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Fall 2013 Avian Field Surveys for the Palen Solar Electric Generating System, Riverside County, California

Final Report

Prepared for:

Palen Solar Holdings, LLC

Prepared by:

Ken Levenstein, Andrea Chatfield, Wally Erickson, and Kimberly Bay

Western EcoSystems Technology, Inc.
415 West 17th Street, Suite 200
Cheyenne, Wyoming 82001

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EXECUTIVE SUMMARY

Palen Solar Holdings, LLC. has proposed a concentrated solar energy facility in Riverside County, California referred to as the Palen Solar Electric Generating System (PSEGS). Palen Solar Holdings, Inc. contracted Western EcoSystems Technology, Inc. (WEST) to estimate the impacts of the solar energy facility's construction and operation on avian species, and to help inform the development of a Bird and Bat Conservation Strategy (BBCS) for the PSEGS. The following document contains results for bird use count (BUC) surveys, shorebird/waterfowl surveys, small bird count (SBC) surveys, and avian mist net surveys conducted at the PSEGS from August 19 through December 15, 2013. A nocturnal avian migration radar study was also conducted at the PSEGS during the fall of 2013, the results of which are presented in a separate report.

The principal objectives of the fall studies were to: 1) provide site-specific fall bird resource and use data that would be useful in evaluating potential impacts from the proposed concentrated solar energy facility; 2) provide information that could be used in project planning and design of the facility to minimize impacts to birds, and 3) recommend further studies or potential mitigation measures, if warranted.

Fixed-point BUC surveys were conducted to estimate the spatial and temporal use of the study area by large birds, particularly diurnal raptors, during the fall migration period. Day-long (8-hour) BUC surveys were conducted four days per week from August 20 through December 13, 2013, at each of six points established throughout the PSEGS, for a total of 414 surveys. During this time, 16,808 birds in 1,475 separate groups were recorded, and 75 unique bird species were identified. Turkey vultures (107,989 observations in 1,960 separate groups) composed 93.6% of total observations recorded during BUC surveys. A total of 1,587 individual diurnal raptors, representing 14 unique species, were recorded, accounting for 1.4% of overall bird observations. Among the bird types that associate with water, waterbirds accounted for 0.9% of total observations, waterfowl accounted for 0.8%, shorebirds accounted for 0.4%, and gulls/terns accounted for 0.4%.

After standardizing the BUC survey data collected during this study to include only observations seen within 800 meters (2,625 feet) from the observer and scaling mean use to the number of birds recorded per observer-hour, overall diurnal raptor use at the PSEGS was 0.18 birds/observer-hour/survey. The diurnal raptor species with the greatest use included red-tailed hawk (0.05 birds/observer-hour/survey), prairie falcon (0.03), Swainson's hawk (0.02), northern harrier (0.02), and Cooper's hawk (0.01). Overall use by turkey vultures was 1.74 birds/observer-hour/survey. Diurnal raptor subtypes were generally most commonly observed flying below 35 meters (m; 115 feet [ft]); however, osprey were more frequently observed flying between 35 and 70 m (115 and 230 ft) and eagles were most commonly observed flying between 105 and 140 m (345 and 459 ft). Vultures were most commonly observed flying between 35 and 105 m, while water-dependent species were most frequently observed flying below 35 m or above 280 m (919 ft). Use by diurnal raptors was greatest at points 1 and 2 while

use by vultures was greatest at points 1 and 6. Use by water-dependent bird types was consistently higher at point 2.

Shorebird/waterfowl surveys were conducted to evaluate use of three agricultural ponds on the northwest side of the PSEGS site by species that associate with water such as migratory shorebirds, waterbirds, and waterfowl. Weekly surveys were conducted at the ponds from August 19 – December 10, 2013, during which time approximately 106 hours of surveys were conducted over the course of 17 visits. A total of 3,169 individual bird observations in 754 separate groups were recorded, and 77 unique species were identified. Overall, water-dependent bird types (i.e., loons/grebes, waterbirds, waterfowl, shorebirds, gulls/terns, and rails/coots) composed 49.5% of total bird observations. The most frequently observed water-dependent species were eared grebe (191 observations), American coot (165 observations), American avocet (152 observations), ring-billed gull (89 observations), common goldeneye (89 observations), and ruddy duck (79 observations), which collectively composed 48.8% of all water-dependent bird observations and 24.1% of overall bird observations. The most common species observed during the shorebird/waterfowl surveys was turkey vulture, which composed 26.6% of all observations. During shorebird/waterfowl surveys, the majority of all bird types were recorded flying below 35 m.

Small bird count (SBC) surveys were conducted to characterize use of the PSEGS site and surrounding area by migrant and resident birds during the late summer and fall period. Ten-minute SBC surveys were conducted weekly at each of 150 points established throughout the site and surrounding 0.5-mile buffer from August 19 to November 14, 2013. During the surveys, 122 unique species were identified and a total of 10,077 individual bird observations within 3,103 separate groups were recorded. Cumulatively, five species (4.1% of all species) comprised 69.6% of the individual observations: horned lark (2,542 observations), turkey vulture (1,877 observations; most seen outside of the 100 m [328 ft] view shed), house finch (1,098 observations), common raven (1,002 observations), and yellow-rumped warbler (496 observations). All other species comprised less than four percent of the observations individually. Passerines had the highest mean use estimate at points 2-3, 2-5, and 9-8 (25.2, 23.38, and 25.77 birds/plot/survey, respectively), and higher average use along transects 1, 2, 3, and 9. For all bird species combined, use was highest at points 2-3, 2-4, 9-8, 3-10, and 7-11 (51.00, 27.08, 25.77, 18.77, and 18.77 birds/point/survey, respectively). Much higher use at point 2-3 was attributed to relatively high use by multiple bird types, including loons/grebes, waterbirds, waterfowl, shorebirds, vultures, and passerines. All bird use at other points ranged from 0.08 to 18.15 birds/point/survey.

Mist net surveys were conducted as a supplement to SBC surveys to increase the probability of detecting inconspicuous birds that might otherwise go undetected. Mist net surveys were conducted for three consecutive days per week from September 18 to October 30, 2013, for a total of 1,080 mist net survey hours. During this period 107 birds, comprising 25 unique species, were captured. The overall capture rate for the 7-week period was 0.10 captures per net-hour, with daily capture rates ranging from zero to 0.51 captures per net-hour. The highest capture rates occurred at Station 4, located within the palm plantation, while no birds were captured at

Station 2 located within creosote scrub. The most common species captured included orange-crowned warbler (eight individuals), white-crowned sparrow (eight individuals), Lincoln's sparrow (six individuals), ruby-crowned kinglet (six individuals), and verdin (four individuals). Seven species were captured during mist net surveys that were not recorded during any other survey type during the fall study (yellow-green vireo, warbling vireo, fox sparrow, Pacific-slope flycatcher, western wood-pewee, red-naped sapsucker, and blue-headed vireo).

During all survey types and incidental observations, a total of 185 unique bird species were recorded within the PSEGS, including 32 species considered sensitive at the state and/or federal level. No federally listed or proposed species were identified; however, six species listed or fully-protected in California were recorded: two state-endangered species (willow flycatcher and Gila woodpecker), two state-threatened species (Swainson's hawk and bank swallow), and two fully-protected species (golden eagle and peregrine falcon). Other sensitive species recorded during the study included 16 state-designated species of special concern, 10 federal species of concern, and six federal priority shorebird species. Additionally, golden eagles are further protected under the federal Bald and Golden Eagle Protection Act.

STUDY PARTICIPANTS

Western EcoSystems Technology

Wally Erickson	Senior Manager, Senior Biometrician
Ken Levenstein	Project Manager, Research Biologist
Andrea Chatfield	Project Manager, Research Biologist
Kimberly Bay	Data and Report Manager
Dave Fox	Statistician
Jon Cicarelli	GIS Technician
Andrea Palochak	Technical Editor
Cyrus Moqtaderi	Field Supervisor
Oscar Johnson	Field Technician
Jennifer Wilcox	Field Technician
Lauren Solomon	Field Technician
Brandon Miller	Field Technician
Jason Pietrzak	Field Technician
Anne Winters	Field Technician
Bill Deppe	Field Technician
John Edwards	Field Technician
Dave Goodward	Field Technician

REPORT REFERENCE

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INTRODUCTION

In July 2013, Palen Solar Holdings, LLC contracted Western EcoSystems Technology, Inc. (WEST) to conduct fall 2013 avian field studies within the Palen Solar Electric Generating System (PSEGS) to estimate the impacts of the solar energy facility's construction and operation on avian species, and to help inform the development of a Bird and Bat Conservation Strategy (BBCS) for the PSEGS. The following document contains results for bird use count surveys, shorebird/waterfowl surveys, small bird counts, and avian mist net surveys conducted at the PSEGS from August 19 through December 13, 2013. A nocturnal migration radar study was also conducted at the PSEGS during the fall of 2013, the results of which are presented in a separate report (Levenstein and Nations 2014).

The protocols for the fall avian studies are based on guidance provided by the Renewable Energy Action Team (REAT) agencies specifically for the PSEGS, and are consistent with the survey types and methods employed during spring and summer 2013 field surveys conducted at the PSEGS by Bloom Biological, Inc. (BBI). The principal objectives of the fall studies were to: 1) provide site-specific fall bird resource and use data that would aid in evaluating potential impacts from the proposed concentrated solar energy facility; 2) provide information that could be used in project planning and design of the facility to minimize impacts to birds, and 3) recommend further studies or potential mitigation measures, if warranted.

STUDY AREA

The PSEGS is situated on approximately 3,793 acres (1,535 hectares [ha]) of land administered by the Bureau of Land Management (BLM) in Riverside County, California, approximately 30 miles (48.3 kilometers [km]) west of the city of Blythe (Figure 1). The PSEGS site is located within the Chuckwalla Valley and is bordered by the Chuckwalla Mountain to the south, the Coxcomb Mountains to the north, and by the Palen Mountains to the northeast. The Palen Dry Lake lies immediately to the north of the site. The topography of the PSEGS is generally flat with no significant terrain features. Elevations within the site range from approximately 134 meters (m; 440 feet [ft]) above mean sea level in the northeast of the site to approximately 207 m (680 ft) in the southwest. The dominant vegetative cover type within the PSEGS is Sonoran Creosote Scrub (Figure 2). Several dry desert washes with sparse to moderately dense areas of Desert Dry Wash Woodland are present within and adjacent to the PSEGS (Figure 2). Immediately adjacent to the northwest boundary of the PSEGS is a privately-owned date palm plantation, approximately 530 acres (215 ha) in size. Within the privately-owned lands to the northwest of the site are three agricultural ponds, each less than 2.5 acres (1.0 ha) in size.

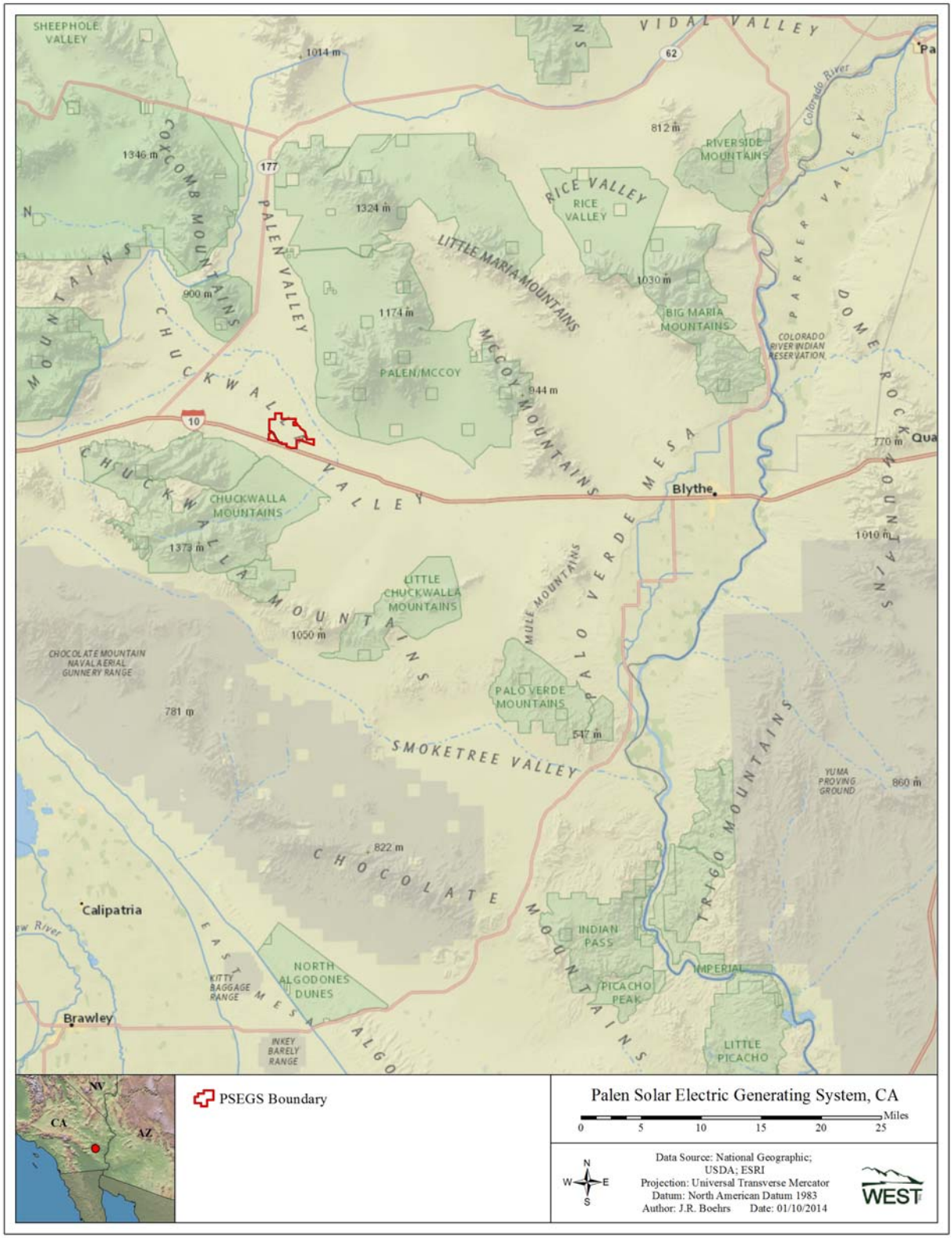

Figure 1. Location of the Palen Solar Electric Generating System.

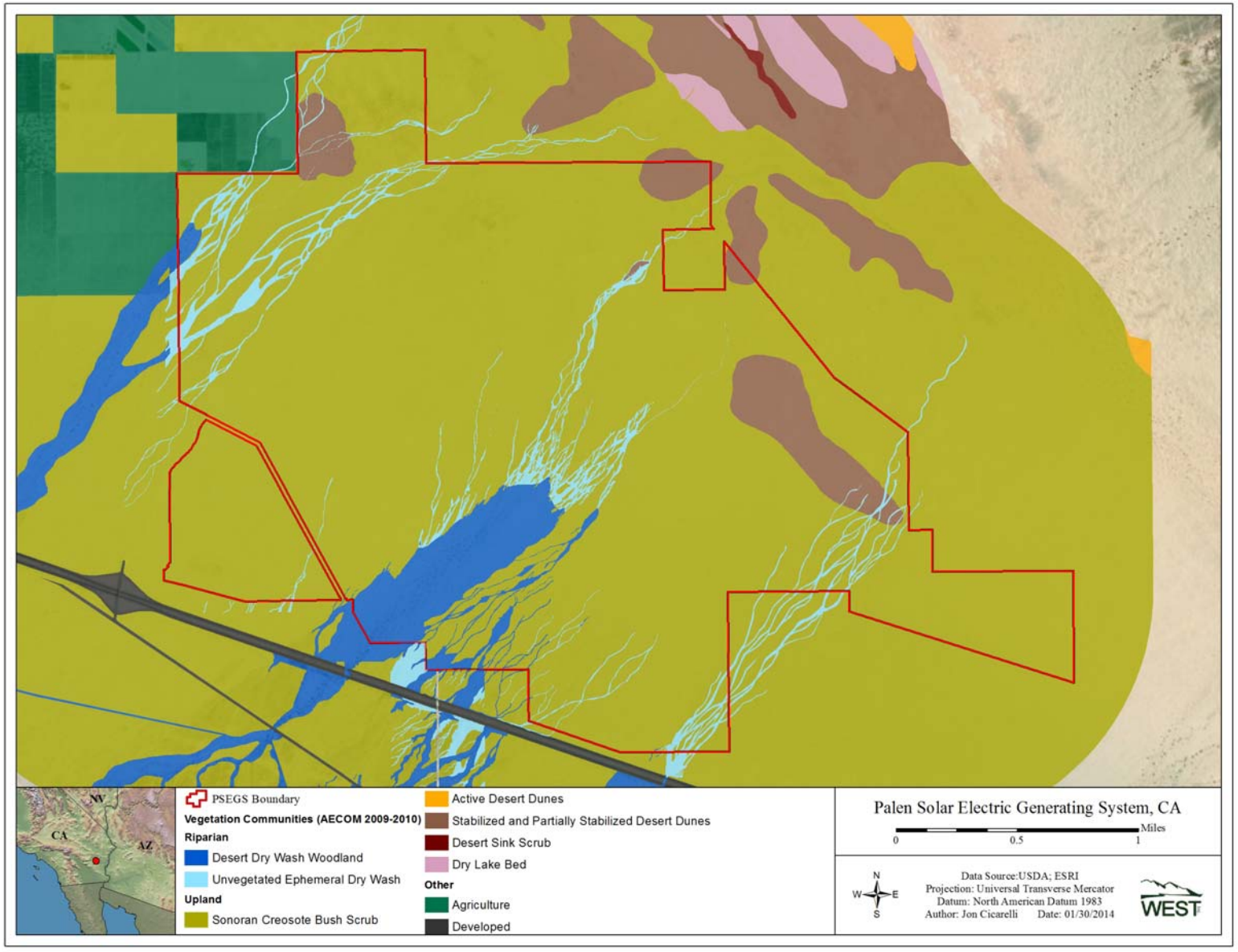

Figure 2. Vegetative cover types of the Palen Solar Electric Generating System.

METHODS

The fall 2013 study at the PSEGS consisted of the following components: 1) bird use count (BUC) surveys; 2) shorebird/waterfowl surveys; 3) small bird count (SBC) surveys, and 4) avian mist net surveys.

Bird Use Count Surveys

The objective of the fall BUC surveys was to estimate the spatial and temporal use of the PSEGS by medium to large birds, particularly vultures and diurnal raptors (i.e., kites, accipiters, buteos, harriers, eagles, falcons and osprey [*Pandion haliaetus*]). Point counts using circular plots (similar to those described by Reynolds et al. 1980, Bibby et al. 1992) were conducted within the PSEGS site. Surveys were designed to document use of the site by resident and migrating raptors and vultures, and other large bird species.

Survey Plots

Surveys were conducted at six BUC observation points established throughout the PSEGS site and surrounding 0.6-mile (1.0-km) buffer, with two of the observation points (points 3 and 5) located within 200 m (220 yards) of the proposed solar collection towers for the PSEGS (Figure 3). Locations of observation points were identical to those surveyed by BBI during spring and summer BUC surveys (BBI 2013a, 2013b). Each survey plot was an 800-m (2,625-ft) radius circle centered on the point.

Survey Methods

Surveys at each observation point were conducted for approximately eight continuous hours per day, four days per week. Survey methods were consistent with those used by the Hawk Migration Association of North America (HMANA), with observers continuously scanning the sky and surrounding areas for target species within the survey area. Every medium to large bird or group of birds observed during the survey was recorded by a unique observation number. Observations of medium to large birds beyond 800-m radius were recorded, but were not included in statistical analyses. Medium to large birds included waterbirds, waterfowl, rails and coots, grebes and loons, gulls and terns, shorebirds, diurnal raptors, owls, vultures, upland game birds, doves and pigeons, goatsuckers, and large corvids (e.g., ravens, magpies, and crows). In addition to these species, all observations of swallows, swifts, and hummingbirds were recorded during each survey as these birds have been found to be potentially susceptible to injury/mortality as a result of entering the solar flux zone (McCrary et al. 1986).

Data recorded for each 8-hour survey period included the date, start and end time of survey period, and observer. Weather information (i.e., temperature, wind speed, wind direction, and cloud cover) was recorded every hour throughout the survey period. For each medium or large species detected during the survey, the following data were recorded: observation number, start and end time of each observation, species or best possible identification, number of individuals, sex and age class (if possible), altitude above ground level (agl) when first observed, highest and lowest altitude agl, distance from plot center when first detected, closest distance, general

flight direction, activity (behavior), and habitat(s). Behavior categories included: perched, soaring, flapping/gliding, hunting/kiting/hovering, stooping/diving at prey, stooping in agonistic interaction with another bird, being mobbed, undulating/territorial flight, auditory, and other. Habitat categories included: desert scrub, desert wash, palm plantation, barren, and other. The initial flight patterns and habitat types (at first observation) were uniquely identified on the data sheet and subsequent patterns and habitats were also recorded. Approximate flight heights and distances from plot center were recorded to the nearest 5-m (16-ft) interval. Any comments or unusual observations were noted in the comments section. For each golden eagle observed, data were recorded every minute that the bird was within view, as recommended in the USFWS Eagle Conservation Plan Guidance for land-based wind energy projects (USFWS 2013).

Flight or movement paths for all medium and large birds and other species of interest were mapped onto US Geological Survey (USGS) base maps, given corresponding observation numbers, and digitized using ArcGIS software. Topographic maps were used to aid in recording locations of observations as accurately as possible.

Observation Schedule

Eight-hour surveys were conducted at each of the six points four days per week during the fall survey period (August 20 – December 13, 2013). Surveys were carried out during all daylight hours throughout the season (approximately 6:00 am to 7:00 pm); however, an emphasis was placed on the late morning through early afternoon time period (approximately 8:00 am to 5:00 pm), the period of greatest activity for diurnal raptors and vultures. To the extent practical, each point was surveyed for roughly the same number of hours during the study period.

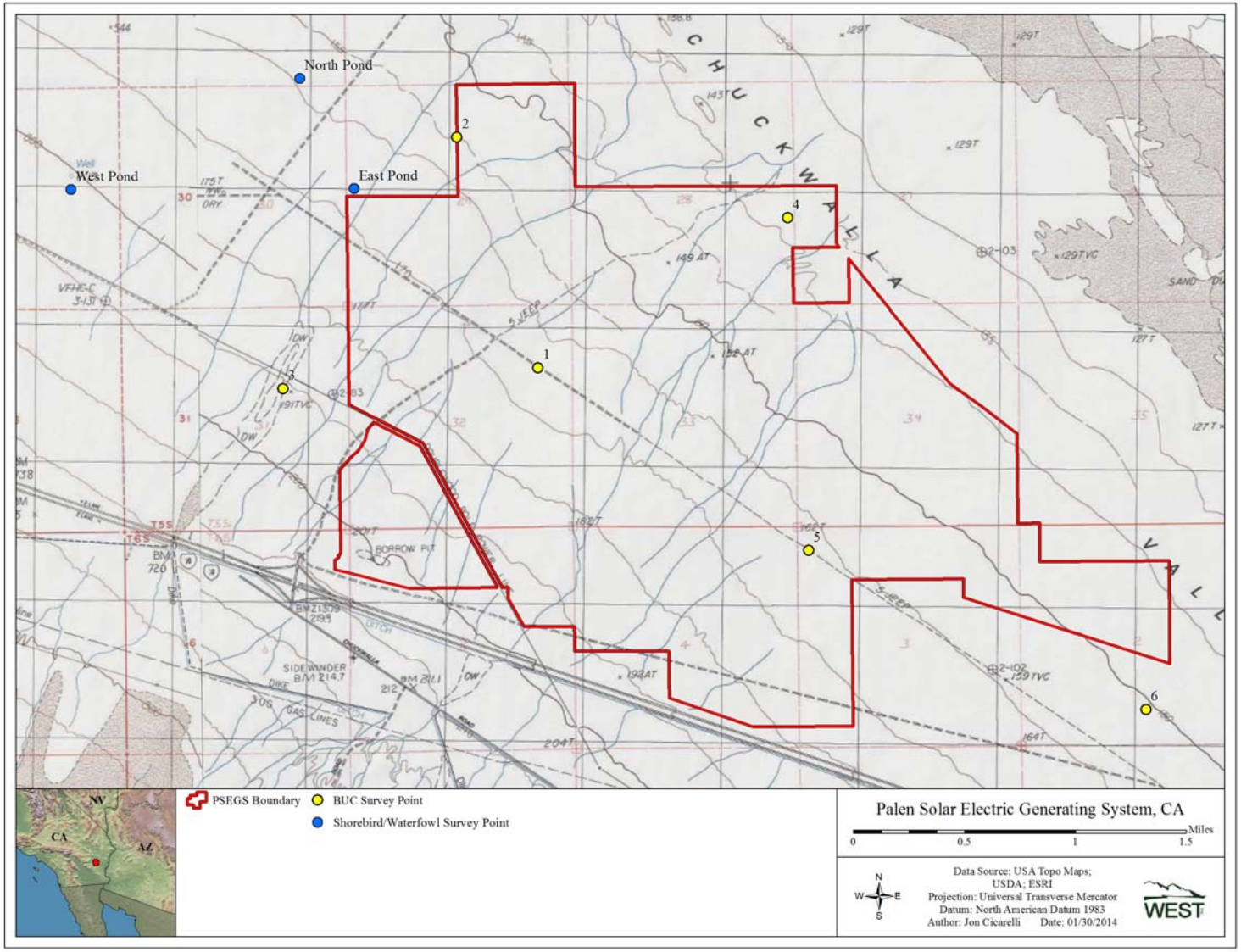

Figure 3. Location of fall 2013 bird use count (BUC) and shorebird/waterfowl survey locations at the Palen Solar Electric Generating System.

