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Post-Construction Monitoring at the Genesis Solar Energy Project Riverside County, California

First Annual Report 2015 - 2016

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EXECUTIVE SUMMARY

The Genesis Solar Energy Project (Project) consists of two solar power electrical generating facilities (Units 1 and 2) with a combined net capacity of 250 megawatts. The project also includes the following linear facilities: a generation tie line, distribution line, natural gas pipeline, and a main access road that are mostly co-located for approximately 10.5 km (6.5 miles). The Project is located on land managed by the Bureau of Land Management (BLM) 40 km (25 miles) west of Blythe, in Riverside County, California.

Avian and bat monitoring surveys were conducted from March 1, 2015 to February 28, 2016 (the 2015 – 2016 monitoring year) in accordance with the Project's Bird and Bat Conservation Strategy (BBCS). Specifically, standardized carcass searches, searcher efficiency trials, and carcass persistence trials were conducted. This report represents the comprehensive annual report for the first year of monitoring, and summarizes monitoring methods and results for those surveys.

Standardized carcass searches were conducted 1) in the solar field, consisting of a random stratified 30% sample of solar troughs or solar collector assemblies (SCAs) of both Project units, 2) at each evaporation pond, 3) along the perimeter of each power block and beneath each air condensed cooling (ACC) unit, 4) along inner and outer portions of the "fenceline", resulting in 100% of the length of the perimeter fence surveyed, and 5) along 25% of the total length of generation-tie (gen-tie) and distribution lines (collectively, overhead lines) from the southernmost Project fence to Wiley's Well rest stop, which co-occur with the Project access road. Searches were conducted at intervals of approximately seven days during spring and fall and 21 days during summer and winter. All components were searched 32 times during the 2015 – 2016 monitoring year (13 times during spring, four during summer, nine during fall, and six during winter).

All dead and injured birds and bats that were discovered by observers, referred to as "detections" in this report, including those found incidentally and during standardized carcass searches, were documented. During the reporting period, 387 avian detections and 13 bat detections were made. Composition of the 2015 – 2016 detections included avian species from 23 guilds (excluding unidentified birds). Waterbirds and waterfowl comprised the largest number of detections (n = 116): the most common waterbird species detected was eared grebe (38 detections or 9.8% of all avian detections), with 29 found at the ponds. Blackbirds and orioles (family Icterid) were the second most common guild (n = 47): the most common blackbird species was western meadowlark (n = 13). Six of the 13 bats detected were found in the power blocks and were detected in summer, fall, and early winter seasons. The most common bat species found was the canyon bat (n = 5).

Avian detections were categorized by likely diurnal or likely nocturnal migration behavior, ecological guild (e.g., raptors, small passerines, and waterbirds/waterfowl), facility component, and suspected cause of death. These standardized carcass search results, along with searcher

efficiency and carcass persistence rates from bias trials conducted on site, were input into a fatality estimator model (Huso 2011) to provide an estimate of the number of fatalities that occurred at the Project during the reporting period adjusted for sources of bias.

To account for scavenging and other forms of carcass removal bias, fatalities were adjusted for the probability of being available at (or "persisting to") the next scheduled search (variable by migration period) following the Huso (2011) estimator. Carcass persistence models estimated the probability of persistence for small birds during spring and fall to be 0.59 (CI: 0.52 – 0.66; n = 61) within the solar field, and 0.25 (CI: 0.19 – 0.32; n = 59) along the overhead lines. The probability of persistence for small birds during summer and winter was 0.34 (CI: 0.27 – 0.42; n= 61) within the solar field and 0.11 (CI: 0.08 – 0.15, n = 59) along the overhead lines. The probability of persistence of medium carcasses in the solar field and at overhead lines was 0.63 (CI: 0.55 – 0.71; n = 40) in spring and fall, 0.79 (CI: 0.65 – 0.90; n = 20) in summer, and 0.43 (CI: 0.35 – 0.51; n = 20) in winter. For large carcasses, the probability of persistence in the spring was 0.98 (CI: 0.95 – 1.00; n = 5) within the solar field and 0.63 (CI: 0.48 – 0.77; n = 5) along the overhead lines; in the summer and winter the probability of persistence was 0.93 (CI: 0.86 – 0.99; n = 10) within the solar field and 0.43 (CI: 0.27 – 0.58; m = 10) along the overhead lines; the probability of persistence in the fall was 1.00 (n = 5) within the solar field as no trial carcass were removed, and 0.95 (CI: 0.83 – 1.00; n = 5) along the overhead lines.

The model predicted median persistence time for small birds was 4.22 days (CI: 3.13 – 5.67; n = 122) within the solar field and 0.88 days (CI: 0.58 – 1.28; n = 118) along the overhead lines. Median persistence time for medium carcass was 5.63 days (CI: 3.76 – 8.92; n = 60) in winter, spring, and fall, and greater than 30 days in summer. For large carcasses, median persistence time was greater than 30 days (n = 20) within the solar field during all seasons and 5.71 days (CI: 2.59 – 12.52; n = 15) along the overhead lines during spring, summer, and winter. During fall, persistence within the overhead lines was also greater than 30 days.

To account for a searcher's ability to detect a carcass, detections were adjusted by searcher efficiency rate following the Huso (2011) estimator. Models suggested that searcher efficiency was influenced by carcass size, season, and Project component location. In the solar field (SCAs + fence + power blocks), searcher efficiency was 80% (CI: 68 – 90%; n = 30), 95% (CI: 90 – 99%; n = 20), and 96% (CI: 91 – 100%; n = 10) during spring and fall for small birds, medium birds, and large birds, respectively; and 93% (CI: 86 – 97%; n = 31), 98% (CI: 96 – 100%; n = 19), and 99% (CI: 97 – 100%; n = 10) during summer and winter for small, medium, and large birds, respectively. Along overhead lines, searcher efficiency during spring and fall was 54% (CI: 39 – 67%; n = 30), 85% (CI: 75 – 95%; n = 20), and 88% (CI: 74 – 100%; n = 10) for small, medium, and large birds, respectively, and 79% (CI: 66 – 89%; n = 30), 95% (CI: 90 – 99%; n = 20), and 96% (CI: 90 – 100%; n = 10) during summer and winter for small, medium, and large birds, respectively.

During the 2015 – 2016 monitoring, there were an estimated 1,507 bird fatalities (CI: 1,214 – 1,952) and 26 bat fatalities (CI: 10 – 46) at the Project (all components combined). For all components associated with both solar units (SCAs, power blocks, evaporation ponds, and along the perimeter fence), there were an estimated 997 (CI: 817 – 1,240) bird fatalities (577/1,000 acres, 4.2/nameplate MW) and 26 (CI: 10 – 46) bat fatalities (15/1,000 acres, 0.1/nameplate MW). Estimates of fatalities along the overhead lines and road outside of the perimeter fence have greater uncertainty (i.e. wide confidence intervals) due to the high rates of scavenging observed during the limited trials at the overhead lines (i.e., large correction factors). There were an estimated 510 (CI: 278 – 894) bird fatalities along overhead lines. No bat carcasses were detected along the overhead lines.

STUDY PARTICIPANTS

Western EcoSystems Technology

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REPORT REFERENCE

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1 INTRODUCTION

1.1 Project Background

The Genesis Solar Energy Project (Project) consists of two solar power electrical generating facilities (Units 1 and 2) and associated infrastructure with a combined net capacity of 250 megawatts. The Project is located on land managed by the Bureau of Land Management (BLM) 40 km (25 miles) west of Blythe, in Riverside County, California (Figure 1). The Project facility consists collectively of two power blocks, power generating equipment (solar collector assemblies [SCAs] of mirrored parabolic troughs [solar troughs or troughs]), support facilities, and evaporation ponds. The project also includes the following linear facilities, a generation tie line, distribution line, natural gas pipeline, and a main access road that are mostly co-located for approximately 10.5 km (6.5 miles). The Project comprises approximately 1,800 acres (728 hectares [ha]). The solar field and associated structures comprise 1,727 acres (699 ha) and linear facilities comprise 93 acres (38 ha).

1.2 Monitoring Plan Overview and Goals

A Bird and Bat Conservation Strategy (BBCS; 2016) was prepared by the Project proponent in collaboration with the US Fish and Wildlife Service (USFWS), California Department of Fish and Wildlife (CDFW), California Energy Commission (CEC), and BLM to guide comprehensive monitoring of impacts to birds and bats associated with operation of the Project. Final agency acceptance of the BBCS occurred in March 2015.

The BBCS details post-construction monitoring to be conducted and the data analysis and reporting processes that will be implemented by Genesis Solar in collaboration with the USFWS, CDFW, CEC, and BLM. As identified in the BBCS, the goals are:

1. Estimate overall annual avian fatality rate and species composition associated with the Project infrastructure. This estimate will include mortality associated with SCAs, overhead lines (gen-tie line and distribution lines), perimeter fence and other features of the Project that may result in injury and mortality.

2. Determine whether there are spatial and temporal/seasonal patterns of mortality associated with Project infrastructure (e.g., different mortality rates near SCAs on the edge of the solar field versus the interior area of the solar field).

3. Provide information that will assist the CEC and BLM, in consultation with the USFWS and the CDFW, in understanding which species and potentially which regional populations are at risk.

4. Collect data in such a way that the CEC and BLM, in consultation with the USFWS and CDFW, may make comparisons with other solar sites.

1.3 Purpose of This Report

This report represents the comprehensive annual report for the first year of monitoring, summarizing monitoring methods and results for avian and bat detections and injuries based on the procedures and requirements specified in the approved BBCS and as required by CEC Condition of Certification BIO-16. This report includes data and final information from all four quarterly monitoring periods.

This report covers the 2015 – 2016 monitoring year, which includes the period from March 1, 2015 to February 28, 2016. This annual report includes the observed mortality rates broken out by likely diurnal and likely nocturnal species, and by ecological guilds of interest (e.g., raptors, water-associated birds, passerines) for each of the facility types and suspected causes of death. Species composition of detections and the results of the bias trials are also included in this report.

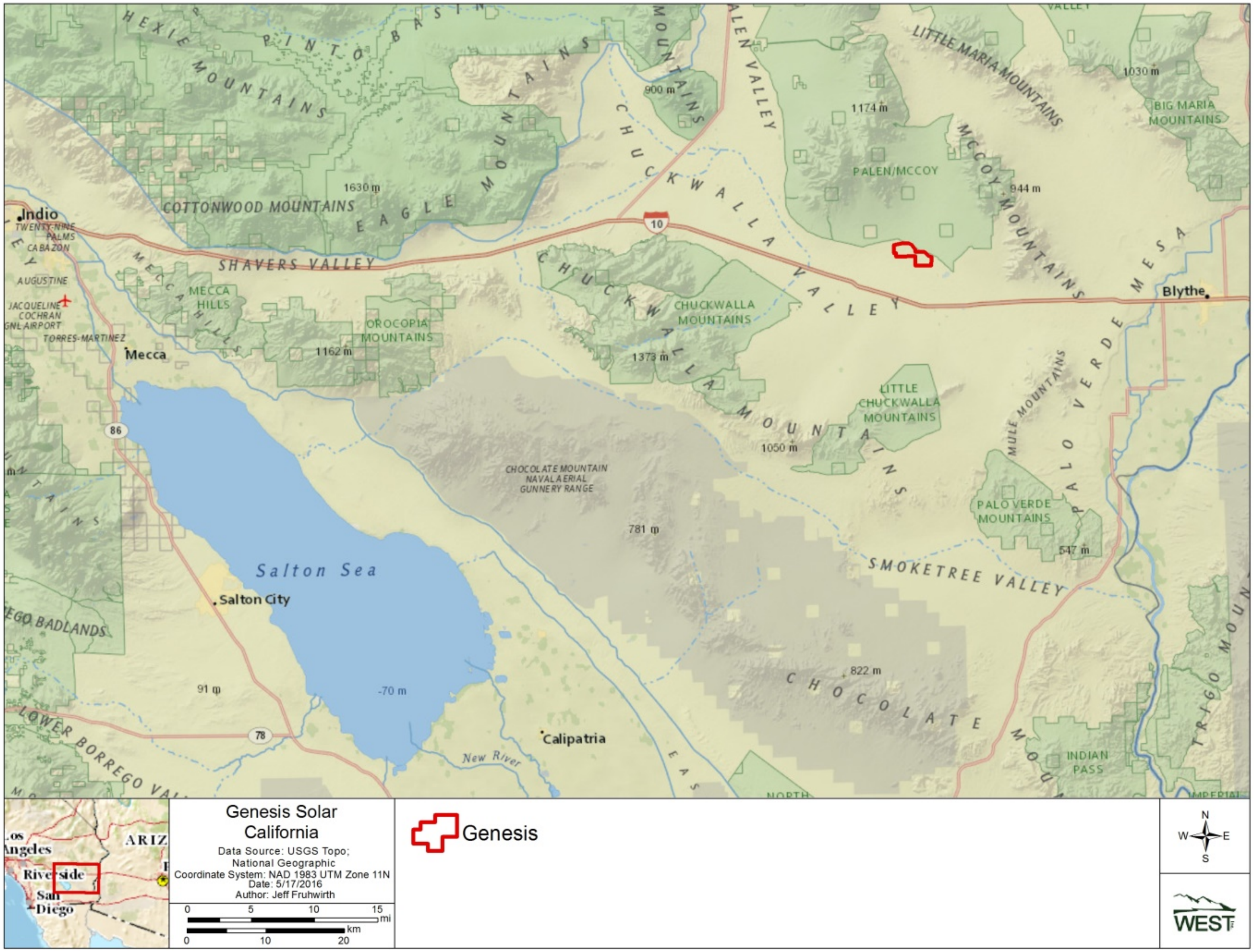

Figure 1. Genesis Solar Energy Project vicinity map, Riverside County, California.

2.0 METHODS

The following section describes the field and statistical methods used during the monitoring period, including the analytical methods for estimating overall avian and bat fatality rates.

2.1 Standardized Carcass Searches

This section describes areas surveyed, the timing and frequency of searches, and the methods by which standardized searches were conducted to identify dead/injured birds and bats at the Project. This section also describes the methods for conducting carcass persistence and searcher efficiency trials, the methods for reporting and analyzing data, and the methods for producing fatality estimates for the Project.

2.1.1 Areas Surveyed

Standardized carcass searches were conducted at a sample of the solar collector assemblies in each unit, the perimeter of each power block (including the area below each air condensed cooling [ACC] unit; Figures 2 and 3), the evaporation ponds (Figure 2), the “fenceline” (defined as the perimeter fence for each unit and includes 100% of the total length of the fence; Figures 2 and 3), and the overhead lines (gen-tie and distribution lines; 25% of the total length of each line from the Project fence to Wiley’s Well rest stop; Figure 4). Table 1 provides information on characteristics (e.g., number and size) of each component as well as the percent of each component that was searched.

To ensure a balanced distribution of plots in solar collector assemblies, each unit was divided into blocks, and each block was sampled using a systematic sample of 30% of pairs of rows with a random starting point. This sampling design ensures that survey plots were not spatially clumped.

2.1.2 Search Frequency and Timing

The 2015 – 2016 monitoring year includes the period from March 1, 2015 through February 28, 2016. Standardized searches occurred at seven-day intervals during spring (March 1 – May 31, 2015) and fall (August 31 – October 31, 2015), and 21-day intervals during summer (June 1 – August 30, 2015) and winter (November 1, 2015 – February 28, 2016). All Project components included in standardized searches were surveyed 32 times during the 2015 – 2016 monitoring year (13 times during spring, four during summer, nine during fall, and six during winter). All searches took place during daylight hours between approximately 6:30 am and 5:00 pm.

The average search interval for all Project components included in the standardized carcass searches was 6.8 days (median 7 days) during spring, 18.9 days (median 21 days) during summer, 7.0 days (median 7 days) during fall, and 21.0 days (median 21 days) during winter. The shorter search interval during spring and fall, typical of most mortality monitoring projects, helps to account for the increase in bird activity during the spring and fall migration periods, higher expected mortality rates, and lower carcass persistence rates during these periods.

Slight variation in search interval was anticipated due to weather, scheduling and logistical delays.

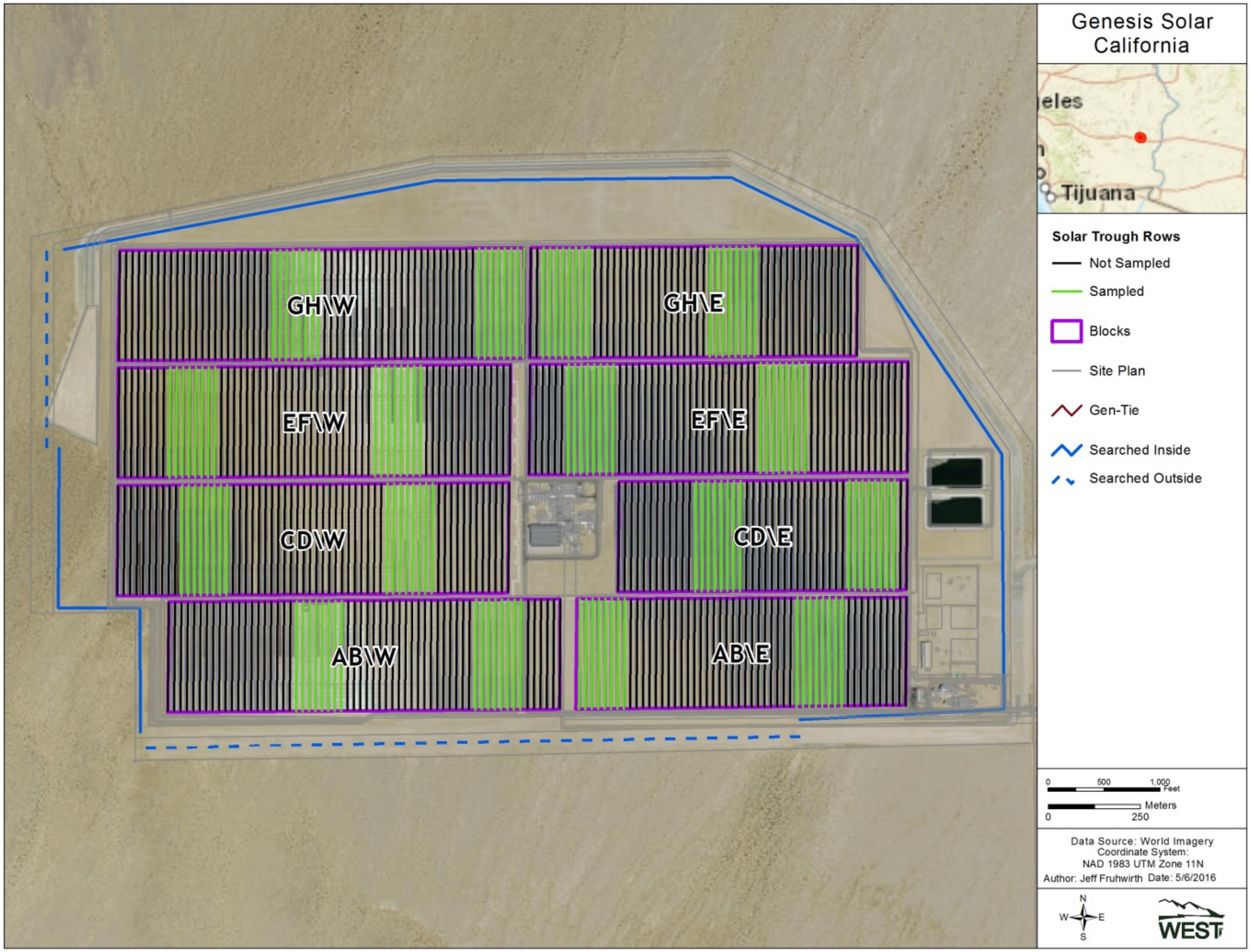

Figure 2. Areas of standardized searches at Unit 1 of the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016)

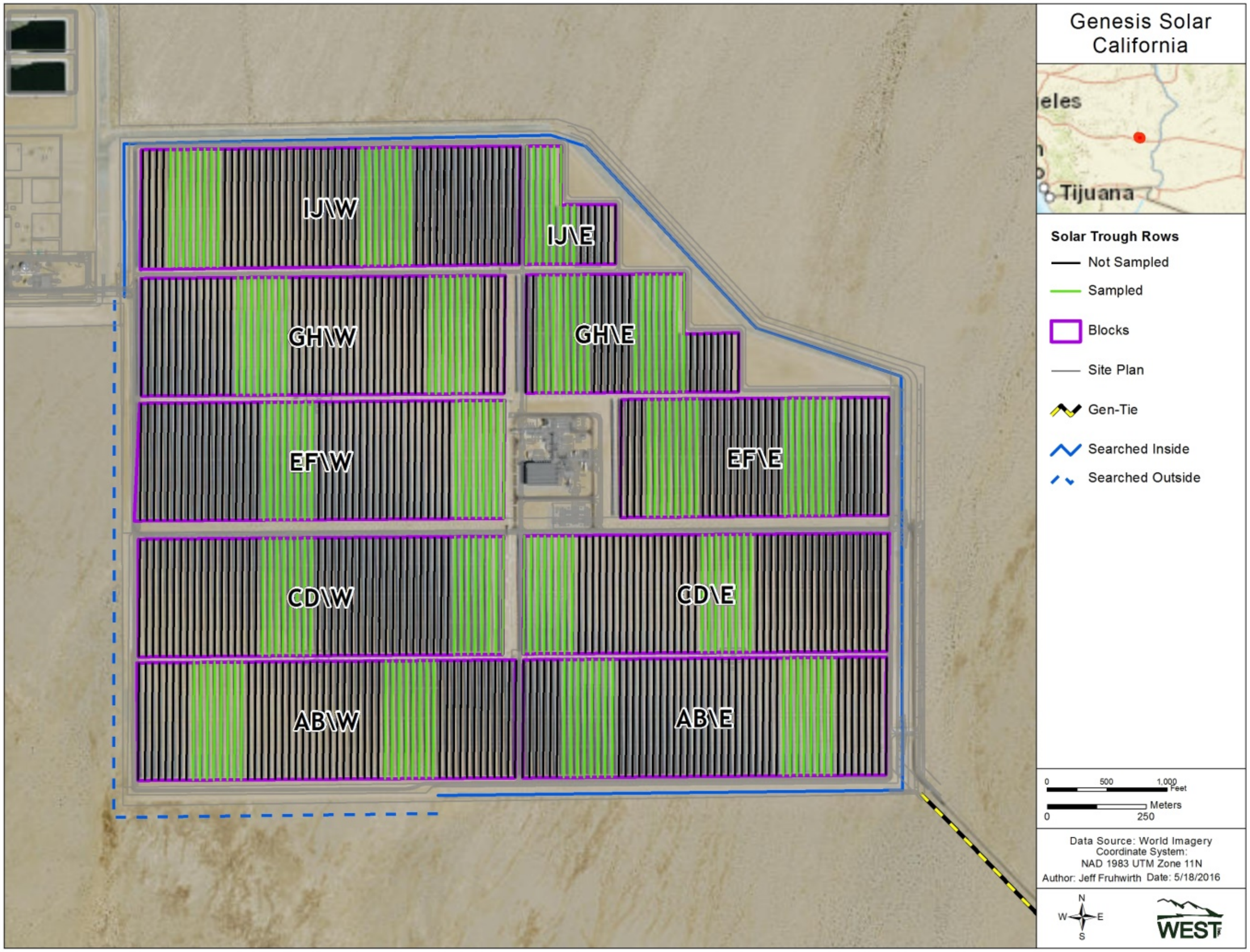

Figure 3. Areas of standardized searches at Unit 2 of the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016)

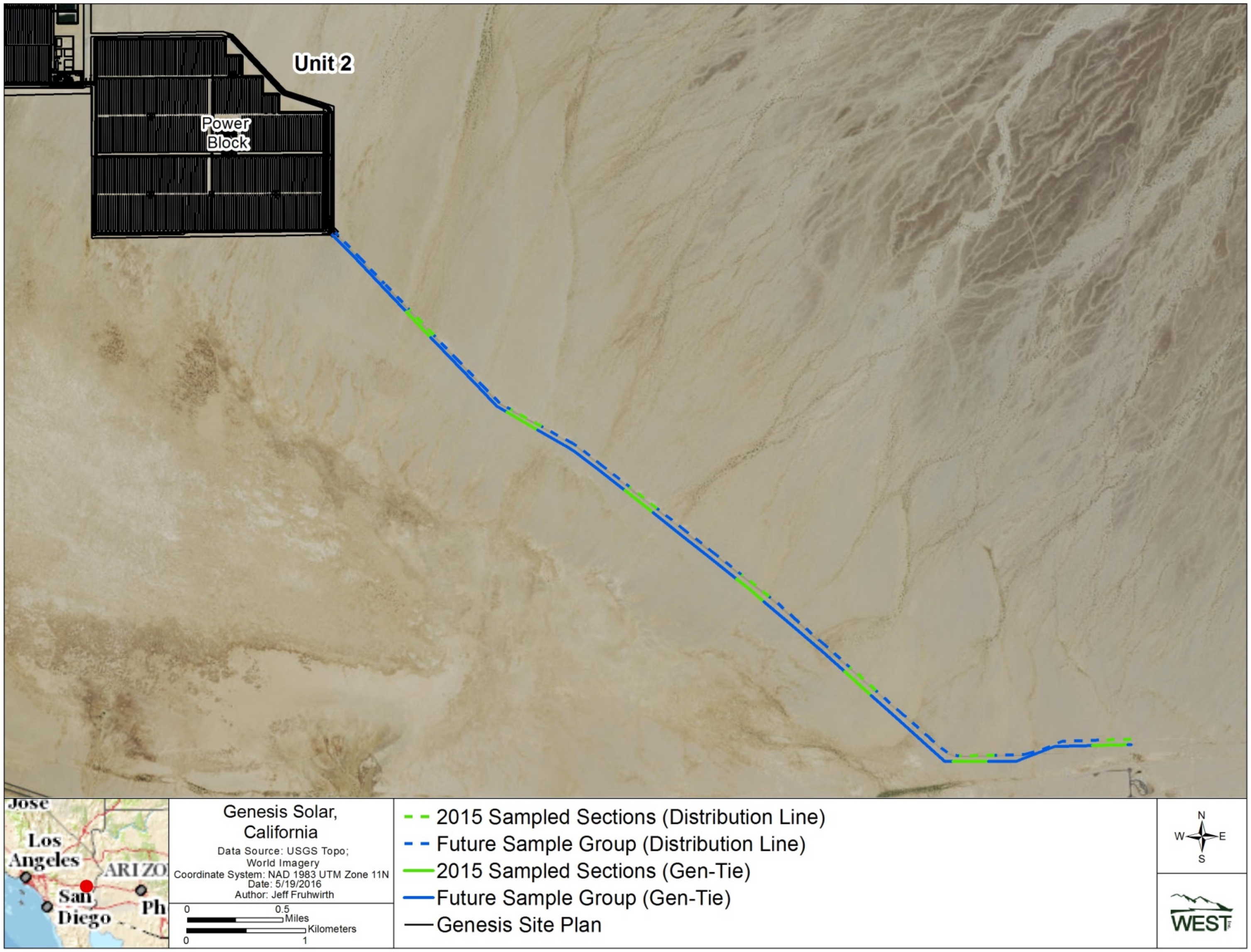

Figure 4. Areas of standardized searches along the overhead lines at the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016)

Table 1. Areas included in standardized carcass searches at the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016).

