Data Request Received: 2025-06-06
Request No. 1239
Submitted by: Manzell Payne, manzell.payne@opc.mo.gov

Response Date: 2025-06-26
Witness/Respondent: Shaen Rooney

REQUEST:

ENVIRONMENTAL IMPACTS TO WIND FACILITIES

Please provide internal or consultant reports, environmental assessments, or compliance monitoring related to potential protected species and wind operations from the past five years.

RESPONSE:

DESIGNATED ATTACHMENTS ARE CONFIDENTIAL PURSUANT TO 20 CSR 4240-2.135(2)(A)5

Please see the attached documents that have been submitted to or delivered from the United States Fish and Wildlife Service in-regards to protected species at North Fork Ridge and Kings Point Wind.

Attachments:

2021-03-22_supplemental_documentation_study-plan-final-1
2021-10a1a-annual-report_esper0011726_2021 CONFIDENTIAL
2021-10a1a-annual-report_esper0011726_2021_redacted PUBLIC
2022-10a1a-annual-report_esper0011726 CONFIDENTIAL
2022-10a1a-annual-report_esper0011726_redacted PUBLIC
empire-bo_signed
empireliberty_nepa-catex-ea-statement_final
federal-permit-esper0011726-empire_signed
final_ada_rpt_esper0011726_kpnfr_2024_20250530 CONFIDENTIAL
final_ada_rpt_esper0011726_kpnfr_2024_20250530_redacted PUBLIC

10(a)(1)(A) Permit # ESPER0011726 Annual Report - 2021

Kings Point Wind Project and North Fork Ridge Wind Project

Barton, Dade, Jasper, and Lawrence Counties, Missouri

January 31, 2022

Prepared for:

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Abbreviations

a_i	fraction of ground searched within each distance band
AIC	Akaike information criterion
control	3.0 m/s cut-in speed
CP	carcass persistence
DWP	density-weighted proportion
Empire	Empire District Electric Company
ft	feet
GenEst	Generalized Estimator
g-value	detection probability
I	search interval
k	SE decay
Kings Point	Kings Point Wind Project
m	meters
mph	miles per hour
m/s	meters per second
MW	megawatt
North Fork Ridge	North Fork Ridge Wind Project
p	Searcher efficiency
Permit	10(a)(1)(A) Permit # ESPER0011726
SE	searcher efficiency
TAL	Technical Assistance Letter
treatment	5.0 m/s cut-in speed
USFWS	U. S. Fish and Wildlife Service
v	temporal coverage
WTGs	Wind Turbine Generators
X_i	number of carcasses found within each distance band

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION AND HISTORY

Empire District Electric Company (Empire) developed and is currently operating two wind power facilities in southwest Missouri. Kings Point Wind Project (Kings Point) in Barton, Dade, and Lawrence counties, Missouri consists of 69 Vestas wind turbine generators (WTGs; 12 Vestas V-110 2.0 megawatt [MW], 57 Vestas V-120 2.2-MW) with an approximate capacity of 149.4 MW. North Fork Ridge Wind Project (North Fork Ridge) in Barton County, Missouri has 69 Vestas WTGs (same composition of turbine models as Kings Point) with an approximate capacity of 149.4 MW. These two wind projects are collectively referred to as "the Projects" throughout this report. A map showing the location of the WTGs for the Projects is provided in Appendix A, Figure A-1.

Due to the potential risk of take of the federally endangered gray bat (*Myotis grisescens*) during operations, Empire applied for a Native Endangered Species Recovery Permit under Section 10(a)(1)(A) of the Endangered Species Act (Permit) to evaluate the effectiveness of smart curtailment on reducing gray bat fatality. The application included a study plan outlining a 4-year research study that was developed through coordination with the U.S Fish and Wildlife Service (USFWS) Columbia, Missouri Ecological Services Field Office and the Missouri Department of Conservation (Stantec 2021). The Permit (ESPER0011726) was issued on August 6, 2021. Prior to issuance of the Permit, the Projects operated in accordance with terms outlined in a Technical Assistance Letter (TAL) issued by the USFWS on May 10, 2019 for Kings Point and June 6, 2019 for North Fork Ridge. This report summarizes the operations and monitoring at the Project for 2021 and is intended to satisfy Condition L (Annual Reporting) of the Permit.