Shorebird/Waterfowl Surveys

The objective of shorebird/waterfowl surveys was to evaluate use of three agricultural ponds adjacent to the northwest boundary of the PSEGS site by species that associate with water (e.g., migratory shorebirds, waterbirds, and waterfowl) that might go undetected during BUC surveys conducted within the PSEGS boundary. While the focus of the surveys was migratory water-dependent species, all medium to large birds, as well as swallows, swifts, and hummingbirds (as described above for BUC surveys) seen or heard during each survey were recorded.

Survey Plots

One survey point was selected at each of three agricultural ponds within the privately-owned land to the northwest of the PSEGS site and just beyond the palm plantation (Figure 3). The original scope of work for fall studies suggested a single point at these ponds be surveyed for eight hours each week; however, during initial study set-up, it was decided that a single point did not provide adequate coverage of the three ponds. Therefore, a point was established at each pond and each point was surveyed for approximately 2.5 hours each visit for a total of approximately eight hours of total survey time in the pond area each week. Points were selected to achieve good visual coverage of each pond and the surrounding landscape. Each survey plot was an 800-m radius circle centered on the point.

Survey Methods

Each of the three points was surveyed for approximately 2.5 hours once per week. Data collection methods were identical to those used during BUC surveys (see Bird Use Count Survey section above). Observations of all water-dependent species and other medium to large birds beyond the 800-m radius were recorded, but were not included in statistical analyses.

Observation Schedule

Surveys at each of the three points were conducted once per week during the fall period (August 19 – December 10, 2013). All three points were surveyed on the same day each week, with surveys scheduled to cover all daylight hours during the study period (approximately 6:00 am to 7:00 pm).

Small Bird Counts

The objective of the SBC surveys was to characterize use by migrant and resident birds, particularly songbirds, within the PSEGS site and surrounding area during the fall period. Survey locations and methodology were consistent with those used during the spring and summer SBCs conducted at the site by BBI (2013a, 2013b). While the focus of the surveys was songbirds, all birds seen or heard during each survey were recorded.

Survey Stations

Surveys were conducted at 150 stations located along 14 transects, each approximately 2,600 yards (2,400 m) in length, established throughout the PSEGS site and surrounding 1.0-mile (1.6-km) buffer (Figure 4). All stations were separated by at least 270 yards (250 m) to ensure

independence of observations. Survey transects provided coverage of the major habitat types present within the project footprint and surrounding region, and the station locations were generally consistent with those surveyed during the spring and summer by BBI, with the exception that during the spring only 120 stations along nine transects were surveyed, and during the summer 176 stations along 15 transects were surveyed (BBI 2013a, 2013b).

Survey Methods

Surveys at each station consisted of a 10-minute (min) passive listening survey, during which time all species seen or heard were recorded. Though birds of all sizes and at all distances from the observer were recorded, an emphasis was placed on detecting all birds within 100 m (328 ft) of the observer. Data recorded for each survey included: date, start and end time of observation period, station number, and weather information (temperature, wind speed, wind direction, precipitation, and cloud cover). For each bird detected, the following data were recorded: station number, species, sex (if known), age (if known), distance from point count station, direction from station, flight height upon initial observation, flight direction, mode of detection (visual, song, call, other), and activity. Activity categories recognized included: perched, soaring, flapping, foraging, gliding, hovering, auditory, and other. If a sensitive species was detected, additional data, such as location (Universal Transverse Mercator [UTM] coordinates), were recorded.

Observation Schedule

All 150 stations were surveyed once per week during the fall survey period (August 19 – November 14, 2013). Surveys at each station were conducted between 15 min before dawn and six hours after dawn to maximize the probability of detecting target species (i.e., passerines).

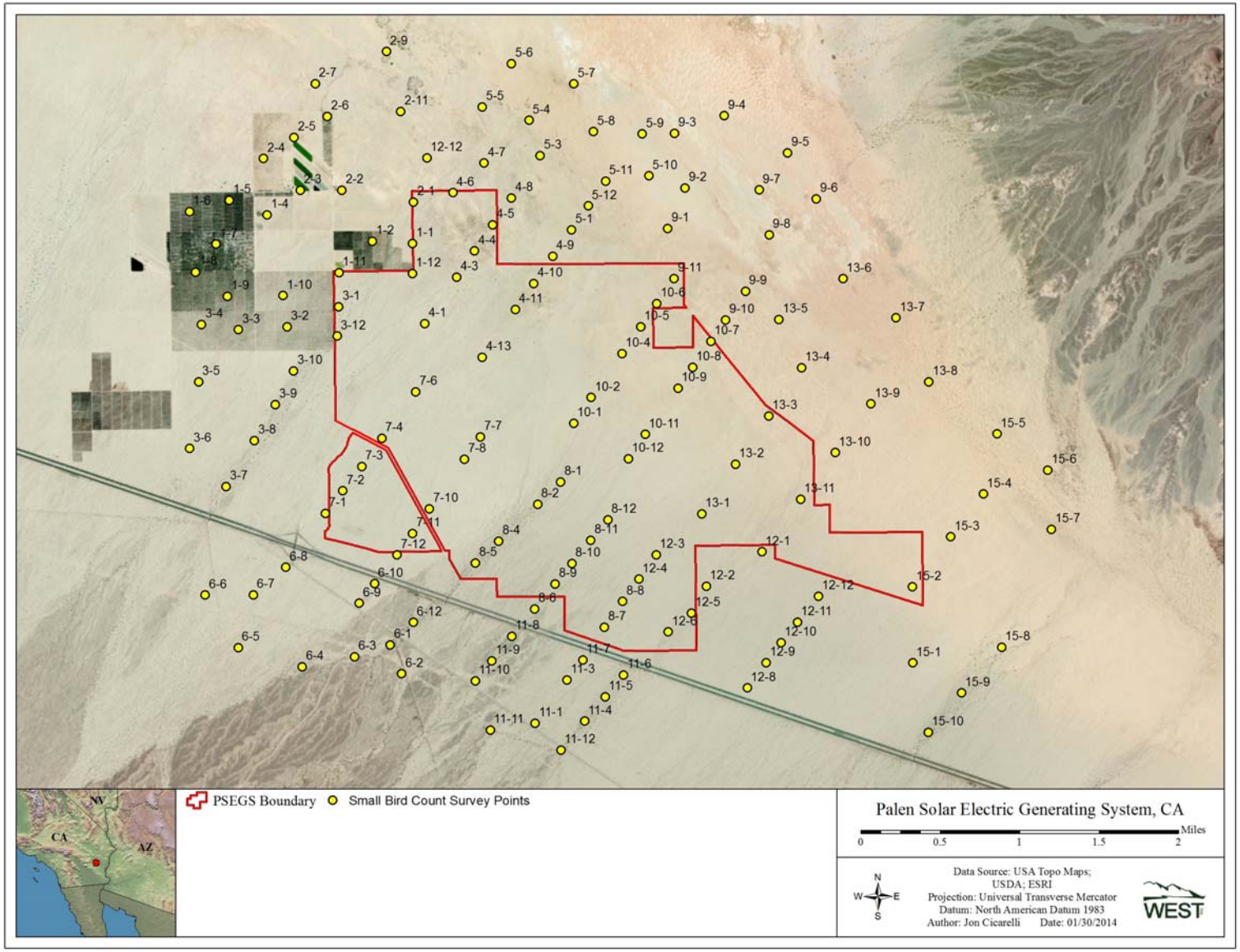

Figure 4. Location of fall 2013 small bird count (SBC) survey points at the Palen Solar Electric Generating System.

Mist Net Surveys

Mist net surveys can be a valuable component of avian survey efforts because they can detect more cryptic, ground-foraging, and non-singing birds than aural or visual surveys. Mist-netting can be a particularly valuable tool during migration periods when birds often remain silent and hard to detect, with birds spending much time during the daylight hours on the move and low to the ground, and stopping to forage within available vegetation. Therefore, mist net surveys were conducted as a way to increase the probability of detecting inconspicuous birds that might otherwise go undetected during SBC surveys.

Survey Stations

Mist net surveys were conducted each week at one of four rotating stations placed in vegetation communities representative of the PSEGS site and surrounding region. Two mist net stations were located within Desert Dry Wash Woodland (Stations 1 and 3) one station was located within Sonoran Creosote Scrub (Station 2), and one station was located within the palm plantation (Station 4; Figure 5). Each week one mist net station was surveyed for three consecutive days (ambient conditions permitting). Surveys were rotated weekly between the four stations, alternating between habitat types each week. At each mist net station, 12 standard 2.6 x 12 m (8.5 x 39 ft) mist nets were used with nets placed so as to minimize detection by small birds (e.g., out of direct sunlight to the extent possible, proximate to shrubs and/or trees when present).

Surveys Methods

At each station, nets were opened at approximately dawn (between 0600 and 0700 hours) and remained open for approximately four hours or until conditions (i.e., temperature, wind, precipitation) required nets to be closed. Surveys were conducted by experienced bird banders holding appropriate state and federal banding permits. All birds captured in nets were removed carefully, banded with a unique aluminum USFWS leg band, and released. Additionally, information recorded for all captured birds included: date, time, station, net number, bander's name, species, band number, molt, level of stored fat, and feather/plumage characteristics, and when possible, age and sex.

Survey Schedule

Mist net surveys were conducted three consecutive days per week for seven weeks during the fall season (September 18 to October 30, 2013).

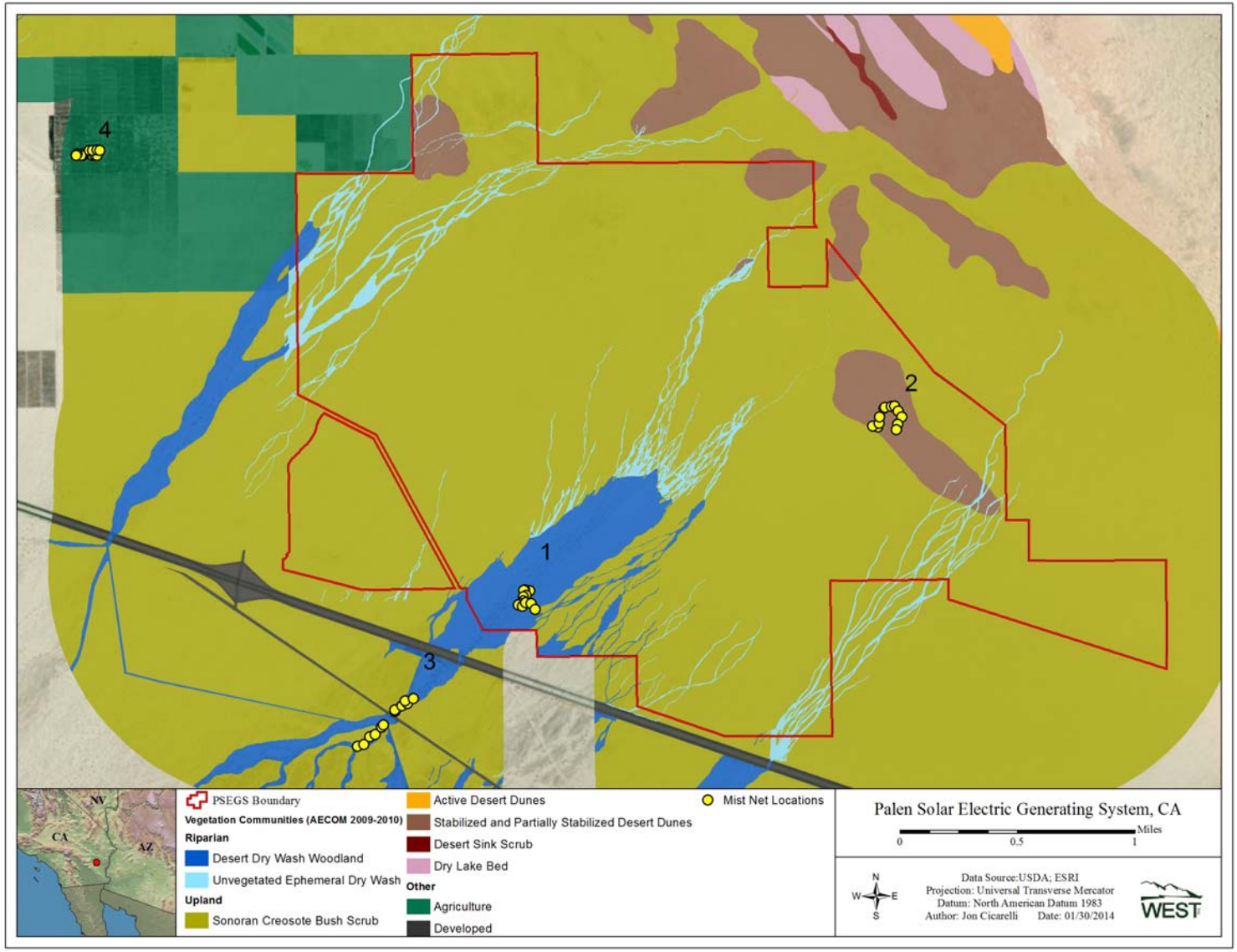

Figure 5. Location of fall 2013 mist net survey stations at the Palen Solar Electric Generating System.

Incidental Wildlife Observations

Incidental wildlife observations provide a record of wildlife seen outside of the standardized survey periods. All diurnal raptors, unusual or unique birds, sensitive species, mammals, reptiles, and amphibians were recorded in a similar fashion to standardized surveys. The observation number, date, time, species, number of individuals, sex/age class, distance from observer, activity, height above ground (for bird species) and habitat were recorded. The location of sensitive species was recorded by UTM coordinates using a hand-held Global Positioning System (GPS) unit.

Statistical Analysis

For the purpose of analysis for each survey type, a visit was defined as the required length of time, in days, to survey all of the plots once within the study area. A visit could be spread across multiple dates, but a single date could not contain surveys from multiple visits. Under certain circumstances, such as extreme weather conditions, plots were not surveyed during some visits. In these cases, a visit might not have constituted a survey of all plots.

Quality Assurance and Quality Control

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

Data Compilation and Storage

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

Bird Diversity and Species Richness

For all survey types (i.e., BUCs, shorebird/waterfowl surveys, SBCs, and mist net surveys), bird diversity was illustrated by the total number of unique species observed. A species list (with the number of observations and the number of groups) was generated for each survey type and included all observations of birds detected/captured, regardless of their distance from the observer. In some cases, the tally of observations may represent repeated sightings of the same individual. Species richness was calculated by first averaging the total number of species observed within each plot during a visit, then averaging across plots within each visit.

Bird Use, Percent of Use, and Frequency of Occurrence

Bird use, percent of use, and frequency of occurrence were calculated for both BUC and SBC surveys. For BUCs, all birds detected within the 800-m radius plot at any time were used in the

calculation of standardized bird use estimates, and the metric used to measure mean bird use was number of birds per plot per one-hour survey. For SBCs, all observations were truncated to a 100-m plot radius for the calculation of standardized use estimates, percent of use and frequency of occurrence. For SBCs, the metric used to measure mean bird use was number of birds per plot per 10-min survey. These standardized estimates of mean bird use were used to compare differences between bird types, survey points, and data collected during previous seasons at the PSEGS, where similar methods were used. Overall mean fall use for each survey type was calculated by first averaging the total number of birds seen within each plot during a visit, then averaging across plots within each visit, followed by averaging across visits within the season.

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

Bird Flight Height and Behavior

Bird flight heights are important metrics to assess potential exposure to collision with facility infrastructure and potential exposure to flux. BrightSource Energy commissioned a study that examined effects of solar flux on various sizes of bird carcasses (Santolo 2012). The Santolo study recognized effects in birds at solar flux levels of 50 kilowatts per square m (kW/m^2) and higher for a period of greater than 30 seconds. Effects on avian species were thought to occur within high levels of solar flux during operation of the Solar One facility (McCrary et al. 1986), which was corroborated by the Santolo study (2012). Two-dimensional images of solar flux provided by BrightSource Energy were used to generate simplified models of risk zones at the PSEGS. The area of flux deemed as hazardous was assumed to be 50 kW/m^2, based upon the only available scientific and commercial data where flux effects to avian species has been tested (Santolo 2012). Based on this information, flight height categories were designated that correspond to the minimum and maximum heights for each of the five solar flux contours representing differing levels of potential flux. In particular, the height range 175 - 245 m (574 – 804 ft), represents the minimum and maximum of the 50 kW/m^2 contour, which is the contour Santolo (2012) identified as representing risk to birds.

For the BUC and shorebird/waterfowl surveys, flight height information was used to calculate the percentage of birds observed flying within the designated height categories. While the solar flux zones exist near the tower rather than across the solar field, the height categories derived from the solar flux contours provide a conservative means of assessing potential risk to avian species based on the flight heights most commonly observed for individual species within the PSEGS.

Spatial Use

Flight paths and perched locations of large and medium birds recorded during BUC and shorebird/waterfowl surveys were qualitatively compared to study area characteristics (e.g., topographic features). The objective of mapping observed large bird locations and flight paths was to identify areas of concentrated use by diurnal raptors and other large birds and/or consistent flight patterns within the study area. This information can be useful in project layout design or adjustments of individual heliostat arrays/towers for micro-siting.

RESULTS

The fall avian study at the PSEGS was conducted from August 19 through December 13, 2013. A total of 185 bird species, five mammal species, and seven reptile species were identified during the study, either during standardized surveys or incidentally. The results of the individual survey types are presented below.

Bird Use Count Surveys

Bird use count surveys were conducted at six observation points, four days per week over the course of the 17-week study (August 20 – December 13, 2013), for a total of 414 surveys totaling approximately 3,234 hours of survey (Table 1).

Table 1. Summary of survey effort during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

Season	Number of Stations	Number of Visits	# Surveys Conducted	# Unique Species	Number of Observer-Hours
Fall	**6**	**68**	**414**	**75**	**3,234**

Bird Diversity and Species Richness

Seventy-five unique bird species were identified during BUC surveys, and a total of 16,808 birds in 1,475 separate groups (defined as one or more individual) were observed (Appendix A). An overall mean of 2.73 species/survey was recorded (Table 2). Species richness was highest at points 2 and 1 (3.38 and 3.33 species/survey, respectively), and lowest at points 4 and 6 (2.31 and 2.47 species/survey, respectively; Table 2).

Table 2. Summary of mean use (number of birds/observer-hour/survey) and species richness (species/survey) during bird use count surveys[a] at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

Observation Point	Mean Use	# Species/Survey
1	4.5	3.33
2	3.24	3.38
3	3.29	2.99
4	1.51	2.31
5	3.12	2.83
6	4.03	2.47
Overall	**3.09**	**2.73**

[a] Includes observations within 800-m plot surrounding the survey point

Regardless of bird size, five species (6.2% of all species) composed 96.8% of all observations: turkey vulture (*Cathartes aura*), barn swallow (*Hirundo rustica*), common raven (*Corvus corax*), white-faced ibis (*Plegadis chihi*), and red-tailed hawk (*Buteo jamaicensis*). All other species accounted for less than 1% of the observations, individually. Turkey vultures alone (107,989 observations in 1,960 separate groups) composed 93.6% of total observations during BUC surveys.

A total of 1,587 individual diurnal raptors, representing 14 unique species, were recorded during the fall BUC surveys (Appendix A). Diurnal raptors accounted for 1.4% of all observations. Among the bird types that associate with water, waterbirds accounted for 0.9% of total observations, waterfowl accounted for 0.8%, shorebirds accounted for 0.4%, and gulls/terns accounted for 0.4%.

Bird Use, Percent Composition, and Frequency of Occurrence

Mean bird use, percent of use, and frequency of occurrence were calculated for all bird types (Table 3) and species (Appendix B). To allow comparison between survey stations, as well as comparison with BUC surveys conducted during previous seasons, estimates of use, percent composition, and frequency of occurrence included only those observations recorded within an 800-m plot surrounding the survey point.

Table 3. Mean bird use (number of birds/observer-hour/survey[a]), percent of total use (%), and frequency of occurrence (%) for each bird type and raptor subtype during fall bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

Type/Species	Mean Use	% of Use	% Frequency
Waterbirds	0.03	1.0	4.6
Gannets	<0.01	<0.1	0.2
Waterfowl	0.11	3.4	5.9
Shorebirds	0.03	0.9	5.6
Gulls/Terns	0.05	1.5	3.5
Diurnal Raptors	0.18	5.7	54.0
Accipiters	*0.02*	*0.7*	*12.8*
Buteos	*0.07*	*2.4*	*30.8*
Northern Harrier	*0.02*	*0.7*	*14.8*
Eagles	*<0.01*	*<0.1*	*1.3*
Falcons	*0.04*	*1.3*	*20.9*
Osprey	*<0.01*	*0.2*	*4.9*
Other Raptors	*0.01*	*0.3*	*6.2*
Owls	<0.01	<0.1	0.4
Vultures	1.74	56.5	47.4
Upland Game Birds	<0.01	<0.1	0.2
Doves/Pigeons	<0.01	<0.1	0.8
Goatsuckers	<0.01	<0.1	0.4
Large Corvids	0.14	4.5	8.6
Swallows	0.70	27.2	49.5
Swifts/Hummingbirds	0.11	3.7	9.8
Overall	**3.09**	**100**	

[a] 800-meter (m) radius plot

Water-Dependent Bird Types

Together, use by all water-dependent bird types (i.e., waterbirds, gannets, waterfowl, shorebirds, and gulls/terns) observed during BUC surveys was 0.22 birds/observer-hour/survey (Table 3). Use by these species composed 6.8% of overall bird use recorded during surveys (Table 3). The water-dependent bird types with the greatest use were waterfowl and gull/terns (0.11 and 0.05 birds/observer-hour/survey), which composed 3.4% and 1.5% of overall bird use recorded during surveys, respectively. Waterfowl were observed during 5.9% of all BUC surveys and gulls/terns were observed during 3.5% of surveys (Table 3). The water-dependent bird species with the greatest use were snow goose (*Chen caerulescens*; 0.05 birds/observer-hour/survey), greater white-fronted goose (*Anser albifrons*; 0.03), white-faced ibis (0.02), and ring-billed gull (*Larus delawarensis*; 0.02), which collectively composed 52.9% of total use by water-dependent species and 3.6% of overall bird use (Appendix B)

Diurnal Raptors

Overall diurnal raptor use recorded during fall BUC surveys was 0.18 birds/observer-hour/survey (Table 3). Diurnal raptors composed 5.7% of total bird use and were observed during 54.0% of surveys (Table 3). The diurnal raptor species with the highest use was red-tailed hawk (0.05 birds/observer-hour/survey), which composed 28.0% of all diurnal raptor use (Appendix B). Other species with relatively high use included prairie falcon (*Falco mexicanus*; 0.03), Swainson's hawk (*Buteo swainsoni*; 0.02 birds/observer-hour/survey), northern harrier (*Circus cyaneus*; 0.02), and Cooper's hawk (*Acciptier cooperii*; 0.01; Appendix B).

Vultures

Vultures, composed entirely of turkey vultures, had a fall use of 1.74 birds/observer-hour/survey (Table 3; Appendix B). Turkey vultures accounted for 56.5% of overall bird use and were observed during 47.4% of surveys (Table 3; Appendix B).

Swallows and Swift/Hummingbirds

Despite being small birds, swallows and swifts/hummingbirds, were also included in the data collection because they are potentially more susceptible to collision and flux-related impacts at solar energy projects, based on fatality monitoring results at the Solar One facility in San Bernardino County, California (McCrary et al. 1986). Swallows had a use estimate of 0.70 birds/observer-hour/survey and composed 27.2% of overall bird use. The swallow species with the greatest use was barn swallow (14.6 birds/observer-hour/survey) which composed 53.7% of all swallow use (Appendix B). Use by swifts/hummingbirds was 0.11 birds/observer-hour/survey, which accounted for 3.7% of overall bird use recorded during surveys. Swallows were recorded during 49.5% of all fall surveys, and swifts/hummingbirds were recorded during 9.8% of fall surveys (Table 3).

Temporal Use

Temporal activity patterns were similar among raptor subtypes during fall BUC surveys (Table 4). Overall diurnal raptor use gradually increased from 0600 hours, reaching peak use between 0900 and 1100 hours, and gradually declining until 1800 hours. The high overall diurnal raptor use during the 1800 hour was the result of two northern harrier observations recorded during the only two surveys conducted during this time period. The observed temporal trend observed for individual raptor subtypes was generally the same as that of overall diurnal raptors with peak use recorded between 0800 and 1200 hours (Table 4). Vulture use in the PSEGS also followed this general trend with increasing use beginning at 0600, peak use occurring from 1000 to 1100 hours, and gradually decreasing until 1500 hours. A second peak in vulture use was observed from 1600 to 1800 hours; however, this higher level of activity may also be influenced by the fact that fewer surveys were conducted during this time period (Table 4).

Table 4. Mean use (number of birds/observer-hour/survey[a]) of diurnal raptor subtypes and vultures by survey hour recorded during fall bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

Time (hrs)	All Raptors	Accipiters	Buteos	Eagles	Falcons	Northern Harrier	Vultures
05:00-06:00	0	0	0	0	0	0	0
06:00-07:00	0.28	0	0.14	0	0.08	0.01	0.14
07:00-08:00	0.29	0.02	0.16	0	0.07	0.04	1.42
08:00-09:00	0.39	0.07	0.07	0	0.07	0.09	27.0
09:00-10:00	0.80	0.16	0.29	0	0.09	0.07	58.0
10:00-11:00	0.81	0.11	0.36	0.01	0.11	0.06	85.0
11:00-12:00	0.54	0.07	0.28	0	0.07	0.03	27.0
12:00-13:00	0.36	0.02	0.24	0.01	0.04	0.02	22.3
13:00-14:00	0.31	0.02	0.21	0	0.03	0.01	13.4
14:00-15:00	0.19	0	0.11	0	0.04	0.01	7.51
15:00-16:00	0.19	0	0.13	0	0.03	0.01	20.1
16:00-17:00	0.11	0.02	0.07	0	0	0	44.8
17:00-18:00	0	0	0	0	0	0	41.1
18:00-19:00	1.00	0	0	0	0	1.00	0
19:00-20:00	0	0	0	0	0	0	0

[a] 800-m survey plot

Seasonal Use

During the fall study, the greatest overall diurnal raptor use was recorded on August 21 (1.68 birds/observer-hour/survey); however, in general, the highest raptor use was observed during October and the lowest use during the study was observed from mid-November through mid-December. Vulture use during the study was concentrated between September 12 and October 24 when 97.9% of all vulture use was recorded. Peak vulture use occurred on October 1 (373.62 birds/observer-hour/survey) when 17,747 vultures within 78 separate groups were recorded.

