2010 Spring Avian Survey

Cimarron Wind Energy Project – Phase I
Gray County, Kansas

Prepared for

CPV Cimarron Renewable Energy Company, LLC

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TETRA TECH EC, INC.

EXECUTIVE SUMMARY

Tetra Tech EC, Inc. (Tetra Tech) was contracted by CPV Cimarron Renewable Energy, LLC (CPV) to undertake spring avian use surveys for the proposed Cimarron Wind Energy Project – Phase I (the Project) in Gray County, Kansas. The studies were conducted to identify potential avian impacts associated with building and operating the Project. Birds have been identified as a group potentially at risk because of collisions with wind turbines and power lines and possible displacement due to the presence of the associated structures. Weekly surveys were performed within the Project Area from March 23 to June 21, 2010 which included the spring through early summer seasons. Fixed point count surveys (800-meter [m] radius) were conducted at 6 points distributed throughout the Project Area.

A total of 5,963 birds from 57 species were observed within the Project Area. Overall mean bird use within the Project Area was 70.99 birds/20 minutes (min) and ranged from 3 to 2,106 birds/20 min.

Songbirds had the highest mean use out of all species groups observed (37.00 birds/20 min). The songbirds with the highest mean use were the red-winged blackbird (18.73 birds/20 min) and western meadowlark (6.26 birds/20 min). Both species had low encounter rates (0.54 birds flying at the rotor swept area [RSA] height/20 min and 0.0 birds flying at RSA height/20 min). The red-winged blackbird and western meadowlark are widespread species and have relatively stable populations; as a result, local mortality, should it occur, is unlikely to have population-level consequences.

Cranes/rails were the group with the second highest mean use (25.06 birds/20 min). The species with the highest overall mean use and the only species in the crane/rail group was the sandhill crane. The sandhill crane had the highest encounter rate (15.48 birds flying at RSA height/20 min) and all were observed in flight heading north over the Project Area. Although large numbers of sandhill cranes were observed within the Project Area on a single day, no sandhill crane fatality has been reported at wind energy facilities. Should fatalities occur, the central North American sandhill crane population is large and appears to be stable; therefore, any fatalities at the Project are not expected to have population-level impacts.

Northern harrier and Swainson's hawk had the highest mean use among raptors (0.38 and 0.36 birds/20 min, respectively), but this level of use was generally low. Despite nesting within the Project Area, Swainson's hawk, great-horned owl, and red-tailed hawk had low encounter rates within the Project Area implying a low likelihood of turbine collisions. Given the number of raptor nests in the Project Area the risk of turbine-related fatalities may increase for nesting raptor species (Swainson's hawk, red-tailed hawk, and great-horned owl) in late spring to early fall as the young begin to fledge from the nests. Additionally, construction and maintenance of the Project could lead to disturbance of nesting raptors within the Project Area. Disturbance of nesting raptors can result in complete desertion of nest, eggs, or young. All of the species listed above are protected by the Migratory Bird Treaty Act (MBTA).

Listed and Sensitive Species

No federally or state-listed endangered or threatened species were observed in the Project Area. Four lesser prairie-chicken leks were found approximately two miles to the northeast of the Project. Currently, the United States Fish and Wildlife Service (USFWS) lists lesser prairie-chicken as a candidate species for listing as threatened. Recent petitions have had the listing advanced to imminent and a final ruling on the status could be issued within the year. Additionally, the Kansas Ornithological Society along with six chapters of the National Audubon Society in Kansas petitioned Kansas Department of Wildlife and Parks (KDWP) requesting the department to consider an emergency listing of the lesser prairie-chicken as a state threatened species. A ruling is still pending. Currently, lesser prairie-chicken is still considered a game species by KDWP and is not protected by the MBTA. The USFWS' Voluntary Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines state that turbines should be placed a set distance from any active lesser prairie-chicken leks. Should the lesser prairie-chicken become listed, new regulatory guidelines could be enacted that may restrict the development of the Project near active leks.

Table ES-1. Spring Avian Use Summary

Variable	Result	Details
Non-raptors		
Mean use	69.96 birds/20 min	
Number of species with high encounter rates (>2.0 birds at RSA height/20 min)	1	Sandhill crane
Federally listed[1] species observed within the Project Area	No	
State-listed species[2] within the Project Area	No	
Grouse leks observed within the Project Area	No	
Grouse leks observed within 2 miles of the Project Area	Yes	Lesser prairie-chicken
Raptors		
Mean use	1.02 birds/20 min	
Number of species with high encounter rates (>2.0 birds at RSA height/20 min)	None	
Federally listed species observed within the Project Area	No	
State-listed species within the Project Area	No	
Habitat		
Native habitat likely to be affected by development	Yes	Native prairie
Lakes (waterfowl attractant)	Yes	Playas
Wetlands (attractant for cranes, waterfowl, and other water-based species)	Yes	Scattered throughout
Cliffs (raptor nesting and traveling)	No	
River (permanent water source, migration corridor)	No	
Known refuges or habitat features that may funnel migrants	No	

[1]Federally listed species include species listed as endangered, threatened, or candidate species in the Endangered Species Act.

[2] State-listed species are protected Under the Kansas Nongame and Endangered Species Conservation Act of 1975.

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1.0 INTRODUCTION

1.1 Wind Energy and Birds

Wind energy provides a clean, renewable energy source that is in high demand. As wind power has become more common, the need to address potential environmental impacts has increased. Birds have been identified as a group potentially at risk because of collisions with wind turbines and power lines and possible displacement due to the presence of the associated structures (Erickson et al. 2005, Drewitt and Langston 2006, Arnett et al. 2007). Specifically, migrant passerines (e.g., songbirds) are found more often in post-construction mortality monitoring compared to other groups of birds (Arnett et al. 2007). In fact, at newer generation wind energy facilities outside of California, approximately 80 percent of documented fatalities have been songbirds, of which 50 percent are often nocturnal migrants (Erickson et al. 2001, Drewitt and Langston 2006, Johnson et al. 2007, Strickland and Morrison 2008). Data suggest that less than 0.01 percent of migrant songbirds that pass over wind farms are killed based on radar data and mortality monitoring (Erickson 2007). Locally breeding songbirds may experience lower mortality rates than migrants because many of these species tend not fly at turbine heights during the breeding season. However, some breeding songbird species have behaviors that increase the risk of collisions with turbines. For example, horned larks have been commonly found as fatalities at wind farms (Erickson et al. 2002). Mortality may be partially attributed to the flight displays in which male horned lark fly to heights of 80 meters (m) to 250 m (Pickwell 1931).

Despite the observation that most wind farm fatalities are songbirds, raptor mortality historically has received the most attention. Raptor mortality at newer generation wind projects has been low relative to previous generation wind farms, possibly due to taller and fewer turbines on the landscape and slower rate of speed that the blades turn, although there is substantial regional variation (Erickson et al. 2002, 2004, Johnson et al. 2002, Kerns and Kerlinger 2004, Jain et al. 2007). Although raptor mortality is reduced at newer generation facilities, mortality may not be eliminated by advances in turbine technology (e.g., turbine height, tower structure) and local micro-siting and site evaluation efforts are still necessary.

In addition to mortality associated with wind farms, concerns have been raised that some bird species may avoid areas near turbines after the wind farm is in operation (Drewitt and Langston 2006). For example, at the Buffalo Ridge wind energy facility in Minnesota, densities of male songbirds were significantly lower in Conservation Reserve Program (CRP) grasslands containing turbines than in CRP grasslands without turbines. It was suggested that the reduced density may be due 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). Reduced abundance of grassland songbirds was found within 50 m of a turbine pad for a wind farm in Washington and Oregon, but the investigators attributed displacement to the direct loss of habitat or reduced habitat quality and not the presence of the turbines (Erickson et al. 2004). Recent research at two sites in North and South Dakota suggests that certain

grassland songbird species (2 of 4 studied) may avoid turbines by as much as 200 m (Shaffer and Johnson 2008) but these results have not been finalized nor verified at additional sites. None of these studies have addressed whether or not these avoidance effects are temporary (i.e., the birds may habituate to the presence of turbines over time) or permanent.

Particular concern over avoidance issues has been raised with respect to grouse species. Research studies are underway to evaluate the effects of wind energy development on lesser prairie-chickens, greater prairie-chickens, and greater sage-grouse. However, data from these studies has yet to be published. Conversely, several studies regarding the effects of other anthropogenic structures such as roads and buildings on grouse have been published (Pitman et al. 2005, Atamian et al. 2007, Lammers and Callopy 2007, Pruett et al. 2009).

Finally, most native birds are protected under the Migratory Bird Treaty Act (MBTA) of 1918. Under the MBTA it is unlawful to pursue, hunt, take, capture or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver or cause to be shipped, exported, imported, transported, carried or received any migratory bird, part, nest, egg or product. Despite extensive liability provisions, the United States Fish and Wildlife Service (USFWS) have narrowly interpreted its permitting authority. "As currently written, USFWS's regulations establish a permitting scheme for a variety of intentional activities, such as hunting, falconry, certain import and export activities, depredation control, and scientific research. But…there is no permitting scheme for the incidental take of migratory birds during otherwise lawful activities" (Beveridge 2005). There is no permitting framework (i.e., incidental take permits) that allows a wind company to protect itself from liability at wind facilities; however, the USFWS does not usually take action if good faith efforts have been made to minimize impacts. To date, no wind development company has been charged for violations of the MBTA.

1.2 Study Description

CPV Cimarron Renewable Energy Company, LLC (CPV) is developing a wind energy conversion facility in southwestern Kansas in Gray County (Figure 1). The Cimarron Wind Energy Project – Phase I (the Project) is located on rural private lands under easement with CPV in Foote Township, an unincorporated portion of Gray County. CPV is committed to environmental due diligence and has contracted Tetra Tech EC, Inc. (Tetra Tech) to conduct spring avian surveys at the Project to quantify local avian use in the area and to identify potential avian impacts associated with building and/or operating the Project.

The Project Area is 13,097 acres and is located in the Western High Plains Ecoregion. The Western High Plains is comprised of smooth to slightly irregular plains having a high percentage of cropland. *Grama* type buffalo grasses are the dominant natural vegetation in this region. Land use is predominantly dry-land farming of winter wheat, corn and sunflowers interspersed with cattle grazing. Playa wetlands of various sizes are scattered throughout the region and the Project Area. Only a few streams are present in the region,

including Buckner Creek, an intermittent stream that passes through the eastern portion of the Project Area.

Kansas has 469 documented bird species (KOS 2009) that are still known to occur in the state and is situated within the Central Flyway, one of the main bird migratory routes (USFWS 2008). The Central Flyway runs through the central portion of the United States and, as a consequence, the Project Area. In the spring, most birds travel northward from wintering grounds from as far away as Central and South America via the central plain states in the United States to their breeding grounds in northern North America (USFWS 2008).

2.0 METHODS

To evaluate avian risk at wind energy facilities, standardized protocols for pre-construction point counts have been established and were used in this study. This protocol is designed to be responsive to the level of effort recommended in the National Wind Coordinating Committee (NWCC) Guidance Document and the USFWS Interim Guidelines. Data collected from these counts are used to identify species or species groups that may be at risk from Project development and may provide additional information for micro-siting wind facilities to minimize impacts to birds. Results in this report are presented in terms of species groups, and highlight federal and state-listed species, and species of concern.

