

Turbine Model Comparison for the 2010 Spring and Fall Avian Surveys

Cimarron Wind Energy Project – Phase 1
Gray County, Kansas



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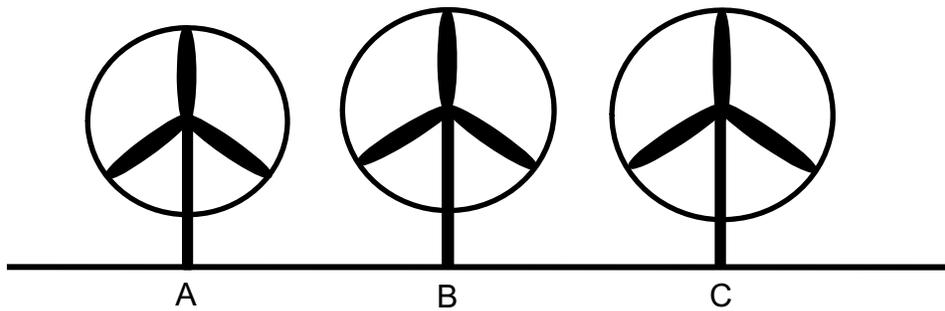
1.0 Introduction

Currently, CPV Cimarron Renewable Energy Company, LLC (CPV) is considering three different wind turbine models to be used at the Cimarron Wind Energy Project – Phase 1 (the Project; Table 1 and Figure 1) proposed in Gray County, Kansas. The wind turbine models under consideration are representative of the same turbine class. Additionally, Project permitting and design reflect the use of either wind turbine model. The only design element that is dependent upon the final wind turbine model selected is the number of turbines utilized at the Project (72 for Turbine A or C versus 66 for Turbine B).

Table 1. Comparison of Turbine Models for the Project					
Turbine	Turbine Model	Hub Height (m)	Rotor Diameter (m)	RSA Low (m)	RSA High (m)
A	Siemens SWT 2.3-101	80	101	29.5	130.5
B	GE 2.5xl	85	103	33.5	136.5
C	Siemens SWT 2.3-108	80	108	26	134

Siemens = Siemens Energy, Inc.
 GE = General Electric
 m = meters
 RSA = rotor swept area

Figure 1. Comparative Sizes of Three Turbine Types under Consideration



In this analysis the RSA is considered to be a broad uninterrupted band above the entire Project Area. The Siemens turbines (Turbine A and C) have a slightly lower hub height and a RSA slightly lower to the ground level. The GE turbine (Turbine B) has a slightly longer rotor diameter than Turbine A and therefore a slightly larger RSA than Turbine A. Turbine B also has the tallest hub height of the three resulting in the RSA with the tallest upper bound. Turbine C has the longest rotor diameter of the three under consideration which results in the largest overall RSA and also the lowest lower bound.

In the 2010 Spring Avian Survey and 2010 Fall Avian Survey (Tetra Tech 2010 and 2011, respectively) for the Project, results of the point count surveys were considered in relation to the proposed Turbine A only. This supplemental Turbine Model Comparison for the spring and fall 2010 avian surveys provides a comparison of the comprehensive point count results considering the three potential turbine models under consideration by

CPV for the Project. It is intended to illustrate what groups and species of birds could potentially be within the RSAs of the turbines.

2.0 Spring 2010 Data

Comparing the three turbine RSAs using spring 2010 avian survey data shows no major difference between Turbine A, B, and C. Turbine A has a slightly smaller RSA range and the overall dimensions of Turbine C give it the largest overall RSA. However, there was no difference in non-raptor and raptor flight heights in relation to the RSA during spring 2010 avian surveys. The slightly higher hub height for Turbine B increases the high point of the RSA. As a result, one non-raptor bird was included in the RSA for Turbine A and Turbine C that was not included in the RSA for Turbine B (Table 2). Raptors remained relatively unchanged between Turbine A, Turbine B, and Turbine C with two additional raptors included in the RSA for Turbine A and Turbine C compared to Turbine B.

Table 2. Comparison of Non-Raptor and Raptors Flight Heights in Relation to the Three Turbine RSAs during Spring 2010 for the Project						
	Turbine A		Turbine B		Turbine C	
	Numbers of Birds	Percent	Numbers of Birds	Percent	Numbers of Birds	Percent
Non-raptors						
Above RSA height	805	16.0	805	16.0	805	16.0
At RSA height	1,349	26.8	1,348	26.8	1,349	26.8
Below RSA height	2,873	57.2	2,874	57.2	2,873	57.2
Raptors						
Above RSA height	1	1.2	1	1.2	1	1.2
At RSA height	44	54.3	42	51.9	44	54.3
Below RSA height	36	44.4	38	46.9	36	44.4

A comparison of the top 10 species' encounter rates shows minimal differences (Table 3) between the turbine models under consideration. Encounter rates for northern harrier (ranked fourth for Turbine A, B, and C) and red-tailed hawks (ranked fifth for Turbine A, B, and C) were slightly lower for Turbine B when compared to the encounter rates for Turbine A and Turbine C (Table 3). High-flying migrating birds such as first ranked sandhill crane and third ranked Swainson's hawk remained unchanged with respect to encounter rate. Other species remained relatively unchanged between turbine models with encounter rates below 0.03 birds flying at RSA height/20 minute (min).