Flight Height Characteristics

Flight height characteristics for bird types and diurnal raptor subtypes are shown in Table 5. Among water-dependent bird types, the majority of waterbirds (58.6%) and shorebirds (79.8%) were observed flying below 35 m (115 ft). Alternatively, waterfowl were most frequently observed flying above 280 m (919 ft) and gulls/terns were divided between less than 35 m (41.2%) and greater than 280 m (40.6%). Diurnal raptors were recorded flying within all height categories; however, the majority were observed below 35 m (37.5%) and above 280 m (18.6%). An additional 26.2% of diurnal raptors were observed flying between 35 and 105 m (115 and 344 ft). Flight heights of accipiters, buteos, and osprey followed this general trend, while northern harriers and falcons were most frequently observed flying below 35 m and most eagles were observed flying between 70 and 140 m (230 and 459 ft; Table 5). Vulture flight heights were distributed across most height categories, with the majority of observations recorded between 35 and 105 m (5.1%) and greater than 280 m (18.3%). All observations (100%) of owls, upland game birds, doves/pigeons, and goatsuckers were recorded flying below 35 m. The majority of passerines (ravens and swallows) and swifts/hummingbirds (85.8% and

68.3%, respectively) were recorded flying below 35 m; however, 19.2% of swifts/hummingbirds were observed flying above 280 m.

Spatial Variation

Overall bird use was highest at points 1 and 6 (4.50 and 4.03 birds/observer-hour/survey), primarily due to higher vulture use at these points which generally dominated fall bird use (Table 6; Figure 6a). Among water-dependent species, use by waterbirds, waterfowl, and shorebirds was greatest at point 2, while use by gulls/terns was highest at point 3. Diurnal raptor use was fairly consistent across all survey points with highest use at points 2 and 1 (0.27 and 0.23 birds/observer-hour/survey) and lowest use at point 6 (0.11; Table 6; Figure 6b). Higher raptor use at points 2 and 1 was attributed to higher use by accipiters and buteos at these points (Table 6). Eagle use was observed at points 1-4 (less than 0.01 birds/observer-hour/survey at each point), and use by northern harriers, falcons, and osprey was distributed fairly evenly across all six points. Large corvids and swifts/hummingbirds both had the greatest use at point 1 (0.43 and 0.17 birds/observer-hour/survey, respectively), while swallows had the greatest use at points 2 and 3 (0.92 and 0.82 birds/observer-hour/survey; Table 6). Flight paths for all major large bird types and raptor subtypes are presented in Appendix C.

Table 5. Flight height characteristics of birds observed during fall bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

						% within Flight Height Categories (m; based on initial observation)								
Bird Type/Species	**# grps**	**# obs.**	**Mean Flight Ht. (m)**	**Median Flight Ht. (m)**	**% in Flight**	**0-35**	**35-70**	**70-105**	**105-140**	**140-175**	**175-210**	**210-245**	**245-280**	**>280**
Waterbirds	24	133	103	25	98.5	58.6	6.0	0.8	1.5	0.8	18.8	0	0	13.5
Gannets	1	1	80	80	100	0	0	100	0	0	0	0	0	0
Waterfowl	45	397	385	200	100	11.6	3.3	15.1	9.8	1.5	15.9	0	0	42.8
Shorebirds	23	99	37	20	91.7	79.8	5.1	6.1	6.1	3.0	0	0	0	0
Gulls/Terns	23	187	233	100	100	41.2	3.7	9.6	0	0	4.3	0	0.5	40.6
Diurnal Raptors	507	581	151	75	94.9	37.5	14.5	11.7	2.4	6.9	5.7	0.2	2.6	18.6
Accipiters	*76*	*81*	*126*	*50*	*97.6*	*37.0*	*21.0*	*13.6*	*1.2*	*2.5*	*2.5*	*1.2*	*1.2*	*19.8*
Buteos	*193*	*248*	*218*	*150*	*94.7*	*27.0*	*11.7*	*10.9*	*2.4*	*10.9*	*6.9*	*0*	*4.8*	*25.4*
Northern Harrier	*76*	*77*	*35*	*10*	*98.7*	*68.8*	*16.9*	*6.5*	*3.9*	*1.3*	*1.3*	*0*	*0*	*1.3*
Eagles	*4*	*4*	*155*	*120*	*100*	*0*	*0*	*25.0*	*50.0*	*0*	*0*	*0*	*0*	*25.0*
Falcons	*108*	*114*	*76*	*25*	*91.9*	*56.1*	*12.3*	*11.4*	*0*	*5.3*	*7.9*	*0*	*1.8*	*5.3*
Osprey	*19*	*20*	*178*	*80*	*90.9*	*5.0*	*40.0*	*25.0*	*5.0*	*5.0*	*0*	*0*	*0*	*20.0*
Other Raptors	*31*	*37*	*324*	*175*	*94.9*	*8.1*	*8.1*	*16.2*	*2.7*	*8.1*	*10.8*	*0*	*0*	*45.9*
Owls	2	2	3	3	100	100	0	0	0	0	0	0	0	0
Vultures	489	6708	135	100	99.8	11.6	20.9	24.2	5.2	6.1	11.6	0	2	18.3
Upland Game Birds	1	2	8	8	100	100	0	0	0	0	0	0	0	0
Doves/Pigeons	6	7	6	5	100	100	0	0	0	0	0	0	0	0
Goatsuckers	2	2	9	9	100	100	0	0	0	0	0	0	0	0
Passerines	930	2720	13	5	99.7	85.8	8.0	3.6	0.4	1.5	0.3	0	<0.1	0.3
Swifts/Hummingbirds	78	224	17	5	100	68.3	1.3	5.8	0	5.4	0	0	0	19.2

Table 6. Mean use (number of birds/observer-hour/survey[a]) by point for all birds, major bird types, and diurnal raptor subtypes observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

	Survey Point					
Bird Type	**1**	**2**	**3**	**4**	**5**	**6**
Waterbirds	<0.01	0.12	0.08	<0.01	<0.01	<0.01
Gannets	<0.01	0	0	0	0	0
Waterfowl	0.17	0.27	0.07	0.02	0.11	0.04
Shorebirds	0.01	0.13	0.02	<0.01	0.02	<0.01
Gulls/Terns	0.03	0.01	0.08	0.02	0.1	0.05
Diurnal Raptors	0.23	0.27	0.14	0.17	0.18	0.11
Accipiters	*0.05*	0.04	0.01	0.01	0.02	<0.01
Buteos	*0.12*	0.13	0.06	0.06	0.06	0.04
Northern Harrier	*0.02*	0.03	0.02	0.02	0.02	0.03
Eagles	*<0.01*	<0.01	<0.01	<0.01	0	0
Falcons	*0.04*	0.05	0.02	0.05	0.05	0.03
Osprey	*<0.01*	<0.01	0.01	<0.01	0.01	<0.01
Other Raptors	*<0.01*	0.01	0.01	0.02	0.02	<0.01
Owls	0	0	0	0	0	<0.01
Vultures	2.66	1.28	1.90	0.73	1.77	3.25
Upland Game Birds	0	0	<0.01	0	0	0
Doves/Pigeons	<0.01	<0.01	<0.01	0	0	<0.01
Goatsuckers	0	0	<0.01	0	<0.01	0
Large Corvids	0.43	0.14	0.14	0.01	0.09	0.12
Swallows	0.77	0.92	0.82	0.53	0.76	0.41
Swifts/Hummingbirds	0.17	0.09	0.03	0.03	0.09	0.03
Overall	**4.50**	**3.24**	**3.29**	**1.51**	**3.12**	**4.03**

[a] 800-meter (m) radius plot

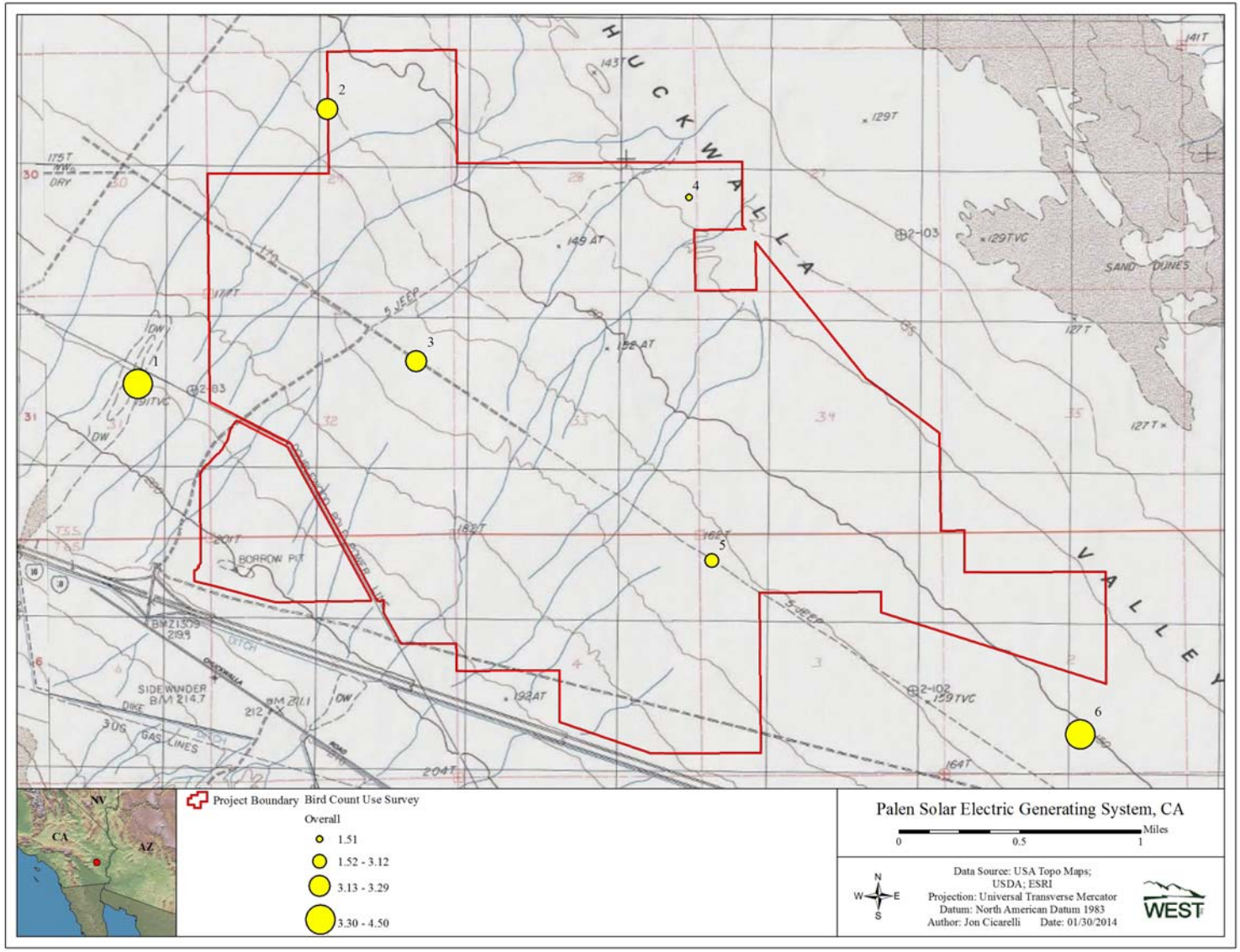

Figure 6a. Bubble plots of overall bird use (# birds/observer-hour/survey) by point during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

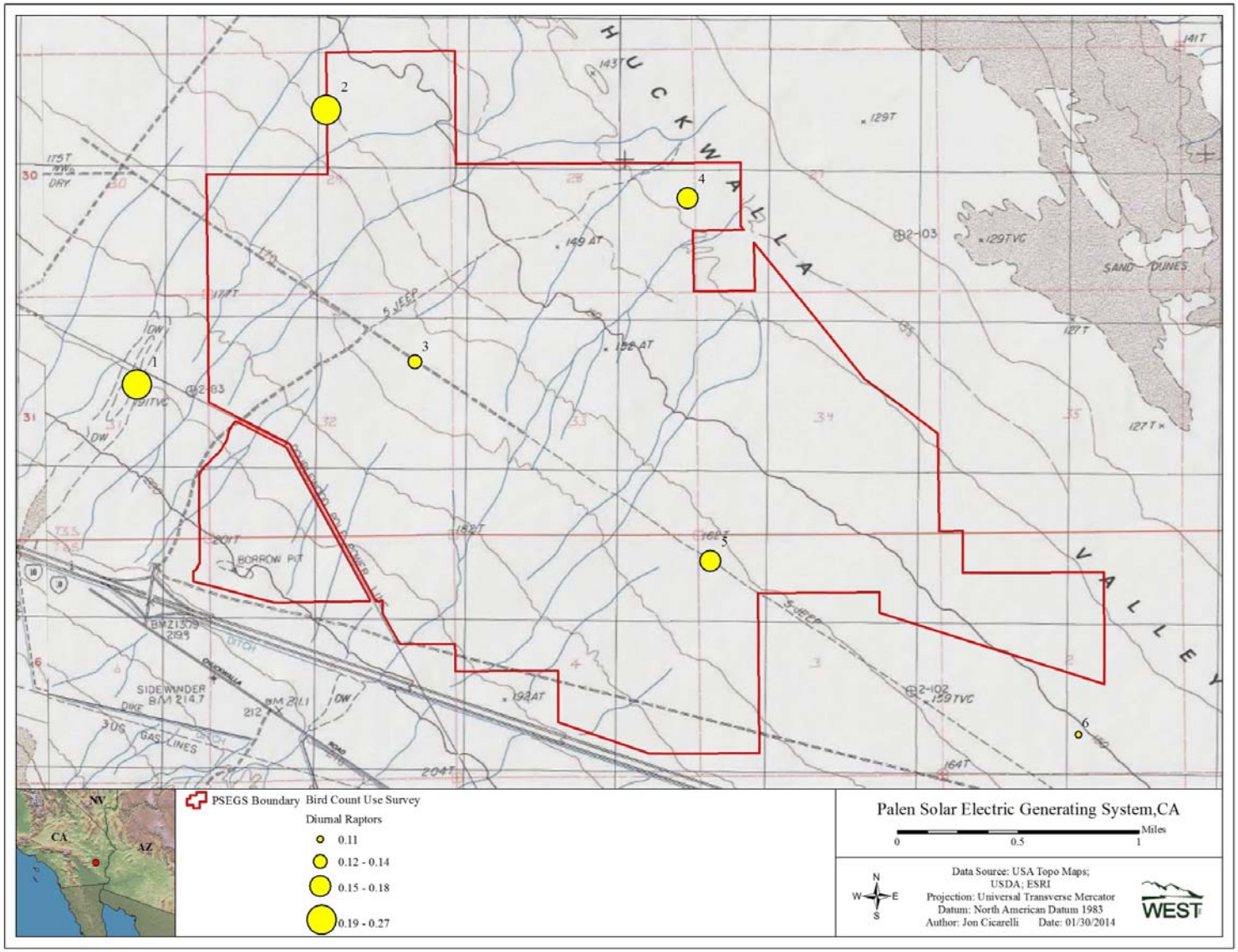

Figure 6b. Bubble plots of diurnal raptor use (# raptors/observer-hour/survey) by point during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

Shorebird/Waterfowl Surveys

Shorebird/waterfowl surveys were conducted at the PSEGS from August 19 – December 10, 2013, during which time approximately 106 hours of surveys were conducted over the course of 17 weekly visits to the three observation points (Table 7).

Table 7. Summary of survey effort and species diversity (# unique species) during shorebird/waterfowl surveys at the Palen Solar Electric Generating System, August 19 – December 10, 2013.

Season	Number of Visits	# Surveys Conducted	Number of Observer-Hours	# Unique Species
Fall	**17**	**51**	**106**	**77**

Bird Diversity and Species Richness

A total of 3,169 individual bird observations within 754 separate groups were recorded during shorebird/waterfowl surveys (Appendix D), and 77 unique species were identified (Table 7). Cumulatively, eight species (8.1% of all species) composed 64.8% of the individual observations: turkey vulture (843 observations), barn swallow (446 observations), eared grebe (*Podiceps nigricollis*; 191 observations), American coot (*Fulica americana*; 165 observations), American avocet (*Recurvirostra americana*; 152 observations), ring-billed gull (89 observations), common goldeneye (*Bucephala clangula*; 89 observations), and ruddy duck (*Oxyura jamaicensis*; 79 observations). All other species composed less than 3% of the observations individually (Appendix D). Major bird types observed during surveys are discussed below.

Loons/Grebes

Loons/grebes composed 8.4% of total observations during surveys. Four species of loons/grebes were recorded, the most common of which was eared grebe (191 observations in 25 separate groups; Appendix D).

Waterbirds

Eight species of waterbirds were observed during surveys, composing 5.4% of overall bird observations. The waterbird species most commonly observed were white-faced ibis (72 observations in 11 separate groups) and great egret (*Ardea alba*; 46 observations in 23 separate groups; Appendix D).

Waterfowl

Waterfowl were the most commonly observed water-dependent bird type recorded during shorebird/waterfowl surveys, composing 15.5% of total observations. Nineteen waterfowl species were observed and the most commonly recorded species were common goldeneye (89 observations within 12 separate groups), ruddy duck (79 observations in 14 separate groups), and northern shoveler (*Anas clypeata*; 72 observations in 15 separate groups).

Shorebirds

Shorebirds were the second most commonly recorded water-dependent bird type observed during surveys, composing 11.4% of total observations. Of the 15 shorebird species recorded, the most common were American avocet (152 observations in 14 separate groups), least sandpiper (*Calidris minutilla*; 53 observations in 21 separate groups), and killdeer (*Charadrius vociferus*; 51 observations in 27 separate groups; Appendix D).

Gull/Terns

Five species of gulls/terns were observed, composing 3.5% of total observations. The most commonly recorded species was the California gull (*Larus californicus*; 12 observations in five separate groups; Appendix D).

Rails/Coots

Only a single rail/coot species was recorded during surveys, American coot (165 observations in 29 separate groups; Appendix D). This species composed 5.2% of overall bird observations.

Diurnal Raptors

A total of 68 observations of diurnal raptors, comprising 11 distinct species, were recorded during shorebird/waterfowl surveys. Diurnal raptors composed 2.1% of total observations. The most common diurnal raptor species recorded were red-tailed hawk (25 observations), prairie falcon (10 observations), and Cooper's hawk (nine observations; Appendix D).

Vultures

Vultures, comprised solely of turkey vultures (843 observations in 69 separate groups), was the most common bird type recorded during shorebird/waterfowl surveys, composing 26.6% of total observations.

Swallows and Swifts/Hummingbirds

Swallows were the second most common bird type recorded during shorebird/waterfowl surveys, composing 20.1% of total observations. The most frequently observed swallow species were barn swallows (446 observations in 82 separate groups) and tree swallow (*Tachycineta bicolor*; 73 observations in 33 separate groups). Swifts/hummingbirds composed only 0.2% of total observations with Vaux's swift (*Chaetura vauxi*; six observations) the only swift/hummingbird species recorded (Appendix D).

Flight Height Characteristics

Flight height characteristics for bird types and diurnal raptor subtypes are shown in Table 8. Among water-dependent bird types, the majority of waterbirds (66.0%), waterfowl (86.6%), shorebirds (86.8%), and gulls/terns (51.4%) were observed flying below 35 m; no loons/grebes were recorded flying (Table 8). Diurnal raptors and vultures were recorded flying primarily below 35 m (76.7% and 84.0%, respectively), and flight heights of raptor subtypes followed this general trend. All observations (100%) of upland game birds, doves/pigeons, goatsuckers, large corvids, and swifts/hummingbirds were recorded flying below 35 m. The majority (98.5%) of swallows were also recorded flying below 35 m (Table 8).

Table 8. Flight height characteristics of birds observed during shorebird/waterfowl surveys[a] at the Palen Solar Electric Generating System, August 19 – December 10, 2013.

						% within Flight Height Categories (m; based on initial observation)								
Bird Type/Species	# grps	# obs.	Mean Flight Ht. (m)	Median Flight Ht. (m)	% in Flight	0-35	35-70	70-105	105-140	140-175	175-210	210-245	245-280	>280
Loons/Grebes	64	267	0	0	0	0	0	0	0	0	0	0	0	0
Waterbirds	72	166	18	15	50.0	66.0	22.3	11.7	0	0	0	0	0	0
Waterfowl	142	492	51	7	18.3	86.6	10.5	0	0	0	0	0	0	3.0
Shorebirds	117	360	9	5	59.8	86.8	0.9	12.3	0	0	0	0	0	0
Gulls/Terns	20	111	81	20	75.0	51.4	10.8	0	0	0	0	0	36.5	1.4
Diurnal Raptors	61	63	30	10	95.1	76.7	8.3	10.0	1.7	0	1.7	0	1.7	0
Accipiters	15	15	30	8	100	86.7	0	6.7	0	0	0	0	6.7	0
Buteos	25	22	34	10	88.0	63.6	18.2	13.6	4.5	0	0	0	0	0
Northern Harrier	6	7	8	1	100	100	0	0	0	0	0	0	0	0
Falcons	12	12	10	12	100	91.7	8.3	0	0	0	0	0	0	0
Osprey	4	4	90	20	100	25.0	0	50.0	0	0	25.0	0	0	0
Vultures	55	450	69	40	89.1	84.0	3.7	3.0	0	4.7	0.7	0	1.5	2.5
Upland Game Birds	9	24	17	18	66.7	100	0	0	0	0	0	0	0	0
Doves/Pigeons	3	12	4	4	33.3	100	0	0	0	0	0	0	0	0
Goatsuckers	1	9	20	20	100	100	0	0	0	0	0	0	0	0
Large Corvids	4	45	16	20	100	100	0	0	0	0	0	0	0	0
Swallows	147	585	8	5	100	98.5	1.5	0	0	0	0	0	0	0
Swifts/Hummingbirds	4	6	12	8	100	100	0	0	0	0	0	0	0	0

[a] Includes observations within an 800-m radius plot.

Small Bird Count Surveys

Small bird count surveys were conducted at the PSEGS from August 19 to November 14, 2013, during which time 1,939 10-min point count surveys (approximately 323 hours of surveys) were conducted at the project site over the course of 13 weekly visits (Table 9).

Table 9. Summary of overall bird use (number of birds/point/10-min survey), species richness (species/point/10-min survey), and sample size during small bird count surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013.

Season	# of Visits	Species Richness	# Species	# Surveys Conducted
Fall	13	1.12	122	1,939

Bird Diversity and Species Richness

One-hundred-twenty-two unique species were identified during the small bird count surveys and the mean number of species observed per point per survey was 1.12 (Table 9). A total of 10,077 individual bird observations in 3,103 separate groups were recorded (Appendix E). Cumulatively, five species (4.1% of all species) composed 69.6% of the individual observations: horned lark (*Eremophila alpestris*; 2,542 observations), turkey vulture (1,877 observations; most seen outside of the 100-m view shed), house finch (*Haemorhous mexicanus*; 1,098 observations), common raven (1,002 observations), and yellow-rumped warbler (*Setophaga coronata*; 496 observations). All other species composed less than 4% of the observations individually (Appendix E).

Bird Use, Composition, and Frequency of Occurrence by Species and Type

Mean bird use estimates, percent of total composition, and frequency of occurrence for all bird types and passerine subtypes within the 100-m plots are shown in Table 10. A complete list of use estimates, percent of total composition, and frequency of occurrence for all birds is presented in Appendix F. Statistics presented in Table 10 and Appendix G include only those observations within a 100-m viewshed surrounding each survey point.

Water-Dependent Bird Types

Together, use by all water-dependent bird types (i.e., loons/grebes, waterbirds, waterfowl, shorebirds, gulls/terns, and rails/coots) observed during SBC surveys was 0.17 birds/observer-hour/survey (Table 10). Use by these bird types composed 4.2% of overall bird use recorded during surveys (Table 10). The water-dependent bird types with the greatest use were shorebirds and loons/grebes (0.05 and 0.04 birds/100-m plot/survey), which composed 1.2% and 1.1% of overall bird use recorded during surveys, respectively. Shorebirds were observed during 1.3% of all SBC surveys and loons/grebes were observed during 0.3% of surveys (Table 10). The water-dependent bird species with the greatest use were eared grebe (0.03 birds/100-m plot/survey), white-faced ibis (0.02), and American coot (0.02), which collectively composed 41.1% of use by water-dependent species (Appendix F).

Table 10. Mean bird use (number of birds/plot/10-min survey), percent of use, and frequency of occurrence (%) for each bird type and species by season during small bird count surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013.