Project Component	Total Size	Units	Percent of Component Searched
SCAs	920.0	rows of solar troughs	30.4
Unit 1	460.0	rows of solar troughs	27.8
Unit 2	460.0	rows of solar troughs	33.0
ACC units	0.9	Hectares	100
Power blocks (perimeter)	0.8	Kilometers	100
Evaporation ponds	3.1	Hectares	100
Distribution line	8.4	Kilometers	25.0
Generation Tie line	8.4	Kilometers	25.0
Fence	14.5	Kilometers	100

2.1.3 Search Methods

Standardized carcass searches were performed by CEC and BLM approved biologists, in accordance with methods outlined in the BBCS.

Within the solar collector assemblies, 280 solar troughs (30.4% of the total number of troughs) were surveyed by vehicle. A single biologist slowly drove (≤5 mph) parallel to troughs and centered between rows, searching ahead and to the driver's side of the vehicle for bird and bat detections. Biologists scanned out to a perpendicular distance of approximately 30 m, or the ground area encompassing two rows of solar troughs.

At each power block, biologists slowly walked around the entire perimeter looking for dead and injured birds and bats, and used binoculars to scan interior portions of the power block. The search area for the power block is defined as the 0.8-km (0.5 miles) perimeter of each power block, and the area of the interior power block that was available for visual inspection from the periphery. Beneath ACC units, biologists walked four or five evenly spaced transects (approx. 15-m apart) through the gravel.

At each evaporation pond, biologists walked the entire perimeter looking for dead and injured birds and bats on the ground, in the netting, and in the pond below the netting. Binoculars or a spotting scope was used to scan across the top of the netting and the surface of each pond.

The entire length of fenceline (19.3 km or approximately 12 miles) was searched by vehicle. Biologists searched approximately 3.2 km (2.0 miles) along drivable sections of the outside of the fence, and the remaining 15.2 to 16.9 km (9.5 to 10.5 miles) were surveyed from the inside of the fence (Figures 2 and 3). Travel speed was below five mph while searching.

The overhead lines were each surveyed using a 30-m wide strip transect centered on the line (i.e., 15 meters (m) of ground on either side of the overhead line). A 25% sample of both lines from the Project fence to the Project outer gate located near the Wiley's Well Road rest stop were searched for detections. Biologists slowly walked every fourth 300-meter (984-ft) segment of each line, scanning for dead or injured birds or bats within 15 meters (49.2 ft) of the transect line. Given the location of the lines relative to the road, detections found in the strip transects below overhead lines could be caused by collision with an overhead line, vehicles along the road, scavenging of carcasses from the road or overhead lines, predation, or some combination thereof.

Once a carcass was detected, it was immediately photographed, and data (i.e. date discovered, species, age, sex, detection condition and description, size class, detection ID, estimated time of death/injury, suspected cause of injury/mortality, evidence of injury, level of certainty for suspected cause, evidence of scavenging, disposition of detection, rehabilitation outcome of injured bird, GPS coordinates of detection location, sample unit, nearest project component, distance and bearing to nearest project feature, inside/outside search area, whether found incidentally or during carcass search, weather conditions, habitat, visibility index, percent vegetation cover, etc.) were recorded according to specifications outlined in Section 6.7 of the approved Genesis BBCS. Detections were immediately retrieved from their location on the ground, labeled, and placed in a freezer on site. In addition, feather spots were classified as a detection according to the standards commonly applied in California (CEC and CDFG 2007), which dictate that when only feathers are found, to be classified as a detection, each find must include a feather spot of at least five tail feathers or two primaries within 5 m (16.4 ft) or less of each other, or a total of 10 feathers.

Suspected cause of death was assigned based on evidence available on the detection (e.g. broken neck, broken wing, broken bill), evidence available on the Project infrastructure (e.g. imprint on panels, feathers on panels), and proximity of the detection to Project infrastructure. Detections that had evidence of scavenging, no evidence of cause on the carcass and lacked evidence on Project infrastructure were assigned as “unknown”. Detections that were relatively intact (i.e., with minimal evidence of scavenging), located in close proximity to Project infrastructure (e.g., found directly beneath overhead lines), and had evidence of injury had a suspected cause of death attributed to the respective Project component. However, it should be noted that there is uncertainty associated with cause of death assignments because no events were directly observed. Detections assigned to the “unknown” category were included in fatality estimates if they were located within standardized carcass search areas, and all detections made during the 2015 – 2016 monitoring year are reported here.

2.2 Carcass Persistence Trials

Carcass persistence trials were conducted in each of the four seasons during the 2015 – 2016 monitoring year. Trial carcasses from three size classes (small [zero-100 grams [g]], medium [101 –999 g], and large [1000+ g) were used for trials. Carcass persistence results from small birds were used as a proxy for bat carcass persistence. The small size class comprised house sparrows (*Passer domesticus*) and two – three week-old coturnix quail (*Coturnix coturnix*), the medium size class comprised rock pigeons (*Columba livia*), chukar (*Alectoris chukar*) and older coturnix quail, and the large size class comprised hen mallard (*Anas platyrhynchos*) and hen ring-necked pheasant (*Phasianus colchicus*).

2.2.1 Carcass Persistence Data Collection

To quantify carcass persistence rates, 15 small, 10 medium, and 5 large trial carcasses were randomly placed and monitored within the solar field (SCAs and the fenceline), and the same number of each size class were placed along the overhead lines, for a total of 60 carcass persistence trials at Genesis Solar Energy Project during each of the four seasons. Thus, 240 carcasses were placed during the 2015 – 2016 monitoring year. During the 2015 – 2016 monitoring year, 54 trial carcasses within the SCAs, eight along the fence, and 15 along the overhead lines were monitored using motion-triggered digital trail cameras, while the remaining trial carcasses were visited on foot for 30 days or until the carcass had deteriorated to a condition at which it would no longer qualify as a documentable carcass (i.e., a feather spot). Fewer trial carcasses along the overhead lines were monitored with cameras because of theft and vandalism concerns. Trial carcasses without trail cameras were visited and photographed once per day for the first four days, and then every three to five days until the end of the monitoring period. To avoid training scavengers to recognize cameras as “feeding stations,” trail cameras were installed five days before specimens were placed, and fake cameras without bias trial carcasses were placed (eight within the Project fence, and four along the overhead lines). Periodic ground-based checking of trial carcasses with trail cameras also occurred to guard against misleading indicators of carcass removal, such as wind blowing the carcass out of the camera’s field of view. To minimize potential bias caused by scavenger swamping (Smallwood 2007, Smallwood et al. 2010), carcass-persistence specimens were distributed randomly across the entire Project so as to not attract scavengers to any one location, especially at regularly searched areas. In addition, trials were initiated on two to four different dates throughout each season so that all trials allocated to a specific size group and season were not all arriving at the same time.

2.2.2 Estimating Carcass Persistence Times

Measurements of carcass persistence rates were subject to censoring. In this context, censoring refers to the instance when a value (e.g., days a carcass is present before being removed) may not be exactly known but is known to be within a finite range. For example, suppose a trial carcass was checked on day seven and was present, and was checked again on day ten, but was found to be missing. The exact time until removal is unknown; however, it is known that the trial carcass became unavailable at some point between seven and ten days. This trial carcass would be considered “interval censored”. Similarly, if a trial carcass lasts the entire 30-day trial period, that carcass is “right censored”— it is known that the carcass lasted at least 30 days, but it may have persisted longer. Because carcass persistence data were censored, persistence was analyzed using methods that can accommodate censored data and still produce unbiased estimates of the probability of persistence (Therneau 2015, Therneau & Grambsch 2000). It is beyond the scope of this document to provide statistical foundations of censored-data survival models, but functions identical to those provided with the USGS-developed fatality estimator software (Huso et al. 2012) were used to fit survival models to the censored carcass persistence data, and some background is available in the documentation provided with that software.

USGS-developed fatality estimator software (Huso et al. 2012) was used to fit survival models to the censored carcass persistence data. There were four distributions implemented in survival models used to estimate the probability that a carcass is available to be found at the end of the search interval (*r)*: exponential, Weibull, loglogistic, and lognormal. These four distributions exhibit varying degrees of flexibility in order to model a wide variety of distributions of persistence time. Akaike's Information Criterion adjusted for sample size (AICc; Akaike 1973) was used to rank the fit of each survival model to censored carcass persistence data. All models within two AICc values of the top model with the lowest AICc value were considered. The model with the fewest parameters (i.e. predictor variables) was selected.

2.3 Searcher Efficiency Trials

Searcher efficiency trials were conducted throughout the 2015 – 2016 monitoring year. Carcasses from three size classes (small, medium, and large) were used for trials. Searcher efficiency results from small birds were used as a proxy for bat detection. The small size class comprised house sparrows and two-three week old coturnix quail, the medium size class comprised rock pigeons, chukar, and older coturnix quail, and the large size class comprised hen mallards and hen ring-necked pheasants.

2.3.1 Searcher Efficiency Data Collection

Sixty searcher efficiency trials (15 small birds, 10 medium birds, and five large birds within SCAs, power blocks, and along the perimeter fence, and the same number of each size class along the overhead lines) were placed at the Project during each season, for a total of 240 trial carcasses placed during the 2015 – 2016 monitoring year. Locations for trials were chosen by taking a randomized sample of all locations included in standardized carcass searches. Trials were placed in various vegetation heights and vegetation types to represent the range of conditions under which searches occur. They were placed in all areas where standardized searches occur except the evaporation ponds. Trial carcasses were placed early the same day that a search was scheduled to occur, and trial carcasses were collected either as they were detected by a searcher, or shortly after the search occurred (always within a few hours of the completion of a search).

2.3.2 Estimating Searcher Efficiency

To evaluate hypotheses regarding differences in carcass detectability among carcass size and visibility classes, logistic regression models were fit to searcher efficiency data and AICc was used to compare models. All models within two AICc values of the top model with the lowest AICc value were considered. The model with the fewest parameters (i.e. predictor variables) was selected. Models including effects of Project component, carcass size (three classes), season (spring, summer, fall, and winter) and visibility index (two classes) were compared to each other and a null model. The two visibility classes present at the Project site are: easy (defined as ≥ 90% bare ground [BG]; vegetation <6" tall) and moderate (defined as 26 – 89% BG; vegetation <6" tall). However, within the solar field the moderate visibility class has a very limited spatial extent due to management aimed at minimizing vegetation cover (only 7.5% of searcher efficiency trials randomly fell in areas of moderate visibility class); thus, visibility class was not considered further for the solar field. Because the moderate visibility class has a greater spatial extent along the overhead lines, we included a test of visibility class when modeling searcher efficiency along overhead lines.

Once the best model was chosen and appropriate classes identified, searcher efficiency, or the proportion of carcasses detected, *p,* was calculated for each class using the following equation:

$$p = \frac{Number\ of\ Carcasses\ Observed}{Number\ of\ Carcasses\ Available}$$

2.4 Fatality Estimator

The adjusted fatality estimate may be written as:

$$F = C/rp,$$

where *F* is the estimated total number of fatalities for the sampled area, *C* is the number of detections found and included in fatality estimation*, r* is the probability that a carcass is un-scavenged and available to be found at the end of the search interval, and *p* is the probability of detecting a carcass (Huso 2011). *F* can then be adjusted up for the sampling fraction (percent of project component searched).

All fatality estimates were calculated using the Huso estimator, as well as 90% confidence using bootstrapping (Manly 1997). Bootstrapping is a computer simulation technique that is useful for calculating point estimates, variances, and confidence intervals for complicated test statistics. A total of 1,000 bootstrap replicates was used for each variable including searcher efficiency (*p*), probability of a carcass persisting to the next search ($\hat{r}$), adjusted search interval and observed detections. From these bootstraps, the probability of available and detected carcasses was calculated and applied to the bootstrapped observed detections. The lower 5th and upper 95th percentiles of the 1,000 bootstrap estimates provide estimates of the lower limit and upper limit of an approximate 90% confidence interval on all estimates.

Confidence intervals for fatality estimates with five or fewer detections are provided but should be interpreted with caution. Low carcass counts create difficulties in the fatality estimation process. Although the Huso estimator accounts for carcasses missed by searchers and scavenged before scheduled searches, all estimators become unstable as the count of carcasses become small. Korner-Nievergelt et. al (2011) showed via simulation that the best possible precision (of estimates) decreases below approximately 10 carcasses, and dramatically so as the count approaches zero. The software published by the USGS to estimate using the Huso estimator suggests caution when 5 or fewer carcasses are observed in a group. The effect is more pronounced as the probability of detection decreases. Intuitively, the low carcass count effect makes sense, as it becomes more and more difficult to determine if the small number of detections is the result of a low fatality rate, a low detection rate, or some combination of both—all of which is unknowable.

2.5 Incidental Reporting

Some detections were outside standardized search areas, or were within search areas but not observed during standardized searches. Such detections were found by WEST avian biologists and operational personnel and were considered “incidental” detections. When found by operational personnel, these detections were reported to WEST avian biologists for documentation. Data on incidental detections are reported here, as well as in the Special Purpose – Utility (SPUT) Permit Avian Injury and Mortality Report Forms, March 1, 2015 – February 28, 2016. To be conservative, all detections made in search areas that were estimated to have occurred within twice the duration of the search interval (seven days during spring and fall; 21 days during summer and winter) were included in fatality estimates, regardless of whether they were detected incidentally or during searches. All incidental detections made at the power blocks, estimated to have occurred within twice the duration of the search interval (assuming a one day interval due to daily maintenance by site personnel) were included in fatality estimates.

3.0 MONITORING RESULTS

3.1 Summary of Avian Detections

Figures 5 – 10 show the locations of detections found during the monitoring year. Detailed areas of detection locations along the overhead lines are provided in Appendix A. During the 2015 – 2016 monitoring year, 400 detections (including all stranded and injured birds, incidental detections, and bats) of 76 identified avian species and five identified species of bats were recorded (Table 2). The most numerous detection of an identified species was of eared grebe (n = 38), followed by mourning dove (n = 26), and ruddy duck (n = 25). The majority of the eared grebes (29) and ruddy ducks (20) were found at the evaporation ponds. The highest number of detections for a species in the SCAs were mourning dove (11) and western meadowlark (11), with no other species with more than 6 detections. Northern flicker (4), great-tailed grackle (3) and rock pigeon (3) were the species with the most detections along the fence. Mourning dove (7), and Wilson’s warbler (4) were the species with the most detections along the overhead lines. Mourning dove (5), American kestrel (5), and greater roadrunner (4) were the species with the most detections in the power blocks. For fresh detections, body weights and weather conditions the preceding nights are described in Appendix B. A summary of all avian guilds and migration behavior represented by detections found during the 2015 – 2016 monitoring year can be found in Appendix C.

More detections (n = 129, or 32.3% of total detections) were found within the SCAs (Tables 2, 3, and 4) than at other project components. However, both the ponds and the power blocks, which are smaller in area compared to the SCAs, appear as concentration areas (Figure 5, 6, 7, 9, and 10). Two hundred thirty detections (57.5%) were made during standardized carcass searches and 170 (42.5%) were documented as incidentals, with most incidental detections found (n = 60) at the evaporation ponds.

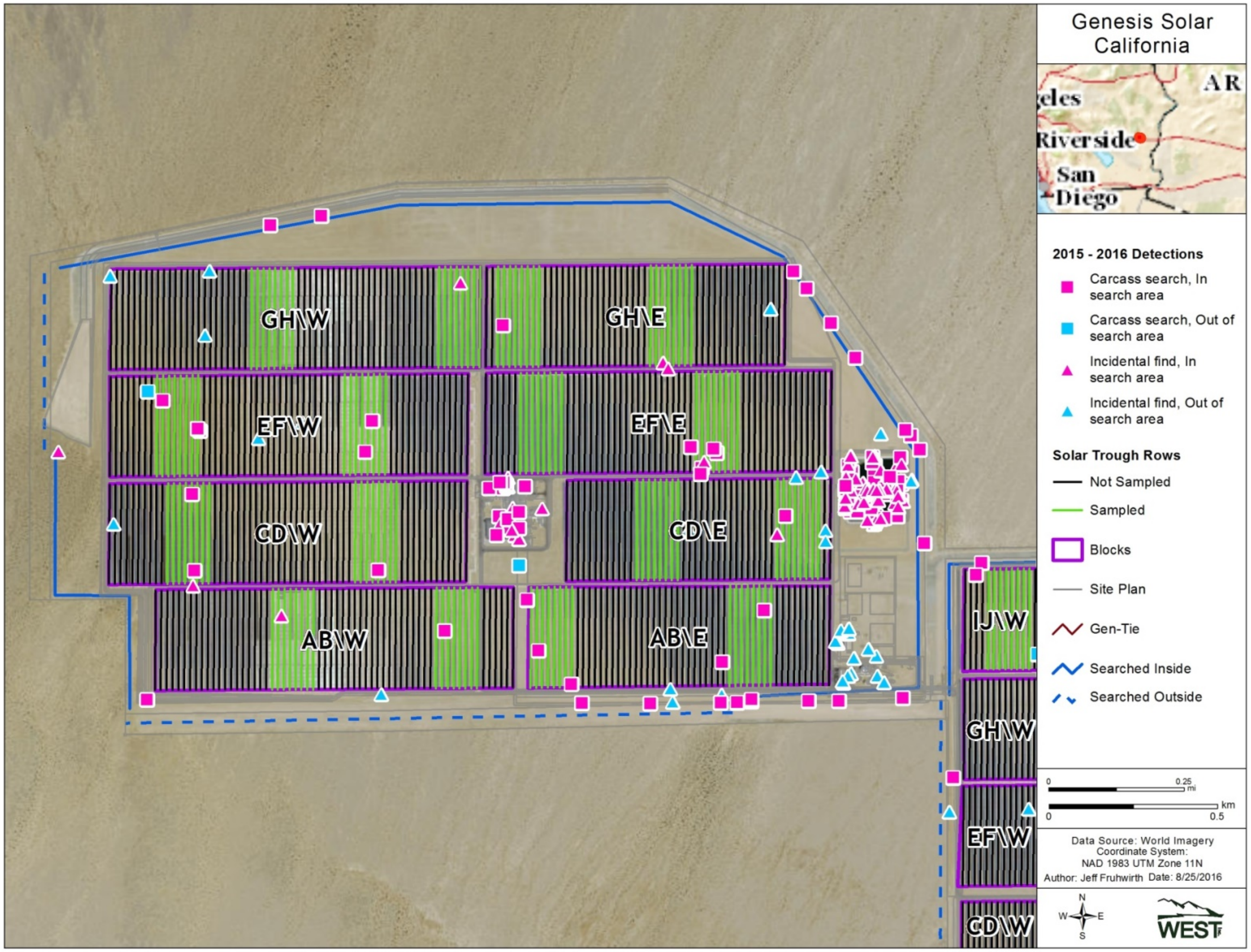

Figure 5. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance) at Unit 1 of the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

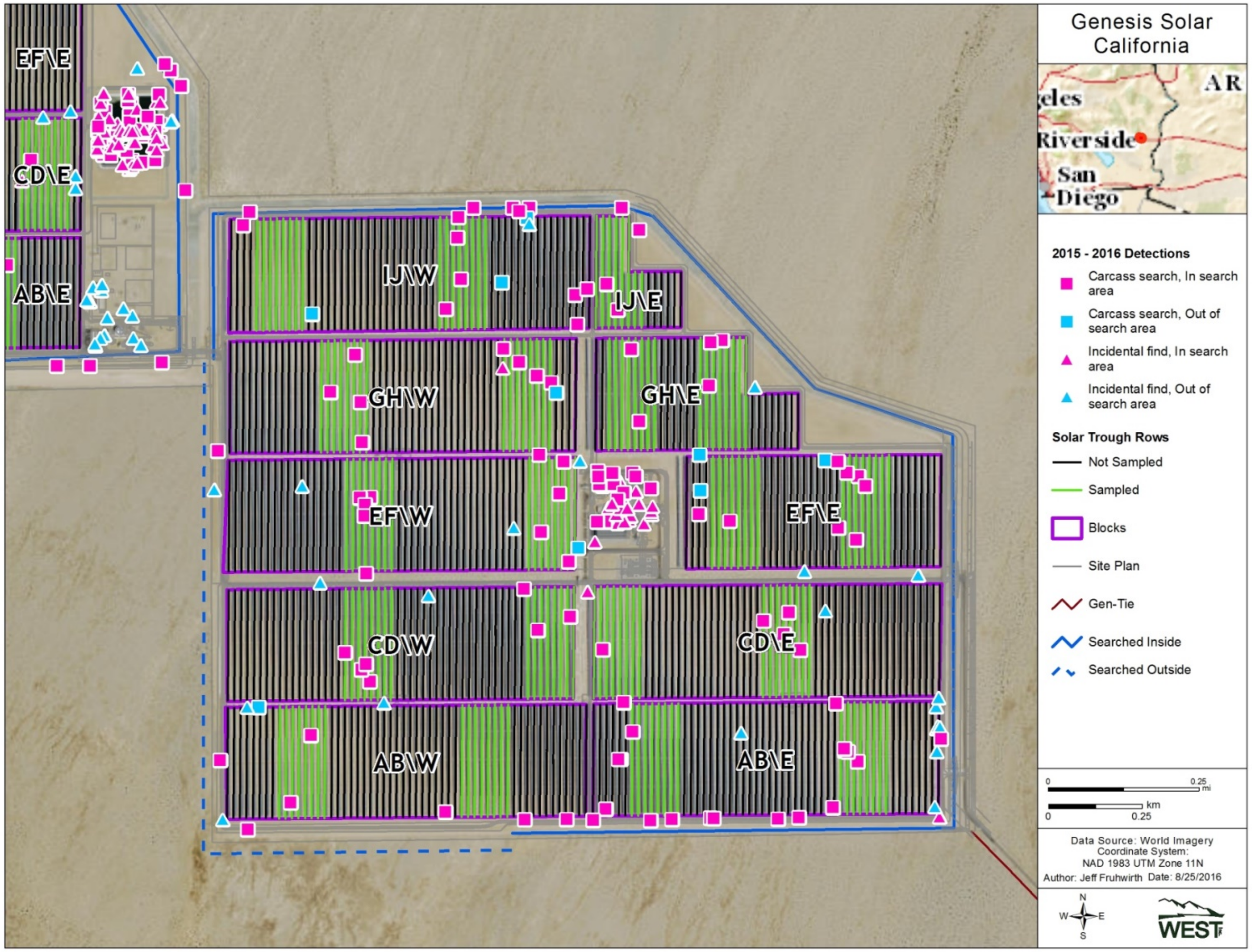

Figure 6. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance) at Unit 2 of the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

