquifers during foundation excavation and other activities.	No applicability to migratory birds and bats.
A-3-86	Water – Road Design	DELETED[2]	
A-3-87	Water – Road Drainage	Whenever possible, existing drainage systems would not be altered, especially in sensitive areas such as erodible soils or steep slopes. Potential soil erosion would be controlled at culvert outlets with appropriate structures. Catch basins, roadway ditches, and culverts would be cleaned and maintained regularly.	Measure will reduce impacts to soils, vegetation, and water quality; increase reclamation success; and maintain habitats that are used by migratory birds and bats.
A-3-88	Water – Road Locations	Roads would be located away from drainage bottoms and avoid wetlands, if practicable.	Measure will reduce impacts to soils, vegetation, and water quality; maintain habitats that are used by migratory birds and bats; and avoid vehicle collision risk in these areas.
A-3-89	Water – Stream Crossings	Access roads would be located to minimize stream crossings. All structures crossing streams would be located and constructed so that they do not decrease channel stability or increase water velocity. Operators would obtain all applicable federal and state permits.	Measure will reduce impacts to soils, vegetation, and water quality; maintain habitats that are used by migratory birds and bats; and avoid vehicle collision risk in these areas.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-90	Water – Waterbodies and Wetlands	Waters of the U.S., including wetlands, will be avoided to the maximum extent practicable. Where these features cannot be completely avoided, impacts will be minimized through design modification, as necessary. Facilities (e.g., turbines, substations, staging areas) would be sited to avoid and/or minimize impacts; however, where impacts are anticipated (e.g., use of Project roads), minimization measures would be employed to minimize impacts (e.g., use of culverts to maintain downstream flow/drainage).	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-91	Water – Waterbodies and Wetlands	All impacts would be the minimum necessary to accomplish the Project, would be mitigated, and the appropriate Section 404 permit would be obtained from the U.S. Army Corps of Engineers (USACE) Wyoming Regulatory Office prior to the start of construction. To complete the Section 404 permit, a delineation of all Waters of the U.S. (WUS), including wetlands, would be performed by qualified wetland scientists to obtain current site-specific data regarding the location and extent of aquatic features within the Project area. Current resource mapping (e.g., U.S. Geological Survey (USGS) topographic maps, U.S. Fish and Wildlife Service (USFWS) NWI maps, Federal Emergency Management Agency (FEMA) floodplain maps, Natural Resources Conservation Service (NRCS) soils data, etc.) would be used to guide this future delineation effort. All aquatic features delineated in the field would be recorded using Global Positioning System (GPS) with sub-meter accuracy.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.
A-3-92	Water – Waterbodies and Wetlands	Any construction that occurs in or adjacent to wetlands and streams would use Applicant Committed BMPs listed in Appendix A to protect surface water quality and to minimize impacts to those resources.	Measure will maintain vegetation, water bodies, and riparian corridors used by migratory birds and bats.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-93	Wildlife – Department of the Interior (DOI) Wind Turbine Guidelines	Although strictly voluntary on non-federal lands, PCW will review the DOI Wind Turbine Guidelines Advisory Committee Wind Turbine Guidelines (anticipated in late summer 2010) once they are finalized with the intention of complying with them as applicable and appropriate and to the extent they do not conflict with any requirements set out by the BLM in its ROD, any agreements entered into between PCW and the USFWS, or other controlling laws, permits, or regulations.	The measures in the Phase I BBCS incorporate the measures recommended in the current USFWS Wind Energy Guidelines.
A-3-94	Wildlife – Disturbance and Harassment	All employees, contractors, and site visitors would be instructed to avoid harassment and disturbance of wildlife, especially during reproductive (e.g., courtship and nesting) seasons. During construction, pets would not be permitted on site; during operation, pets would be controlled to avoid harassment and disturbance to wildlife.	Measures to reduce impacts to migratory birds and bats will be included in employee training as described in the Phase I BBCS.
A-3-95	Wildlife – Excavation and Blasting Activities	Explosives would be used only within specified times and at specified distances from sensitive wildlife or streams and lakes, as established by the BLM or other federal and state agencies.	Use of explosives per agency guidance and measures described in the Phase I BBCS will reduce risk to migratory birds and bats.
A-3-96	Wildlife – Habitat Restoration	In accordance with the habitat restoration plan, restoration would be undertaken as soon as practical after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.	Reclamation and revegetation will minimize the amount and duration of surface disturbance which will benefit the migratory birds and bats using the habitats in Phase I.

TABLE 4. APPLICANT COMMITTED BEST MANAGEMENT PRACTICES (ROD TABLE D-3)

Item	Resource Concern	Measure	Applicability to Migratory Birds and Bats
A-3-97	Wildlife – Vehicle Collisions	Project personnel and contractors would be instructed and required to adhere to speed limits commensurate with road types, traffic volumes, vehicle types, and site-specific conditions, to ensure safe and efficient traffic flow and to reduce wildlife collisions and disturbance and airborne dust.	Employee training and controlling vehicle speed will minimize risks to migratory birds and bats from vehicle collisions.
A-3-98	Wildlife – Yellow-billed Cuckoo	Yellow-billed cuckoo habitat (i.e., riparian areas) would be avoided to the maximum extent possible.	Yellow-billed cuckoo habitat does not occur in the vicinity of the CCSM Project. Minimization of impacts in riparian areas will maintain habitats used by other migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
General	GEN-1	Phased Construction Sequencing. Limit surface disturbance to areas where turbines would be constructed within 12 months with a goal to mitigate impacts from surface disturbance to wildlife, soils, water, and vegetation (e.g., weeds). Four ROW grants would be issued for the project: 1) internal haul road; 2) transmission line between the two sites; 3) Sierra Madre development; and 4) Chokecherry development.	This measure minimizes impacts to migratory birds and bats by minimizing habitat fragmentation and ensuring that undisturbed habitats are available in areas adjacent to Phase I for use by any individuals displaced during construction.
	GEN-2	Off-site Compensatory Mitigation. Off-site compensatory mitigation may be considered through future consultations between the BLM, Cooperating Agencies, and PCW if mitigation measures established through the project-wide EIS are later determined to not be adequate.	Off-site compensatory mitigation is addressed in the Phase I BBCS.
Air		No additional mitigation measures proposed.	
Cultural	CR-1	To minimize unauthorized collecting of archaeological material or vandalism to known archaeological sites, PCW and its contractors, and all construction personnel, shall attend mandatory training and be educated on the significance of cultural resources and the relevant federal regulations intended to protect them.	No applicability to migratory birds and bats.
	CR-2	Additional mitigation measures will be included in the Programmatic Agreement, which will be developed in coordination with the BLM, SHPO, ACHP, PCW; Indian tribes; and other interested parties.	No applicability to migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Geology and Mineral Resources		No additional mitigation measures proposed.	
Land Use		No additional mitigation measures proposed.	
Paleontology	PALEO-1	If any vertebrate fossils or scientifically important fossils are discovered during construction operations on federal lands, the permittee shall cease activities immediately and notify the BLM so the agency can determine the significance of the discovery. The BLM shall evaluate or have evaluated such discoveries and shall notify PCW what action shall be taken with respect to such discoveries. Additionally, PCW also would contract with a qualified paleontologist approved by the BLM who shall be on call during all construction periods and available to travel to the site within 24 hours following notice of a discovery, and that the on-call paleontologist shall consult with the BLM to reach agreement on the significance of the discovery within 24 hours following arrival at the site by the on-call paleontologist. The BLM will then promptly notify PCW as to what actions shall be taken.	No applicability to migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	PALEO-2	Any fossils recovered during the assessment of paleontological resources will be prepared in accordance with standard professional paleontological techniques. The fossils will be curated in a BLM-approved facility. A report on the findings and significance of the salvage program, including a list of the recovered fossils, will be prepared following completion of the program. A copy of this report will accompany the fossils, and a copy will be submitted to the Wyoming Museum, University of Wyoming.	No applicability to migratory birds and bats.
Range	RANGE-1	Coordinate construction schedules and ranching operations to allow sequencing of pasture use to the extent practicable within the Pine Grove/Bolten allotment and other affected allotments (Cottonwood Draw, Middlewood Hill, Grizzly, McCarty Canyon, and Sage Creek) in a manner to minimize conflicts between grazing and construction activities.	No applicability to migratory birds and bats.
Recreation		No additional mitigation measures proposed.	
Socioeconomics		No additional mitigation measures proposed.	
Soils	SOIL-1	Road fabric, or equivalent base stabilization as determined by the BLM, will be applied where roads cross sensitive soils (wet, severely erodible soils, and soils with low soil strength).	Measure will reduce impacts to soils, vegetation, and water quality and maintain habitats that are used by migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	SOIL-2	Excess subsoil excavated from tower foundations will not be used as topsoil or spread on top of topsoil without further laboratory testing of the subsoil physical and chemical characteristics, and agency approval. PCW will identify the acceptable disposal method for excess subsoil in the final reclamation plan.	Use of native topsoil or subsoils that have the appropriate physical and chemical characteristics will increase reclamation success and benefit migratory birds and bats.
	SOIL-3	Areas identified as having limited reclamation potential (as defined in the Rawlins Instruction Memorandum No. WYD-03-2011-002) will be avoided during construction unless an acceptable site-specific reclamation plan is approved by the BLM.	Reclamation and revegetation following the Phase I reclamation plan will minimize the amount and duration of surface disturbance which will benefit the migratory birds and bats using these habitats.
	SOIL-4	To reduce impacts related to road density in the Application Area, roads that are no longer needed will be effectively reclaimed.	This measure would reduce surface disturbance and fragmentation in habitats used by migratory birds and bats.
	SOIL-5	PCW will be required to submit a snow removal plan as part of the ROW grant application. The snow removal plan will include measures to ensure protection of soil and water resources.	No applicability to migratory birds and bats.
	SOIL-6	Drainages, vegetated sand dunes, salt flats, steep slopes, and gullied areas will be avoided for towers, laydown areas, facilities, and roads (to the extent possible). Towers, laydown areas, and other facilities will be re-located to areas of generally stable soils. These avoidances shall be taken into consideration during site specific analyses.	Measure will reduce impacts to soils, vegetation, and water quality; increase reclamation success; and maintain habitats that are used by migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Transportation	TRANS-1	To the extent that all governmental entities are willing to participate, PCW shall participate in a coordinated transportation planning process with the BLM, WYDOT, Carbon County, the Town of Sinclair and the City of Rawlins, to identify and develop measures to avoid, manage or mitigate transportation impacts of construction. The BLM shall coordinate with affected local governments to solicit input from the Sinclair Refinery, the CIG compressor station, affected grazing operators, and other major property owners (including the operator of the truck stop just north of I-80 Exit 221) in the affected area. The group shall meet prior to and during the construction phase of the project and in the initial year of project operations, as needed.	No applicability to migratory birds and bats.
	TRANS-2	PCW shall develop measures to inform and update Carbon County residents and travelers on I-80 near Sinclair and WY 71 about potential delays during peak months and especially during peak hours. In coordination with WYDOT, electronic signage shall be used near I-80 Exit 221 to encourage I-80 travelers to use alternate access to Sinclair during peak hours.	No applicability to migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	TRANS-3	PCW shall coordinate with WYDOT to identify measures to control traffic and enhance traffic flows in the vicinity of I-80 Exit 221 during shift changes and at times when oversized vehicles will be crossing the bridge over I-80, and along WY 71 within the City of Rawlins if the WY 71/CR 407 (Sage Creek Road) workforce commuting option is selected.	No applicability to migratory birds and bats.
	TRANS-4	PCW shall implement incentives for carpooling and/ or other workforce transportation measures to reduce traffic and congestion during shift changes.	No applicability to migratory birds and bats.
Vegetation	VEG-1	Survey and mark the disturbance boundary to minimize unintentional surface disturbance. Actively monitor construction to ensure construction and staff stays within the defined limits.	This measure will ensure that the project footprint is minimized reducing impacts and fragmentation in habitats used by migratory birds and bats.
	VEG-2	Salvage vegetative debris and redistribute to reclaimed surface areas in order to reduce erosion and preserve native organic material and seed sources.	Measure will reduce impacts to soils, vegetation, and water quality; increase reclamation success; and maintain habitats that are used by migratory birds and bats.
	VEG-3	In areas where excavating soil is not necessary, such as temporary laydown areas or temporary access roads, avoid disturbing native soil and root zones where possible to preserve soil structure and soil biology and improve the success for reclamation.	Measure will reduce impacts to soils, vegetation, and water quality; increase reclamation success; and maintain habitats that are used by migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Visual	VR-1	Monopole and H-frame transmission structures and overhead collector line structures would be treated to have a muted, darker color than conventional galvanized steel or laminated wood to reduce color contrasts. The recommended paint color for transmission structures is Shadow Gray from the BLM Standard Environmental Colors Chart CC-00 or an equivalent color. Steel pole equivalents used in the installation of the overhead electric collector lines should be finished with paint or a self-weathering finish that will harmonize with colors of the surrounding landscape (i.e., approximate the color of wood when used with wood overhead collector lines). When not used with wood poles, the recommended paint color for powerline structures is Shadow Gray from the BLM Standard Environmental Colors Chart CC-00. Conductors would have a non-reflective finish.	No applicability to migratory birds and bats.
	VR-2	Place vegetative debris on cut-and-fill slopes to vary texture and color of cut-and-fills until vegetation has been re-established.	Measure will reduce impacts to soils, vegetation, and water quality; increase reclamation success; and decrease fragmentation in habitats that are used by migratory birds and bats.
	VR-3	Lighting for ancillary facilities shall be motion-activated and shielded downward to limit night lighting impacts beyond the site.	Measure will reduce impacts to nocturnal and night-migrating birds and bats. Measure will also ensure that unnecessary artificial light sources do not attract insect activity and associated migratory bird or bat foraging.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	VR-4	Audio Visual Warning System (AVWS) for aircraft detection and warning may be required to reduce day and night lighting impacts from WTGs if technologies become available that are approved by FAA, are proven reliable at the scale of CCSM, and BLM determines that systems are cost effective.	No applicability to migratory birds and bats
	VR-5	Substation components and fencing would be Shadow Gray from the BLM Standard Environmental Colors Chart CC-00 or a similar color in a dark gray color range. Color mitigation would not be required on facilities that are treated in accordance with safety and engineering concerns.	No applicability to migratory birds and bats

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Wetlands	WET-1	Conduct on-site delineations of all waters of the U.S., including wetlands and waterbodies within the Alternative Development Area prior to construction. The surveys would be performed and documented by qualified wetland scientists to determine the types and spatial extent of site-specific wetland and riparian features. Current resource mapping (e.g., USGS topographic maps, USFWS NWI maps, FEMA floodplain maps, AECOM wetland and riparian data, NRCS soils data, etc.) would be used to guide this future delineation effort. All features would be recorded using a GPS unit with sub-meter accuracy, in addition to photographic and written documentation of each feature according to standardized USACE delineation data requirements and any additional BLM data requirements. Subsequent NEPA tiering would include the site-specific waters of the U.S. delineation results.	Phase I wetland information was used to minimize impacts in wetland and riparian areas resulting in decreased habitat fragmentation, maintenance of native vegetation, and conservation of water bodies and riparian corridors used by migratory birds and bats.
Water	WR-1	Stream water quality monitoring sites will be identified by the BLM. Stream monitoring shall continue through construction, operation, and decommissioning of the project by PCW to monitor for changes in water quality.	The watershed monitoring program will document any changes to hydrologic conditions and stream channel characteristics that may impact habitats used by migratory birds and bats.
	WR-2	PCW will be required to submit the site-specific SWPPP as part of the ROW grant application for approval by the BLM.	Measure will reduce impacts to soils and water quality, increase reclamation success, and maintain habitats that are used by migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Wildlife and Fisheries	WFM-1	Workers, with the exception of security personnel, will not be allowed to possess firearms during work activities and will attend mandatory training (provided by WGFD) on wildlife regulations and ways to reduce disturbance to wildlife.	Removal of firearms from the CCSM Project Site will ensure that unauthorized take of migratory birds by employees or contractors does not occur.
	WFM-2	Snow fences, if used, will be limited to segments of one-quarter mile or less. In addition, escape openings will be provided along roads, every one-quarter mile or less, to facilitate exit of big game animals from snowplowed roads.	No applicability to migratory birds and bats.
	WFM-3	If measured bat mortality is determined to be above levels of concern for the project (as presented in section 4.14 of the EIS), measures appropriate to avoid, minimize, and mitigate impacts to bat species will be identified in the Bat Protection Plan for the Project. Thresholds of impacts to bats and appropriate responses to exceeding such impact thresholds will be determined by BLM in coordination with the WGFD, and if appropriate, the USFWS, as part of the conservation, avoidance, minimization and mitigation measures identified in the Bat Protection Plan.	The Phase I BBCS serves as the Bat Protection Plan described in WFM-3 and identifies measures to avoid, minimize, and mitigate impacts to bat species.
	WFM-4	Instream construction (stream crossings and stream construction activities) will occur during the low flow period (July 15 to September 30).	Measure will reduce impacts to soils and water quality, increase reclamation success, and maintain habitats that are used by migratory birds and bats. In addition, this measure results in disturbance of these areas after the nesting season or late in the nesting season when impacts to migratory birds will be minimized.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
Special Status Species	SSS-1	Prior to construction activities in suitable pygmy rabbit habitat, presence/absence surveys would be conducted following appropriate protocols. Areas within 0.25 mile of proposed disturbance that show characteristics of pygmy rabbit habitat will be surveyed in accordance with the Interagency Pygmy Rabbit Working Group Survey Protocols (Ulmschneider et al. 2004). If the surveys conclude that the pygmy rabbits occur, the "Habitat Preservation and Restoration" conservation measures will apply (Keinath and McGee 2004).	No applicability to migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	SSS-2	Prior to construction activities in suitable Wyoming pocket gopher habitat, presence/absence surveys will be conducted following appropriate protocols. If active Wyoming pocket gopher mounds are identified by the presence/absence survey, the proposed surface disturbing activities will avoid the active pocket gopher mounds by 75 m (BLM 2009f). However, if PCW does not wish to avoid the active pocket gopher mounds by 75 m, classification surveys (via live capture) must be completed to identify the pocket gopher to the species level responsible for the mounds. If the results conclude that the Wyoming pocket gopher is responsible for the mounds, the "Occupied Wyoming Pocket Gopher Habitat Protection Measures" will apply (BLM 2009f). If the results conclude that the associated species is a Northern pocket gopher, then the proposed surface disturbance may proceed without mitigation. If the classification survey fails to conclusively identify the associated pocket gopher to the species level, then it will be assumed that the species is a Wyoming pocket gopher and the "Occupied Wyoming Pocket Gopher Habitat Protection Measures" will apply (BLM 2009f).	No applicability to migratory birds and bats.

TABLE 5. PROPOSED MITIGATION MEASURES (ROD TABLE D-4)

Resource	Code	Proposed Mitigation Measure	Applicability to Migratory Birds and Bats
	SSS-3	To protect potential mountain plover habitat, prior to any surface disturbance, a presence/absence survey for active mountain plover nests will be conducted in all potential habitat within the area proposed for surface disturbance. Surveys are to be performed by a wildlife biologist familiar with mountain plover and their associated habitat. If evidence of mountain plovers is found during the preconstruction survey, then additional stipulations may apply (BLM 2009a).	Measure will minimize impacts to mountain plovers and other migratory bird and bat species that use occupied mountain plover habitats.
Noise	N-1	USEPA guidance stipulates the threshold for residential noise impacts resulting from construction activities, including blasting, is reached at 55 dB(A) at 1,600 feet (USEPA 1974). When a residence is within 1,600 feet of construction activities, construction activities exceeding 55 dB(A) would only be allowed to occur between the hours of 7 a.m. and 10 p.m., and on weekdays.	Measure will reduce disturbance migratory birds and bats that occur within these areas.
	N-2	Whenever feasible, multiple construction activities (e.g., blasting and earthmoving) shall be scheduled to occur concurrently to minimize the length of time residences within 1,600 feet may be affected.	Measure will reduce disturbance migratory birds and bats that occur within these areas.

