



TETRA TECH EC, INC.

July 27, 2007

Ms. Illona Jeffcoat-Sacco
Executive Secretary
North Dakota Public Service Commission
Department 408
600 East Boulevard Avenue
Bismarck, ND 58505

**RE: Langdon Wind, LLC -Langdon Wind Energy Center, Cavalier County,
North Dakota**

Dear Ms. Jeffcoat-Sacco:

On behalf of Langdon Wind, LLC (Langdon Wind), attached is an original and 10 copies of the 2007 spring avian survey for the Langdon project (Case No. PU-07-26) filed with the ND PSC on March 22, 2007.

If you could please incorporate this report into the Langdon Wind file, that would be appreciated. Please call Mr. Brian Bjella (applicant's counsel) at 701-223-6585 with any questions.

Sincerely,
TETRA TECH EC, INC.

A handwritten signature in black ink, appearing to read 'Tracey M. Martorano', with a long horizontal flourish extending to the right.

Tracey M. Martorano, PE
Senior Project Manager

Cc: Jeff Rice, Tetra Tech MM

**SPRING AVIAN SURVEY
LANGDON WIND RESOURCE AREA
CAVALIER COUNTY,
NORTH DAKOTA**



PREPARED FOR



Prepared by



July 2007

Executive Summary

Langdon Wind, LLC (Langdon Wind) contracted with Tetra Tech EC (TtEC) to perform spring avian surveys to quantify local avian use and to identify potential avian impacts associated with the construction and/or the operation of the proposed Langdon Wind Resource Area (WRA). TtEC performed a Spring Avian Point Count Survey at the proposed Langdon Wind WRA. Twenty point stations were surveyed throughout the study area to best cover the proposed 106 turbine array.

A total of 84,886 birds were counted, including 51 known and eight unknown species, indicating that the overall avian use at Langdon is high. However, these high numbers are related to a major migration event which was documented during the first week of the survey. Of the total 84,886 birds counted during this survey, 61,391 (72.3%) were seen over the first observation point survey (which consisted of two days). Two species (unidentified sparrow and snow goose) made up 97.3% of that first week total and 70.3% of the entire survey total. Many of these species have low exposure risk according to the risk exposure index as they primarily fly below the anticipated rotor swept area (RSA).

Raptor use at the Langdon Wind WRA (0.4 birds/20 min) was low and ranked lowest out of fourteen published point count studies for raptor use when compared to rates observed at existing wind facilities. Additionally, overall exposure risk for the site when compared with other wind energy sites is relatively low. The Northern harrier, the major contributor to overall raptor use, was observed in 14.5% of all surveys. Although northern harriers were the most common raptor species, their exposure risk (0.026) is relatively low due to the fact that most harriers were observed flying below the RSA. The remaining raptor species including a bald eagle, a golden eagle, red-tailed hawks, American kestrels, and sharp-shinned hawks all exhibited low exposure risk (≤ 0.01), as a result of both low overall raptor use and that fact that the majority of individuals were flying below the RSA.

Mortality events are most likely to occur when birds fly within RSAs. Overall, the majority of birds observed flew below the RSA (83.8%); fewer flew above the RSA (10.2%) or within the RSA (6.0%). As a group, raptors were observed primarily below the RSA (72.9%); fewer flew within the RSA (18.8%) or above the RSA (8.3%).

An index of relative risk of turbine collision, which takes into account both flight height and abundance, was calculated for each species. Risk was highest for snow geese (2.28), and to a lesser extent, migrating flocks of Canada geese (0.37), tundra swans (0.36), and northern pintails (0.27). Flight heights of many species did not overlap the RSA, which results in a low overall mortality risk due to collisions.

Special status species observed on the Langdon Wind WRA included a single bald eagle and a single golden eagle. Both species of eagle are state listed species of concern protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act and the bald eagle was formerly federally listed as a threatened species. Finally, State Species of Conservation Priority observed on site included: northern harriers, black terns, sharp-tailed grouse, and Franklin's gull.

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INTRODUCTION

Langdon Wind, LLC (Langdon Wind) is planning to develop a wind energy conversion facility in Cavalier County, North Dakota. The Langdon Wind Resource Area (WRA) encompasses approximately 30,400 acres on private land three miles southeast of the town of Langdon (Figure 1). The WRA is located in a rural farming area and is comprised almost entirely of cultivated farm fields interspersed with small farmsteads and several small wetland areas found predominantly in the southern portion of the WRA. Langdon Wind is committed to environmental stewardship and therefore contracted Tetra Tech EC (TtEC) to conduct spring avian surveys to quantify local avian use and to identify potential avian impacts associated with the construction and/or the operation of the proposed wind facility at the Langdon Wind WRA.

The ecoregions near the WRA are characterized by flat to gently rolling landscapes comprised of a thick mantle of glacial till. The subhumid conditions foster a grassland transitional area between the tall and shortgrass prairie. Because of the productive soil and near level topography, this ecoregion is almost entirely cultivated, with many wetlands drained or simply tilled and planted. However, temporary and seasonal wetlands create favorable conditions for duck nesting and migration within the WRA and vicinity.

The WRA is utilized by migratory species, including grassland birds and waterfowl, during the spring migration period. Kelly's Slough, a United States Fish and Wildlife Service (USFWS) refuge and major staging area for migrating shorebirds, is located approximately 100 miles southeast of the WRA. Based on historical field research and observations, shorebirds may also migrate north through Kelly's Slough in May.

METHODS

Field Methods

Fixed-point Surveys

Avian point count surveys were conducted to evaluate avian use and behavior during the spring migration season at the WRA (**Appendix A**). Survey dates and locations of survey points were selected to occur during spring avian migration, to cover a diversity of habitats, and to ensure the best possible viewshed. Surveys were conducted weekly between March 26 and May 31, 2007 (**Table 1**) at 20 points distributed throughout the WRA (**Figure 2**). Surveys were conducted during daylight hours under variable weather conditions.

Data were collected on all birds observed within an 800-meter radius circle centered on the point station. Surveys at each point lasted for 20 minutes, during which the observer continuously scanned for birds and recorded both visual and auditory observations (**Table 2**). Behaviors recorded included perching, flying, and singing. Flight heights and distances from the observer were estimated by experienced field ornithologists who used existing telephone poles, local transmission lines, and topographic maps for reference. A sample data sheet is shown in **Appendix B**.

Incidental Observations

Incidental observations were those recorded outside of the official 20-minute survey period. Incidental observations included observations that occurred 1) during travel between points, 2) before or after the official 20-minute survey period, and 3) outside the 800-meter radius circle. These observations were recorded on separate data sheets to provide additional information on avian use of the WRA.