Table 3. Top 10 Species by Encounter Rate (in Descending Order) for the Three Turbine Models during Spring 2010 for the Project					
Turbine A		Turbine B		Turbine C	
Species	Encounter Rate	Species	Encounter Rate	Species	Encounter Rate
sandhill crane	15.48	sandhill crane	15.48	sandhill crane	15.48
red-winged blackbird	0.54	red-winged blackbird	0.54	red-winged blackbird	0.54
Swainson's hawk	0.32	Swainson's hawk	0.32	Swainson's hawk	0.32

northern harrier	0.14	northern harrier	0.13	northern harrier	0.14
red-tailed hawk	0.04	red-tailed hawk	0.02	red-tailed hawk	0.04
turkey vulture	0.02	turkey vulture	0.02	turkey vulture	0.02
barn swallow	0.01	barn swallow	0.01	barn swallow	0.01
horned lark	0.01	killdeer	0.01	horned lark	0.01
killdeer	0.01	mallard	0.01	killdeer	0.01
mallard	0.01	yellow warbler	0.00	mallard	0.01

Encounter Rate = birds flying at RSA height/20 min

A complete listing of all avian survey RSA and encounter data for the spring 2010 can be found in Appendix 1 presented as revised Tables 4 and 5 from the spring 2010 avian survey report for Turbines A, B, and C.

3.0 Fall 2010 Data

Comparing the three turbine types using fall 2010 avian survey data shows slight differences between Turbine A, B, and C (Table 4). The slightly higher hub height increases the high point of the RSA for Turbine B which results in 140 fewer non-raptor birds in the RSA than for Turbine A and Turbine C’s RSA. Raptors remained relatively unchanged between Turbine A, B, and C with 13 additional raptors in the RSA for Turbine A and Turbine C. Encounter rates for golden eagles in the fall 2010 data remained unchanged at 0.01 birds flying at RSA height/20 min.

	Turbine A		Turbine B		Turbine C	
	Numbers of Birds	Percent	Numbers of Birds	Percent	Number of Birds	Percent
Non-raptors						
Above RSA height	65	3.2	65	3.2	65	3.2
At RSA height	463	22.8	323	15.9	463	22.8
Below RSA height	1,506	74.0	1,646	80.9	1,506	74.0
Raptors						
Above RSA height	5	1.6	5	1.6	5	1.6
At RSA height	186	61.2	173	56.9	186	61.2
Below RSA height	113	37.2	126	41.4	113	37.2

As shown in Table 5, the major difference between Turbine A, Turbine B, and Turbine C is the encounter rates for the third ranked Lapland longspurs (0.94 for Turbine A and Turbine C, and 0.47 for Turbine B) and fourth ranked horned larks (0.91 for Turbine A and Turbine C, and 0.42 for Turbine B). Additionally American crow, ranked fifth (0.46 encounter rate) for Turbine A and Turbine C, dropped to ninth for Turbine B (0.08 encounter rate). Cliff swallow, ranked seventh (0.24 encounter rate) for Turbine A and Turbine C, dropped to no encounter rate for Turbine B. Higher-flying migrating birds such as the first ranked Canada goose and second ranked Swainson’s hawk remained

unchanged with respect to encounter rate (Table 5). Other species remained unchanged between turbine types with encounter rates below 0.05 birds flying at RSA height/20 min.

Table 5. Top 10 Species by Encounter Rate (in descending order) for the Three Turbine Models during Fall 2010 for the Project					
Turbine A		Turbine B		Turbine C	
Species	Encounter Rate	Species	Encounter Rate	Species	Encounter Rate
Canada goose	2.49	Canada goose	2.49	Canada goose	2.49
Swainson's hawk	1.57	Swainson's hawk	1.57	Swainson's hawk	1.57
Lapland longspur	0.94	Lapland longspur	0.47	Lapland longspur	0.94
horned lark	0.91	horned lark	0.42	horned lark	0.91
American crow	0.46	cackling goose	0.37	American crow	0.46
cackling goose	0.37	red-tailed hawk	0.25	cackling goose	0.37
red-tailed hawk	0.36	northern harrier	0.11	red-tailed hawk	0.36
cliff swallow	0.24	turkey vulture	0.10	cliff swallow	0.24
northern harrier	0.13	American crow	0.08	northern harrier	0.13
turkey vulture	0.10	sharp-shinned hawk	0.01	turkey vulture	0.10

A complete listing of all avian survey RSA and encounter data for the fall 2010 can be found in Appendix 1 presented as revised Tables 4 and 5 from the fall 2010 avian survey report for Turbines A, B, and C.

4.0 Conclusions

In comparing the three turbine models being considered by CPV for the Project, there are minimal differences among the number of birds or the encounter rates documented within each RSA. In spring and fall 2010 there were slightly more birds within the Turbine A and Turbine C RSA and Turbine A and Turbine C had a slightly greater encounter rate than Turbine B. The majority of the difference occurred in the spring data with Lapland longspurs and horned lark having a greater encounter rate for Turbine A and Turbine C. Both Lapland longspurs and horned larks are grassland songbirds that tend to fly low to the ground and Turbine A and Turbine C has an RSA slightly lower to the ground than Turbine B due primarily to a lower hub height. Turbine C also has a larger rotor diameter which makes it the lowest turbine to the ground. Horned lark fatalities have been reported at other wind farms (Table 6), but the number of fatalities at each site is low.

Table 6. Comparison of Post-construction Carcass Search Surveys with Numbers of Horned Lark Fatalities at Wind Energy Facilities with Publicly Available Data						
Turbine Model	Hub Height (m)	Rotor Diameter (m)	Low RSA* (m)	Horned Lark Fatalities	State	Source
Mitsubishi	40	42	19	32	WY	Young et al. 2007
Vestas V47	50	47	26.5	89	OR/WA	Erickson et al. 2004
Vestas V80 1.8MW	67	78	28	11	WA	Erickson et al. 2008
<i>Not stated</i>	70	40	30	9	NE	Derby et al. 2007
GE 1.5 MW	70	73	33.5	8	OR	NWC & West 2007
Siemens 2.3 MW	80	93	33.5	21	WA	Gritski et al. 2009

*Table is sorted from lowest to highest by Low RSA. Additionally, by comparison, the Low RSA for the Project is 29.5 m, 33.5 m, and 26 m for Turbine A, B, and C, respectively, as shown in Table 1 above.