2.1 Avian Surveys

2.1.1 Fixed-point Surveys

An experienced field biologist conducted 20-minute (min) point count surveys at 6 locations within the Project Area to evaluate avian use, behavior, and species composition during spring migration (Figure 2). The biologist conducted weekly surveys from March 23 to June 21 (Table 1), thereby encompassing the spring migration to early summer breeding seasons. Tetra Tech distributed the survey locations throughout the Project Area and chose locations that maximized the 360-degree sight distance for the observer and covered a diversity of habitats.

The biologist collected data on all birds observed within an 800-m radius of the point count location. Surveys at each point lasted for 20 min, during which time biologist continuously recorded any visual or auditory observations. The biologist recorded the following data: species, number of birds, time of observation, height aboveground, behavior, and flight directions (for those birds making non-localized flights). Data on flight direction can be found in Appendix 1. The biologist calibrated flight heights and distances with a laser rangefinder and used local transmission line poles and topographic maps as additional references.

The survey protocol used in this study is designed to collect data on all bird species and to provide results that are comparable with other studies at wind farms rather than to target specific taxa. The benefit of using this protocol is that it estimates avian use throughout the day and captures activity by a variety of bird species. During the breeding

season, and to a lesser extent in the fall and winter, songbirds are most active in the morning and can be difficult to detect during the afternoon. In contrast, raptors become active as the sunlight heats the air and creates thermals, which individuals use for soaring (Ballam 1984). Thus, raptors are more readily detected several hours after sunrise. Therefore, this protocol is appropriate for characterizing the bird community using the Project during this time of year.

Tetra Tech chose 20-min survey periods because they provide adequate time to detect both raptors and non-raptors. However, time periods of 20 min may lead to double-counting of songbirds (i.e., counting the same individual more than once) because individuals may appear and disappear from view. For example, if a horned lark is detected perched on a fence then disappears from view and, 6 min later, a horned lark is seen flying, these birds are recorded as separate observations because it is not possible to distinguish individuals. Double-counting of birds is not problematic for this type of survey because the objective is to document avian activity in terms of number of birds noted per 20-min survey, and not to quantify the number of distinct individual birds (i.e., determine population size) present in the Project Area.

Detectability varies among species and potentially not all individuals within the 800-m radius were counted. This variation in detectability results in an overestimate of mean use for conspicuous species and an underestimate of mean use for reclusive species (Thompson 2002). Birds not easily identifiable, such as those seen under low light conditions or small birds seen at a distance were identified to the lowest taxonomic level possible. Hence, unidentified birds are included in the results.

2.1.2 Raptor Nest Surveys

The purpose of raptor nest surveys is to estimate the number of active and inactive raptor nests in the Project Area. The biologist conducted the raptor nest survey across the Project Area before trees began to leaf out. This helps to improve the detection of raptor nests. Where possible, the biologist also surveyed over an approximately 1-mile buffer around the Project Area. Once a nest was located, the biologist returned during the raptor breeding season to collect data on species, location, and activity status. The activity status (i.e., active or inactive) was determined by the presence of an adult or young, active territory defense by an individual, or the presence of feathers, egg shells or droppings underneath the nest. In addition, the biologist determined the nest condition and substrate. The biologist visited nests a minimum of two times, once to determine the location of the nest and once to determine if the nest was active. This second check also allowed the biologist to detect late-nesting species, such as Swainson's hawks. Raptor nest surveys provide an estimate of the number and species of raptors that use stick nests in the area. A summary of the raptor nests monitored during the survey are in Appendix 2. Ground-nesting raptor species, such as northern harriers, were not surveyed.

2.1.3 Lek Location Surveys

The biologist conducted grouse lek surveys to identify areas of use by breeding prairie grouse in the Project Area and 2-mile buffer outside the Project Area boundary. The biologist conducted lek surveys between March 20 and April 20 using protocols recommended by the Kansas Department of Wildlife and Parks (KDWP) and

incorporating recommendations from the Lesser Prairie-Chicken Conservation Initiative (Davis et al. 2008). Lek surveys were conducted from approximately 40 min before sunrise to 9:00 a.m. in the morning, with additional areas surveyed at sunset. The biologist drove county roads through areas identified as potential lek habitat. Grouse lek habitat is classified as open, short-grass vegetation with minimal amounts of agriculture. When conducting lek surveys, the biologist stopped every mile and listened for a minimum of 3 min for vocalizations of displaying males. Locating leks using these methods assumes that on a calm morning, sharp-tailed grouse males may be heard at a distance of up to ¾ mile and prairie-chickens can be heard from up to one mile away (Davis et al. 2008). The biologist did not conduct listening stops when winds exceeded 12 miles per hour (mph) or if there was any type of precipitation. If a lek was located and visible, the biologist observed the lek for 10 min to count the number of males and females. If displaying grouse were heard, but the lek was not visible, the biologist attempted to pinpoint the location by driving county roads.

2.1.4 Incidental Observations

Incidental observations included observations that occurred 1) during travel between points, 2) before or after the official 20-min survey period, and 3) outside of the 800-m radius circular plot. The biologist recorded these observations on separate data sheets and these data were not used in the formal analysis; however, a summary of incidental birds is presented to provide additional information about species found in the local area.

2.1.5 Listed Species Information

The USFWS lists three bird species in Gray County, Kansas (whooping crane, piping plover, and interior least tern) as threatened or endangered under the Endangered Species Act (ESA; USFWS 2010). Listing under this act affords protection to these species and their habitat and directs the Department of Interior to develop recovery plans for each species. Information on species currently protected under the ESA can be found at: http://www.fws.gov/endangered/.

Kansas lists 59 wildlife species as endangered or threatened. State-listed endangered and threatened species in Kansas are protected by the Kansas Nongame and Endangered Species Conservation Act of 1975, which states that an action permit is required if any action is taken that will impact a state-listed threatened or endangered species (KSA 32-957-963) (KDWP 2010).

2.1.6 Data Quality Assurance/Quality Control

Tetra Tech implemented quality assurance and quality control measures during all stages of data collection, analysis, and report preparation. To ensure legibility and completeness of data sheets, each biologist reviewed, and clarified if needed, all data sheets before data entry into a Filemaker Pro™ relational database for data storage and analysis. Prior to analysis, an independent reviewer conducted a 100-percent quality review of the data entries. Any questions that arose at this time were directed toward and answered by the field biologist.

2.2 Analysis

2.2.1 Species Groupings

Tetra Tech considered two primary groups of interest: raptors and non-raptors. Tetra Tech defined raptors as vultures, hawks, eagles, falcons, and owls. As turkey vulture flight behavior is similar to raptors and as they are often included as raptors in other studies, Tetra Tech has included them with raptors for the purpose of our analyses. Non-raptors were defined as all other species groups.

2.2.2 Avian Use of the Project

Tetra Tech derived avian use (mean use) of the Project Area by calculating the average number of birds observed per 20-min (birds/20 min) survey at each point. Tetra Tech also calculated a measure of variability (90% confidence intervals) for all mean use values. To evaluate the diversity and composition of avian species using the Project Area further, Tetra Tech summarized the frequency of occurrence (percentage of surveys a species was observed) and percent composition (number of birds observed of a particular species divided by total number of birds observed). 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 whether high mean use is driven by a single event (e.g., a large flock of birds moving through the Project Area on migration). Because individual birds are not uniquely marked and identified, actual population size or abundance cannot be determined. One individual may be counted more than once during a survey period or across survey periods. Therefore, avian mean use does not equate to abundance.

2.2.3 Flight Behavior

Tetra Tech evaluated flight behavior by calculating the proportion of flying birds observed below, within, or above the height of the anticipated turbine rotor swept area (RSA). The turbine type currently being considered for the Project is the 2.3 megawatt (MW) Siemens SWT-2.3-101; therefore, an 80-m hub height and 101-m rotor diameter was used to calculate the RSA. With these specifications, the estimated RSA was between 29.5 and 130.5 m above ground. Tetra Tech considered a bird to have flown within the height of the anticipated RSA if any of its recorded heights fell within the upper or lower limits of the anticipated RSA.

2.2.4 Encounter Rate

To estimate the rate at which a species flew at the height of the anticipated RSA, Tetra Tech applied the following equation to every species observed in the Project:

$$Encounter\ Rate = A*P_f*P_t$$

A is the mean number of birds/20 min for a given species, P_f is the proportion of all activity observations for a given species that were flying; and P_t is the proportion flying observations that were at the height of a turbine RSA for a given species. The encounter rate provides information on the rate at which a species may move at a height that is consistent with the RSA of the proposed turbines. This information is an important component in evaluating risk of collisions; however, this number alone does not indicate

risk to a species. Species with a high encounter rate are at a higher risk of collision than species with a low encounter rate, but it does not mean that mortality is certain. Other factors such as turbine location or a species ability to detect turbine blades, flight maneuverability, and habitat selection also influence mortality (Orloff and Flannery 1992). Values are sensitive to large flocks of birds flying within the RSA; that is, a species will have a high encounter rate even if only seen a few times in large flying flocks. Encounter rate also does not account for migrating behavior of nocturnal migrants.

2.2.5 Mortality Risk

The relationship between pre-construction avian use and post-construction mortality is not yet completely defined due to a lack of pre- and post-construction data from sites with moderate to high use. Based on the available data, raptor fatality rates generally are low at most wind energy developments with exceptions demonstrated at certain facilities in California with a predominance of older generation turbines (NWCC 2010). The highly regional nature of avian mean use across North America and the scarce data on avian mortality at wind farms in many parts of the continent contribute to uncertainty in predicting fatality rates (Arnett et al. 2007). To date, the most comprehensive source of regional information on avian fatality rates is the Avian and Bat Fact Sheet, which shows that estimated fatalities range from 14 birds per MW per year (birds/MW/year) in Tennessee to 0 birds/MW/year in Oklahoma (NWCC 2010). As a result of uncertainty in predicting fatality rates, Tetra Tech did not attempt to derive mortality estimates from mean use data but will highlight those species or groups that may experience mortality or displacement that could significantly affect local or regional populations, based on the data provided in this report and other information sources.

3.0 RESULTS

3.1 Avian Use and Frequency of Occurrence

The biologist surveyed 2,979 acres during point count surveys, covering 23 percent of the Project Area. The 6 point count locations were surveyed 14 times, resulting in 84 20-min surveys. A total 5,963 birds from 57 species were observed within the Project Area during the 84 fixed-point count surveys (Table 2). Overall mean bird use within the Project Area was 70.99 birds/20 min and ranged from 3 to 2,106 birds/20 min.

Overall mean use by non-raptors was 69.96 birds/20 min and, among species groups, mean use was highest for songbirds (37.00 birds/20 min; Table 2); songbirds were observed in the majority of surveys and were widely distributed throughout the Project Area. The songbirds with the highest mean use were the red-winged blackbird (18.73 birds/20 min, observed in 75% of all surveys) and western meadowlark (6.26 birds/20 min; 97.6%). Another frequently observed species was the horned lark (3.21 birds/20 min, observed in 72.6% of all surveys; Table 2). Each other songbird species had a mean use of fewer than 3.0 birds/20 min and were detected in less than 30 percent of all surveys.