Bird Type / Species	Mean Use	% of Use	% Frequency
Loons/Grebes	0.04	1.1	0.3
Waterbirds	0.03	0.8	0.7
Waterfowl	0.03	0.6	0.5
Shorebirds	0.05	1.2	1.3
Gulls/Terns	<0.01	0.1	<0.1
Rails/Coots	0.02	0.6	0.4
Diurnal Raptors	0.03	0.8	3.2
Owls	<0.01	<0.1	0.1
Vultures	0.55	13.6	2.1
Upland Game Birds	0.07	1.8	0.9
Doves/Pigeons	0.14	3.4	4.5
Passerines	3.07	75.6	52.9
Blackbirds/Orioles	*0.07*	*1.8*	*1.6*
Corvids	*0.24*	*6.0*	*7.9*
Finches/Crossbills	*0.53*	*13.1*	*12.2*
Flycatchers	*0.08*	*1.9*	*6.4*
Gnatcatchers/Kinglet	*0.06*	*1.5*	*4.0*
Grassland/Sparrows	*1.31*	*32.3*	*20.9*
Mimids	*0.01*	*0.3*	*1.1*
Swallows	*0.25*	*6.1*	*6.8*
Shrikes	*0.05*	*1.2*	*4.5*
Tanagers/Grosbeaks/Cardinals	*<0.01*	*0.1*	*0.3*
Thrushes	*<0.01*	*<0.1*	*0.1*
Titmice/Chickadees	*0.12*	*2.9*	*9.8*
Vireos	*<0.01*	*<0.1*	*0.1*
Warblers	*0.28*	*7.0*	*9.6*
Waxwings	*<0.01*	*<0.1*	*0.2*
Wrens	*0.02*	*0.6*	*1.8*
Unidentified Passerines	*0.03*	*0.7*	*1.7*
Swifts/Hummingbirds	<0.01	0.1	0.3
Woodpeckers	0.01	0.3	0.8
Unidentified Birds	<0.01	<0.1	0.1
Overall	**4.07**	**100**	

Diurnal Raptors

The majority of diurnal raptors were observed outside of the 328-ft viewshed. Those observed within the viewshed resulted in a use of 0.03 birds/100-m plot/survey (Table 10). The diurnal raptor species with the greatest use was red-tailed hawk (0.01 birds/100-m plot/survey); all other diurnal raptor species had use estimates of less than 0.01 birds/100-m plot/survey; Appendix F). Diurnal raptors were observed during 3.2% of the surveys and composed 0.8% of the overall use during SBC surveys (Table 10).

Vultures

Most of the vultures (comprised entirely of turkey vultures) were observed outside of the 100-m viewshed; however, those observed within the viewshed resulted in a use of 0.55 birds/100-m plot/survey (Table 10; Appendix F). While vultures were observed during only 2.1% of the surveys, they composed 13.6% of the overall use (Table 10).

Upland Game Birds

One upland game bird species was observed during surveys, Gambel's quail (*Callipepla gambelii*), resulting in use of 0.07 birds/100-m plot/survey. Gambel's quail were observed during 0.9% of surveys and composed 1.8% of the overall use (Table 10).

Passerines

Mean use by passerines was 3.07 birds/100-m plot/survey. Passerines were observed during 52.9% of all surveys and composed 75.6% of overall use (Table 10). The majority of use by passerines was attributed to the subtypes grassland/sparrow (1.31 birds/point/survey), finches/crossbills (0.53 birds/plot/survey), warblers (0.28 birds/plot/survey), swallows (0.25 birds/plot/survey), and corvids (0.24 birds/plot/survey), which collectively composed 64.5% of all passerine use (Table 10). Individual passerine species with the greatest use included horned lark (1.18 birds/100-m plot/survey), house finch (0.25), yellow-rumped warbler (0.25), and common raven (0.24; Appendix F).

Spatial Use

Mean use (birds/point/survey) by point for all birds combined and major bird types (waterbirds, waterfowl, shorebirds, diurnal raptors, owls, vultures, upland game birds, doves/pigeons, passerines, swifts/hummingbirds, and woodpeckers) is included in Appendix G. For all bird species combined, use was highest at points 2-3, 2-4, 9-8, 3-10, and 7-11 (51.00, 27.08, 25.77, 18.77, and 18.77 birds/point/survey, respectively; Figure 7). Much higher use at point 2-3 was attributed to relatively high use by multiple bird types, including loons/grebes, waterbirds, waterfowl, shorebirds, vultures, and passerines. All bird use at other points ranged from 0.08 to 18.15 birds/point/survey. Use by water-dependent species (e.g., loons/grebes, waterbirds, waterfowl, and shorebirds) occurred primarily along transects 1 and 2 in the northwest portion of the study area (Appendix G). Use by diurnal raptors was generally higher along transects 1 and 3; however, the highest use by diurnal raptors was observed at point 5-5 (0.31 birds/plot/survey). Use by vultures was generally higher along transects 2, 3, 7, and 11, with the highest vulture use observed at point 3-10 (15.62 birds/point/survey). Owls were only observed at points 5-7 and 12-12 (0.08 birds/point/survey at each). Passerines had the highest mean use estimate at points 2-3, 2-5, and 9-8 (25.2, 23.38, and 25.77 birds/plot/survey, respectively), and higher average use along transects 1, 2, 3, and 9 (Appendix G; Figure 7). The subtype swift/hummingbird was recorded only at points 2-3, 10-11, 11-10, 12-3, and 15-7, and ranged from 0.08 to 0.23 birds/plot/survey. Use by woodpeckers was recorded only along transects 1 and 3 with use values ranging from zero to 0.54 birds/plot/survey (Appendix G).

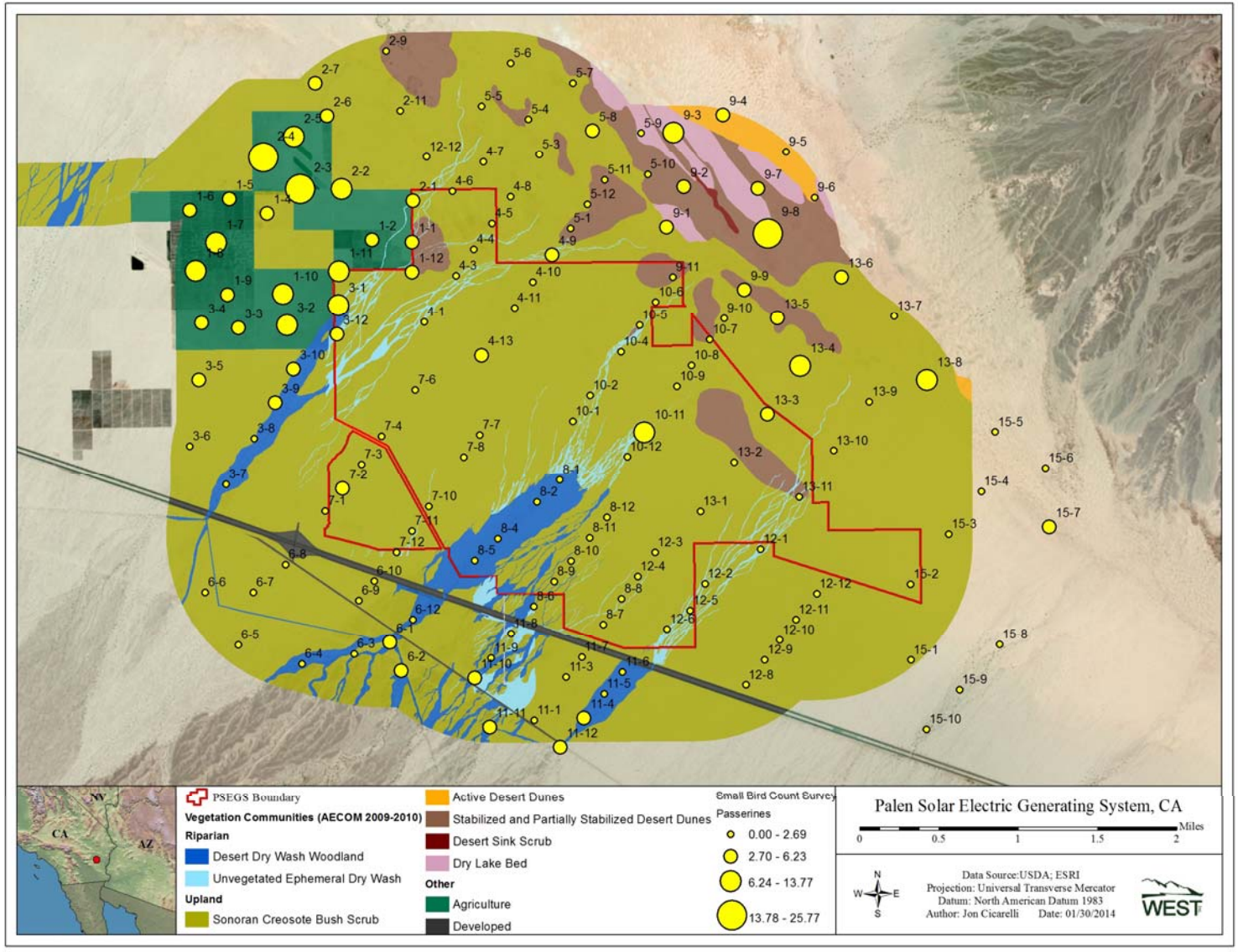

Figure 7. Bubble plots of passerine use (# birds/observer-hour/survey) by point during small bird count surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013.

Mist Net Surveys

Mist net surveys were conducted for three consecutive days per week for seven weeks, with one of four different stations surveyed each week. Each survey ranged in duration from 3.3 hours (ending early due to high temperature, a risk to mist-netted birds) to 5.0 hours per day, and averaged 4.5 hours in duration over the entire seven-week period. A total of 1,080 mist net survey hours (survey hours X number of nets) was conducted during this period and 107 birds, comprising 25 unique species, were captured (Table 11). Capture rates varied considerably across survey days and stations, with daily averages ranging from zero to 0.51 captures per net-hour (Table 11). The highest capture rates occurred at Station 4 (the palm plantation), while no birds were captured at Station 2 (creosote scrub; Table 11). The overall capture rate for the 7-week period was 0.10 captures per net-hour. A complete list of all individuals captured is presented in Table 12, with information regarding the date and location of capture, as well as habitat type. The most common species captured included orange-crowned warbler (*Oreothlypis celata*; eight individuals), white-crowned sparrow (*Zonotrichia leucophrys*; eight individuals), Lincoln's sparrow (*Melospiza lincolnii*; six individuals), ruby-crowned kinglet (*Regulus calendula*; six individuals), and verdin (*Auriparus flaviceps*; four individuals; Table 12). Seven species were captured during mist net surveys that were not recorded during any other survey type during the fall study, including yellow-green vireo (*Vireo flavoviridis*), warbling vireo (*V. gilvus*), fox sparrow (*Passerella iliaca*), Pacific-slope flycatcher (*Empidonax difficilis*), western wood-pewee (*Contopus sordidulus*), red-naped sapsucker (*Sphyrapicus nuchalis*), and blue-headed vireo (*V. solitarius*; Table 12).

Table 11. Mist net survey effort and capture rates at the Palen Solar Electric Generating System, September 18 to October 30, 2013.

Date	Station	Habitat	# of Nets	Net-hours	# of captures	# of species	# of captures/ net-hour
9/18/2013	1	dry wash woodland	12	54	1	1	0.02
9/19/2013	1	dry wash woodland	12	54	0	0	0
9/20/2013	1	dry wash woodland	12	48	1	1	0.02
9/24/2013	2	creosote scrub	12	45	0	0	0
9/25/2013	2	creosote scrub	12	45	0	0	0
9/26/2013	2	creosote scrub	12	48	0	0	0
9/30/2013	3	dry wash woodland	12	48	3	3	0.06
10/1/2013	3	dry wash woodland	12	48	0	0	0
10/2/2013	3	dry wash woodland	12	48	8	6	0.17
10/9/2013	4	palm plantation	12	54	4	4	0.07
10/10/2013	4	palm plantation	12	57	8	5	0.14
10/11/2013	4	palm plantation	12	54	20	10	0.37
10/14/2013	4	palm plantation	12	60	10	5	0.17
10/15/2013	4	palm plantation	12	57	8	5	0.14
10/16/2013	4	palm plantation	12	57	29	8	0.51
10/21/2013	3	dry wash woodland	12	51	3	3	0.06
10/22/2013	3	dry wash woodland	12	54	7	5	0.13
10/23/2013	3	dry wash woodland	12	51	3	3	0.06
10/28/2013	1	dry wash woodland	12	48	0	0	0
10/29/2013	1	dry wash woodland	12	48	1	1	0.02
10/30/2013	1	dry wash woodland	12	51	1	1	0.02
Overall			**252**	**1,080**	**107**	**25**	**0.10**

Table 12. Species captured by date and station/habitat type during mist net surveys at the Palen Solar Electric Generating System, September 18 to October 30, 2013.

Common Name	Scientific Name	Date	Station	Habitat Type
verdin	*Auriparus flaviceps*	9/18/2013	1	dry wash woodland
verdin	*Auriparus flaviceps*	10/21/2013	3	dry wash woodland
verdin	*Auriparus flaviceps*	10/22/2013	3	dry wash woodland
verdin	*Auriparus flaviceps*	10/23/2013	3	dry wash woodland
black-tailed gnatcatcher	*Polioptila melanura*	9/20/2013	1	dry wash woodland
house wren	*Troglodytes aedon*	9/30/2013	3	dry wash woodland
house wren	*Troglodytes aedon*	10/2/2013	3	dry wash woodland
house wren	*Troglodytes aedon*	10/22/2013	3	dry wash woodland
orange-crowned warbler	*Oreothlypis celata*	9/30/2013	3	dry wash woodland
orange-crowned warbler	*Oreothlypis celata*	10/2/2013	3	dry wash woodland
orange-crowned warbler	*Oreothlypis celata*	10/9/2013	4	palm plantation
orange-crowned warbler	*Oreothlypis celata*	10/10/2013	4	palm plantation
orange-crowned warbler	*Oreothlypis celata*	10/11/2013	4	palm plantation
orange-crowned warbler	*Oreothlypis celata*	10/14/2013	4	palm plantation
orange-crowned warbler	*Oreothlypis celata*	10/15/2013	4	palm plantation
orange-crowned warbler	*Oreothlypis celata*	10/16/2013	4	palm plantation
white-crowned sparrow	*Zonotrichia leucophrys*	9/30/2013	3	dry wash woodland
white-crowned sparrow	*Zonotrichia leucophrys*	10/2/2013	3	dry wash woodland
white-crowned sparrow	*Zonotrichia leucophrys*	10/11/2013	4	palm plantation
white-crowned sparrow	*Zonotrichia leucophrys*	10/14/2013	4	palm plantation
white-crowned sparrow	*Zonotrichia leucophrys*	10/15/2013	4	palm plantation
white-crowned sparrow	*Zonotrichia leucophrys*	10/16/2013	4	palm plantation
white-crowned sparrow	*Zonotrichia leucophrys*	10/21/2013	3	dry wash woodland
white-crowned sparrow	*Zonotrichia leucophrys*	10/22/2013	3	dry wash woodland
Wilson's warbler	*Cardellina pusilla*	10/2/2013	3	dry wash woodland
yellow warbler	*Setophaga petechia*	10/2/2013	3	dry wash woodland
yellow warbler	*Setophaga petechia*	10/14/2013	4	palm plantation
yellow-green vireo	*Vireo flavoviridis*	10/2/2013	3	dry wash woodland
warbling vireo	*Vireo gilvus*	10/9/2013	4	palm plantation
Lincoln's sparrow	*Melospiza lincolnii*	10/9/2013	4	palm plantation
Lincoln's sparrow	*Melospiza lincolnii*	10/11/2013	4	palm plantation
Lincoln's sparrow	*Melospiza lincolnii*	10/14/2013	4	palm plantation
Lincoln's sparrow	*Melospiza lincolnii*	10/15/2013	4	palm plantation
Lincoln's sparrow	*Melospiza lincolnii*	10/16/2013	4	palm plantation
Lincoln's sparrow	*Melospiza lincolnii*	10/22/2013	3	dry wash woodland
ruby-crowned kinglet	*Regulus calendula*	10/9/2013	4	palm plantation
ruby-crowned kinglet	*Regulus calendula*	10/11/2013	4	palm plantation
ruby-crowned kinglet	*Regulus calendula*	10/15/2013	4	palm plantation
ruby-crowned kinglet	*Regulus calendula*	10/16/2013	4	palm plantation
ruby-crowned kinglet	*Regulus calendula*	10/23/2013	3	dry wash woodland
ruby-crowned kinglet	*Regulus calendula*	10/30/2013	1	dry wash woodland
black phoebe	*Sayornis nigricans*	10/10/2013	4	palm plantation
fox sparrow	*Passerella iliaca*	10/10/2013	4	palm plantation
Pacific-slope flycatcher	*Empidonax difficilis*	10/10/2013	4	palm plantation
Pacific-slope flycatcher	*Empidonax difficilis*	10/11/2013	4	palm plantation
Pacific-slope flycatcher	*Empidonax difficilis*	10/16/2013	4	palm plantation
western wood-pewee	*Contopus sordidulus*	10/10/2013	4	palm plantation
willow flycatcher	*Empidonax traillii*	10/11/2013	4	palm plantation
willow flycatcher	*Empidonax traillii*	10/16/2013	4	palm plantation

Table 12. Species captured by date and station/habitat type during mist net surveys at the Palen Solar Electric Generating System, September 18 to October 30, 2013.

Common Name	Scientific Name	Date	Station	Habitat Type
red-naped sapsucker	*Sphyrapicus nuchalis*	10/11/2013	4	palm plantation
loggerhead shrike	*Lanius ludovicianus*	10/11/2013	4	palm plantation
loggerhead shrike	*Lanius ludovicianus*	10/22/2013	3	dry wash woodland
yellow-rumped warbler	*Setophaga coronata*	10/11/2013	4	palm plantation
yellow-rumped warbler	*Setophaga coronata*	10/16/2013	4	palm plantation
yellow-rumped warbler	*Setophaga coronata*	10/23/2013	3	dry wash woodland
hermit thrush	*Catharus guttatus*	10/11/2013	4	palm plantation
common yellowthroat	*Geothlypis trichas*	10/14/2013	4	palm plantation
Savannah sparrow	*Passerculus sandwichensis*	10/15/2013	4	palm plantation
blue-headed vireo	*Vireo solitarius*	10/16/2013	4	palm plantation
MacGillivray's warbler	*Geothlypis tolmiei*	10/21/2013	3	dry wash woodland
Bewick's wren	*Thryomanes bewickii*	10/29/2013	1	dry wash woodland

Incidental Wildlife Observations

A total of 113 bird species, totaling 7,433 birds within 425 separate groups, were recorded incidentally at the PSEGS during all survey types (Appendix H). Ten species were only observed incidentally (i.e., not observed during any standardized survey): belted kingfisher (*Ceryle alcyon*), black-throated sparrow (*Amphispiza bilineata*), chestnut-collared longspur (*Calcareius ornatus*), dickcissel (*Spiza americana*), mountain bluebird (*Sialia currucoides*), swamp sparrow (*Melospiza georgiana*), Swainson's thrush (*Catharus ustulatus*), Townsend's warbler (*Setophaga townsendi*), vesper sparrow (*Pooecetes gramineus*), and western scrub-jay (*Aphelocoma californica*; Appendix H). Five mammal species and seven reptile species were also observed incidentally within the PSEGS (Appendix H).

Sensitive Species Observations

Thirty-two sensitive bird species were recorded during all survey types and incidentally (Table 13). No federal listed or proposed species were identified during the study; however, six species listed or fully-protected in California were recorded. These included two state-endangered species (willow flycatcher [*Empidonax traillii*] and Gila woodpecker [*Melanerpes uropygialis*), two state-threatened species (Swainson's hawk and bank swallow [*Riparia riparia*]), and two fully-protected species (golden eagle and peregrine falcon [*Falco peregrinus*]; Table 13). It should be noted that one subspecies of willow flycatcher, the southwestern willow flycatcher (*Empidonax traillii extimus*), is also a federal-endangered species (CDFW 2013); however it is unknown which subspecies of willow flycatcher was observed during surveys. Other sensitive species recorded during surveys or incidentally included 16 state-designated species of special concern, 10 federal species of concern, and six federal priority shorebird species. Additionally, golden eagles are further protected under the federal Bald and Golden Eagle Protection Act (BGEPA 1940).

Table 13. Summary of sensitive species observed at the Palen Solar Electric Generating System during bird use count surveys (BUC), shorebird/waterfowl surveys (S/W), small bird count surveys (SBC), mist net surveys (MN), and as incidental wildlife observations (Inc.) from August 19 – December 13, 2013.

			BUC		S/W		SBC		MN		Inc		Total	
Species	Scientific Name	Status	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs	# grps	# obs
American white pelican	*Pelecanus erythrorhynchos*	SSC	9	32	2	9	1	1	0	0	0	0	12	42
sandhill crane	*Grus canadensis*	SSC	6	57	0	0	0	0	0	0	1	1	7	58
redhead	*Aythya americana*	SSC	0	0	8	10	4	4	0	0	2	2	14	16
long-billed curlew	*Numenius americanus*	FSC, FPS	5	5	1	1	0	0	0	0	0	0	6	6
mountain plover	*Charadrius montanus*	FPS,SSC	1	6	0	0	0	0	0	0	0	0	1	6
short-billed dowitcher	*Limnodromus griseus*	FPS	1	1	1	2	1	2	0	0	1	2	4	7
solitary sandpiper	*Tringa solitaria*	FPS	0	0	3	9	0	0	0	0	0	0	3	9
western sandpiper	*Calidris mauri*	FPS	4	33	0	0	1	3	0	0	2	3	7	39
Wilson's phalarope	*Phalaropus tricolor*	FPS	0	0	1	4	0	0	0	0	0	0	1	4
black tern	*Chlidonias niger*	SSC	0	0	2	2	0	0	0	0	0	0	2	2
Swainson's hawk	*Buteo swainsoni*	ST	130	236	3	3	6	6	0	0	8	52	147	297
golden eagle	*Aquila chrysaetos*	EA, SFP	8	8	0	0	0	0	0	0	1	1	9	9
northern harrier	*Circus cyaneus*	SSC	140	142	6	7	22	22	0	0	3	3	171	174
peregrine falcon	*Falco peregrinus*	FSC, SFP	2	2	1	1	0	0	0	0	0	0	3	3
prairie falcon	*Falco mexicanus*	FSC	149	158	10	10	24	26	0	0	1	2	184	196
burrowing owl	*Athene cunicularia*	FSC, SSC	1	1	0	0	2	2	0	0	0	0	3	3
short-eared owl	*Asio flammeus*	SSC	2	2	0	0	1	1	0	0	0	0	3	3
bank swallow	*Riparia riparia*	ST	21	26	8	20	2	3	0	0	0	0	31	49
Bell's vireo	*Vireo bellii*	FSC	0	0	0	0	1	1	0	0	0	0	1	1
crissal thrasher	*Toxostoma crissale*	SSC	0	0	0	0	1	1	0	0	0	0	1	1
Lawrence's goldfinch	*Spinus lawrencei*	FSC	0	0	0	0	1	1	0	0	2	2	3	3
Le Conte's thrasher	*Toxostoma lecontei*	FSC	0	0	0	0	39	42	0	0	3	3	42	45
loggerhead shrike	*Lanius ludovicianus*	SSC	0	0	0	0	153	160	2	2	17	27	172	189
purple martin	*Progne subis*	SSC	0	0	1	1	0	0	0	0	0	0	1	1
vesper sparrow	*Pooecetes gramineus*	SSC	0	0	0	0	0	0	0	0	1	1	1	1
willow flycatcher	*Empidonax traillii*	SE	0	0	0	0	6	6	2	2	2	2	10	10
yellow-breasted chat	*Icteria virens*	SSC	0	0	0	0	1	1	0	0	0	0	1	1
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	SSC	0	0	0	0	11	27	0	0	7	25	18	52

Table 13. Summary of sensitive species observed at the Palen Solar Electric Generating System during bird use count surveys (BUC), shorebird/waterfowl surveys (S/W), small bird count surveys (SBC), mist net surveys (MN), and as incidental wildlife observations (Inc.) from August 19 – December 13, 2013.

			BUC		S/W		SBC		MN		Inc		Total	
Species	**Scientific Name**	**Status**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**	**# grps**	**# obs**
yellow warbler	*Setophaga petechia*	FSC, SSC	0	0	0	0	6	7	2	2	1	1	9	10
Costa's hummingbird	*Calypte costae*	FSC	0	0	4	4	0	0	0	0	0	0	4	4
Vaux's swift	*Chaetura vauxi*	SSC	61	132	4	6	6	9	0	0	2	3	73	150
Gila woodpecker	*Melanerpes uropygialis*	FSC, SE	0	0	0	0	1	1	0	0	1	1	2	2
Total	**32 Species**		**540**	**841**	**55**	**89**	**290**	**326**	**6**	**6**	**55**	**131**	**946**	**1,393**

ST = State Threatened (CDFW 2013); FSC = Federal Species of Concern within Bird Conservation Region 33 (USFWS 2008); SSC = State Species of Special Concern (CDFG 2011); FPS = USFWS priority shorebird species (USFWS 2004); SE = State Endangered. (CDFG 2013); EA = Bald and Golden Eagle Protection Act (BGEPA 1940); SFP = State Fully Protected Species (CDFG 2011).

DISCUSSION

Potential Impacts

Solar energy facilities can directly or indirectly impact wildlife resources. Direct impacts include fatalities from construction and operation of the proposed facility. Indirect impacts include the displacement of wildlife, either temporarily or permanently, during construction of or during the operational period of the solar energy facility.

Mortality or injury due to collision with heliostats, power towers, overhead transmission lines, or perimeter fences, as well as mortality or injury caused by exposure to zones of intense solar flux are possible forms of direct impact to birds from concentrated solar energy facilities. Project construction could affect birds through loss of habitat or potential fatalities from construction related equipment. However, mortality from construction related equipment is expected to be relatively low, as equipment used in solar energy facility construction generally moves at slow rates of speed or is stationary for long periods. The greatest risk of direct mortality to birds due to construction related activities would most likely come during initial site clearing when nests built on the ground or in a shrub could be destroyed by project equipment. Impacts due to activities associated with decommissioning of the facility are anticipated to be similar to those from construction in terms of noise, disturbance, and equipment used.

In addition to direct effects through collision and solar flux mortality, solar energy development may indirectly affect wildlife resources by causing loss of habitat where infrastructure is placed or loss of habitat through behavioral avoidance. There is also the potential to indirectly affect birds through the mechanisms associated with habitat fragmentation. Loss of habitat from the installation of the solar energy facility infrastructure (i.e., heliostat arrays, towers, access roads, maintenance buildings, and overhead transmission lines) can be long-term or temporary.