Vestas = Vestas Wind Systems

Mitsubishi = Mitsubishi Power Systems

Despite being an abundant winter resident (flock size can be into the millions) along the west coast and central plain states, no Lapland longspur fatalities have been reported at any wind farms with publicly available data. Migrating Lapland longspurs have been killed in collisions with other objects (communication towers and gas wells) during low visibility weather conditions such as snowstorms and fog, and with isolated groups of lights (tower and residential light sources), which apparently resulted in disorientation of the migrating birds (Hussell and Montgomerie 2002). American crow fatalities have been reported at other wind farms with publicly available data (Jain et al. 2007, Gritski et al. 2009). Cliff swallow fatalities have been reported at other wind farms with publicly available data (Jain et al. 2007, Jacques Whitford 2009, Drake et al. 2010). However, each of the studies listed had only one fatality each for both species.

In comparing the three turbine models being considered by CPV for the Project, although Turbine B had slightly fewer birds observed in the RSA and had a slightly lesser encounter rate for some species than Turbine A and Turbine C, there are no major differences between the numbers of birds observed within each RSA nor is there a major difference in the encounter rates calculated for the birds within each of the RSAs that would favor one turbine model over the other. The survey results indicated that the final selection of a wind turbine model between Turbines A, B, and C does not make a substantial difference with bird interactions.

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Appendix 1

Turbine A

Table 4a. Summary of avian flight heights¹ in relation to the turbine rotor swept area (RSA)² during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

	Birds	
	Number	Percentage
Non-raptors		
Above RSA height (>130.5m)	805	16.0%
At RSA height (29.5m–130.5m)	1349	26.8%
Below RSA height (<29.5m)	2873	57.2%
Raptors		
Above RSA height (>130.5m)	1	1.2%
At RSA height (29.5m–130.5m)	44	54.3%
Below RSA height (<29.5m)	36	44.4%

¹ Includes only flying birds with flight height data

² These values assume a rotor diameter of 101 (m) and a hub height of 80 (m)

Turbine B

Table 4b. Summary of avian flight heights¹ in relation to the turbine rotor swept area (RSA)² during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

	Birds	
	Number	Percentage
Non-raptors		
Above RSA height (>136.5m)	805	16.0%
At RSA height (33.5m–136.5m)	1348	26.8%
Below RSA height (<33.5m)	2874	57.2%
Raptors		
Above RSA height (>136.5m)	1	1.2%
At RSA height (33.5m–136.5m)	42	51.9%
Below RSA height (<33.5m)	38	46.9%

¹ Includes only flying birds with flight height data

² These values assume a rotor diameter of 103 (m) and a hub height of 85 (m)

Turbine C

Table 4c. Summary of avian flight heights¹ in relation to the turbine rotor swept area (RSA)² during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase 1 .

	Birds	
	Number	Percentage
Non-raptors		
Above RSA height (>134m)	805	16.0%
At RSA height (26m–134m)	1349	26.8%
Below RSA height (<26m)	2873	57.2%
Raptors		
Above RSA height (>134m)	1	1.2%
At RSA height (26m–134m)	44	54.3%
Below RSA height (<26m)	36	44.4%

¹ Includes only flying birds with flight height data

² These values assume a rotor diameter of 108 (m) and a hub height of 80 (m)

Turbine A

Table 5a. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
sandhill crane	15.48	25.06 (0.00 - 65.99)	100.0	38.2	61.8	0.0
red-winged blackbird	0.54	18.73 (13.03 - 24.43)	96.8	0.0	3.0	97.0
Swainson's hawk	0.32	0.36 (0.00 - 0.75)	100.0	0.0	90.0	10.0
northern harrier	0.14	0.38 (0.24 - 0.52)	100.0	0.0	37.5	62.5
red-tailed hawk	0.04	0.11 (0.05 - 0.17)	55.6	0.0	60.0	40.0
turkey vulture	0.02	0.07 (0.00 - 0.15)	100.0	0.0	33.3	66.7
barn swallow	0.01	0.74 (0.44 - 1.04)	100.0	0.0	1.6	98.4
horned lark	0.01	3.21 (2.57 - 3.85)	68.9	0.0	0.5	99.5
killdeer	0.01	0.20 (0.12 - 0.28)	82.4	0.0	7.1	92.9
mallard	0.01	0.08 (0.02 - 0.14)	100.0	0.0	14.3	85.7
yellow warbler	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
western meadowlark	0.00	6.26 (5.42 - 7.10)	58.6	0.0	0.0	100.0
western kingbird	0.00	0.57 (0.32 - 0.82)	87.5	0.0	0.0	100.0
white-crowned sparrow	0.00	0.15 (0.00 - 0.30)	15.4	0.0	0.0	100.0
vesper sparrow	0.00	0.20 (0.03 - 0.37)	88.2	0.0	0.0	100.0
upland sandpiper	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
song sparrow	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
short-eared owl	0.00	0.05 (0.00 - 0.11)	100.0	0.0	0.0	100.0
savannah sparrow	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
Say's phoebe	0.00	0.08 (0.02 - 0.14)	71.4	0.0	0.0	100.0
ring-necked pheasant	0.00	1.94 (1.52 - 2.36)	6.1	0.0	0.0	100.0
rough-legged hawk	0.00	0.01 (0.00 - 0.03)	100.0	100.0	0.0	0.0
red-headed woodpecker	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
peregrine falcon	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
orchard oriole	0.00	0.18 (0.09 - 0.27)	60.0	0.0	0.0	100.0
northern rough-winged swallow	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
northern mockingbird	0.00	0.08 (0.02 - 0.14)	71.4	0.0	0.0	100.0