Data Quality Assurance/Quality Control

QA/QC measures were implemented during all stages of data collection, analysis, and report preparation. To ensure legibility and completeness of data sheets, each observer reviewed, and clarified if needed, all data sheets before data entry into a spreadsheet for data storage and analysis.

Analysis

Avian Use of the WRA

Avian use of the WRA was derived by calculating the average number of birds observed per point. To evaluate the diversity and composition of avian species using the WRA, the number of individuals of each species was summarized. In addition, the number of observations is also presented, where an observation can be either an individual bird or a discrete flock of birds. This information helps evaluate if a high use number is driven by a single event (e.g., flock of birds moving through the rotor swept area).

Flight Behavior

Flight behavior was evaluated by calculating the proportion of flying birds that were observed below, within, or above the turbine rotor swept area (RSA). At the initiation of this project the General Electric 1.5 Megawatt turbine was anticipated to be used. As a consequence, a rotor swept area (RSA) between 41.5 and 118.5 meters above ground was used, the largest blades being considered by Langdon Wind at the time of the analysis. Birds that were observed flying, but for which there were no flight height data (<2% of our observations), were not included in this analysis. A bird was considered to have flown within the RSA if any of its recorded heights overlapped the RSA. That is, if a bird flew at heights that correspond to the RSA at any time during the survey, it was considered to have occurred within the RSA.

Risk Index

To estimate the exposure risk of collision for each species, the following equation was applied:

$$R = A * P_f * P_t$$

where R is the exposure risk, A is the mean number of birds/20 min, P_f is the proportion of all activity observations of species i that were observed flying; and P_t is the proportion of species i that were observed flying within the turbine RSA. This exposure risk of a species assists in conducting a comparison of species risk at the Langdon Wind Resource Area.

RESULTS

Langdon Wind WRA

A total of 15.5 square miles of the Langdon Wind WRA were surveyed during spring point count surveys, covering approximately 33% of the total WRA.

Species Composition

A total of 84,886 birds of 51 identified and eight unidentified resident and migrant species were recorded during 200 fixed-point count surveys (**Table 3**). The most frequently observed birds were red-winged blackbirds, (found in 54.5% of surveys), horned larks (53.5% of surveys), unidentified sparrows (52% of surveys), Canada goose (26.5% of surveys), mallards (20.5% of surveys) and killdeer (19% of surveys). Each remaining species comprised 18 percent or less of the total number of birds observed (**Table 5**).

Due to characteristics of flight and movements during their migration, the majority of sparrows seen in this survey were extremely difficult to accurately identify. After reviewing observers field notes, range maps, habitat preferences, time of migration and discussing these with Jill Shaffer of the US Geological Services Northern Prairie Wildlife Research Center (USGS; Personal communication, 2007) the most likely sparrow species or combination of sparrow and passerine species observed were: American tree sparrow (*Spizella arborea*), song sparrow (*Melospica melodia*), white-throated sparrow (*Zonotrichia albicollis*), horned lark (*Eremophila alpestris*), Lapland larkspur (*Calcarius lapponicus*), or chestnut-collared longspur (*Calcarius ornatus*).

Avian Use

Overall mean bird use within the Langdon Wind WRA was 424.4 birds/20 min, ranging from zero to 41,025 birds per 20 minute point count. Among taxonomic groups, mean use was highest for passerines (343.5 birds/20 min). The top species, an unidentified sparrow (288.0 birds/20 min) accounted for more than eighty percent of these individuals (**Table 4**). Other species with relatively high use included red-winged blackbird (24.5 birds/20 min), and snow bunting (23.2 birds/20 min). Mean use for each other passerine species was 3.0 birds/20 min or fewer.

Of the remaining taxonomic groups, waterbirds (waterbirds imply shorebirds, wading birds, gulls and waterfowl) had the second highest mean use (80.5 birds/20 min) and was dominated by snow goose (66.4 birds/20 min). Shorebirds by themselves had a total mean use of 0.5 birds/20min. Mean use for each other waterbird species was 6.6 birds/20 min per species or fewer. Raptor mean use was 0.4 birds/20 min with northern harrier (0.2 birds/20 min) having the largest contribution. Mean use for each other raptor species was 0.1 birds/20 min per species or fewer and includes bald eagles, golden eagles, red-tailed hawks, American kestrels, sharp-shinned hawks and an unidentified raptor.

Frequency of Occurrence

Red-winged blackbirds, horned larks and unidentified sparrows were detected at the majority of observation point surveys (54.5%, 53.5% and 52.0% of surveys, respectively). Canada

geese were detected in just over a quarter of the surveys (26.5% of surveys). Mallards and unidentified ducks were seen in 20.5% and 17.5% of surveys. All other birds were detected in 15.0% of the surveys or less (**Table 5**).

Flight Height and Exposure Risk

During spring avian use surveys, behavioral data were collected for 98% of all birds observed during point count surveys. Of flying birds with height data, 84% occurred below the anticipated RSA, 10% flew above the anticipated RSA, and 6% were within the anticipated RSA; (**Table 6**). For raptor species, which comprise less than 0.1% of the total species, 72.9% flew below the RSA, 18.8% of flew within the RSA, and 8.3% above the RSA.

Exposure risk was determined by multiplying mean use, by the proportion of birds observed flying, and the proportion of birds that occurred within the anticipated RSA. Snow geese had the greatest exposure risk (2.277), followed by the Canada goose (0.370) and tundra swan (0.355). The highest exposure risk for raptors was the northern harrier (0.026) followed by the red-tailed hawk (0.002) (**Table 7**).

Flight Direction

In general birds appeared to be flying in a northerly direction (25.9% flying north, 4.6% northeast, and 8.2% flying northwest (**Table 8**). Some of these movements, however, represent ordinary activity by resident species, such as foraging, (e.g., red-winged blackbirds) occurring throughout the site. The preponderance of the species recorded included multiple flocks of red-wing blackbird, unidentified sparrows, snow geese, Canada geese and various duck species. Birds flew in all of the remaining cardinal directions (e.g., east, south, west) around 12% of the time with birds flying in various directions (i.e. a hawk soaring around in circles) 10.3% of the time (**Table 8**).

Incidental Surveys

Five species were documented as incidentals during the spring surveys that were not seen during the point count surveys (**Table 9**). These additional species include yellow warbler, unidentified diver, semipalmated plover, lesser yellowlegs, and blue jay.

Biologist also looked for active stick nests throughout the survey to determine if any raptors were nesting near proposed turbine locations. Two red-tailed hawks were observed utilizing a stick nest near observation point 16 during the third and fourth survey. Although red-tailed hawks were seen again within the 800 meter radius, they were not seen within the immediate vicinity of the nest after week four.