Cranes/rails were the group with the second highest mean use (25.06 birds/20 min; Table 2). The species with the highest mean use (and the only species in the crane/rail group) was the sandhill crane. Sandhill cranes were observed in only 2.4 percent of all surveys indicating that most of the sandhill cranes observed in the Project Area were in a few large flocks. Among the remaining species groups, pigeons/doves and gamebirds had the next highest mean use values of 5.63 birds/20 min and 1.95 birds/20 min, respectively (Table 2).

Non-raptor mean use was highest on March 23 (373.5 birds/20 min; Figure 3). The species that contributed to high mean use on March 23 was the sandhill crane (two large flocks of 1,300 and 790 birds observed at point 4). Mean use was also relatively high on April 14 (74.33 birds/20 min), May 25 (65.60 birds/20 min), June 14 (59 birds/20 min), and June 8 (58.85 birds/20 min). Mean use for non-raptors was highest at point 4 (225.64 birds/20 min) and observations at this point included the above mentioned sandhill cranes (2,090 birds; Table 3; Figure 4). All of the sandhill cranes observed were in flight heading in a northward direction and were not using the Project Area for foraging or roosting. The remaining survey points had mean use values of fewer than 54 birds/20 min (Figure 4).

Raptors are a group of special interest because of their propensity to fly at heights similar to a turbine RSA. Overall mean use for raptors was 1.02 birds/20 min (Table 2) and raptors were not among the most frequently observed species groups during the spring surveys. The raptor species with the highest use were northern harrier (0.38 birds/20 min; 25.0% of all surveys) and Swainson's hawk (0.36 birds/20 min; 11.9% of surveys). Mean use for each other raptor species was 0.11 birds/20 min or fewer: red-tailed hawk, turkey vulture, short-eared owl, American kestrel, rough-legged hawk, peregrine falcon, and great-horned owl.

Mean use by raptors was highest on April 7 (3.50 birds/20 min; Figure 5) and included 20 Swainson's hawks and 1 northern harrier. Mean use by raptors was lower than 1.85 birds/20 min for all other survey dates. Mean use by raptors was highest at point count locations 5 (2.36 birds/20 min) and 2 (1.79 birds/20 min; Figure 6). The majority of raptors observed at point 5 were Swainson's hawks (22 birds; Table 3) of which 20 were observed on April 7. During that day, at point 5, two farm tractors were tilling the nearby fields and the Swainson's hawks were observed hunting opportunistically behind the tractors either on the ground or in flight over the area. Most of the raptor observations at point 2 were of a pair of northern harriers. While a nest was never discovered, a recently fledged northern harrier was observed on the June 8 survey.

3.2 Flight Height and Encounter Rate

During spring avian use surveys, the biologist collected behavioral data for all of the birds observed during point count surveys. The biologist observed 85.7 percent of birds flying and collected flight height data for 99.9 percent of these birds. Of the birds observed flying, 42.1 percent made directional flights and the biologist collected flight direction for all of these birds (Appendix 1). Of non-raptors observed flying, 57.2 percent flew below the height of the anticipated RSA, 26.8 percent flew at the height of the

anticipated RSA, and 16.0 percent flew above the anticipated RSA (Table 4). Of raptors observed flying, 44.4 percent flew below the height of the anticipated RSA, 54.3 percent flew at the height of the anticipated RSA, and 1.2 percent flew above the anticipated RSA (Table 4).

The sandhill crane had the highest encounter rate (15.48 birds flying at RSA height/20 min, Table 5). All other species had encounter rates of fewer than 0.55 birds flying at RSA height/20 min.

3.3 Raptor Nest Surveys

Nine raptor nests of three species were found during the raptor nest surveys (Figure 7). Five red-tailed hawk, three great-horned owl, and one Swainson's hawk nests were identified and monitored on subsequent visits (Appendix 2). Only one red-tailed hawk nest was noted to be inactive. Nests were located in osage orange, hackberry, Siberian elm, red cedar, or cottonwood trees along windbreaks or around riparian corridors. Nest heights ranged from 5 m to 12 m.

3.4 Lek Surveys

Four active lesser prairie-chicken leks were found within the vicinity of the Project Area during the grouse lek surveys (Figure 8; Appendix 3). The lek sizes ranged from high counts of 11 to 30 birds with both males and females observed at sites 2 and 3. All four leks remained active throughout the survey period.

3.5 Incidental Observations

The biologist documented 37 species as incidental observations (Table 6), 25 of which were not observed during the point count surveys: American white pelican, green heron, American wigeon, blue-winged teal, green-winged teal, northern pintail, Cooper's hawk, lesser prairie-chicken, long-billed curlew, lesser yellowlegs, spotted sandpiper, stilt sandpiper, willet, white-rumped sandpiper, Wilson's phalarope, barn owl, burrowing owl, scissor-tailed flycatcher, chimney swift, yellow-rumped warbler, McCown's longspur, great-tailed grackle, yellow-headed blackbird, Baltimore oriole, and unidentified sapsucker. Additionally, the lesser prairie-chickens that were observed as incidental observations were in areas just outside of the Project Area and associated with the active leks to the northeast (Figure 8).

4.0 DISCUSSION AND RECOMMENDATIONS

4.1 Non-Raptor Use and Encounter Rate

Songbirds had the highest mean use out of all groups, a value largely driven by red-winged blackbird and western meadowlark. Red-winged blackbird had an encounter rate of 0.54 birds flying at RSA height/20 min, a value that is very low relative to publicly available data. Red-winged blackbird mortality has been documented at other wind energy facilities with publicly available data (Erickson et al. 2004 and Jain et al. 2007). However, the number of fatalities recorded from each of these studies was fewer than five birds. If fatalities do occur at the Project, they are unlikely to have population-level impacts because regional red-winged blackbird populations appear to be increasing

(Sauer et al. 2008). Furthermore, blackbirds and grackles in general are attracted to agricultural crops (corn, soybean, and sunflower) and are often targeted by agriculture industry as a nuisance species through take permits issued by the USFWS under the MBTA. All other songbirds, including the western meadowlark, had encounter rates of 0.01 or fewer birds flying at RSA height/20 min which is a very low risk for turbine related fatalities.

Cranes/rails had the second highest mean use among species groups, a value largely driven by large flocks of migratory sandhill cranes. Sandhill cranes had the highest encounter rate of all species (15.48 birds flying at RSA height/20 min). All the sandhill cranes were observed in flight and 61.8 percent of these observations were at RSA height (38.2% were above RSA height). Three separate observations (total of 2,105 birds) were made on one day (March 23). This coincides with the natural migration period of sandhill cranes that pass through Kansas during March and April heading north to breeding areas in Canada (Tacha et al. 1992). Generally, sandhill cranes tend to migrate at heights of fewer than 1,600 m with 75 percent observed migrating at heights between 150 m and 760 m (Tacha et al. 1992) generally putting migratory individuals above RSA height. Based on the flight height profile of the cranes observed in the Project Area suggests that the flock of about 1,300 birds had either recently taken off from a nearby location, or were searching for a place to land. Given the general lack of suitable wetlands within the Project Area, the former scenario (roosting outside of the Project Area) is more likely. The other group of 790 birds were in flight heading northward at 400 m to 800 m. The third flock (15 birds) was observed heading northward flying at 300 m in height. The combination of limited habitat availability with the observation that no sandhill crane fatality has been reported at wind energy facilities suggested a low potential for negative turbine interaction. In the unlikely event that fatalities occur, the central North American sandhill crane population is large (~650,000 individuals; International Crane Foundation 2010) and appears to be stable (Sauer et al. 2008); therefore, any fatalities at the Project are not expected to have population-level impacts.

4.2 Raptor Use and Encounter Rate

High raptor use has been associated with high raptor mortality at wind farms (Erickson 2007). Conversely, raptor mortality appears to be low when raptor use is low, as defined by Erickson (2007) as <1.0 birds/20 min. Overall raptor use at the Project was 1.02 birds/20 min, suggesting a low probability of negative interactions with turbines.

Northern harriers and Swainson's hawks were the most commonly observed raptor species during avian surveys. Although both species have been reported as fatalities at existing wind farms (Young et al. 2003 and Erickson et al. 2004), the very low encounter rates (0.14 and 0.32 birds flying at RSA height/20 min, respectively) observed in the Project Area suggest that the likelihood of turbine-related fatalities for northern harrier and red-tailed hawk at the Project is low.

Red-tailed hawk and great-horned owl were the most common raptor species nesting in the Project Area. The risk of turbine-related fatalities may increase for nesting raptors (red-tailed hawk, great-horned owl and Swainson's hawk) in late spring to early fall as

the young begin to fledge from the nests. Construction and maintenance of the Project could lead to disturbance of nesting raptors within the Project Area. Human activities are known to impact raptors in at least 3 ways: by causing mortality to eggs, young, or adults; by altering habitats; and by disrupting birds' normal behavior (Postovit and Postovit 1987). Disturbance of nesting raptors can result in complete desertion of the nest, eggs, and/or young. Even a temporary departure by adults can lead to exposure of eggs or young to the weather, increased predation risk on eggs or young, or missed feedings (Suter and Jones 1981).

The Project is likely to have minimal impacts on the other observed raptor species—turkey vulture, peregrine falcon, American kestrel, rough-legged hawk and short-eared owl—given their low mean use values and low encounter rates. Mean use by raptors was highest at point count locations 5 and 2. The observations at point 5 were greatly influenced by farming activities. Observations at point 2 were consistently of a pair of northern harriers. While the nest was never found, the pair was later confirmed by the biologist to have nested when a recently fledged northern harrier was observed during the June 8 count. Habitat at point 2 has a large grassland field and wheat fields and is not considered unique on the landscape and these data should not be used to guide turbine siting discussions.

4.3 Listed and Sensitive Species

The biologist did not detect any species listed as candidate, threatened or endangered under the federal ESA. Additionally, no state-listed species were observed. Caution should be used when using the KDWP website on listed species at it appears to be out of date. Most of the native species observed are protected by the MBTA. There is currently no permitting framework that allows a wind company to protect itself from liability at wind facilities. To date, no wind development company has been charged for violations of the MBTA.

4.4 Species of Interest

In July of 2009, the Kansas Ornithological Society along with six chapters of the National Audubon Society in Kansas petitioned KDWP requesting the department to consider an emergency listing of the lesser prairie-chicken as a state threatened species (KOS 2010). A ruling is still pending. Currently, lesser prairie chicken is still considered a game species by KDWP and is not protected by the MBTA. The distribution and populations of lesser prairie-chicken in Kansas appear to be decreasing (Sauer et al. 2008). Threats to the lesser prairie-chicken include land development and CRP lands being turned into agriculture which contribute to a loss in habitat. Much of southwest Kansas currently provides suitable habitat for lesser prairie-chickens (Hagen and Giesen 2005). A total of 4 lesser prairie-chicken lek locations have been recorded near the Project Area during the spring breeding season (Figure 8). Lek locations were concentrated to the northeast of the Project with the nearest lek being over 2 miles from the Project Area boundary. Currently the USFWS has designated the lesser prairie-chicken as a candidate species. The USFWS' Voluntary Interim Guidelines to Avoid and Minimize Wildlife Impacts from Wind Turbines state that turbines should be setback from any active lesser prairie-chicken leks (Manville 2004). Should the lesser prairie-

chicken become listed at either the state or federal level, new regulatory guidelines could be enacted that may restrict the development of the Project near active leks.