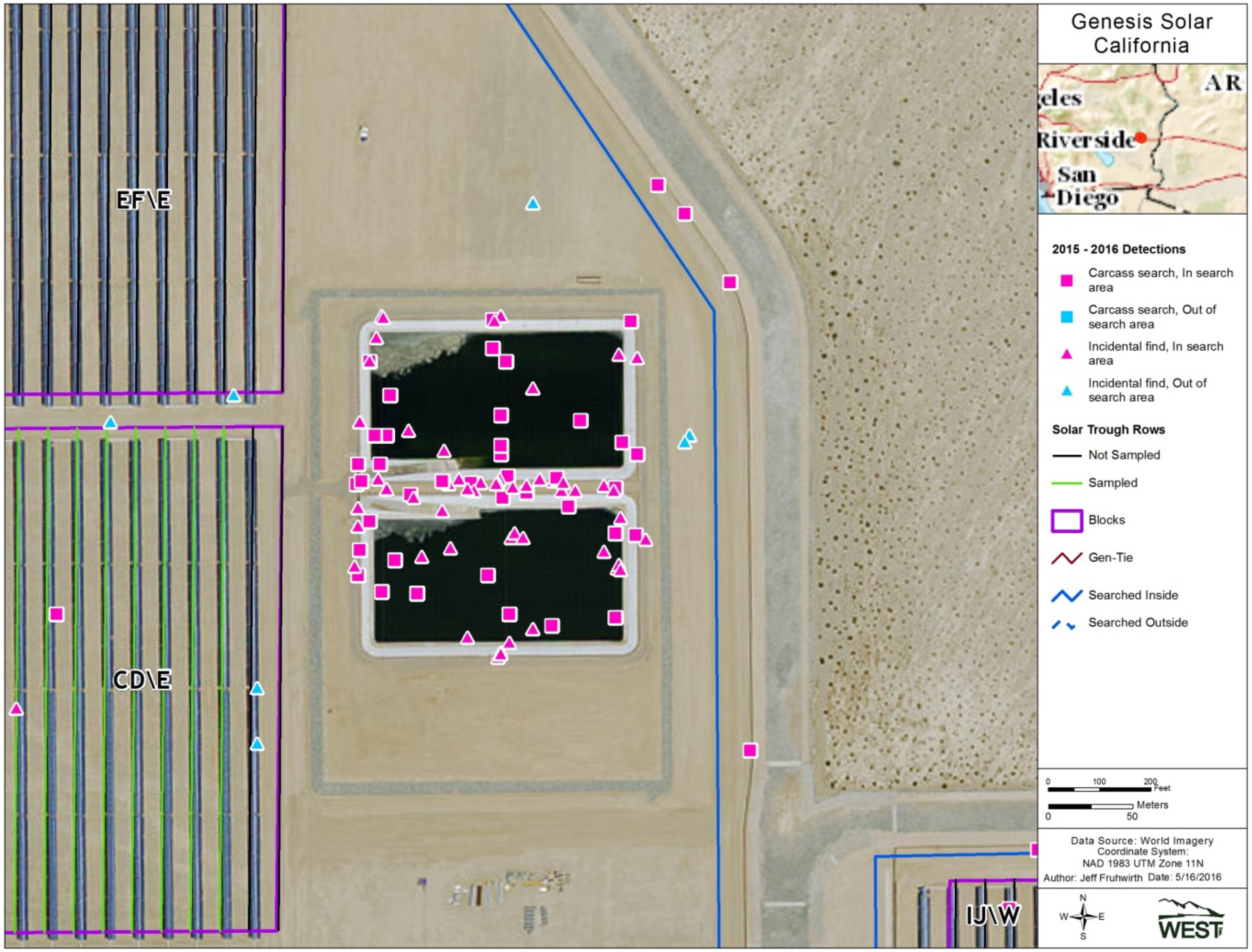

Figure 7. Close-up of area at evaporation ponds and detections (those made during searches and those made incidental to operations and maintenance) within Unit 1 of the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

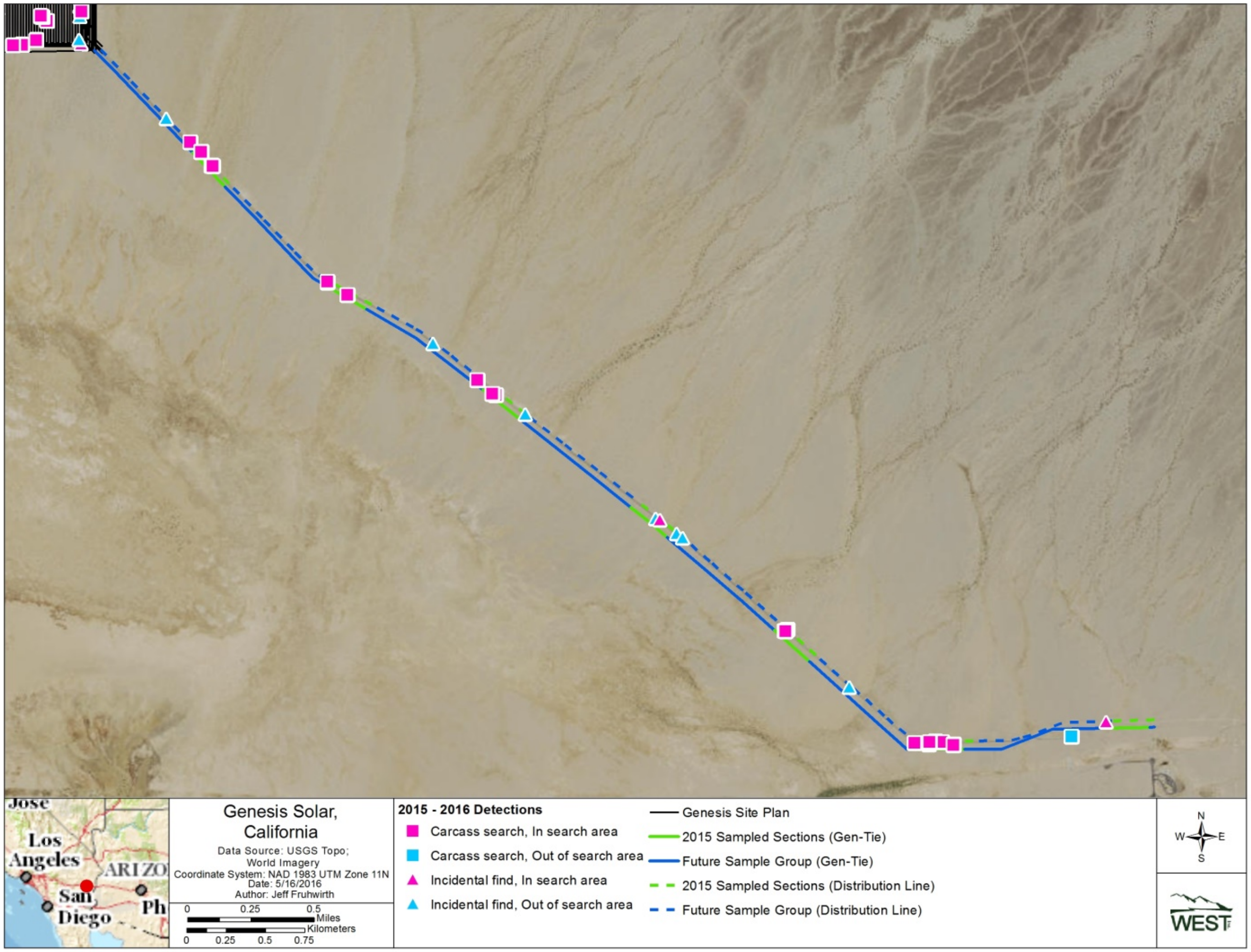

Figure 8. Areas of standardized searches and detections (those made during searches and those made incidental to operations and maintenance activities) along the overhead lines and Project access road at the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

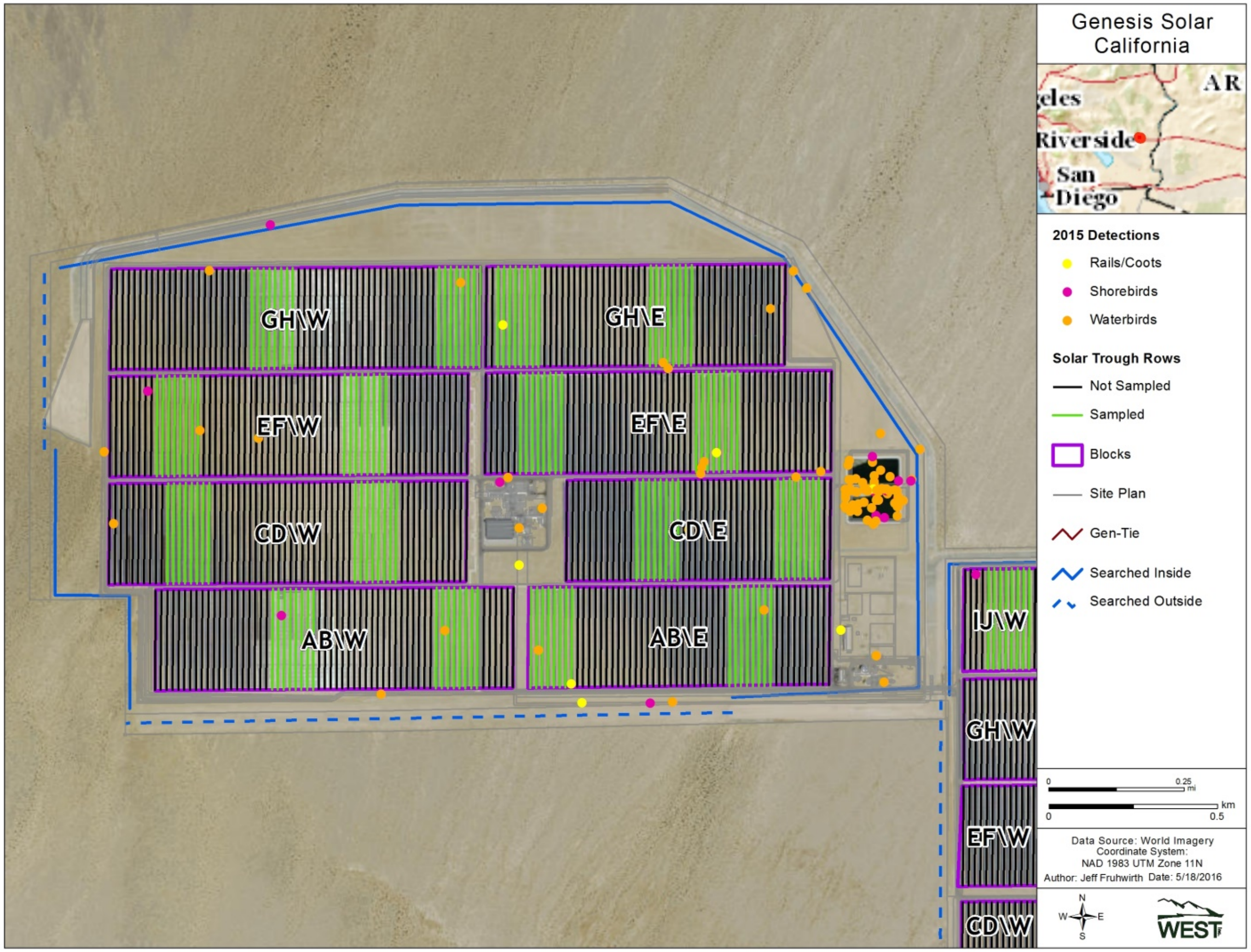

Figure 9. Locations of water-associated bird detections at Unit 1 of the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

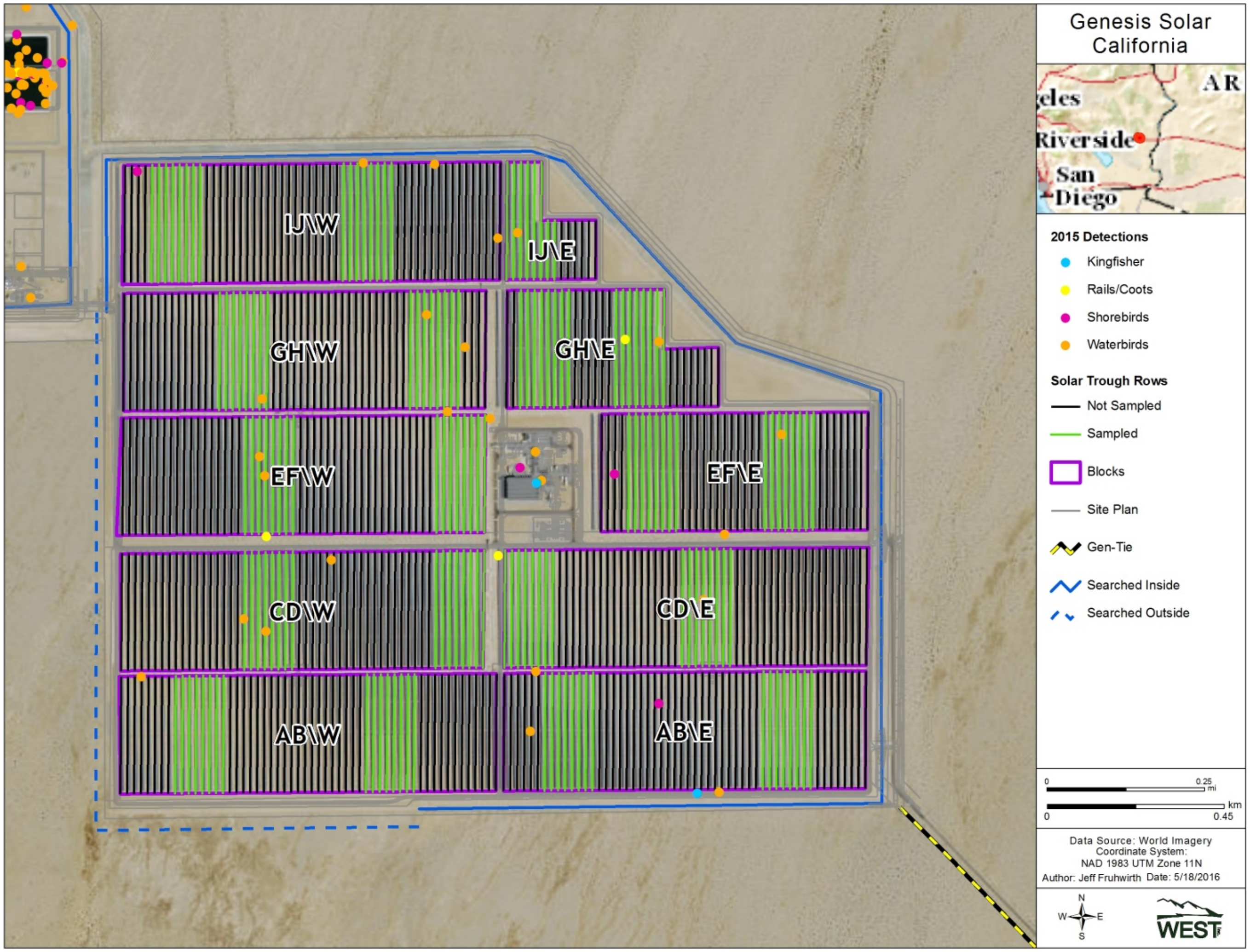

Figure 10. Locations of water-associated bird detections at Unit 2 of the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

Table 2. Number of individual detections (those made during standardized carcass searches and incidentally), by species and component, during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. SCA = solar collector assembly; overhead lines = gen-tie and distribution lines, which are co-located with the facility access road). NA = not applicable

Common Name	Scientific Name	Size	Building	Fence	Overhead lines	Pond	Power Blocks	SCAs	Total Count
				Water-Associated Birds					
eared grebe	*Podiceps nigricollis*	MB	0	2	1	29	0	6	38
ruddy duck	*Oxyura jamaicensis*	MB	0	0	0	20	0	5	25
unidentified grebe	*NA*	MB	0	3	1	2	0	3	9
American coot	*Fulica americana*	MB	1	1	0	2	1	3	8
unidentified duck	*NA*	MB	0	2	0	1	0	5	8
cinnamon teal	*Anas cyanoptera*	MB	0	0	0	3	1	3	7
unidentified teal	*Anas spp*	MB	1	0	0	2	1	2	6
western grebe	*Aechmophorus occidentalis*	LB	0	0	0	0	2	3	5
killdeer	*Charadrius vociferus*	MB	0	0	0	1	1	2	4
green-winged teal	*Anas crecca*	MB	0	1	0	0	0	2	3
redhead	*Aythya americana*	LB	0	0	0	2	0	1	3
sora	*Porzana carolina*	SB	0	0	0	0	0	3	3
unidentified shorebird	*NA*	SB	0	0	0	3	0	0	3
belted kingfisher	*Megaceryle alcyon*	MB	0	1	0	0	1	0	2
blue-winged teal	*Anas discors*	MB	0	0	0	0	0	2	2
common loon	*Gavia immer*	LB	0	0	0	0	0	2	2
snowy egret	*Egretta thula*	MB	0	0	0	0	1	1	2
spotted sandpiper	*Actitis macularia*	SB	0	0	0	1	0	1	2
unidentified sandpiper	*NA*	SB	0	0	0	1	1	0	2
bufflehead	*Bucephala albeola*	MB	1	0	0	0	0	0	1
California gull	*Larus californicus*	MB	0	0	0	0	0	1	1
great blue heron	*Ardea herodias*	LB	0	0	0	1	0	0	1
great egret	*Ardea alba*	LB	0	0	0	1	0	0	1
long-billed curlew	*Numenius americanus*	MB	0	0	0	0	0	1	1
northern shoveler	*Anas clypeata*	MB	0	0	0	0	0	1	1
red-necked phalarope	*Phalaropus lobatus*	SB	0	0	0	1	0	0	1
unidentified egret	*NA*	LB	0	0	0	0	0	1	1
unidentified gull	*NA*	LB	0	1	0	0	0	0	1
unidentified merganser	*Mergus spp*	MB	0	0	0	1	0	0	1
unidentified tern	*NA*	SB	0	1	0	0	0	0	1
western gull	*Larus occidentalis*	LB	0	0	0	0	0	1	1
western sandpiper	*Calidris mauri*	SB	0	0	0	1	0	0	1
Subtotal (waterbirds)			3	12	2	72	9	49	147

Table 2. Number of individual detections (those made during standardized carcass searches and incidentally), by species and component, during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. SCA = solar collector assembly; overhead lines = gen-tie and distribution lines, which are co-located with the facility access road). NA = not applicable

Common Name	Scientific Name	Size	Building	Fence	Overhead lines	Pond	Power Blocks	SCAs	Total Count
				Non-Water-Associated Birds					
mourning dove	Zenaida macroura	MB	1	1	7	1	5	11	26
unidentified sparrow	NA	SB	0	0	1	5	3	5	14
unidentified bird (small)	NA	SB	1	2	0	1	1	8	13
western meadowlark	Sturnella neglecta	MB	0	0	0	0	2	11	13
greater roadrunner	Geococcyx californianus	MB	0	2	1	0	4	4	11
brown-headed cowbird	Molothrus ater	SB	1	1	0	0	3	4	9
unidentified bird (unknown size)	NA	Unk	0	2	3	2	0	2	9
American kestrel	Falco sparverius	MB	0	1	0	0	5	2	8
rock pigeon	Columba livia	MB	0	3	1	0	0	4	8
lesser goldfinch	Spinus psaltria	SB	0	0	0	1	2	3	6
northern flicker	Colaptes auratus	MB	0	4	0	0	0	1	5
red-winged blackbird	Agelaius phoeniceus	SB	0	1	0	2	0	2	5
unidentified blackbird	NA	SB	0	3	0	0	0	2	5
Brewer's blackbird	Euphagus cyanocephalus	SB	0	1	1	1	0	1	4
great-tailed grackle	Quiscalus mexicanus	MB	1	3	0	0	0	0	4
savannah sparrow	Passerculus sandwichensis	SB	0	0	0	1	1	2	4
unidentified bird (medium)	NA	MB	0	0	0	3	1	0	4
western tanager	Piranga ludoviciana	SB	0	1	2	0	0	1	4
white-winged dove	Zenaida asiatica	MB	0	0	0	0	3	1	4
Wilson's warbler	Cardellina pusilla	SB	0	0	4	0	0	0	4
yellow warbler	Setophaga petechia	SB	1	2	1	0	0	0	4
Eurasian collared-dove	Streptopelia decaocto	MB	1	1	0	0	1	0	3
horned lark	Eremophila alpestris	SB	1	1	0	0	0	1	3
house finch	Haemorhous mexicanus	SB	0	0	0	0	3	0	3
lesser nighthawk	Chordeiles acutipennis	MB	0	0	1	1	1	0	3
loggerhead shrike	Lanius ludovicianus	SB	0	0	1	0	1	1	3
Townsend's warbler	Setophaga townsendi	SB	0	0	1	0	1	1	3
unidentified dove	NA	SB	0	2	0	0	1	0	3
unidentified warbler	NA	SB	0	0	0	0	2	1	3
yellow-headed blackbird	Xanthocephalus xanthocephalus	SB	0	0	0	1	2	0	3
yellow-rumped warbler	Setophaga coronata	SB	0	0	0	3	0	0	3

Table 2. Number of individual detections (those made during standardized carcass searches and incidentally), by species and component, during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. SCA = solar collector assembly; overhead lines = gen-tie and distribution lines, which are co-located with the facility access road). NA = not applicable

Common Name	Scientific Name	Size	Building	Fence	Overhead lines	Pond	Power Blocks	SCAs	Total Count
black phoebe	Sayornis nigricans	SB	0	0	0	0	2	0	2
Brewer's sparrow	Spizella breweri	SB	0	0	1	0	0	1	2
brown thrasher	Toxostoma rufum	SB	0	1	0	0	1	0	2
European starling	Sturnus vulgaris	SB	0	1	0	0	1	0	2
Gambel's quail	Callipepla gambelii	MB	0	0	1	0	0	1	2
lazuli bunting	Passerina amoena	SB	0	0	2	0	0	0	2
Lincoln's sparrow	Melospiza lincolnii	SB	1	0	0	0	1	0	2
Nashville warbler	Oreothlypis ruficapilla	SB	0	0	2	0	0	0	2
rock wren	Salpinctes obsoletus	SB	0	0	1	1	0	0	2
unidentified owl	NA	LB	0	2	0	0	0	0	2
unidentified passerine	NA	SB	0	0	1	0	1	0	2
western kingbird	Tyrannus verticalis	SB	1	0	0	0	1	0	2
American pipit	Anthus rubescens	SB	0	0	0	0	0	1	1
bank swallow	Riparia riparia	SB	0	0	0	0	1	0	1
barn owl	Tyto alba	MB	0	1	0	0	0	0	1
burrowing owl	Athene cunicularia	MB	0	0	0	0	0	1	1
cliff swallow	Petrochelidon pyrrhonota	SB	0	0	0	0	1	0	1
dark-eyed junco	Junco hyemalis	SB	0	0	0	0	0	1	1
house wren	Troglodytes aedon	SB	0	0	0	0	0	1	1
orange-crowned warbler	Oreothlypis celata	SB	0	0	1	0	0	0	1
pine siskin	Spinus pinus	SB	0	0	0	0	0	1	1
prairie falcon	Falco mexicanus	MB	0	0	1	0	0	0	1
ruby-crowned kinglet	Regulus calendula	SB	0	0	1	0	0	0	1
ruddy ground-dove	Columbina talpacoti	SB	0	0	0	0	0	1	1
rusty blackbird	Euphagus carolinus	SB	0	0	0	1	0	0	1
sagebrush sparrow	Artemisiospiza nevadensis	SB	0	0	1	0	0	0	1
Scott's oriole	Icterus parisorum	SB	0	0	0	0	0	1	1
tree swallow	Tachycineta bicolor	SB	0	0	0	1	0	0	1
unidentified goldfinch	NA	SB	0	0	0	1	0	0	1
unidentified quail	NA	MB	0	1	0	0	0	0	1
unidentified swallow	NA	SB	0	0	0	0	0	1	1
western wood-pewee	Contopus sordidulus	SB	0	0	0	0	0	1	1
white-crowned sparrow	Zonotrichia leucophrys	SB	0	0	1	0	0	0	1
yellow-billed cuckoo	Coccyzus americanus	SB	0	0	0	0	1	0	1

Table 2. Number of individual detections (those made during standardized carcass searches and incidentally), by species and component, during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. SCA = solar collector assembly; overhead lines = gen-tie and distribution lines, which are co-located with the facility access road). NA = not applicable

Common Name	Scientific Name	Size	Building	Fence	Overhead lines	Pond	Power Blocks	SCAs	Total Count
Subtotal (non water-associated birds)			9	37	37	26	52	79	240
Subtotal (all birds)			12	49	39	98	61	128	387
Bats									
canyon bat	*Parastrellus hesperus*	Bat	2	0	0	1	2	0	5
big brown bat	*Eptesicus fuscus*	Bat	0	0	0	0	1	1	2
Mexican free-tailed bat	*Tadarida brasiliensis*	Bat	0	0	0	0	2	0	2
unidentified bat		Bat	0	0	0	1	1	0	2
long-legged bat	*Myotis volans*	Bat	1	0	0	0	0	0	1
pallid bat	*Antrozous pallidus*	Bat	0	1	0	0	0	0	1
Subtotal (bats)			3	1	0	2	6	1	13
Total (All Species)			**15**	**50**	**39**	**100**	**67**	**129**	**400**

3.2 Suspected Cause of Avian Mortality

Most detections observed did not show clear outward signs of cause of death (Table 3). However, 72 detections were feather spots and 159 detections showed signs of scavenging, impeding positive identification of a suspected cause of mortality. Evidence of collision as cause of death could include broken neck or beak, or bird imprint in the dust on a solar mirror, but only a few detections had such evidence. There were 147 water-associated birds (including waterbirds, waterfowl, rails, coots, shorebirds, and kingfisher) detected during the 2015 -– 2016 monitoring year, and 80.3% were assigned unknown cause, 8.2% were suspected to have been stranded, 6% were suspected to be due to collision, 4.1% entangled, and 1.4% due to predation (Table 3). There were 240 non-water associated birds detected during the 2015 – 2016 monitoring year and 75.8% were assigned unknown cause, 18% were suspected to be due to collision, 2.6% appeared to have drowned, 1% entangled, 1.3% entrapped, 0.8% stranded, and 0.5% due to predation (Table 3). Of the three bats assigned a suspected cause of death, two were suspected to have died due to collision and one due to drowning (Table 3).