Turbine A

Table 5a. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
northern flicker	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
northern bobwhite	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
mourning dove	0.00	5.52 (4.17 - 6.87)	81.5	0.0	0.0	100.0
loggerhead shrike	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
Lincoln's sparrow	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
lark sparrow	0.00	0.35 (0.00 - 0.74)	27.6	0.0	0.0	100.0
lark bunting	0.00	0.24 (0.01 - 0.47)	100.0	0.0	0.0	100.0
house wren	0.00	0.02 (0.00 - 0.05)	0.0	0.0	0.0	0.0
house sparrow	0.00	0.38 (0.12 - 0.64)	62.5	0.0	0.0	100.0
house finch	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
grasshopper sparrow	0.00	0.49 (0.33 - 0.65)	14.6	0.0	0.0	100.0
great horned owl	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
field sparrow	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
European starling	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0
Eurasian collared-dove	0.00	0.11 (0.04 - 0.18)	88.9	0.0	0.0	100.0
eastern meadowlark	0.00	0.05 (0.00 - 0.10)	0.0	0.0	0.0	0.0
dickcissel	0.00	2.45 (1.60 - 3.30)	50.0	0.0	0.0	100.0
dark-eyed junco	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
common grackle	0.00	1.11 (0.62 - 1.60)	94.6	0.0	0.0	100.0
cliff swallow	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
chipping sparrow	0.00	0.02 (0.00 - 0.06)	0.0	0.0	0.0	0.0
clay-colored sparrow	0.00	0.02 (0.00 - 0.05)	0.0	0.0	0.0	0.0
Bullock's oriole	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
brown thrasher	0.00	0.21 (0.09 - 0.33)	27.8	0.0	0.0	100.0
brown-headed cowbird	0.00	1.07 (0.51 - 1.63)	78.9	0.0	0.0	100.0
Baltimore oriole	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
American robin	0.00	0.07 (0.02 - 0.12)	50.0	0.0	0.0	100.0

Turbine A

Table 5a. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
American kestrel	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
American goldfinch	0.00	0.06 (0.00 - 0.12)	100.0	0.0	0.0	100.0
American crow	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0

¹These values assume a rotor diameter of 101 (m) and a hub height of 80 (m)

Turbine B

Table 5b. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
sandhill crane	15.48	25.06 (0.00 - 65.99)	100.0	38.2	61.8	0.0
red-winged blackbird	0.54	18.73 (13.03 - 24.43)	96.8	0.0	3.0	97.0
Swainson's hawk	0.32	0.36 (0.00 - 0.75)	100.0	0.0	90.0	10.0
northern harrier	0.13	0.38 (0.24 - 0.52)	100.0	0.0	34.4	65.6
red-tailed hawk	0.02	0.11 (0.05 - 0.17)	55.6	0.0	40.0	60.0
turkey vulture	0.02	0.07 (0.00 - 0.15)	100.0	0.0	33.3	66.7
barn swallow	0.01	0.74 (0.44 - 1.04)	100.0	0.0	1.6	98.4
killdeer	0.01	0.20 (0.12 - 0.28)	82.4	0.0	7.1	92.9
mallard	0.01	0.08 (0.02 - 0.14)	100.0	0.0	14.3	85.7
yellow warbler	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
western meadowlark	0.00	6.26 (5.42 - 7.10)	58.6	0.0	0.0	100.0
western kingbird	0.00	0.57 (0.32 - 0.82)	87.5	0.0	0.0	100.0
white-crowned sparrow	0.00	0.15 (0.00 - 0.30)	15.4	0.0	0.0	100.0
vesper sparrow	0.00	0.20 (0.03 - 0.37)	88.2	0.0	0.0	100.0
upland sandpiper	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
song sparrow	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
short-eared owl	0.00	0.05 (0.00 - 0.11)	100.0	0.0	0.0	100.0
savannah sparrow	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
Say's phoebe	0.00	0.08 (0.02 - 0.14)	71.4	0.0	0.0	100.0
ring-necked pheasant	0.00	1.94 (1.52 - 2.36)	6.1	0.0	0.0	100.0
rough-legged hawk	0.00	0.01 (0.00 - 0.03)	100.0	100.0	0.0	0.0
red-headed woodpecker	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
peregrine falcon	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
orchard oriole	0.00	0.18 (0.09 - 0.27)	60.0	0.0	0.0	100.0
northern rough-winged swallow	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
northern mockingbird	0.00	0.08 (0.02 - 0.14)	71.4	0.0	0.0	100.0
northern flicker	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0

Turbine B

Table 5b. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
northern bobwhite	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
mourning dove	0.00	5.52 (4.17 - 6.87)	81.5	0.0	0.0	100.0
loggerhead shrike	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
Lincoln's sparrow	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
lark sparrow	0.00	0.35 (0.00 - 0.74)	27.6	0.0	0.0	100.0
lark bunting	0.00	0.24 (0.01 - 0.47)	100.0	0.0	0.0	100.0
house wren	0.00	0.02 (0.00 - 0.05)	0.0	0.0	0.0	0.0
house sparrow	0.00	0.38 (0.12 - 0.64)	62.5	0.0	0.0	100.0
horned lark	0.00	3.21 (2.57 - 3.85)	68.9	0.0	0.0	100.0
house finch	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
grasshopper sparrow	0.00	0.49 (0.33 - 0.65)	14.6	0.0	0.0	100.0
great horned owl	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
field sparrow	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
European starling	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0
Eurasian collared-dove	0.00	0.11 (0.04 - 0.18)	88.9	0.0	0.0	100.0
eastern meadowlark	0.00	0.05 (0.00 - 0.10)	0.0	0.0	0.0	0.0
dickcissel	0.00	2.45 (1.60 - 3.30)	50.0	0.0	0.0	100.0
dark-eyed junco	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
common grackle	0.00	1.11 (0.62 - 1.60)	94.6	0.0	0.0	100.0
cliff swallow	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
chipping sparrow	0.00	0.02 (0.00 - 0.06)	0.0	0.0	0.0	0.0
clay-colored sparrow	0.00	0.02 (0.00 - 0.05)	0.0	0.0	0.0	0.0
Bullock's oriole	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
brown thrasher	0.00	0.21 (0.09 - 0.33)	27.8	0.0	0.0	100.0
brown-headed cowbird	0.00	1.07 (0.51 - 1.63)	78.9	0.0	0.0	100.0
Baltimore oriole	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
American robin	0.00	0.07 (0.02 - 0.12)	50.0	0.0	0.0	100.0

Turbine B

Table 5b. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
American kestrel	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
American goldfinch	0.00	0.06 (0.00 - 0.12)	100.0	0.0	0.0	100.0
American crow	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0

¹These values assume a rotor diameter of 103 (m) and a hub height of 85 (m)

Turbine C

Table 5c. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase 1 .