TABLE 6. PROPOSED APPLICANT COMMITTED MEASURES FOR THE DEADMAN CREEK SOUTH LEK

Resource	Code	Proposed Measure	Applicability to Migratory Birds and Bats
Special Status Species	DCS-01	PCW will conduct all construction activities within 0.25 mile of the Deadman Creek South lek before March 1st or after May 20th.	Measure will minimize impacts to sagebrush habitats surrounding leks that are used by sagebrush obligate bird species and other migratory bird and bat species.
	DCS-02	PCW will conduct all non-critical operation and maintenance activities within 0.25 mile of the Deadman Creek South lek before March 1st or after May 20th. Critical operation and maintenance activities may include but are not limited to road, culvert, and erosion control repair; disabled vehicle repair or removal; and application of dust suppression.	Measure will minimize impacts to sagebrush habitats surrounding leks that are used by sagebrush obligate bird species and other migratory bird and bat species.
	DCS-03	PCW will conduct all non-critical construction, operation and maintenance activities that require use of the road located within 0.25 mile of the Deadman Creek South lek before March 1st or after May 20th. Critical construction, operation and maintenance activities may include but are not limited to unscheduled maintenance of wind turbines and electrical components; road, culvert, and erosion control repair; disabled vehicle repair or removal; and application of dust suppression.	Measure will minimize impacts to sagebrush habitats surrounding leks that are used by sagebrush obligate bird species and other migratory bird and bat species.

TABLE 6. PROPOSED APPLICANT COMMITTED MEASURES FOR THE DEADMAN CREEK SOUTH LEK

	DCS-04	During the period from March 1st to May 20th, PCW will conduct all critical, non-emergency, construction, operation and maintenance activities located within 0.25 mile of the Deadman Creek South lek or that require use of the road located within 0.25 mile of the Deadman Creek South lek between the hours of 9:00 am and 6:00 pm. Critical construction, operation and maintenance activities may include but are not limited to unscheduled maintenance of wind turbines and electrical components; road, culvert, and erosion control repair; disabled vehicle repair or removal; and application of dust suppression.	Measure will minimize impacts to sagebrush habitats surrounding leks that are used by sagebrush obligate bird species and other migratory bird and bat species.

APPENDIX J

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AVIAN AND BAT FATALITY REPORTING FORM

ID#	
Species	
Date/Time	
Turbine#	
Observer	

SITE INFORMATION

Site Name: ***Chokecherry and Sierra Madre Wind Energy Project***

DISCOVERY DATA (FILL OUT SEPARATE FORM FOR EACH FATALITY EVENT)

Identification No.: (month [XX], day [XX}, year [XX], sequential number of form filled out that day [-X], if incidental add "-I" i.e., 092815-1)	**Observer Name, Organization:** (if 2 observers found at same time or 2 observers found multiple parts, list both)
Date, Time of Find: (XX/XX/XXXX, military time)	**Contact Phone:**

Search Method: Formal Search ☐ Informal Search ☐ **Describe:**

Incidental? Yes☐ No☐ (Incidentals are found outside search plots or while conducting other activities unrelated to formal searches)

Species:
(Common Name, Scientific Name)

☐**Alive/Injured** ☐**Fatality**	**Complete** ☐ **Parts/Dismembered** ☐ **Feathers** ☐ **Bones** ☐ (Feather piles are 10 or more total feathers or 2 or more primaries/tail feathers; if fewer, no need to record)

Apparent Cause of Fatality
(e.g., Electrocution, Turbine Collision, Building Collision, Roadkill, Other [specify]); if close to road or building indicate distance and describe)**:**

SEARCH DATA (*FILL OUT SECTION ONLY IF CONDUCTING FORMAL SEARCHES*)

Search Start Time:	**Search End Time:**	**Date Since Last Search of Turbine:**

LOCATION OF FIND

State, County: ***Wyoming, Carbon County***

GPS Location: _____**E** _____**N** (UTM; Nad 83, Zone 12)
OR **lat** ___._____° **long** -____._____° (Decimal Degrees, Lat Long)
(format : **E:** Easting, 6 digits; **N:** Northing, 7 digits; Decimal Degrees Lat, Long: Lat XX.XXXXXX°, Long: -XXX.XXXXXX°)

Distance from Turbine: _____Feet ☐ _____Meters ☐	**Direction (Degrees, Cardinal) from Turbine**: _____°,_____ (i.e., 30°, NNE)
Nearest Turbine #: (if transmission, indicate pole/tower # and specify)	**Substrate:** (e.g., habitat/substrate surrounding carcass: pad, gravel; road, gravel; bare ground (soil/rock); tall grass (>10cm); short grass (<10cm); weedy vegetation; shrub/tree)

If multiple parts, list parts by size:	**Distance**	**Degrees, Cardinal Direction**
Part 1:	___feet☐___meters☐	
Part 2:	___feet☐___meters☐	
Part 3:	___feet☐___meters☐	

SPECIES IDENTIFICATION

AVIAN AND BAT FATALITY REPORTING FORM

ID#	
Species	
Date/Time	
Turbine#	
Observer	

Sex: (Male/Female if known, UNK if unknown)	**Age:** (Adult/Juvenile if known; UNK if unknown)	**Field Marks Used for ID:** (e.g., plumage, specific characteristics distinguishing from similar species, provide measurements if applicable; for bats, provide forearm measurement in mm, presence of keeled calcar, etc.)

CARCASS CONDITION AND ESTIMATED TIME OF DEATH

Banded? Yes☐ No☐ Unknown (Leg(s) missing)☐ **Include Band #:**
Note if wearing radio-transmitter or auxillary marker and specifiy # or unique identifier:

Physical Condition Description/Comments:
(Describe physical condition of find at time of discovery; e.g. belly up, belly down, wings out, dismembered, fresh/decomposing condition)

Describe scavenging activity:

Estimated Time Since Death or Injury (in days)*: ≤1☐ <4☐ <7☐ <14☐ <30☐ >30☐,
if uncertain/rough estimate indicate ≤1☐ >7☐

Carcass Decomposition:** Fresh☐ Decomposing (early)☐ Decomposing (late)☐ Desiccated☐ N/A☐

Infestation Activity: Yes☐ No☐; if yes, Fly larvae (maggots)☐ Adult flies☐ Beetles☐ Ants☐ Other☐

CARCASS DISPOSITION

Left On Site☐ Buried On Site☐ Facility Freezer☐ Consultant Freezer☐ Other☐ If Other, specify:

ANY RELEVANT NOTES OR ADDITIONAL INFORMATION?

Attachment C

USFWS Eagle Fatality Modeling

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U.S. Fish and Wildlife Service Summary Document for Review of Eagle Use Data and Eagle Fatality Prediction Analysis for the Chokecherry and Sierra Madre Wind Energy Project Phase 1

U.S. Fish and Wildlife Service, Region 6, Wyoming Ecological Services Field Office
and Region 6 Migratory Bird Management Office

May 27, 2014

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U.S. Fish and Wildlife Service Summary Document for Review of Eagle Use Data and Eagle Fatality Prediction Analysis for the Chokecherry and Sierra Madre (CCSM) Wind Energy Project Phase 1

EXECUTIVE SUMMARY

This document describes the data, decision criteria, and methods used by the U.S. Fish and Wildlife Service (USFWS) to calculate the estimated bald eagle and golden eagle fatalities associated with Phase 1 of the Chokecherry Sierra Madre Wind Energy Project. The methods used by the USFWS generally followed recommendations in the Eagle Conservation Plan Guidance (ECPG 2013), such as using data from points counts that fall within 1 kilometer of the project footprint (ECPG 2013, p. 57).

The number of estimated eagle fatalities was calculated using long-watch data collected from April 2011 to July 2012 and 800-meter (0.5 mile) point count data collected from August 2012 to August 2013. The data were collected over two and a half years using varying methods (i.e., observer distances, eagle flight heights, surveys periods, and number of survey points); therefore, the data could not be easily combined into a single model run. Because of the varying survey effort and volumes, the data were stratified by sampling methodology.

Data from April 2011 to July 2012 were collected using similar long-watch methods, so data from the 16 months were combined into one year of data (Year1) and were run independently of the other four survey periods (Fall 2012, Winter 2012, Spring 3013, Summer 2013). Because the eagle fatality model uses a Bayesian framework, the posterior from Year1 was used to inform Year2 as the new prior.

The second "year" (Year2, August 2012 to August 2013) was collected over 13 months from different numbers of survey points using different eagle flight heights. Data from the 13 months of Year2 were pooled and used to predict fatalities for one 12-month year; however, the code in the eagle fatality model was modified to account for different survey volumes and hazardous area volumes. In model runs for both years, daylight hours were adjusted to account for curtailment of 17 turbines during the spring.

Estimates of golden eagle fatalities and bald eagle fatalities were calculated for Chokecherry and for Sierra Madre using two different turbine sizes. Using the largest on-shore turbine anticipated (120-meter diameter blade), the 80 percent upper credible interval (80% UCI) from the USFWS peer-reviewed model predicts 14 golden eagle fatalities and 2 bald eagle fatalities annually for Phase 1 of the Chokecherry and Sierra Madre Wind Energy Project. Using a smaller turbine (103-meter blade), the model predicts the 80% UCI for 500 turbines of Phase 1 will result in 10 golden eagle and 1.4 bald eagle fatalities annually.

POINT COUNTS TO INCLUDE/EXCLUDE FROM EAGLE FATALITY MODELING

Decision Criteria

(1) Data from point counts were included in the eagle fatality model runs if the 800-meter circle overlapped turbines or if the circle occurred within 1 kilometer (km) of at least one turbine.

Rationale: This approach assumes that at a distance of 1 km, there is a close association between the sampling sites and the turbine locations such as a similarity of habitat types and/or eagle use (ECPG 2013, p. 57).

Exception to Criterion #1: Data from point counts along the eastern side of the "interior rim" of Chokecherry were excluded from the analysis even though turbines occurred within 1 km of the 800-meter circle.

Rationale: Data from point counts can be excluded if topographic features and vegetation types are not representative of the project footprint.

Exception to Criterion #1: Data from point counts on the periphery of the project footprint could be excluded if: (a) spatial coverage approached 30 percent, (b) turbines did not overlap the 800-meter circle, and (c) removing data from these point counts did not create a gap in spatial coverage.

Rationale: Eagle activity on the periphery of the project may be substantially different than within the project footprint; therefore, data from points on the periphery might not reflect project-related risk to eagles. However, without other data, points on the periphery may represent the best available information about risk to eagles and should be included.

Data from points on the periphery should only be considered for exclusion if: (a) removing the points does not substantially reduce spatial coverage from 30 percent, (b) turbines do not overlap the 800-meter circle (otherwise there is a direct relationship between turbines and eagle use within the point count); and (3) removing the points does not leave a gap in spatial coverage and data from adjacent points are representative of conditions on the periphery of the project footprint.

(2) If data from the point counts in criterion #1 provided less than 30 percent spatial coverage of the project footprint, point counts farther than 1 km were also included in the analysis if the point counts were representative of conditions within the project footprint.

Rationale: The sampling design should provide a minimum spatial coverage of at least 30 percent of the project footprint (ECPG 2013, p. 54). When available eagle use data from point counts did not meet the minimum recommendations from the ECPG, adding data from nearby point counts can be used to compensate for the lack of data, provided the points are representative of topographic features and vegetation types that characterize turbine strings within the project footprint.

Chokecherry-Specific Modifications to Decision Criteria

(See Figures 1 through 4 in Appendix A)

(A) Points RM5 and RM11 (April 2011 to March 2012) and RM21 (Summer 2012) occur along the "interior rim" and data from these points were removed from Phase 1 eagle fatality estimates for the following reasons:

(a1) **RM 5** is along eastern side of the "interior rim," away from Phase 1 development. No turbines occur within the point count or within 1 km of the 800-meter circle around RM5. While data from RM5 could be included due to less than 30 percent spatial coverage (criterion #2), the eastern face of the "interior rim" is a unique topographic feature that is not representative of the project footprint; therefore, data from RM5 were excluded.

(a2) **RM11** One turbine is located within 1 km of the 800-meter circle; therefore, data from RM11 could be included due to criterion #1; however, RM 11 is located along the eastern cliff face of the "interior rim," away from Phase 1 development. Furthermore, almost all eagle observations within the 800-meter point count occur along the eastern face of the rim, and the majority of eagle observations occur outside of Phase 1 development. Data from RM11 were excluded because the topographic feature and pattern of eagle use are not representative of the project footprint.

(a3) **RM21** was a long-watch site during May to July 2012 and replaced the points along the "interior rim" (RM5, RM6 and RM11). Five turbines occur within 1-km of the 800-meter point count, so data from RM21 could be included due to criterion #2. However, data from RM21 were excluded because the point count is located on the eastern face of a unique topographic feature and most eagle movements along the "interior rim" were north-south and did not overlap Phase 1. Data from RM21 were excluded because the topographic feature and pattern of eagle use are not representative of the project footprint.

(B) **RM 6** occurs along the western side of the "interior rim" nearest Phase 1. Even though RM6 is on the periphery of the project footprint and all eagle observations from this point count occur within the PCW avoidance area, data from RM6 were included because spatial coverage was considerably less than 30 percent and because two turbines occur within the 800-meter point count and 8 turbines are within 1 km of the circle (criterion #1).

(C) Data from RM12, CC8 and CC13 (the points are located in the SW corner of Chokecherry near Sheep Mountain) were included in the initial model runs, because turbines occur within 1 km of the 800-meter point count circles (criterion #1). In addition, kernel density analysis of the 2011 to 2012 data identified the SW corner of Chokecherry (near RM12) as a "high eagle use" area. In the current project layout, PCW removed turbines from the SW corner of Chokecherry. Because RM12, CC8 and CC13 are now on the periphery of the project footprint, they were considered for exclusion.

(c1) Data from **RM12** were included in the survey period from April 2011 to March 2012, because spatial coverage during this time was considerably less than 30 percent and because removing these data would leave only two point counts to represent eagle use for 202 turbines.

(c2) Data from **RM12** were included in the data from summer of 2012 (May to July), because spatial coverage was considerably less than 30 percent and because removing these data would leave only one point count to represent eagle use for 202 turbines.

(c3) Data from **CC8** (Aug to Nov 2012) were removed from analysis because there are eight other points in Chokecherry during this period and two survey points (CC2 and CC5) provide data for turbines near CC8.

(c4) Data from **CC13** and **RM12** (Dec 2012 to Aug 2013) were removed from analysis, because there are eleven other points in Chokecherry during this period and data from two survey points (CC2 and CC5) provide coverage for nearby turbines.

Sierra Madre-Specific Modifications to Decision Criteria

(See Figures 5 through 8 in Appendix A)

(A) Even though turbines are more than 1 km from **RM15**, data from this point were included in the period from April 2011 to March 2012, because spatial coverage during this period was considerably less than 30 percent and the habitat and features at RM15 are similar to those in the project footprint (criterion #2).

There are only four point count locations in Sierra Madre during April 2011 to March 2012, and only two of those points are on the eastern side of Miller Hill. Including data from RM15 adds a third point to the eastern side of Miller Hill and a fifth survey point to Sierra Madre, which has 298 turbines. Two turbines are within 1.25 km of RM15, and the vegetation and habitat are similar between RM15 and the eastern side of Sierra Madre.

Data from RM15 were not included in the survey periods between November 2012 and August 2013, because there are 18 other points in Sierra Madre during this time and spatial coverage approached 30 percent.

(B) **PG6** is located outside of the project footprint, east of the county road. Five turbines occur within 1 km of the 800-meter point count, so data from PG6 are included due to criterion #1. Because the point is on the eastern fringe of Phase 1, data from PG6 could be considered for exclusion, but doing so would substantially reduce the spatial coverage in the northeast portion of Sierra Madre and leave numerous turbines without nearby point count data. In addition, one of the largest and densest white-tailed prairie dog (WTPD) colonies in Sierra Madre occurs west of PG6; therefore, data from PG6 likely characterizes eagle use of the prey resource during the WTPD active period (about April through September).

(C) **PG3** is outside of the project footprint on the north side of Miller Hill, and only one turbine occurs near the edge of the 1 km buffer of the 800-meter point count; therefore, data from this point count were considered for exclusion. Four of the habitat types in and around PG3 (Open Water, Aspen-Mixed Conifer, and Montane Shrubland) are not representative of the project footprint. Other nearby points (PG10, PG6, and PG9) contain representative habitat types, and these points provide good spatial coverage of turbine locations; therefore data from PG3 were removed from the analysis.

Appendix B summarizes point count locations by survey period and phase of development.

CALCULATING EAGLE MINUTES FOR THE FATALITY MODEL

April 2011 to March 2012

In June of 2012, the Power Company of Wyoming (PCW) provided a summary spreadsheet of survey effort and eagle observations from the 15 long-watch raptor count locations that were surveyed between April 2011 and March 2012. The dataset included eagle observations out to 6.4 km (4.0 miles), but eagle observations from the long-watch data were truncated at 800-meters due to concerns about detectability falling below assumed 100% beyond 800-meters and to be consistent with survey recommendations in the ECPG (ECPG 2013, pp. 54-59). The truncated dataset (i.e., at 800-meters) for both Phase 1 and Phase 2 included 729 golden eagle minutes, 73 bald eagle minutes and 3 unidentified eagle minutes. Total survey effort included 129,750 minutes or 2,163 hours of observation. These same data were also used in PCW's draft Eagle Conservation Plan and in numerous reports from PCW.

In comparing eagle minutes in the summary spreadsheet with detailed eagle observations in the GIS data file (Raptors201104_201203), it became apparent that the summary spreadsheet had substantially more eagle minutes within 800-meters than could be accounted for in the GIS data. The GIS file included start and end times for each eagle observation, so minutes for each eagle observation could be directly calculated from the GIS file. In contrast, the summary spreadsheet only contained a single column for eagle minutes without any record of how minutes were derived. Upon further review, it was determined that the summary spreadsheet ascribed minutes from the entire flight path to each point in the path instead of just the time for that segment of the flight path. In addition, eagle minutes outside the 800-meter point count were included in the spreadsheet if part of the flight path crossed the point count.

Because the GIS file represents the best available data and because the results from the GIS file can be repeated, the summary spreadsheet and the associated data were not used in the analysis to predict eagle fatalities.

The start and end times in the GIS file were recorded in hours and minutes but did not include seconds (e.g., 08:01 to 08:02 a.m.). Recommendations in the ECPG include rounding time of each eagle observation to "the next highest integer (e.g., an eagle observed flying within the plot for about 15 seconds is 1 eagle minute, another observed within for about 1 minute 10 seconds is 2 eagle-minutes, and so on…)" (ECPG 2013, p. 56). Because seconds were not provided, the number of eagle minutes was rounded to include all minutes in which the eagles were observed. In the above example, the observation occurred at both 08:01 and 08:02, resulting in a total of two eagle minutes. In some cases, this method may inflate the number of eagle minutes, but it ensures the number of eagle minutes is not underestimated. Using this method, the dataset from the GIS file includes 198 golden eagle, 39 bald eagle, and 0 unidentified eagle minutes for Phase 1 (Table 1; GOEA Minutes; BAEA Minutes).