4.5 Project Conclusions

The point count surveys suggest that the Project Area is utilized by a wide number and diversity of bird species during the spring migratory period. However, the behavioral data (e.g., flight patterns) suggest that the probability of negative interactions between birds and turbines in the Project Area is generally low for most species. Spring non-raptor use was dominated by red-winged blackbirds, western meadowlarks and large migratory flocks of sandhill cranes (all observed on a single day). Sandhill cranes had the highest encounter rate. The regional central North American populations of sandhill cranes that migrate through Kansas have large, stable populations; therefore, if fatalities do occur they are unlikely to have population-level consequences. Nocturnal migrants (e.g., some songbirds) may pass through the Project Area and would not be detected by the survey methods used in this study if the birds did not stop-over within the Project Area. However, mortality of nocturnal migrants at the Project is not expected to have population-level implications because less than 0.01 percent of nocturnal migrants that fly through wind farms are killed (Erickson 2007).

Spring raptor use in the Project Area was low. The level of raptor use in the Project Area suggests that raptor mortality is anticipated to be low, especially based on the results by Erickson 2007. Northern harriers and Swainson's hawks were the most common raptor observed in the Project Area and fatalities of the species have occurred at wind farms (Young et al. 2003 and Erickson et al. 2004). However, the overall numbers and encounter rates of northern harriers and Swainson's hawks detected in the Project Area were low, thereby minimizing the probability of negative interactions with turbines.

Given the number of raptor nests in the Project Area the risk of turbine-related fatalities may increase for nesting raptor species (red-tailed hawk, great-horned owl and Swainson's hawk) in late spring to early fall as the young begin to fledge from the nests. Additionally, construction and maintenance of the Project could lead to disturbance of nesting raptors within the Project Area. Disturbance of nesting raptors can result in complete desertion of nest, eggs, or young.

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TABLES

Table 1. Spring 2010 point count survey dates at the Cimarron Wind Energy Project-Phase I.

Survey number	Date(s)
1	3/23
2	3/30
3	4/7
4	4/14
5	4/22
6	4/27
7	5/4
8	5/11
9	5/18
10	5/25
11	6/2
12	6/8
13	6/14
14	6/21

Table 2. Avian species, by species grouping, observed during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species Grouping	Overall Rank[1]	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)		Frequency % of surveys detected	Percent Composition	
							Group	Overall
Songbirds								
red-winged blackbird	2	1573	71	18.73	(13.03-24.43)	75.0	50.6%	26.4%
western meadowlark	3	526	103	6.26	(5.42-7.10)	97.6	16.9%	8.8%
horned lark	5	270	72	3.21	(2.57-3.85)	72.6	8.7%	4.5%
dickcissel	6	206	27	2.45	(1.60-3.30)	29.8	6.6%	3.5%
common grackle	8	93	28	1.11	(0.62-1.60)	26.2	3.0%	1.6%
brown-headed cowbird	9	90	32	1.07	(0.51-1.63)	31.0	2.9%	1.5%
barn swallow	10	62	24	0.74	(0.44-1.04)	23.8	2.0%	1.0%
western kingbird	11	48	23	0.57	(0.32-0.82)	23.8	1.5%	0.8%
grasshopper sparrow	12	41	29	0.49	(0.33-0.65)	29.8	1.3%	0.7%
house sparrow	13	32	10	0.38	(0.12-0.64)	11.9	1.0%	0.5%
lark sparrow	16	29	9	0.35	(0.00-0.74)	10.7	0.9%	0.5%
lark bunting	17	20	5	0.24	(0.01-0.47)	4.8	0.6%	0.3%
brown thrasher	18	18	16	0.21	(0.09-0.33)	14.3	0.6%	0.3%
vesper sparrow	19	17	7	0.20	(0.03-0.37)	8.3	0.5%	0.3%
orchard oriole	21	15	12	0.18	(0.09-0.27)	13.1	0.5%	0.3%
white-crowned sparrow	22	13	4	0.15	(0.00-0.30)	4.8	0.4%	0.2%
Say's phoebe	25	7	7	0.08	(0.02-0.14)	7.1	0.2%	0.1%
northern mockingbird	25	7	7	0.08	(0.02-0.14)	6.0	0.2%	0.1%
American robin	28	6	5	0.07	(0.02-0.12)	6.0	0.2%	0.1%
American goldfinch	30	5	3	0.06	(0.00-0.12)	3.6	0.2%	0.1%
eastern meadowlark	31	4	3	0.05	(0.00-0.10)	3.6	0.1%	0.1%
song sparrow	33	2	2	0.02	(0.00-0.05)	2.4	0.1%	0.0%
northern rough-winged swallow	33	2	2	0.02	(0.00-0.05)	2.4	0.1%	0.0%
loggerhead shrike	33	2	2	0.02	(0.00-0.05)	2.4	0.1%	0.0%
house wren	33	2	2	0.02	(0.00-0.05)	2.4	0.1%	0.0%
house finch	33	2	2	0.02	(0.00-0.05)	2.4	0.1%	0.0%

Table 2. Avian species, by species grouping, observed during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species Grouping	Overall Rank[1]	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)		Frequency % of surveys detected	Percent Composition	
							Group	Overall
European starling	33	2	1	0.02	(0.00-0.06)	1.2	0.1%	0.0%
chipping sparrow	33	2	1	0.02	(0.00-0.06)	1.2	0.1%	0.0%
clay-colored sparrow	33	2	2	0.02	(0.00-0.05)	2.4	0.1%	0.0%
American crow	33	2	1	0.02	(0.00-0.06)	1.2	0.1%	0.0%
yellow warbler	43	1	1	0.01	(0.00-0.03)	1.2	0.0%	0.0%
savannah sparrow	43	1	1	0.01	(0.00-0.03)	1.2	0.0%	0.0%
Lincoln's sparrow	43	1	1	0.01	(0.00-0.03)	1.2	0.0%	0.0%
field sparrow	43	1	1	0.01	(0.00-0.03)	1.2	0.0%	0.0%
dark-eyed junco	43	1	1	0.01	(0.00-0.03)	1.2	0.0%	0.0%
cliff swallow	43	1	1	0.01	(0.00-0.03)	1.2	0.0%	0.0%
Bullock's oriole	43	1	1	0.01	(0.00-0.03)	1.2	0.0%	0.0%
Baltimore oriole	43	1	1	0.01	(0.00-0.03)	1.2	0.0%	0.0%
Group Total		**3108**	**520**	**37.00**	(30.44-43.56)	**100.0**		**52.1%**
Cranes/Rails								
sandhill crane	1	2105	3	25.06	(0.00-65.99)	2.4	100.0%	35.3%
Group Total		**2105**	**3**	**25.06**	(0.00-65.99)	**2.4**		**35.3%**
Pigeons/Doves								
mourning dove	4	464	92	5.52	(4.17-6.87)	76.2	98.1%	7.8%
Eurasian collared-dove	23	9	7	0.11	(0.04-0.18)	7.1	1.9%	0.2%
Group Total		**473**	**99**	**5.63**	(4.26-7.00)	**76.2**		**7.9%**
Gamebirds								
ring-necked pheasant	7	163	78	1.94	(1.52-2.36)	71.4	99.4%	2.7%
northern bobwhite	43	1	1	0.01	(0.00-0.03)	1.2	0.6%	0.0%
Group Total		**164**	**79**	**1.95**	(1.53-2.37)	**71.4**		**2.8%**
Raptors								
northern harrier	13	32	25	0.38	(0.24-0.52)	25.0	37.2%	0.5%
Swainson's hawk	15	30	11	0.36	(0.00-0.75)	11.9	34.9%	0.5%

Table 2. Avian species, by species grouping, observed during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species Grouping	Overall Rank[1]	Number of Birds	Number of Observations	Mean Use # birds per 20 min. (90% confidence interval)		Frequency % of surveys detected	Percent Composition	
							Group	Overall
red-tailed hawk	23	9	9	0.11	(0.05-0.17)	10.7	10.5%	0.2%
turkey vulture	28	6	3	0.07	(0.00-0.15)	3.6	7.0%	0.1%
short-eared owl	31	4	2	0.05	(0.00-0.11)	2.4	4.7%	0.1%
American kestrel	33	2	2	0.02	(0.00-0.05)	2.4	2.3%	0.0%
rough-legged hawk	43	1	1	0.01	(0.00-0.03)	1.2	1.2%	0.0%
peregrine falcon	43	1	1	0.01	(0.00-0.03)	1.2	1.2%	0.0%
great horned owl	43	1	1	0.01	(0.00-0.03)	1.2	1.2%	0.0%
Group Total		**86**	**55**	**1.02**	(0.59-1.45)	**46.4**		**1.4%**
Waterbirds								
killdeer	19	17	16	0.20	(0.12-0.28)	17.9	94.4%	0.3%
upland sandpiper	43	1	1	0.01	(0.00-0.03)	1.2	5.6%	0.0%
Group Total		**18**	**17**	**0.21**	(0.13-0.29)	**19.0**		**0.3%**
Waterfowl								
mallard	25	7	6	0.08	(0.02-0.14)	7.1	100.0%	0.1%
Group Total		**7**	**6**	**0.08**	(0.02-0.14)	**7.1**		**0.1%**
Woodpeckers								
red-headed woodpecker	43	1	1	0.01	(0.00-0.03)	1.2	50.0%	0.0%
northern flicker	43	1	1	0.01	(0.00-0.03)	1.2	50.0%	0.0%
Group Total		**2**	**2**	**0.02**	(0.00-0.05)	**2.4**		**0.0%**
Grand Total		**5963**	**781**	**70.99**	(30.02-111.95)			

[1] A ranking of 1 indicates highest mean use

Table 3. Avian species observed by point during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Number of Birds	Number of Obs.	Points					
			1	2	3	4	5	6
sandhill crane	2105	3	0	15	0	2090	0	0
red-winged blackbird	1573	71	354	198	301	523	57	140
western meadowlark	526	103	91	67	94	115	82	77
mourning dove	464	92	141	50	71	136	32	34
horned lark	270	72	50	41	38	20	35	86
dickcissel	206	27	29	44	0	84	19	30
ring-necked pheasant	163	78	31	15	19	52	15	31
common grackle	93	28	11	0	52	28	2	0
brown-headed cowbird	90	32	11	3	27	17	19	13
barn swallow	62	24	5	0	2	6	45	4
western kingbird	48	23	9	1	14	9	14	1
grasshopper sparrow	41	29	1	14	0	2	4	20
northern harrier	32	25	3	21	1	1	2	4
house sparrow	32	10	1	0	1	5	25	0
Swainson's hawk	30	11	2	2	3	0	22	1
lark sparrow	29	9	0	0	3	21	5	0
lark bunting	20	5	0	0	0	10	0	10
brown thrasher	18	16	0	0	15	3	0	0
vesper sparrow	17	7	1	0	0	0	9	7
killdeer	17	16	6	1	2	3	2	3
orchard oriole	15	12	2	0	3	3	7	0
white-crowned sparrow	13	4	0	0	0	8	5	0
red-tailed hawk	9	9	1	1	3	0	4	0
Eurasian collared-dove	9	7	1	0	2	6	0	0
Say's phoebe	7	7	0	0	0	0	7	0
northern mockingbird	7	7	0	0	1	0	6	0
mallard	7	6	0	1	2	2	0	2
turkey vulture	6	3	0	1	0	1	4	0
American robin	6	5	0	0	0	6	0	0
American goldfinch	5	3	0	0	5	0	0	0
short-eared owl	4	2	0	0	0	4	0	0
eastern meadowlark	4	3	0	3	1	0	0	0
song sparrow	2	2	0	0	0	0	2	0
northern rough-winged swallow	2	2	0	0	0	0	1	1
loggerhead shrike	2	2	0	0	0	1	1	0
house wren	2	2	0	0	2	0	0	0
house finch	2	2	0	0	1	1	0	0
European starling	2	1	0	0	2	0	0	0
chipping sparrow	2	1	0	0	0	2	0	0
clay-colored sparrow	2	2	0	0	0	1	1	0