DISCUSSION AND RECOMMENDATIONS:

Raptor Use and Exposure Risk

Raptors, because of their propensity to fly at heights similar to those encompassed by turbine rotor sweep areas, are a group of special interest. Raptor use at the Langdon Wind WRA (0.4 birds/20 min) was low and ranked lowest out of fourteen published point count studies for

raptor use when compared to rates observed at existing wind facilities (**Table 10**). Because studies of avian use do not share identical methodologies (e.g., length of survey period), comparisons should be used to provide useful generalities only.

Northern harrier, the major contributor to overall raptor use, was regularly seen throughout the WRA (observed in 14.5% of all surveys). Although northern harriers were the most common raptor species, their exposure risk (0.026) is relatively low due to the fact that most harriers were observed flying below the RSA. The remaining raptor species all exhibited low exposure risk (≤ 1.0), as a result of both low overall raptor use and that fact that the majority of individuals were flying below the RSA.

Three raptor species have been identified as special status species. A single bald eagle, a formerly federally-listed threatened species and a state listed species of concern was seen in the study area. A USFWS news release on June 28, 2007 announced the removal of the bald eagle from the Federal List of Endangered and Threatened Wildlife and Plants effective 30 days after publication in the Federal Register. This official publication is dated July 9, 2007. In addition, one golden eagle, a state listed species of concern was seen in the study area. Both species of eagle continue to be protected under the Bald and Golden Eagle Protection Act as well as the Migratory Bird Treaty Act. Finally, northern harriers, a regularly seen species, are also listed as a species of concern.

Non-raptor Use and Exposure Risk

Overall avian use at Langdon is high. Use by non-raptor birds collectively at the Langdon Wind WRA (424.2 birds/20 minute; **Table 4**) was the second highest of other previously recorded rates reported from ten existing wind facilities throughout the country (**Table 10**). These high numbers do not reflect regularly high use in the area, but were related to a major migration event which was documented during a two day survey of all 20 observation points the first week of the survey. Of the total 84,886 birds counted during this survey, 61,391 (72.3%) were seen during the first week. Two species (unidentified sparrow and snow goose) made up 97.3% of that first week total and 70.3% of the entire survey total. Without this migration event in the first two day survey, the total avian use would be reduced from 424.2 birds/20 minutes to 117.5 birds/20 minutes, a 72% decrease in observations.

High avian use at the Langdon Wind WRA can also be attributed to high numbers of red-winged blackbirds (24.5 birds/20 min), as was also found at the site with the highest avian use, Montezuma Hills (**Table 10**). This was the third most common species seen during the survey (unidentified sparrow and snow goose were first and second, respectively) making up 5.6% of the total surveyed birds. Land use within the WRA is predominantly row crop agriculture of canola and sunflower, which commonly attracts blackbirds traveling in flocks that contain large numbers of birds. Within the United States, blackbirds are very abundant, exhibiting broad stable populations, and often managed as a pest species in agricultural settings (Yasukawa and Searcy 1995), consequently, fluctuation in their local populations elicit very little concern from wildlife agencies. Additionally, in a post-construction fatality monitoring survey conducted at the Montezuma Hills wind facility, where blackbird use has been shown to be high (474 birds/30 min), only two red-winged blackbirds fatalities were recorded during the year long survey (Kerlinger et al. 2005).

Of the three most common species surveyed, only the snow goose estimates reflected measurable risk (2.277). This risk value was lower than might be anticipated because although mean use was high (66.4 birds/20 min), only 4.3% of snow geese surveyed were flying within the RSA. Unidentified sparrows and red-winged blackbirds both have minimal exposure risk because although mean use was high (24.5 birds/20 min), these individuals stayed below the RSA (**Table 7**). Additional species potentially at risk for this study site are waterfowl including; Canada goose (0.370) Tundra swan (0.355) and northern pintail (0.271).

Shorebird use (0.5 birds per 20 min) of the project area is relatively low when compared to shorebird abundance seen at the Kelly's Slough National Wildlife refuge located approximately 100 miles southeast of the Langdon WRA. The study at Kelly's Slough (Carey, 2003) resulted in an average of 18 different species and 1,832 individual birds being surveyed during the month of June (2000-2002). Only, five (5) different species of shorebirds were seen during observation point surveys at the Langdon WRA with a total of 150 individual birds. Of these five species seen, only two (killdeer and an unidentified shorebird) were seen flying with both of the individual birds flying below the RSA (**Table 7**). The Langdon WRA exposure risk for all shorebirds surveyed during this study is less than 0.01.

None of the passerine species surveyed during this study exhibit an exposure risk higher than 0.003. Post-construction fatality monitoring surveys of several passerine species (American pipit, American robin, common grackle, and Lapland longspur), as well as many species with similar flight characteristics, suggest these passerines avoid collisions with turbines (Kerlinger et al. 2005; Johnson et al. 2005a).

The remaining species, many of which were local residents, showed low exposure risk according to the risk exposure index, because they primarily flew below the anticipated RSA. Although the exposure index does provide a relative ranking as to what species may be most at risk, an index value of zero indicates low, rather than no risk associated with the construction and operation of wind turbines at the Langdon Wind WRA.

Three of the non-raptor species seen during the point counts are listed as Species of Conservation Priority. These include sharp-tailed grouse (1 individual), black-tern (20 individuals), and Franklin's gull (7 individuals).

Potential Impacts to Avian Species

The impacts to avian species that could result from the construction and operation of the Langdon Wind WRA are direct mortality and injury from collisions with turbines or guy wires (Kerlinger 2004), permanent or temporary habitat loss, and displacement of birds from habitats near turbines. Raptor mortality at newer generation wind projects has been very low. The Langdon Wind WRA, located in northeastern North Dakota, is similar in habitat (cultivated agricultural fields) to other operating wind facilities, such as Vansycle (OR) and the Buffalo Ridge (MN) WRAs, where post construction monitoring has occurred (Erikson et al. 2000, 2002). At these sites, only one raptor mortality was recorded over a four-year study at the Buffalo Ridge WRA, and no raptor mortalities were documented at the Vansycle

WRA during a one-year study (Erickson et al. 2001). Raptor use at these sites was significantly higher than that observed at the Langdon Wind WRA, and may not be indicative of wind projects in North Dakota.