3.3 Temporal Patterns of Avian Detections

The fact that different search intervals were used for the migration (7-day) and non-migration seasons (21-day) should be kept in mind while interpreting temporal patterns of the avian detections. The search interval influences the number of searches, so observed patterns can be influenced by effort. The number of detections per day represents those discovered during standardized carcass searches as well as those discovered incidentally. For each day in which there were six or more detections made, an Avian Injury & Mortality Report form (in accordance with Special Utilities Permit MB44900B-0 Condition H.1(c)) was submitted within 24 hours to the USFWS, BLM, CDFW, and CEC.

The 2015 - 2016 monitoring year was characterized by a peak in avian detections during the fall season. The number of avian detections recorded daily during the 2015 – 2016 monitoring year ranged from zero to 33 (Figure 11). Six or more detections occurred on a total of 15 days. On October 1, 2015, 33 avian detections were reported (including 25 at the ponds). Of those 33 detections, 11 were eared grebes. The next highest daily count was 14 detections on October 19, 2015.

The highest peaks in avian detections at the evaporation ponds, SCAs, power blocks, fence, and buildings occurred during the fall season, while the small peaks in detections along the overhead lines occurred during the spring season (Figure 12). The greatest number of avian detections occurred during the month of October (Figure 12; n = 119) followed by September (n = 92) and August (n = 39), with water-associated bird detections greatest during September (n = 44) and October (n = 60; Figure 12).

Table 3. Total detections (including incidentals) by Project component and suspected cause of death during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California.

	Suspected Cause of Death*								
Project Component	**Collision**	**Drowned**	**Entangled**	**Entrapped**	**Predated**	**Stranded**	**Vehicle**	**Unknown**	**% of Total**
Water-associated birds									
Buildings	0	0	0	0	0	0	0	3	2
Fence	0	0	0	0	0	0	0	12	8
Overhead lines/road	0	0	0	0	0	0	0	2	1
Ponds	5	0	6	0	1	11	0	49	49
Power Blocks	1	0	0	0	0	0	0	8	6
SCAs	3	0	0	0	1	1	0	44	33
Waterbird total	9	0	6	0	2	12	0	118	100
% of total	6.0	0	4.1	0	1.4	8.2	0	80.3	100
Non-water-associated birds									
Buildings	3	0	0	0	0	0	0	6	4
Fence	2	0	0	0	0	0	0	35	15
Overhead lines/road	19	0	0	0	1	0	1	16	15
Ponds	3	1	2	2	0	2	0	16	11
Power Blocks	8	5	0	1	0	0	0	38	22
SCAs	8	0	0	0	0	0	0	71	33
Non-water-associated bird total	43	6	2	3	1	2	1	182	100
% of total	18.0	2.6	1.0	1.3	0.5	0.8	0	75.8	100
Bats									
Buildings	0	0	0	0	0	0	0	3	23
Fence	0	0	0	0	0	0	0	1	8
Overhead lines/road	0	0	0	0	0	0	0	0	0
Ponds	0	0	0	0	0	0	0	2	15
Power Blocks	2	1	0	0	0	0	0	3	46
SCAs	0	0	0	0	0	0	0	1	8
Bat total	2	1	0	0	0	0	0	10	100
% of total	15.0	8.0	0	0	0	0	0	77.0	100
Grand Total	**54**	**7**	**8**	**3**	**3**	**14**	**1**	**310**	**100**
% of grand total	**13.5**	**1.8**	**2.0**	**0.8**	**0.8**	**3.5**	**0.3**	**77.6**	**100**

* Suspected cause of death was assigned based on evidence available on the detection, evidence available on Project infrastructure, and proximity of detection to Project infrastructure. Detections that lacked sufficient evidence to make a determination of cause of the fatality were assigned as "unknown". Detections that were relatively intact (i.e., minimal evidence of scavenging), located in close proximity to Project infrastructure (e.g., found directly beneath overhead lines), and

containing evidence of injury had a suspected cause of death attributed to the respective Project component. However, it should be noted that there is uncertainty associated with cause of death assignments because no events were directly observed.

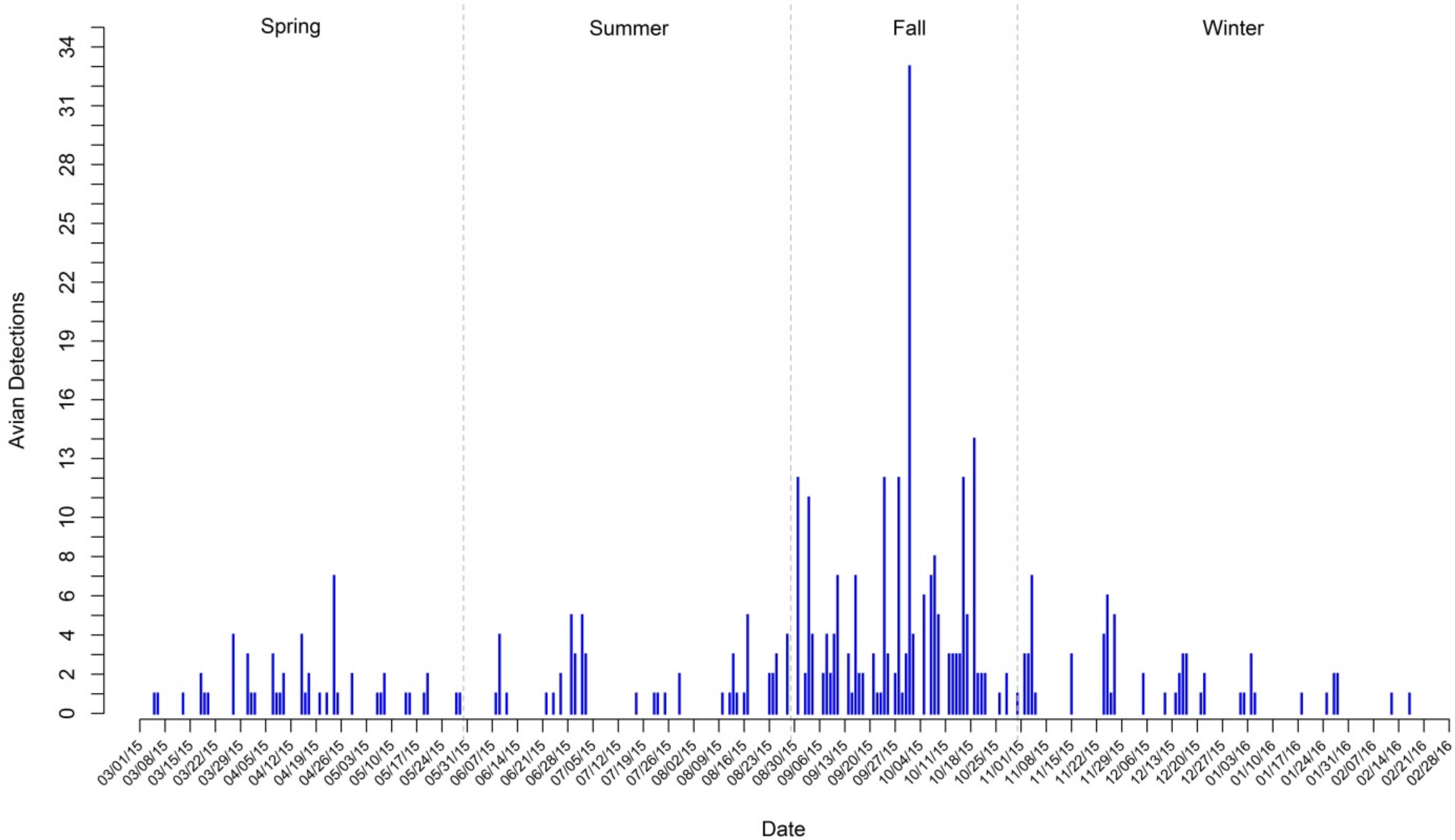

Figure 11. Total number of avian detections by date during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California.

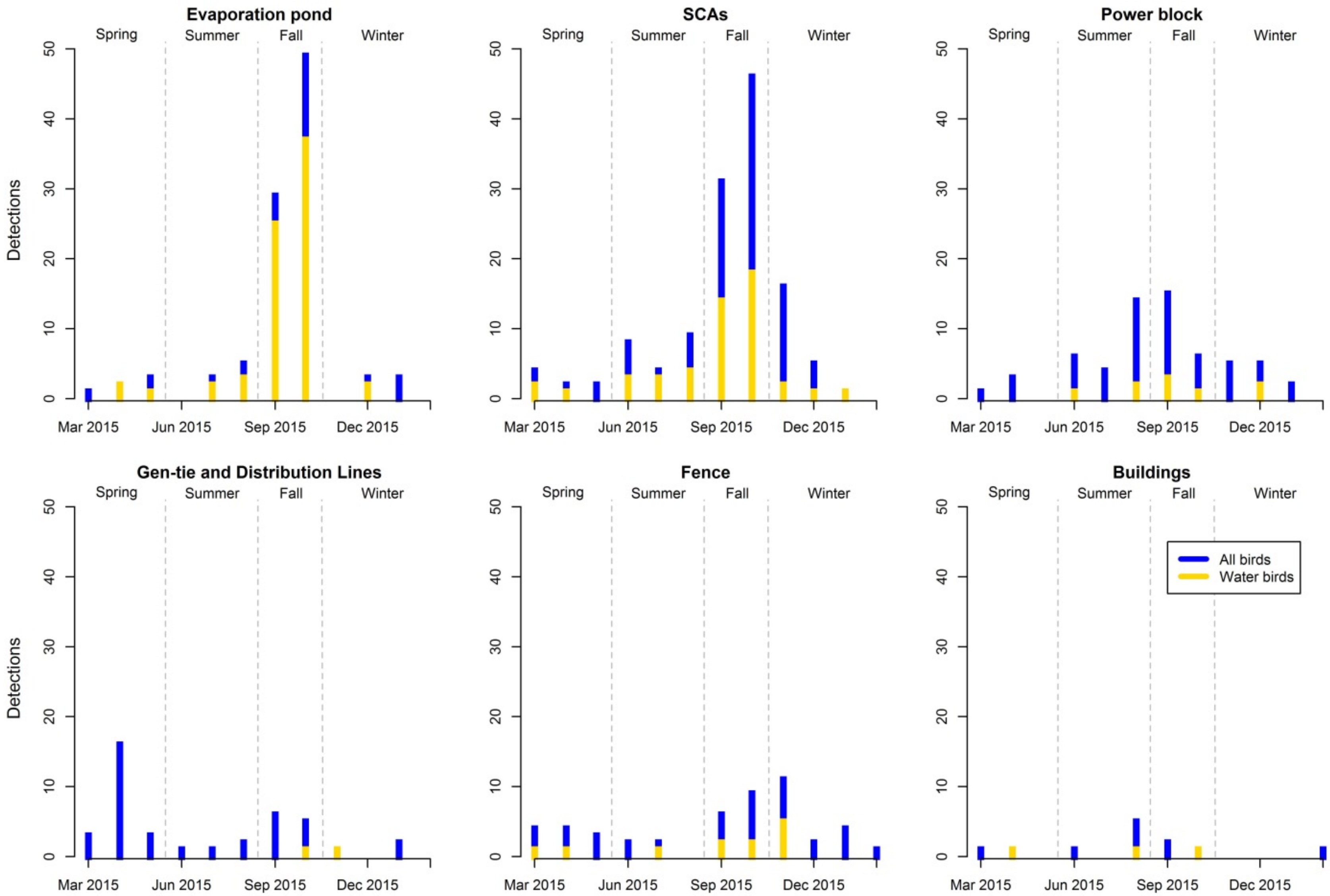

Figure 12. Total number of avian detections by month and component during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California.

3.4 Spatial Distribution of Avian Detections

3.4.1 Detections by Project Component

During the 2015 – 2016 monitoring year, detections were documented from Project buildings, the perimeter fence, overhead lines, evaporation ponds, the power blocks, and the SCAs (Tables 2, 3, and 4; Figures 5 – 10). Of the 246 detections within both Project units (SCAs, power blocks, and fence), 93 (37.8%; 89 birds, 4 bats) were detected at Unit 1, and 153 (62.2%; 149 birds, 4 bats) were detected at Unit 2. When considering the SCAs only, there were 43 (28 on search areas) detections (43 birds, 0 bats) at Unit 1 SCAs and 86 (68 on search areas) detections (85 birds, 1 bat) at Unit 2 SCAs. There were 18 water-associated birds found at Unit 1 SCAs and 19 at Unit 2 SCAs. A larger number of mourning doves was found in Unit 2, accounting for the larger number of birds observed at Unit 2 SCAs compared to Unit 1 SCAs. There were 100 detections (98 birds, 2 bats) at the evaporation ponds (excluded from Unit 1 and Unit 2 tally). The majority of water-associated birds detected (n = 72; 49%) were found at the ponds while most non-water associated birds were detected at the SCAs (n = 79; 33%) and power blocks (n = 52; 22%; Table 3).

Table 4. Total avian and bat detections by Project component and detection category during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California.

Project Component	Inside carcass search area		Outside carcass search area		Total
	Carcass search	Incidental	Carcass search	Incidental	
Water-associated birds					
Buildings	0	0	0	3	3
Fence	8	1	1	2	12
Overhead lines/road	2	0	0	0	2
Ponds	26	43	0	3	72
Power Blocks	3	6	0	0	9
SCAs	27	7	2	13	49
Waterbird totals	66	57	3	21	147
Non-water-associated birds					
Buildings	0	0	0	9	9
Fence	33	2	0	2	37
Overhead lines/road	19	3	1	14	37
Ponds	13	13	0	0	26
Power Blocks	22	30	0	0	52
SCAs	59	2	7	11	79
Non-water bird totals	146	50	8	36	240
Bats					
Buildings	0	0	0	3	3
Fence	0	0	0	0	1
Overhead lines/road	0	0	0	0	0
Ponds	1	1	0	0	2
Power Blocks	5	1	0	0	6
SCAs	1	0	0	0	1

Table 4. Total avian and bat detections by Project component and detection category during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California.

Project Component	Inside carcass search area		Outside carcass search area		Total
	Carcass search	Incidental	Carcass search	Incidental	
Bat totals	7	2	0	4	13
All detection totals	**219**	**109**	**11**	**61**	**400**

3.4.2 Feather Spot Detections

Seventy-two (18%) of the 400 detections made during the 2015 – 2016 monitoring year consisted of feather spots. Along the fence, 19 of 49 total detections (38.8%) were feather spots. Eleven detections along the overhead lines and road and three detections at the evaporation ponds were feather spots. Eleven of 67 total detections (16.4%) at the power blocks were feather spots. Twenty-eight of 130 total detections (21.5%) at SCAs were feather spots.

3.5 Detections of Stranded and Injured Birds

There were 26 detections of stranded or injured birds and no bat detections of stranded or injured bats during the 2015 – 2016 monitoring year (Table 5). Most of the stranded or injured bird detections (n = 21; 80.8%) were water-associated birds, found at the evaporation ponds on top of the netting.

Table 5. Detections of stranded or injured birds at the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016).

Project Component	Common Name	Latin Name	Outcome	Count
Ponds	Ruddy duck	*Oxyura jamaicensis*	Died	3
			Released	1
			Transported	5
			Euthanized	1
	Eared grebe	*Podiceps nigricollis*	Released	2
			Transported	1
			Euthanized	1
	Unidentified grebe	-	Died	1
	American coot	*Fulica Americana*	Transported	1
	Savannah sparrow	*Passerculus sandwichensis*	Released	1
	Unidentified goldfinch	-	Unknown*	1
	Unidentified sparrow	-	Unknown*	2
	Rock wren	*Salpinctes obsoletus*	Died	1
Power Blocks	Western grebe	*Aechmophorus occidentalis*	Released	1
SCAs	Eared grebe	*Podiceps nigricollis*	Released	1
	Common loon	*Gavia immer*	Released	2
Building	American coot	*Fulica Americana*	Released	1

* Unidentified passerines were flying around within the area enclosed by netting. These birds could not be rescued and eventually were no longer detected by observers.

3.6 Summary of Bat Detections

Thirteen bats were detected during the 2015 – 2016 monitoring year. Identified species included big brown bat (*Eptesicus fuscus*), canyon bat (*Parastrellus hesperus)*, long-legged bat (*Myotis volans*), Mexican free-tailed (*Tadarida brasiliensis*), and pallid bat (*Antrozous pallidus*; Table 2). The number of bat detections recorded daily during the 2015 – 2016 monitoring year ranged from zero to two (Figure 13). Nearly all bat detections occurred during summer and fall. One bat was found during late winter (Figure 13). The greatest number of bat detections occurred during August (Figure 14; n = 4), followed by September (n = 3) and October (n = 3); only three other bats were detected outside of these months. Of the thirteen bats detected, two (15%) were found at the ponds, one at the fence (8%), three at buildings (23%), one at the SCAs (8%) and six at the power blocks (46%; Table 4, Figure 15).

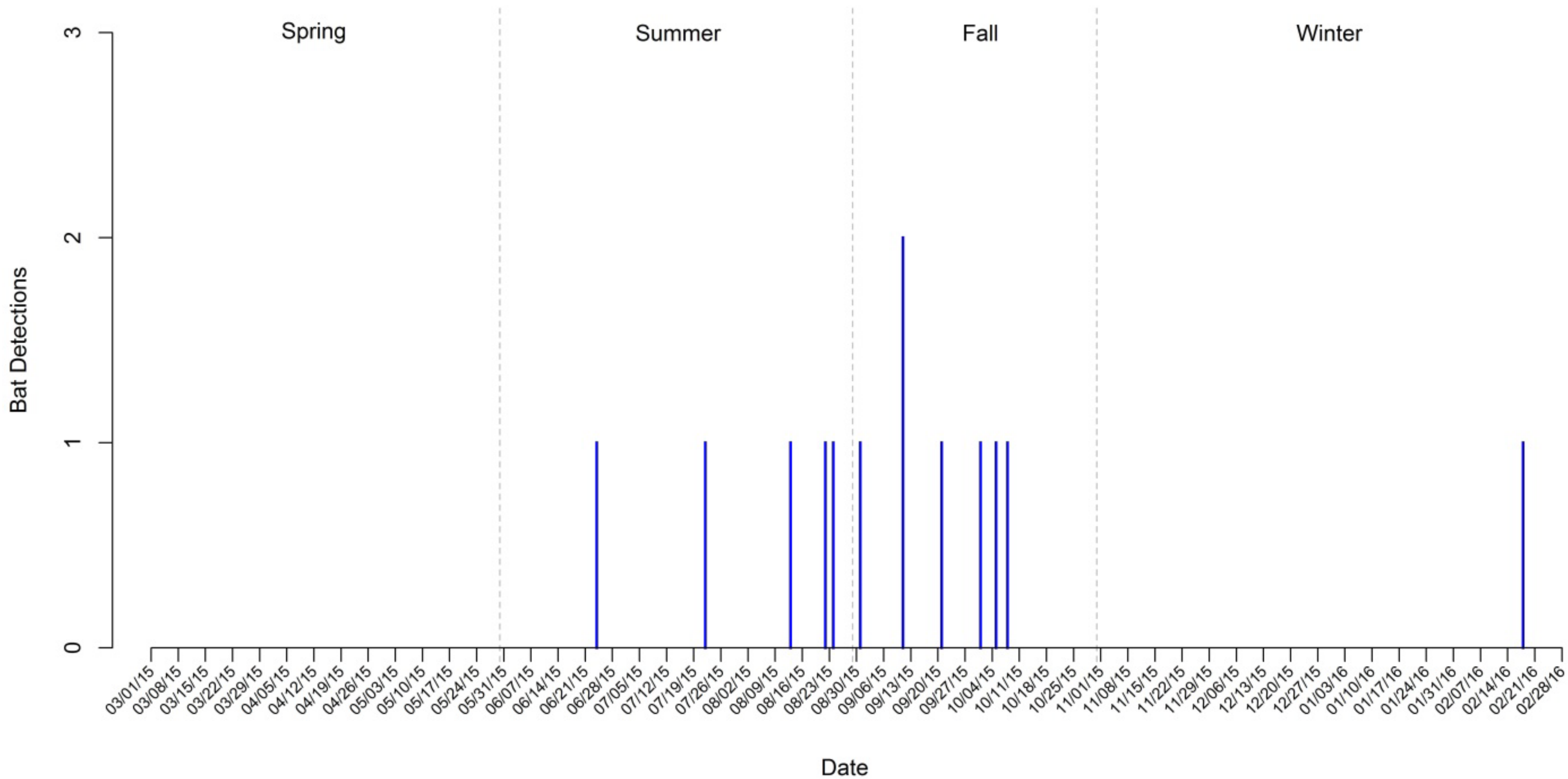

Figure 13. Total number of bat detections by date during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California.

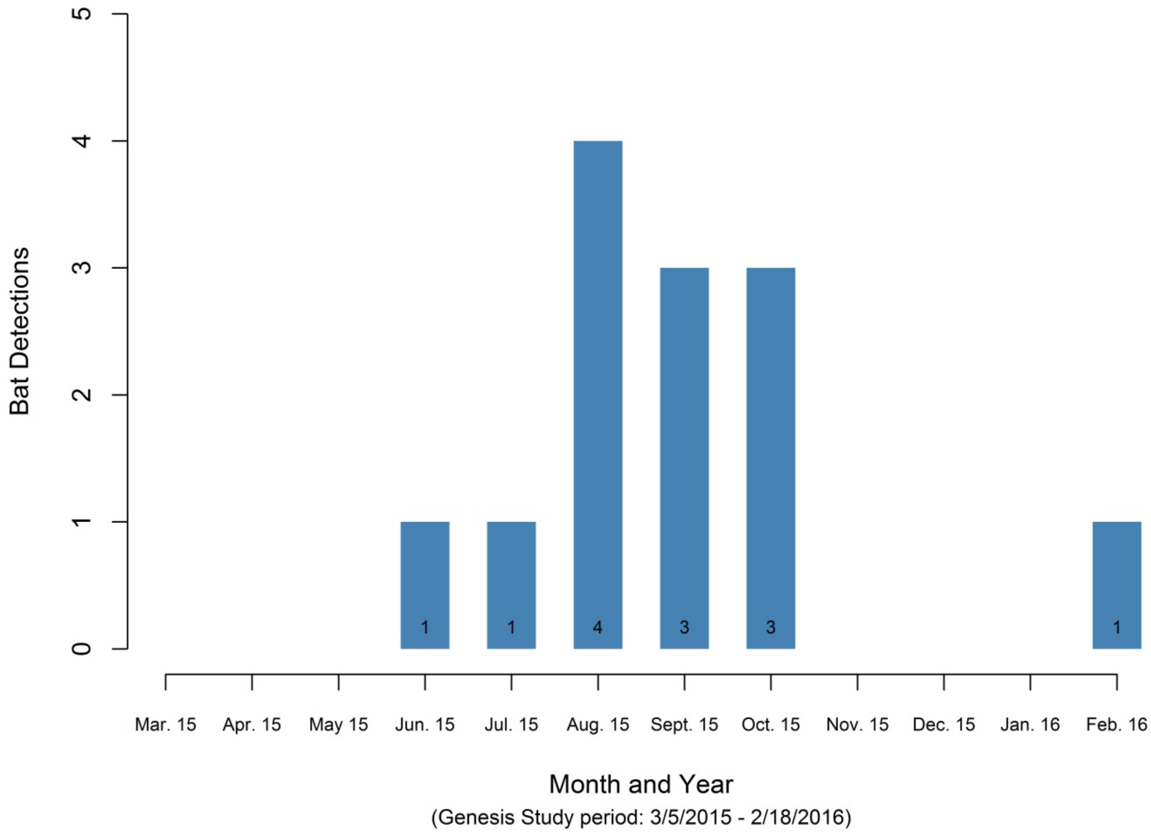

Figure 14. Total number of bat detections by month during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California.