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
sandhill crane	15.48	25.06 (0.00 - 65.99)	100.0	38.2	61.8	0.0
red-winged blackbird	0.54	18.73 (13.03 - 24.43)	96.8	0.0	3.0	97.0
Swainson's hawk	0.32	0.36 (0.00 - 0.75)	100.0	0.0	90.0	10.0
northern harrier	0.14	0.38 (0.24 - 0.52)	100.0	0.0	37.5	62.5
red-tailed hawk	0.04	0.11 (0.05 - 0.17)	55.6	0.0	60.0	40.0
turkey vulture	0.02	0.07 (0.00 - 0.15)	100.0	0.0	33.3	66.7
barn swallow	0.01	0.74 (0.44 - 1.04)	100.0	0.0	1.6	98.4
horned lark	0.01	3.21 (2.57 - 3.85)	68.9	0.0	0.5	99.5
killdeer	0.01	0.20 (0.12 - 0.28)	82.4	0.0	7.1	92.9
mallard	0.01	0.08 (0.02 - 0.14)	100.0	0.0	14.3	85.7
yellow warbler	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
western meadowlark	0.00	6.26 (5.42 - 7.10)	58.6	0.0	0.0	100.0
western kingbird	0.00	0.57 (0.32 - 0.82)	87.5	0.0	0.0	100.0
white-crowned sparrow	0.00	0.15 (0.00 - 0.30)	15.4	0.0	0.0	100.0
vesper sparrow	0.00	0.20 (0.03 - 0.37)	88.2	0.0	0.0	100.0
upland sandpiper	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
song sparrow	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
short-eared owl	0.00	0.05 (0.00 - 0.11)	100.0	0.0	0.0	100.0
savannah sparrow	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
Say's phoebe	0.00	0.08 (0.02 - 0.14)	71.4	0.0	0.0	100.0
ring-necked pheasant	0.00	1.94 (1.52 - 2.36)	6.1	0.0	0.0	100.0
rough-legged hawk	0.00	0.01 (0.00 - 0.03)	100.0	100.0	0.0	0.0
red-headed woodpecker	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
peregrine falcon	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
orchard oriole	0.00	0.18 (0.09 - 0.27)	60.0	0.0	0.0	100.0
northern rough-winged swallow	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
northern mockingbird	0.00	0.08 (0.02 - 0.14)	71.4	0.0	0.0	100.0

Turbine C

Table 5c. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase 1 .

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
northern flicker	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
northern bobwhite	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
mourning dove	0.00	5.52 (4.17 - 6.87)	81.5	0.0	0.0	100.0
loggerhead shrike	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
Lincoln's sparrow	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
lark sparrow	0.00	0.35 (0.00 - 0.74)	27.6	0.0	0.0	100.0
lark bunting	0.00	0.24 (0.01 - 0.47)	100.0	0.0	0.0	100.0
house wren	0.00	0.02 (0.00 - 0.05)	0.0	0.0	0.0	0.0
house sparrow	0.00	0.38 (0.12 - 0.64)	62.5	0.0	0.0	100.0
house finch	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
grasshopper sparrow	0.00	0.49 (0.33 - 0.65)	14.6	0.0	0.0	100.0
great horned owl	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
field sparrow	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
European starling	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0
Eurasian collared-dove	0.00	0.11 (0.04 - 0.18)	88.9	0.0	0.0	100.0
eastern meadowlark	0.00	0.05 (0.00 - 0.10)	0.0	0.0	0.0	0.0
dickcissel	0.00	2.45 (1.60 - 3.30)	50.0	0.0	0.0	100.0
dark-eyed junco	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
common grackle	0.00	1.11 (0.62 - 1.60)	94.6	0.0	0.0	100.0
cliff swallow	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
chipping sparrow	0.00	0.02 (0.00 - 0.06)	0.0	0.0	0.0	0.0
clay-colored sparrow	0.00	0.02 (0.00 - 0.05)	0.0	0.0	0.0	0.0
Bullock's oriole	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
brown thrasher	0.00	0.21 (0.09 - 0.33)	27.8	0.0	0.0	100.0
brown-headed cowbird	0.00	1.07 (0.51 - 1.63)	78.9	0.0	0.0	100.0
Baltimore oriole	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
American robin	0.00	0.07 (0.02 - 0.12)	50.0	0.0	0.0	100.0

Turbine C

Table 5c. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase 1 .