Much of the Langdon Wind WRA is already disturbed, consisting predominantly of agricultural and pasture lands; however, the WRA does provide birds and other wildlife with cover and opportunities for nesting, perching, and foraging in wooded areas associated with drainages, shelterbelts, and surrounding scattered residences. Permanent habitat loss caused by the construction of the Langdon wind facility will likely consist of the removal of approximately 100 acres of rangeland and cropland, depending on the total number of turbines and associated access roads. Overall this is a very small proportion of the WRA (< 1%). Short-term disturbance associated with construction activities could temporarily displace birds from these areas and may result in the abandonment of nests; however, many species will have fledged by the time construction begins. Long-term noise and disturbance associated with turbine operation may also reduce habitat quality and result in the permanent displacement of birds from the WRA.

Avian displacement associated with wind power development has been documented at other wind plants, much of which is attributed to the direct loss of habitat or reduced habitat quality within 50 meters of the turbine pad (WEST and NWCC 2004). For example, at the Buffalo Ridge WRA, densities of male songbirds were significantly lower in Conservation Reserve Program (CRP) grasslands containing turbines than in CRP grasslands without turbines, which has been attributed to avoidance of turbine noise and maintenance activities, and reduced habitat quality due to the presence of access roads and large gravel pads surrounding the turbines (Leddy et al. 1999). Likewise, at the Buffalo Ridge site in Minnesota, the abundance of shorebirds, waterbirds, upland gamebirds, woodpeckers, and several groups of passerines was found to be lower in areas with turbines than without (Johnson et al. 2000a). However, data from Johnson et al. (2000a) suggest that the extent of reduced use is primarily limited to areas only within 100 meters of turbines.

Recommendations

Based on overall pattern of bird use, lack of high-value habitat and recent discussions with USFWS and NDG&F, there are no recommendations for future studies at the Langdon Wind Energy Center.

FPL Energy's post-construction monitoring plan includes the Wildlife Response Reporting System (WRRS). During routine maintenance operations FPL Energy field technicians are required to walk three concentric circles around the base of each turbine and report and document avian mortalities. These records will be kept for review and monitoring purposes.

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TABLES

Table 1. 2007 spring point count survey dates at the Langdon Wind Resource Area.

Date	
March 26th	May 2nd
April 5th	May 11th
April 11th	May 17th
April 17th	May 24th
April 25th	May 31st

Table 2. Data recorded during fixed point count surveys.

Variables Measured	Variables Measured	Variables Measured
date	observer	distance from observation point (first and closest)
start time/end time of the observation period	wind speed (low, high)	behavior
point number	species (or best possible identification)	flight height (in meters when first observed, low, and high)
visibility (good, fair poor)	# individuals	flight direction to (8 cardinal directions)
wind direction (8 cardinal directions)	sex/age class, when known	habitat

Table 3. Avian species observed during spring point count surveys at the Langdon Wind Resource Area, 2007.

Species	# of Total Birds	# of Observations	Percent Composition (% of total birds observed)
unidentified sparrow	57609	104	67.9
snow goose	13287	11	15.6
red-winged blackbird	4905	109	5.8
snow bunting	4642	12	5.5
Canada goose	1321	53	1.6
yellow-headed blackbird	590	29	0.7
unidentified duck	376	35	0.4
horned lark	366	107	0.4
mallard	305	41	0.4
European starling	267	3	0.3
northern pintail	199	21	0.2
unidentified swallow	172	6	0.2
tundra swan	168	8	0.2
ruddy duck	129	5	0.1
killdeer	74	38	0.1
brown-headed cowbird	56	16	0.1
northern shovelers	41	9	<0.1
northern harrier	31	29	<0.1
common raven	30	20	<0.1
rock dove	29	8	<0.1
blue wing teal	24	4	< 0.1
red-tailed hawk	24	20	< 0.1
gadwall	23	7	< 0.1
black tern	20	3	< 0.1
redhead	20	4	< 0.1
cliff swallow	17	12	< 0.1
American coot	16	5	< 0.1
American golden plover	13	1	< 0.1
rusty blackbird	13	2	< 0.1
canvasback	12	3	< 0.1
unidentified raptor	10	8	< 0.1
unidentified gull	9	4	< 0.1
Franklin's gull	7	1	< 0.1
hooded merganser	6	1	< 0.1
unidentified tern	4	1	< 0.1
unidentified goose	6	6	< 0.1
eastern kingbird	6	1	< 0.1
western meadowlark	5	4	< 0.1
black-bellied plover	5	2	< 0.1
blue jay	4	1	< 0.1
bobolink	4	3	< 0.1
bufflehead	4	1	< 0.1
common merganser	4	1	< 0.1
sharp-shinned hawk	4	4	< 0.1
unidentified shorebird	4	1	< 0.1
white-throated sparrow	4	4	< 0.1
grey partridge	3	2	< 0.1

Table 3. Avian species observed during spring point count surveys at the Langdon Wind Resource Area, 2007.

Species	# of Total Birds	# of Observations	Percent Composition (% of total birds observed)
mourning dove	3	2	< 0.1
American kestrel	2	2	< 0.1
northern flicker	2	2	< 0.1
ruffed grouse	2	1	< 0.1
Wilson's phalarope	2	1	< 0.1
American robin	1	1	< 0.1
bald eagle	1	1	< 0.1
black-billed magpie	1	1	< 0.1
great blue heron	1	1	< 0.1
golden eagle	1	1	< 0.1
willet	1	1	< 0.1
sharp-tailed grouse	1	1	< 0.1
Grand Total	84886	803	100%

Table 4. Mean use by taxonomic group for birds observed within 800 m of observers during spring point count surveys at the Langdon Wind Resource Area, 2007.		
Taxonomic Group	Species	Mean Use (# birds/20 minutes)
Corvid	blue jay	0.02
	common raven	0.15
	group total	0.17
Gamebird	grey partridge	0.02
	ruffed grouse	0.01
	sharp-tailed grouse	<0.01
	group total	0.04
Heron/Stork/Egret	great blue heron	<0.01
	group total	<0.01
Passerine	red-winged blackbird	24.52
	barn swallow	0.27
	black-billed magpie	<0.01
	bobolink	0.02
	European starling	1.33
	American robin	<0.01
	horned lark	1.83
	cliff swallow	0.08
	brown-headed cowbird	0.28
	eastern kingbird	0.03
	rusty blackbird	0.06
	white-throated sparrow	0.02
	yellow-headed blackbird	2.95
	unidentified sparrow	288.04
	western meadowlark	0.02
	unidentified swallow	0.86
	snow bunting	23.21
group total	343.54	
Pigeons/Doves	rock dove	0.01
	mourning dove	0.01
	group total	0.02
Raptor	bald eagle	<0.01
	golden eagle	<0.01
	northern harrier	0.15
	red-tailed hawk	0.12
	American kestrel	0.01
	sharp-shinned hawk	0.02
	unidentified raptor	0.05
group total	0.37	
Shorebird	killdeer	0.37
	black tern	0.10
	unidentified tern	0.02
	Franklin's gull	0.03