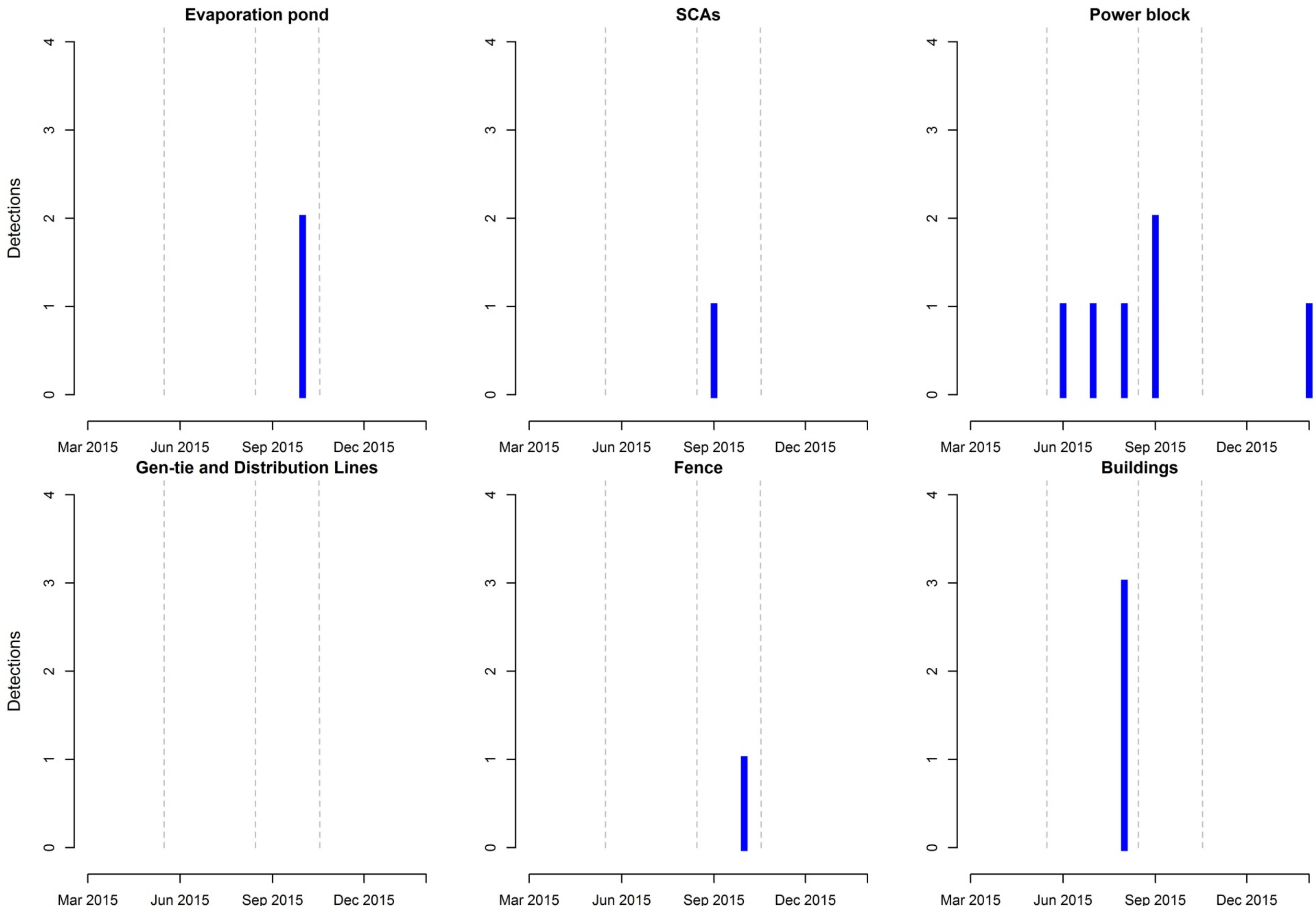

Figure 15. Total number of bat detections by month and component during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California.

3.7 Carcass Persistence Trials

Data from the trial carcasses used in the carcass persistence trials were available from all four seasonal monitoring periods at the solar field (which includes the SCAs, power blocks, and perimeter fence) and overhead lines. There were 5, 10, and 15 large, medium and small birds, respectively, placed at the solar field and along the overhead lines each season, except in spring when one medium bird was inadvertently placed along the overhead lines rather than the solar field, and one small bird was inadvertently placed at the solar field rather than along the overhead line. A total of 240 trial carcasses were available for model fitting.

Using carcass persistence data from the 2015 – 2016 monitoring year, survival models were fitted separately for each size class and compared for relative quality using the corrected AICc score, as suggested in Huso (2011). The AICc score provides a relative measure of model fit and parsimony among a selection of candidate models. The model with lowest AICc is typically chosen as the "best" model relative to other models tested; however, any model within two AICc points of the best model is considered competitive with the best model (Burnham and Anderson 2004).

Models were fit to each size class separately to allow for the selection of different model distributions and covariate combinations to achieve the best fit for each size class. Model comparisons using AICc suggested that season was an important predictor of carcass persistence for medium and large sized birds, while Project component location was important for both small and large sized birds. For small birds, the best model included main effects of Project component location, either inside the solar field or at the overhead lines. Season was not an important predictor in the small bird carcass persistence model. For medium birds, the AICc suggested that a seasonal covariate with two categories, summer and the lumped spring, fall and winter was not the top rated model but within two AICc points from the top model. This was the model chosen because it has similar predictive ability as the top model but also has fewer parameters to estimate. Project component location was not an important predictor in the medium bird carcass persistence model. Both season and Project component were important in the large bird persistence model. For large birds, the AICc suggested that a seasonal covariate with two categories (fall and the lumped spring, summer and winter) and the main effect of Project location was the best predictive model. The best models for small, medium and large birds followed a loglogistic, lognormal and lognormal distribution, respectively (Table 6). The sample sizes for the interception of each of the three models were 120, 80, and 40 for small, medium, and large trial carcasses, respectively.

Table 6. Top five carcass persistence models for each size class from the AICc model selection process. (*) indicates chosen model. ΔAICc **is the difference in AICc between the model listed and the top model.**

Size	Model Predictors	Distribution	AICc	ΔAICc
Small Birds	Project Loc.*	loglogistic	483.97	0
	Project Loc.	lognormal	485.02	1.05
	Project Loc. + Sp/Fa & Su/Wi	loglogistic	485.40	1.43
	Project Loc. + Fa & Sp/Su/Wi	loglogistic	485.62	1.65
	Sp/Fa & Su/Wi + Project Loc.	lognormal	486.76	2.79
Medium Birds	Project Loc. + Su & Sp/Fa/Wi	lognormal	359.42	0
	Project Loc. + Su & Sp/Fa/Wi	loglogistic	359.86	0.44
	Su & Sp/Fa/Wi*	lognormal	360.12	0.70
	Su & Sp/Fa/Wi	loglogistic	360.26	0.84
	Su & Sp/Fa/Wi	Weibull	360.68	1.26
Large Birds	Project Loc. + Fa & Sp/Su/Wi*	lognormal	115.33	0
	Project Loc. + Fa & Sp/Su/Wi	loglogistic	115.51	0.18
	Project Loc. + Fa & Sp/Su/Wi	Weibull	116.93	1.60
	Project Loc. + Fa & Sp/Su/Wi + Project Loc.* Fa & Sp/Su/Wi	lognormal	117.84	2.51
	Project Loc. + Fa & Sp/Su/Wi + Project Loc.* Fa & Sp/Su/Wi	loglogistic	117.98	2.65

The average probability that a carcass in the solar field or a carcass along the overhead lines persists for an average search interval (approximately 7 days for spring and fall; 21 days for spring and winter), is provided for each season and size class in Table 7. Median carcass persistence times in the solar field and at the overhead lines are also provided for each season and size class (Table 8). Figure 16 shows the proportion of trial carcasses remaining as a function of days since placement and carcass model covariate (component location and/or season).

The game cameras, used to monitor 77 of the trial carcasses, provided information regarding the scavenger community. Final carcass condition for each trial carcass is provided by scavenger in Table 9. Ten of the cameras failed to record images, thus results are presented for 67 trial carcasses. Kit fox was the most common scavenger (n = 16) followed by turkey vulture (n = 12), and common raven (n = 11). The majority of trial carcasses (66%) were removed by scavengers, while scavenged remains of 24% were still present at the end of the camera trials. All that remained for 10% of the trial carcasses were feather spots. Representative photos of each scavenger are provided in Appendix D.

Table 7. Average probability of carcass persistence to the next search ($\hat{r}$; search interval approximately is 7 days during spring and fall migration periods, and 21 days during summer and winter non-migration periods)

	Small Birds		Medium Birds		Large Birds	
	$\hat{r}$	90% CI.	$\hat{r}$	90% CI	$\hat{r}$	90% CI
Solar Field						
Spring	0.59	0.52 – 0.66	0.63	0.55 – 0.71	0.98	0.95 – 1.00
Summer	0.34	0.27 – 0.42	0.79	0.65 – 0.90	0.93	0.86 – 0.99
Fall	0.59	0.52 – 0.66	0.63	0.55 – 0.71	1.00	-
Winter	0.34	0.27 – 0.32	0.43	0.35 – 0.51	0.93	0.86 – 0.99
Overhead lines						
Spring	0.25	0.19 – 0.32	0.63	0.55 – 0.71	0.63	0.48 – 0.77
Summer	0.11	0.08 – 0.15	0.79	0.65 – 0.90	0.43	0.27 – 0.58
Fall	0.25	0.19 – 0.32	0.63	0.55 – 0.71	0.95	0.83 – 1.00
Winter	0.11	0.08 – 0.15	0.43	0.35 – 0.51	0.43	0.27 – 0.58

Note: confidence interval (CI)

Table 8. Median carcass persistence time in days during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California.

	Small Birds		Medium Birds		Large Birds	
	Median	**90% CI**	**Median**	**90% CI**	**Median**	**90% CI**
Solar Field						
Spring	4.22	3.13 – 5.67	5.63	3.76 – 8.92	>30	-
Summer	4.22	3.13 – 5.67	>30	-	>30	-
Fall	4.22	3.13 – 5.67	5.63	3.76 – 8.92	>30	-
Winter	4.22	3.13 – 5.67	5.63	3.76 – 8.92	>30	-
Overhead Lines						
Spring	0.88	0.58 – 1.28	5.63	3.76 – 8.92	5.71	2.69 – 12.52
Summer	0.88	0.58 – 1.28	>30	-	5.71	2.69 – 12.52
Fall	0.88	0.58 – 1.28	5.63	3.76 – 8.92	>30	-
Winter	0.88	0.58 – 1.28	5.63	3.76 – 8.92	5.71	2.69 – 12.52

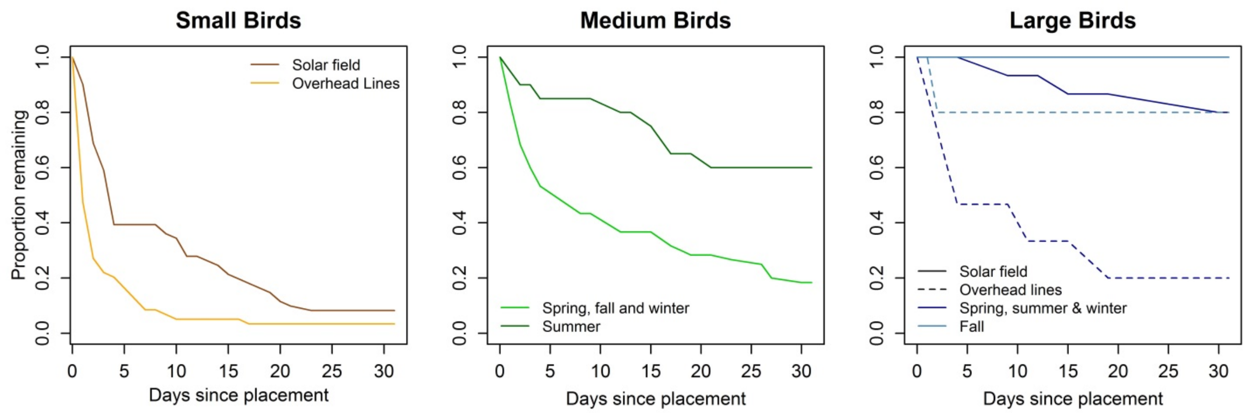

Figure 16. Proportion of trial carcasses remaining as a function of days since placement and carcass model covariate (component location and/or season) during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. Sample size used to produce each panel of the above figure was n = 120, 80, and 40 for small, medium, and large size classes, respectively.

Table 9. Final carcass condition by scavenger for the carcass removal camera bias trials during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California

Final Carcass Condition By Size	**Scavenger**						
	Common Raven	Coyote	Greater Roadrunner	Kit Fox	Turkey Vulture	Unknown	**Total**
Feather Spot							
Large	2	0	0	1	0	0	3
Medium	1	0	0	2	0	1	4
Small	0	0	0	0	0	0	0
Removed							
Small	1	0	0	1	0	1	3
Medium	1	1	1	4	3	4	14
Large	5	0	0	6	2	14	27
Scavenged							
Small	1	1	0	1	4	0	7
Medium	0	0	0	1	3	2	6
Large	0	0	0	0	0	3	3
Total	**11**	**2**	**1**	**16**	**12**	**25**	**67**

3.8 Searcher Efficiency Trials

During the 2015 – 2016 monitoring year, 60 searcher efficiency trial carcasses (30 small, 20 medium, and 10 large birds) were placed at the Project during each of the four seasonal study periods for a total of 240 searcher efficiency trial carcasses placed. Overall, 77 trial carcasses were placed in the SCAs, 30 trial carcasses were placed along perimeter fences (inner and outer perimeters), and 13 trial carcasses were placed at power blocks (along perimeter and beneath ACC units). Fifty-three trial carcasses were placed along the gen-tie and 67 were placed along the distribution line. Two hundred twenty trial carcasses were available to be found, and twenty trial carcasses disappeared (four in the SCAs, three along the fence, one at the power blocks, and twelve along the overhead lines). All trial carcasses removed by scavengers during searcher efficiency trials are assumed to have been removed before the observer had a chance to detect the trial carcass. Four observers conducted searches at the Project during the 2015 – 2016 monitoring year. Searcher efficiency trials were conducted on each observer in approximate proportion to the number of searches they conducted at the Project, as follows: Sarah Nichols (number of trials available to be found: 147), Anika Mahoney (31), Darin Blood (24), and Wanda Bruhns (18). All trials were included in the estimation of searcher efficiency.

Model comparisons using AICc suggested that size, season and Project component location were important predictors of searcher efficiency. The best model included a main effect of size and season variables, with spring and fall pooled and summer and winter pooled. It also included the main effect of Project component location (Table 10).

Table 10. Top five searcher efficiency models from model selection. (*) indicates chosen model form. ΔAICc is the difference in AICc between the model listed and the top model.

Model Form	AICc	ΔAICc
response ~ size + Project Loc. + Sp/Fa & Su/Wi*	162.15	0.00
response ~ size + Project Comp. + Sp/Fa & Su/Wi	162.50	0.35
response ~ size + Project Loc. + Sp/Su/Fa & Wi	162.68	0.53
response ~ size + Project Loc. + Sp/Su/Fa & Wi + size*Sp/Su/Fa & Wi	162.68	0.54
response ~ size + Project Loc. + Sp/Fa & Su/Wi + size*Sp/Fa & Su/Wi	162.78	0.64

The best model included the main effects of season (with data from spring and fall seasons pooled and summer and winter seasons pooled), carcass size, and Project component. In the solar field searcher efficiency during spring/fall was 80%, 95%, and 96% for small birds, medium birds, and large birds, respectively, and 93%, 98%, and 99% during summer/winter for small, medium, and large birds, respectively (confidence intervals provided in Table 11; Appendix E). Along overhead lines, searcher efficiency during spring/fall was 54%, 85%, and 88% for small, medium, and large birds, respectively, and 79%, 95%, and 96% during summer/winter for small, medium, and large birds, respectively (confidence intervals provided in Table 11, Appendix E).

Table 11. Searcher efficiency estimates by Project component

	Small Birds		Medium Birds		Large Birds	
	Mean	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**
Solar Field						
Spring & Fall	0.80	0.68 – 0.90	0.95	0.90 – 0.99	0.96	0.91 – 1.00
Summer & Winter	0.93	0.86 – 0.97	0.98	0.96 – 1.00	0.99	0.97 – 1.00
Overhead lines						
Spring & Fall	0.54	0.39 – 0.67	0.85	0.75 – 0.95	0.88	0.74 – 1.00
Summer & Winter	0.79	0.66 – 0.89	0.95	0.90 – 0.99	0.96	0.90 – 1.00

Note: confidence interval (CI)

3.9 Fatality Estimates

Fatality estimates were calculated separately for each component (SCAs, power blocks, fence, evaporation ponds, and overhead lines). There were 400 bird and bat detections during the 2015 – 2016 monitoring year. Detections found in the standardized search areas that were determined to have occurred less than twice the length of the search interval were included. Detections used in the analysis, bias corrections, fatality estimates, and 90% confidence intervals are detailed in Appendix E.

Using the Huso (2011) fatality estimator model, during the 2015 – 2016 monitoring year there were an estimated total of 1,507 bird fatalities (CI: 1,214 – 1,952) and 26 bat fatalities (CI: 10 – 46) at the Project (all components combined). Of the estimated avian fatalities, the model estimates 20 (CI: 8 – 36) large birds, 562 (CI: 423 - 744) medium birds, and 925 (CI: 674 –

1,347) small birds at the Project (all components combined; Table 12). Adjusted fatality estimates are provided by guild in Table 12.

For all components associated with both solar units (SCAs, power blocks, evaporation ponds, and along the perimeter fence), there were an estimated 997 bird fatalities (CI: 817 – 1,240) (577/1,000 acres, 4.2/nameplate MW) and 26 (CI: 10 – 46) bat fatalities (15/1,000 acres, 0.1/nameplate MW; Table 13). A breakdown by Project component is provided in Appendix E.

There were an estimated 510 (CI: 278 – 894) bird fatalities along overhead lines (Table 13). No bat carcasses were detected along the overhead lines. Fatality estimates for each component are provided by guild in Table 14. A complete list of fatality estimates for each Project component and carcass size class with confidence intervals is presented in Appendix E.

Fatality estimates for resident, nocturnal migrating, diurnal migrating, and unidentified passerines during the spring (March 1 – May 31, 2015) and fall (August 15 – October 31) passerine migration periods are provided in Table 15. At the SCAs, the model estimated 136 (CI: 86 – 196) resident passerines, 20 (CI: 0 – 49) nocturnal migrating passerines, and no diurnal migrating passerines. At the overhead lines, the model estimated 118 (CI: 23 – 283) resident passerines, 177 (CI: 62 – 363) nocturnal migrating passerines, and no diurnal passerines. Of the 216 (CI: 101 – 408) estimated nocturnal migrating passerines fatalities, 82% were along the overhead lines. Of the estimated 302 (CI: 179 – 481) resident passerines fatalities, slightly more were estimated at the SCAs (45%) than at the overhead lines (39%). At the ponds, the model estimated 23 (CI: 2 – 51) resident passerines, 2 (CI: 0 – 6) diurnal migrating passerines, and no nocturnal migrating passerines (Table 15).

A very general species fatality estimate (often referred to as the species composition approach) can be calculated by multiplying the percent composition of a species by the overall fatality estimate (Erickson et al. 2014). We provide examples below to provide a general range of the individual species fatality estimates, but more formal calculations with variance estimates will be provided after the second year. Using this simple species composition approach, a point estimate for the most common water-associated birds detected during the study can be calculated. Eared grebe fatality estimates are approximately 22 fatalities in the SCAs, 50 at the ponds and 82 total for the Project in the first year. Estimates for ruddy duck fatality are approximately 15 fatalities in the SCAs, 31 at the ponds and 47 overall. Cinnamon teal estimates are approximately 13 fatalities in the SCAs, 6 at the ponds and approximately 19 total from the Project. Fatality estimates for each of the other water-associated bird species at the Project would be less than 20 individuals.

Table 12. Adjusted fatality estimates by size and taxonomic groupings during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California

Size	Detections (carcass search and incidental)	Total Adjusted Fatalities	90% CI
Bats	13	26	10 – 46
Large Birds	17	20	8 – 36
Medium Birds	214	562	423 – 744
Small Birds	156	925	674 – 1,347
Passerines	145	900	664 – 1,302
All water-associated birds	147	372	263 – 518
Doves/Pigeons	45	167	107 – 235
Diurnal Raptors	9	8	3 – 14

Table 13. Estimated number of fatalities within the solar field and along the overhead lines (using Huso estimator model) at the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016).

	Project Component	Actual Detections (carcass search and incidental)	Huso Estimates (fatalities)	90% CI	Huso Estimates (fatalities/acre)	Huso Estimates (fatalities/mw)
Birds	Solar Field	347	**997**	817 – 1,240	0.58	3.99
	Overhead Lines	40	**510**	278 – 894	5.48	2.04
Bats	Solar Field	13	**26**	10 – 46	0.02	0.10
	Overhead Lines	0	-	-	-	-

Table 14. Adjusted fatality estimates by guild and component type for the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. Confidence intervals in italics are considered unreliable due to low detection counts.

Guild	Fence	90% CI	Overhead Lines	90% CI	Ponds	90% CI	Power Block	90% CI	SCAs	90% CI	Overall	90% CI
Passerines	40	21 – 62	429	189 – 807	57	21 – 105	47	10 – 99	328	227 – 453	900	664 – 1302
All water-associated birds	16	6 – 28	14	6 – 33	123	28 – 255	10	4 – 17	210	150 – 283	372	263 – 518
Doves/Pigeons	11	3 – 21	52	13 – 106	2	*0 – 5*	11	5 – 35	91	47 – 146	167	107 – 245
Diurnal Raptors	2	*0 – 7*	-	-	-	-	6	2 – 11	-	-	8	3 – 14
Bats	-	-	-	-	4	*0 - 13*	15	4 – 30	7	*0 – 21*	26	10 – 46

Table 15. Adjusted fatality estimates by passerine group and component type for the spring (March 1 – May 31 2015), and fall (August 15 – October 31, 2015) seasons at the Genesis Solar Energy Project, Riverside County, California. Confidence intervals in italics are considered unreliable due to low detection counts.

Guild	Fence	90% CI	Overhead Lines	90% CI	Ponds	90% CI	Power Block	90% CI	SCAs	90% CI	Overall	90% CI
Passerines												
Diurnal	-	-	-	-	2	*0 – 6*	6	*0 – 15*	-	-	8	*1 – 18*
Nocturnal	6	*2 – 13*	177	62 – 363	-	-	12	0 – 31	20	*0 – 49*	216	101 – 408
Resident	8	*0 – 18*	118	*23 - 283*	23	2 – 51	16	0 – 41	136	86 - 196	302	179 – 481
Unidentified	4	*0 – 10*	91	*0 – 243*	13	5 – 24	3	*0 – 7*	48	*7 - 97*	159	55 – 311

4.0 DISCUSSION

The 2015 - 2016 monitoring year represented the first year of standardized mortality monitoring at the Genesis Solar Energy Project. Searcher efficiency trials and carcass persistence trials were conducted during each of the four seasons at the SCAs, power blocks, fencelines, and along the overhead lines. Data from these trials were used to produce fatality estimates adjusted for searcher efficiency and carcass persistence bias. The results provided in each seasonal report were considered preliminary because estimating carcass persistence, searcher efficiency, and adjusted numbers of fatalities within each season represents information based on a limited sample size. For this annual report, the analysis is comprehensive, with data from all four seasons included in the analysis.