In GIS, eagle observations with corresponding flight paths for Phase 1 were reviewed point by point. Using best professional judgment, eagle minutes were reduced if the eagle flew out of the 800-meter point count. For example, if a three-minute observation of an eagle started at the edge of the point count (i.e., at 800-meters) and the eagle flew away from the circle, that three-minute observation became one eagle minute. This analysis reduced golden eagle minutes for Phase 1 from 198 to 189 minutes and bald eagle from 39 to 34 minutes (Table 1; Flight Adjusted).

The ECPG recommends eagle minutes be "recorded as ≤ 200 m (at or below conservative approximation of maximum height of blade tip of tallest turbine) or > 200 m" (ECPG 2013, p. 56). In the GIS file, heights of eagle observations were recorded as above or below150 meters, therefore, it is impossible to know whether an eagle minute recorded as 150+ meters was between 150 and 200 meters or above 200 meters. To address this issue, all eagle minutes with heights greater than 150 meters were removed. This adjustment reduced golden eagle minutes for Phase 1 from 189 to 145 minutes and bald eagle minutes from 34 to 32 minutes (Table 1; Height Adjusted). Because flight heights were truncated at 150 meters, the prior for exposure in the model was modified to account for sampling volume and the sampled volume term in the model code was adjusted from 200 to 150 meters.

Table 1. Summary of raw, flight-adjusted, and height-adjusted golden eagle (GOEA; orange color) and bald eagle (BAEA; blue color) minutes for Chokecherry (CC) and Sierra Madre (SM) Phase1, based on data from the GIS file.

Phase / Location	GOEA Minutes	Flight Adjusted	Height Adjusted	BAEA Minutes	Flight Adjusted	Height Adjusted
CC Phase 1	50	50	37	13	10	10
SM Phase 1	148	139	108	26	24	22
Total	198	189	**145**	39	34	**32**

May 2012 to August 2013

For five survey periods between May 2012 and August 2013, the PCW provided spreadsheets containing detailed descriptions of eagle observations within the 800-meter point counts, including start and end times for each eagle observation. Start and end times were recorded in hours and minutes but did not include seconds (e.g., 10:05 to 10:07 a.m.). Recommendations in the ECPG include rounding time of each eagle observation to "the next highest integer" (ECPG 2013, p. 56). Similar to treatment of the earlier GIS data, the number of eagle minutes was rounded to include all minutes in which the eagles were observed. In the above example, the observation occurred in 10:05, 10:06 and 10:07, resulting in a total of three eagle minutes. In some cases, this method may inflate the number of eagle minutes, but it ensures the number of eagle minutes is not underestimated.

For the Summer 2012 dataset and a portion of the Fall 2012 dataset, eagle minutes were recorded as above or below 150 meters instead of 200 meters as recommended (ECPG 2013, p. 56). To address this issue, all eagle minutes with heights greater than 150 meters were removed, and then sampled volume in the model code was adjusted from 200 to 150 meters. For the second half of the Fall 2012 dataset, and the Winter 2012, Spring 2013 and Summer 2013 datasets, eagle observations were recorded as above or below 200 meters.

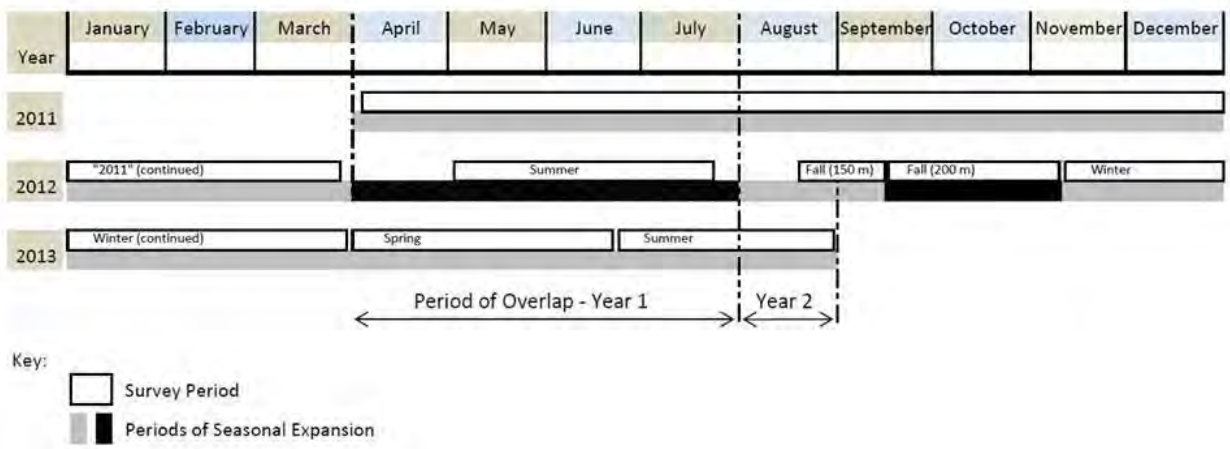
Periods of Sampling Overlap for "Year1" and "Year2"

Data from the first year (April 2011 to March 2012) and data from the summer of 2012 (May 2012 to July 2012) were collected using the same methods. Even though the number and location of points differed, the data from the 16 months can be combined into one year (Year1) for use in the model, because the data were collected using similar methods. Data from the 16 months of "Year 1" were pooled and used to predict fatalities for one 12-month year (Figure 1).

The second year of data (August 2012 to August 2013) was collected over thirteen months from different numbers of survey points (i.e., 40 and 60) and using different eagle flight heights (i.e., 150 and 200 meters). Because of the varying survey effort and different volumes, the data were stratified by sampling methodology. The sampling periods from Year2 are "Fall2012-150m" (40 points, 150 meters), "Fall2012-200m" (40 points, 200 meters) and "Winter2012 / Spring2013 / Summer2013" (60 points, 200 meters).

Data from the 13 months of "Year2" were pooled and used to predict fatalities for one 12-month year; however, the code in the eagle fatality model was modified to account for different survey volumes and hazardous area volumes (Figure 1).

Figure 1. Survey effort (and period of expansion) overlapped from April 2011 through July 2012 (collectively "Year 1") and from August 2012 to August 2013(collectively "Year 2").



Appendix C summarizes survey effort and eagle minutes for individual survey points during each survey period.

Appendix D summarizes total survey effort and eagle minutes for Chokecherry and Sierra Madre during each survey period based on the decision criteria whether to include or exclude survey points.

ADJUSTMENTS DUE TO AVOIDANCE AREAS

In general, eagle minutes observed at observation points that overlapped the PCW-avoidance areas were not subtracted from the model runs by USFWS. The avoidance areas are primarily a concern for the April 2011 to March 2012 dataset, because later point count locations were placed outside of the avoidance areas. Earlier attempts by USFWS and PCW to exclude eagle minutes that occurred within the avoidance areas were based on data from the summary spreadsheet (rather than GIS data), and resulted in removal of between 40 to 75 percent of eagle minutes depending on method used.

Using data from the GIS file (instead of the summary spreadsheet) for those points included in the decision criteria results in the removal of a small percentage of eagle minutes from Phase 1 survey points. One possible reason to exclude data within the avoidance areas is that they are

areas where turbines will not be built and so risk to eagles should be lower; however, in most cases there are not enough eagle observations to conclude that eagle activity differs between areas within an 800-meter survey point. Furthermore, removing eagle minutes within the avoidance areas may result in a higher eagle fatality estimate due to the corresponding subtraction of survey area within the avoidance areas.

RM5, RM11, and RM21 occur within the avoidance areas. As discussed earlier, eagle minutes from RM5, RM11, and RM21 were not included, because the points occur along the eastern face of the "interior rim," a unique topographic feature that does not represent the project footprint. In addition, most eagle movements occur within the avoidance areas. All eagle minutes from RM5, RM11, and RM21 are excluded from the model.

ADJUSTMENTS TO ANNUAL DAYLIGHT HOURS

Based on the location of Teton Reservoir, which is about halfway between Chokecherry and Sierra Madre, the daylight hour function (author: M. Otto, USFWS) calculated 4,458 daylight hours on an annual basis (Appendix E). Using turbine-specific information, the percent of daylight operational periods for each of the 500 turbines ranges from 70 to 98 percent, with an annual average of 91.9 percent for all 500 turbines combined (AWS Truepower 2014). Operational hours for each turbine were provided by season; therefore, seasonal averages for Chokecherry range from 88.4 to 96.3 percent and from 85.1 to 94.5 percent for Sierra Madre (Appendix E).

Based on a project-wide average of an eight percent non-operational period, and based on the seasonal curtailment of 17 turbines near nest "162" for 89.25 days between 1 February and 30 April, the annual daylight hours were adjusted from 4,458 to 4,064 daylight hours per year (Appendix E).

Fatality estimates were also run separately for Phase 1 of Chokecherry and Phase 1 of Sierra Madre. Because there is no pre-planned curtailment within Chokecherry, the adjusted daylight hours (4,149.6) are based on the average season operational hours of turbines only within Chokecherry (Appendix E).

At Sierra Madre, 17 turbines near nest "162" will be curtailed during all daylight hours for 89.25 days between February 1st and April 30th. Subtracting the turbine-hours for the 17 turbines during the curtailment period, and using the average seasonal operational hours for the 298 turbines within Sierra Madre, there are 4,005 daylight hours per year (Appendix E).

VOLUME ADJUSTMENTS

The volume of the observed area in the model (the 200-meter high cylinder around each turbine) was adjusted for the April 2011 to March 2012 dataset, the Summer 2012 dataset (05/01/12 - 07/24/12) and part of the fall 2012 dataset (08/20/12 - 09/15/12), because eagle observations were recorded as above or below 150 meters rather than 200 meters recommended in the ECPG.

The eagle fatality model code was modified to compute the exposure prior and posterior and hazardous area in the expansion factor as volumes since some of the data collection did not use the recommended 200-m and below. These changes are indicated in the model code used in the USFWS analysis.

MODEL INPUTS AND RESULTS

Appendix F summarizes the data used as inputs into the eagle fatality model as well as the model results. Individual estimates of golden eagle fatalities and bald eagle fatalities were also run separately for Phase 1 of Chokecherry and Phase 1 of Sierra Madre. Fatalities for each species were predicted using turbines with 103-meter diameter blades and 120-meter diameter blades.

Due to similarity of data collection methods, the data from Year1 (April 2011 to July 2012) were combined into one model run for Chokecherry and one model run for Sierra Madre. Because the eagle fatality model uses a Bayesian framework, the posterior from Year1 informs Year2 as the new prior. Because the second "year" (Year2, August 2012 to August 2013) was collected over thirteen months using different methods, data from the Year2 were pooled and used to predict fatalities for one 12-month year (see prior discussion).

In the Bayesian framework, results from Year2 are actually a combination of the data from both Year1 and Year2. Therefore, while results are shown for Year1 in Appendix F, the results from Year2 are the "final" predicted eagle fatalities.

Using the largest on-shore turbine anticipated (120-meter diameter blade), the 80 percent upper credible interval (80% UCI) from the USFWS peer-reviewed model predicts 14 golden eagle fatalities and 2 bald eagle fatalities annually for Phase 1 of the Chokecherry and Sierra Madre Wind Energy Project. Using a smaller turbine (103-meter blade), the 80% UCI from the model predicts the 500 turbines of Phase 1 will result in 10 golden eagle and 1.4 bald eagle fatalities annually (7 bald eagles every 5 years).

The average (mean) fatality estimates are also provided in Appendix F; however, the Eagle Conservation Plan Guidance recommends using a risk-averse method such as the 80% UCI for calculating programmatic eagle take, rather than using the average (ECPG 2013, p. 29). However, the average number of predicted fatalities is 7 and 10 golden eagles and 1 and 2 bald eagles for 103-meter and 120-meter blades, respectively.

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Appendix A: Maps of Point Count Locations

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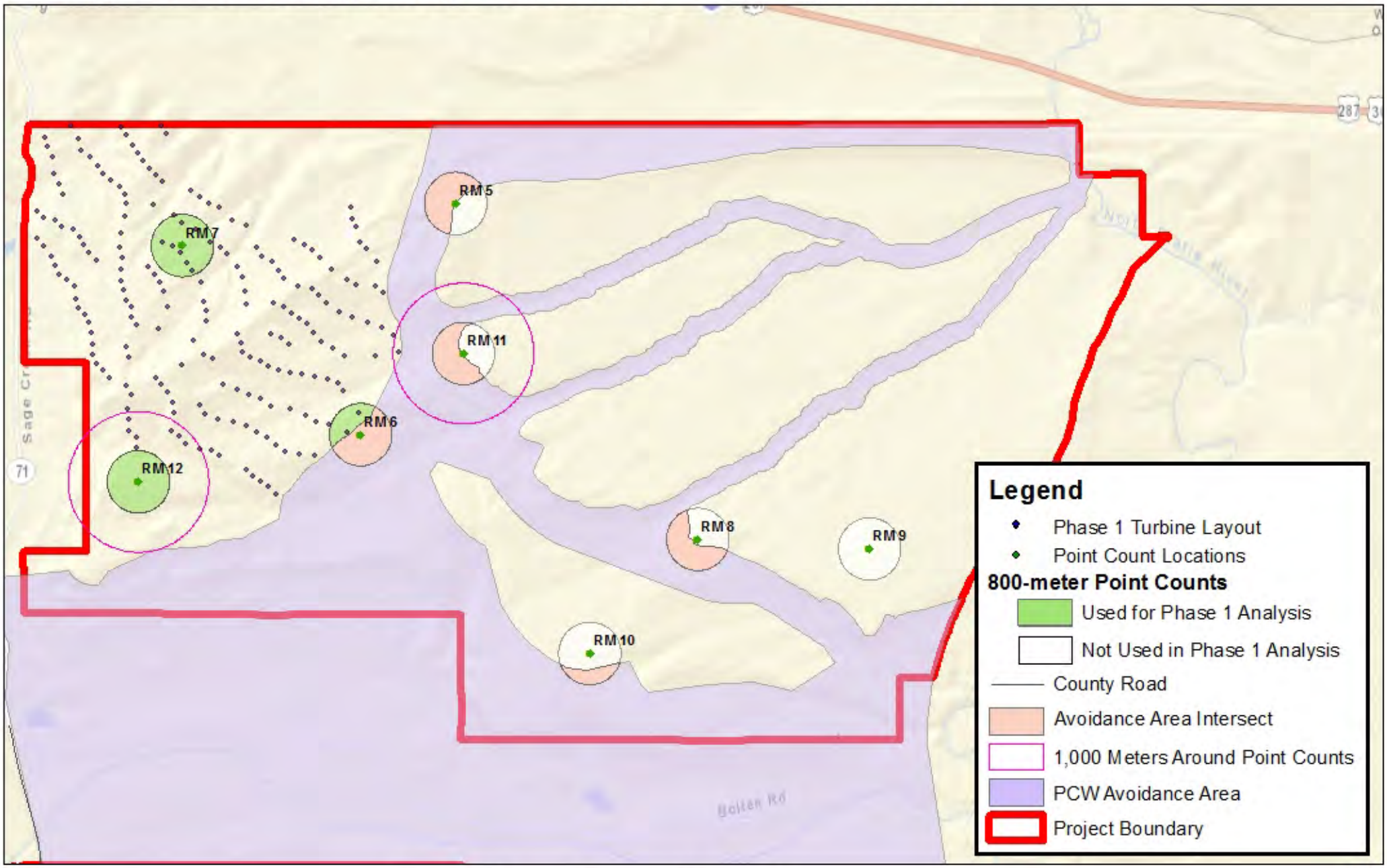
Figure 1. Chokecherry Survey Locations, April 2011 through March 2012



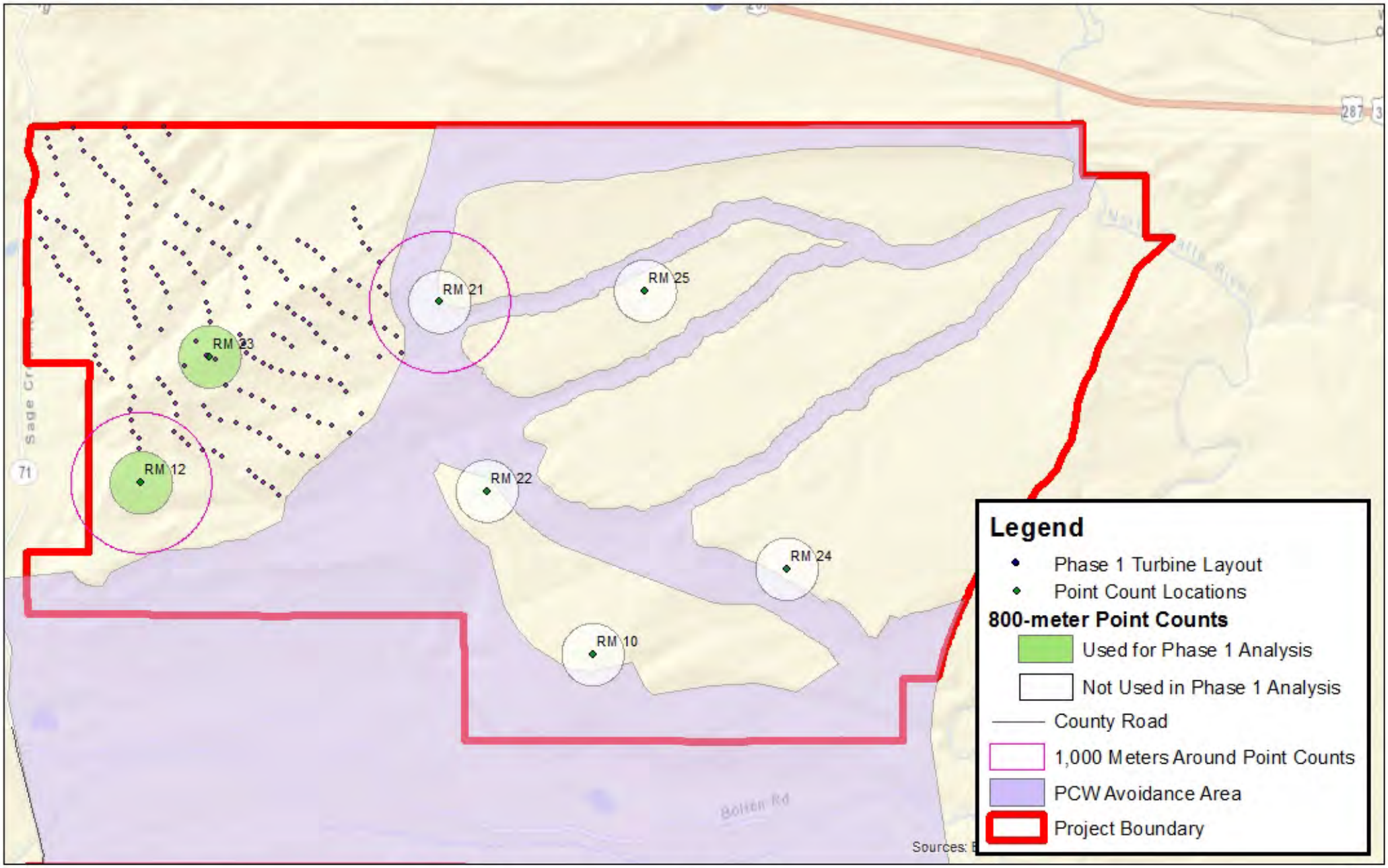
Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