Table 4. Mean use by taxonomic group for birds observed within 800 m of observers during spring point count surveys at the Langdon Wind Resource Area, 2007.		
Taxonomic Group	Species	Mean Use (# birds/20 minutes)
	unidentified gull	0.04
	golden plover	0.06
	unidentified shorebird	0.02
	willet	<0.01
	Wilson's phalarope	0.01
	black-bellied plover	0.02
	group total	0.68
Waterbird	blue-winged teal	0.12
	bufflehead	0.02
	canvasback	0.06
	common merganser	0.02
	American coot	0.08
	northern shoveler	0.20
	northern pintail	0.99
	redhead	0.10
	ruddy duck	0.64
	unidentified duck	1.88
	hooded merganser	0.03
	unidentified goose	0.03
	tundra swan	0.84
	snow goose	66.43
	gadwall	0.11
	mallard	1.52
	Canada goose	6.60
group total	79.67	
Woodpecker	northern flicker	0.01
	Group Total	0.01
All Species	Grand Total	424.56

Table 5. Frequency of occurrence for species documented during spring point count surveys at the Langdon Wind Resource Area, 2007.

Taxonomic Group	Species	Frequency of occurrence (% surveys where detected)
Corvid	blue jay	0.5
	common raven	10.0
Gamebird	grey partridge	0.1
	ruffed grouse	0.5
	sharp-tailed grouse	0.5
Heron/Stork/Egret	great blue heron	0.5
Passerine	red-winged blackbird	54.5
	barn swallow	9.0
	black-billed magpie	0.5
	bobolink	1.5
	European starling	1.5
	American robin	0.5
	horned lark	53.5
	cliff swallow	6.0
	brown-headed cowbird	8.0
	eastern kingbird	0.5
	rusty blackbird	1.0
	white-throated sparrow	2.0
	yellow-headed blackbird	14.5
	unidentified sparrow	52.0
	western meadowlark	2.0
	unidentified swallow	3.0
snow bunting	6.0	
Pigeons/Doves	rock dove	4.0
	mourning dove	1.0
Raptor	bald eagle	0.5
	golden eagle	0.5
	northern harrier	14.5
	red-tailed hawk	10.0
	American kestrel	1.0
	sharp-shinned hawk	2.0
	unidentified raptor	4.0
Shorebird/Gull	killdeer	19.0
	black tern	1.5
	unidentified tern	0.5
	Franklin's gull	0.5
	unidentified gull	2.0
	golden plover	0.5
	unidentified shorebird	0.5
	willet	0.5
	Wilson's phalarope	0.5
black-bellied plover	1.0	

Table 5. Frequency of occurrence for species documented during spring point count surveys at the Langdon Wind Resource Area, 2007.

Taxonomic Group	Species	Frequency of occurrence (% surveys where detected)
Waterbird	blue-winged teal	2.0
	bufflehead	0.5
	canvasback	1.5
	common merganser	0.5
	American coot	2.5
	northern shoveler	4.5
	northern pintail	10.5
	redhead	2.0
	ruddy duck	2.5
	unidentified duck	17.5
	hooded merganser	0.5
	unidentified goose	3.0
	tundra swan	4.0
	snow goose	5.5
	gadwall	3.5
	mallard	20.5
Canada goose	26.5	
Woodpecker	northern flicker	1.0

Table 6. Summary of avian flight height in relation to the turbine rotor swept area (RSA) during spring point count surveys at the Langdon Wind Resource Area, 2007

	Observations		Individuals	
	#	%	#	%
All Birds				
<41.5 meters (below RSA)	351	83.8	59338	83.9
41.5-118.5 meters (within RSA)	25	6.0	908	1.3
>118.5 meters (above RSA)	43	10.2	10465	14.8
Total	419	100	70711	100
Raptors				
<41.5 meters (below RSA)	35	72.9	38	76.0
41.5-118.5 meters (within RSA)	9	18.8	7	14.0
>118.5 meters (above RSA)	4	8.3	5	10.0
Total	48	100	50	100

Table 7. Avian flight height characteristics in relation to the turbine rotor swept area (RSA) for species at risk of collision at the Langdon Wind Resource Area, 2007.

Species	Exposure Risk ¹	Mean Use (# birds/20 minute survey)	% Flying	% Below RSA ²	% In RSA	% Above RSA
snow goose	2.277	66.43	79.7	20.3	4.3	75.4
Canada goose	0.370	6.6	48.8	60.9	11.5	27.6
tundra swan	0.355	0.84	100	48.8	42.3	8.9
northern pintail	0.271	0.99	67.3	47.7	40.7	11.6
northern harrier	0.026	0.15	90.3	80.7	19.3	0
unidentified duck	0.023	1.88	22.9	90.4	5.3	4.3
great blue heron	0.010	0.01	100	0	100	0
unidentified raptor	0.009	0.05	90	60	20	20
mallard	0.004	1.52	11.1	94.7	2.6	2.6
red-tailed hawk	0.002	0.12	37.5	83.3	4.2	12.5
common raven	0.000	0.15	33.3	100	0	0
golden eagle	0.000	0.01	100	100	0	0
red-winged blackbird	0.000	24.52	7.4	99.9	0	0.1
bald eagle	0.000	0.01	100	100	0	0
American robin	0.000	0.01	0	100	0	0
European starling	0.000	1.33	6.4	100	0	0
brown-headed cowbird	0.000	0.28	8.9	100	0	0
horned lark	0.000	1.83	6.3	100	0	0
blue-winged teal	0.000	0.12	4.2	4.2	0	0
mourning dove	0.000	0.01	33.3	100	0	0
rock dove	0.000	0.14	17.2	100	0	0
redhead	0.000	0.1	50	50	0	50
northern flicker	0.000	0.01	100	100	0	0
unidentified goose	0.000	0.03	16.7	100	0	0
American kestrel	0.000	0.01	50	100	0	0
sharp-shinned hawk	0.000	0.02	25	100	0	0
black tern	0.000	0.1	65	65	0	0
unidentified tern	0.000	0.02	100	100	0	0
killdeer	0.000	0.37	33.8	100	0	0
unidentified gull	0.000	0.04	33.3	88.9	0	11.1
unidentified shorebird	0.000	0.02	25	25	0	0

Table 7. Avian flight height characteristics in relation to the turbine rotor swept area (RSA) for species at risk of collision at the Langdon Wind Resource Area, 2007.