The completion of the first year of monitoring met the goals and objectives (Section 1.2) of the BBCS (WEST 2016), and the second year of study will add to the understanding of avian and bat mortality associated with Genesis. Prior to the initiation of monitoring, NextEra and representatives from each agency discussed whether monitoring at the gen-tie line was warranted. It was ultimately expressed by the agencies that it was their policy that monitoring will be conducted along the gen-tie at solar facilities. NextEra agreed to monitoring, but expressed their concern about the potential for low carcass persistence outside of the Project fence (e.g., along the gen-tie line) and wanted to focus their resources on facility components that are unique to solar projects (e.g., the SCAs). Overhead lines are a facility component also found at most other energy facilities.

4.1 Carcass Persistence and Searcher Efficiency Trials

During the first year of monitoring at the Project, as anticipated, the carcass persistence rate was low outside of the Project fence along the overhead lines, while persistence rates were greater within the Project fence. Overall, carcass persistence rates were greater for medium and large birds compared to smaller birds, but there was variation by season and Project component. Longer persistence times for larger sized birds compared to smaller sized birds is a consistent result seen in many other studies (e.g. wind energy project: Smallwood et al., 2010, Morrison 2002; and solar energy project: WEST, 2016b). Longer persistence rates were observed for medium birds during summer and for large birds during fall. The cause of these longer persistence rates for medium birds and large birds during these particular seasons cannot be inferred from the data, but some of the observed differences may be due to random variation.

Carcass persistence trial cameras revealed that kit fox and raven scavenging activity was greatest during late winter and spring. Additionally, field surveyors noted that during late winter, ravens appeared suddenly and in large numbers in the area and persisted through spring. The kit fox is primarily active at night; as such, there were only a few anecdotal observations of kit foxes during the surveys, which take place during the daylight hours.

The placement of an abundance of trial carcasses in one location could result in more food resources than scavengers are naturally able to remove. If scavengers are ‘swamped’ by having more carcasses than they can remove, the persistence time would be biased low suggesting that carcasses persist longer than they would at other areas of the Project where searches are not conducted. Thus, to minimize potential bias caused by scavenger swamping (Smallwood 2007; Smallwood et al. 2010), carcass persistence trial carcasses were distributed throughout the entire project area, not just in areas subject to standard surveys. A covariate for carcass location did not improve model fit supporting the assumption that carcass removal at sampled units was not different from the rest of the Project area.

Carcass size and season are typically included in searcher efficiency models for mortality monitoring at renewable energy facilities. During TAG meetings, the potential for ground cover to affect search efficiency was discussed as areas of vegetation could result in lower searcher efficiency. While visibility class may have some effect on searcher efficiency, the very limited spatial extent of more difficult visibility classes at the Project diminishes any measurable influence this factor may have on fatality estimates. In the SCAs, searcher efficiency was high regardless of carcass size and this is likely a function of the limited vegetation cover beneath solar troughs. Vegetation cover is higher beneath overhead lines, outside the Project fence; however, this did not have a major impact on the overall searcher efficiency for the Project. Carcass size influenced searcher efficiency, but searcher efficiency was relatively high overall, ranging from an overall mean of 76% (CI: 70 – 83%) for small carcasses to 95% (CI: 87 – 100%) for large carcasses.

Due to the high searcher efficiency, modifications for the second year of monitoring were made by increasing the transect width of searches from 30 m to over 50 m (larger search plots), which allowed an increase in the spatial coverage of the SCAs from 30% to 50% (WEST 2016). This should result in more precise estimates, especially for the medium and large water-associated birds for the same total effort.

4.2 Temporal and Spatial Patterns of Detections

Temporal patterns of detections were examined for evidence of large mortality events (i.e. 30 or more detections during one survey) or seasonal peaks in detections to determine if correlates of risk were evident. Studies at other structures/development often report whether any large mortality events occur. One large event occurred at the Project. On October 1, 2015, one bat detection and 33 avian detections were reported, most of which were associated with the netted ponds. The next highest daily count was 14 detections on October 19, 2015. There was nothing unusual (e.g. weather, wind, temperature, site conditions) about these particular dates that would explain the causal mechanism of this event. Typical carcass detection associated with the other project features were primarily single detections. Six or more detections occurred on a total of 15 days. During all other survey days, five or fewer birds and bats were detected.

A peak in detections occurred during the fall season, beginning in September and continuing through the end of October. This peak in detections coincides with the fall bird migration period and was influenced by detections of water-associated birds at the evaporation ponds, with a smaller contribution of water-associated birds within the SCAs. The higher number of detections during fall migration compared to spring migration is not well understood and we hypothesize it could be attributable to a larger population size in fall compared to spring due to the presence of juveniles. In addition, there may be differences in migration patterns and routes for some of the affected bird species resulting in more birds moving through the region in fall compared to spring (Patton et al. 2003). These are all currently untested hypotheses and the additional second year of study and results from other projects could provide more inference into seasonal risk patterns.

Spatial patterns of detections were not distinct within the SCAs. While a concentration of detections are visually shown at the ponds, the SCAs near the ponds do not show higher level of detections. Density of water-associated birds was not higher in the Unit containing the ponds (Unit 1) and did not show any other spatial patterns. Higher bird detections overall were observed in Unit 2, with the higher densities attributable primarily to larger number of mourning dove detections in Unit 2.

4.3 Causation and Other Potential Biases

Detections attributed to an unknown cause accounted for approximately 78% of all detections during the 2015 – 2016 monitoring year, and the distribution of the unknown cause detections varied by Project component with the highest percentage of unknowns (29%) occurring in association with SCAs. Of the 310 detections attributed to an unknown cause, 70 (22.6%) were feather spots and 142 (45.8%) were scavenged detections. Determining a cause of mortality from a feather spot or scavenged bird is challenging because there is rarely visible evidence available on which to determine a cause of death.

Fatality estimates included detections resulting from any cause, including those detections with unknown cause, which is similar to the approach that has been used in wind energy studies. Smaller birds such as passerines are the most common detection found on wind (Erickson et al. 2014), and PV solar projects (Althouse and Meade 2014, WEST 2016b; H.T. Harvey and Associates 2014) and they are also the most difficult to determine cause of death.

Detections assigned an unknown cause could be attributed to the Project; however, it is not unreasonable to assume that some of the detections found and assigned an unknown cause might have died from causes unrelated to the facility (e.g. predation). Due to this uncertainty of causation, some studies have estimated background fatality estimates at reference or control areas to try to provide some basis for addressing causation. Such studies, however, due to their location, cannot be used to represent background mortality expected at this Project.

In addition to issues associated with background mortality, scavengers could create multiple feather spots from one detection (WEST 2016b). The Technical Advisory Group (TAG) for the Ivanpah Solar Electric Generating Facility (ISEGS) reviewed bias trials for ISEGS and determined that in some cases scavengers created multiple feather spots from a single carcass. Adjustments to the fatality estimate were not conducted based on this finding as it is unknown how often feather spots disperse from a carcass location to be considered distinct. However, camera data from ISEGS support the idea that there is the potential for multiple feather spots to originate from one trial carcass. At Genesis, game cameras trained on carcasses for carcass persistence trials at the Project have also documented the potential for multiple feather spots originating from a single trial carcass. Ravens and turkey vultures, and possibly roadrunners, dislodge feathers from their attachment to the skin of the carcass during the scavenging process. Thus, the presence of feather spots among the detections for the Project may inflate the fatality estimate based on the potential for multiple feather spots, resulting from one detection being counted as separate detections if feathers are blown around the site, or they are scattered by predators (e.g., plucking by ravens). Nonetheless, feather spots are included in the analysis here to provide a more conservative estimate of fatality.

4.4 Fatality Estimates

The power block fatality estimates should be interpreted with caution. The standardized searches are conducted from the perimeter of the power blocks. However, most of the carcasses reported in the power blocks are from operations personnel who make daily inspections throughout the area during routine maintenance checks. To be conservative, we adjusted the carcasses found incidentally by operations personnel as if they were found during the standardized searches, which may lead to an overestimate for the power blocks.

The density of estimated fatalities in the SCAs was 0.56 fatalities per acre for the year. A higher fatality estimate was produced for the overhead lines than the SCAs; however, estimates for overhead lines have greater uncertainty (i.e. wider confidence intervals) due to high carcass removal rates along that Project component. The greater uncertainty for the overhead lines estimate was especially apparent for small carcass sizes, where the probability of persistence to the next search was lowest. Low probabilities of persistence were a result of quick removal rates and shorter effective search intervals in relation to the actual search interval. Effective search intervals were shorter along the gen-tie for small carcasses during summer and winter than during spring and fall, and the probability of persistence was adjusted appropriately. This potential result was discussed at the beginning of the Project by representatives from each agency and NextEra.

One unforeseen outcome of the first year of monitoring was the number of water-associated bird detections associated with the netted ponds. The netting was an agency requirement after bird detections were discovered in the ponds during construction. It was not anticipated that the netting would still lead to measurable mortality, given the small mesh size used. A more formal evaluation of the netting impacts will be made after the 2^{nd} year of monitoring is complete. One suggestion that was made and has been implemented was to remove a wire over the netting as an adaptive management measure.

4.5 Year Two Monitoring Changes

Modifications were made to the sample based on results of the first year of monitoring, and these changes will be implemented for the second year. The design was modified to increase the viewsheds of the observers during the transect surveys at Genesis Solar Energy Project by modifying the distance sampling transect layout, and increasing the percent area of the solar field that is searched. The reason for the recommended change is that searcher efficiency rates are high for medium and large birds with the current viewsheds. Increasing the area surveyed may improve the precision of the estimates and reduce confidence intervals by covering more SCAs overall but with less effort per sample unit (i.e., larger viewsheds). Benefits may be more pronounced for medium and large birds, but small bird estimates should be at least as good as current estimates and may see some benefit, as well. Thus, for the second year of monitoring at the Genesis Solar Energy Project, the TAG approved a study design with greater viewsheds and an increase in the percent area of the solar field searched. These larger viewsheds are consistent with recommendations made by Huso et al. (2016).

During the first year of study at the Genesis Solar Energy Project, biologists drove parallel to troughs and centered between rows, searching ahead and to the driver's side of the vehicle for bird and bat carcasses and scanning out to a perpendicular distance of approximately 30 m, or the ground area encompassing two rows of solar troughs. Huso et al. (2016) recommended that instead, the biologist could travel perpendicular and beneath the mirror rows at 150 m intervals, looking in both directions, and effectively increase the percent area sampled. This search pattern, however, would not be possible at the Genesis Solar Energy Project due to the layout of the facility. There are only three drivable roads running east-west in Unit 1 and four in Unit 2 because elsewhere there are header pipes that block access. Besides piping obstructions, driving below the mirrors presents safety concerns. The potential also exists for the mirrors to be damaged while driving beneath them. Additionally, the orientation of the mirrors changes throughout the day. Thus, the only time period during which mirrors could be driven under is approximately between 11 AM and 5 PM which is not an ideal time for biologists to be outdoors due to the extreme desert heat.

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Appendix A. Detailed Areas of Standardized Searches and Detection Locations along the Distribution and Generation Tie Lines of the Genesis Solar Energy Project during the 2015 – 2016 Monitoring Year (March 1, 2015 – February 28, 2016)

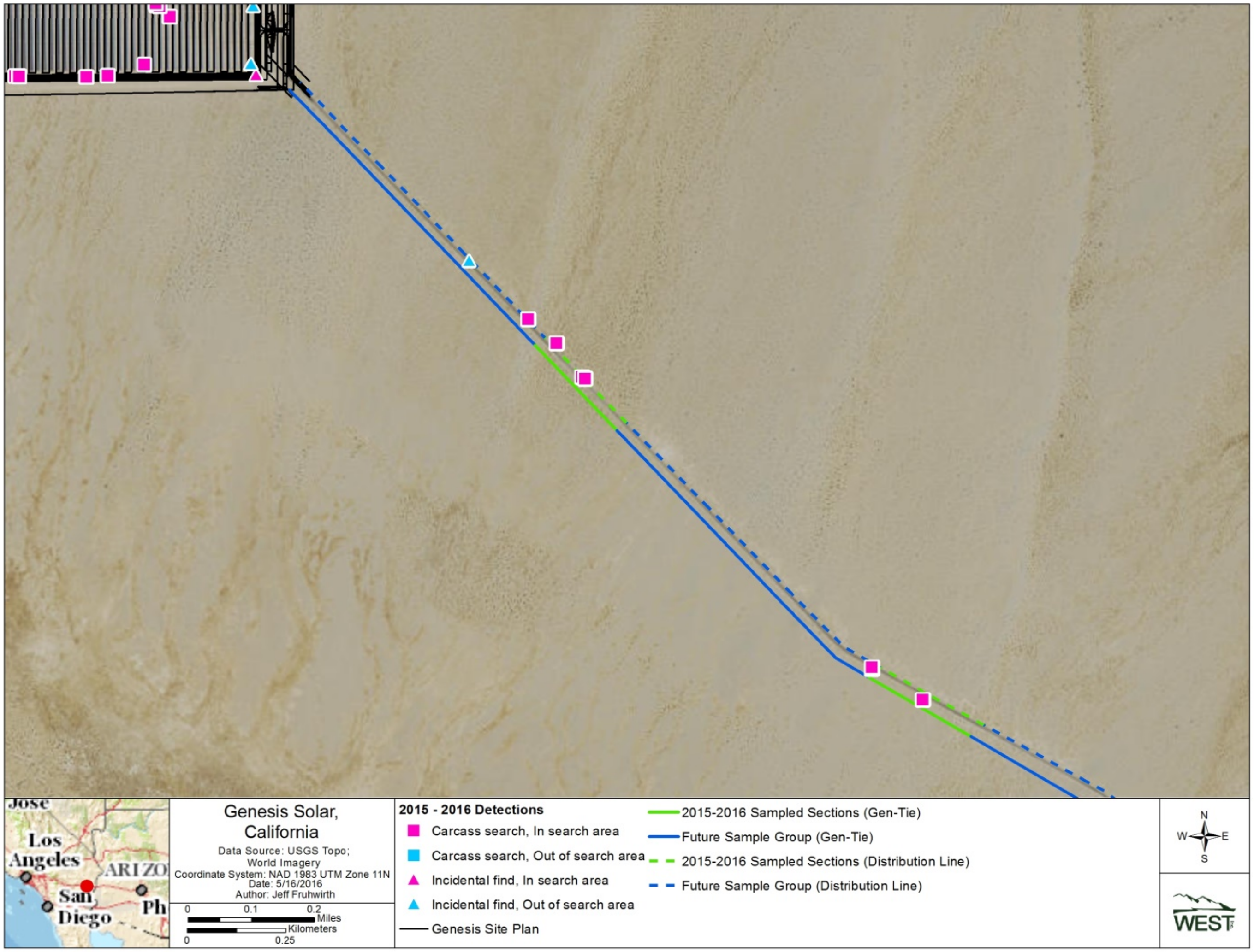

Figure A-1. Detailed map sections of detections along the overhead lines of the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

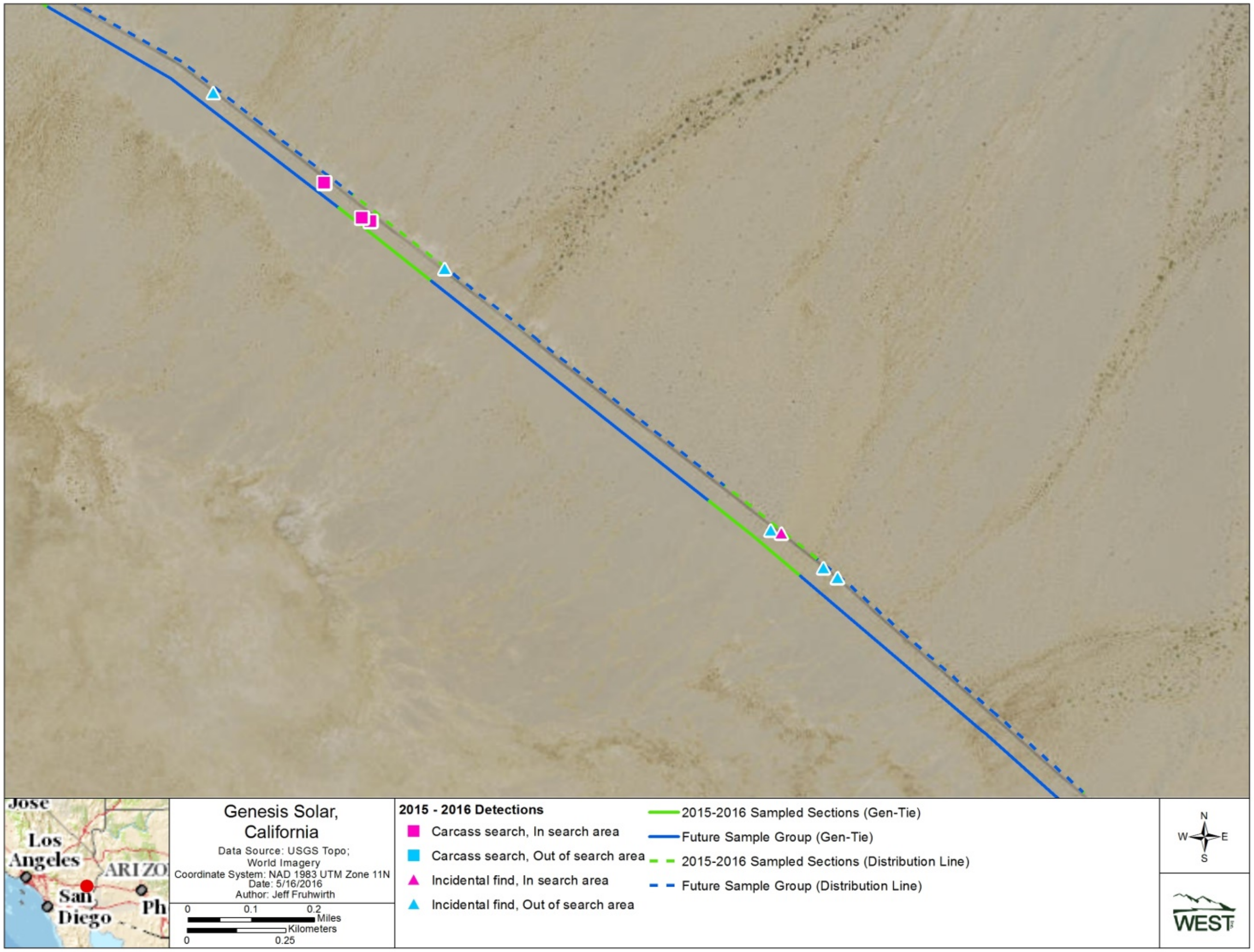

Figure A-2. Detailed map sections of detections along the overhead lines of the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

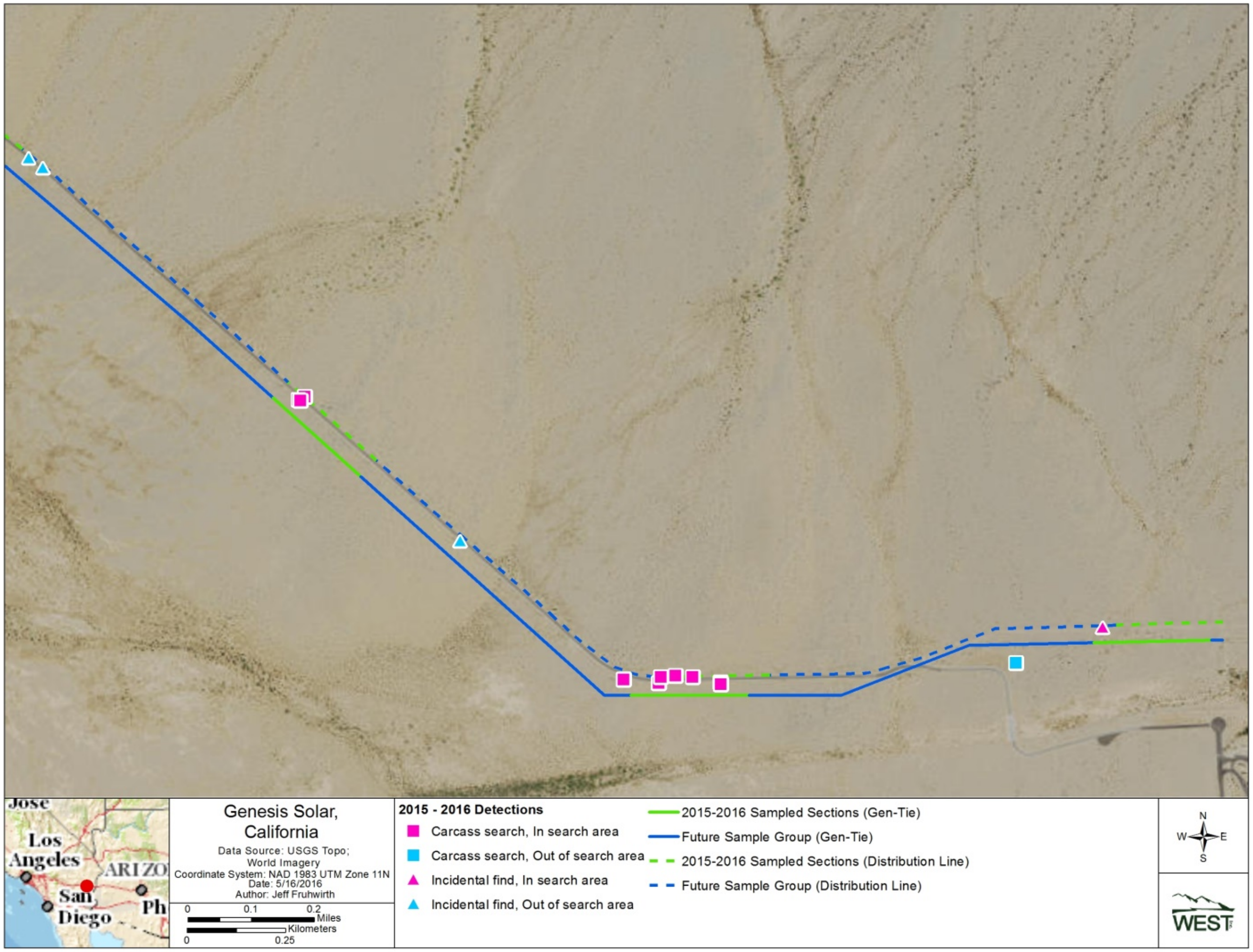

Figure A-3. Detailed map sections of detections along the overhead lines of the Genesis Solar Energy Project during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016). Spatial error associated with the digital imagery results in some detections appearing as if they were outside of carcass search areas when they were actually inside, and vice versa. Whether a detection is inside or outside a search area is determined by the biologist in the field at the time of observation and is based on actual field measurements and not GPS.

Appendix B. Weather Conditions and Body Weights Associated with Avian Detections Estimated to have been dead less Than 24 Hours during the 2015 – 2016 Monitoring Year (March 1, 2015 – February 28, 2016)

Table B. Weather conditions and body weights associated with avian detections estimated to have been dead less than 24 hours during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at Genesis Solar Energy Project, Riverside County, California.