N

U.S. Fish & Wildlife Service Wyoming Ecological Services

Figure 2. Chokecherry Survey Locations, May 2012 through July 2012

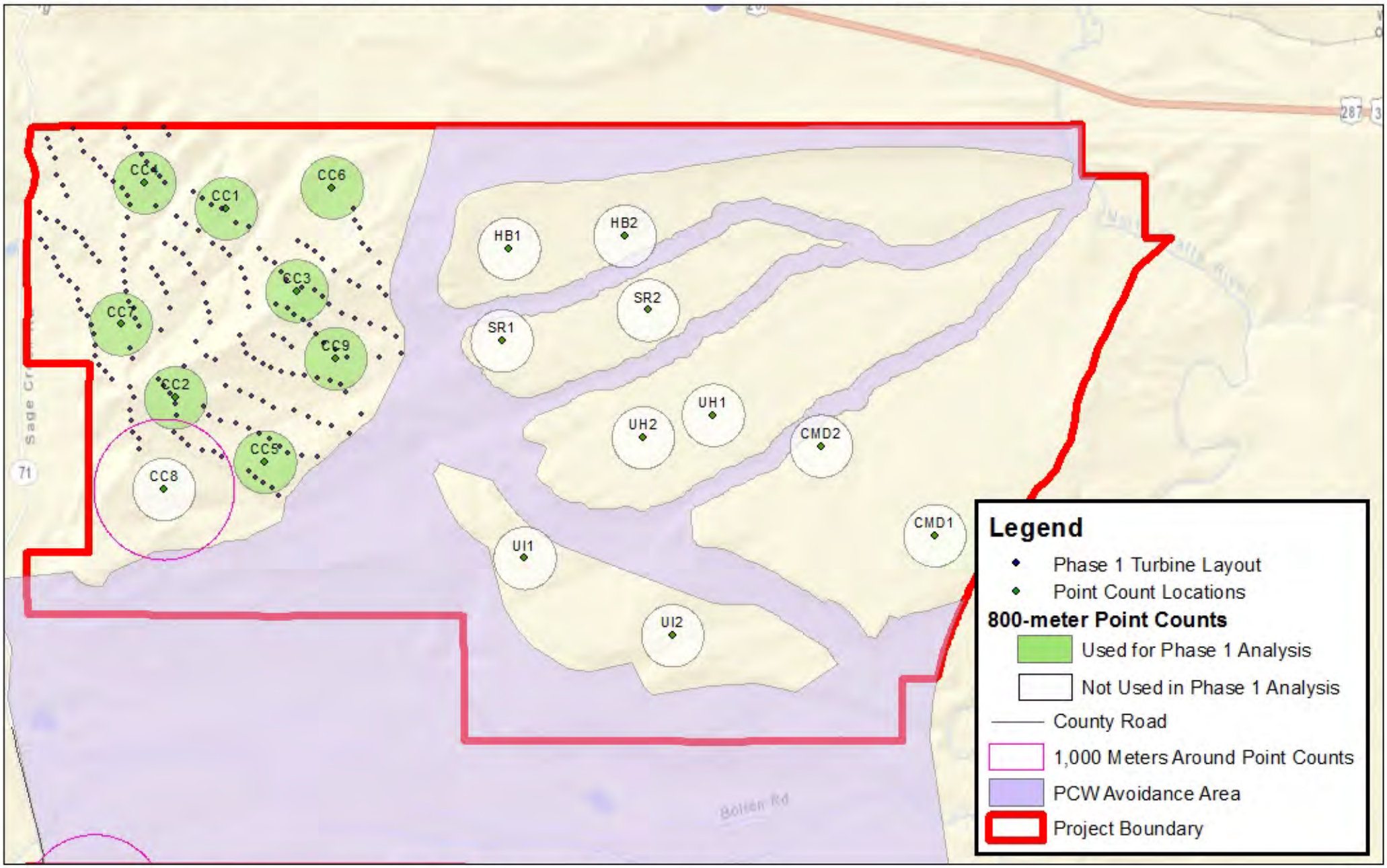


Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

N

Figure 3. Chokecherry Survey Locations, August through November 2012

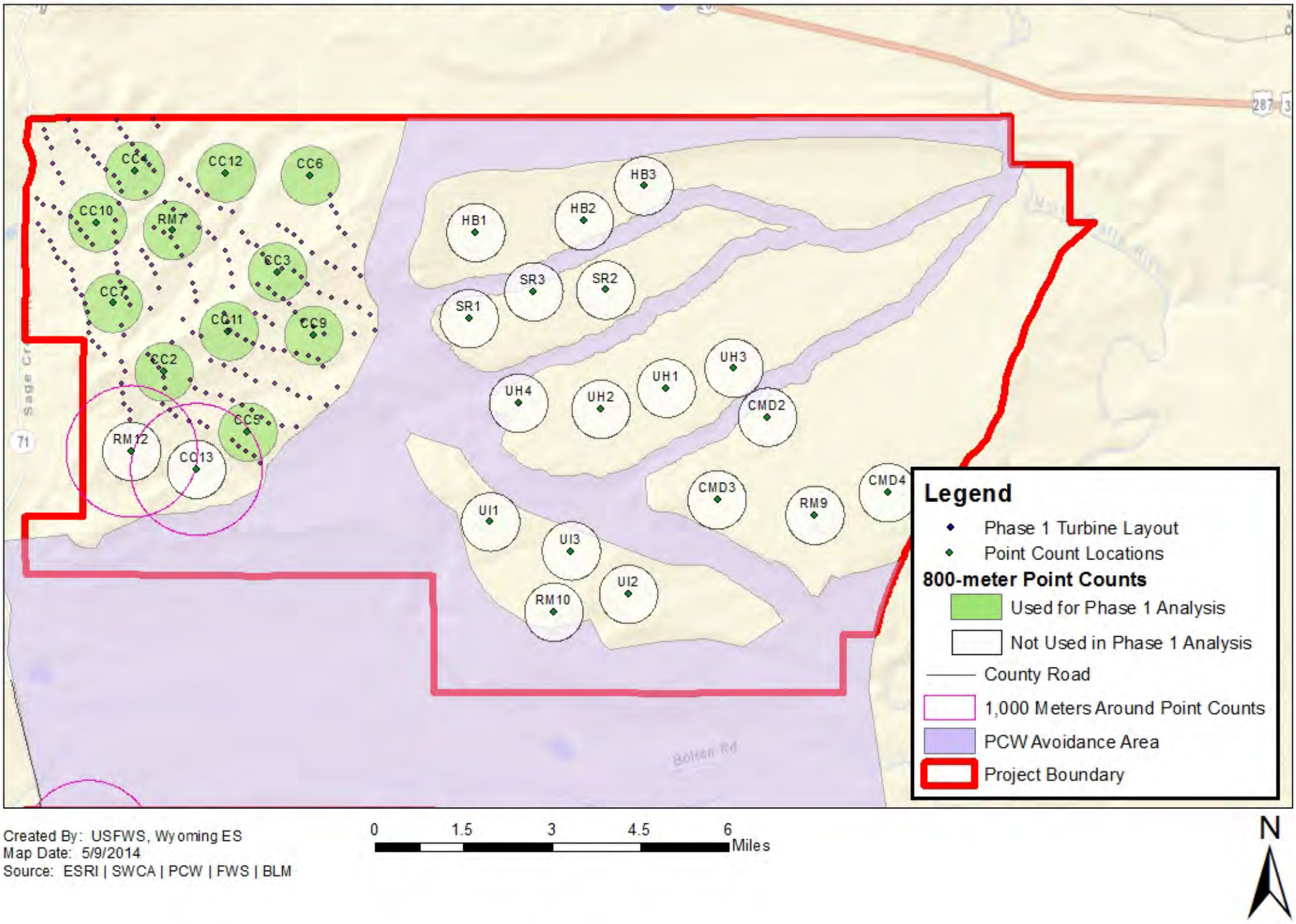


Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

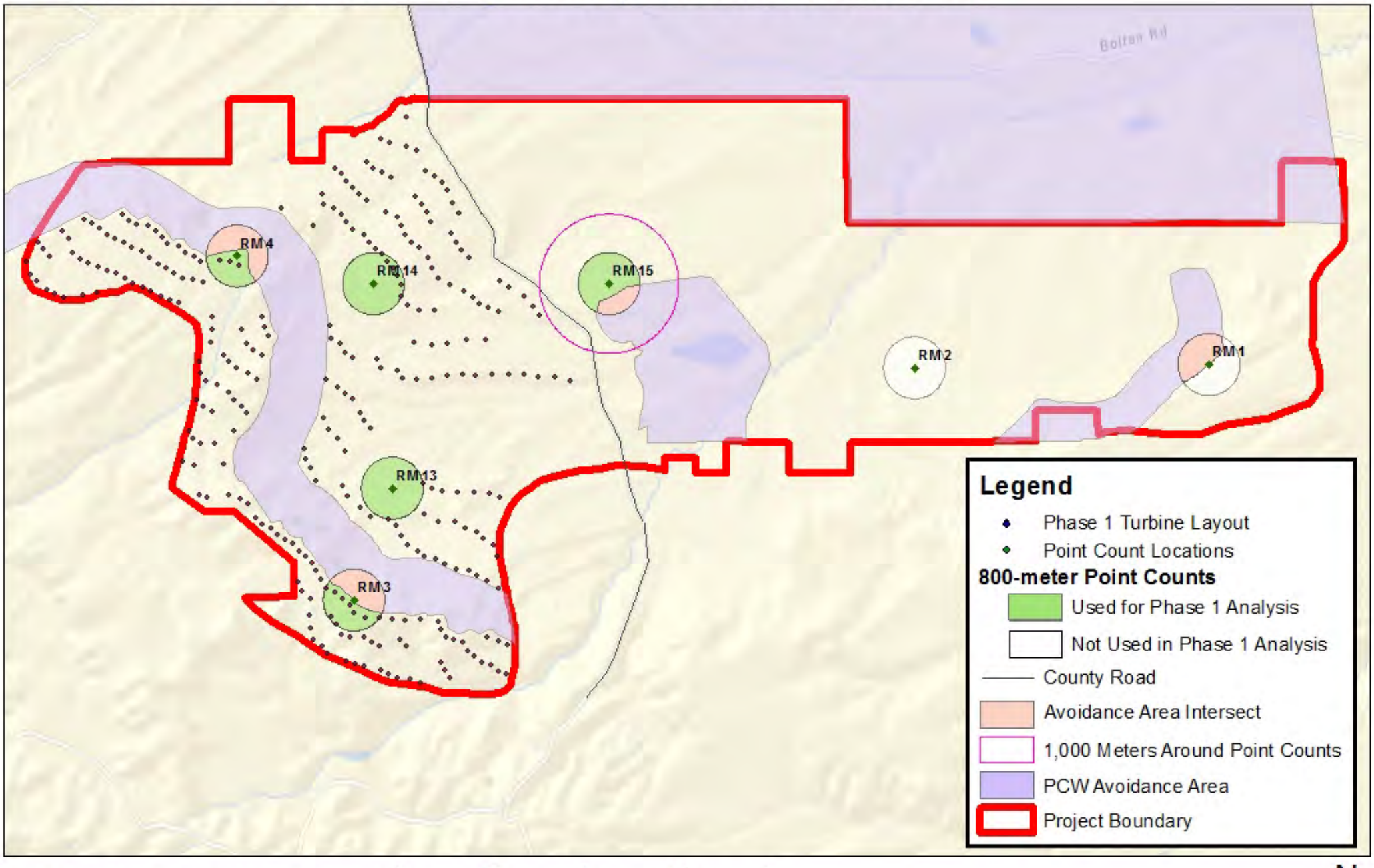
N

Figure 4. Chokecherry Survey Locations, November 2012 through August 2013



Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

Figure 5. Sierra Madre Survey Locations, April 2011 through March 2012

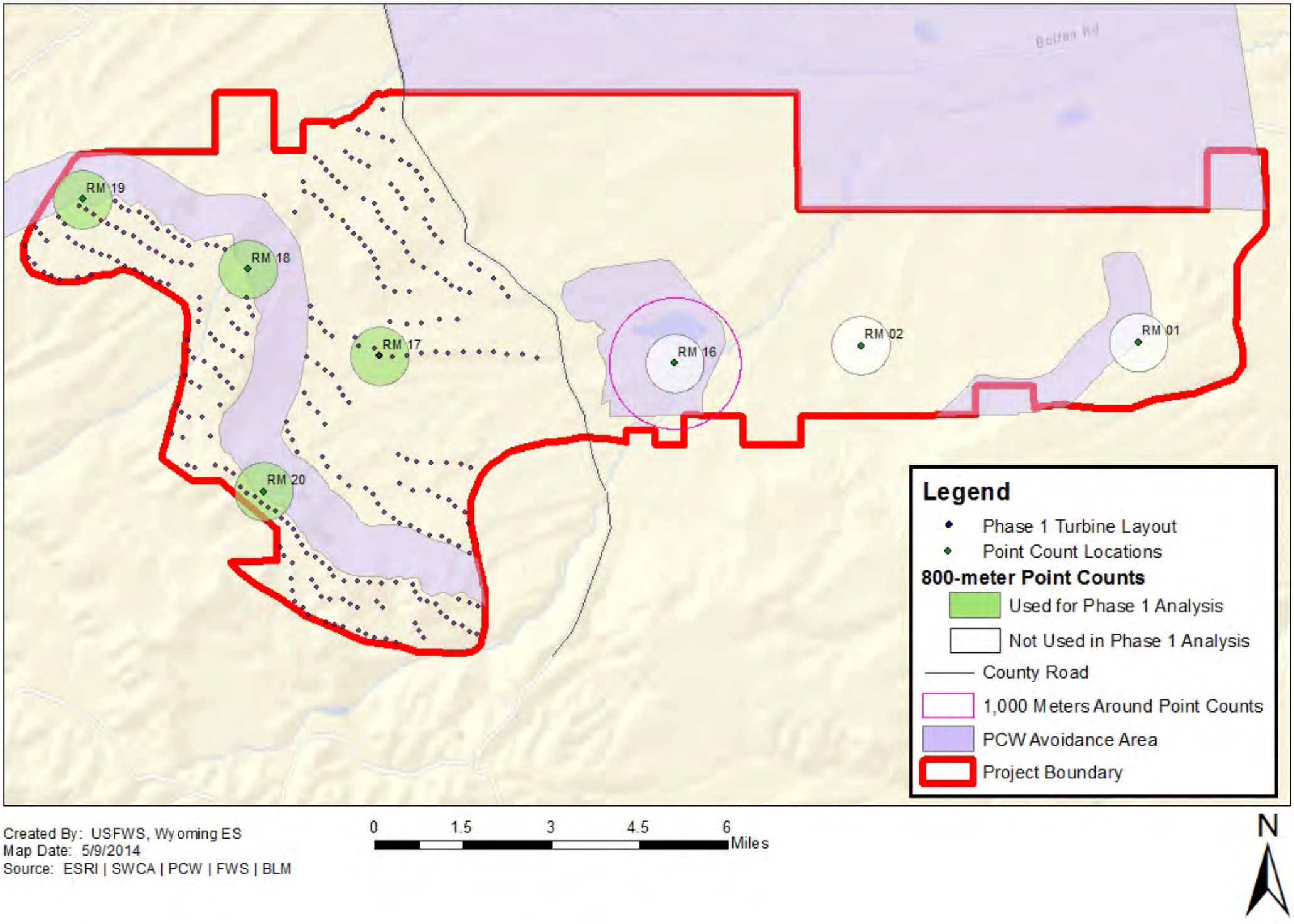


Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

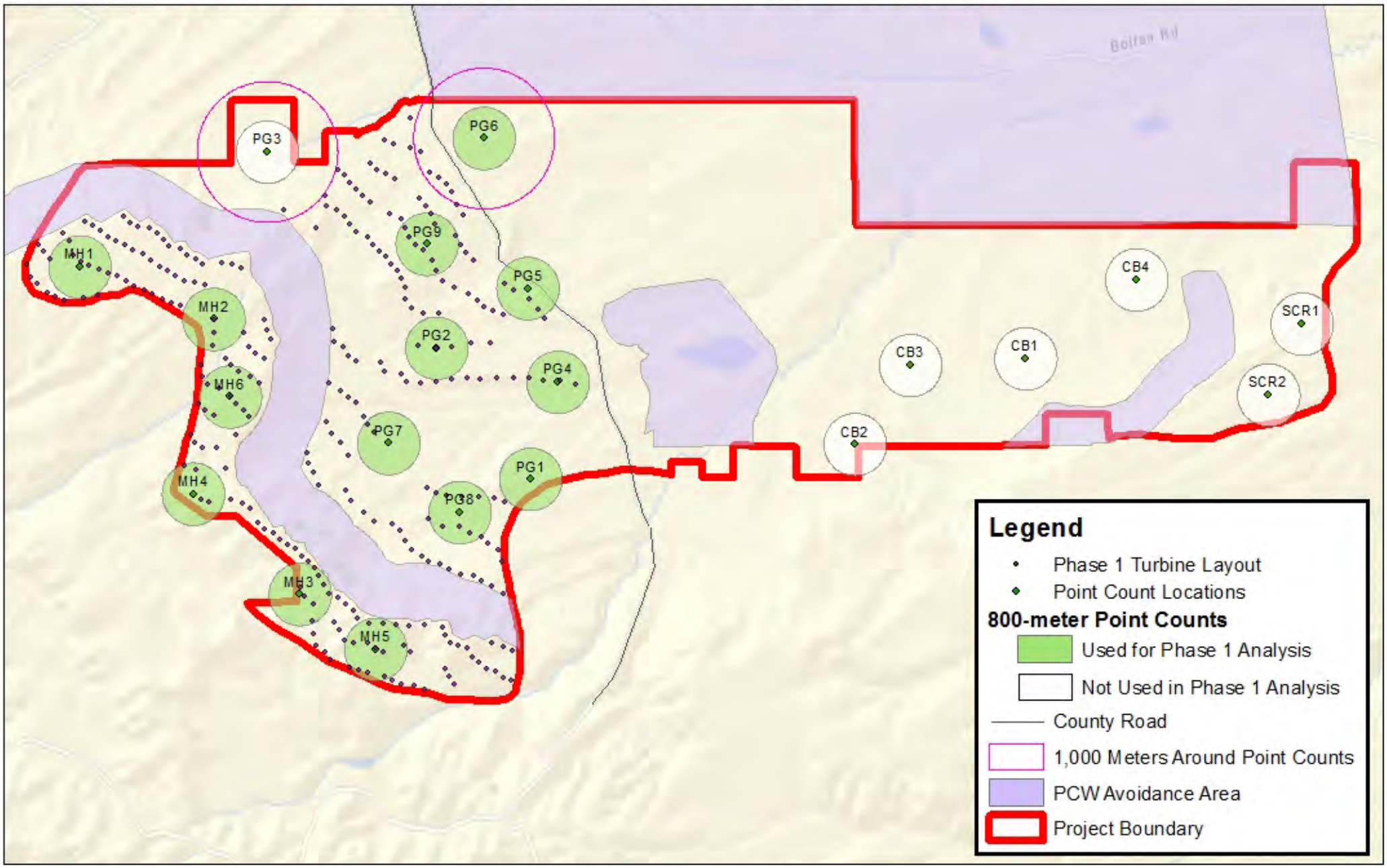
N

Figure 6. Sierra Madre Survey Locations, May 2012 through July 2012



Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

Figure 7. Sierra Madre Survey Locations, August through November 2012

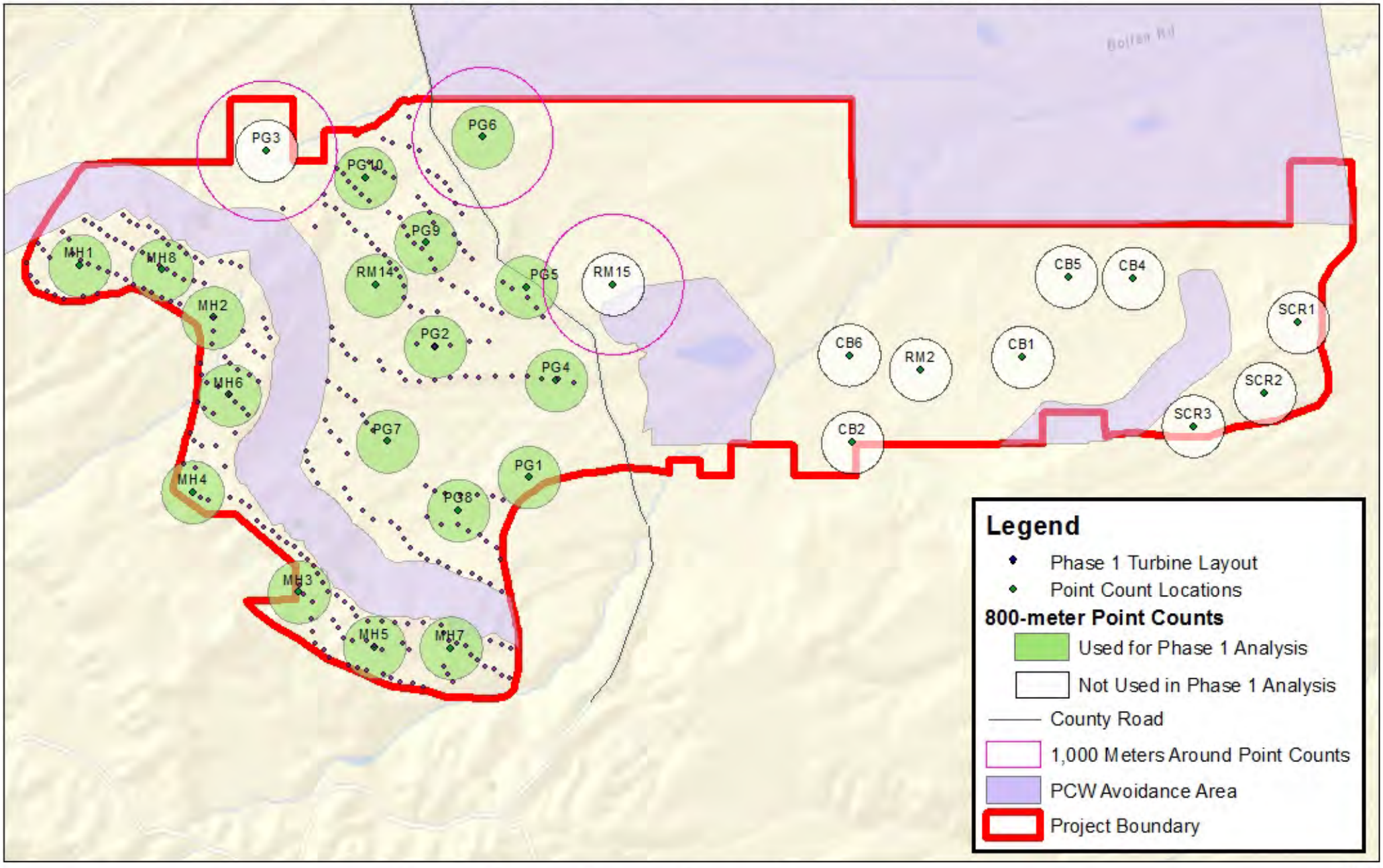


Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

N

Figure 8. Sierra Madre Survey Locations, November 2012 through August 2013



Created By: USFWS, Wyoming ES
Map Date: 5/9/2014
Source: ESRI | SWCA | PCW | FWS | BLM

0 1.5 3 4.5 6 Miles

N

Appendix B: Summary Table of Point Count Locations in Phase 1 for Each Survey Period

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Geographic Location of Survey Points by Survey Period - Phase 1

15 SURVEY POINTS 04/04/11 - 03/27/12		**14 SURVEY POINTS** 05/01/12 - 07/24/12		**40 SURVEY POINTS** 08/20/12 - 11/09/12		**60 SURVEY POINTS** 11/12/12 - 08/30/13	
PHASE 1		PHASE 1		Phase 1		PHASE 1	
CC	SM	CC	SM	CC	SM	CC	SM
RM6	RM13	RM12	RM17	CC1	MH1	CC10	MH1
RM7	RM14	RM23	RM18	CC2	MH2	CC11	MH2
RM12	RM3		RM19	CC3	MH3	CC12	MH3
	RM4		RM20	CC4	MH4	CC13	MH4
	RM15			CC5	MH5	CC2	MH5
				CC6	MH6	CC3	MH6
				CC7	PG1	CC4	MH7
				CC8	PG2	CC5	MH8
				CC9	PG3	CC6	PG1
					PG4	CC7	PG10
					PG5	CC9	PG2
					PG6	RM12	PG3
					PG7	RM7	PG4
					PG8		PG5
					PG9		PG6
							PG7
							PG8
							PG9
							RM14
3	5	2	4	9	15	13	19

In this period, data from RM15 are included in Sierra Madre Phase 1

Data from CC8, CC13 and RM12 excluded from Chokecherry Phase 1 starting Fall 2012

Data from PG3 excluded from Sierra Madre starting Fall 2012

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Appendix C: Eagle Minutes and Survey Effort by Survey Point and Sampling Period

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Survey Data by Point Count by Survey Period

** GOEA = Golden Eagle; BAEA = Bald Eagle; Obs = Observation
** Eagle minutes are rounded up.
** Eagle observations recorded as 150+ meters are not included.
** Fall 2012 data are split at 9/16 due to different methods used to record eagle altitude.

2011 Spring to 2012 Spring Data (04/04/11 - 03/27/12) (<150 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Minutes Obs	Area Obs*	Eagle Exposure[1]
CC - West	RM 6	24	5	9041	2.01	0.00132
CC - West	RM 7	0	5	7790	2.01	0.00000
CC - West	RM 12	13		7970	2.01	0.00081
SM - West	RM 3	1	1	7173	2.01	0.00007
SM - West	RM 4	13		8171	2.01	0.00079
SM - West	RM 13	20	4	10563	2.01	0.00094
SM - West	RM 14	50	17	8264	2.01	0.00301
SM - West	*RM 15*	24		8558	2.01	0.00140
SM-East	RM 1	29		8889	2.01	0.00162
SM-East	RM 2	49		8606	2.01	0.00283
CC - East	RM 5	41		8480	2.01	0.00241
CC - East	RM 8	59	1	8913	2.01	0.00329
CC - East	RM 9	9		9290	2.01	0.00048
CC - East	RM 10	4		8729	2.01	0.00023
CC - East	RM 11	101	5	9313	2.01	0.00540

2011 Spring to 2012 Spring Summary of Minutes by Phase			
Phase	**GOEA**	**BAEA**	**Obs**
CC - East	214	6	44,725
CC - West	37	10	24,801
SM - West	108	22	42,729
SM-East	78		17,495
Grand Total	**437**	**38**	**129,750**

2012 Summer Data (05/01/12 - 07/24/12) (eagle minutes <150 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Minutes Obs	Area Obs*	Eagle Exposure[1]
CC - West	RM12			1080	2.01	0.00000
CC - West	RM23			1044	2.01	0.00000
SM - West	RM17	5		1082	2.01	0.00230
SM - West	RM18	3		1088	2.01	0.00137
SM - West	RM19	9		1080	2.01	0.00415
SM - West	RM20	2		1080	2.01	0.00092
CC - East	RM10			1080	2.01	0.00000
CC - East	RM21			1080	2.01	0.00000
CC - East	RM22			1082	2.01	0.00000
CC - East	RM24			1080	2.01	0.00000
CC - East	RM25	2		1083	2.01	0.00092
SM-East	RM01	4		1140	2.01	0.00175
SM-East	RM02			1140	2.01	0.00000
SM-East	RM16			1080	2.01	0.00000

2012 Summer Data Summary of Minutes by Phase			
Phase	**GOEA**	**BAEA**	**Obs**
CC - East	2		5,405
CC - West			2,124
SM - West	19		4,330
SM-East	4		3,360
Grand Total	**25**	**0**	**15,219**

2012 Fall Data (in part) (08/20/12 - 09/15/12) (eagle minutes <150 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Obs	Area Obs*	Eagle Exposure[1]
CC - West	CC1			240	2.01	0.00000
CC - West	CC2			240	2.01	0.00000
CC - West	CC3			240	2.01	0.00000
CC - West	CC4			240	2.01	0.00000
CC - West	CC5			240	2.01	0.00000
CC - West	CC6			240	2.01	0.00000
CC - West	CC7			300	2.01	0.00000
CC - West	CC8	0		240	2.01	0.00000
CC - West	CC9			240	2.01	0.00000
SM - West	MH1	7		240	2.01	0.01451
SM - West	MH2			240	2.01	0.00000
SM - West	MH3			300	2.01	0.00000
SM - West	MH4			240	2.01	0.00000
SM - West	MH5			300	2.01	0.00000
SM - West	MH6			240	2.01	0.00000
SM - West	PG1			240	2.01	0.00000
SM - West	PG2	2		240	2.01	0.00415
SM - West	PG3		2	240	2.01	0.00000
SM - West	PG4			240	2.01	0.00000
SM - West	PG5			300	2.01	0.00000
SM - West	PG6			240	2.01	0.00000
SM - West	PG7			240	2.01	0.00000
SM - West	PG8			240	2.01	0.00000
SM - West	PG9			240	2.01	0.00000
CC - East	CMD1			300	2.01	0.00000
CC - East	CMD2			240	2.01	0.00000
CC - East	HB1			240	2.01	0.00000
CC - East	HB2			240	2.01	0.00000
CC - East	SR1			240	2.01	0.00000
CC - East	SR2			240	2.01	0.00000
CC - East	UH1			300	2.01	0.00000
CC - East	UH2			240	2.01	0.00000
CC - East	UI1			240	2.01	0.00000
CC - East	UI2			240	2.01	0.00000
SM-East	CB1			300	2.01	0.00000
SM-East	CB2			240	2.01	0.00000
SM-East	CB3			240	2.01	0.00000
SM-East	CB4			240	2.01	0.00000
SM-East	SCR1	3		240	2.01	0.00622
SM-East	SCR2	6		240	2.01	0.01244

2012 Fall Data (in part)
Summary of Minutes by Phase

Phase	GOEA	BAEA	Obs
CC - East			2,520
CC - West	0		2,220
SM - West	9	2	3,780
SM-East	9		1,500
Grand Total	**18**	**2**	**10,020**