Species	Exposure Risk ¹	Mean Use (# birds/20 minute survey)	% Flying	% Below RSA ²	% In RSA	% Above RSA
barn swallow	0.000	0.27	63.6	100	0	0
back-billed magpie	0.000	0.01	100	100	0	0
bobolink	0.000	0.02	25	100	0	0
western meadowlark	0.000	25.00	60	100	0	0
cliff swallow	0.000	0.08	94.1	94.1	0	0
brown-headed cowbird	0.000	0.28	8.9	100	0	0
grey partridge	0.000	0.02	100	100	0	0
yellow-headed blackbird	0.000	2.95	0.2	100	0	0
unidentified sparrow	0.000	288	91.9	100	0	0
unidentified swallow	0.000	0.86	65.7	100	0	0
snow bunting	0.000	23.21	95	100	0	0
sharp-tailed grouse	0.000	0.01	100	100	0	0

¹ Exposure risk = % birds flying x % flying within the RSA x mean use
² Turbine rotor swept area =32-130 m above ground level (based on a turbine with an 80 m hub height and 96 m diameter blades)

Table 8. Flight directions of birds observed during spring point count surveys at the Langdon Wind Resource Area 2007.

Species	# Birds Included	# of Observations	Percent of Flights Toward Various Flight Directions								
			N	NE	E	SE	S	SW	W	NW	Variable
unidentified sparrow	52959	76	23.7	11.8	21.0	5.3	6.6		11.9	7.9	11.8
snow goose	10592	9	11.1			11.1	11.1	11.1	33.3	11.1	11.1
snow bunting	4888	14	42.9		7.1	14.3	7.1		14.3	14.3	
Canada goose	645	46	37.0	4.3	6.5	4.3	21.7	6.5	17.4	6.5	2.2
horned lark	531	33	30.3	6.1	21.2	6.1	27.3	6.1	6.1	12.1	
red-winged blackbird	361	46	21.7	4.3	19.6	4.3	15.8	6.1	19.6	4.3	4.3
tundra swan	168	15	33.3			13.3	20.0		20.0	6.7	
northern pintail	134	15	20.0	6.7	6.7	6.7	33.3	13.3	6.7	13.3	
unidentified swallow	113	4					25.0		25.0	25.0	25.0
unidentified duck	86	22	18.2	4.5	9.1	9.1	18.2	13.6	18.2		
barn swallow	35	11			9.1		27.3		9.1		54.5
mallard	34	16	25.0		12.5	6.2	37.5		12.5	12.5	6.2
northern harrier	28	26	23.1	3.8	3.8		19.2		7.7	3.8	34.6
killdeer	25	17	41.2		5.9	11.8	29.4		11.8		
European starling	17	2					50.0		50.0		
cliff swallow	16	9	11.1	11.1		11.1	11.1		33.3	11.1	32.2
black tern	13	3				33.3	33.3	33.3			
redhead	10	1			100.0						
common raven	10	9	22.2		11.1			11.1	33.3	11.1	11.1
unidentified raptor	9	8	12.5			25.0	12.5				50.0
red-tailed hawk	9	10	40.0				10.0				50.0
brown-headed cowbird	5	4	50.0						25.0	25.0	
rock dove	5	3	66.7		33.3						
unidentified tern	4	1								100.0	
unidentified gull	3	3	33.3		66.7						
western meadowlark	3	2	50.0		50.0						
grey partridge	3	2					50.0			50.0	
northern flicker	2	2	50.0						50.0		
bald eagle	1	1	100.0								
golden eagle	1	1	100.0								
blue-winged teal	1	1						100.0			
mourning dove	1	1							100.0		

Table 8. Flight directions of birds observed during spring point count surveys at the Langdon Wind Resource Area 2007.

Species	# Birds Included	# of Observations	Percent of Flights Toward Various Flight Directions									
			N	NE	E	SE	S	SW	W	NW	Variable	
unidentified goose	1	1							100.0			
American kestrel	1	1			100							
sharp-shinned hawk	1	1										
great blue heron	1	1			100.0							
unidentified shorebird	1	1										
back-billed magpie	1	1								100.0		
bobolink	1	1						100.0				
yellow-headed blackbird	1	1								100.0		
sharp-tailed grouse	1	1								100.0		
Percent of Total Birds Flying in Each Direction			25.9	4.6	12.8	8.5	14.4	3.8	11.5	8.2	10.3	
Grand Total	70711	417										

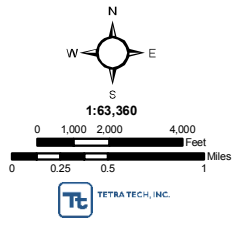
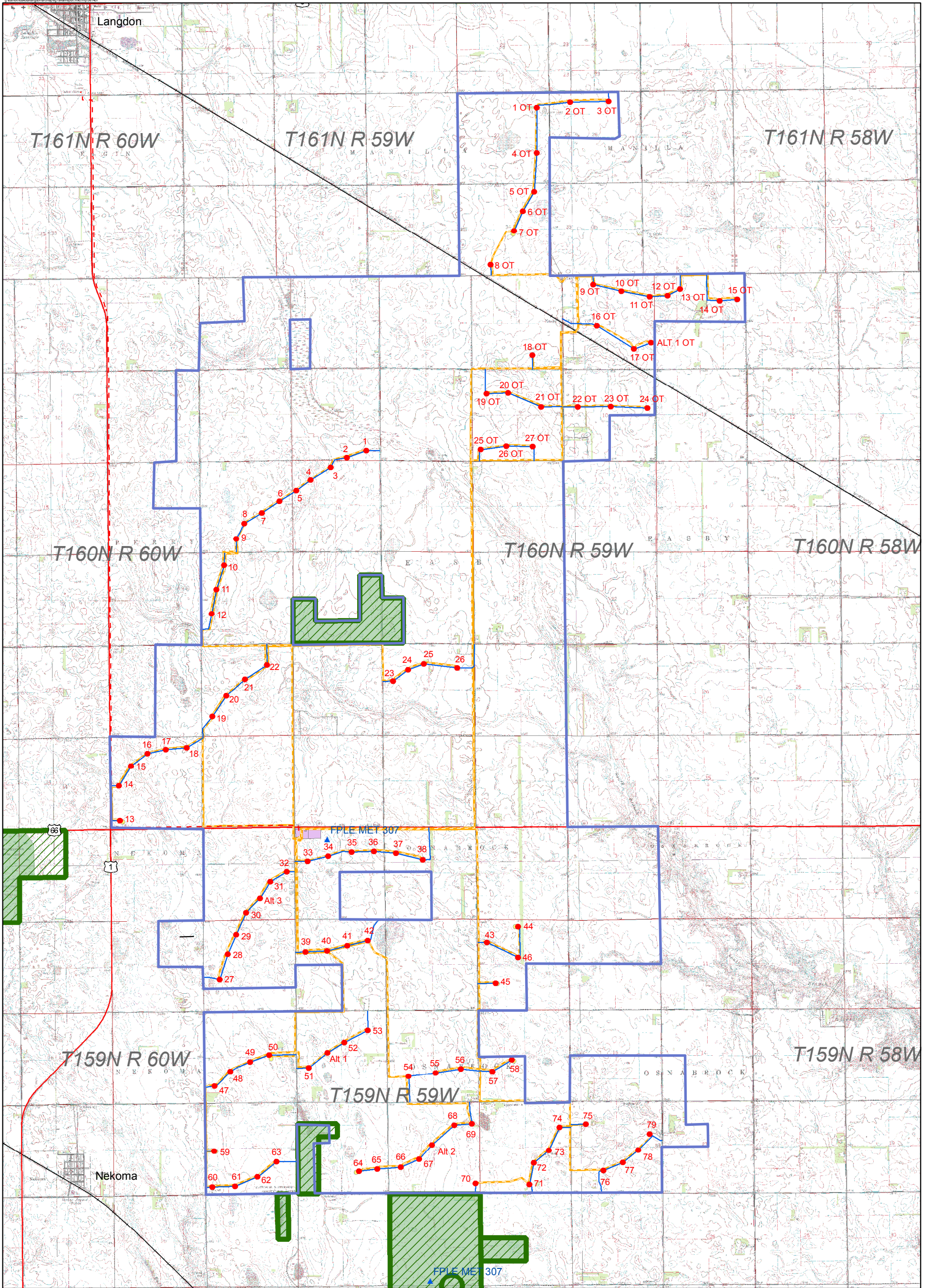
Table 9. Incidental observations of birds not seen at observation points within the Langdon Wind Resource Area, 2007.