Table 3. Avian species observed by point during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Number of Birds	Number of Obs.	Points					
			1	2	3	4	5	6
American kestrel	2	2	1	0	0	1	0	0
American crow	2	1	0	0	0	2	0	0
yellow warbler	1	1	0	0	0	0	1	0
upland sandpiper	1	1	0	1	0	0	0	0
savannah sparrow	1	1	0	0	0	0	1	0
rough-legged hawk	1	1	0	0	0	1	0	0
red-headed woodpecker	1	1	0	0	0	0	1	0
peregrine falcon	1	1	0	0	1	0	0	0
northern flicker	1	1	0	0	0	1	0	0
northern bobwhite	1	1	0	0	0	1	0	0
Lincoln's sparrow	1	1	0	0	0	0	1	0
great horned owl	1	1	0	0	0	0	1	0
field sparrow	1	1	0	0	1	0	0	0
dark-eyed junco	1	1	0	0	0	1	0	0
cliff swallow	1	1	0	0	0	0	0	1
Bullock's oriole	1	1	0	0	1	0	0	0
Baltimore oriole	1	1	0	0	1	0	0	0
Grand Total	**5963**	**781**	**751**	**479**	**669**	**3167**	**432**	**465**

Table 4. Summary of avian flight heights[1] 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)

Table 5. 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

Table 5. 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 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
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

Table 5. 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
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
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

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

Table 6. Incidental observations of birds during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species
American crow
American wigeon
American white pelican
barn owl
Baltimore oriole
burrowing owl
blue-winged teal
chimney swift
Cooper's hawk
great horned owl
green heron
great-tailed grackle
green-winged teal
long-billed curlew
lesser prairie-chicken
lesser yellowlegs
loggerhead shrike
mallard
McCown's longspur
northern harrier
northern pintail
peregrine falcon
rough-legged hawk
red-tailed hawk
sandhill crane
short-eared owl
spotted sandpiper
scissor-tailed flycatcher
stilt sandpiper
Swainson's hawk
turkey vulture
unidentified sapsucker
willet
Wilson's phalarope
white-rumped sandpiper
yellow-headed blackbird
yellow-rumped warbler

FIGURES

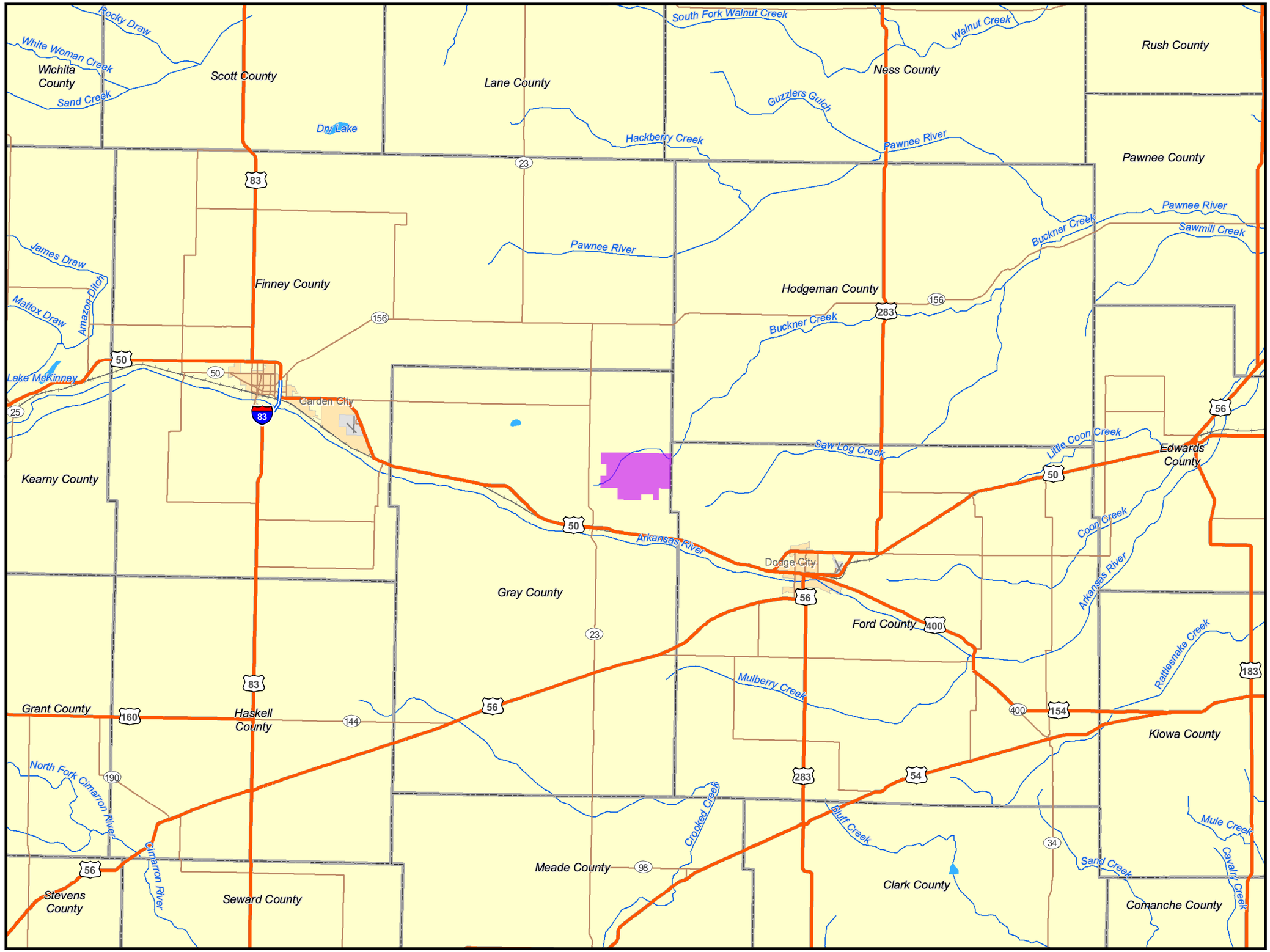

Figure 1

Vicinity map

Cimarron Wind Energy Project-Phase I

Gray County, KS

- Project Area (6-28-2010)
- County Boundary
- River/Stream
- Lake/Pond
- Interstate Highway
- Federal Highway
- State Highway

N W E S

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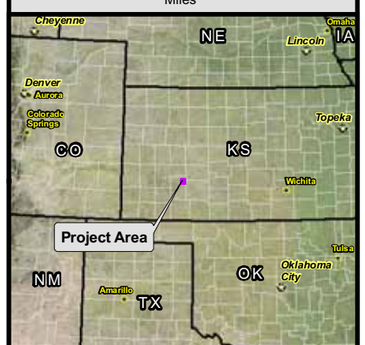
NAD 1983 UTM 14

0 2 4 6 8 10

Miles



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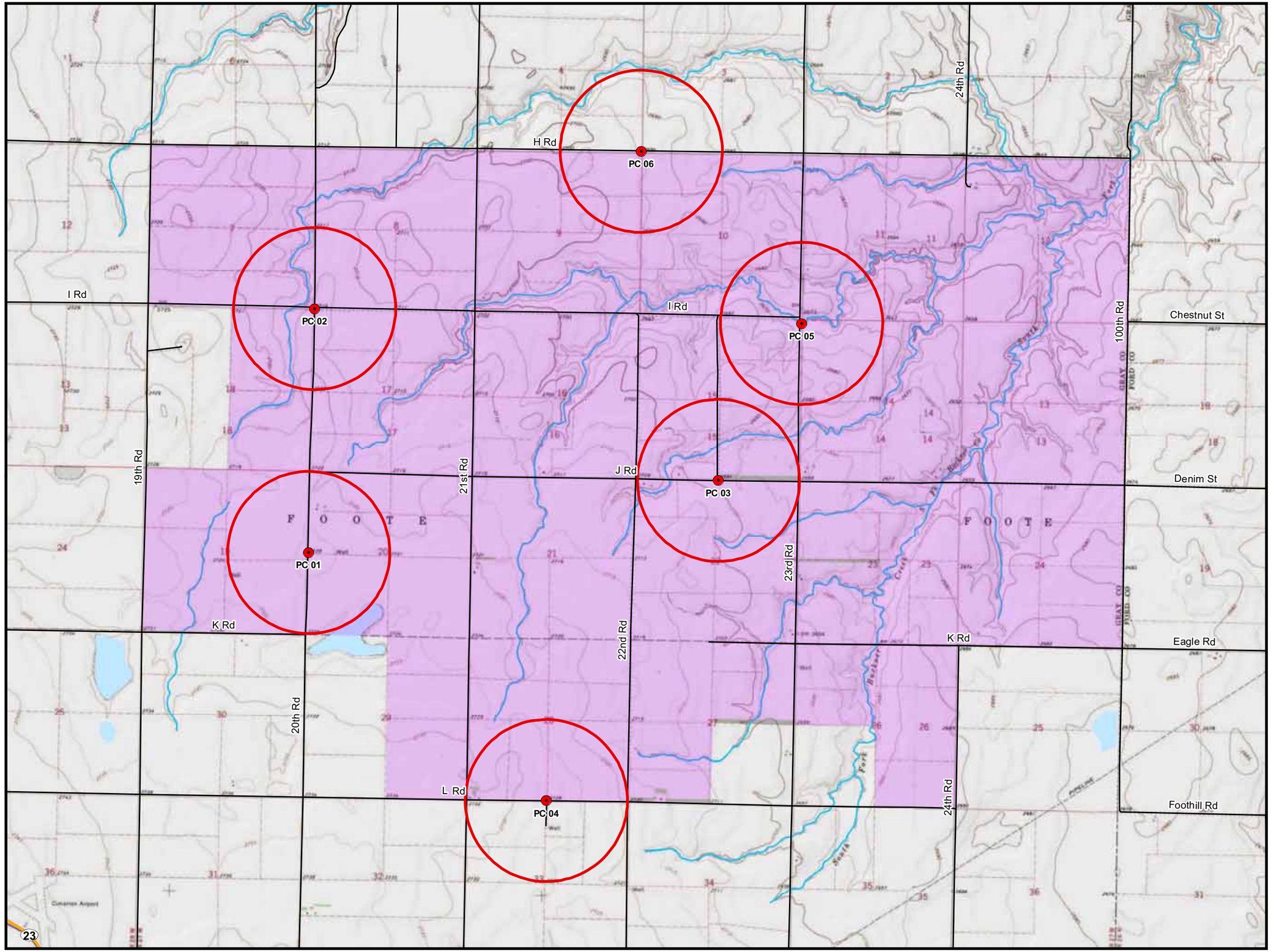