Detection ID	Date	Estimated time since death (hours)	Species	Weight (grams) if intact	Weather Summary for Preceding 24 hours
060315-MODO-GENTIE24-1	3/6/2015	0-8hrs	mourning dove	NA	High- 75f; low-48f; wind 16mph; no rain
031915-PRFA-GENTIE23-1	3/19/2015	8-24hrs	prairie falcon	NA	Sprinkles. Overcast overnight thru 0900
033115-COLO-1-E-C/D-57-1	3/31/2015	0-8hrs	common loon	NA	NA
040815-NAWA-GENTIE-12-1	4/8/2015	8-24hrs	Nashville warbler	NA	Windy overnight-this morning, clear skies
041515-NAWA-GENTIE-12-4	4/15/2015	8-24hrs	Nashville warbler	NA	Very windy yesterday evening and this morning
041515-UNBI-GENTIE-24-1	4/15/2015	0-8hrs	mourning dove	NA	NA
042015-COLO-1-W-G/H-2-1	4/20/2015	0-8hrs	common loon	NA	NA
042415-WETA-GENTIE-20-1	4/24/2015	8-24hrs	western tanager	NA	Windy overnight (too fresh to be related to the tornados)
042415-LAZB-GENTIE-20-2	4/24/2015	8-24hrs	lazuli bunting	8	Windy overnight (too fresh to be tornado related)
042415-TOWA-GENTIE-21-3	4/24/2015	8-24hrs	Townsend's warbler	NA	Windy overnight (too fresh to be related to the tornado)
042415-UNPA-GENTIE-20-4	4/24/2015	8-24hrs	western tanager	NA	Windy overnight (seems to fresh to be a result of the tornado)
042415-WIWA-GENTIE-20-5	4/24/2015	8-24hrs	Wilson's warbler	NA	Windy overnight (too fresh to be tornado related)
042415-WIWA-GENTIE-20-6	4/24/2015	8-24hrs	Wilson's warbler	NA	Windy overnight (too fresh to be tornado related)
042415-LAZB-GENTIE-5-8	4/25/2015	8-24hrs	lazuli bunting	NA	Windy overnight (too fresh to be tornado related)
042915-BRBL-Gentielines-1	4/29/2015	8-24hrs	Brewer's blackbird	65	NA
050615-WETA-GENTIETOWER-38-1	5/6/2015	0-8hrs	western tanager	20	Relatively calm winds, cooler temps from preceding week
050815-YEWA-1-FENCE-E-INSIDE-1	5/8/2015	8-24hrs	yellow warbler	9	Weather front moved through, very windy, gusts up to 30mph, from yesterday afternoon through late evening. Cooler temps last several days
050815-YEWA-2-FENCE-W-OUTSIDE-2	5/8/2015	8-24hrs	yellow warbler	9	Weather front passing through, very windy yesterday afternoon through the late evening- gusts of 30mph
051515-UNWA-GENTIE-01	5/15/2015	0-8hrs	Wilson's warbler	11	Winds greater then 30mph previous afternoon/evening. A front is moving thru the area
052015-WIWA-GENTIE-08-1	5/20/2015	0-8hrs	Wilson's warbler	6	Clear overnight, clouds moving in this morning
060915-ECDO-OMBUILDING-STAIRCASE-1	6/9/2015	0-8hrs	Eurasian collared-dove	150	NA
061115-GRRO-GENTIE16-1	6/11/2015	8-24hrs	greater roadrunner	240	NA
062215-CAGU-1-E-C/D-53-1	6/22/2015	8-24hrs	California gull	350	High temp: 107.1, low temp: 70.9, max wind spd: 8.3mph, avg wind spd: 7.6mph, direction: south, clear sky, moon phase: waxing crescent
062615-GRRO-1-W-G/H-62-01	6/26/2015	8-24hrs	greater roadrunner	165	Avg wind spd: 11mph, max wind spd: 17mph, wind direction: south, clear sky, moon phase: waning gibbous

Table B. Weather conditions and body weights associated with avian detections estimated to have been dead less than 24 hours during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at Genesis Solar Energy Project, Riverside County, California.

Detection ID	Date	Estimated time since death (hours)	Species	Weight (grams) if intact	Weather Summary for Preceding 24 hours
062915-SNEG-2-POWERBLOCK-INSIDE-02	6/29/2015	8-24hrs	snowy egret	NA	Max wind spd. 17mph, avg wind spd: 8mph, direction: s/sw, conditions: clear with thunderstorms, moon phase: waxing gibbous
072915-LENI-GENTIE-13-01	7/29/2015	0-8hrs	lesser nighthawk	43	Wind S @ 7-14 mph, waxing gibbous moon, clear, 10 mi visibility
081315-TRES-EVAPPOND-N-01	8/13/2015	8-24hrs	tree swallow	13	6-16 MPH SE wind, Temp 109F, waning crescent moon. Clear through 1pm 8/12, partly to mostly cloudy through 9pm, then clear.
081715-MODO-2-POWERBLOCK-02	8/17/2015	8-24hrs	mourning dove	NA	9-21mph S wind. Waxing crescent moon, clear through 12 noon, partly to mostly cloudy through 11pm then clear
081715-MODO-GENTIE-17-01	8/17/2015	8-24hrs	mourning dove	NA	9-21mph S wind, waxing crescent moon, clear through 12 noon, partly to mostly cloudy through 11pm, then clear
082215-UNBA-ADMINBUILDING-01	8/22/2015	0-8hrs	canyon bat	2	12-20 mph S wind, waxing crescent moon, clear
082315-TOWA-2-POWERBLOCK-OVERFLOWPUMP-B-01	8/23/2015	8-24hrs	Townsend's warbler	6	12-20 S wind, temp 107, waxing crescent moon, clear until 1500, partly cloudy until 2000, then clear until bird found
082315-MODO-GENTIE-10-03	8/23/2015	8-24hrs	mourning dove	99	12-20mph S wind, temp 107, waxing crescent moon, clear until 1500, partly cloudy until 2000, then clear until bird found
082415-UNBA-ASSEMBLYLINEBUILDING-FREEZER-02	8/24/2015	8-24hrs	canyon bat	NA	8-14 mph S-SW wind, waxing gibbous moon, partly cloudy to clear to cloudy
082815-BHCO-1-W-G/H-44-03	8/28/2015	8-24hrs	brown-headed cowbird	21	5-21 mph SSW wind, waxing gibbous moon, thunderstorm in the area
082815-CITE-EVAPPOND-N-01	8/28/2015	8-24hrs	cinnamon teal	345	5-21 mph SSW wind, waxing gibbous moon, thunderstorm in area
083115-BWTE-2-E-F/E-36-01	8/31/2015	8-24hrs	blue-winged teal	282	8-16 mph SSW wind, full moon, max temp 111, clear
083115-UNBA-ASSEMBLYLINEBUILDING-02	8/31/2015	8-24hrs	long-legged bat	10	8-16 mph SSW wind, full moon, max temp 111, clear
083115-LEGO-2-POWERBLOCK-TRAIN2-EVAPORATOR2-03	8/31/2015	0-8hrs	lesser goldfinch	9	8-16 mph SSW wind, full moon, max temp 111, clear
083115-TEAL-WATERTREATMENT-12	8/31/2015	0-8hrs	unidentified teal	NA	8-16 mph SSW wind, full moon, max temp 111, clear
090215-MODO-GENTIE-24-02	9/2/2015	0-8hrs	mourning dove	NA	Max wind speed: 14 mph, avg wind speed: 9 mph, wind direction: south. Moon phase: waning gibbous, partly cloudy
091015-CITE-EVAPPOND-S-01	9/10/2015	8-24hrs	cinnamon teal	NA	Max wind speed- 15. Avg wind speed- 8. Wind direction- south. Moon phase- waning crescent. Mostly clear.
091015-CITE-EVAPPOND-N-02	9/10/2015	8-24hrs	cinnamon teal	NA	Max wind speed- 15. Avg wind speed- 8. Wind direction- south. Moon phase- waning crescent. Mostly clear.
091415-AMCO-2-W-F/E-33-01	9/14/2015	8-24hrs	American coot	430	15-20 mph wind, waxing crescent moon, 108 F high, clear this morning but significant cloud cover moved in >50% winds picked up. Partly cloudy

Table B. Weather conditions and body weights associated with avian detections estimated to have been dead less than 24 hours during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at Genesis Solar Energy Project, Riverside County, California.

Detection ID	Date	Estimated time since death (hours)	Species	Weight (grams) if intact	Weather Summary for Preceding 24 hours
091715-UNGR-EVAPPOND-N-01	9/17/2015	0-8hrs	eared grebe	NA	6-16 mph NW wind, waxing crescent moon, bright and sunny w/ little cloud cover and gusts of wind
092115-UNBA-2-W-B/A-41-04	9/21/2015	8-24hrs	big brown bat	NA	Max wind speed: 15. Avg wind speed: 5. Wind direction: north. Moon phase: waxing crescent. Max temp: 106. According to wunderground.com, clear on 9/20 and 9/21. However, by 7:45am on 7/21 I saw 60% clouds, and by 9:20 am 85% clouds which remained
092215-LEGO-1-W-C/D-49-01	9/22/2015	8-24hrs	lesser goldfinch	NA	Max wind speed: 18mph. Avg wind speed: 10 mph. Wind direction: sse. Moon phase: waxing gibbous. Cloudy and slightly breezy.
092415-RUDU-EVAPPOND-N-01	9/24/2015	0-8hrs	ruddy duck	530	4-8 mph SE wind, waxing gibbous moon, max temp 99 on 9.23. Clear until bird found
092415-EAGR-EVAPPOND-S-04	9/24/2015	8-24hrs	eared grebe	240	4-8 mph SE wind, waxing gibbous moon, max temp 99 on 9.23, clear until bird found
092415-RUDU-EVAPPOND-S-09	9/24/2015	0-8hrs	ruddy duck	NA	4-8 mph SE wind, waxing gibbous, max temp 99 on 9.23, clear until bird found
092415-RUDU-EVAPPOND-N-10	9/24/2015	0-8hrs	ruddy duck	NA	4-8 mph SE wind, waxing gibbous, max temp 99 on 9.23. Clear until bird found
092415-BRBL-EVAPPOND-N-11	9/24/2015	0-8hrs	Brewer's blackbird	65	2-7 mph wind, waxing gibbous, clear
092515-RUDU-EVAPPOND-S-01	9/25/2015	0-8hrs	ruddy duck	NA	2-7 mph SSW wind, waxing gibbous moon, clear
092515-AMCO-2-E-C/D-04-02	9/25/2015	0-8hrs	American coot	NA	2-7 mph SSW wind, waxing gibbous, clear
092715-LISP-2-POWERBLOCK-02	9/27/2015	8-24hrs	Lincoln's sparrow	11	6-15 mph wind, full moon,
092815-EAGR-EVAPPOND-S-01	9/28/2015	0-8hrs	eared grebe	NA	6-15 mph wind, full moon, clear
092815-EAGR-EVAPPOND-S-03	9/28/2015	0-8hrs	eared grebe	209	6-15 mph wind, full moon, clear
092815-EAGR-EVAPPOND-S-04	9/28/2015	8-24hrs	eared grebe	220	6-15 mph, full moon, clear
092815-EAGR-EVAPPOND-S-05	9/28/2015	8-24hrs	eared grebe	195	6-15 mph wind, full moon, clear
092815-EAGR-EVAPPOND-S-06	9/28/2015	0-8hrs	eared grebe	220	6-15 mph wind, full moon, clear
092815-WEME-2-W-F/E-33-03	9/28/2015	8-24hrs	western meadowlark	80	6-15 mph wind, full moon, not given on weather underground for this day
093015-UNSP-ASSEMBLYLINEBUILDING-OUTSIDE-01	9/30/2015	8-24hrs	Lincoln's sparrow	12	12 max wind speed. 6 avg wind speed. SW wind direction. Waning gibbous moon phase. Hot w/ few clouds.
100115-AMCO-ASSEMBLYLINEBUILDING-OUTSIDE-01	10/1/2015	0-8hrs	American coot	NA	12 max wind speed. 5 avg wind speed. WSW wind direction. Waning gibbous moon phase. Clear.
100115-BRBL-1-W-C/D-48-02	10/1/2015	0-8hrs	Brewer's blackbird	55	12 max wind speed. 5 avg wind speed. WSW wind direction. Waning gibbous. Clear.

Table B. Weather conditions and body weights associated with avian detections estimated to have been dead less than 24 hours during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at Genesis Solar Energy Project, Riverside County, California.

Detection ID	Date	Estimated time since death (hours)	Species	Weight (grams) if intact	Weather Summary for Preceding 24 hours
100115-AMCO-EVAPPOND-N-01	10/1/2015	8-24hrs	American coot	330	12 max wind speed. 5 avg wind speed. WSW wind direction. Waning gibbous moon phase. High temp 107 on 09/30. Clear until bird found.
100115-RWBL-EVAPPOND-N-06	10/1/2015	8-24hrs	red-winged blackbird	37	12 max wind speed. Gusts 22. 5 avg wind speed. WSW wind direction. Waning gibbous moon phase. High temp 107 on 09/30. Clear until bird found.
100115-UNSP-EVAPPOND-S-30	10/1/2015	0-8hrs	unidentified sparrow	NA	12 max wind speed. 5 avg wind speed. WSW wind direction. Waning gibbous moon phase. Clear.
100115-UNSP-EVAPPOND-S-31	10/1/2015	0-8hrs	unidentified sparrow	NA	12 max wind speed. 5 avg wind speed. WSW wind direction. Waning gibbous moon phase. Clear.
100115-RWBL-EVAPPOND-S-10	10/1/2015	8-24hrs	red-winged blackbird	NA	Max wind speed: 12. Avg wind speed: 5. Gusts: 22. Wind direction: WSW. Moon phase: waning gibbous. High temp: 107 on 09/30. Clear until bird found
100115-UNSP-EVAPPOND-N-32	10/1/2015	0-8hrs	Savannah sparrow	NA	Max wind speed: 12. Avg wind speed: 5. Wind direction: WSW. Moon phase: waning gibbous. Clear
100115-RUDU-EVAPPOND-N-13	10/1/2015	0-8hrs	ruddy duck	520	Max wind speed: 12. Gusts: 22. Avg wind speed: 5. Wind direction: WSW. Mon phase: waning gibbous. 107 high temp on 09/30. Clear until bird found
100115-UNBA-EVAPPOND-N-22	10/1/2015	8-24hrs	unidentified bat	NA	Max wind speed: 12. Avg wind speed: 5. Wind direction: WSW. Moon phase: waning gibbous. Clear
100515-PABA-2-W-FENCE-INSIDE-03	10/5/2015	0-8hrs	Pallid bat	15	Max wind speed: 25 mph. Avg wind speed: 14. Wind direction: SSW. Moon phase: waning gibbous. Slightly windy, partly cloudy
100515-WEGR-1-POWERBLOCK-02	10/5/2015	0-8hrs	western grebe	NA	Max wind speed: 25 mph. Avg wind speed: 14. Wind direction: SSW. Moon phase: waning gibbous. Slightly windy, partly cloudy
100815-UNGF-EVAPPOND-N-11	10/8/2015	0-8hrs	unidentified goldfinch	NA	NA
100915-RCKI-GENTIE-TOWER-43-01	10/9/2015	0-8hrs	ruby-crowned kinglet	NA	Max wind speed: 13 mph. Avg wind speed: 3 mph. Wind direction: N. Moon phase: waning crescent. Mostly sunny, slightly breezy
100915-REDH-1-E-F/E-62-02	10/9/2015	0-8hrs	redhead	NA	Max wind speed: 13 mph. Avg wind speed: 3 mph. Wind direction: N. Moon phase: waning crescent. Mostly sunny and slightly breezy
101215-RUDU-EVAPPOND-N-02	10/12/2015	0-8hrs	ruddy duck	NA	Max wind speed: 9. Avg wind speed: 4. Wind direction: NW. Moon phase: waning crescent. High temp 99f. Clear until bird found
101315-RUDU-1-E-C/D-39-01	10/13/2015	8-24hrs	ruddy duck	NA	Max wind speed: 10. Avg wind speed: 4. Wind direction: ESE. Moon phase: waning crescent. Max temp on 10-12, 95 deg. Clear until bird found

Table B. Weather conditions and body weights associated with avian detections estimated to have been dead less than 24 hours during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at Genesis Solar Energy Project, Riverside County, California.

Detection ID	Date	Estimated time since death (hours)	Species	Weight (grams) if intact	Weather Summary for Preceding 24 hours
101315-WEME-1-W-C/D-16-02	10/13/2015	8-24hrs	western meadowlark	NA	NA
101415-WCSP-GENTIE-08-03	10/14/2015	8-24hrs	white-crowned sparrow	NA	NA
101515-AMCO-EVAPPOND-N-01	10/15/2015	0-8hrs	American coot	NA	Avg wind speed: 3. Max wind speed: 6. Wind direction: ENE. Moon phase: waning crescent. Visibility 10 mi, no major events
101515-WEGR-2-W-B/A-51-01	10/15/2015	0-8hrs	western grebe	NA	Max wind speed: 6 mph. Ang wind speed: 3 mph. Wind direction: ENE. Moon phase: waning crescent. Visibility was 10 miles, no major events
101615-RUDU-EVAPPOND-S-01	10/16/2015	0-8hrs	ruddy duck	NA	Avg wind speed: 6. Max wind speed: 21. Wind direction: NNW. Moon phase: waning crescent. Clear, becoming cloudy with thunderstorms
101615-RUDU-EVAPPOND-S-02	10/16/2015	0-8hrs	ruddy duck	NA	Max wind speed: 21. Avg wind speed: 6. Wind direction: NNW. Moon phase: waning crescent. Clear early, becoming cloudy with thunderstorms
101615-RUDU-EVAPPOND-S-03	10/16/2015	0-8hrs	ruddy duck	NA	Max wind speed: 21. Avg wind speed: 6. Wind direction: NNW. Moon phase: waning crescent. Clear early, becoming cloudy with thunderstorms
101615-RUDU-EVAPPOND-S-04	10/16/2015	0-8hrs	ruddy duck	NA	Max wind speed: 24. Avg wind speed: 14. Wind direction: NE. Moon phase: waning crescent. Mostly cloudy with rain and thunderstorms
101615-RUDU-EVAPPOND-S-06	10/16/2015	8-24hrs	ruddy duck	NA	Avg wind speed: 6. Max wind speed: 21. Wind direction: NNW. Moon phase: waning crescent. Clear early, becoming cloudy with thunderstorms
101615-RUDU-EVAPPOND-S-07	10/16/2015	8-24hrs	ruddy duck	430	Avg wind speed: 6. Max wind speed: 21. Wind direction: NNW. Moon phase: waning crescent. Clear early, becoming cloudy with thunderstorms
101615-RUDU-EVAPPOND-S-08	10/16/2015	0-8hrs	ruddy duck	NA	Avg wind speed: 6. Max wind speed: 21. Wind direction: NNW. Moon phase: waning crescent. Clear early, becoming cloudy with thunderstorms
101615-WEME-1-E-B/A-35-09	10/16/2015	8-24hrs	western meadowlark	NA	NA
101615-GWTE-1-E-F/E-41-10	10/16/2015	8-24hrs	green-winged teal	NA	Avg wind speed: 6. Max wind speed: 21. Wind direction: NNW. Moon phase: waning crescent. Clear early, becoming cloudy with thunderstorms
101715-EAGR-EVAPPOND-S-06	10/17/2015	0-8hrs	eared grebe	NA	Avg wind speed: 14. Max wind speed: 24. Wind direction: NE. Moon phase: waxing crescent. Mostly cloudy with rain and thunderstorms

Table B. Weather conditions and body weights associated with avian detections estimated to have been dead less than 24 hours during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at Genesis Solar Energy Project, Riverside County, California.

Detection ID	Date	Estimated time since death (hours)	Species	Weight (grams) if intact	Weather Summary for Preceding 24 hours
101715-RUDU-EVAPPOND-S-01	10/17/2015	8-24hrs	ruddy duck	NA	Avg wind speed: 14. Max wind speed: 24. Wind direction: NE. Moon phase: waxing crescent. Mostly cloudy with rain and thunderstorms
101715-EAGR-EVAPPOND-S-02	10/17/2015	8-24hrs	eared grebe	NA	Avg wind speed: 14. Max wind speed: 24. Wind direction: NE. Moon phase: waxing crescent. Mostly cloudy with rain and thunderstorms
101715-RUDU-EVAPPOND-S-03	10/17/2015	8-24hrs	ruddy duck	NA	Avg wind speed: 14. Max wind speed: 24. Wind direction: NE. Moon phase: waxing crescent. Mostly cloudy with rain and thunderstorms
101715-RUDU-EVAPPOND-S-05	10/17/2015	8-24hrs	unidentified bird (medium)	NA	Avg wind speed: 14. Max wind speed: 24. Wind direction: NE. Moon phase: waxing crescent. Mostly cloudy with rain and thunderstorms
101915-UNGR-1-W-F/E-36-05	10/19/2015	8-24hrs	unidentified grebe	NA	Avg wind speed: 8. Max wind speed: 14. Wind direction: SSW. Moon phase: waxing crescent. Gusts: 32. Max temp 89 deg f. Clear until 3 pm, then clouds/rain/thunderstorms until 5 pm, then clear until 1 am. See data sheet for notes
102115-UNGR-GENTIE-04-01	10/21/2015	8-24hrs	eared grebe	NA	NA
102115-SAGS-GENTIE-12-02	10/21/2015	0-8hrs	Sagebrush sparrow	18	8 avg wind speed. 33 max wind speed. + wind direction. Waxing crescent moon phase. Rain thunderstorms.
102215-EAGR-1-W-G/H-45-01	10/22/2015	0-8hrs	eared grebe	NA	5 avg wind speed. 8 max wind speed. E wind direction. First quarter moon phase. Max temp on 10/21 82f. Visibility 10 mi. Clear until 2 pm on 10/21, then partly cloudy until 3 pm
103115-BRTH-1-POWERBLOCK-QUENCHPIT-01	10/31/2015	8-24hrs	brown thrasher	NA	33 max wind speed. 25 avg wind speed. NNW wind direction. 45 gust speed. Waning gibbous moon phase. Max temp 82 on 10/30. 6-mile visibility. Winds >20 mph from 2 am until 4 pm, then clear until bird found on 10/31.
120515-RUDU-1-E-G/H-54-01	12/5/2015	8-24hrs	ruddy duck	NA	Avg. Wind speed 3. Max wind speed 8. Wind direction W. Moon phase last quarter. Max temp 63 f. Clear. 10 mi visibility.
120515-HOFI-2-POWERBLOCK-02	12/5/2015	8-24hrs	house finch	NA	Avg wind speed 3. Max wind speed 8. Wind direction W. Moon phase last quarter. Max temp 63 f. Clear. 10 mi. Visibility.
121115-EAGR-EVAPPOND-N-01	12/11/2015	0-8hrs	eared grebe	NA	Avg. Wind speed 6. Max wind speed 18. Wind direction W. Moon phase waning crescent. Clear 10 mi. Visibility.
121415-ROWR-EVAPPOND-N-01	12/14/2015	0-8hrs	rock wren	13	Avg wind speed 8. Max wind speed 20. Gusts 26. Wind direction SSW. Moon phase waxing crescent. Max temp on 12/13 70 f. Clear until midnight. Moderately windy starting at 2 pm with gusts to 26.5 mph throughout 4 am. Winds died down, sky cleared 5 am.
122115-HOFI-2-POWERBLOCK-CLOSEDCOOLINGWATERPUMPB-1	12/21/2015	8-24hrs	house finch	18	Avg wind speed- 3. Max wind speed- 8. Wind direction- SE. Moon phase- waxing gibbous. Clear from 8 pm on 12-20 until bird found. Low temp overnight 37 f.

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Detection ID	Date	Estimated time since death (hours)	Species	Weight (grams) if intact	Weather Summary for Preceding 24 hours
122215-UNGR-EVAPPOND-S-01	12/22/2015	0-8hrs	unidentified grebe	NA	Avg wind speed- 3. Max wind speed- 8. Wind direction-SE. Moon phase- waxing gibbous. Clear from 8 am on 12/21 until 5 am on 12/22, then mostly cloudy/overcast until bird found. Winds below 7 mph until 1 am on 12/22 (then 9-15 mph until bird found).
010216-YRWA-EVAPPOND-N-01	1/2/2016	8-24hrs	yellow-rumped warbler	9	Avg wind speed 8. Max wind speed 15. Wind direction NNW. Moon phase waning gibbous. Clear. Overnight low 37.

Appendix C. Guild and Migration Behavior for All Avian Detections Made during Standardized Carcass Searches and Incidentally, by Species, during the 2015 – 2016 Monitoring Year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California

Table C. Guild and migration behavior for all avian detections (those made during standardized carcass searches and incidentally), by species, during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. SCA = Solar collector assembly; OH line = overhead lines (gen-tie and distribution lines).