Species	Number
semipalmated plover	11
lesser yellowlegs	8
unidentified diver	2
blue jay	1
yellow warbler	1
Total	23

Table 10. Comparison of mean use at the Langdon Wind Resource Area to existing WRA (estimates standardized to #/20-minute survey).

Project site	Mean Use(spring surveys unless otherwise indicated)		Estimate Basis	Reference
	Raptors	Other Birds		
Montezuma Hills, CA	6.72 (annual average)	474 (mostly unidentified blackbirds)	1.5* use/20 min	Kerlinger et al. (2005)
Altamont Pass WEC, CA	3.20 (annual average)	N/A	1.5*use/20 min	Orloff and Flannery (1992)
Cotterel Mountain, ID	2.54	14.29	1.5*use/20 min	BLM (2005)
Klickitat County PEIS study area, WA	1.43	23.01	1.5*Use/20 min	Johnson et al. (2007)
Windy Point, WA	1.19	25.75	1.5*Use/20 min	Johnson et al. (2007)
Buffalo Ridge WEC, MN	0.96-1.26 (various areas)	N/A	1.5*use/20 min	Erickson et al. (2002)
Stateline Wind Project, OR-WA	0.88	10.64	1.5*use/20 min	West, Inc. (2004)
Foote Creek WEC, WY	0.73	N/A	0.75*use/40 min	Johnson et al. (2000b)
Klondike, OR	0.70	N/A	1.5*use/20 min	Erickson et al. (2002)
Wild Horse, WA	0.68(Fall-summer)	8.63	Use/30 min	Erickson et al. (2003)
Condon, OR	0.52	7.14	1.5*use/20 min	URS Corporation et al. (2001)
Biglow Canyon, OR project site and reference area	0.47 0.54	15.18 10.09	Use/30 min	WEST, Inc. (2005)
Maiden, WA	0.44	6.83	Use/30 min	Young et al. (2002)
Langdon Wind Energy Center, ND	0.36	424.1	use/20 min	This Study

FIGURES

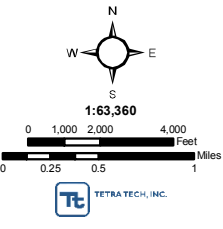
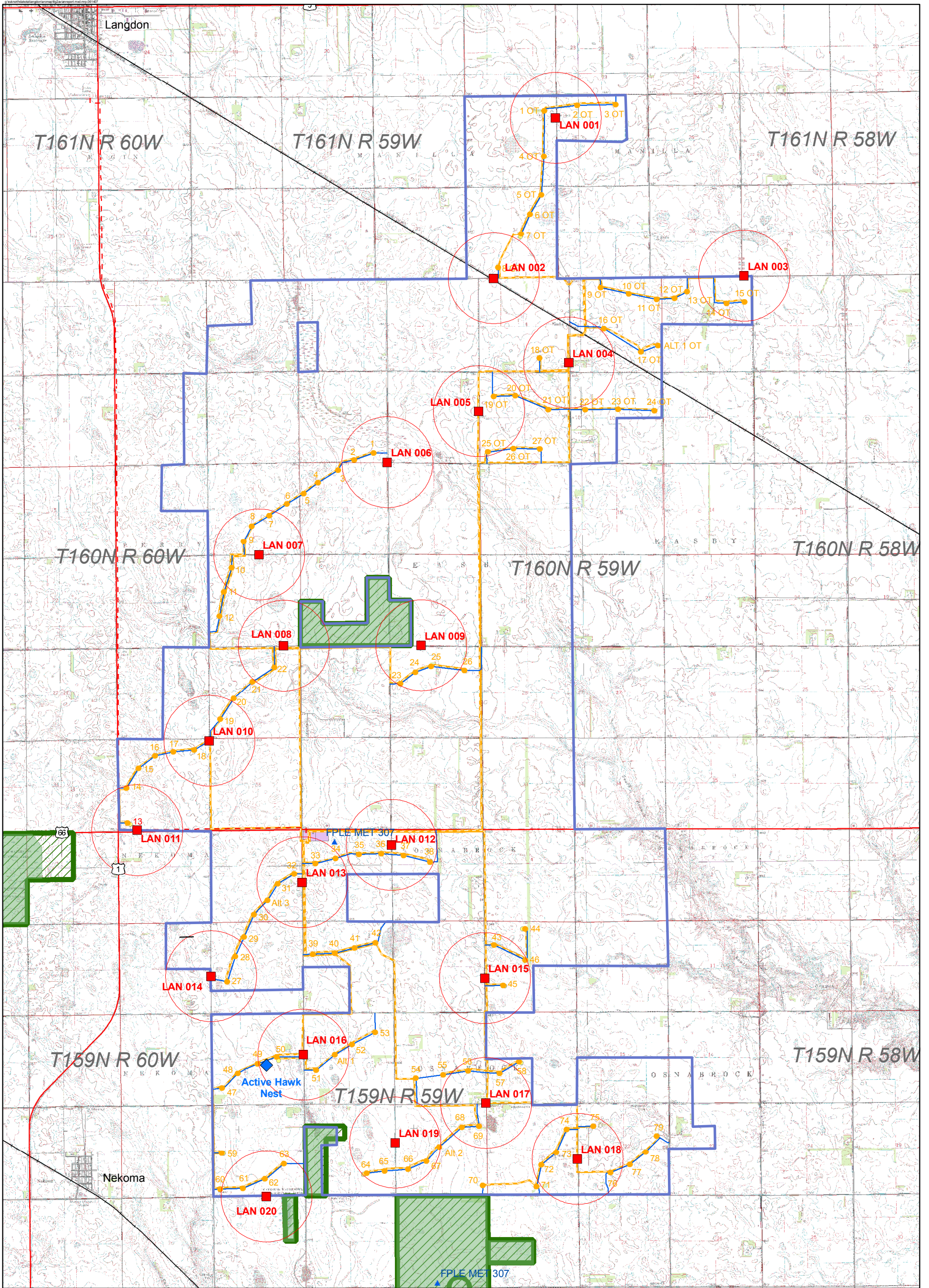