Figure 2

Point count location map (Spring 2010)

Cimarron Wind Energy Project-Phase I

Gray County, KS

Avian Survey Point

Avian Survey Point 800-m Radius

PC# Point Count Number

Project Area (6-28-2010)

River/Stream

Lake/Pond

State Highway

Local Road

N W E S

1:36,000

NAD 1983 UTM 14

Last Modified: 7-15-2010

0 0.25 0.5 0.75 1

Miles

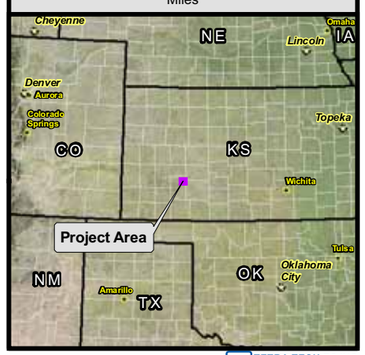

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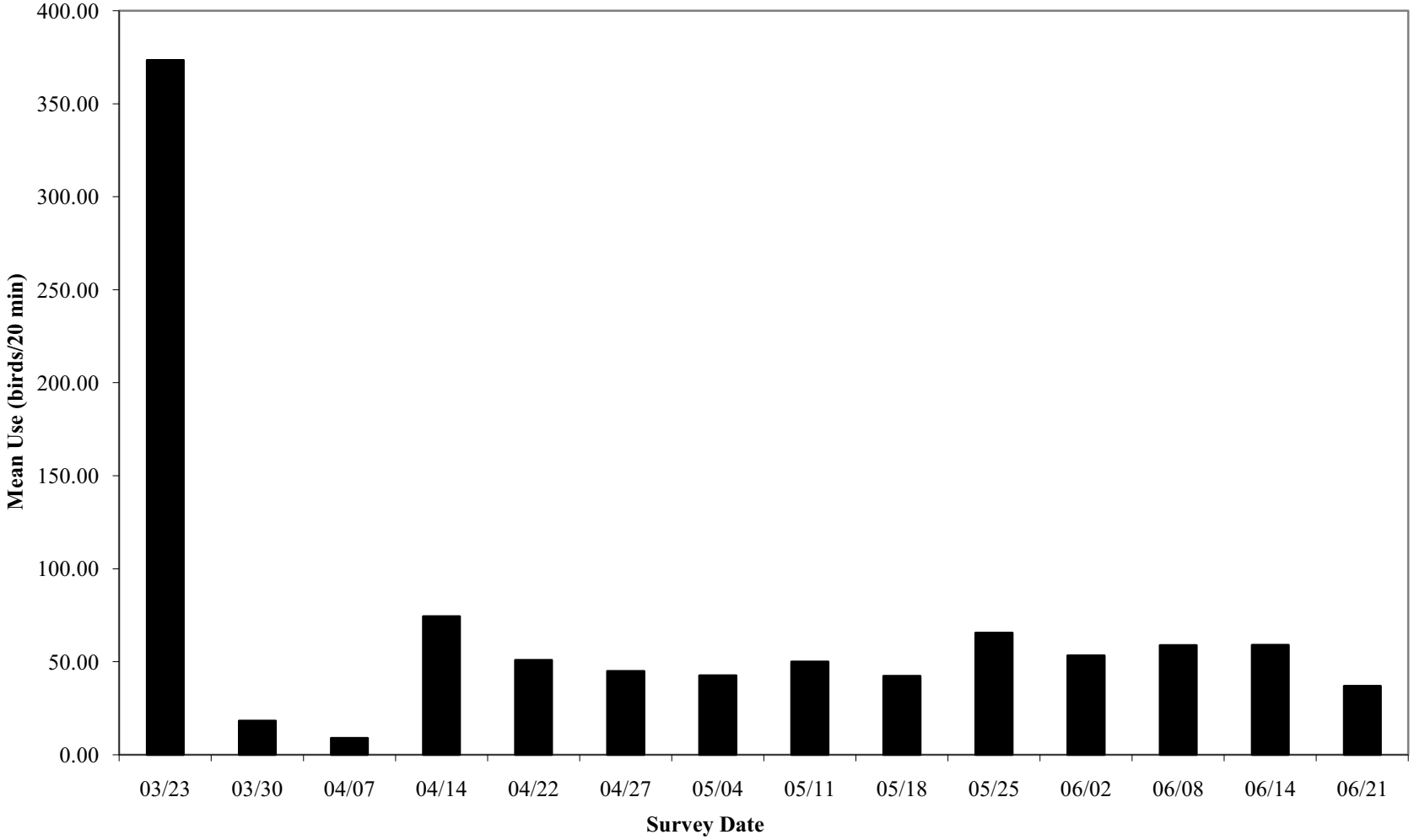
Figure 3. Non-raptor mean use by survey date in Spring 2010 at the Cimarron Wind Energy Project-Phase I.



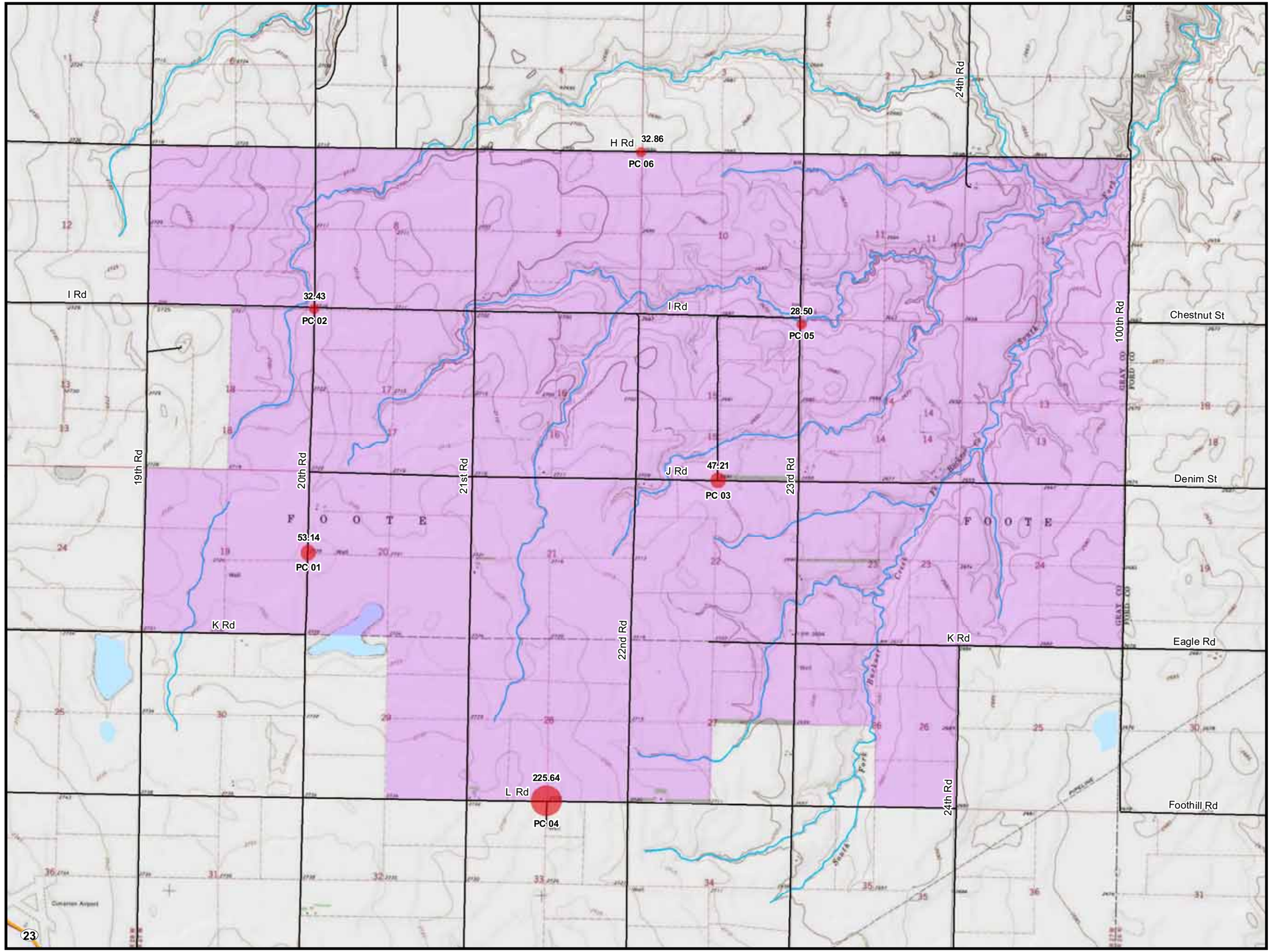


Figure 4

Non-raptor mean use by point count location (Spring 2010)

Cimarron Wind Energy Project-Phase I

Gray County, KS

Non-Raptors per 20 Minutes

- 0.01 - 46.00
- 46.01 - 92.00
- 92.01 - 138.00
- 138.01 - 184.00
- 184.01 - 230.00

\# Mean Use Value

PC# Point Count Number

- Project Area (6-28-2010)
- River/Stream
- Lake/Pond
- State Highway
- Local Road