Behavioral displacement (avoidance) may result when birds affected by the placement of project infrastructure relocate to lower quality habitat. When birds are forced to relocate to lower quality habitat the relocating individuals may suffer lower rates of reproductive success and/or a decrease in fitness as they may be forced to compete with birds already occupying the area. Indirect effects that may result from the design and placement of a solar facility include habitat fragmentation (e.g., a decrease in areas of contiguous habitat and a concomitant increase in habitat edge due to the placement of roads, etc.). Edge effects detrimental to birds due to habitat fragmentation may be caused as the number of roads, resistance-free travel lanes for predators and competitors, result in an increase in the number of predators coming into contact with nesting birds. As a result, the survivorship and reproductive success of birds may decrease.

Fall avian use documented during this study is consistent with that recorded during the spring and summer surveys conducted at the PSEGS site using similar methods. The habitat and features of the PSEGS are not unique to the surrounding landscape, nor do they appear to be

particularly preferred or critical to migrants. The areas of greatest use were located near the north-western boundary of the site close to where a date palm plantation and three small agricultural ponds sit just outside the PSEGS site; and along a stand of desert microphyll vegetation located in a dry wash in the south central portion of the Project. A detailed risk assessment incorporating the results of all baseline avian and bat studies conducted at the PSEGS to date (spring – fall 2013) will be presented in the Bird and Bat Conservation Strategy and Eagle Conservation Plan currently in preparation for the PSEGS.

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Appendix A. All Bird Types and Species Observed at the Palen Solar Electric Generating System during Bird Use Count Surveys, August 20 – December 13, 2013

Appendix A. Summary of the number of observations and groups recorded by species and bird type during bird use count surveys at the Palen Solar Electric Generating System[a], August 20 – December 13, 2013.

Type / Species	*Scientific Name*	# grps	# obs
Waterbirds		**132**	**1,090**
American white pelican	*Pelecanus erythrorhynchos*	9	32
double-crested cormorant	*Phalacrocorax auritus*	4	34
great blue heron	*Ardea herodias*	33	41
great egret	*Ardea alba*	43	119
sandhill crane	*Grus canadensis*	6	57
snowy egret	*Egretta thula*	3	3
unidentified egret		2	5
unidentified waterbird		1	16
white-faced ibis	*Plegadis chihi*	31	783
Gannets		**1**	**1**
blue-footed booby	*Sula nebouxii*	1	1
Waterfowl		**108**	**973**
American wigeon	*Anas americana*	1	1
blue-winged teal	*Anas discors*	4	23
cackling goose	*Branta hutchinsii*	2	2
Canada goose	*Branta canadensis*	12	117
cinnamon teal	*Anas cyanoptera*	1	11
gadwall	*Anas strepera*	1	1
greater white-fronted goose	*Anser albifrons*	5	195
green-winged teal	*Anas crecca*	3	10
northern shoveler	*Anas clypeata*	3	28
ring-necked duck	*Aythya collaris*	1	1
Ross' goose	*Chen rossii*	14	32
snow goose	*Chen caerulescens*	31	230
unidentified duck		16	182
unidentified goose		12	128
unidentified teal		1	7
unidentified waterfowl		1	5
Shorebirds		**50**	**404**
American avocet	*Recurvirostra americana*	11	276
black-bellied plover	*Pluvialis squatarola*	1	2
black-necked stilt	*Himantopus mexicanus*	2	43
greater yellowlegs	*Tringa melanoleuca*	4	4
killdeer	*Charadrius vociferus*	10	15
least sandpiper	*Calidris minutilla*	8	14
long-billed curlew	*Numenius americanus*	5	5
mountain plover	*Charadrius montanus*	1	6
pectoral sandpiper	*Calidris melanotos*	1	1
semipalmated plover	*Charadrius semipalmatus*	1	1
short-billed dowitcher	*Limnodromus griseus*	1	1
unidentified shorebird		1	3
western sandpiper	*Calidris mauri*	4	33

Appendix A. Summary of the number of observations and groups recorded by species and bird type during bird use count surveys at the Palen Solar Electric Generating System[a], August 20 – December 13, 2013.

Type / Species	*Scientific Name*	# grps	# obs
Gulls/Terns		**65**	**495**
Bonaparte's gull	*Chroicocephalus philadelphia*	4	6
California gull	*Larus californicus*	12	108
herring gull	*Larus argentatus*	5	49
laughing gull	*Leucophaeus atricilla*	3	6
mew gull	*Larus canus*	4	46
ring-billed gull	*Larus delawarensis*	24	184
unidentified gull		13	96
Shearwaters/Petrels		**1**	**17**
unidentified shearwater		1	17
Diurnal Raptors		**1346**	**1,587**
Accipiters		*189*	*200*
Cooper's hawk	*Accipiter cooperii*	130	134
sharp-shinned hawk	*Accipiter striatus*	52	59
unidentified accipiter		7	7
Buteos		*588*	*740*
ferruginous hawk	*Buteo regalis*	9	9
red-shouldered hawk	*Buteo lineatus*	3	3
red-tailed hawk	*Buteo jamaicensis*	442	488
Swainson's hawk	*Buteo swainsoni*	130	236
unidentified buteo		2	2
zone-tailed hawk	*Buteo albonotatus*	2	2
Northern Harrier		*140*	*142*
northern harrier	*Circus cyaneus*	140	142
Eagles		*8*	*8*
golden eagle	*Aquila chrysaetos*	8	8
Falcons		*210*	*219*
American kestrel	*Falco sparverius*	54	54
merlin	*Falco columbarius*	1	1
peregrine falcon	*Falco peregrinus*	2	2
prairie falcon	*Falco mexicanus*	149	158
unidentified falcon		4	4
Osprey		*91*	*109*
osprey	*Pandion haliaetus*	91	109
Other Raptors		*120*	*169*
unidentified hawk		23	28
unidentified raptor		97	141
Owls		**3**	**3**
burrowing owl	*Athene cunicularia*	1	1
short-eared owl	*Asio flammeus*	2	2
Vultures		**1,960**	**107,989**
turkey vulture	*Cathartes aura*	1,960	107,989
Upland Game Birds		**1**	**2**
ring-necked pheasant	*Phasianus colchicus*	1	2
Doves/Pigeons		**6**	**7**
common ground-dove	*Columbina passerina*	1	1
mourning dove	*Zenaida macroura*	3	4
rock pigeon	*Columba livia*	1	1
white-winged dove	*Zenaida asiatica*	1	1

Appendix A. Summary of the number of observations and groups recorded by species and bird type during bird use count surveys at the Palen Solar Electric Generating System[a], August 20 – December 13, 2013.

Type / Species	*Scientific Name*	# grps	# obs
Goatsuckers		**2**	**2**
lesser nighthawk	*Chordeiles acutipennis*	2	2
Large Corvids		**124**	**268**
American crow	*Corvus brachyrhynchos*	2	4
common raven	*Corvus corax*	122	862
Swallows		**927**	**2,439**
bank swallow	*Riparia riparia*	22	27
barn swallow	*Hirundo rustica*	547	1,536
cliff swallow	*Petrochelidon pyrrhonota*	102	206
northern rough-winged swallow	*Stelgidopteryx serripennis*	18	37
tree swallow	*Tachycineta bicolor*	50	126
unidentified swallow		134	355
violet-green swallow	*Tachycineta thalassina*	54	152
Swifts/Hummingbirds		**83**	**307**
Anna's hummingbird	*Calypte anna*	1	1
black-chinned hummingbird	*Archilochus alexandri*	2	2
Costa's hummingbird	*Calypte costae*	4	4
unidentified hummingbird		3	3
unidentified swift		2	3
Vaux's swift	*Chaetura vauxi*	61	132
white-throated swift	*Aeronautes saxatalis*	10	162
Overall		**4,685**	**115,316**

[a] Within an unlimited viewshed

Appendix B. Mean Use, Percent of Use, and Frequency of Occurrence for All Birds Observed during Bird Use Count Surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013

Appendix B. Mean bird use (number of birds/observer-hour/survey[a]), percent of total use (%), and frequency of occurrence (%) for each bird type and species during fall bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

Type/Species	Mean Use	% of Use	% Frequency
Waterbirds	**0.03**	**1.0**	**4.6**
American white pelican	<0.01	<0.1	0.6
great blue heron	<0.01	0.1	1.9
great egret	<0.01	0.2	1.1
sandhill crane	<0.01	<0.1	0.4
white-faced ibis	0.02	0.6	0.6
Gannets	**<0.01**	**<0.1**	**0.2**
blue-footed booby	<0.01	<0.1	0.2
Waterfowl	**0.11**	**3.4**	**5.9**
American wigeon	<0.01	<0.1	0.2
blue-winged teal	<0.01	<0.1	0.4
Canada goose	<0.01	0.2	0.3
cinnamon teal	<0.01	<0.1	0.2
greater white-fronted goose	0.03	0.9	0.6
green-winged teal	<0.01	<0.1	0.4
northern shoveler	<0.01	0.1	0.2
Ross' goose	<0.01	0.2	1.6
snow goose	0.05	1.5	2.9
unidentified duck	<0.01	0.2	0.8
unidentified goose	<0.01	<0.1	0.4
unidentified waterfowl	<0.01	<0.1	0.2
Shorebirds	**0.03**	**0.9**	**5.6**
American avocet	<0.01	<0.1	0.2
black-bellied plover	<0.01	<0.1	0.2
black-necked stilt	<0.01	0.2	0.2
greater yellowlegs	<0.01	<0.1	0.4
killdeer	<0.01	0.1	2.3
least sandpiper	<0.01	<0.1	1.4
long-billed curlew	<0.01	<0.1	0.6
mountain plover	<0.01	<0.1	0.2
pectoral sandpiper	<0.01	<0.1	0.2
semipalmated plover	<0.01	<0.1	0.2
western sandpiper	<0.01	0.3	0.8
Gulls/Terns	**0.05**	**1.5**	**3.5**
Bonaparte's gull	<0.01	<0.1	0.4
California gull	<0.01	0.2	0.8
Herring gull	<0.01	0.2	0.4
laughing gull	<0.01	<0.1	0.4
mew gull	<0.01	0.3	0.2
ring-billed gull	0.02	0.6	1.6
unidentified gull	<0.01	0.1	0.4
Diurnal Raptors	**0.18**	**5.7**	**54.0**
Accipiters	*0.02*	*0.7*	*12.8*
Cooper's hawk	0.01	0.5	10.6
sharp-shinned hawk	<0.01	0.3	4.1
unidentified accipiter	<0.01	<0.1	0.2

Appendix B. Mean bird use (number of birds/observer-hour/survey[a]), percent of total use (%), and frequency of occurrence (%) for each bird type and species during fall bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

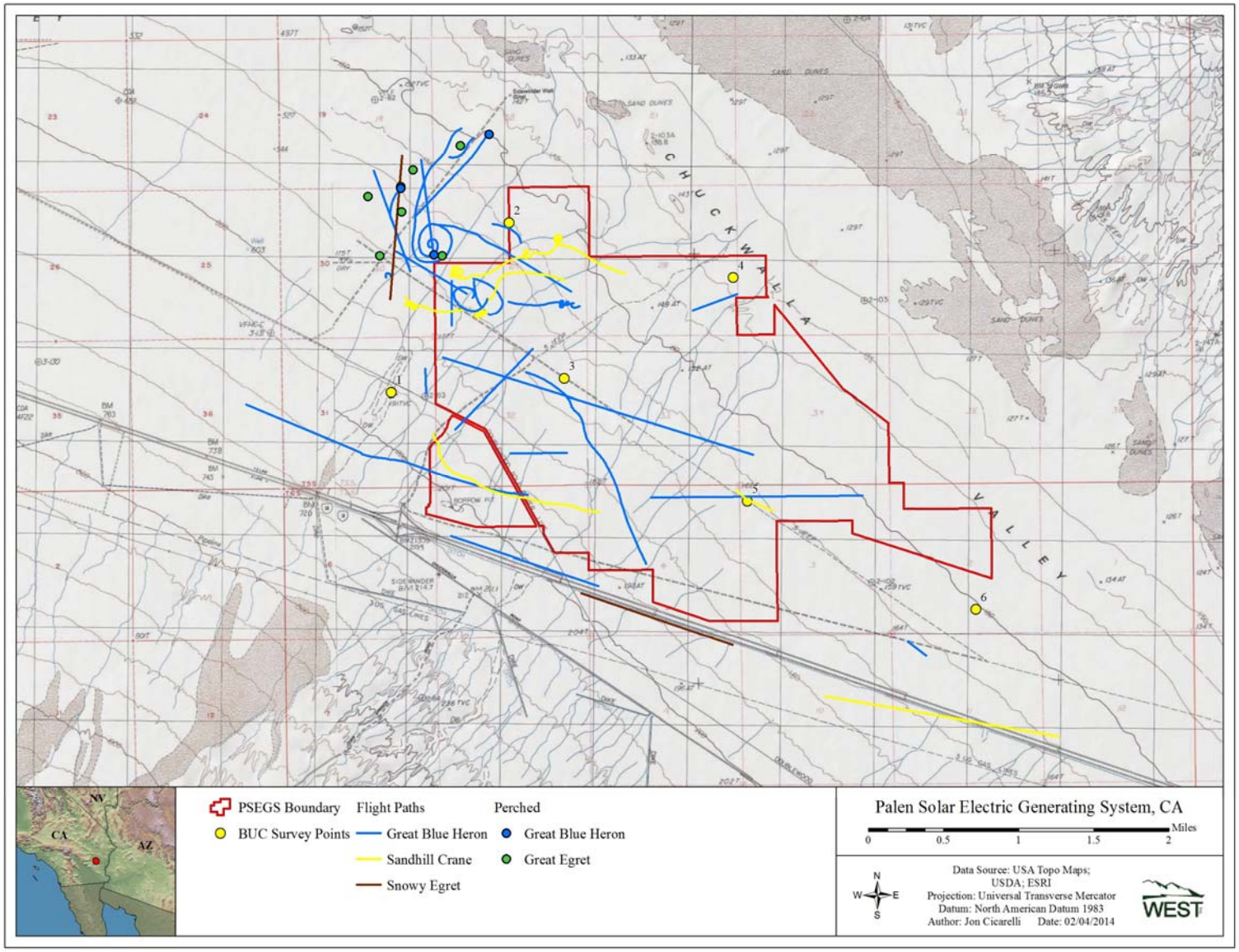
Type/Species	Mean Use	% of Use	% Frequency
Buteos	*0.07*	*2.4*	*30.8*
ferruginous hawk	<0.01	<0.1	0.6
red-shouldered hawk	<0.01	<0.1	0.2
red-tailed hawk	0.05	1.6	25.6
Swainson's hawk	0.02	0.7	7.6
unidentified buteo	<0.01	<0.1	0.3
zone-tailed hawk	<0.01	<0.1	0.2
Northern Harrier	*0.02*	*0.7*	*14.8*
northern harrier	0.02	0.7	14.8
Eagles	*<0.01*	*<0.1*	*1.3*
golden eagle	<0.01	<0.1	1.3
Falcons	*0.04*	*1.3*	*20.9*
American kestrel	<0.01	0.3	7.3
merlin	<0.01	<0.1	0.2
prairie falcon	0.03	1.0	16.0
unidentified falcon	<0.01	<0.1	0.4
Osprey	*<0.01*	*0.2*	*4.9*
osprey	<0.01	0.2	4.9
Other Raptors	*0.01*	*0.3*	*6.2*
unidentified hawk	<0.01	<0.1	1.5
unidentified raptor	<0.01	0.3	4.9
Owls	**<0.01**	**<0.1**	**0.4**
burrowing owl	<0.01	<0.1	0.2
short-eared owl	<0.01	<0.1	0.2
Vultures	**1.74**	**56.5**	**47.4**
turkey vulture	1.74	56.5	47.4
Upland Game Birds	**<0.01**	**<0.1**	**0.2**
ring-necked pheasant	<0.01	<0.1	0.2
Doves/Pigeons	**<0.01**	**<0.1**	**0.8**
common ground-dove	<0.01	<0.1	0.2
mourning dove	<0.01	<0.1	0.6
rock pigeon	<0.01	<0.1	0.2
white-winged dove	<0.01	<0.1	0.2
Goatsuckers	**<0.01**	**<0.1**	**0.4**
lesser nighthawk	<0.01	<0.1	0.4
Large Corvids	**0.14**	**4.5**	**8.6**
American crow	<0.01	<0.1	0.4
common raven	0.14	4.5	8.6
Swallows	**0.70**	**27.2**	**49.5**
bank swallow	<0.01	0.2	3.0
barn swallow	0.45	14.6	33.2
cliff swallow	0.05	1.6	11.1
northern rough-winged swallow	0.01	0.3	3.0
tree swallow	0.03	1.0	6.9
unidentified swallow	0.10	3.1	14.3
violet-green swallow	0.06	1.9	5.9

Appendix B. Mean bird use (number of birds/observer-hour/survey[a]), percent of total use (%), and frequency of occurrence (%) for each bird type and species during fall bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

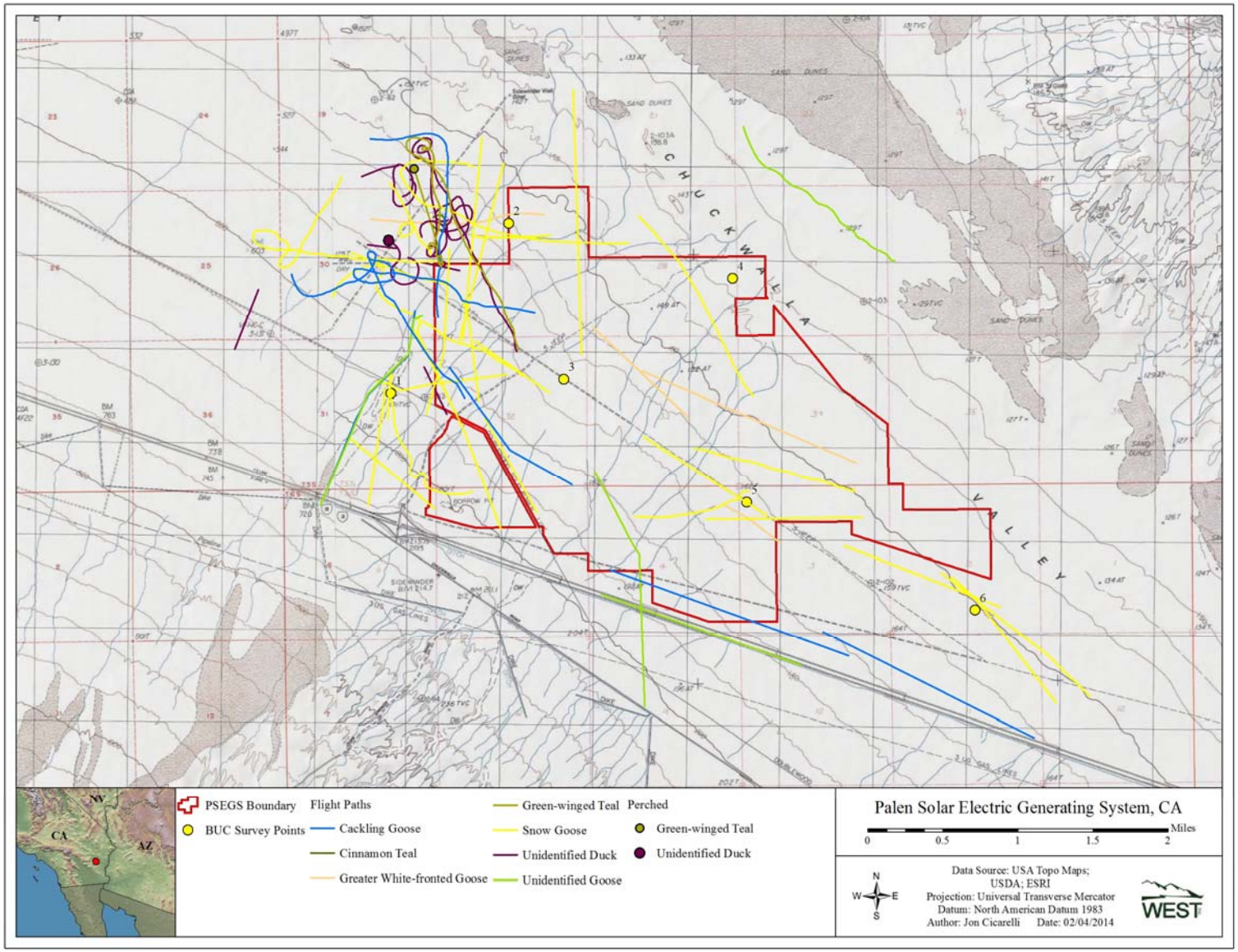
Type/Species	Mean Use	% of Use	% Frequency
Swifts/Hummingbirds	**0.11**	**3.7**	**9.8**
Anna's hummingbird	<0.01	<0.1	0.2
black-chinned hummingbird	<0.01	<0.1	0.4
Costa's hummingbird	<0.01	<0.1	0.9
unidentified hummingbird	<0.01	<0.1	0.5
unidentified swift	<0.01	<0.1	0.6
Vaux's swift	0.05	1.7	7.2
white-throated swift	0.06	1.9	2.0
Overall	**3.09**	**100**	

[a] 800-m radius plot

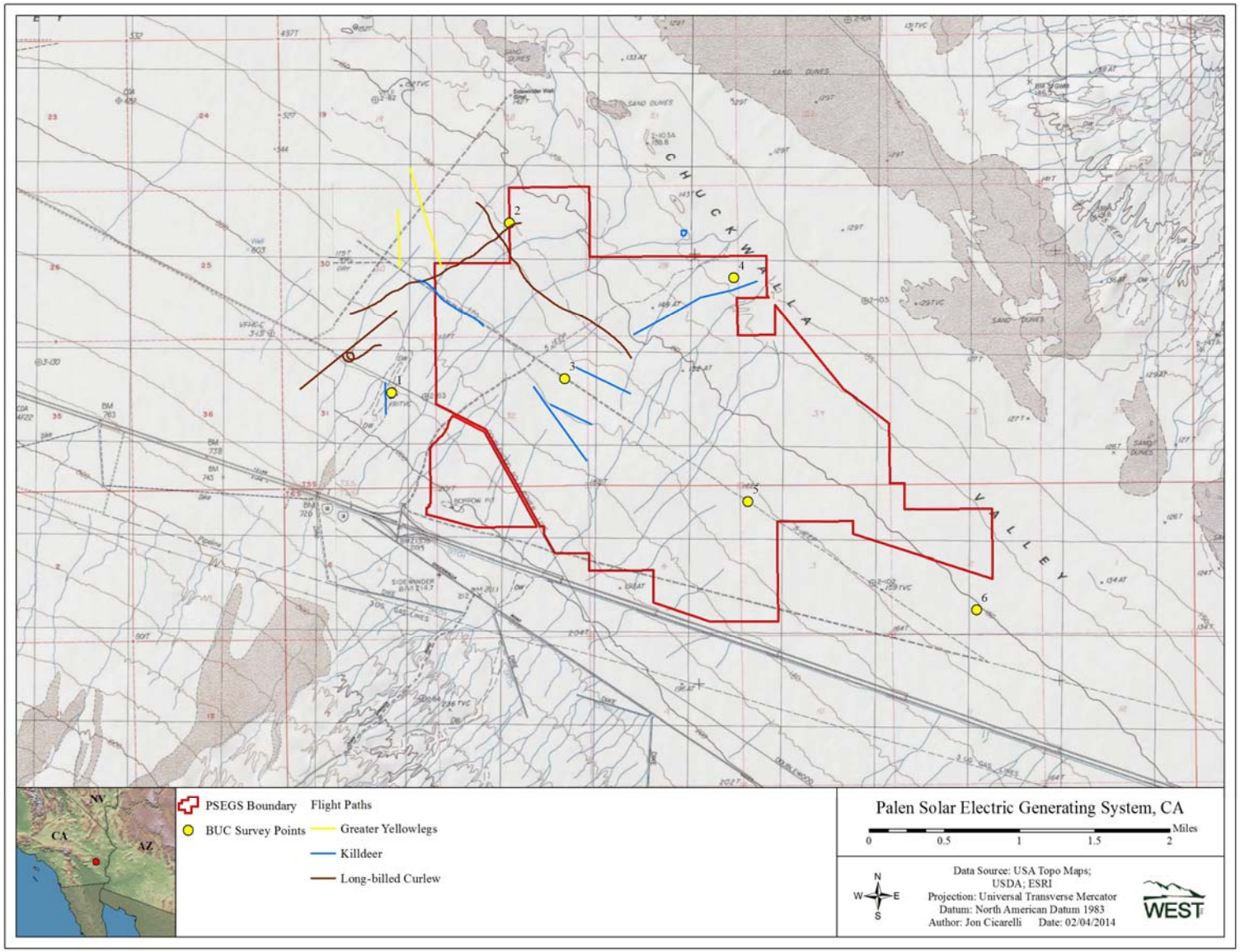
Appendix C. Flight Paths and Perched Locations for Major Bird Types and Raptor Subtypes Observed during Bird Use Count Surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013



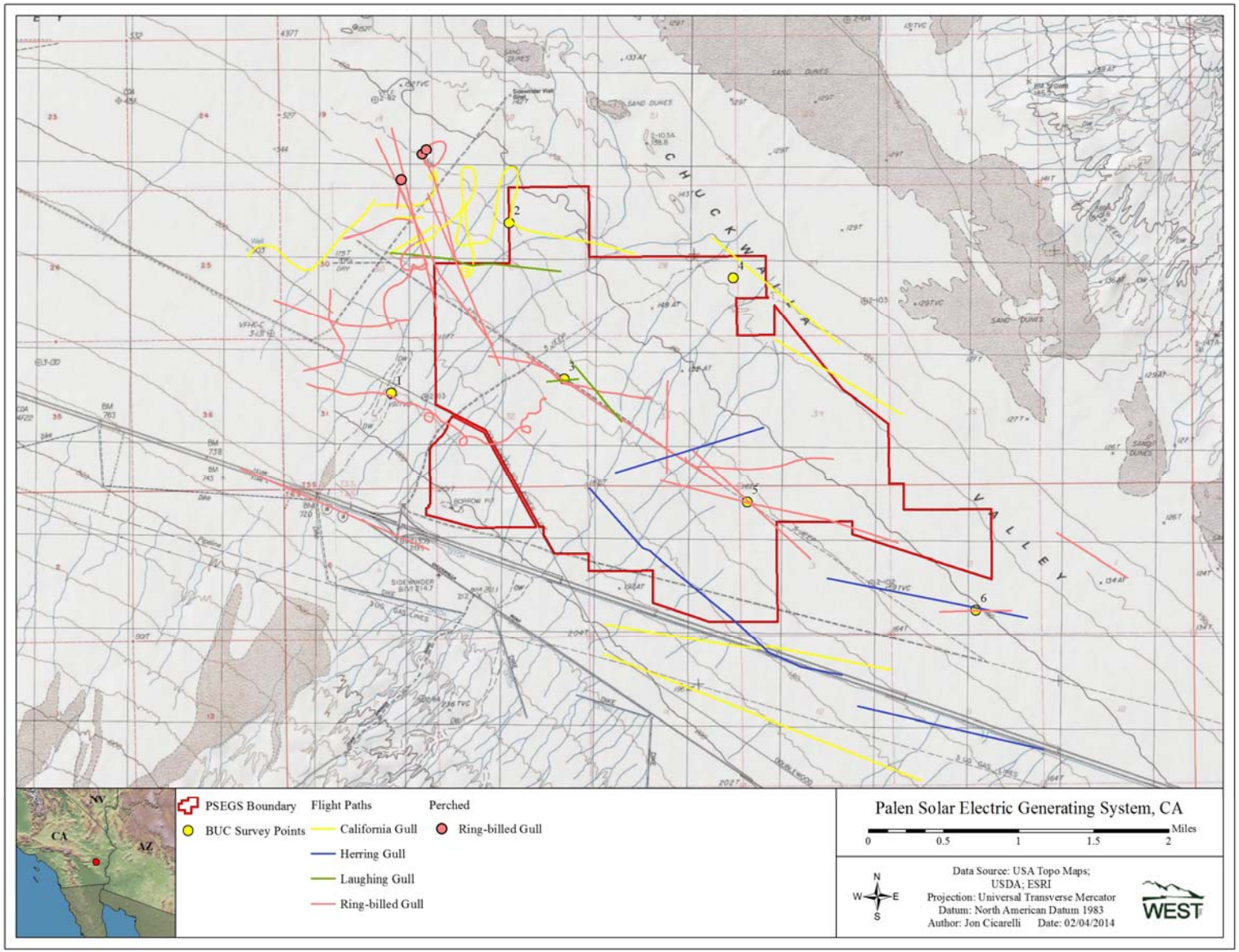
Appendix C1. Flight paths and perched locations of waterbirds observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.