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
American kestrel	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
American goldfinch	0.00	0.06 (0.00 - 0.12)	100.0	0.0	0.0	100.0
American crow	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0

¹These values assume a rotor diameter of 108 (m) and a hub height of 80 (m)

Turbine A

Table 4a. Summary of avian flight heights¹ in relation to the turbine rotor swept area (RSA)² during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

	Birds	
	Number	Percentage
Non-raptors		
Above RSA height (>130.5m)	65	3.2%
At RSA height (29.5m–130.5m)	463	22.8%
Below RSA height (<29.5m)	1506	74.0%
Raptors		
Above RSA height (>130.5m)	5	1.6%
At RSA height (29.5m–130.5m)	186	61.2%
Below RSA height (<29.5m)	113	37.2%

¹ Includes only flying birds with flight height data

² These values assume a rotor diameter of 101 (m) and a hub height of 80 (m)

Turbine B

Table 4b. Summary of avian flight heights¹ in relation to the turbine rotor swept area (RSA)² during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

	Birds	
	Number	Percentage
Non-raptors		
Above RSA height (>136.5m)	65	3.2%
At RSA height (33.5m–136.5m)	323	15.9%
Below RSA height (<33.5m)	1646	80.9%
Raptors		
Above RSA height (>136.5m)	5	1.6%
At RSA height (33.5m–136.5m)	173	56.9%
Below RSA height (<33.5m)	126	41.4%

¹ Includes only flying birds with flight height data

² These values assume a rotor diameter of 103 (m) and a hub height of 85 (m)

Turbine C

Table 4c. Summary of avian flight heights¹ in relation to the turbine rotor swept area (RSA)² during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase 1 .

	Birds	
	Number	Percentage
Non-raptors		
Above RSA height (>134m)	65	3.2%
At RSA height (26m–134m)	463	22.8%
Below RSA height (<26m)	1506	74.0%
Raptors		
Above RSA height (>134m)	5	1.6%
At RSA height (26m–134m)	186	61.2%
Below RSA height (<26m)	113	37.2%

¹ Includes only flying birds with flight height data

² These values assume a rotor diameter of 108 (m) and a hub height of 80 (m)

Turbine A

Table 5a. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
Canada goose	2.49	2.49 (0.25 - 4.73)	100.0	0.0	100.0	0.0
Swainson's hawk	1.57	2.07 (0.00 - 4.51)	78.2	2.2	97.1	0.7
Lapland longspur	0.94	1.27 (0.32 - 2.22)	100.0	0.0	73.8	26.2
horned lark	0.91	2.79 (1.76 - 3.82)	94.0	0.0	34.5	65.5
American crow	0.46	0.51 (0.00 - 1.13)	93.0	0.0	97.5	2.5
cackling goose	0.37	0.37 (0.00 - 0.96)	100.0	0.0	100.0	0.0
red-tailed hawk	0.36	0.86 (0.67 - 1.05)	88.9	0.0	46.9	53.1
cliff swallow	0.24	0.68 (0.00 - 1.80)	100.0	0.0	35.1	64.9
northern harrier	0.13	0.90 (0.67 - 1.13)	98.7	0.0	14.7	85.3
turkey vulture	0.10	0.11 (0.03 - 0.19)	100.0	11.1	88.9	0.0
western meadowlark	0.05	3.98 (2.31 - 5.65)	88.0	0.0	1.4	98.6
chestnut-collared longspur	0.03	0.05 (0.00 - 0.11)	100.0	0.0	50.0	50.0
sharp-shinned hawk	0.02	0.06 (0.01 - 0.11)	100.0	20.0	40.0	40.0
mourning dove	0.01	1.64 (0.51 - 2.77)	91.3	0.0	0.8	99.2
barn swallow	0.01	0.21 (0.07 - 0.35)	100.0	0.0	5.6	94.4
golden eagle	0.01	0.01 (0.00 - 0.03)	100.0	0.0	100.0	0.0
ferruginous hawk	0.01	0.01 (0.00 - 0.03)	100.0	0.0	100.0	0.0
common nighthawk	0.01	0.01 (0.00 - 0.03)	100.0	0.0	100.0	0.0
Cooper's hawk	0.01	0.02 (0.00 - 0.05)	100.0	0.0	50.0	50.0
yellow-headed blackbird	0.00	0.06 (0.00 - 0.16)	0.0	0.0	0.0	0.0
Wilson's warbler	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
western kingbird	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0
white-crowned sparrow	0.00	0.06 (0.00 - 0.12)	100.0	0.0	0.0	100.0
vesper sparrow	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
unidentified sparrow	0.00	0.33 (0.00 - 0.68)	96.4	0.0	0.0	100.0
savannah sparrow	0.00	0.10 (0.00 - 0.21)	87.5	0.0	0.0	100.0
Say's phoebe	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0

Turbine A

Table 5a. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
sandhill crane	0.00	0.77 (0.00 - 2.04)	100.0	100.0	0.0	0.0
red-winged blackbird	0.00	6.74 (0.00 - 13.58)	98.4	0.0	0.0	100.0
ring-necked pheasant	0.00	1.08 (0.53 - 1.63)	42.9	0.0	0.0	100.0
rough-legged hawk	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
orange-crowned warbler	0.00	0.04 (0.00 - 0.08)	66.7	0.0	0.0	100.0
northern shrike	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
northern mockingbird	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
northern flicker	0.00	0.12 (0.02 - 0.22)	70.0	0.0	0.0	100.0
merlin	0.00	0.04 (0.01 - 0.07)	100.0	0.0	0.0	100.0
loggerhead shrike	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
lark sparrow	0.00	0.06 (0.00 - 0.16)	100.0	0.0	0.0	100.0
lark bunting	0.00	0.12 (0.00 - 0.26)	100.0	0.0	0.0	100.0
killdeer	0.00	0.10 (0.02 - 0.18)	62.5	0.0	0.0	100.0
house sparrow	0.00	0.06 (0.00 - 0.13)	100.0	0.0	0.0	100.0
house finch	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0
hairy woodpecker	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
great horned owl	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
European starling	0.00	0.89 (0.00 - 2.26)	94.7	0.0	0.0	100.0
Eurasian collared-dove	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
eastern kingbird	0.00	0.04 (0.00 - 0.10)	100.0	0.0	0.0	100.0
downy woodpecker	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
dickcissel	0.00	0.02 (0.00 - 0.06)	0.0	0.0	0.0	0.0
dark-eyed junco	0.00	0.12 (0.00 - 0.26)	100.0	0.0	0.0	100.0
chipping sparrow	0.00	0.07 (0.00 - 0.17)	100.0	0.0	0.0	100.0
clay-colored sparrow	0.00	0.12 (0.00 - 0.32)	100.0	0.0	0.0	100.0
blue jay	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
brown-headed cowbird	0.00	0.69 (0.00 - 1.59)	100.0	0.0	0.0	100.0