2012 Fall Data (in part) (09/17/12 - 11/09/12) (eagle minutes <200 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Obs	Area Obs*	Eagle Exposure[1]
CC - West	CC1			480	2.01	0.00000
CC - West	CC2			480	2.01	0.00000
CC - West	CC3	3		458	2.01	0.00326
CC - West	CC4	6		480	2.01	0.00622
CC - West	CC5			480	2.01	0.00000
CC - West	CC6	4		476	2.01	0.00418
CC - West	CC7			480	2.01	0.00000
CC - West	CC8	0		480	2.01	0.00000
CC - West	CC9			480	2.01	0.00000
SM - West	MH1			480	2.01	0.00000
SM - West	MH2			480	2.01	0.00000
SM - West	MH3			480	2.01	0.00000
SM - West	MH4			480	2.01	0.00000
SM - West	MH5			480	2.01	0.00000
SM - West	MH6	5		480	2.01	0.00518
SM - West	PG1	3		480	2.01	0.00311
SM - West	PG2	2		480	2.01	0.00207
SM - West	PG3			480	2.01	0.00000
SM - West	PG4			600	2.01	0.00000
SM - West	PG5	3		480	2.01	0.00311
SM - West	PG6			360	2.01	0.00000
SM - West	PG7			480	2.01	0.00000
SM - West	PG8			600	2.01	0.00000
SM - West	PG9			360	2.01	0.00000
CC - East	CMD1			480	2.01	0.00000
CC - East	CMD2			480	2.01	0.00000
CC - East	HB1			480	2.01	0.00000
CC - East	HB2			480	2.01	0.00000
CC - East	SR1			480	2.01	0.00000
CC - East	SR2			480	2.01	0.00000
CC - East	UH1			462	2.01	0.00000
CC - East	UH2			480	2.01	0.00000
CC - East	UI1			480	2.01	0.00000
CC - East	UI2			480	2.01	0.00000
SM-East	CB1			480	2.01	0.00000
SM-East	CB2			480	2.01	0.00000
SM-East	CB3			360	2.01	0.00000
SM-East	CB4			600	2.01	0.00000
SM-East	SCR1			480	2.01	0.00000
SM-East	SCR2	9		480	2.01	0.00933

2012 Fall Data (in part)
Summary of Minutes by Phase

Phase	GOEA	BAEA	Obs
CC - East			4,782
CC - West	13		4,294
SM - West	13		7,200
SM-East	9		2,880
Grand Total	**35**	**0**	**19,156**

2012 Winter Data (11/12/12 - 03/29/13) (eagle minutes <200 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Minutes Obs	Area Obs*	Eagle Exposure[1]
CC - West	CC10			540	2.01	0.00000
CC - West	CC11			540	2.01	0.00000
CC - West	CC12			540	2.01	0.00000
CC - West	CC13	14		540	2.01	0.01290
CC - West	CC2			540	2.01	0.00000
CC - West	CC3			510	2.01	0.00000
CC - West	CC4			540	2.01	0.00000
CC - West	CC5			420	2.01	0.00000
CC - West	CC6			480	2.01	0.00000
CC - West	CC7	8		480	2.01	0.00829
CC - West	CC9			480	2.01	0.00000
CC - West	RM12	0		540	2.01	0.00000
CC - West	RM7			540	2.01	0.00000
SM - West	MH1			300	2.01	0.00000
SM - West	MH2			480	2.01	0.00000
SM - West	MH3			480	2.01	0.00000
SM - West	MH4			300	2.01	0.00000
SM - West	MH5			480	2.01	0.00000
SM - West	MH6			540	2.01	0.00000
SM - West	MH7			480	2.01	0.00000
SM - West	MH8	3		540	2.01	0.00276
SM - West	PG1			540	2.01	0.00000
SM - West	PG10			540	2.01	0.00000
SM - West	PG5			540	2.01	0.00000
SM - West	PG2			540	2.01	0.00000
SM - West	PG3	12		540	2.01	0.01106
SM - West	PG4	7		540	2.01	0.00645
SM - West	PG6	3		540	2.01	0.00276
SM - West	PG7			480	2.01	0.00000
SM - West	PG8			480	2.01	0.00000
SM - West	PG9			480	2.01	0.00000
SM - West	RM14	9		480	2.01	0.00933
CC - East	CMD2			480	2.01	0.00000
CC - East	CMD3			400	2.01	0.00000
CC - East	CMD4			540	2.01	0.00000
CC - East	HB1			600	2.01	0.00000
CC - East	HB2			540	2.01	0.00000
CC - East	HB3	4		480	2.01	0.00415
CC - East	RM10			540	2.01	0.00000
CC - East	RM9			480	2.01	0.00000
CC - East	SR1	6		540	2.01	0.00553
CC - East	SR2			540	2.01	0.00000
CC - East	SR3			540	2.01	0.00000

2012 Winter Data
Summary of Minutes by Phase

Phase	GOEA	BAEA	Obs
CC - East	20		9,313
CC - West	22		6,690
SM - West	34		9,300
SM-East	32		5,220
Grand Total	**108**	**0**	**30,523**

CC - East	UH1			513	2.01	0.00000
CC - East	UH2			600	2.01	0.00000
CC - East	UH3			540	2.01	0.00000
CC - East	UH4	2		480	2.01	0.00207
CC - East	UI1	2		420	2.01	0.00237
CC - East	UI2	6		600	2.01	0.00498
CC - East	UI3			480	2.01	0.00000
SM-East	CB1	7		540	2.01	0.00645
SM-East	CB2			420	2.01	0.00000
SM-East	CB4	5		540	2.01	0.00461
SM-East	CB5			540	2.01	0.00000
SM-East	CB6	8		480	2.01	0.00829
SM-East	RM15	12		600	2.01	0.00995
SM-East	RM2			540	2.01	0.00000
SM-East	SCR1			540	2.01	0.00000
SM-East	SCR2			480	2.01	0.00000
SM-East	SCR3			540	2.01	0.00000

2013 Spring Data (04/01/13 - 06/21/13) (eagle minutes <200 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Obs	Area Obs*	Eagle Exposure[1]
CC - West	CC10			360	2.01	0.00000
CC - West	CC11			360	2.01	0.00000
CC - West	CC12			300	2.01	0.00000
CC - West	CC13	0		300	2.01	0.00000
CC - West	CC2			360	2.01	0.00000
CC - West	CC3	2		360	2.01	0.00276
CC - West	CC4			300	2.01	0.00000
CC - West	CC5			300	2.01	0.00000
CC - West	CC6			300	2.01	0.00000
CC - West	CC7			360	2.01	0.00000
CC - West	CC9			360	2.01	0.00000
CC - West	RM12	0		300	2.01	0.00000
CC - West	RM7			300	2.01	0.00000
SM - West	MH1			360	2.01	0.00000
SM - West	MH2			360	2.01	0.00000
SM - West	MH3			360	2.01	0.00000
SM - West	MH4			300	2.01	0.00000
SM - West	MH5			300	2.01	0.00000
SM - West	MH6			360	2.01	0.00000
SM - West	MH7			360	2.01	0.00000
SM - West	MH8			300	2.01	0.00000
SM - West	PG1			360	2.01	0.00000
SM - West	PG10			300	2.01	0.00000
SM - West	PG5			360	2.01	0.00000

2013 Spring Data Summary of Minutes by Phase			
Phase	**GOEA**	**BAEA**	**Obs**
CC - East			5,940
CC - West	2		4,260
SM - West	1		6,360
SM-East	4		3,314
Grand Total	**7**	**0**	**19,874**

SM - West	PG2		300	2.01	0.00000
SM - West	PG3		360	2.01	0.00000
SM - West	PG4		360	2.01	0.00000
SM - West	PG6		300	2.01	0.00000
SM - West	PG7		360	2.01	0.00000
SM - West	PG8		300	2.01	0.00000
SM - West	PG9		300	2.01	0.00000
SM - West	RM14	1	360	2.01	0.00138
CC - East	CMD2		360	2.01	0.00000
CC - East	CMD3		360	2.01	0.00000
CC - East	CMD4		360	2.01	0.00000
CC - East	HB1		300	2.01	0.00000
CC - East	HB2		300	2.01	0.00000
CC - East	HB3		300	2.01	0.00000
CC - East	RM10		300	2.01	0.00000
CC - East	RM9		360	2.01	0.00000
CC - East	SR1		300	2.01	0.00000
CC - East	SR2		360	2.01	0.00000
CC - East	SR3		300	2.01	0.00000
CC - East	UH1		300	2.01	0.00000
CC - East	UH2		300	2.01	0.00000
CC - East	UH3		360	2.01	0.00000
CC - East	UH4		360	2.01	0.00000
CC - East	UI1		300	2.01	0.00000
CC - East	UI2		360	2.01	0.00000
CC - East	UI3		360	2.01	0.00000
SM-East	CB1	4	300	2.01	0.00663
SM-East	CB2		270	2.01	0.00000
SM-East	CB4		360	2.01	0.00000
SM-East	CB5		360	2.01	0.00000
SM-East	CB6		360	2.01	0.00000
SM-East	RM15		360	2.01	0.00000
SM-East	RM2		300	2.01	0.00000
SM-East	SCR1		360	2.01	0.00000
SM-East	SCR2		360	2.01	0.00000
SM-East	SCR3		284	2.01	0.00000