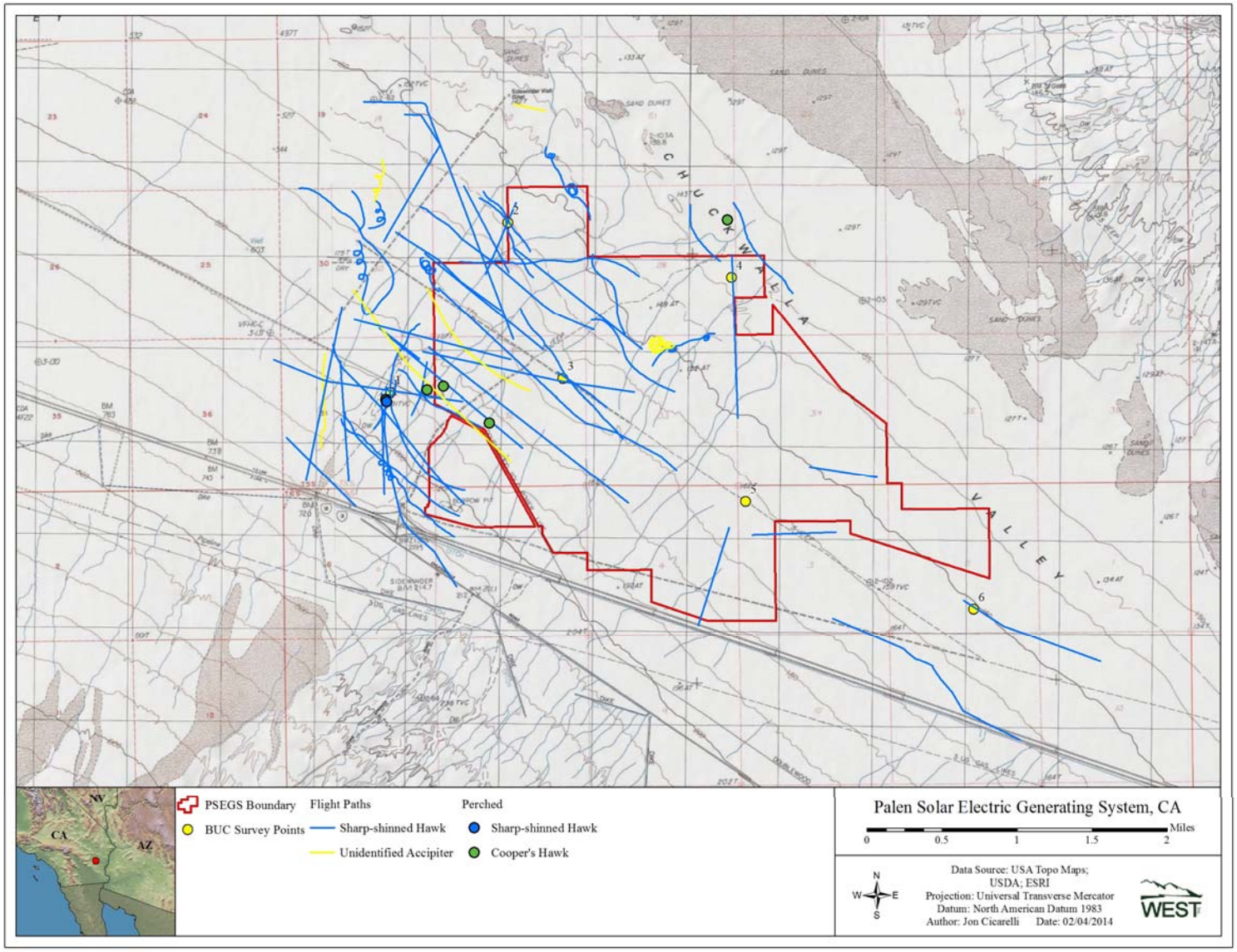
Appendix C2. Flight paths and perched locations of waterfowl observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.



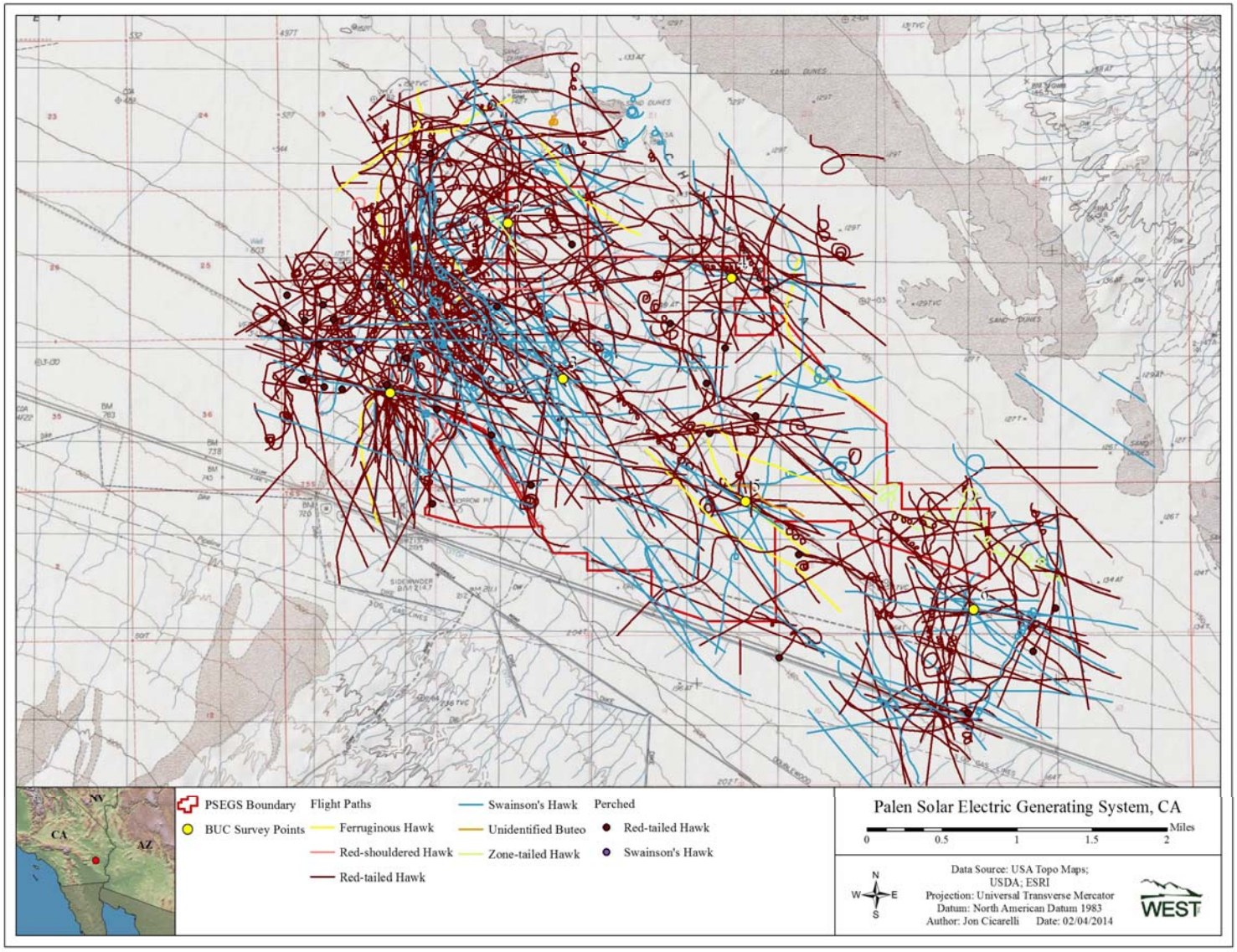
Appendix C3. Flight paths of shorebirds observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.



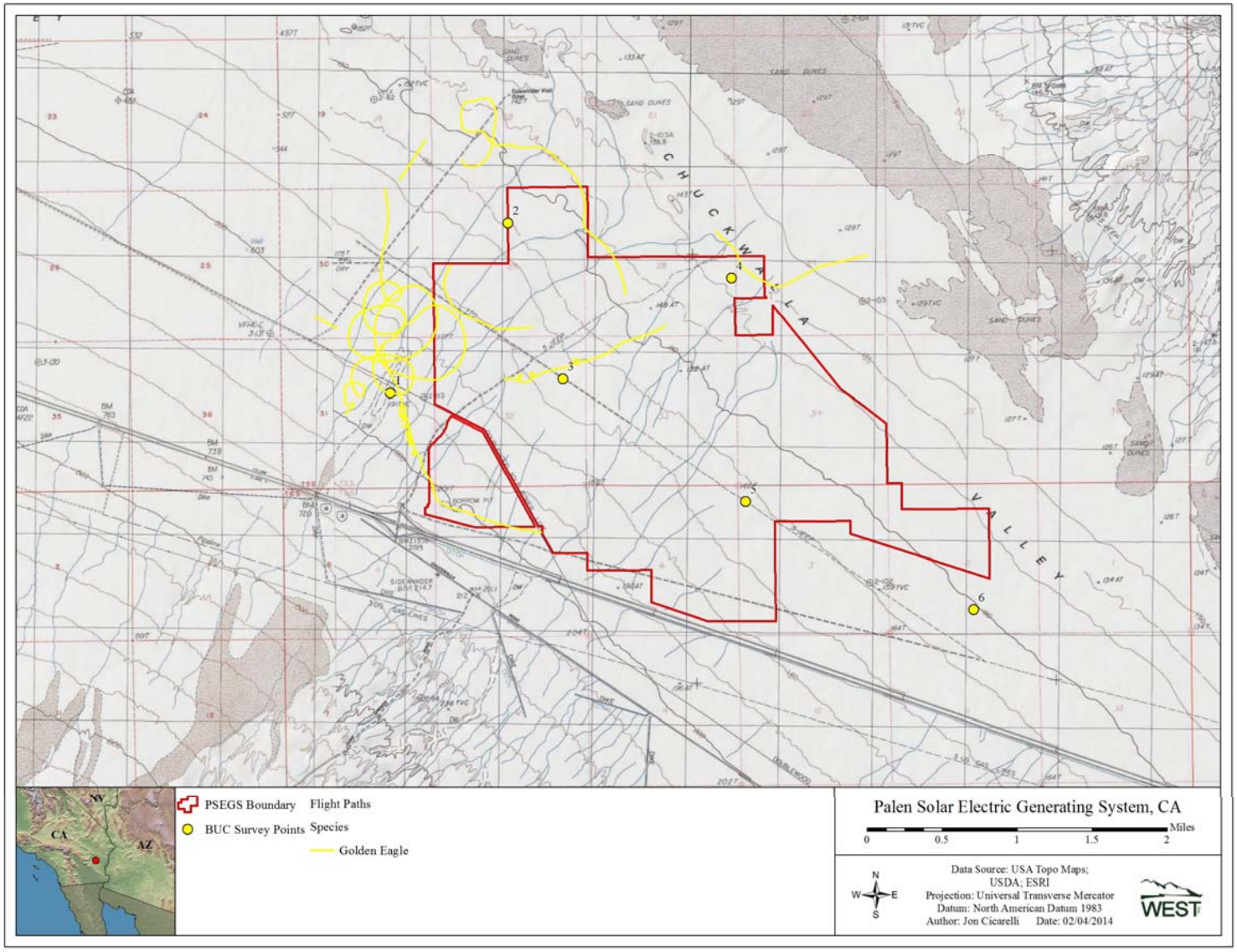
Appendix C4. Flight paths and perched locations of gulls/terns observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.



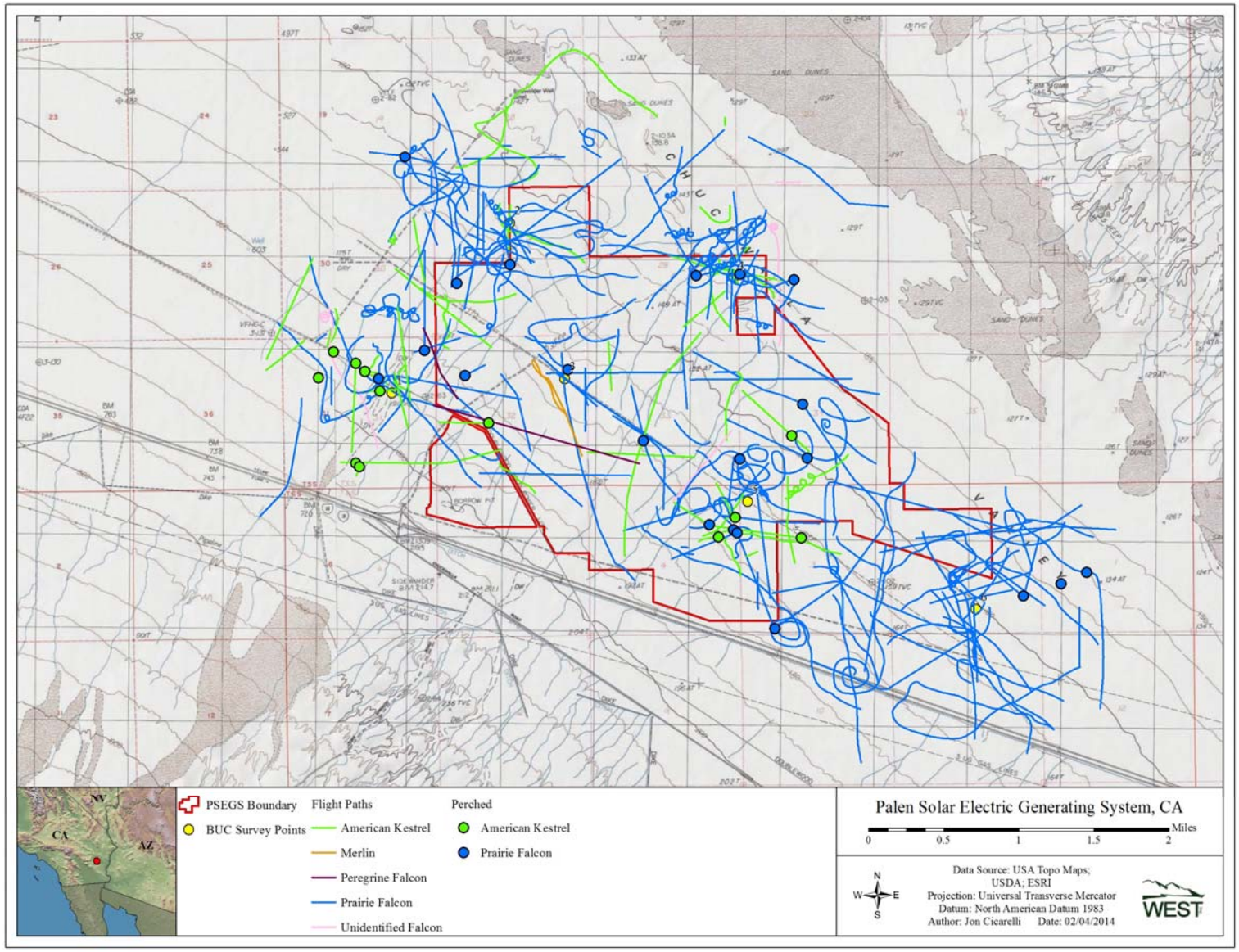
Appendix C5. Flight paths and perched locations of accipiters observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.



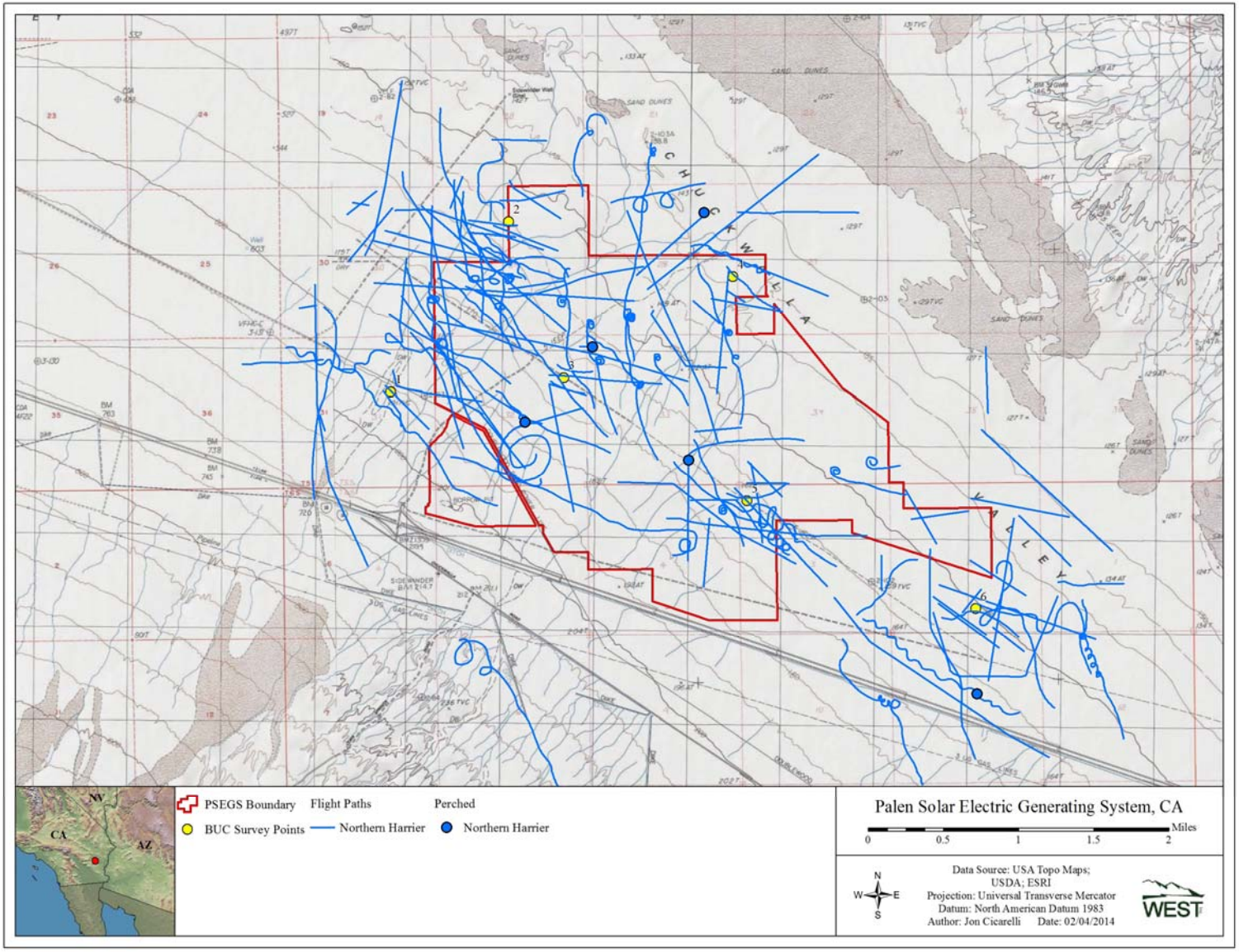
Appendix C6. Flight paths and perched locations of buteos observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.



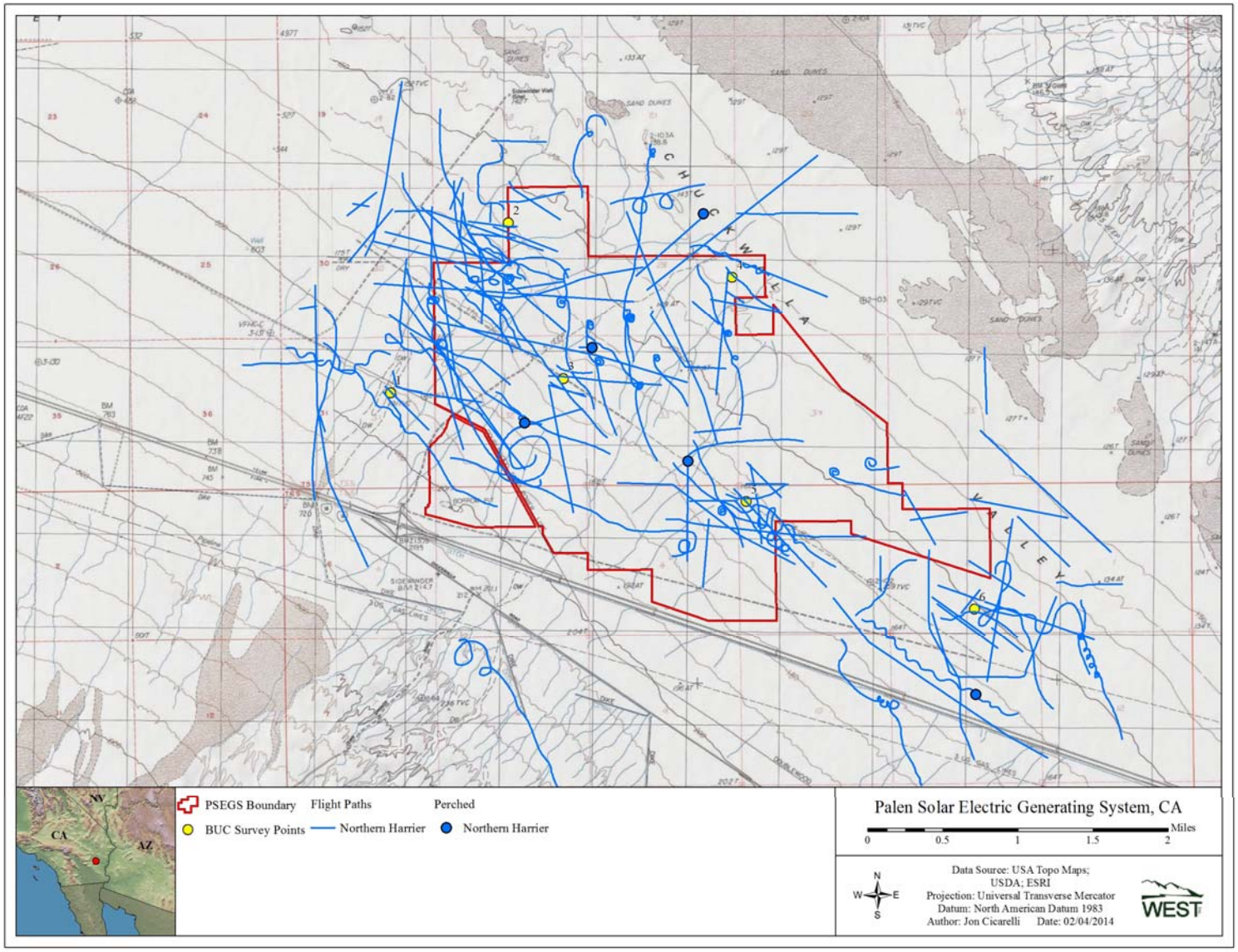
Appendix C7. Flight paths of eagles observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.