N W E S

1:36,000

NAD 1983 UTM 14

Last Modified: 7-15-2010

0 0.25 0.5 0.75 1

Miles

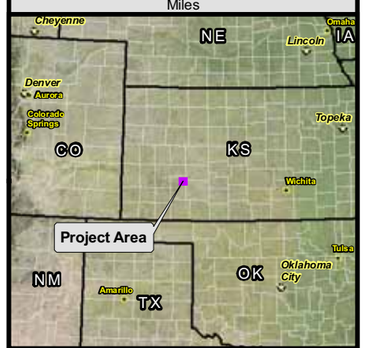


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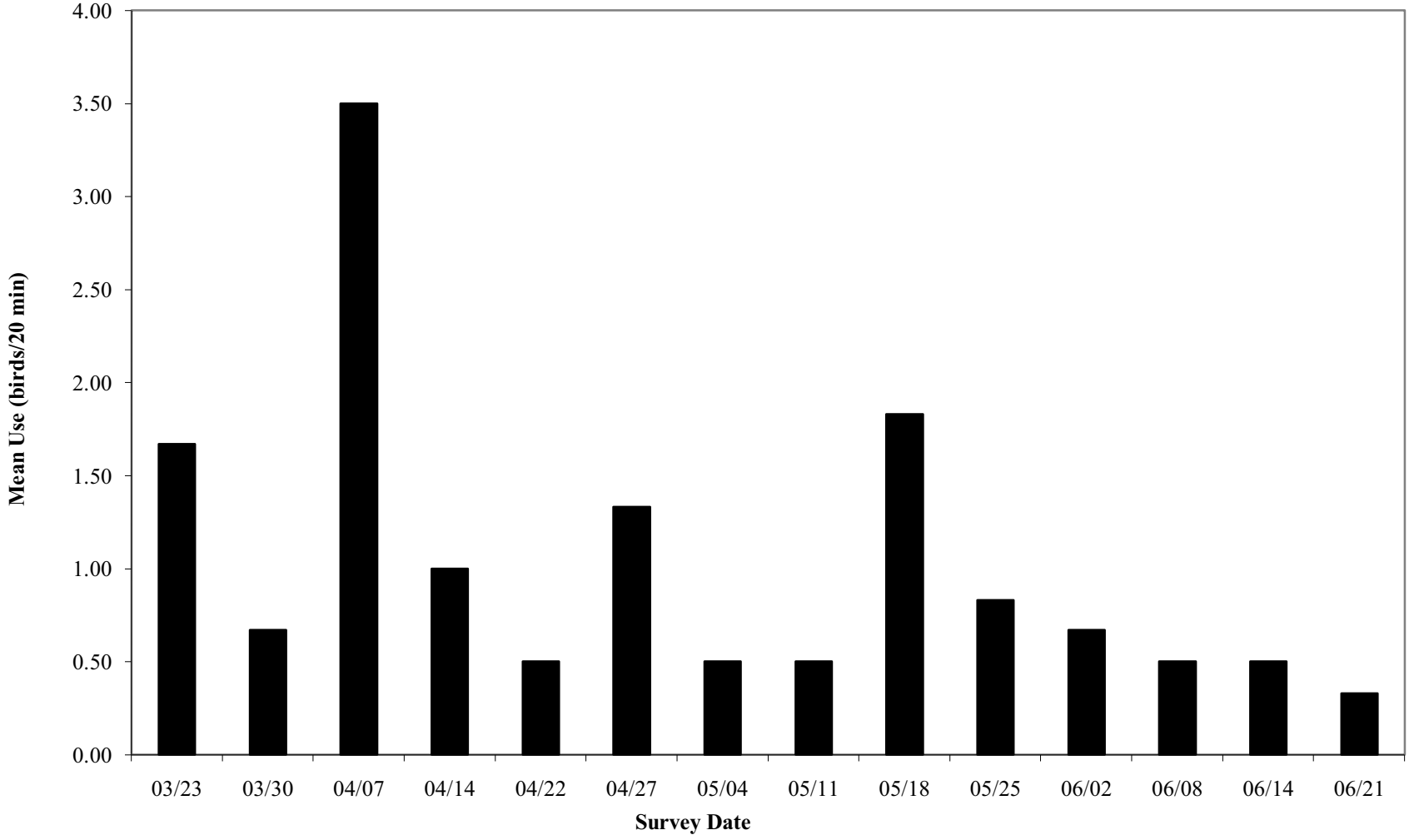
Figure 5. Raptor mean use by survey date in Spring 2010 at the Cimarron Wind Energy Project-Phase I.



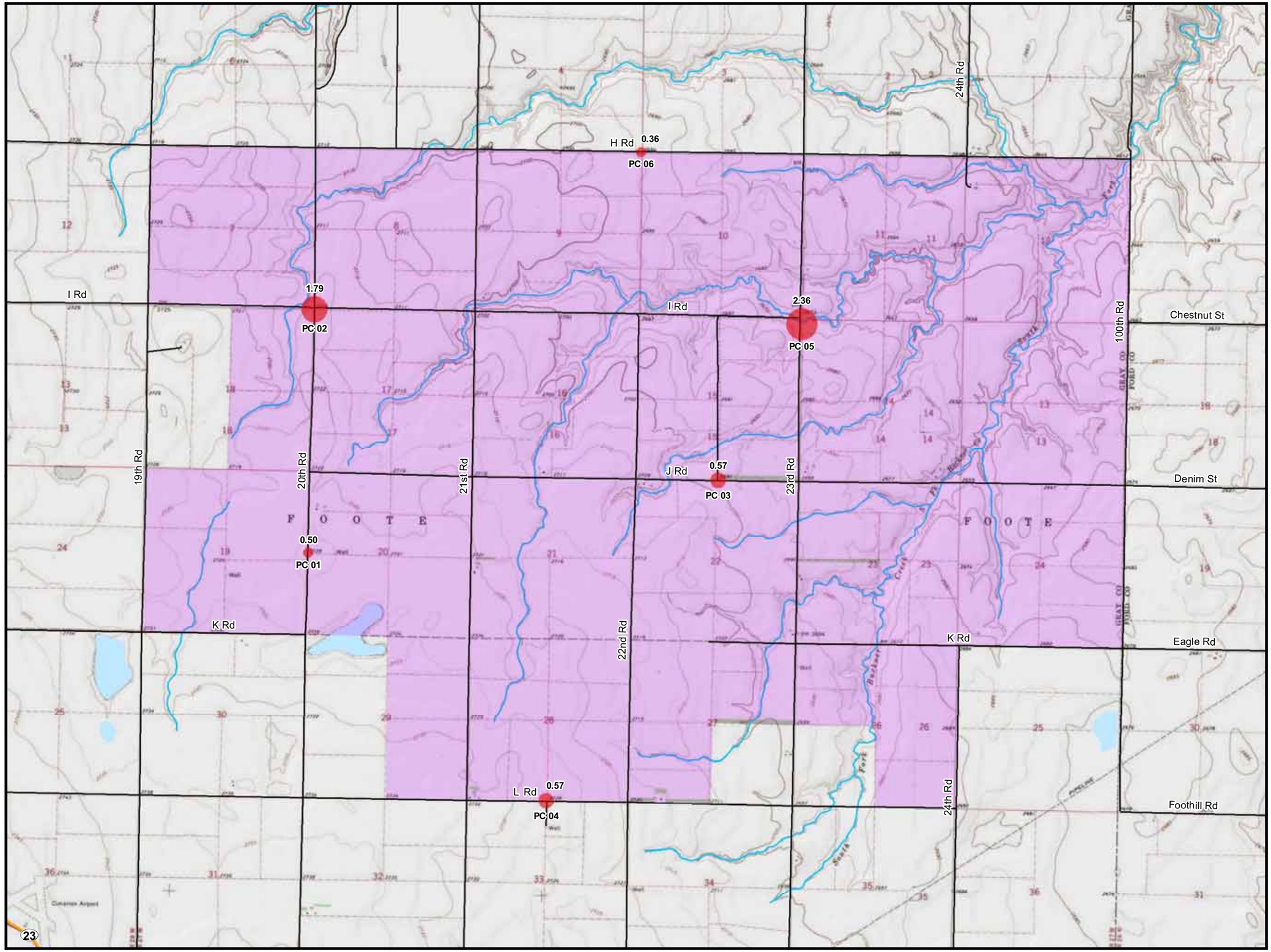


Figure 6

Raptor mean use by point count location (Spring 2010)

Cimarron Wind Energy Project-Phase I

Gray County, KS

Raptors per 20 Minutes

- 0.01 - 0.50
- 0.51 - 1.00
- 1.01 - 1.50
- 1.51 - 2.00
- 2.01 - 2.50

\# Mean Use Value

PC# Point Count Number

- Project Area (6-28-2010)
- River/Stream
- Lake/Pond
- State Highway
- Local Road

N W E S

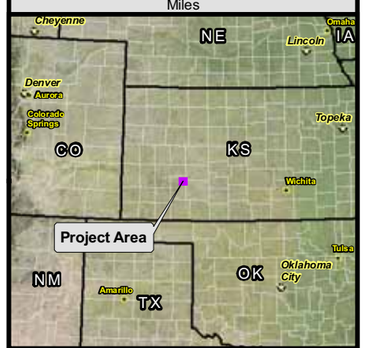
1:36,000

NAD 1983 UTM 14

Last Modified: 7-15-2010

0 0.25 0.5 0.75 1

Miles



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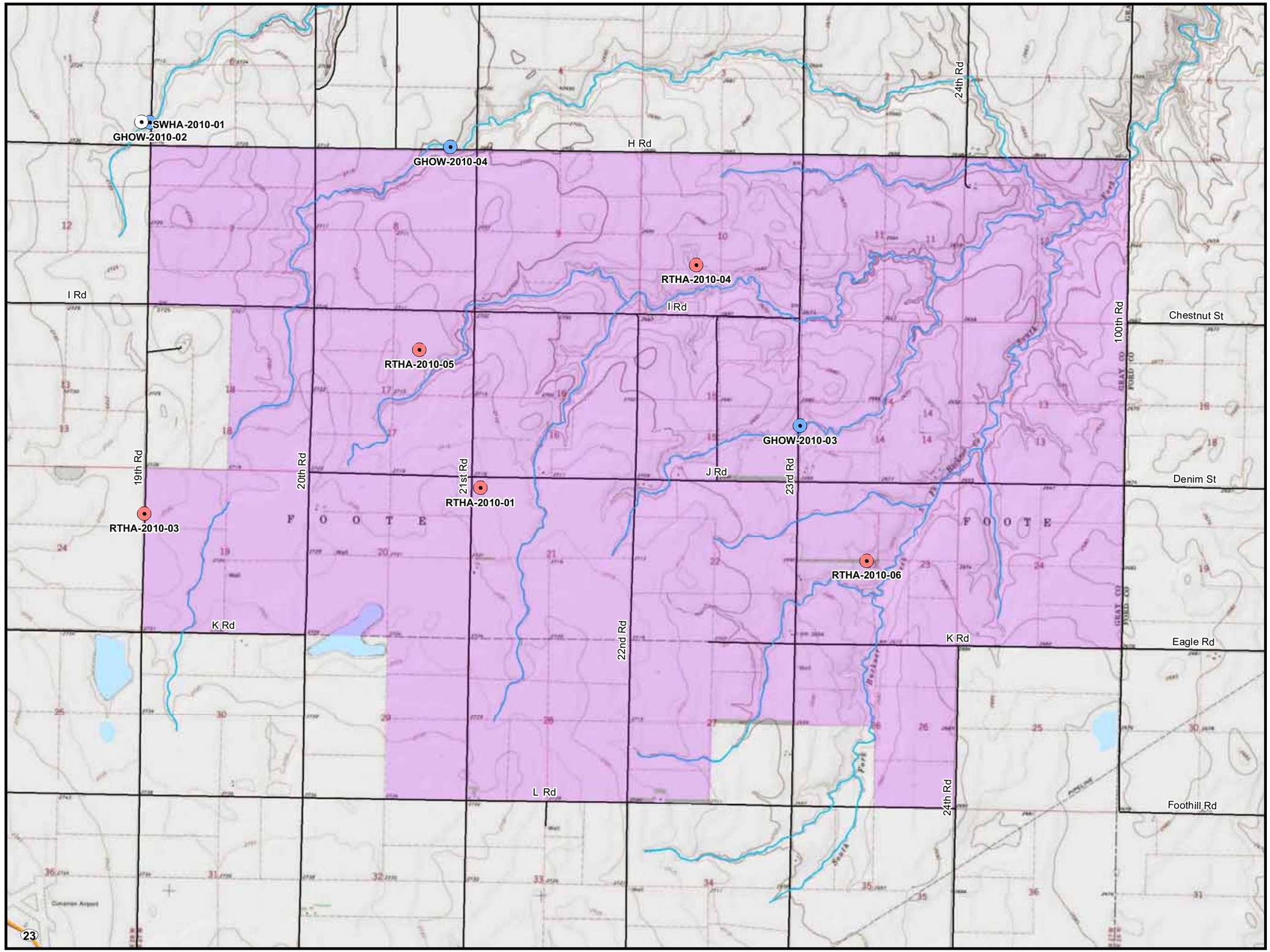