2013 Summer Data (06/24/13 - 08/30/13) (eagle minutes <200 meters)

Phase	Survey Point	Minutes GOEA	Minutes BAEA	Minutes Obs	Area Obs*	Eagle Exposure[1]
CC - West	CC10			300	2.01	0.00000
CC - West	CC11			300	2.01	0.00000
CC - West	CC12			300	2.01	0.00000
CC - West	CC13	4		300	2.01	0.00663
CC - West	CC2			300	2.01	0.00000
CC - West	CC3	2		300	2.01	0.00332
CC - West	CC4			300	2.01	0.00000
CC - West	CC5	2		300	2.01	0.00332
CC - West	CC6			300	2.01	0.00000
CC - West	CC7			300	2.01	0.00000
CC - West	CC9			300	2.01	0.00000
CC - West	RM12	0		300	2.01	0.00000
CC - West	RM7			300	2.01	0.00000
SM - West	MH1			300	2.01	0.00000
SM - West	MH2			300	2.01	0.00000
SM - West	MH3			300	2.01	0.00000
SM - West	MH4			300	2.01	0.00000
SM - West	MH5			300	2.01	0.00000
SM - West	MH6			300	2.01	0.00000
SM - West	MH7			300	2.01	0.00000
SM - West	MH8			300	2.01	0.00000
SM - West	PG1			300	2.01	0.00000
SM - West	PG10			300	2.01	0.00000
SM - West	PG5			300	2.01	0.00000
SM - West	PG2			300	2.01	0.00000
SM - West	PG3			300	2.01	0.00000
SM - West	PG4			300	2.01	0.00000
SM - West	PG6			300	2.01	0.00000
SM - West	PG7			300	2.01	0.00000
SM - West	PG8			300	2.01	0.00000
SM - West	PG9			300	2.01	0.00000
SM - West	RM14	2		300	2.01	0.00332
CC - East	CMD2			300	2.01	0.00000
CC - East	CMD3	1		300	2.01	0.00166
CC - East	CMD4			300	2.01	0.00000
CC - East	HB1			300	2.01	0.00000
CC - East	HB2			300	2.01	0.00000
CC - East	HB3			300	2.01	0.00000
CC - East	RM10			300	2.01	0.00000
CC - East	RM9			300	2.01	0.00000
CC - East	SR1			300	2.01	0.00000
CC - East	SR2			300	2.01	0.00000
CC - East	SR3			300	2.01	0.00000

2013 Summer Data
Summary of Minutes by Phase

Phase	GOEA	BAEA	Obs
CC - East	1		5,400
CC - West	8		3,900
SM - West	2		5,700
SM-East	5		3,000
Grand Total	**16**	**0**	**18,000**

CC - East	UH1		300	2.01	0.00000
CC - East	UH2		300	2.01	0.00000
CC - East	UH3		300	2.01	0.00000
CC - East	UH4		300	2.01	0.00000
CC - East	UI1		300	2.01	0.00000
CC - East	UI2		300	2.01	0.00000
CC - East	UI3		300	2.01	0.00000
SM-East	CB1		300	2.01	0.00000
SM-East	CB2		300	2.01	0.00000
SM-East	CB4		300	2.01	0.00000
SM-East	CB5		300	2.01	0.00000
SM-East	CB6		300	2.01	0.00000
SM-East	RM15	3	300	2.01	0.00498
SM-East	RM2	2	300	2.01	0.00332
SM-East	SCR1		240	2.01	0.00000
SM-East	SCR2		300	2.01	0.00000
SM-East	SCR3		360	2.01	0.00000

Appendix D: Summary of Eagle Minutes and Survey Effort for Each Survey Period Based on the Decision Criteria

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Summary of Survey Data for Chokecherry Sierra Madre

** GOEA = Golden Eagle; BAEA = Bald Eagle; Obs = Observation; Min = Minutes
** Eagle minutes are rounded up.
** # = Eagle minutes >150 meters are not included; adjust volume to 150 meters.
** Fall 2012 data are split at 9/16 due to different methods for eagle altitude.
** Data are based on final decision criteria.

2011 Spring to 2012 Spring Data

(04/04/11 - 03/27/12) (15 points) (>150 meters are not included) #

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	Notes
CC - West	1	3	24801	37	10	
SM - West	1	5	42729	108	22	RM15 included
Total		8	67,530	145	32	

2012 Summer Data

(05/01/12 - 07/24/12) (14 points) (18 eagle minutes >150 meters not included) #

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	2	2124	0	0	
SM - West	1	4	4330	19	0	
Total		6	6,454	19	0	

2012 Fall Data (in part)

(08/20/12 - 09/15/12) (40 points) (23 eagle minutes >150 meters not included) #

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	9	1980	0	0	CC8 excluded
SM - West	1	15	3540	9	0	Exclude PG3
Total		24	5,520	9	0	

2012 Fall Data (in part)

(09/17/12 - 11/09/12) (40 points) (eagle minutes <200 meters)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	9	3814	13	0	CC8 excluded
SM - West	1	15	6720	13	0	Exclude PG3
Total		24	10,534	26	0	

2012 Winter Data

(11/12/12 - 03/29/13) (60 points)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	13	5610	8	0	CC13, RM12 Excluded
SM - West	1	21	8760	22	0	Exclude RM15, PG3
Total		34	14,370	30	0	

2013 Spring Data

(04/01/13 - 06/21/13) (60 points)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	13	3660	2	0	CC13, RM12 Excluded
SM - West	1	21	6000	1	0	Exclude RM15, PG3
Total		34	9,660	3	0	

2013 Summer Data

(06/24/13 - 08/30/13) (60 points)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min	
CC - West	1	13	3300	4	0	CC13, RM12 Excluded
SM - West	1	21	5400	2	0	Exclude RM15, PG3
Total		34	8,700	6	0	

All Data Combined

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min
CC - West	1	n/a	45289	64	10
SM - West	1	n/a	77479	174	22
Total		0	122,768	238	32

"Year1 "Split (April 2011-July2012)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min
CC - West	1	n/a	26925	37	10
SM - West	1	n/a	47059	127	22
Total			73,984	164	32

"Year2" Split (August 2012-August 2013)

Area	Phase	Points	Obs Minutes	GOEA Min	BAEA Min
CC - West	1	n/a	18364	27	0
SM - West	1	n/a	30420	47	0
Total			48,784	74	0

Appendix E: Adjustments to Daylight Hours

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The following is an example of the model code used to calculate annual and seasonal daylight hours.

```
## Define seasonal strata and calculate daylight hours
LatLng<-c(41.6038693,-107.261601)

# Annual Daylight Hours
SeasonType<-"Annual"
DayLtHr<-DayLen(LatLng[2],LatLng[1],Type=SeasonType)
colnames(DayLtHr)[1]<-"Season"
DayLtHr$AveDayLen<-with(DayLtHr,DayLtHr/Days)

# Seasonal Daylight Hours (to determine total daylight hours during curtailment period)
SeasonEndDay<-c(Winter="1/31",Curtail="4/30",Spring="6/30",Summer="8/15",Fall="11/15")
DayLtHr<-DayLen(-107.128973,41.767919,Type=SeasonEndDay,
Labels=names(SeasonEndDay))
DayLtHr$AveDayLen<-with(DayLtHr,DayLtHr/Days)

# Day length based on National Oceanic and Atmospheric Administration solar calculator:
#       http://www.esrl.noaa.gov/gmd/grad/solcalc/calcdetails.html
```

Daylight Operational Hours

Percent of Daylight Operational Hours by "Season" for All Turbines

Row Labels	Average of Winter (Nov 16 - Jan 31)	Average of Curtailment Season (Feb 1 - Apr 30)	Average of Active Nest Season (May 1 - Jun 30)	Average of Summer (Jul 1 - Aug 15)	Average of Fall (Aug 16 - Nov 15)	Average of Entire Year (Jan 1 - Dec 31)
Chokecherry	96.258%	94.582%	94.049%	88.434%	91.543%	93.072%
Sierra Madre	94.468%	93.539%	92.019%	85.087%	89.543%	91.126%
Project Average	95.191%	93.960%	92.839%	86.439%	90.351%	91.912%

Percent of Daylight Operational Hours by "Season" for All Turbines with Seasonal Curtailment

Row Labels	Average of Winter (Nov 16 - Jan 31)	Average of Curtailment Season (Feb 1 - Apr 30)	Average of Active Nest Season (May 1 - Jun 30)	Average of Summer (Jul 1 - Aug 15)	Average of Fall (Aug 16 - Nov 15)	Average of Entire Year (Jan 1 - Dec 31)
Chokecherry	96.258%	94.582%	94.049%	88.434%	91.543%	93.072%
Sierra Madre	94.468%	93.496%	92.019%	85.087%	89.543%	91.126%
Project Average	95.191%	93.951%	92.839%	86.439%	90.351%	91.912%

Seasonal values are an average of percent operational time during daylight hours of individual turbines provided by AWS Truepower, May 2014.

Highlighted values include the curtailment of 17 turbines in Sierra Madre from 1 Feb to 30 April.

Daylight Hours Adjustment for Seasonal Curtailment

	Location Latitude	Longitude
Teton Reservoir	41.604	-107.261601

Season	cRange	Days	AveDayLen	DayLtHr
Annual	01/01-12/31	365.25	12.20462	4457.739
Base Annual Daylight Hours for Teton Reservoir				

Season	Day Range	Days	AveDayLen	DayLtHr	Turbines	% Operational	Turbine-Hours*
Winter	11/16-01/31	77.00	9.409873	724.5602	500	95.191%	344,858.18
Curtail	02/01-04/30	89.25	12.020020	1072.7868	500	93.960%	503,996.84
Spring	05/01-06/30	61.00	14.864888	906.7582	500	92.839%	420,911.98
Summer	07/01-08/15	46.00	14.604142	671.7905	500	86.439%	290,344.26
Fall	08/16-11/15	92.00	11.762141	1082.1170	500	90.351%	488,851.57
Calculating Annual Daylight Hours				4458.013		sum=	2,048,962.83
For 500 turbines without Curtailment							4,097.926

Season	Day Range	Days	AveDayLen	DayLtHr	Turbines	% Operational	Turbine-Hours*
Winter	11/16-01/31	77.00	9.409873	724.5602	500	95.191%	344,858.18
Curtail	02/01-04/30	89.25	12.020020	1072.7868	483	93.951%	486,810.25
Spring	05/01-06/30	61.00	14.864888	906.7582	500	92.839%	420,911.98
Summer	07/01-08/15	46.00	14.604142	671.7905	500	86.439%	290,344.26
Fall	08/16-11/15	92.00	11.762141	1082.1170	500	90.351%	488,851.57
Annual Daylight Hours for **500 Turbines** (CC & SM)						sum=	2,031,776.25
With **17 Turbines Curtailed** for 89.25 Days in Sierra Madre							4,063.552

Season	Day Range	Days	AveDayLen	DayLtHr	Turbines	% Operational	Turbine-Hours*
Winter	11/16-01/31	77.00	9.409873	724.5602	298	94.468%	203,973.84
Curtail	02/01-04/30	89.25	12.020020	1072.7868	281	93.496%	281,847.99
Spring	05/01-06/30	61.00	14.864888	906.7582	298	92.019%	248,646.83
Summer	07/01-08/15	46.00	14.604142	671.7905	298	85.087%	170,338.32
Fall	08/16-11/15	92.00	11.762141	1082.1170	298	89.543%	288,749.36
Annual Daylight Hours for **298 Turbines** (Only SM)						sum=	1,193,556.34
With **17 Turbines Curtailed** for 89.25 Days in Sierra Madre							4,005.223

Season	Day Range	Days	AveDayLen	DayLtHr	Turbines	% Operational	Turbine-Hours*
Winter	11/16-01/31	77.00	9.409873	724.5602	202	96.258%	140,884.34
Curtail	02/01-04/30	89.25	12.020020	1072.7868	202	94.582%	204,962.27
Spring	05/01-06/30	61.00	14.864888	906.7582	202	94.049%	172,265.15
Summer	07/01-08/15	46.00	14.604142	671.7905	202	88.434%	120,005.94
Fall	08/16-11/15	92.00	11.762141	1082.1170	202	91.543%	200,102.21
Annual Daylight Hours for **202 Turbines** (Only CC)						sum=	838,219.90
No pre-planned curtailment in Chokecherry							4,149.603

*TurbineHours = DayLtHr*Turbines*%Operational

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Appendix F: Eagle Fatality Model Inputs and Results

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Predicted Fatalities

Golden Eagle, Chokecherry Sierra Madre combined, 103-m blade

Golden Eagle, Chokecherry Sierra Madre combined, 120-m blade

Bald Eagle, Chokecherry Sierra Madre combined, 103-m blade

Bald Eagle, Chokecherry Sierra Madre combined, 120-m blade

Golden Eagle, Chokecherry, 103-m blade

Golden Eagle, Sierra Madre, 103-m blade

Golden Eagle, Chokecherry, 120-m blade

Golden Eagle, Sierra Madre, 120-m blade

Bald Eagle, Chokecherry, 103-m blade

Bald Eagle, Sierra Madre, 103-m blade

Bald Eagle, Chokecherry, 120-m blade

Bald Eagle, Sierra Madre, 120-m blade

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Eagle Fatality Model Inputs and Results

Model inputs and results are combined for Chokecherry and for Sierra Madre.
Posterior from Year1 becomes the prior for Year2.
Results from Year2 are a combination of data from Year1 and Year2.
Results from Year2 are the "final" predicted eagle fatalities.
Fatalities are predicted for two different turbine blade lengths: 103-meter and 120-meter diameter blades.

"Year" and Dates	GOLDEN EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~8% non-operational period; includes data from RM15.	Chokecherry Sierra Madre	800	73,984
"Year 2" August 2012 to August 2013	GOEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~8% non-operational period; does not include RM15. Does not inlcude CC8, CC13, RM12 and PG3 starting Fall 2012.. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Chokecherry Sierra Madre	800	48,784

"Year" and Dates	GOLDEN EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~8% non-operational period; includes data from RM15.	Chokecherry Sierra Madre	800	73,984
"Year 2" August 2012 to August 2013	GOEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~8% non-operational period; does not include RM15. Does not inlcude CC8, CC13, RM12 and PG3 starting Fall 2012.. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Chokecherry Sierra Madre	800	48,784

Golden Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
164	4,063.6	103/2	500	0.443	0.0345	8.7	5.7	13
74	4,063.6	103/2	500	0.346	0.0224	6.8	4.5	10
Golden Eagle annual predicted fatalities with 103-m diameter blade =								**10**

Golden Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
164	4,063.6	120/2	500	0.443	0.0344	12	7.8	17
74	4,063.6	120/2	500	0.347	0.0224	9.2	6.1	14
Golden Eagle annual predicted fatalities with 120-m diameter blade =								**14**

"Year" and Dates	BALD EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~8% non-operational period; includes data from RM15.	Chokecherry Sierra Madre	800	73,984
"Year 2" August 2012 to August 2013	BAEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~8% non-operational period; does not include RM15. Does not inlcude CC8, CC13, RM12 and PG3 starting Fall 2012.. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Chokecherry Sierra Madre	800	48,784

"Year" and Dates	BALD EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~8% non-operational period; includes data from RM15.	Chokecherry Sierra Madre	800	73,984
"Year 2" August 2012 to August 2013	BAEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~8% non-operational period; does not include RM15. Does not inlcude CC8, CC13, RM12 and PG3 starting Fall 2012.. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Chokecherry Sierra Madre	800	48,784

Bald Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
32	4,063.6	103/2	500	0.0886	0.0154	1.7	1.2	2.6
0	4,063.6	103/2	500	0.0478	0.0084	0.94	0.79	1.4
	Bald Eagle annual predicted fatalities with 103-m diameter blade =							**1.4**

Bald Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
32	4,063.6	120/2	500	0.0884	0.0154	2.3	1.6	3.5
0	4,063.6	120/2	500	0.0477	0.0083	1.3	0.87	1.9
	Bald Eagle annual predicted fatalities with 120-m diameter blade =							**2**

Eagle Fatality Model Inputs and Results - GOLDEN EAGLE

Model inputs and data results are run separately for Chokecherry and for Sierra Madre.
Posterior from Year1 becomes the prior for Year2.
Results from Year2 are a combination of data from Year1 and Year2.
Results from Year2 are the "final" predicted eagle fatalities.
Fatalities are predicted for two different turbine blade lengths: 103-meter and 120-meter diameter blades.

"Year" and Dates	GOLDEN EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adusted for flight heights. Daylight adjusted for about 7% non-operational period, no seasonal curtailment.	Chokecherry	800	26,925
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~9% non-operational period; includes data from RM15.	Sierra Madre	800	47,059
"Year 2" August 2012 to August 2013	GOEA minutes based on 4 survey periods, adjusted for flight heights. Daylight adjusted for ~7% non-operational period; no seasonal curtailment. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume). Does not inlcude CC8, CC13 and RM12 starting Fall 2012.	Chokecherry	800	18,364
"Year 2" August 2012 to August 2013	GOEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~9% non-operational period; does not include RM15. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Sierra Madre	800	30,420

Golden Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
37	4,149.6	103/2	202	0.279	0.0455	2.3	1.5	3.3
127	4,005.2	103/2	298	0.540	0.0476	6.2	4.2	9.2
27	4,149.6	103/2	202	0.254	0.315	2.1	1.4	3.0
47	4,005.2	103/2	298	0.402	0.0304	4.6	3.1	6.8
Golden Eagle annual predicted fatalities with 103-m diameter blade =								**10**

Note: because Chokecherry and Sierra Madre are analyzed independently, their results are rounded up before being added together.

"Year" and Dates	GOLDEN EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adusted for flight heights. Daylight adjusted for about 7% non-operational period, no seasonal curtailment.	Chokecherry	800	26,925
"Year 1" April 2011 to July 2012	GOEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~9% non-operational period; includes data from RM15.	Sierra Madre	800	47,059
"Year 2" August 2012 to August 2013	GOEA minutes based on 4 survey periods, adjusted for flight heights. Daylight adjusted for ~7% non-operational period; no seasonal curtailment. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume). Does not inlcude CC8, CC13 and RM12 starting Fall 2012.	Chokecherry	800	18,364
"Year 2" August 2012 to August 2013	GOEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~9% non-operational period; does not include RM15. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Sierra Madre	800	30,420

Golden Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
37	4,149.6	120/2	202	0.280	0.0454	3.1	2.1	4.5
127	4,005.2	120/2	298	0.540	0.0477	8.5	5.6	12
27	4,149.6	120/2	202	0.254	0.0315	2.8	1.9	4.1
47	4,005.2	120/2	298	0.402	0.0304	6.3	4.1	9.2
Golden Eagle annual predicted fatalities with 120-m diameter blade =								**15**

Note: because Chokecherry and Sierra Madre are analyzed independently, their results are rounded up before being added together.

Eagle Fatality Model Inputs and Results - BALD EAGLE

Model inputs and data results are run separately for Chokecherry and for Sierra Madre.
Posterior from Year1 becomes the prior for Year2.
Results from Year2 are a combination of data from Year1 and Year2.
Results from Year2 are the "final" predicted eagle fatalities.
Fatalities are predicted for two different turbine blade lengths: 103-meter and 120-meter diameter blades.