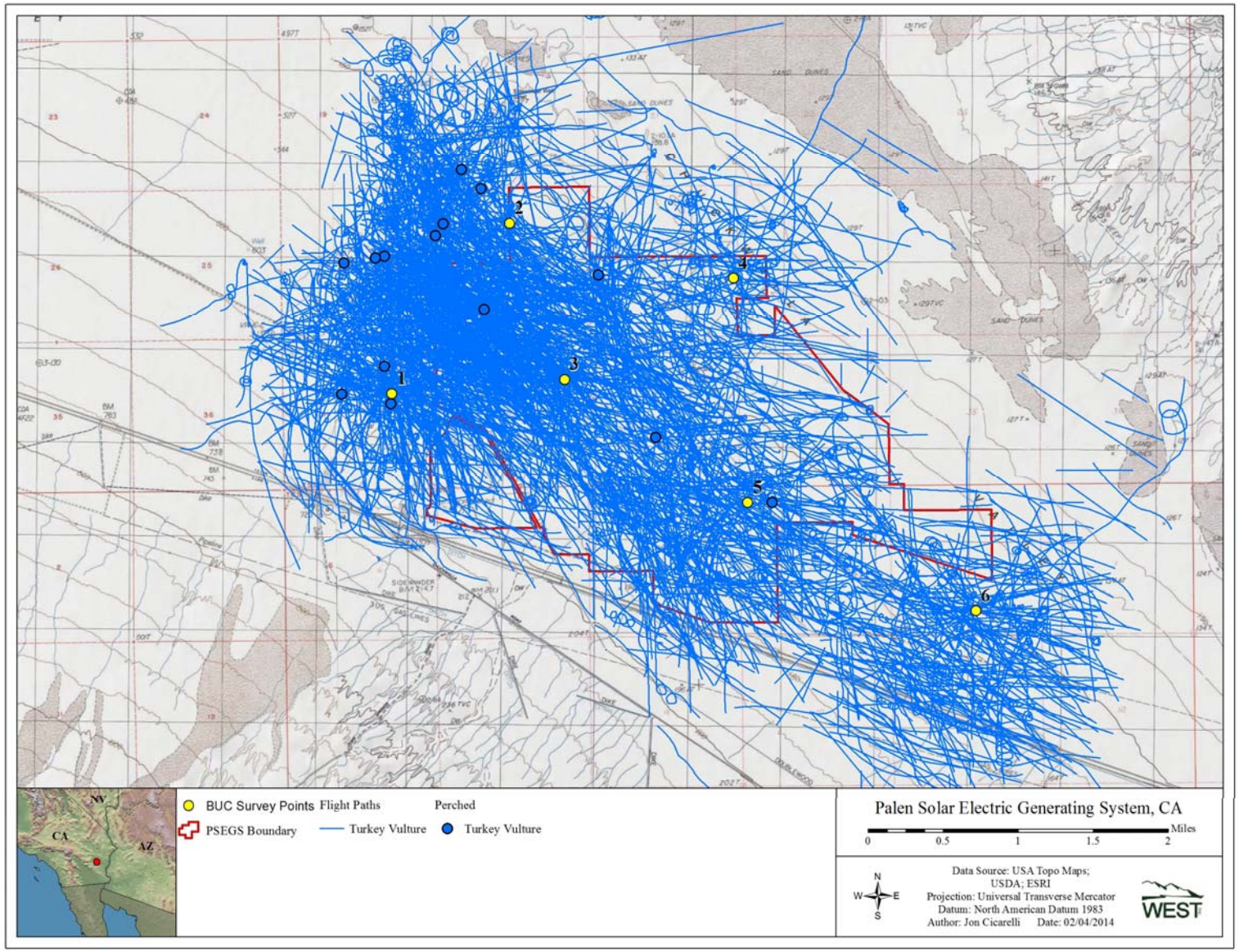
Appendix C8. Flight paths and perched locations of falcons observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.



Appendix C9. Flight paths and perched locations of northern harriers observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.



Appendix C10. Flight paths and perched locations of osprey observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.



Appendix C11. Flight paths and perched locations of vultures observed during bird use count surveys at the Palen Solar Electric Generating System, August 20 – December 13, 2013.

Appendix D. All Bird Types and Species Observed at the Palen Solar Electric Generating System during Shorebird/Waterfowl Surveys, August 19 – December 10, 2013

Appendix D. Total number of groups and individuals for each bird type and species during shorebird/waterfowl surveys at the Palen Solar Electric Generating System[a], August 19 – December 10, 2013.

Bird Type / Species	Scientific Name	# grps	# obs
Loons/Grebes		**64**	**267**
Clark's grebe	*Aechmophorus clarkii*	3	29
eared grebe	*Podiceps nigricollis*	25	191
pied-billed grebe	*Podilymbus podiceps*	17	23
western grebe	*Aechmophorus occidentalis*	19	24
Waterbirds		**75**	**173**
American white pelican	*Pelecanus erythrorhynchos*	2	9
cattle egret	*Bubulcus ibis*	2	2
double-crested cormorant	*Phalacrocorax auritus*	7	7
great blue heron	*Ardea herodias*	21	28
great egret	*Ardea alba*	23	46
green heron	*Butorides virescens*	7	7
snowy egret	*Egretta thula*	2	2
white-faced ibis	*Plegadis chihi*	11	72
Waterfowl		**142**	**492**
American wigeon	*Anas americana*	10	24
blue-winged teal	*Anas discors*	9	21
bufflehead	*Bucephala albeola*	4	8
canvasback	*Aythya valisineria*	3	6
cinnamon teal	*Anas cyanoptera*	5	17
common goldeneye	*Bucephala clangula*	12	89
gadwall	*Anas strepera*	5	6
greater scaup	*Aythya marila*	2	2
green-winged teal	*Anas crecca*	16	66
hooded merganser	*Lophodytes cucullatus*	4	4
lesser scaup	*Aythya affinis*	4	13
mallard	*Anas platyrhynchos*	7	17
northern pintail	*Anas acuta*	7	8
northern shoveler	*Anas clypeata*	15	72
redhead	*Aythya americana*	8	10
ring-necked duck	*Aythya collaris*	13	37
Ross' goose	*Chen rossii*	1	1
ruddy duck	*Oxyura jamaicensis*	14	79
snow goose	*Chen caerulescens*	2	2
unidentified teal		1	10
Shorebirds		**117**	**360**
American avocet	*Recurvirostra americana*	14	152
black-necked stilt	*Himantopus mexicanus*	3	7
greater yellowlegs	*Tringa melanoleuca*	16	26
killdeer	*Charadrius vociferus*	27	51
least sandpiper	*Calidris minutilla*	21	53
lesser yellowlegs	*Tringa flavipes*	1	1
long-billed curlew	*Numenius americanus*	1	1
long-billed dowitcher	*Limnodromus scholopaceus*	3	4
pectoral sandpiper	*Calidris melanotos*	1	1
short-billed dowitcher	*Limnodromus griseus*	1	2
solitary sandpiper	*Tringa solitaria*	3	9

Appendix D. Total number of groups and individuals for each bird type and species during shorebird/waterfowl surveys at the Palen Solar Electric Generating System[a], August 19 – December 10, 2013.

Bird Type / Species	Scientific Name	# grps	# obs
spotted sandpiper	*Actitis macularia*	12	15
unidentified sandpiper		4	19
western sandpiper	*Calidris mauri*	5	11
Wilson's phalarope	*Phalaropus tricolor*	1	4
Wilson's snipe	*Gallinago delicata*	4	4
Gulls/Terns		**21**	**112**
black tern	*Chlidonias niger*	2	2
Bonaparte's gull	*Chroicocephalus philadelphia*	3	8
California gull	*Larus californicus*	5	12
little gull	*Hydrocoloeus minutus*	1	1
ring-billed gull	*Larus delawarensis*	10	89
Rails/Coots		**29**	**165**
American coot	*Fulica americana*	29	165
Diurnal Raptors		**66**	**68**
American kestrel	*Falco sparverius*	1	1
Cooper's hawk	*Accipiter cooperii*	9	9
merlin	*Falco columbarius*	1	1
northern harrier	*Circus cyaneus*	6	7
osprey	*Pandion haliaetus*	4	4
peregrine falcon	*Falco peregrinus*	1	1
prairie falcon	*Falco mexicanus*	10	10
red-shouldered hawk	*Buteo lineatus*	1	1
red-tailed hawk	*Buteo jamaicensis*	24	25
sharp-shinned hawk	*Accipiter striatus*	3	3
Swainson's hawk	*Buteo swainsoni*	3	3
unidentified accipiter		3	3
Vultures		**69**	**843**
turkey vulture	*Cathartes aura*	69	843
Upland Game Birds		**9**	**24**
ring-necked pheasant	*Phasianus colchicus*	9	24
Doves/Pigeons		**3**	**12**
Eurasian collared-dove	*Streptopelia decaocto*	3	12
Large Cuckoos		**2**	**2**
greater roadrunner	*Geococcyx californianus*	2	2
Goatsuckers		**1**	**9**
lesser nighthawk	*Chordeiles acutipennis*	1	9
Large Corvids		**5**	**51**
common raven	*Corvus corax*	5	51
Swallows		**152**	**636**
bank swallow	*Riparia riparia*	8	20
barn swallow	*Hirundo rustica*	82	446
cliff swallow	*Petrochelidon pyrrhonota*	12	24
northern rough-winged swallow	*Stelgidopteryx serripennis*	3	3
purple martin	*Progne subis*	1	1
tree swallow	*Tachycineta bicolor*	33	73
unidentified swallow		3	4
violet-green swallow	*Tachycineta thalassina*	5	14
Swifts/Hummingbirds		**4**	**6**
Vaux's swift	*Chaetura vauxi*	4	6
Overall		**754**	**3,169**

[a]Regardless of distance from observer

Appendix E. All Bird Types and Species Observed at the Palen Solar Electric Generating System during Small Bird Count Surveys, August 19 – November 14, 2013

Appendix E. Total number of groups and individuals for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System[a], August 19 – November 14, 2013.

Bird Type / Species	Scientific Name	# grps	# obs
Loons/Grebes		**14**	**85**
eared grebe	*Podiceps nigricollis*	6	65
pied-billed grebe	*Podilymbus podiceps*	3	11
western grebe	*Aechmophorus occidentalis*	5	9
Waterbirds		**29**	**189**
American white pelican	*Pelecanus erythrorhynchos*	1	1
cattle egret	*Bubulcus ibis*	1	8
great blue heron	*Ardea herodias*	5	6
great egret	*Ardea alba*	8	11
green heron	*Butorides virescens*	4	4
snowy egret	*Egretta thula*	3	3
white-faced ibis	*Plegadis chihi*	7	156
Waterfowl		**27**	**63**
American wigeon	*Anas americana*	1	1
blue-winged teal	*Anas discors*	4	13
bufflehead	*Bucephala albeola*	2	3
greater scaup	*Aythya marila*	2	2
green-winged teal	*Anas crecca*	2	6
northern shoveler	*Anas clypeata*	2	3
redhead	*Aythya americana*	4	4
ring-necked duck	*Aythya collaris*	2	3
ruddy duck	*Oxyura jamaicensis*	4	9
snow goose	*Chen caerulescens*	2	9
unidentified duck		1	8
unidentified teal		1	2
Shorebirds		**43**	**93**
American avocet	*Recurvirostra americana*	2	22
black-necked stilt	*Himantopus mexicanus*	3	19
greater yellowlegs	*Tringa melanoleuca*	3	4
killdeer	*Charadrius vociferus*	15	15
least sandpiper	*Calidris minutilla*	6	15
lesser yellowlegs	*Tringa flavipes*	1	2
long-billed dowitcher	*Limnodromus scholopaceus*	3	3
semipalmated plover	*Charadrius semipalmatus*	1	1
short-billed dowitcher	*Limnodromus griseus*	1	2
spotted sandpiper	*Actitis macularia*	4	4
unidentified dowitcher		1	1
unidentified shorebird		1	1
western sandpiper	*Calidris mauri*	1	3
Wilson's snipe	*Gallinago delicata*	1	1
Gulls/Terns		**1**	**9**
Herring gull	*Larus argentatus*	1	9
Rails/Coots		**8**	**48**
American coot	*Fulica americana*	8	48
Diurnal Raptors		**123**	**128**
American kestrel	*Falco sparverius*	5	6
Cooper's hawk	*Accipiter cooperii*	8	8
ferruginous hawk	*Buteo regalis*	2	2
northern harrier	*Circus cyaneus*	22	22
osprey	*Pandion haliaetus*	4	4
prairie falcon	*Falco mexicanus*	24	26

Appendix E. Total number of groups and individuals for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System[a], August 19 – November 14, 2013.

Bird Type / Species	Scientific Name	# grps	# obs
red-shouldered hawk	*Buteo lineatus*	2	2
red-tailed hawk	*Buteo jamaicensis*	42	43
sharp-shinned hawk	*Accipiter striatus*	3	4
Swainson's hawk	*Buteo swainsoni*	6	6
unidentified accipiter		1	1
unidentified buteo		1	1
unidentified raptor		3	3
Owls		**3**	**3**
burrowing owl	*Athene cunicularia*	2	2
short-eared owl	*Asio flammeus*	1	1
Vultures		**100**	**1,877**
turkey vulture	*Cathartes aura*	100	1,877
Upland Game Birds		**22**	**144**
Gambel's quail	*Callipepla gambelii*	22	144
Doves/Pigeons		**112**	**302**
Eurasian collared-dove	*Streptopelia decaocto*	10	23
mourning dove	*Zenaida macroura*	96	266
white-winged dove	*Zenaida asiatica*	6	13
Passerines		**2,576**	**7,081**
Blackbirds/Orioles		*52*	*194*
Brewer's blackbird	*Euphagus cyanocephalus*	6	21
brown-headed cowbird	*Molothrus ater*	7	7
Bullock's oriole	*Icterus bullockii*	3	3
European starling	*Sturnus vulgaris*	6	52
great-tailed grackle	*Quiscalus mexicanus*	15	78
red-winged blackbird	*Agelaius phoeniceus*	2	3
western meadowlark	*Sturnella neglecta*	2	3
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	11	27
Corvids		*379*	*1,002*
common raven	*Corvus corax*	379	1,002
Finches/Crossbills		*354*	*1,124*
American goldfinch	*Spinus tristis*	2	2
house finch	*Haemorhous mexicanus*	337	1,098
Lawrence's goldfinch	*Spinus lawrencei*	1	1
lesser goldfinch	*Spinus psaltria*	14	23
Flycatchers		*164*	*171*
ash-throated flycatcher	*Myiarchus cinerascens*	9	10
black phoebe	*Sayornis nigricans*	33	34
Say's phoebe	*Sayornis saya*	112	117
unidentified flycatcher		1	1
western kingbird	*Tyrannus verticalis*	3	3
willow flycatcher	*Empidonax traillii*	6	6
Gnatcatchers/Kinglet		*96*	*122*
black-tailed gnatcatcher	*Polioptila melanura*	86	106
blue-gray gnatcatcher	*Polioptila caerulea*	5	9
ruby-crowned kinglet	*Regulus calendula*	5	7
Grassland/Sparrows		*568*	*2,799*
American pipit	*Anthus rubescens*	7	9
Bell's sparrow	*Artemisiospiza belli*	61	106
Brewer's sparrow	*Spizella breweri*	1	3
chipping sparrow	*Spizella passerina*	4	5
dark-eyed junco	*Junco hyemalis*	1	2

Appendix E. Total number of groups and individuals for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System[a], August 19 – November 14, 2013.

Bird Type / Species	Scientific Name	# grps	# obs
horned lark	*Eremophila alpestris*	447	2,542
house sparrow	*Passer domesticus*	2	2
lark sparrow	*Chondestes grammacus*	1	1
Lincoln's sparrow	*Melospiza lincolnii*	3	4
Savannah sparrow	*Passerculus sandwichensis*	4	9
song sparrow	*Melospiza melodia*	1	1
unidentified sparrow		5	7
white-crowned sparrow	*Zonotrichia leucophrys*	31	108
Mimids		*45*	*48*
crissal thrasher	*Toxostoma crissale*	1	1
Le Conte's thrasher	*Toxostoma lecontei*	39	42
northern mockingbird	*Mimus polyglottos*	4	4
sage thrasher	*Oreoscoptes montanus*	1	1
Swallows		*178*	*520*
bank swallow	*Riparia riparia*	2	3
barn swallow	*Hirundo rustica*	112	321
cliff swallow	*Petrochelidon pyrrhonota*	12	42
northern rough-winged swallow	*Stelgidopteryx serripennis*	12	26
tree swallow	*Tachycineta bicolor*	18	72
unidentified swallow		14	33
violet-green swallow	*Tachycineta thalassina*	8	23
Tanagers/Grosbeaks/Cardinals		*9*	*10*
black-headed grosbeak	*Pheucticus melanocephalus*	1	1
blue grosbeak	*Guiraca caerulea*	1	1
lazuli bunting	*Passerina amoena*	4	4
painted bunting	*Passerina ciris*	1	1
western tanager	*Piranga ludoviciana*	2	3
Shrikes		*153*	*160*
loggerhead shrike	*Lanius ludovicianus*	153	160
Thrushes		*2*	*2*
hermit thrush	*Catharus guttatus*	1	1
unidentified thrush		1	1
Titmice/Chickadees		*219*	*242*
verdin	*Auriparus flaviceps*	219	242
Vireos		*2*	*2*
Bell's vireo	*Vireo bellii*	1	1
Cassin's vireo	*Vireo cassinii*	1	1
Warblers		*270*	*556*
black-throated gray warbler	*Setophaga nigrescens*	1	1
common yellowthroat	*Geothlypis trichas*	10	10
MacGillivray's warbler	*Geothlypis tolmiei*	4	4
Nashville warbler	*Oreothlypis ruficapilla*	1	1
orange-crowned warbler	*Oreothlypis celata*	15	20
unidentified warbler		2	2
Wilson's warbler	*Cardellina pusilla*	13	14
yellow-breasted Chat	*Icteria virens*	1	1
yellow-rumped warbler	*Setophaga coronata*	217	496
yellow warbler	*Setophaga petechia*	6	7
Waxwings		*5*	*5*
phainopepla	*Phainopepla nitens*	5	5

Appendix E. Total number of groups and individuals for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System[a], August 19 – November 14, 2013.

Bird Type / Species	Scientific Name	# grps	# obs
Wrens		*40*	*53*
Bewick's wren	*Thryomanes bewickii*	3	3
cactus wren	*Campylorhynchus brunneicapillus*	31	44
house wren	*Troglodytes aedon*	2	2
rock wren	*Salpinctes obsoletus*	4	4
Unidentified Passerines		*40*	*71*
unidentified passerine		40	71
Swifts/Hummingbirds		**6**	**9**
Vaux's swift	*Chaetura vauxi*	6	9
Woodpeckers		**36**	**42**
Gila woodpecker	*Melanerpes uropygialis*	1	1
ladder-backed woodpecker	*Picoides scalaris*	1	1
northern flicker	*Colaptes auratus*	34	40
Unidentified Birds		**3**	**4**
unidentified small bird		3	4
Overall		**3,103**	**10,077**

[a]Regardless of distance from observer

Appendix F. Mean Use, Percent of Use, and Frequency of Occurrence for All Birds Observed during Small Bird Count Surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013

Appendix F. Mean bird use (number of birds/plot[a]/10-min survey), percent of total use (%), and frequency of occurrence (%) for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013.

Type / Species	Mean Use	% of Use	% Frequency
Loons/Grebes	**0.04**	**1.1**	**0.3**
eared grebe	0.03	0.8	0.3
pied-billed grebe	<0.01	0.1	0.2
western grebe	<0.01	0.1	0.2
Waterbirds	**0.03**	**0.8**	**0.7**
American white pelican	<0.01	<0.1	<0.1
great blue heron	<0.01	<0.1	0.2
great egret	<0.01	0.1	0.3
green heron	<0.01	<0.1	0.2
snowy egret	<0.01	<0.1	0.1
white-faced ibis	0.02	0.5	0.2
Waterfowl	**0.03**	**0.6**	**0.5**
American wigeon	<0.01	<0.1	<0.1
blue-winged teal	<0.01	0.2	0.2
bufflehead	<0.01	<0.1	0.1
greater scaup	<0.01	<0.1	0.1
green-winged teal	<0.01	<0.1	0.1
northern shoveler	<0.01	<0.1	0.1
redhead	<0.01	<0.1	0.2
ring-necked duck	<0.01	<0.1	<0.1
ruddy duck	<0.01	0.1	0.2
snow goose	<0.01	<0.1	<0.1
unidentified teal	<0.01	<0.1	<0.1
Shorebirds	**0.05**	**1.2**	**1.3**
American avocet	0.01	0.3	0.1
black-necked stilt	<0.01	0.2	0.2
greater yellowlegs	<0.01	<0.1	0.2
killdeer	<0.01	0.2	0.7
least sandpiper	<0.01	0.2	0.3
lesser yellowlegs	<0.01	<0.1	<0.1
long-billed dowitcher	<0.01	<0.1	0.2
semipalmated plover	<0.01	<0.1	<0.1
short-billed dowitcher	<0.01	<0.1	<0.1
spotted sandpiper	<0.01	<0.1	0.2
unidentified dowitcher	<0.01	<0.1	<0.1
unidentified shorebird	<0.01	<0.1	<0.1
western sandpiper	<0.01	<0.1	<0.1
Gulls/Terns	**<0.01**	**0.1**	**<0.1**
Herring gull	<0.01	0.1	<0.1
Rails/Coots	**0.02**	**0.6**	**0.4**
American coot	0.02	0.6	0.4
Diurnal Raptors	**0.03**	**0.8**	**3.2**
American kestrel	<0.01	<0.1	0.1
Cooper's hawk	<0.01	<0.1	0.4
ferruginous hawk	<0.01	<0.1	0.1
northern harrier	<0.01	0.1	0.5
osprey	<0.01	<0.1	<0.1
prairie falcon	<0.01	0.2	0.6
red-tailed hawk	0.01	0.3	1.1

Appendix F. Mean bird use (number of birds/plot[a]/10-min survey), percent of total use (%), and frequency of occurrence (%) for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013.

Type / Species	Mean Use	% of Use	% Frequency
sharp-shinned hawk	<0.01	<0.1	0.1
Swainson's hawk	<0.01	<0.1	0.2
unidentified raptor	<0.01	<0.1	<0.1
Owls	**<0.01**	**<0.1**	**0.1**
burrowing owl	<0.01	<0.1	<0.1
short-eared owl	<0.01	<0.1	<0.1
Vultures	**0.55**	**13.6**	**2.1**
turkey vulture	0.55	13.6	2.1
Upland Game Birds	**0.07**	**1.8**	**0.9**
Gambel's quail	0.07	1.8	0.9
Doves/Pigeons	**0.14**	**3.4**	**4.5**
Eurasian collared-dove	0.01	0.3	0.5
mourning dove	0.12	2.9	3.9
white-winged dove	<0.01	0.2	0.3
Passerines	**3.07**	**75.6**	**52.9**
Blackbirds/Orioles	*0.07*	*1.8*	*1.6*
Brewer's blackbird	0.01	0.3	0.3
brown-headed cowbird	<0.01	<0.1	0.3
Bullock's oriole	<0.01	<0.1	0.2
European starling	<0.01	0.1	0.1
great-tailed grackle	0.04	0.9	0.7
red-winged blackbird	<0.01	<0.1	<0.1
western meadowlark	<0.01	<0.1	0.1
yellow-headed blackbird	0.01	0.3	0.5
Corvids	*0.24*	*6.0*	*7.9*
common raven	0.24	6.0	7.9
Finches/Crossbills	*0.53*	*13.1*	*12.2*
American goldfinch	<0.01	<0.1	0.1
house finch	0.52	12.8	11.7
Lawrence's goldfinch	<0.01	<0.1	<0.1
lesser goldfinch	0.01	0.3	0.7
Flycatchers	*0.08*	*1.9*	*6.4*
ash-throated flycatcher	<0.01	<0.1	0.3
black phoebe	0.02	0.4	1.7
Say's phoebe	0.05	1.3	4.7
unidentified flycatcher	<0.01	<0.1	<0.1
western kingbird	<0.01	<0.1	0.1
willow flycatcher	<0.01	<0.1	0.2
Gnatcatchers/Kinglet	*0.06*	*1.5*	*4.0*
black-tailed gnatcatcher	0.05	1.3	3.4
blue-gray gnatcatcher	<0.01	0.1	0.3
ruby-crowned kinglet	<0.01	<0.1	0.3
Grassland/Sparrows	*1.31*	*32.3*	*20.9*
American pipit	<0.01	0.1	0.3
Bell's sparrow	0.05	1.2	2.7
Brewer's sparrow	<0.01	<0.1	<0.1
chipping sparrow	<0.01	<0.1	0.2
dark-eyed junco	<0.01	<0.1	<0.1
horned lark	1.18	29.1	17.2
house sparrow	<0.01	<0.1	<0.1
lark sparrow	<0.01	<0.1	<0.1
Lincoln's sparrow	<0.01	<0.1	0.2

Appendix F. Mean bird use (number of birds/plot[a]/10-min survey), percent of total use (%), and frequency of occurrence (%) for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013.