- Turbine Locations 050807
- ▲ MET Locations 041607
- Service Roads 050807
- - - Collectors 050807
- - - Transmission Line 050807
- Substation O&M Layout 050807
- Turnaround (250' dia.)
- Approximate Project Area
- Waterfowl Production Areas
- Wetland Easements

Grid: NAD 83 UTM Zone 14N meters

June 2007

Figure 1
Project Area Location Map
Langdon Wind Energy Center
Cavalier County, North Dakota



- Turbine Locations 050807
- ▲ MET Locations 041607
- Avian Point Count Location
- ◆ Active Hawk Nest
- 800 Meter Survey Plot
- Service Roads 050807
- - - Collectors 050807
- - - Transmission Line 050807
- Substation O&M Laydown 050807
- Turnaround (250' dia.)
- Approximate Project Area
- Langdon WPA-WE Areas
- Wetland Easements

Grid: NAD 83 UTM Zone 14N meters

June 2007

Figure 2
Avian Survey Location Map
Langdon Wind Energy Center
Cavalier County, North Dakota

APPENDIX A
AVIAN POINT COUNT SURVEY PROTOCOL

AVIAN POINT COUNT SURVEY PROTOCOL APPENDIX A

PROTOCOL

The following sections present the methodology for conducting pre-construction avian point count surveys.

1.1 Observation Points

Avian observation points were selected based on the proposed number and spacing of wind turbines and habitat (i.e., visibility). Point count surveys of large circular plots were conducted to provide baseline information on both resident and migratory avian species within the WRA during the spring. Survey points were located near turbine strings (if their locations were known), and distributed throughout the Wind Resource Area, but also covered nearby wetlands and open water areas that could attract waterfowl, water-associated birds, eagles, and cranes. The radius of each circular plot was 800 meters. Birds observed beyond 800 meters were recorded, but not included in the site use calculations for comparison to other sites.

1.2 Sampling Frequency, Duration, and Intensity

A qualified biologist conducted observations for 20 minutes at each observation point; all birds observed were recorded. Species observed, number of birds (single or in a flock), flight height range, flight direction, habitat, distance from observer at closest approach, and activity was recorded to determine how species were using the Wind Resource Area. This sampling strategy gives an assessment of the overall use of the Wind Resource Area by birds, as well as details on the specific locations of birds relative to topographic features and turbine locations. Environmental conditions (weather/visibility, temperature, precipitation, and wind speed) were recorded at each observation point.

Bird flight heights were summarized by percent of observations to quantify the location of birds in the Wind Resource Area relative rotor swept area.

Wildlife observed while on the Wind Resource Area but not during a 30-minute observation session was recorded as incidental observations, and used to supplement the data.

APPENDIX B
EXAMPLE DATA SHEET

Avian Point Count Data Sheet									
Avian Observation Data Sheet (Fixed Point and Instantaneous Count)									
Date (mmddyy) _____ Observer (init.) _____ Start Time _____ End Time _____							Point No. _____		
Weather Visibility (circle one):			Good Fair Poor			Precipitation (circle): It rain, heavy rain, snow			Page ___ of ___
Wind: Direction From: (circle one):			N NE E SE S SW W NW n/a			Speed Low High			(kph/mpH) (circle one)
Precipitation (circle one)		none light rain rain snow sleet hail other							

Obs #	Species Code	Sex	Age	# of ind.	Dist. (m) from obs. 1st closest	Activity			Flight Dirn (to)	Flight Height (m)			Habitat			Ins. Count (5, 10, 15, 20 min)	Aud?	10-min obs per.	Notes
	Time					PE	SO	FL		1st	low	high	BR	F	SG				
1						PE	SO	FL				BR	F	SG	5 10 15 20 25 30		1 2 3		
		CS	HU	OT				AG	DI	OT									
2						PE	SO	FL				BR	F	SG	5 10 15 20 25 30		1 2 3		
		CS	HU	OT				AG	DI	OT									
3						PE	SO	FL				BR	F	SG	5 10 15 20 25 30		1 2 3		
		CS	HU	OT				AG	DI	OT									
4						PE	SO	FL				BR	F	SG	5 10 15 20 25 30		1 2 3		
		CS	HU	OT				AG	DI	OT									
5						PE	SO	FL				BR	F	SG	5 10 15 20 25 30		1 2 3		
		CS	HU	OT				AG	DI	OT									
6						PE	SO	FL				BR	F	SG	5 10 15 20 25 30		1 2 3		
		CS	HU	OT				AG	DI	OT									
7						PE	SO	FL				BR	F	SG	5 10 15 20 25 30		1 2 3		
		CS	HU	OT				AG	DI	OT									
8						PE	SO	FL				BR	F	SG	5 10 15 20 25 30		1 2 3		
		CS	HU	OT				AG	DI	OT									
9						PE	SO	FL				BR	F	SG	5 10 15 20 25 30		1 2 3		
		CS	HU	OT				AG	DI	OT									
10						PE	SO	FL				BR	F	SG	5 10 15 20 25 30		1 2 3		
		CS	HU	OT				AG	DI	OT									