"Year" and Dates	BALD EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adusted for flight heights. Daylight adjusted for about 7% non-operational period, no seasonal curtailment.	Chokecherry	800	26,925
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~9% non-operational period; includes data from RM15.	Sierra Madre	800	47,059
"Year 2" August 2012 to August 2013	BAEA minutes based on 4 survey periods, adjusted for flight heights. Daylight adjusted for ~7% non-operational period; no seasonal curtailment. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume). Does not inlcude CC8, CC13 and RM12 starting Fall 2012.	Chokecherry	800	18,364
"Year 2" August 2012 to August 2013	BAEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~9% non-operational period; does not include RM15. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Sierra Madre	800	30,420

Bald Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
10	4,149.6	103/2	202	0.0807	0.0244	0.65	0.53	0.97
22	4,005.2	103/2	298	0.0969	0.0202	1.1	0.78	1.6
0	4,149.6	103/2	202	0.0429	0.013	0.35	0.26	0.51
0	4,005.2	103/2	298	0.0528	0.0111	0.61	0.51	0.9
	Bald Eagle annual predicted fatalities with 103-m diameter blade =							**2**

Note: because Chokecherry and Sierra Madre are analyzed independently, their results are rounded up before being added together.

"Year" and Dates	BALD EAGLE Notes	Location	Radius	Survey Minutes
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adusted for flight heights. Daylight adjusted for about 7% non-operational period, no seasonal curtailment.	Chokecherry	800	26,925
"Year 1" April 2011 to July 2012	BAEA minutes based on observation times in GIS file, adjusted for flight paths and volume adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89.25 days in spring, plus ~9% non-operational period; includes data from RM15.	Sierra Madre	800	47,059
"Year 2" August 2012 to August 2013	BAEA minutes based on 4 survey periods, adjusted for flight heights. Daylight adjusted for ~7% non-operational period; no seasonal curtailment. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume). Does not inlcude CC8, CC13 and RM12 starting Fall 2012.	Chokecherry	800	18,364
"Year 2" August 2012 to August 2013	BAEA minutes from 4 survey periods, adjusted for flight heights. Daylight adjusted for 17 turbines curtailed for 89 days in spring, plus ~9% non-operational period; does not include RM15. Year1 posterior becomes Year2 prior. Model code modified to account for height (volume).	Sierra Madre	800	30,420

Bald Eagle Minutes	Daylight Hours	Blade Length	Turbines	Eagle Exposure	Exposure Std Dev	Average Fatality	Fatality Std Dev	80% UCI Fatality
10	4,149.6	120/2	202	0.0808	0.0245	0.89	0.66	1.3
22	4,005.2	120/2	298	0.0969	0.0203	1.5	1.3	2.2
0	4,149.6	120/2	202	0.0427	0.013	0.47	0.35	0.7
0	4,005.2	120/2	298	0.0527	0.011	0.82	0.58	1.2
Bald Eagle annual predicted fatalities with 120-m diameter blade =								**3**

Note: because Chokecherry and Sierra Madre are analyzed independently, their results are rounded up before being added together.

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Appendix G: Example of Model Code Used to Predict Eagle Fatalities

The following is an example of the model code and inputs used by the U.S. Fish and Wildlife Service to predict the number of bald eagle and golden eagle fatalities at the Chokecherry Sierra Madre Phase 1 Project. The description, inputs and results of the twelve different model runs are presented in Appendix F.

In the example below, differences between the model runs are identified. Comments and other explanatory notes that may differ between model runs are highlighted in yellow. Changes to the model inputs or the model code are identified by red, bolded text and are highlighted in yellow. These changes, which are also identified by sequential numerals surrounded by asterisks and parentheses, are further explained here:

(*1*) – Description of the model run, including area (e.g., Chokecherry) and year (e.g., Year 1)
(*2*) – Number of turbines (i.e., 500, 298, or 202)
(*3*) – Blade length (i.e., 120- or 103-meter blade)
(*4*) – Description of the run,
Number of eagle minutes
Number of counts (total observation minutes / 60)
Daylight hours (see Appendix E)
(*5*) – Adjust sample volume (e.g., 150 or 200 meters / 100)
(*6*) – For all 12 runs, the priors for Year 1 were adjusted to account for non-standard volume
(*7*) – The posteriors for Year 1 were used as the priors for Year 2

```
# Example Code for Model Run
# CC & SM West for GOEA with 120-m rotor blade Yr1Pooled and Yr2Pooled
# all eagle observations were recorded up to 150-m
# requires FWS functions R2Gamma.R, FatalFcns.R, and RVSmry.R and the R packages rv and
#     maptools

### Chokecherry Sierra Madre West Yr1 - below 150m ###

cProject<-"CCSM_West_Yr1_150m"      #project ID                                          (*1*)
nTurbine<-c(500)                    #number of turbines                                  (*2*)
HazRadKm<-c(120/2/1000)     #radius of hazardous area around each turbine(in kilometers)  (*3*)
HzKM2<-(nTurbine*pi*HazRadKm^2)   # hazardous area will be converted to volume later
CntHr<-c(1)                         # count duration (in hours)

## Create the "ExpSvy" data frame (Eagle Minutes observed, number of counts conducted,
#         the area observed at each observation point, and the future daylight hours),
#         includes some observed EMin with no ht recorded

# (*4*)
ExpSvy<-data.frame(row.names=c("CCSM_Y1-150m"),
            EMin=c(164),
            nCnt=c(1233.067),
            CntKM2=c(pi*0.8^2),
            DayLtHr=c(4063.552))

# DayLtHr includes ~8% non-operational hours annually (17 turbines curtailed 89.25 days in spring)

AddTot<-FALSE          #Add strata for total (TRUE) or not (FALSE)
## Analysis Inputs ##
UCI<-c(0.5,0.8,0.9,0.95)
nSims<-100000
setnsims(nSim)
PlotFile<-NULL

## Survey Inputs ##
nSvy<-nrow(ExpSvy)
cSvy<-(rownames(ExpSvy))

## Modified expansion and offset calculations
# we multiply the "offset" (the sampling effort that goes with the eagle minutes observed
#     and is used to calculate the exposure) by 150-m (0.15 km) to give us eagle mins per hr*km^3
# (*5*)
Height <- c(0.15)
SmpHrKM3<- with(ExpSvy,nCnt*CntHr*CntKM2*Height)

# we multiply the "expansion factor" (the product of operational daylight hours and
```

```
#      hazardous area) by 200-m (0.2 km)
ExpFac<- ExpSvy$DayLtHr*HzKM2*.2

# Calculate the fatalities and store as a temporary object.                    (*6*)
tmp<-with(ExpSvy,mapply(simFatal,EMin=EMin,SmpHrKM2=SmpHrKM3,ExpFac=ExpFac,
                aPriExp=0.9684375,bPriExp=0.5519703,aPriCPr=2.31,bPriCPr=396.69,
                SIMPLIFY=FALSE))

# Put 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){
  # i<-1
  Fatalities[i]<-tmp[[i]]
  Exp[i,]<-attr(tmp[[i]],"Exp")
}
rm(tmp)
names(Fatalities)<-cSvy

# Summarize
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))}
# Determine Yr2 exposure prior parameters from the Yr1 exposure posterior
Prior2<-N2Gamma(mn=Exp$Mean,sd=Exp$SD)

# define objects to pull into the simFatal function for Year2
aPriExpY2<-Prior2[1]
bPriExpY2<-Prior2[2]

### Chokecherry Sierra Madre West Yr2 ###

cProject<-"CCSM_West_Yr2"          #project ID to associate with model outputs          (*1*)
nTurbine<-c(500)                   #number of turbines                                  (*2*)
HazRadKm<-c(120/2/1000)      #radius of hazardous area around each turbine (in kilometers)  (*3*)
HzKM2<-(nTurbine*pi*HazRadKm^2)   # hazardous area will be converted to volume

# (*4*) (*5*)
## Create the "ExpSvy" data frame by pooling data
EMinPooled<-sum(9,26,30,3,6)
SmpHr<-c(5520/60,10534/60,14370/60,9660/60,8700/60)
SmpKM2<-pi*0.8^2
```

```
SmpHt<-c(0.15,0.2,0.2,0.2,0.2)
SmpHrKM3Pooled<-sum(SmpKM2*SmpHr*SmpHt)

ExpSvy<-data.frame(row.names=c("Yr2_Pooled"),
            Emin=EminPooled,
            SmpHrKM3=SmpHrKM3Pooled,
            DayLtHr=4063.552)

# DayLtHr includes ~8% non-operational hours annually (17 turbines curtailed 89.25 days in spring)

AddTot<-FALSE        #Add strata for total (TRUE) or not (FALSE)

## Analysis Inputs (if different than Year 1)##
## Survey Inputs ###
nSvy<-nrow(ExpSvy)
cSvy<-(rownames(ExpSvy))

## Modified expansion and offset calculations
ExpFac<- ExpSvy$DayLtHr*HzKM2*.2

# Calculate the fatalities and store as a temporary object.                    (*7*)
tmp<-mapply(simFatal,EMin=ExpSvy$EMin,SmpHrKM2=ExpSvy$SmpHrKM3,ExpFac=ExpFac,
        aPriExp=aPriExpY2,bPriExp=bPriExpY2,aPriCPr=2.31,bPriCPr=396.69,
        SIMPLIFY=FALSE)

# Put 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){
 # i<-1
 Fatalities[i]<-tmp[[i]]
 Exp[i,]<-attr(tmp[[i]],"Exp")
}
rm(tmp)
names(Fatalities)<-cSvy

# Summarize the surveys, 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)
 )}
```

Attachment D

Bird Species Known or Likely to Occur in the CCSM Phase I Project Area

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Common Name	*Scientific Name*
Anseriformes	
Canada Goose	*Branta canadensis*
Gadwall	*Anas strepera*
American Wigeon	*Anas americana*
Mallard	*Anas platyrhynchos*
Blue-winged Teal	*Anas discors*
Cinnamon Teal	*Anas cyanoptera*
Northern Shoveler	*Anas clypeata*
Northern Pintail	*Anas acuta*
Green-winged Teal	*Anas crecca*
Canvasback	*Aythya valisineria*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*
Greater Scaup	*Aythya marila*
Lesser Scaup	*Aythya affinis*
Surf Scoter	*Melanitta perspicillata*
White-winged Scoter	*Melanitta fusca*
Bufflehead	*Bucephala albeola*
Hooded Merganser	*Lophodytes cucullatus*
Common Merganser	*Mergus merganser*
Ruddy Duck	*Oxyura jamaicensis*
Galliformes	
Greater Sage-grouse	*Centrocercus urophasianus*
Columbian sharp-tailed grouse*	*Tympanuchus phasianellus columbianus*
Gaviiformes	
Common Loon	*Gavia immer*
Podicipediformes	
Pied-billed Grebe	*Podilymbus podiceps*
Horned Grebe	*Podiceps auritus*
Eared Grebe	*Podiceps nigricollis*
Western Grebe	*Aechmophorus occidentalis*
Clark's Grebe	*Aechmophorus clarkii*
Suliformes	
Double-crested Cormorant	*Phalacrocorax auritus*
Pelecaniformes	
American White Pelican	*Pelecanus erythrorhynchos*
Great Blue Heron	*Ardea herodias*
Snowy Egret	*Egretta thula*
Black-crowned Night-heron	*Nycticorax nycticorax*
White-faced Ibis	*Plegadis chihi*
Accipitriformes	
Turkey Vulture	*Cathartes aura*
Osprey	*Pandion haliaetus*
Bald Eagle	*Haliaeetus leucocephalus*

Northern Harrier	*Circus cyaneus*
Sharp-shinned Hawk	*Accipiter striatus*
Cooper's Hawk	*Accipiter cooperii*
Northern Goshawk	*Accipiter gentilis*
Swainson's Hawk	*Buteo swainsoni*
Red-tailed Hawk	*Buteo jamaicensis*
Rough-legged Hawk	*Buteo lagopus*
Ferruginous Hawk	*Buteo regalis*
Golden Eagle	*Aquila chrysaetos*
Gruiformes	
Virginia Rail*	*Rallus limicola*
Sora	*Porzana carolina*
American Coot	*Fulica americana*
Sandhill Crane	*Grus canadensis*
Charadriiformes	
American Avocet	*Recurvirostra americana*
Killdeer	*Charadrius vociferus*
Mountain Plover	*Charadrius montanus*
Spotted Sandpiper	*Actitis macularius*
Greater Yellowlegs	*Tringa melanoleuca*
Willet	*Tringa semipalmata*
Lesser Yellowlegs	*Tringa flavipes*
Marbled Godwit	*Limosa fedoa*
Least Sandpiper	*Calidris minutilla*
Pectoral Sandpiper	*Calidris melanotos*
Long-billed Dowitcher	*Limnodromus scolopaceus*
Wilson's Snipe	*Gallinago delicata*
Wilson's Phalarope	*Phalaropus tricolor*
Ring-billed Gull	*Larus delawarensis*
California Gull	*Larus californicus*
Herring Gull	*Larus argentatus*
Columbiformes	
Rock Dove*	*Columba livia*
Mourning Dove	*Zenaida macroura*
Cuculiformes	
Yellow-billed Cuckoo*	*Coccyzus americanus*
Strigiformes	
Great Horned Owl	*Bubo Virginianus*
Burrowing Owl	*Athene cunicularia*
Short-eared Owl*	*Asio flammeus*
Caprimulgiformes	
Common Nighthawk	*Chordeiles minor*
Common Poorwill	*Phalaenoptilus nuttallii*
Apodiformes	
White-throated Swift	*Aeronautes saxatalis*

Broad-tailed Hummingbird	*Selasphorus platycercus*
Rufous Hummingbird	*Selasphorus rufus*
Piciformes	
Downy Woodpecker*	*Picoides pubescens*
Northern Flicker	*Colaptes auratus*
Falconiformes	
American Kestrel	*Falco sparverius*
Merlin	*Falco columbarius*
Peregrine Falcon*	*Falco peregrinus*
Prairie Falcon	*Falco mexicanus*
Passeriformes	
Western Wood-pewee	*Contopus sordidulus*
Hammond's Flycatcher	*Empidonax hammondii*
Dusky Flycatcher	*Empidonax oberholseri*
Say's Phoebe	*Sayornis saya*
Western Kingbird	*Tyrannus verticalis*
Eastern Kingbird*	*Tyrannus tyrannus*
Loggerhead Shrike	*Lanius ludovicianus*
Warbling Vireo	*Vireo gilvus*
Clark’s Nutcracker	*Nucifraga columbiana*
Black-billed Magpie	*Pica hudsonia*
American Crow	*Corvus brachyrhynchos*
Common Raven	*Corvus corax*
Horned Lark	*Eremophila alpestris*
Tree Swallow	*Tachycineta bicolor*
Violet-green Swallow	*Tachycineta thalassina*
Northern Rough-winged Swallow	*Stelgidopteryx serripennis*
Bank Swallow*	*Riparia riparia*
Cliff Swallow	*Petrochelidon pyrrhonota*
Barn Swallow	*Hirundo rustica*
Black-capped Chickadee	*Poecile atricapillus*
Mountain Chickadee	*Poecile gambeli*
Rock Wren	*Salpinctes obsoletus*
Canyon Wren*	*Catherpes mexicanus*
House Wren	*Troglodytes aedon*
Bewick's Wren	*Thryomanes bewickii*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Ruby-crowned Kinglet	*Regulus calendula*
Mountain Bluebird	*Sialia currucoides*
Townsend’s Solitaire	*Myadestes townsendi*
Swainson's Thrush	*Catharus ustulatus*
Hermit Thrush	*Catharus guttatus*
American Robin	*Turdus migratorius*
Sage Thrasher	*Oreoscoptes montanus*
European Starling*	*Sturnus vulgaris*

Mccown's Longspur*	*Calcarius mccownii*
Snow Bunting	*Plectrophenax nivalis*
Orange-crowned Warbler	*Oreothlypis celata*
MacGillivray's Warbler	*Geothlypis tolmiei*
Common Yellowthroat	*Geothlypis trichas*
Yellow Warbler	*Dendroica petechia*
Yellow-rumped Warbler	*Dendroica coronata*
Wilson's Warbler	*Wilsonia pusilla*
Yellow-breasted Chat	*Icteria virens*
Green-tailed Towhee	*Pipilo chlorurus*
Spotted Towhee*	*Pipilo maculatus*
American Tree Sparrow*	*Spizella arborea*
Chipping Sparrow	*Spizella passerina*
Brewer's Sparrow	*Spizella breweri*
Vesper Sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
Sagebrush Sparrow	*Artemisiospiza nevadensis*
Lark Bunting	*Calamospiza melanocorys*
Savannah Sparrow	*Passerculus sandwichensis*
Grasshopper Sparrow	*Ammodramus savannarum*
Song Sparrow	*Melospiza melodia*
Lincoln’s Sparrow	*Melospiza lincolnii*
Dark-eyed Junco	*Junco hyemalis*
Western Tanager*	*Piranga ludoviciana*
Lazuli Bunting	*Passerina amoena*
Red-winged Blackbird	*Agelaius phoeniceus*
Western Meadowlark	*Sturnella neglecta*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Brown-headed Cowbird	*Molothrus ater*
Bullock's Oriole*	*Icterus bullockii*
Gray-crowned Rosy-finch	*Leucosticte tephrocotis*
House Finch	*Carpodacus mexicanus*
American Goldfinch	*Spinus tristis*
Evening Grosbeak	*Coccothraustes vespertinus*
House Sparrow*	*Passer domesticus*

Attachment E

Chokecherry and Sierra Madre Phase I Wind Energy Project Local Area Population Analysis for Golden and Bald Eagles

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U.S. Fish and Wildlife Service, Region 6, Migratory Bird Management Office,

November 11, 2016

Chokecherry and Sierra Madre (CCSM) Phase I Wind Energy Project Local Area Population (LAP) Analysis for Golden and Bald Eagles

To assess cumulative impacts to the local-area population we followed methods outlined in Appendix F of the Eagle Conservation Plan Guidance (USFWS 2013) and we utilized a USFWS cumulative effects tool developed to complete local-area population analysis. Further for this analysis we used eagle mortality records available to us in a proprietary USFWS eagle mortality database, and an additional set of eagle mortality records available from the Wyoming Game and Fish Department (WGFD). A major caveat with the 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. Except for some of the wind energy industry mortality records, there were no searcher efficiency or carcass persistence trials associated with any of these records so that a bias correction factor could be applied to them as would be the case for studies conducted using statistically valid sample designs. Also, some industries that impact eagles have self-reported eagle mortalities at a higher rate than other industries, and some types of eagle mortalities lend themselves better to discovery and reporting. Hence there are many types of bias associated with these records given this caveat. Still we elected to use the eagle mortality records in the USFWS database and WYGF database because this was the best scientific information available to us regarding eagle mortalities within the local-area populations for both bald and golden eagles.

We employed key decision criteria while working with the records in the USFWS eagle mortality database according to guidance developed by USFWS, Region 6. Based on the Region 6 guidance memo we used eagle mortality records from the USFWS database for only the most recent 10 full years (2005 – 2014). We used this approach because work on the EA for the new 2009 BGEPA regulations for non-purposeful take of eagles started about eight to nine years ago. And the EA for the 2009 BGEPA regulations included estimates of the existing baseline in terms of eagle populations and current mortality levels. Also, the 2009 BGEPA regulations themselves were issued about 7 years ago and there has likely been an increase in reporting of eagle mortalities to USFWS since these went into effect which provides us with a more accurate estimate of eagle mortalities compared to the preceding 20 or 30 years. Lastly most wind energy facilities operating in Wyoming became functional within the last 10 years and this is also when some of these facilities have voluntarily reported eagle fatalities to USFWS.