Turbine A

Table 5a. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
American tree sparrow	0.00	0.26 (0.00 - 0.57)	100.0	0.0	0.0	100.0
American pipit	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
American kestrel	0.00	0.10 (0.05 - 0.15)	75.0	0.0	0.0	100.0
American goldfinch	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0

¹These values assume a rotor diameter of 101 (m) and a hub height of 80 (m)

Turbine B

Table 5b. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
Canada goose	2.49	2.49 (0.25 - 4.73)	100.0	0.0	100.0	0.0
Swainson's hawk	1.57	2.07 (0.00 - 4.51)	78.2	2.2	97.1	0.7
Lapland longspur	0.47	1.27 (0.32 - 2.22)	100.0	0.0	37.4	62.6
horned lark	0.42	2.79 (1.76 - 3.82)	94.0	0.0	15.9	84.1
cackling goose	0.37	0.37 (0.00 - 0.96)	100.0	0.0	100.0	0.0
red-tailed hawk	0.25	0.86 (0.67 - 1.05)	88.9	0.0	32.8	67.2
northern harrier	0.11	0.90 (0.67 - 1.13)	98.7	0.0	12.0	88.0
turkey vulture	0.10	0.11 (0.03 - 0.19)	100.0	11.1	88.9	0.0
American crow	0.08	0.51 (0.00 - 1.13)	93.0	0.0	17.5	82.5
sharp-shinned hawk	0.01	0.06 (0.01 - 0.11)	100.0	20.0	20.0	60.0
barn swallow	0.01	0.21 (0.07 - 0.35)	100.0	0.0	5.6	94.4
golden eagle	0.01	0.01 (0.00 - 0.03)	100.0	0.0	100.0	0.0
ferruginous hawk	0.01	0.01 (0.00 - 0.03)	100.0	0.0	100.0	0.0
yellow-headed blackbird	0.00	0.06 (0.00 - 0.16)	0.0	0.0	0.0	0.0
Wilson's warbler	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
western meadowlark	0.00	3.98 (2.31 - 5.65)	88.0	0.0	0.0	100.0
western kingbird	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0
white-crowned sparrow	0.00	0.06 (0.00 - 0.12)	100.0	0.0	0.0	100.0
vesper sparrow	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
unidentified sparrow	0.00	0.33 (0.00 - 0.68)	96.4	0.0	0.0	100.0
savannah sparrow	0.00	0.10 (0.00 - 0.21)	87.5	0.0	0.0	100.0
Say's phoebe	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
sandhill crane	0.00	0.77 (0.00 - 2.04)	100.0	100.0	0.0	0.0
red-winged blackbird	0.00	6.74 (0.00 - 13.58)	98.4	0.0	0.0	100.0
ring-necked pheasant	0.00	1.08 (0.53 - 1.63)	42.9	0.0	0.0	100.0
rough-legged hawk	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
orange-crowned warbler	0.00	0.04 (0.00 - 0.08)	66.7	0.0	0.0	100.0

Turbine B

Table 5b. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
northern shrike	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
northern mockingbird	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
northern flicker	0.00	0.12 (0.02 - 0.22)	70.0	0.0	0.0	100.0
mourning dove	0.00	1.64 (0.51 - 2.77)	91.3	0.0	0.0	100.0
merlin	0.00	0.04 (0.01 - 0.07)	100.0	0.0	0.0	100.0
loggerhead shrike	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
lark sparrow	0.00	0.06 (0.00 - 0.16)	100.0	0.0	0.0	100.0
lark bunting	0.00	0.12 (0.00 - 0.26)	100.0	0.0	0.0	100.0
killdeer	0.00	0.10 (0.02 - 0.18)	62.5	0.0	0.0	100.0
house sparrow	0.00	0.06 (0.00 - 0.13)	100.0	0.0	0.0	100.0
house finch	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0
hairy woodpecker	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
great horned owl	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
European starling	0.00	0.89 (0.00 - 2.26)	94.7	0.0	0.0	100.0
Eurasian collared-dove	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
eastern kingbird	0.00	0.04 (0.00 - 0.10)	100.0	0.0	0.0	100.0
downy woodpecker	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
dickcissel	0.00	0.02 (0.00 - 0.06)	0.0	0.0	0.0	0.0
dark-eyed junco	0.00	0.12 (0.00 - 0.26)	100.0	0.0	0.0	100.0
common nighthawk	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
Cooper's hawk	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
cliff swallow	0.00	0.68 (0.00 - 1.80)	100.0	0.0	0.0	100.0
chipping sparrow	0.00	0.07 (0.00 - 0.17)	100.0	0.0	0.0	100.0
clay-colored sparrow	0.00	0.12 (0.00 - 0.32)	100.0	0.0	0.0	100.0
chestnut-collared longspur	0.00	0.05 (0.00 - 0.11)	100.0	0.0	0.0	100.0
blue jay	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
brown-headed cowbird	0.00	0.69 (0.00 - 1.59)	100.0	0.0	0.0	100.0

Turbine B

Table 5b. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
American tree sparrow	0.00	0.26 (0.00 - 0.57)	100.0	0.0	0.0	100.0
American pipit	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
American kestrel	0.00	0.10 (0.05 - 0.15)	75.0	0.0	0.0	100.0
American goldfinch	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0

¹These values assume a rotor diameter of 103 (m) and a hub height of 85 (m)

Turbine C

Table 5c. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase 1 .