Common Name	Scientific Name	Migration Behavior*	Guild	SCA	Power Blocks	Ponds	Fence	OH lines/ road	Other	Guild Total
American pipit	*Anthus rubescens*	diurnal	Grassland/ Sparrows	1	0	0	0	0	0	1
bank swallow	*Riparia riparia*	diurnal	Swallows	0	1	0	0	0	0	1
barn owl	*Tyto alba*	unresolved	Owls	0	0	0	1	0	0	1
bufflehead	*Bucephala albeola*	nocturnal	Waterbirds/ Waterfowl	1	0	0	0	0	0	1
burrowing owl	*Athene cunicularia*	resident	Owls	1	0	0	0	0	0	1
California gull	*Larus californicus*	diurnal	Shorebirds	1	0	0	0	0	0	1
cliff swallow	*Petrochelidon pyrrhonota*	diurnal	Swallows	0	1	0	0	0	0	1
dark-eyed junco	*Junco hyemalis*	nocturnal	Grassland/ Sparrows	1	0	0	0	0	0	1
great blue heron	*Ardea herodias*	resident	Waterbirds/ Waterfowl	0	0	1	0	0	0	1
great egret	*Ardea alba*	unresolved	Waterbirds/ Waterfowl	0	0	1	0	0	0	1
house wren	*Troglodytes aedon*	nocturnal	Wrens	1	0	0	0	0	0	1
long-billed curlew	*Numenius americanus*	nocturnal	Shorebirds	1	0	0	0	0	0	1
northern shoveler	*Anas clypeata*	both	Waterbirds/ Waterfowl	1	0	0	0	0	0	1
orange-crowned warbler	*Oreothlypis celata*	nocturnal	Warblers	0	0	0	0	1	0	1
pine siskin	*Spinus pinus*	both	Finches/ Crossbills	1	0	0	0	0	0	1
prairie falcon	*Falco mexicanus*	resident	Falcons	0	0	0	0	1	0	1
red-necked phalarope	*Phalaropus lobatus*	nocturnal	Shorebirds	0	0	1	0	0	0	1
ruby-crowned kinglet	*Regulus calendula*	nocturnal	Gnatcatcher s/Kinglet	0	0	0	0	1	0	1

Table C. Guild and migration behavior for all avian detections (those made during standardized carcass searches and incidentally), by species, during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. SCA = Solar collector assembly; OH line = overhead lines (gen-tie and distribution lines).

Common Name	Scientific Name	Migration Behavior*	Guild	SCA	Power Blocks	Ponds	Fence	OH lines/ road	Other	Guild Total
ruddy ground-dove	*Columbina talpacoti*	resident	Doves/ Pigeons	1	0	0	0	0	0	1
rusty blackbird	*Euphagus carolinus*	diurnal	Blackbirds /Orioles	0	0	1	0	0	0	1
sagebrush sparrow	*Artemisiospiza nevadensis*	na	Grassland/ Sparrows	0	0	0	0	1	0	1
Scott's oriole	*Icterus parisorum*	unresolved	Blackbirds/ Orioles	1	0	0	0	0	0	1
tree swallow	*Tachycineta bicolor*	diurnal	Swallows	0	0	1	0	0	0	1
unidentified egret	na	na	Waterbirds/ Waterfowl	1	0	0	0	0	0	1
unidentified goldfinch	na	na	Finches/ Crossbills	0	0	1	0	0	0	1
unidentified gull	na	na	Shorebirds	0	0	0	1	0	0	1
unidentified merganser	*Mergus* spp	na	Waterbirds/ Waterfowl	0	0	1	0	0	0	1
unidentified quail	na	na	Upland Game Birds	0	0	0	1	0	0	1
unidentified swallow	na	na	Swallows	1	0	0	0	0	0	1
unidentified tern	na	na	Shorebirds	0	0	0	1	0	0	1
western gull	*Larus occidentalis*	na	Shorebirds	1	0	0	0	0	0	1
western sandpiper	*Calidris mauri*	both	Shorebirds	0	0	1	0	0	0	1
western wood-pewee	*Contopus sordidulus*	nocturnal	Flycatchers	1	0	0	0	0	0	1
white-crowned sparrow	*Zonotrichia leucophrys*	nocturnal	Grassland/ Sparrows	0	0	0	0	1	0	1
yellow-billed cuckoo	*Coccyzus americanus*	nocturnal	Cuckoos	0	1	0	0	0	0	1
belted kingfisher	*Megaceryle alcyon*	nocturnal	Kingfishers	0	1	0	1	0	0	2
black phoebe	*Sayornis nigricans*	variable	Flycatchers	0	2	0	0	0	0	2

Table C. Guild and migration behavior for all avian detections (those made during standardized carcass searches and incidentally), by species, during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. SCA = Solar collector assembly; OH line = overhead lines (gen-tie and distribution lines).

Common Name	Scientific Name	Migration Behavior*	Guild	SCA	Power Blocks	Ponds	Fence	OH lines/ road	Other	Guild Total
blue-winged teal	*Anas discors*	nocturnal	Waterbirds/ Waterfowl	2	0	0	0	0	0	2
Brewer's sparrow	*Spizella breweri*	nocturnal	Grassland/ Sparrows	1	0	0	0	1	0	2
brown thrasher	*Toxostoma rufum*	nocturnal	Mimids	0	1	0	1	0	0	2
common loon	*Gavia immer*	diurnal	Waterbirds/ Waterfowl	2	0	0	0	0	0	2
European starling	*Sturnus vulgaris*	variable	Blackbirds/ Orioles	0	1	0	1	0	0	2
Gambel's quail	*Callipepla gambelii*	resident	Upland Game Birds	1	0	0	0	1	0	2
lazuli bunting	*Passerina amoena*	nocturnal	Tanagers	0	0	0	0	2	0	2
Lincoln's sparrow	*Melospiza lincolnii*	nocturnal	Grassland/ Sparrows	0	1	0	0	0	1	2
Nashville warbler	*Oreothlypis ruficapilla*	nocturnal	Warblers	0	0	0	0	2	0	2
rock wren	*Salpinctes obsoletus*	nocturnal	Wrens	0	0	1	0	1	0	2
snowy egret	*Egretta thula*	nocturnal	Waterbirds/ Waterfowl	1	1	0	0	0	0	2
spotted sandpiper	*Actitis macularia*	both	Shorebirds	1	0	1	0	0	0	2
unidentified owl	na	na	Owls	0	0	0	2	0	0	2
unidentified passerine	na	na	Passerines	0	1	0	0	1	0	2
unidentified sandpiper	na	na	Shorebirds	0	1	1	0	0	0	2
western kingbird	*Tyrannus verticalis*	diurnal	Flycatchers	0	1	0	0	0	1	2
Eurasian collared-dove	*Streptopelia decaocto*	resident	Doves/ Pigeons	0	1	0	1	0	1	3
green-winged teal	*Anas crecca*	nocturnal	Waterbirds/ Waterfowl	2	0	0	1	0	0	3

Table C. Guild and migration behavior for all avian detections (those made during standardized carcass searches and incidentally), by species, during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. SCA = Solar collector assembly; OH line = overhead lines (gen-tie and distribution lines).

Common Name	Scientific Name	Migration Behavior*	Guild	SCA	Power Blocks	Ponds	Fence	OH lines/ road	Other	Guild Total
horned lark	*Eremophila alpestris*	resident	Grassland/ Sparrows	1	0	0	1	0	1	3
house finch	*Haemorhous mexicanus*	resident	Finches/ Crossbills	0	3	0	0	0	0	3
lesser nighthawk	*Chordeiles acutipennis*	diurnal	Goatsuckers	0	1	1	0	1	0	3
loggerhead shrike	*Lanius ludovicianus*	diurnal	Shrikes	1	1	0	0	1	0	3
redhead	*Aythya americana*	both	Waterbirds/ Waterfowl	1	0	2	0	0	0	3
sora	*Porzana carolina*	nocturnal	Rails/ Coots	3	0	0	0	0	0	3
Townsend's warbler	*Setophaga townsendi*	unresolved	Warblers	1	1	0	0	1	0	3
unidentified dove	na	na	Doves/ Pigeons	0	1	0	2	0	0	3
unidentified shorebird	na	na	Shorebirds	0	0	3	0	0	0	3
unidentified warbler	na	na	Warblers	1	2	0	0	0	0	3
yellow-headed blackbird	*Xanthocephalus xanthocephalus*	diurnal	Blackbirds/ Orioles	0	2	1	0	0	0	3
yellow-rumped warbler	*Setophaga coronata*	nocturnal	Warblers	0	0	3	0	0	0	3
Brewer's blackbird	*Euphagus cyanocephalus*	diurnal	Blackbirds/ Orioles	1	0	1	1	1	0	4
great-tailed grackle	*Quiscalus mexicanus*	resident	Blackbirds/ Orioles	0	0	0	3	0	1	4
killdeer	*Charadrius vociferus*	variable	Shorebirds	2	1	1	0	0	0	4
Savannah sparrow	*Passerculus sandwichensis*	nocturnal	Grassland/ Sparrows	2	1	1	0	0	0	4
unidentified bird (medium)	na	na	Unidentified Birds	0	1	3	0	0	0	4
western tanager	*Piranga ludoviciana*	nocturnal	Tanagers	1	0	0	0	3	0	4

Table C. Guild and migration behavior for all avian detections (those made during standardized carcass searches and incidentally), by species, during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. SCA = Solar collector assembly; OH line = overhead lines (gen-tie and distribution lines).

Common Name	Scientific Name	Migration Behavior*	Guild	SCA	Power Blocks	Ponds	Fence	OH lines/ road	Other	Guild Total
white-winged dove	*Zenaida asiatica*	variable	Doves/ Pigeons	1	3	0	0	0	0	4
Wilson's warbler	*Cardellina pusilla*	nocturnal	Warblers	0	0	0	0	4	0	4
yellow warbler	*Setophaga petechia*	nocturnal	Warblers	0	0	0	2	1	1	4
northern flicker	*Colaptes auratus*	both	Woodpeckers	1	0	0	4	0	0	5
red-winged blackbird	*Agelaius phoeniceus*	diurnal	Blackbirds/ Orioles	2	0	2	1	0	0	5
unidentified blackbird	na	na	Blackbirds/ Orioles	2	0	0	3	0	0	5
western grebe	*Aechmophorus occidentalis*	nocturnal	Waterbirds/ Waterfowl	3	2	0	0	0	0	5
lesser goldfinch	*Spinus psaltria*	resident	Finches/ Crossbills	3	2	1	0	0	0	6
unidentified teal	*Anas* spp	na	Waterbirds/ Waterfowl	2	1	2	0	0	1	6
cinnamon teal	*Anas cyanoptera*	nocturnal	Waterbirds/ Waterfowl	3	1	3	0	0	0	7
American coot	*Fulica americana*	nocturnal	Rails/Coots	3	1	2	1	0	1	8
American kestrel	*Falco sparverius*	resident	Falcons	2	5	0	1	0	0	8
rock pigeon	*Columba livia*	resident	Doves/ Pigeons	4	0	0	3	1	0	8
unidentified duck	na	na	Waterbirds/ Waterfowl	5	0	1	2	0	0	8
brown-headed cowbird	*Molothrus ater*	diurnal	Blackbirds/ Orioles	4	3	0	1	0	1	9
unidentified bird (unknown size)	na	na	Unidentified Birds	2	0	2	2	3	0	9
unidentified grebe	na	na	Waterbirds/ Waterfowl	3	0	2	3	1	0	9

Table C. Guild and migration behavior for all avian detections (those made during standardized carcass searches and incidentally), by species, during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California. SCA = Solar collector assembly; OH line = overhead lines (gen-tie and distribution lines).

Common Name	Scientific Name	Migration Behavior*	Guild	SCA	Power Blocks	Ponds	Fence	OH lines/ road	Other	Guild Total
greater roadrunner	*Geococcyx californianus*	resident	Cuckoos	4	4	0	2	1	0	11
unidentified bird (small)	na	na	Unidentified Birds	8	1	1	2	0	1	13
western meadowlark	*Sturnella neglecta*	diurnal	Blackbirds/ Orioles	11	2	0	0	0	0	13
unidentified sparrow	na	na	Grassland/Sparrows	5	3	5	0	1	0	14
ruddy duck	*Oxyura jamaicensis*	nocturnal	Waterbirds/ Waterfowl	5	0	20	0	0	0	25
mourning dove	*Zenaida macroura*	variable	Doves/ Pigeons	11	5	1	1	7	1	26
eared grebe	*Podiceps nigricollis*	nocturnal	Waterbirds/ Waterfowl	6	0	29	2	1	0	38

* See literature cited for migration behavior references; information for most species was taken from the respective species accounts found in Birds of North America (BNA) Online (http://bna.birds.cornell.edu/bna/); where information on migration behavior was lacking in BNA accounts, Evans and Mellinger (1999), Newton (2008), or Murray (2004) were used.

Appendix D. Scavengers Observed at the Carcass Persistence Trial Carcasses during the 2015 – 2016 Monitoring Year (March 1, 2015 – February 28, 2016) at the Genesis Solar Energy Project, Riverside County, California

Figure D-1. Kit fox observed at a carcass persistence trial carcass during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016).

Figure D-2. Coyote observed at a carcass persistence trial carcass during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016).

Figure D-3. Common raven observed at a carcass persistence trial carcass during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016).

Figure D-4. Turkey vultures observed at a carcass persistence trial carcass during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016).

Figure D-5. Greater roadrunner observed at a carcass persistence trial carcass during the 2015 – 2016 monitoring year (March 1, 2015 – February 28, 2016).

Appendix E. Correction Factors and Bird and Bat Estimated Fatality Rates at the Genesis Solar Energy Project during the 2015 – 2016 Monitoring Year (March 1, 2015 – February 28, 2016)

Table E-1. Correction factors and estimated numbers of fatalities at the Genesis Solar Energy Generation Facility during the 2015 – 2016 Monitoring year (March 1, 2015 – February 18, 2016).

Parameter	Small birds Mean	Small birds 90% CI	Medium birds Mean	Medium birds 90% CI	Large birds Mean	Large birds 90% CI	Bats Mean	Bats 90% CI
Proportion of Area Searched								
Fence	1.00	-	1.00	-	1.00	-	1.00	-
Overhead lines	0.25	-	0.25	-	0.25	-	0.25	-
Ponds	1.00	-	1.00	-	1.00	-	1.00	-
Power Blocks	1.00	-	1.00	-	1.00	-	1.00	-
SCAs	0.30	-	0.30	-	0.30	-	0.30	-
Searcher Efficiency								
Solar Field								
Spring & Fall	0.80	0.68 – 0.89	0.95	0.90 – 0.99	0.96	0.91 – 1.00	0.80	0.68 – 0.89
Summer & Winter	0.93	0.86 – 0.97	0.98	0.96 – 1.00	0.99	0.97 – 1.00	0.93	0.86 – 0.97
Overhead lines								
Spring & Fall	0.54	0.39 – 0.67	0.85	0.75 – 0.95	0.88	0.74 – 1.00	0.54	0.39 – 0.67
Summer & Winter	0.79	0.66 – 0.89	0.95	0.90 – 0.99	0.96	0.90 – 1.00	0.79	0.66 – 0.89
Average Probability of Carcass Persistence to the Next Search (average search interval 7.2 during migration, and 21.0 during non-migration seasons)								
Solar Field								
Spring	0.59	0.52 – 0.66	0.63	0.55 – 0.71	0.98	0.95 – 1.00	0.59	0.52 – 0.66
Summer	0.34	0.27 – 0.42	0.79	0.65 – 0.90	0.93	0.86 – 0.99	0.34	0.27 – 0.41
Fall	0.59	0.52 – 0.66	0.63	0.55 – 0.71	1.00	-	0.59	0.52 – 0.66
Winter	0.34	0.27 – 0.32	0.43	0.35 – 0.51	0.93	0.86 – 0.99	0.34	0.27 – 0.42
Overhead lines								
Spring	0.25	0.19 – 0.32	0.63	0.55 – 0.71	0.63	0.48 – 0.77	0.25	0.19 – 0.32
Summer	0.11	0.08 – 0.15	0.79	0.65 – 0.90	0.43	0.27 – 0.58	0.11	0.08 – 0.16
Fall	0.25	0.19 – 0.32	0.63	0.55 – 0.71	0.95	0.83 – 1.00	0.25	0.19 – 0.32
Winter	0.11	0.08 – 0.15	0.43	0.35 – 0.51	0.43	0.27 – 0.58	0.11	0.08 – 0.16
Observed Detection Counts Included in Adjustment (Counts of detections on the fence, power blocks and ponds have no variance because all components at the facility were searched)								
Spring								
Fence	5	-	5	-	1	-	0	-
Overhead lines	8	3 – 14	3	0 – 9	0	-	0	-

Table E-1. Correction factors and estimated numbers of fatalities at the Genesis Solar Energy Generation Facility during the 2015 – 2016 Monitoring year (March 1, 2015 – February 18, 2016).

	Small birds		Medium birds		Large birds		Bats	
Parameter	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**
Ponds	3	-	3	-	0	-	0	-
Power Blocks	2	-	2	-	0	-	0	-
SCAs	4	1 – 7	1	0 – 3	1	0 – 3	0	-
Summer								
Fence	1	-	2	-	1	-	0	-
Overhead lines	0	-	1	0 – 3	0	-	0	-
Ponds	2	-	3	-	0	-	0	-
Power Blocks	3	-	6	-	0	-	3	-
SCAs	4	1 – 7	4	1 – 7	0	-	0	-
Fall								
Fence	6	-	7	-	0	-	0	-
Overhead lines	5	1 – 10	4	1 – 8	0	-	0	-
Ponds	18	-	56	-	4	-	2	-
Power Blocks	15	-	12	-	1	-	2	-
SCAs	22	14 – 31	35	24 – 48	2	0 – 6	1	0 – 3
Winter								
Fence	4	-	9	-	1	-	0	-
Overhead lines	1	0 – 3	2	0 – 4	0	-	0	-
Ponds	4	-	2	-	0	-	0	-
Power Blocks	3	-	2	-	1	-	1	-
SCAs	9	4 – 14	10	4 - 16	0	-	0	-
Average Probability of Carcass Availability and Detected (Searcher efficiency * average probability of carcass persistence)								
Solar Field								
Spring	0.47	0.38 – 0.55	0.60	0.52 – 0.68	0.94	0.88 – 0.99	0.47	0.39 – 0.56
Summer	0.32	0.25 – 0.39	0.77	0.64 – 0.88	0.92	0.85 – 0.98	0.32	0.25 – 0.38
Fall	0.47	0.38 – 0.55	0.60	0.52 – 0.68	0.96	0.91 – 1.00	0.47	0.39 – 0.56
Winter	0.32	0.25 – 0.39	0.43	0.35 – 0.50	0.92	0.85 – 0.98	0.32	0.25 – 0.38
Overhead lines								
Spring	0.13	0.09 – 0.18	0.54	0.45 – 0.63	0.56	0.41 – 0.71	0.13	0.09 – 0.19
Summer	0.09	0.06 – 0.12	0.75	0.62 – 0.86	0.42	0.26 – 0.56	0.09	0.06 – 0.13
Fall	0.13	0.09 – 0.18	0.54	0.45 – 0.63	0.84	0.65 – 0.97	0.13	0.09 – 0.19

Table E-1. Correction factors and estimated numbers of fatalities at the Genesis Solar Energy Generation Facility during the 2015 – 2016 Monitoring year (March 1, 2015 – February 18, 2016).

	Small birds		Medium birds		Large birds		Bats	
Parameter	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**	**Mean**	**90% CI**
Winter	0.09	0.06 – 0.12	0.41	0.33 – 0.49	0.42	0.26 – 0.56	0.09	0.06 – 0.13
Overall Probability of Detection (average probability of carcass availability and detected * proportion of area searched; overall probability of detection is the probability of detection and availability when proportion of area searched is 1 at the ponds, power blocks, and fence)								
SCAs								
Spring	0.14	0.12 – 0.17	0.18	0.16 – 0.20	0.28	0.26 – 0.30	0.14	0.12 – 0.17
Summer	0.10	0.08 – 0.12	0.23	0.19 – 0.27	0.28	0.25 – 0.29	0.10	0.08 – 0.12
Fall	0.14	0.12 – 0.17	0.18	0.16 – 0.20	0.29	0.27 – 0.30	0.14	0.12 – 0.17
Winter	0.10	0.08 – 0.12	0.13	0.10 – 0.15	0.28	0.25 – 0.29	0.10	0.08 – 0.12
Overhead lines								
Spring	0.03	0.02 – 0.05	0.14	0.11 – 0.16	0.14	0.10 – 0.18	0.03	0.02 – 0.05
Summer	0.02	0.01 – 0.03	0.19	0.15 – 0.21	0.11	0.07 – 0.14	0.02	0.01 – 0.03
Fall	0.03	0.02 – 0.05	0.14	0.11 – 0.16	0.21	0.16 – 0.24	0.03	0.02 – 0.05
Winter	0.02	0.01 – 0.03	0.10	0.08 – 0.12	0.11	0.07 – 0.14	0.02	0.01 – 0.03
Adjusted Fatality Estimates (detection count / (overall detectability); values in italics are considered unreliable due to low counts of detections; lower bounds in parentheses are actual counts; bootstrap analysis indicated a lower bound of zero; Small bird estimates include unidentified species of unknown size.								
Spring	**287.8**	**121.99 – 549.42**	**43.65**	**12.01 – 88.14**	***4.6***	***(2) – 11.52***	-	-
Fence	10.53	(5) – 25.21	8.4	(5) – 17.70	*1.06*	*(1) – 3.15*	-	-
Overhead lines	238.55	72.29 – 493.63	*22.33*	*(3) – 68.40*	-	-	-	-
Ponds	*6.32*	*(3) – 15.20*	*5.01*	*(3) – 11.69*	-	-	-	-
Power Blocks	*4.33*	*(2) – 10.67*	*2.35*	*(2) – 6.96*	-	-	-	-
SCAs	*28.07*	*7.12 – 52.31*	*5.56*	*(1) – 16.32*	*3.54*	*(1) – 10.62*	-	-
Summer	**53.58**	**22.71 – 92.74**	**35.46**	**17.89 – 56.33**	***1.09***	***(1) – 3.28***	***7.38***	***(3) – 17.46***
Fence	*3.24*	*(1) – 9.71*	*2.47*	*(2) – 7.39*	*1.09*	*(1) – 3.28*	-	-
Overhead lines	-	-	*5.36*	*(1) – 15.70*	-	-	-	-
Ponds	*6.21*	*(2) – 18.76*	*3.88*	*(3) – 11.33*	-	-	-	-
Power Blocks	*5.58*	*(3) – 13.77*	6.7	(6) – 17.85	-	-	*7.38*	*(3) – 17.46*
SCAs	38.55	10.25 – 75.57	17.05	4.17 – 31.57	-	-	-	-
Fall	**426.39**	**292.96 – 627.51**	**370.24**	**259.89 – 520.34**	**12.13**	**2.05 – 27.23**	***15.44***	***3.46 – 32.11***
Fence	12.51	2.30 – 25.52	11.6	3.63 – 20.99	-	-	-	-
Overhead lines	147.36	39.22 – 328.96	*37.28*	*9.37 – 72.58*	-	-	-	-
Ponds	44.13	(18) – 105.15	95.6	(56) – 229.23	*4.16*	*(4) –11.15*	*4.21*	*(2) – 12.23*

Table E-1. Correction factors and estimated numbers of fatalities at the Genesis Solar Energy Generation Facility during the 2015 – 2016 Monitoring year (March 1, 2015 – February 18, 2016).

Parameter	Small birds		Medium birds		Large birds		Bats	
	Mean	90% CI	Mean	90% CI	Mean	90% CI	Mean	90% CI
Power Blocks	33.06	(25) – 89.20	18.26	(12) – 41.57	*1.04*	*(1) – 3.08*	*4.21*	*(2) – 12.23*
SCAs	189.33	111.81 – 286.70	207.5	140.09 – 290.95	6.93	(2) – 20.85	7.02	(1) – 20.78
Winter	**157.55**	**82.30 – 264.22**	**112.19**	**68.42 – 168.41**	***2.18***	***(2) – 5.00***	***3.15***	***(1) – 9.34***
Fence	12.77	3.25 – 24.74	20.56	(9) – 47.41	*1.09*	*(1) – 3.23*	-	-
Overhead lines	*42.91*	*(1) – 133.12*	*15.94*	*(2) – 37.35*	-	-	-	-
Ponds	*12.59*	*(4) – 37.17*	*4.69*	*(2) – 11.10*	-	-	-	-
Power Blocks	*4.36*	*(3) – 12.77*	*4.03*	*(2) – 9.57*	*1.09*	*(1) – 3.24*	*3.15*	*(1) – 9.34*
SCAs	84.92	39.47 – 140.25	66.97	28.69 – 109.19	-	-	-	-
TOTAL OVERALL	**925.32**	**673.87 – 1347.42**	**561.54**	**422.80 – 744.11**	**20**	**7.64 – 36.30**	**25.97**	**9.91 – 46.25**

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Table E-2. Detections excluded from the 2015 - 2016 estimated fatality analysis at the Genesis Solar Energy Project, Riverside County, California due to 1) having been detected outside of a regular search area 2), having been found during the clearing search or 3) having an estimated carcass age that is twice that of the actual search interval and hence violating assumptions of the Huso estimator.

Parameter	Small birds	Medium birds	Large birds	Bats
Buildings	6	6	0	3
Fence	3	4	0	1
Overhead lines	10	4	0	0
Ponds	11	2	0	0
Power Blocks	8	6	0	0
SCAs	8	23	5	0
Total:	**37**	**45**	**5**	**4**