Using our USFWS eagle fatality prediction model (USFWS ECPG 2013), and information provided to us by the CCSM Phase I Project proponent on turbine blade sizes and eagle use, we developed predictions for take of golden and bald eagles for the CCSM Phase I Project. Estimates of golden eagle fatalities and bald eagle fatalities were calculated for CCSM Phase I Project using g two different turbine sizes. Using the largest on-shore wind turbine anticipated (120-meter diameter blade), the 80 percent upper credible interval (80% UCI) from the USFWS peer-reviewed model predicts 14 golden eagle fatalities and 2 bald eagle fatalities annually for CCSM Phase I Project. Using a smaller turbine (103-meter blade), the

model predicts the 80% UCI for CCSM Phase 1 Project will result in 10 golden eagle and 1 bald eagle fatalities annually. Below we present our analysis of how take of 10 or 14 golden eagles per year affects golden eagles at the LAP level, and how take of 1 or 2 bald eagles per year affects bald eagles at the LAP level. Both take levels for both eagle species are presented in our analysis. But on a comparative basis the take of eagles at the higher predicted level would be of greater concern from a conservation perspective for both species than that predicted for the lower predicted level.

Golden Eagle LAP Analysis

Using the above approach the local-area population for golden eagles is delimited by a circle with a radius of 140 miles around the project footprint, with 140 miles representing the mean natal dispersal distance for golden eagles. The eagle management units currently used by USFWS to manage golden eagle populations are the Bird Conservation Regions (BCR) (USFWS 2013). For the CCSM Phase I Project the local-area population of golden eagles is comprised of eagles in four BCR's. These include the Badlands and Prairies, Northern Rockies, Southern Rockies/Colorado Plateau, and Shortgrass Prairie BCR's (Table 1). The local area population of golden eagles for the Chokecherry and Sierra Madre project is approximately 1932 eagles (Table 1) and the 1% and 5% benchmarks for this local-area population are about 19 and 97 golden eagles respectively. USFWS has identified that take rates of between 1% and 5% of the estimated total eagle population size at this scale as significant, 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).

Based on the combined records in the USFWS eagle mortality database and WGFD database there were 430 golden eagle mortalities within the local-area population between 2005 and 2014 (Table 2). About 92% of these reported mortalities were due to anthropogenic causes with only 4 (about 1%) reported cases of mortality due to natural causes, and for another 7% (32 total eagle mortalities) of the total mortalities there no ability to determine whether they were due to anthropogenic vs. natural causes (Table 2). Given that there were undoubtedly other eagle mortalities due to natural causes within this ten year span this further illustrates a bias with these mortality records since there is not a systematic mortality survey effort, nor a standardized method of data collection on found deceased eagles. Of the anthropogenic causes most (50%) were power line related with 217 cases of electrocutions and 4 cases of collisions with power lines (Table 2). Most of the remaining eagle mortalities due to anthropogenic causes were either due to collisions with wind turbines (97 records; 23% of all records; Table 2) or collisions with vehicles along highways/roads (60 records; 14%; Table2). There also were 7 records of eagles being shot, 3 records of collisions with trains along railroad lines, 2 records of mortality due to collision with a fence, 2 records of non-target snaring, 1 due to collision but where the type of structure collided with was unknown, and 1 where an eagle was killed due to management/research trapping (Table 2). All types of collision mortalities combined together comprised 37% of these mortalities. Although most of the available golden eagle mortality records combined from the USFWS database and WGFD database are related to power lines (mostly electrocutions) or collisions with wind turbines or motor vehicles, we cannot say that these sources of eagle mortality are more important as factors in eagle mortality within the local-area population than shooting, poisoning, or any other anthropogenic

sources of eagle mortality. Facility maintenance practices for electric utility and wind energy companies ensure that these facilities are on a regular inspection schedule which may explain the higher rates of reporting of eagle mortalities for these industries. Similarly, dead eagles are more visible along highways than areas away from roadways. It is certainly possible that the eagle mortality factors such as shooting are actually more important in terms of total eagle take within this area, we simply lack the data to really assess this.

For golden eagle mortalities due to collisions with wind turbines at wind energy facilities we used the USFWS cumulative effects tool to calculate that about 17 eagles per year are taken by existing online wind facilities at the local-area population level. A further caveat on this estimate is that it is only based on golden eagle mortality records self-reported to USFWS by online operating wind facilities. There are other online wind energy facilities within the local-area population that are not reporting golden eagle mortalities to USFWS, but for which eagle mortalities are likely occurring at some level. However, in this analysis we elected not to assign a value for golden eagle mortalities to these wind facilities because this approach is too speculative. Still the above estimate of 17 golden eagles taken per year within this local-area population by online wind facilities should be viewed as a minimum estimate of mortalities due to this mortality type. Subtracting the estimate of 17 eagles taken by wind facilities per year from the above 1% and 5% benchmarks leaves approximately 2 eagles at the 1% level and 80 eagles at the 5% level for the local area population.

For golden eagle mortalities due to power line impacts (combination of both electrocutions and collisions with power lines) the total number from 2005 through 2014 was 221 (Table 2) for an average of about 22 per year. Since not all eagles that are taken by electrocutions or collisions with power lines are discovered and reported to USFWS this average of 22 golden eagles per year killed by power line impacts should again be viewed as a minimum estimate of this type of take. Subtracting the estimate of 22 eagles per year taken by power lines from the above numbers for wind turbine impacts leaves -20 eagles at the 1% level and 58 eagles at the 5% level for the local area population. And the combined golden eagle take due to wind turbines and power lines is about 39 eagles per year.

For golden eagle mortalities due to collisions with vehicles on highways the total number from 2005 through 2014 was 60 (Table 2) for an average of about 6 eagles per year. Since not all eagles killed along highways in collisions with motor vehicles are discovered and reported this average of 6 eagles taken per year should again be viewed as a minimum estimate for this type of take. Subtracting the estimate of 6 eagles per year taken by vehicle collisions along highways from the above combined numbers for take due to wind turbine and power line impacts leaves -26 eagles at the 1% level and 52 eagles at the 5% level for the local area population. And the combined take of eagles due to wind turbine, power line, and vehicle collision impacts is about 45 eagles per year.

Analysis for wind turbines with 103 meter blades:

Using the USFWS eagle fatality prediction model (USFWS 2013), we predicted the number of golden eagles the CCSM Phase I Project would take per year for two different size wind turbine blades. At the upper 80th credible interval level we estimate, with the data provided, this wind project would take 10

golden eagles per year if wind turbines with 103 meter blades. Using this estimate, and the above reductions against the 1 % and 5% benchmarks due to wind energy, power lines, and vehicle collisions, if 10 golden eagles were taken by the CCSM Phase I Project per year then the combined cumulative take would be -36 eagles at the 1% level and 42 eagles at the 5% level for the local area population. So the combined take of eagles due to collisions with turbines, power line impacts, collisions with vehicles, and predicted take from the CCSM Phase I Project is about 55 eagles per year or about 2.9% of the local area population. Hence, USFWS would have some concern about this combined take level for golden eagles for this local area population since at 2.9% total it exceeds the 1% benchmark, but this concern would be offset by the fact that combined take would still be below the 5% benchmark level.

Analysis for wind turbines with 120 meter blades:

At the upper 80th credible interval level we predict, with the data provided, this wind project would take 14 golden eagles per year if the CCSM Phase I Project were built with wind turbines that had 120 meter blades. Using this estimate, and the above reductions against the 1 % and 5% benchmarks due to wind energy, power lines, and vehicle collisions, if 14 golden eagles were taken by the CCSM Phase I Project per year then the combined cumulative take would be -40 eagles at the 1% level and 38 eagles at the 5% level for the local area population. So the combined take of eagles due to collisions with turbines, power line impacts, collisions with vehicles, and predicted take from the CCSM Phase I Project is about 59 eagles per year or about 3.1% of the local area population. Hence, USFWS would have some concern about this combined take level for golden eagles for this local area population since at 3.1% total it exceeds the 1% benchmark, but this concern would be offset by the fact that combined take would still be below the 5% benchmark level.

Table 1: Estimated Golden Eagle Local Area Population (LAP) for the Proposed CCSM Phase I Project Wind Energy Facility in Carbon County, Wyoming.

BCR	Estimated No. of Golden Eagles
Badlands and Prairies	356.85
Northern Rockies	1125.90
Southern Rockies/Colorado Plateau	422.14
Shortgrass Prairie	27.31
Total Local Area Population	1932.20
1% LAP Benchmark	19.32
5% LAP Benchmark	96.61

Table 2: Known Golden Eagle Mortalities within 140 Miles of the Proposed CCSM Phase I Project Wind Energy Facility, 2005 through 2014.

Natural Causes	Number of Mortalities	Percent of Total Mortalities
Killed by another animal	1	<1
Emaciation/Starvation	2	<1
Physiological Stress	1	<1
Anthropogenic Causes		
Electrocution	217	50
Collision with Power Line	4	1
Collision	1	<1
Collision with Wind Turbine	97	23
Collision with Vehicle	60	14
Collision with Fence	2	<1
Railroad Collision	3	<1
Shot	7	2
Non-target Snaring	2	<1
Management/Research Trapping	1	<1
Unknown	19	4
Other	13	3
Total Mortalities	430	100

Bald Eagle LAP Analysis

Using the above approach the local-area population for bald eagles is delimited by a circle with a radius of 43 miles around the project footprint, with 43 miles representing the mean natal dispersal distance for bald eagles. The eagle management units currently used by USFWS to manage bald eagle populations are the Eagle Management Units (EMU) (USFWS 2013). For the Chokecherry and Sierra Madre project the local-area population is comprised of bald eagles in the Northern Rocky Mountains and the Rocky Mountains and Plains EMU's. The local area population of bald eagles for the Chokecherry and Sierra Madre project is approximately 117 eagles (Table 3) and the 1% and 5% benchmarks for this local-area population are about 1 and 6 bald eagles respectively. USFWS has identified that take rates of between 1% and 5% of the estimated total eagle population size at this scale as significant, 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).

Based on the USFWS eagle mortality database, and an additional set of eagle mortality records available from the WGFD, there were 11 reported bald eagle mortalities within the local-area population for the CCSM Phase I Project between 2005 and 2014 (Table 4). All of these reported mortalities where the cause of the mortality was identified were due to anthropogenic causes; with 3 records of collisions with wind turbines, 3 records of highway accidents (assumed to be cases where vehicles collided with eagles), 2 records of electrocution on power lines, and 1 record of a collision with a power line (Table 4). There were 2 other bald eagle mortalities where the cause was unknown which means they could have been due to either natural or anthropogenic causes. With these data again a major caveat is that these records are biased due to the manner they were obtained and reported. Although most of the available bald eagle mortality records in the USFWS database and WGFD database are related to power lines, wind turbines, and collisions with vehicles we cannot say that these sources of eagle mortality are more important as factors in eagle mortality within the local-area population than other potential mortality sources such as shooting, poisoning, or any other anthropogenic sources of eagle mortality. Facility maintenance practices for electric utility and wind energy companies ensure that these facilities are on a regular inspection schedule which may explain the higher rates of reporting of eagle mortalities for these industries. It is certainly possible that the eagle mortality factors such as shooting or poisoning are actually much more important in terms of total eagle take within this area, we simply lack the data to really assess this.

For bald eagle mortalities due to collisions with wind turbines at wind energy facilities we used a USFWS cumulative effects tool to calculate that about 0.8 bald eagles per year are taken by existing online wind facilities at the local-area population level. A further caveat on this estimate is that it is only based on bald eagle mortality records self-reported to USFWS by online operating wind facilities. There are other online wind energy facilities within the local-area population that are not reporting bald eagle mortalities to USFWS, but for which eagle mortalities are likely occurring at some level. However, in this analysis we elected not to assign a value for bald eagle mortalities to these wind facilities because this approach is too speculative. Still the above estimate of 0.8 bald eagles taken per year within this

local-area population by online wind facilities should be viewed as a minimum estimate for this type of take. Subtracting the estimate of 0.8 bald eagles taken by wind facilities per year from the above 1% and 5% benchmarks leaves approximately 0.2 eagles at the 1% level and 5.2 eagles at the 5% level.

For bald eagle mortalities due to power line impacts the total number reported from 2005 through 2014 was 3 (Table 4) for an average of about 0.3 per year. Since not all eagles that are taken by electrocutions or collisions with power lines are discovered and reported to USFWS this average of 0.3 bald eagles killed by power line impacts should again be viewed as a minimum estimate for this type of take. Subtracting the estimate of 0.3 eagles per year taken by power lines from the above numbers for wind turbine impacts leaves -0.1 eagles at the 1% level and 4.9 eagles at the 5% level. And the combined bald eagle take due to wind turbines and power lines is about 1.1 bald eagles per year.

For bald eagle mortalities due to collisions with vehicles on highways the total number from 2005 through 2014 was 3 (Table 4) for an average of about 0.3 eagles per year. Since not all eagles killed along highways in collisions with motor vehicles are discovered and reported this average of 0.3 eagles taken per year should again be viewed as a minimum estimate for this type of take. Subtracting the estimate of 0.3 eagles per year taken by vehicle collisions along highways from the above combined numbers for take due to wind turbine and power line impacts leaves -0.4 eagles at the 1% level and 4.6 eagles at the 5% level. . And the combined take of eagles due to wind turbine, power line, and vehicle collision impacts is about 1.4 bald eagles per year.

Analysis for wind turbines with 103 meter blades:

Using the USFWS eagle fatality prediction model (USFWS 2013), we predicted the number of bald eagles the CCSM Phase I Project would take per year for two different size wind turbine blades. At the upper 80th credible interval level we estimate, with the data provided, this wind project would take 1 bald eagle per year if the CCSM Phase I Project were built with wind turbines that had 103 meter blades. Using this estimate, and the above combined reductions against the 1 % and 5% benchmarks due to wind energy, power lines, and vehicle collisions, if 1 bald eagle was taken by the CCSM Phase I Project per year then the combined cumulative take at the 1% level would be -1.4 bald eagles and 3.6 bald eagles at the 5% benchmark level. Total eagle take per year due to the CCSM Phase 1 Project plus other ongoing take due to other unpermitted ongoing types of take would be 2.4 bald eagles per year (1 eagle predicted/year for CCSM Phase I Project + 0.8 eagles/year due to other ongoing take at wind facilities + 0.3 eagles/year ongoing take due to power lines + 0.3 eagles/year ongoing take due to vehicle collisions) or about 2.1% of the local area population Hence, USFWS would have some concerns about this take level for bald eagles since the combined annual take of 2.1% of the local area population would exceed the 1% benchmark level. But this concern would be offset by the fact that this take level is still below the 5% benchmark level for this local area population.

Also, USFWS has established take thresholds for bald eagle populations by EMU in the Final Environmental Assessment (FEA) for the 2009 BGEPA take regulations. For the Northern Rocky Mountains EMU the annual take threshold for the portion within the USFWS Region 6 boundary is 30.73 bald eagles per year, and for the Rocky Mountains and Plains EMU the annual take threshold is 13.02

eagles per year for a combined annual take threshold of 43.75 bald eagles per year (USFWS 2009). Hence, even with an estimated 2.4 bald eagles per year (estimated take due to the CCSM Phase 1 Project plus other ongoing eagle take) taken out of this combined threshold level for the Northern Rocky Mountains and Rocky Mountains and Plains EMU's from the FEA, this would still leave 41.35 bald eagles per year that could be taken from these combined EMU's in Region 6. Most of the bald eagles for the local area population associated with the Chokecherry and Sierra Madre project are from the Northern Rocky Mountains EMU (Table 3). So considering only the Northern Rocky Mountain EMU threshold of 30.73 eagles per year, and subtracting out the estimated take above of 2.4 bald eagles per year, this still leaves 28.33 bald eagles per year that still could be taken; a reduction for the Northern Rocky Mountain EMU of only about 8%. However the reduction in the USFWS thresholds for the bald eagle EMU's in Region 6 are considered the net impact is that this reduction would be relatively minimal.

Analysis for wind turbines with 120 meter blades:

Using the USFWS eagle fatality prediction model (USFWS 2013) we utilized eagle data from pre-construction eagle surveys to predict the number of bald eagles the CCSM Phase I Project would take per year. At the upper 80th credible interval level we predict, with the data provided, that this wind project would take 2 bald eagles per year if the CCSM Phase 1 Project were built with wind turbines that had blades that were 120 meters. Using this estimate, and the above combined reductions against the 1 % and 5% benchmarks due to wind energy, power lines, and vehicle collisions, if 2 bald eagles were taken by the CCSM Phase I Project per year then the combined cumulative take at the 1% level would be -2.4 bald eagles and 2.6 bald eagles at the 5% benchmark level. Total eagle take per year due to the CCSM Phase I Project plus other ongoing take due to other unpermitted ongoing types of take would be 3.4 bald eagles per year (2 eagles predicted/year for CCSM Phase I Project + 0.8 eagles/year due to other ongoing take at wind facilities + 0.3 eagles/year ongoing take due to power lines + 0.3 eagles/year ongoing take due to vehicle collisions) or about 2.9% of the local area population Hence, USFWS would have some concerns about this take level for bald eagles since the combined annual take of 2.9% of the local area population would exceed the 1% benchmark level. But this concern would be offset by the fact that this take level is still below the 5% benchmark level for this local area population.

Also, USFWS has established take thresholds for bald eagle populations by EMU in the Final Environmental Assessment (FEA) for the 2009 BGEPA take regulations. For the Northern Rocky Mountains EMU the annual take threshold for the portion within the USFWS Region 6 boundary is 30.73 bald eagles per year, and for the Rocky Mountains and Plains EMU the annual take threshold is 13.02 eagles per year for a combined annual take threshold of 43.75 bald eagles per year (USFWS 2009). Hence, even with an estimated 3.4 bald eagles per year (estimated take due to the CCSM Phase I Project plus other ongoing eagle take) taken out of this combined threshold level for the Northern Rocky Mountains and Rocky Mountains and Plains EMU's from the FEA, this would still leave 40.35 bald eagles per year that could be taken from these combined EMU's in Region 6. Most of the bald eagles for the local area population associated with the Chokecherry and Sierra Madre project are from the Northern Rocky Mountains EMU (Table 3). So considering only the Northern Rocky Mountain EMU threshold of 30.73 eagles per year, and subtracting out the estimated take above of 3.4 bald eagles per year, this still leaves 27.33 bald eagles per year that could still be taken, a reduction for the Northern Rocky Mountain

EMU of only about 11%. However the reduction in the USFWS thresholds for the bald eagle EMU's in Region 6 are considered the net impact is that this reduction would be relatively minimal.

Table 3: Estimated Bald Eagle Local Area Population (LAP) for the Proposed CCSM Phase I Project Wind Energy Facility in Carbon County, Wyoming.

EMU	Estimated No. of Bald Eagles
Northern Rocky Mountains	114.05
Rocky Mountains and Plains	2.81
Total Local Area Population	116.86
1% LAP Benchmark	1.17
5% LAP Benchmark	5.84

Table 4: Known Bald Eagle Mortalities within 43 Miles of the Proposed CCSM Phase I Project Wind Energy Facility, 2005 through 2014.

	Number of Mortalities	Percent of Total Mortalities
Anthropogenic Causes		
Electrocution	2	18.1
Collision with Power Line	1	9.2
Collision with Wind Turbine	3	27.3
Highway Accident	3	27.3
Unknown	2	18.1
Total Mortalities	11	100

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