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
Canada goose	2.49	2.49 (0.25 - 4.73)	100.0	0.0	100.0	0.0
Swainson's hawk	1.57	2.07 (0.00 - 4.51)	78.2	2.2	97.1	0.7
Lapland longspur	0.94	1.27 (0.32 - 2.22)	100.0	0.0	73.8	26.2
horned lark	0.91	2.79 (1.76 - 3.82)	94.0	0.0	34.5	65.5
American crow	0.46	0.51 (0.00 - 1.13)	93.0	0.0	97.5	2.5
cackling goose	0.37	0.37 (0.00 - 0.96)	100.0	0.0	100.0	0.0
red-tailed hawk	0.36	0.86 (0.67 - 1.05)	88.9	0.0	46.9	53.1
cliff swallow	0.24	0.68 (0.00 - 1.80)	100.0	0.0	35.1	64.9
northern harrier	0.13	0.90 (0.67 - 1.13)	98.7	0.0	14.7	85.3
turkey vulture	0.10	0.11 (0.03 - 0.19)	100.0	11.1	88.9	0.0
western meadowlark	0.05	3.98 (2.31 - 5.65)	88.0	0.0	1.4	98.6
chestnut-collared longspur	0.03	0.05 (0.00 - 0.11)	100.0	0.0	50.0	50.0
sharp-shinned hawk	0.02	0.06 (0.01 - 0.11)	100.0	20.0	40.0	40.0
mourning dove	0.01	1.64 (0.51 - 2.77)	91.3	0.0	0.8	99.2
barn swallow	0.01	0.21 (0.07 - 0.35)	100.0	0.0	5.6	94.4
golden eagle	0.01	0.01 (0.00 - 0.03)	100.0	0.0	100.0	0.0
ferruginous hawk	0.01	0.01 (0.00 - 0.03)	100.0	0.0	100.0	0.0
common nighthawk	0.01	0.01 (0.00 - 0.03)	100.0	0.0	100.0	0.0
Cooper's hawk	0.01	0.02 (0.00 - 0.05)	100.0	0.0	50.0	50.0
yellow-headed blackbird	0.00	0.06 (0.00 - 0.16)	0.0	0.0	0.0	0.0
Wilson's warbler	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
western kingbird	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0
white-crowned sparrow	0.00	0.06 (0.00 - 0.12)	100.0	0.0	0.0	100.0
vesper sparrow	0.00	0.02 (0.00 - 0.05)	100.0	0.0	0.0	100.0
unidentified sparrow	0.00	0.33 (0.00 - 0.68)	96.4	0.0	0.0	100.0
savannah sparrow	0.00	0.10 (0.00 - 0.21)	87.5	0.0	0.0	100.0
Say's phoebe	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0

Turbine C

Table 5c. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase 1 .

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
sandhill crane	0.00	0.77 (0.00 - 2.04)	100.0	100.0	0.0	0.0
red-winged blackbird	0.00	6.74 (0.00 - 13.58)	98.4	0.0	0.0	100.0
ring-necked pheasant	0.00	1.08 (0.53 - 1.63)	42.9	0.0	0.0	100.0
rough-legged hawk	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
orange-crowned warbler	0.00	0.04 (0.00 - 0.08)	66.7	0.0	0.0	100.0
northern shrike	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
northern mockingbird	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
northern flicker	0.00	0.12 (0.02 - 0.22)	70.0	0.0	0.0	100.0
merlin	0.00	0.04 (0.01 - 0.07)	100.0	0.0	0.0	100.0
loggerhead shrike	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
lark sparrow	0.00	0.06 (0.00 - 0.16)	100.0	0.0	0.0	100.0
lark bunting	0.00	0.12 (0.00 - 0.26)	100.0	0.0	0.0	100.0
killdeer	0.00	0.10 (0.02 - 0.18)	62.5	0.0	0.0	100.0
house sparrow	0.00	0.06 (0.00 - 0.13)	100.0	0.0	0.0	100.0
house finch	0.00	0.02 (0.00 - 0.06)	100.0	0.0	0.0	100.0
hairy woodpecker	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
great horned owl	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
European starling	0.00	0.89 (0.00 - 2.26)	94.7	0.0	0.0	100.0
Eurasian collared-dove	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
eastern kingbird	0.00	0.04 (0.00 - 0.10)	100.0	0.0	0.0	100.0
downy woodpecker	0.00	0.01 (0.00 - 0.03)	0.0	0.0	0.0	0.0
dickcissel	0.00	0.02 (0.00 - 0.06)	0.0	0.0	0.0	0.0
dark-eyed junco	0.00	0.12 (0.00 - 0.26)	100.0	0.0	0.0	100.0
chipping sparrow	0.00	0.07 (0.00 - 0.17)	100.0	0.0	0.0	100.0
clay-colored sparrow	0.00	0.12 (0.00 - 0.32)	100.0	0.0	0.0	100.0
blue jay	0.00	0.02 (0.00 - 0.05)	50.0	0.0	0.0	100.0
brown-headed cowbird	0.00	0.69 (0.00 - 1.59)	100.0	0.0	0.0	100.0

Turbine C

Table 5c. Avian flight height characteristics in relation to the turbine rotor swept area (RSA)¹ during Fall 2010 point count surveys at the Cimarron Wind Energy Project-Phase 1 .

Species	Encounter Rate	Mean Use # birds/ 20 min. (90% confidence interval)	Percent Flying	Percent Above RSA Height	Percent At RSA Height	Percent Below RSA Height
American tree sparrow	0.00	0.26 (0.00 - 0.57)	100.0	0.0	0.0	100.0
American pipit	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0
American kestrel	0.00	0.10 (0.05 - 0.15)	75.0	0.0	0.0	100.0
American goldfinch	0.00	0.01 (0.00 - 0.03)	100.0	0.0	0.0	100.0

¹These values assume a rotor diameter of 108 (m) and a hub height of 80 (m)