Type / Species	Mean Use	% of Use	% Frequency
Savannah sparrow	<0.01	0.1	0.2
unidentified sparrow	<0.01	<0.1	0.3
white-crowned sparrow	0.06	1.4	1.5
Mimids	*0.01*	*0.3*	*1.1*
Le Conte's thrasher	0.01	0.3	0.9
northern mockingbird	<0.01	<0.1	0.1
sage thrasher	<0.01	<0.1	<0.1
Swallows	*0.25*	*6.1*	*6.8*
bank swallow	<0.01	<0.1	0.1
barn swallow	0.16	4.0	4.8
cliff swallow	0.02	0.5	0.6
northern rough-winged swallow	<0.01	0.2	0.5
tree swallow	0.03	0.7	0.8
unidentified swallow	0.01	0.3	0.5
violet-green swallow	0.01	0.3	0.4
Tanagers/Grosbeaks/Cardinals	*<0.01*	*0.1*	*0.3*
black-headed grosbeak	<0.01	<0.1	<0.1
blue grosbeak	<0.01	<0.1	<0.1
lazuli bunting	<0.01	<0.1	0.2
painted bunting	<0.01	<0.1	<0.1
western tanager	<0.01	<0.1	0.1
Shrikes	*0.05*	*1.2*	*4.5*
loggerhead shrike	0.05	1.2	4.5
Thrushes	*<0.01*	*<0.1*	*0.1*
hermit thrush	<0.01	<0.1	<0.1
unidentified thrush	<0.01	<0.1	<0.1
Titmice/Chickadees	*0.12*	*2.9*	*9.8*
verdin	0.12	2.9	9.8
Vireos	*<0.01*	*<0.1*	*0.1*
Bell's vireo	<0.01	<0.1	<0.1
Cassin's vireo	<0.01	<0.1	<0.1
Warblers	*0.28*	*7.0*	*9.6*
black-throated gray warbler	<0.01	<0.1	<0.1
common yellowthroat	<0.01	0.1	0.4
MacGillivray's warbler	<0.01	<0.1	0.2
Nashville warbler	<0.01	<0.1	<0.1
orange-crowned warbler	0.01	0.3	0.7
unidentified warbler	<0.01	<0.1	0.1
Wilson's warbler	<0.01	0.2	0.6
yellow-breasted Chat	<0.01	<0.1	<0.1
yellow-rumped warbler	0.25	6.2	7.9
yellow warbler	<0.01	<0.1	0.3
Waxwings	*<0.01*	*<0.1*	*0.2*
phainopepla	<0.01	<0.1	0.2
Wrens	*0.02*	*0.6*	*1.8*
Bewick's wren	<0.01	<0.1	0.2
cactus wren	0.02	0.5	1.3
house wren	<0.01	<0.1	0.1
rock wren	<0.01	<0.1	0.2
Unidentified Passerines	*0.03*	*0.7*	*1.7*
unidentified passerine	0.03	0.7	1.7

Appendix F. Mean bird use (number of birds/plot[a]/10-min survey), percent of total use (%), and frequency of occurrence (%) for each bird type and species during small bird count surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013.

Type / Species	Mean Use	% of Use	% Frequency
Swifts/Hummingbirds	**<0.01**	**0.1**	**0.3**
Vaux's swift	<0.01	0.1	0.3
Woodpeckers	**0.01**	**0.3**	**0.8**
northern flicker	0.01	0.3	0.8
Unidentified Birds	**<0.01**	**<0.1**	**0.1**
unidentified small bird	<0.01	<0.1	0.1
Overall	**4.07**	**100**	

[a] 100-meter (m) radius plot

Appendix G. Mean Use by Point for All Birds and Major Bird Types during Small Bird Count Surveys at the Palen Solar Electric Generating System, August 19 – November 14, 2013

Appendix G. Mean use (number of birds/10-minute survey) by point for all birds and major bird types observed at the Palen Solar Electric Generating System during small bird count surveys, August 19 – November 14, 2013.

Point	Loons/ Grebes	Waterbirds	Waterfowl	Shorebirds	Diurnal Raptors	Owls	Vultures	Upland Game Birds	Doves/ Pigeons	Passerines	Swifts/ Humming-birds	Wood-peckers	All Birds
1_1	0	0	0	0	0.08	0	0	0	0	4.54	0	0	4.62
1_2	0	0	0	0	0	0	0	1.08	0.15	4.92	0	0	6.15
1_4	0	0	0	0	0.15	0	0	0	0.23	4.77	0	0	5.15
1_5	0	0	0	0	0.08	0	1.92	0	0.08	5.38	0	0.31	7.85
1_6	0	0	0	0	0.15	0	0	0	0	4.69	0	0.31	5.15
1_7	0	0	0	0	0.08	0	0	0	1.08	8.15	0	0.54	9.85
1_8	0	0	0	0	0.15	0	0	0	0.15	10.92	0	0.15	11.38
1_9	0	0	0	0	0	0	0	0	0	4.31	0	0	4.31
1_10	0	0	0	0.15	0	0	0.08	0	0	7.15	0	0.15	7.54
1_11	0	0.31	0.23	2.08	0.08	0	0	0.08	0.23	10.69	0	0	13.92
1_12	0	0	0	0	0	0	0	0	0.23	3.77	0	0	4.00
2_1	0	0	0	0	0.08	0	0	0	0	3.38	0	0	3.46
2_2	0	0	0	0.08	0	0	0	0	0	8.31	0	0	8.38
2_3	6.54	2.54	3.23	4.46	0.08	0	3.92	0	1.46	25.23	0.08	0	51.00
2_4	0	0.15	0	0	0	0	3.38	0	0.15	23.38	0	0	27.08
2_5	0	0	0	0	0	0	3.69	0	0.08	13.77	0	0	17.54
2_6	0	0	0	0	0	0	0	0	0	5.62	0	0	5.62
2_7	0	0	0	0	0	0	0	0	0.15	3.08	0	0	3.23
2_9	0	0	0	0	0	0	0	0	0.08	1.62	0	0	1.69
2_11	0	0	0	0	0.08	0	0	0	0	0.69	0	0	0.77
2_12	0	0	0	0	0	0	0	0	0	1.15	0	0	1.15
3_1	0	0	0	0.08	0.08	0	0	0.46	0.31	10.46	0	0.08	11.46
3_2	0	0	0	0	0.23	0	0.08	0	0	7.69	0	0	8.00
3_3	0	0	0	0	0	0	0	0	0	5.08	0	0.08	5.15
3_4	0	0	0	0	0.08	0	0	0	0.23	4.85	0	0.08	5.23
3_5	0	0	0	0	0.08	0	0	0	0	5.08	0	0	5.15
3_6	0	0	0	0	0	0	0	0	0	1.38	0	0	1.38
3_7	0	0	0	0	0.08	0	0	0	0.08	1.62	0	0	1.77
3_8	0	0	0	0	0	0	0	0	0.08	1.54	0	0	1.62
3_9	0	0	0	0	0.08	0	0	0	0	3.85	0	0	3.92
3_10	0	0	0	0	0	0	15.62	0	0.08	3.08	0	0	18.77
3_12	0	1.62	0	0	0.08	0	1.08	1.62	0	5.31	0	0.08	9.92
4_1	0	0	0	0	0	0	3.08	0	0	1.75	0	0	4.83
4_3	0	0	0	0	0.15	0	0	0	0	0.77	0	0	0.92
4_4	0	0	0	0	0	0	0	0	0	1.23	0	0	1.23

Appendix G. Mean use (number of birds/10-minute survey) by point for all birds and major bird types observed at the Palen Solar Electric Generating System during small bird count surveys, August 19 – November 14, 2013.

Point	Loons/ Grebes	Waterbirds	Waterfowl	Shorebirds	Diurnal Raptors	Owls	Vultures	Upland Game Birds	Doves/ Pigeons	Passerines	Swifts/ Humming-birds	Wood-peckers	All Birds
4_5	0	0	0	0	0	0	0	0	0	1.38	0	0	1.38
4_6	0	0	0	0	0.08	0	0	0	0	0.85	0	0	0.92
4_7	0	0	0	0	0.15	0	0	0	0.23	0.69	0	0	1.08
4_8	0	0	0	0	0	0	0	0	0	1.46	0	0	1.46
4_9	0	0	0	0	0	0	0	0	0	4.15	0	0	4.15
4_10	0	0	0	0	0	0	0.15	0	0	2.69	0	0	2.85
4_11	0	0	0	0	0	0	0	0	0	0.08	0	0	0.08
4_13	0	0	0	0	0.08	0	4.00	0	0	3.58	0	0	7.67
5_1	0	0	0	0	0	0	0	0	0	2.58	0	0	2.58
5_3	0	0	0	0	0	0	0	0	0	2.15	0	0	2.15
5_4	0	0	0	0	0.08	0	0	0	0.38	2.62	0	0	3.08
5_5	0	0	0	0	0.31	0	0	0	0.38	1.54	0	0	2.23
5_6	0	0	0	0	0.08	0	0	0	0	1.85	0	0	1.92
5_7	0	0	0	0	0	0.08	0	0	0	1.46	0	0	1.54
5_8	0	0	0	0	0	0	0	0	0	3.00	0	0	3.00
5_9	0	0	0	0	0	0	0	0	0	0.77	0	0	0.77
5_10	0	0	0	0	0	0	0.23	0	0	2.54	0	0	2.77
5_11	0	0	0	0	0	0	0	0	0	2.08	0	0	2.08
5_12	0	0	0	0	0	0	0	0	0	1.31	0	0	1.31
6_1	0	0	0	0	0	0	0	2	0.08	3.00	0	0	5.08
6_2	0	0	0	0	0	0	0	0	0.08	2.77	0	0	2.85
6_3	0	0	0.23	0.08	0.15	0	0	0.15	0.08	1.23	0	0	1.92
6_4	0	0	0	0	0	0	0	0.38	0.46	2.23	0	0	3.08
6_5	0	0	0	0	0	0	0	0	0.08	1.00	0	0	1.08
6_6	0	0	0	0	0.08	0	0	0	0.46	1.31	0	0	1.85
6_7	0	0	0	0	0	0	0	0	0.31	0.62	0	0	0.92
6_8	0	0	0	0	0	0	0	0	0.23	1.08	0	0	1.31
6_9	0	0	0	0	0	0	0	0	0.15	0.92	0	0	1.08
6_10	0	0	0	0	0	0	0	0	0.08	0.75	0	0	0.83
6_12	0	0	0	0	0	0	0.08	0.54	0.31	2.08	0	0	3.00
7_1	0	0	0	0	0	0	0	0	0	0.92	0	0	0.92
7_2	0	0	0	0	0	0	0	0	0	4.00	0	0	4.00
7_3	0	0	0	0	0.08	0	0.08	0	0	0.81	0	0	0.96
7_4	0	0	0	0	0	0	0	0	0	1.38	0	0	1.38
7_6	0	0	0	0	0	0	0.38	0	0	0.92	0	0	1.31

Appendix G. Mean use (number of birds/10-minute survey) by point for all birds and major bird types observed at the Palen Solar Electric Generating System during small bird count surveys, August 19 – November 14, 2013.

Point	Loons/ Grebes	Waterbirds	Waterfowl	Shorebirds	Diurnal Raptors	Owls	Vultures	Upland Game Birds	Doves/ Pigeons	Passerines	Swifts/ Humming-birds	Wood-peckers	All Birds
7_7	0	0	0	0	0	0	2.00	0	0	0.23	0	0	2.23
7_8	0	0	0	0	0	0	0.23	0	0	0.46	0	0	0.69
7_10	0	0	0	0	0	0	0	0	0	0.69	0	0	0.69
7_11	0	0	0	0	0	0	18.46	0	0	0.31	0	0	18.77
7_12	0	0	0	0	0	0	0	0	0.08	0.69	0	0	0.77
8_1	0	0	0	0	0.09	0	0	0	0	1.45	0	0	1.55
8_2	0	0	0	0	0	0	0	0	0	1.18	0	0	1.18
8_4	0	0	0	0	0	0	0	0	1.55	1.55	0	0	3.09
8_5	0	0	0	0	0	0	0	0	0.60	1.80	0	0	2.40
8_6	0	0	0	0	0	0	0	0	0.38	1.31	0	0	1.69
8_7	0	0	0	0	0	0	0	0	0	1.62	0	0	1.62
8_8	0	0	0	0	0	0	0	0	0	0.69	0	0	0.69
8_9	0	0	0	0	0	0	0.08	0	0	2.62	0	0	3.38
8_10	0	0	0	0	0	0	0	0	0	1.92	0	0	1.92
8_11	0	0	0	0	0.08	0	0	0	0	0.77	0	0	0.85
8_12	0	0	0	0	0	0	0	0	0	1.17	0	0	1.17
9_1	0	0	0	0	0	0	0	0	0	5.85	0	0	5.85
9_2	0	0	0	0	0	0	0	0	0	5.31	0	0	5.31
9_3	0	0	0	0	0	0	0	0	0	8.54	0	0	8.54
9_4	0	0	0	0	0	0	0	0	0	3.15	0	0	3.15
9_5	0	0	0	0	0.15	0	0	0	0	2.46	0	0	2.62
9_6	0	0	0	0	0	0	0	0	0	1.38	0	0	1.38
9_7	0	0	0	0	0	0	0	0	0	3.85	0	0	3.85
9_8	0	0	0	0	0	0	0	0	0	25.77	0	0	25.77
9_9	0	0	0	0	0	0	0	0	0	3.69	0	0	3.69
9_10	0	0	0	0	0	0	0.17	0	0	0.42	0	0	0.58
9_11	0	0	0	0	0	0	0	0	0	0.50	0	0	0.5
10_1	0	0	0	0	0	0	0	0	0	0.85	0	0	0.85
10_2	0	0	0	0	0	0	0	0	0	1.62	0	0	1.62
10_4	0	0	0	0	0.08	0	0	0	0	0.92	0	0	1.00
10_5	0	0	0	0	0	0	0	0	0	2.38	0	0	2.38
10_6	0	0	0	0	0.08	0	0	0	0	0.92	0	0	1.00
10_7	0	0	0	0	0	0	0	0	0	0.62	0	0	0.62
10_8	0	0	0	0	0	0	0	0	0.08	0.46	0	0	0.54
10_9	0	0	0	0	0	0	0.77	0	0	0.58	0	0	1.35

Appendix G. Mean use (number of birds/10-minute survey) by point for all birds and major bird types observed at the Palen Solar Electric Generating System during small bird count surveys, August 19 – November 14, 2013.

Point	Loons/ Grebes	Waterbirds	Waterfowl	Shorebirds	Diurnal Raptors	Owls	Vultures	Upland Game Birds	Doves/ Pigeons	Passerines	Swifts/ Humming-birds	Wood-peckers	All Birds
10_11	0	0	0	0	0.08	0	0	0	0	8.23	0.23	0	8.54
10_12	0	0	0	0	0	0	0	0	0.08	0.85	0	0	0.92
11_1	0	0	0	0	0.08	0	0	0	0.23	0.38	0	0	0.69
11_3	0	0	0	0	0.08	0	17.15	0	0	0.92	0	0	18.15
11_4	0	0	0	0	0.08	0	0	0	1.31	3.54	0	0	4.92
11_5	0	0	0	0	0	0	0	0.15	4.62	0.92	0	0	5.69
11_6	0	0	0	0	0	0	0	0	0.23	1.38	0	0	1.62
11_7	0	0	0	0	0	0	0	0	0	0.62	0	0	0.62
11_8	0	0	0	0	0.08	0	0	0	0.15	1.62	0	0	1.85
11_9	0	0	0	0	0	0	0.15	0	0.23	0.69	0	0	1.08
11_10	0	0	0	0	0	0	0	1.54	0	3.23	0.08	0	4.85
11_11	0	0	0	0	0	0	0	0	0.62	3.38	0	0	4.00
11_12	0	0	0	0	0.15	0	0.08	2.77	1	4.69	0	0	8.69
12_1	0	0	0	0	0	0	0	0	0	2.15	0	0	2.15
12_2	0	0.08	0	0	0	0	0	0	0	1.23	0	0	1.31
12_3	0	0	0	0	0	0	0	0	0	1.92	0.08	0	2.00
12_4	0	0	0	0.08	0	0	0	0	0	1.31	0	0	1.38
12_5	0	0	0	0	0.08	0	0	0	0.69	1.15	0	0	1.92
12_6	0	0	0	0	0	0	4.23	0	0	2.62	0	0	6.85
12_8	0	0	0	0	0	0	0	0	0	0.42	0	0	0.42
12_9	0	0	0	0	0	0	0	0	0	0	0	0	0
12_10	0	0	0	0	0.15	0	0	0	0	0.69	0	0	0.85
12_11	0	0	0	0	0.15	0	0.38	0	0	1.15	0	0	1.69
12_12	0	0	0	0	0	0.08	0	0	0	1.85	0	0	1.92
13_1	0	0	0	0	0	0	0	0	0	1.54	0	0	1.54
13_2	0	0	0	0	0	0	0	0	0	2.08	0	0	2.08
13_3	0	0	0	0	0	0	0	0	0	4.08	0	0	4.08
13_4	0	0	0	0	0	0	0	0	0	8.38	0	0	8.38
13_5	0	0	0	0	0.08	0	0	0	0	6.23	0	0	6.31
13_6	0	0	0	0	0	0	0	0	0	4.31	0	0	4.31
13_7	0	0	0	0	0	0	0	0	0	1.46	0	0	1.46
13_8	0	0	0	0	0	0	0.08	0	0.08	7.62	0	0	7.77
13_9	0	0	0	0	0	0	0	0	0	1.31	0	0	1.31
13_10	0	0	0	0	0.08	0	0.77	0	0	2.08	0	0	2.92
13_11	0	0	0	0	0	0	0	0	0	1.04	0	0	1.04

Appendix G. Mean use (number of birds/10-minute survey) by point for all birds and major bird types observed at the Palen Solar Electric Generating System during small bird count surveys, August 19 – November 14, 2013.

Point	Loons/ Grebes	Waterbirds	Waterfowl	Shorebirds	Diurnal Raptors	Owls	Vultures	Upland Game Birds	Doves/ Pigeons	Passerines	Swifts/ Humming-birds	Wood-peckers	All Birds
15_1	0	0	0	0	0	0	0.08	0	0	0.69	0	0	0.77
15_2	0	0	0	0	0	0	0	0	0	0.62	0	0	0.62
15_3	0	0	0	0	0.08	0	0	0	0	0.46	0	0	0.54
15_4	0	0	0	0	0	0	0	0	0.46	1.23	0	0	1.69
15_5	0	0	0	0	0	0	0	0	0	2.00	0	0	2.00
15_6	0	0	0	0	0.23	0	0	0	0	2.31	0	0	2.54
15_7	0	0	0	0	0.08	0	0	0	0	2.77	0.23	0	3.08
15_8	0	0	0.08	0	0	0	0	0	0	0.77	0	0	0.85
15_9	0	0	0	0	0	0	0	0	0	1.85	0	0	1.85
15_10	0	0	0	0	0.08	0	0	0	0.08	1.46	0	0	1.62

Appendix H. Incidental Species Observations at the Palen Solar Electric Generating System, August 19 – December 13, 2013

Appendix H. Incidental wildlife observed while conducting all survey types at the Palen Solar Electric Generating System, August 19, - December 13, 2013.

Species	Scientific Name	# grps	# obs
turkey vulture	*Cathartes aura*	14	5,376
common raven	*Corvus corax*	18	406
yellow-rumped warbler	*Setophaga coronata*	17	345
horned lark	*Eremophila alpestris*	16	213
house finch	*Haemorhous mexicanus*	15	67
European starling	*Sturnus vulgaris*	4	64
northern flicker	*Colaptes auratus*	17	64
white-faced ibis	*Plegadis chihi*	3	56
eared grebe	*Podiceps nigricollis*	6	53
Swainson's hawk	*Buteo swainsoni*	8	52
Gambel's quail	*Callipepla gambelii*	5	43
great-tailed grackle	*Quiscalus mexicanus*	5	42
black-tailed gnatcatcher	*Polioptila melanura*	6	41
American coot	*Fulica americana*	5	36
American pipit	*Anthus rubescens*	9	36
white-crowned sparrow	*Zonotrichia leucophrys*	2	36
great egret	*Ardea alba*	5	34
mourning dove	*Zenaida macroura*	3	30
loggerhead shrike	*Lanius ludovicianus*	17	27
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	7	25
Savannah sparrow	*Passerculus sandwichensis*	11	21
Say's phoebe	*Sayornis saya*	13	18
Eurasian collared-dove	*Streptopelia decaocto*	2	16
black phoebe	*Sayornis nigricans*	14	14
Lincoln's sparrow	*Melospiza lincolnii*	3	13
northern shoveler	*Anas clypeata*	6	12
cinnamon teal	*Anas cyanoptera*	3	11
green-winged teal	*Anas crecca*	4	11
Bell’s/sagebrush sparrow	*Artemisiospiza spp.*	5	11
American avocet	*Recurvirostra americana*	2	10
snowy egret	*Egretta thula*	3	9
ring-necked duck	*Aythya collaris*	2	9
pied-billed grebe	*Podilymbus podiceps*	4	8
ruddy duck	*Oxyura jamaicensis*	3	8
greater yellowlegs	*Tringa melanoleuca*	4	8
Brewer's blackbird	*Euphagus cyanocephalus*	4	8
verdin	*Auriparus flaviceps*	5	8
lesser goldfinch	*Spinus psaltria*	6	7
orange-crowned warbler	*Oreothlypis celata*	4	7
ruby-crowned kinglet	*Regulus calendula*	5	7
western meadowlark	*Sturnella neglecta*	5	7
American wigeon	*Anas americana*	2	6
Cooper's hawk	*Accipiter cooperii*	4	6
blue-gray gnatcatcher	*Polioptila caerulea*	5	6
belted kingfisher	*Ceryle alcyon*	6	6
western grebe	*Aechmophorus occidentalis*	3	5
osprey	*Pandion haliaetus*	2	5
red-tailed hawk	*Buteo jamaicensis*	5	5
northern pintail	*Anas acuta*	3	4
least sandpiper	*Calidris minutilla*	1	4
spotted sandpiper	*Actitis macularia*	3	4
red-shouldered hawk	*Buteo lineatus*	4	4

Appendix H. Incidental wildlife observed while conducting all survey types at the Palen Solar Electric Generating System, August 19, - December 13, 2013.

Species	Scientific Name	# grps	# obs
Brewer's sparrow	*Spizella breweri*	3	4
chipping sparrow	*Spizella passerina*	4	4
house wren	*Troglodytes aedon*	3	4
great blue heron	*Ardea herodias*	3	3
green heron	*Butorides virescens*	3	3
western sandpiper	*Calidris mauri*	2	3
northern harrier	*Circus cyaneus*	3	3
white-winged dove	*Zenaida asiatica*	3	3
barn swallow	*Hirundo rustica*	2	3
cactus wren	*Campylorhynchus brunneicapillus*	2	3
lark sparrow	*Chondestes grammacus*	1	3
Le Conte's thrasher	*Toxostoma lecontei*	3	3
rock wren	*Salpinctes obsoletus*	2	3
Vaux's swift	*Chaetura vauxi*	2	3
cattle egret	*Bubulcus ibis*	2	2
blue-winged teal	*Anas discors*	2	2
greater scaup	*Aythya marila*	2	2
redhead	*Aythya americana*	2	2
killdeer	*Charadrius vociferus*	2	2
short-billed dowitcher	*Limnodromus griseus*	1	2
American kestrel	*Falco sparverius*	2	2
prairie falcon	*Falco mexicanus*	1	2
sharp-shinned hawk	*Accipiter striatus*	2	2
greater roadrunner	*Geococcyx californianus*	2	2
ash-throated flycatcher	*Myiarchus cinerascens*	2	2
brown-headed cowbird	*Molothrus ater*	1	2
black-throated gray warbler	*Setophaga nigrescens*	2	2
common yellowthroat	*Geothlypis trichas*	2	2
Lawrence's goldfinch	*Spinus lawrencei*	2	2
western tanager	*Piranga ludoviciana*	2	2
willow flycatcher	*Empidonax traillii*	2	2
Clark's grebe	*Aechmophorus clarkii*	1	1
sandhill crane	*Grus canadensis*	1	1
bufflehead	*Bucephala albeola*	1	1
gadwall	*Anas strepera*	1	1
mallard	*Anas platyrhynchos*	1	1
California gull	*Larus californicus*	1	1
little gull	*Hydrocoloeus minutus*	1	1
ferruginous hawk	*Buteo regalis*	1	1
golden eagle	*Aquila chrysaetos*	1	1
merlin	*Falco columbarius*	1	1
rock pigeon	*Columba livia*	1	1
American goldfinch	*Spinus tristis*	1	1
black-throated sparrow	*Amphispiza bilineata*	1	1
Bullock's oriole	*Icterus bullockii*	1	1
chestnut-collared longspur	*Calcarius ornatus*	1	1
dickcissel	*Spiza americana*	1	1
lazuli bunting	*Passerina amoena*	1	1
mountain bluebird	*Sialia currucoides*	1	1
Nashville warbler	*Oreothlypis ruficapilla*	1	1
Oregon dark eyed junco	*Junco hyemalis oregonus*	1	1
red-winged blackbird	*Agelaius phoeniceus*	1	1

Appendix H. Incidental wildlife observed while conducting all survey types at the Palen Solar Electric Generating System, August 19, - December 13, 2013.

Species	Scientific Name	# grps	# obs
swamp sparrow	*Melospiza georgiana*	1	1
Swainson's thrush	*Catharus ustulatus*	1	1
Townsend's warbler	*Setophaga townsendi*	1	1
vesper sparrow	*Pooecetes gramineus*	1	1
Pacific-slope flycatcher	*Empidonax difficilis*	1	1
western kingbird	*Tyrannus verticalis*	1	1
western scrub-jay	*Aphelocoma californica*	1	1
yellow warbler	*Setophaga petechia*	1	1
Gila woodpecker	*Melanerpes uropygialis*	1	1
Bird Subtotal	***115 Species***	**425**	**7,433**
coyote	*Canis latrans*	7	7
kit fox	*Vulpes macrotis*	4	4
black-tailed jackrabbit	*Lepus californicus*	4	4
round-tailed ground squirrel	*Spermophilus tereticaudus*	2	3
white-tailed antelope squirrel	*Ammospermophilus leucurus*	1	1
Mammal Subtotal	***5 Species***	**18**	**19**
desert iguana	*Dipsosaurus dorsalis*	12	14
Great Basin whiptail	*Aspidoscelis tigris tigris*	6	6
zebra-tailed lizard	*Callisaurus draconoides*	4	4
Mojave fringe-toed lizard	*Uma scoparia*	3	3
desert horned lizard	*Phrynosoma platyrhinos*	2	2
Glossy snake	*Arizona elegans*	1	1
Ornate tree lizard	*Urosaurus ornatus*	1	1
Reptile Subtotal	***7 Species***	29	31