Figure 7

Raptor nest map (Spring 2010)

Cimarron Wind Energy Project-Phase I

Gray County, KS

- Project Area (6-28-2010)
- State Highway
- Local Road

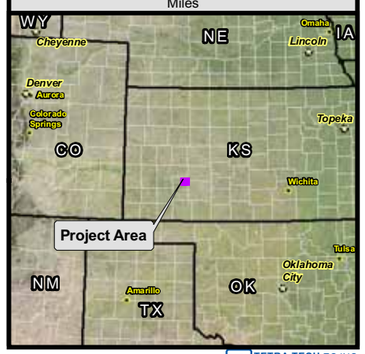
Raptor Nest Species

- Great Horned Owl
- Red-tailed Hawk
- Swainson's Hawk

N W E S

1:36,000
NAD 1983 UTM 14
Last Modified: 7-15-2010

0 0.25 0.5 0.75 1
Miles



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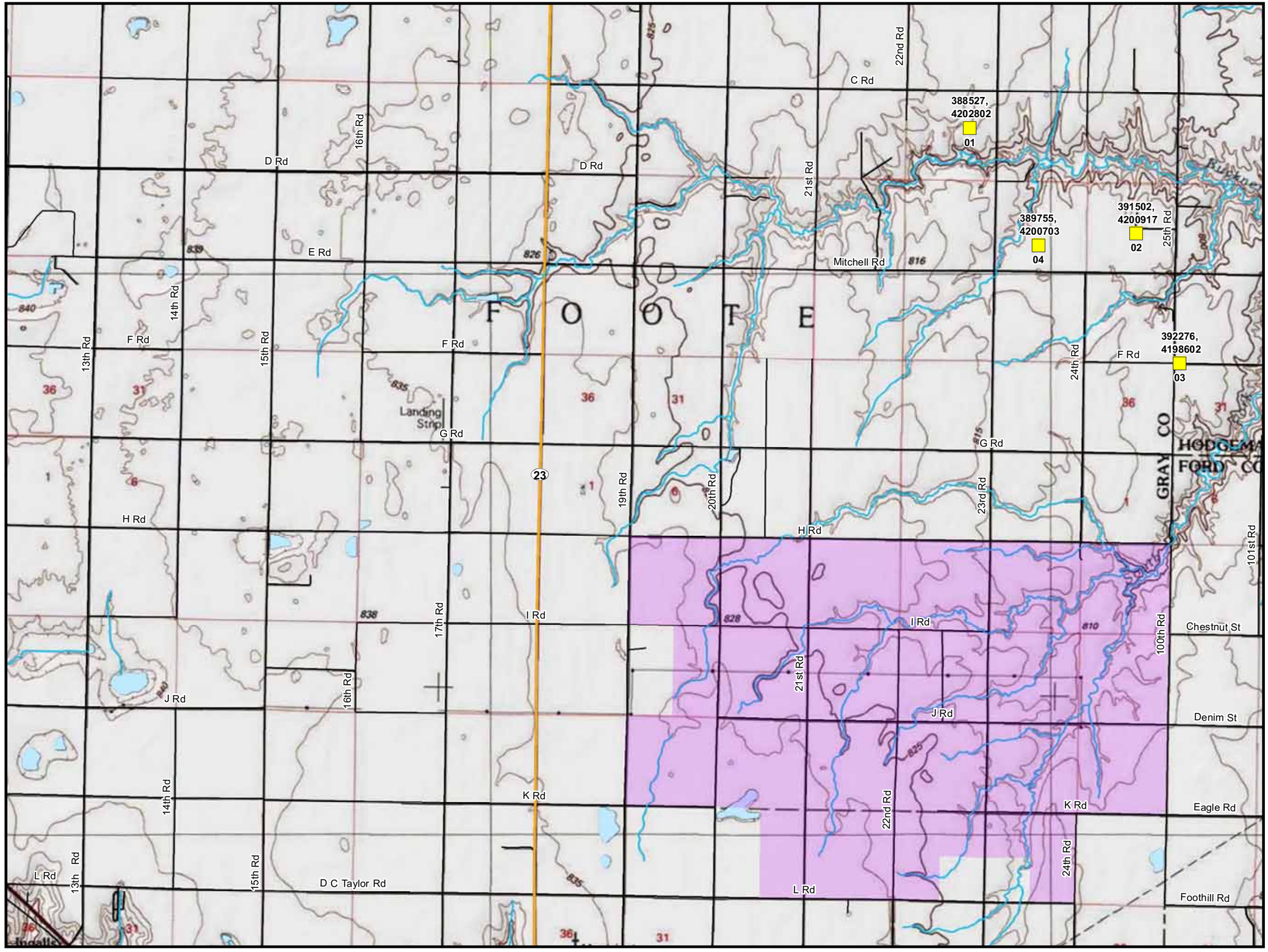


Figure 8

Lek location map (Spring 2010)

Cimarron Wind Energy Project-Phase I

Gray County, KS

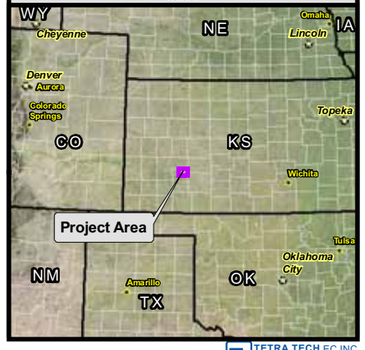
- Project Area (6-28-2010)
- State Highway
- Local Road

Lek Species

- Lesser prairie-chicken

1:65,000
NAD 1983 UTM 14
Last Modified: 7-15-2010

0 0.5 1 1.5 2 Miles



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APPENDICES

Appendix 1. Flight directions of birds observed during Spring 2010 point count surveys at the Cimarron Wind Energy Project-Phase I.

Species	Number of Birds[1]	Number of Observations	Percentage of Flights								
			N	NE	E	SE	S	SW	W	NW	Variable
sandhill crane	2105	3	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
lark bunting	10	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
red-winged blackbird	6	2	0.0	0.0	0.0	0.0	83.3	0.0	16.7	0.0	0.0
northern harrier	4	4	0.0	75.0	0.0	0.0	0.0	0.0	25.0	0.0	0.0
mourning dove	4	2	0.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0
common grackle	3	2	0.0	0.0	66.7	0.0	0.0	0.0	33.3	0.0	0.0
Swainson's Hawk	2	2	0.0	0.0	0.0	0.0	50.0	0.0	50.0	0.0	0.0
mallard	2	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
horned lark	2	2	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Eurasian collared-dove	2	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
American robin	2	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
American crow	2	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
turkey vulture	1	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
red-tailed hawk	1	1	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
rough-legged hawk	1	1	0.0	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0
peregrine falcon	1	1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
killdeer	1	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
house finch	1	1	0.0	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0
great horned owl	1	1	0.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
American goldfinch	1	1	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0	0.0
Grand Total	**2152**	**30**	**97.9**	**0.2**	**0.7**	**0.0**	**0.5**	**0.0**	**0.7**	**0.0**	**0.0**

[1] Includes only flying birds with flight directions

Appendix 2. Raptor nests observed at the Cimarron Wind Energy Project-Phase I, 2010.

Nest Number	Dates Surveyed	Species	Status	Substrate	Nest Height (m)	Nest Condition
GHOW-2010-02	03/30/2010 04/03/2010 4/27/2010	great horned owl great horned owl NA	Active Active Inactive	Cottonwood	7	Excellent
RTHA-2010-01	03/30/2010 04/03/2010 4/14/2010	great horned owl great horned owl great horned owl	Active Active Inactive	Elm	6	Excellent
RTHA-2010-03	04/03/2010 05/02/2010	red-tailed hawk NA	Inactive Inactive	Hackberry tree	6	Poor
GHOW-2010-03	04/03/2010 4/27/2010 05/02/2010 05/11/2010 05/18/2010	great horned owl great horned owl great horned owl great horned owl great horned owl	Active Active Active Active Active	Osage orange	9	Excellent
RTHA-2010-04	04/14/2010 04/27/2010 05/02/2010 05/11/2010 05/18/2010	red-tailed hawk NA NA red-tailed hawk NA	Active Inactive Inactive Inactive Inactive	Cottonwood	10	Excellent
RTHA-2010-05	4/27/2010 05/03/2010	red-tailed hawk NA	Active Inactive	Osage orange	8	Excellent
RTHA-2010-06	05/11/2010 05/18/2010 05/25/2010	red-tailed hawk red-tailed hawk red-tailed hawk	Active Active Active	Siberian Elm	12	Excellent
SWHA-2010-01	04/27/2010 05/11/2010 05/18/2010 05/25/2010	Swainson's hawk NA Swainson's hawk Swainson's hawk	Active Inactive Active Active	Cottonwood	8	Good
GHOW-2010-04	04/27/2010 05/03/2010 05/11/2010	great horned owl great horned owl NA	Active Active Inactive	Red Cedar	5	Excellent

NA means not applicable

Appendix 3. Grouse surveys at the Cimarron Wind Energy Project-Phase I , 2010.

Lek Number	Survey #	Survey date	Survey time	Species	Status	# Total	# Males	# Females	# Unknown*
1									
	1	03/23/201	820	lesser prairie-chicken	Active	20	-	-	20
	2	03/30/201	700	lesser prairie-chicken	Active	30	20	-	10
	3	04/03/201	2000	lesser prairie-chicken	Active	5	5	-	-
	4	4/27/2010	800	lesser prairie-chicken	Active	10	5	-	5
	5	04/27/201	1930	lesser prairie-chicken	Active	10	10	-	-
	6	05/03/201	2010	lesser prairie-chicken	Active	20	20	-	-
	7	05/11/201	730	lesser prairie-chicken	Active	20	20	-	-
2									
	1	03/30/201	0800	lesser prairie-chicken	Active	30	10	-	20
	2	04/03/201	2015	lesser prairie-chicken	Active	13	12	1	-
	3	04/14/201	1820	lesser prairie-chicken	Active	23	23	-	-
	4	04/27/201	730	lesser prairie-chicken	Active	12	12	-	-
	5	05/03/201	1930	lesser prairie-chicken	Active	20	12	2	6
	6	05/11/201	800	lesser prairie-chicken	Active	14	14	-	-
3									
	1	03/30/201	0830	lesser prairie-chicken	Active	13	10	3	-
	2	04/03/201	0630	lesser prairie-chicken	Active	9	9	-	-
	3	04/27/201	0720	lesser prairie-chicken	Active	7	7	-	-
	4	04/27/201	2010	lesser prairie-chicken	Active	6	6	-	-
	5	05/11/201	0805	lesser prairie-chicken	Active	3	3	-	-
4									
	1	04/07/201		lesser prairie-chicken	Active	11	-	-	11
	2	05/03/201		lesser prairie-chicken	Active	10	10	-	-
	3	05/11/201	1950	lesser prairie-chicken	Active	5	5	-	-
	4	05/18/201		lesser prairie-chicken	Active	5	5	-	-

* indicates the presence of an unknown number of birds