1.1.1 Spring and Summer 2021 - TAL

Operations and monitoring during the spring and summer of 2021 were in accordance with the TAL for the Projects. Conditions of the TAL required feathering of all turbine blades below 8.0 meters per second (m/s) when ambient temperature was above 50 degrees Fahrenheit during the gray bat active season (March 1 through November 15) from 30 minutes prior to sunset through 30 minutes after sunrise. Bat fatality monitoring began March 3, 2021 for North Fork Ridge and April 8, 2021 for Kings Point. Bat fatality monitoring included search efforts expected to achieve a detection probability (g-value) of 0.2 based on Evidence of Absence (EofA; Dalthorp et al. 2017). Fatality monitoring included twice weekly searches at all WTGs on graveled roads and pads and 60-m radius cleared plots around WTGs. Searcher efficiency and carcass persistence trials were completed in accordance with the TAL.

1.1.2 Fall 2021 – 10(a)(1)(A)

After receiving the Permit, fatality monitoring and operational curtailment were adjusted, and acoustic monitoring was added at the Projects to begin collecting data to address the research objectives outlined in the study plan for the Permit. Fatality monitoring efforts included an expansion of search plots from 60-m radius cleared plots to 100-m radius cleared plots at 8 WTGs on August 23, 2021. Figures A-2 and A-3 (see Appendix A) show the search plot types for Kings Point and North Fork Ridge, respectively. On September 7, 2021 (Kings Point) and August 30, 2021 (North Fork Ridge) the Projects began operating half of their turbines at 3.0 m/s (control) and half at 5.0 m/s (treatment) cut-in speeds. Figures A-4 and A-5 (see Appendix A) show the control and treatment assignments for Kings Point and North Fork Ridge, respectively. Acoustic bat monitors were installed on WTGs the last 2 weeks of August. Purpose and Objectives of the Study

The goal of this study is to evaluate and understand gray bat fatality rates at wind facilities to develop and test an optimal curtailment strategy for reducing impacts. This will aid in the recovery of the gray bat by providing a basis of understanding for gray bat and wind energy interactions. The study will span 4 years and combines acoustic bat monitoring on WTG nacelles, fatality monitoring beneath WTGs, and operational curtailment treatments applied to WTGs to achieve 4 study objectives:

- Objective 1: Quantify turbine-related fatality rates for gray bats
- Objective 2: Quantify relationship between exposed gray bat activity and fatality
- Objective 3: Quantify effectiveness of blanket curtailment turbine operation (e.g., 5.0 m/s cut-in speed from April 1 – October 31 at temperatures above 50 degrees Celsius, 30 minutes before sunset through 30 minutes after sunrise) for reducing gray bat fatality
- Objective 4: Demonstrate use of nacelle-based acoustic and weather data to optimize turbine operation curtailment and evaluate its effectiveness at reducing gray bat fatality

2.0 METHODS

Survey methods for carcass searches, searcher efficiency (SE) trials, carcass persistence (CP) trials, and acoustic monitoring followed those specified in the TAL, Permit conditions and as outlined in the study plan (Stantec 2021). Post-construction monitoring included the following components:

- Standardized carcass searches to systematically search plots at all WTGs for bat fatalities attributable to the WTGs
- SE trials to estimate the percentage of bat carcasses that were found by the searcher(s)
- CP trials to estimate the persistence time of carcasses on-site before scavengers removed them
- Acoustic monitoring to assess gray bat activity at nacelle height on WTGs and beneath the rotor-sweep

2.1 FIELD METHODS

2.1.1 Standardized Carcass Searches

Standardized carcass searches were completed at 100% of the Projects' WTGs between March 3 and October 29, 2021. Standardized carcass searches consisted of searching the graveled areas of turbine pads and access roads out to 100 m (road and pad searches) and within a 60-m radius of turbines (60-m cleared plot) during spring and summer. The distribution of the search plots during spring and summer was as follows:

- Kings Point – 45 WTGs with road and pad searches, 24 WTGs with 60-m cleared plot searches
- North Fork Ridge – 45 WTGs with road and pad searches, 24 WTGs with 60-m cleared plot searches

After issuance of the Permit, 8 of the 60-m cleared plots were expanded to cover a 100 m radius around the turbines (100-m cleared plots). Searches at the 100-m cleared plots began August 23, 2021. The distribution of the search plots during the fall was as follows:

- Kings Point – 45 WTGs with road and pad searches, 20 WTGs with 60-m cleared plot searches, 4 WTGs with 100-m cleared plot searches
- North Fork Ridge – 45 WTGs with road and pad searches, 20 WTGs with 60-m cleared plot searches, 4 WTGs with 100-m cleared plot searches

[redacted]

Standardized carcass searches were conducted by qualified searchers trained in mortality search methods, including proper handling and reporting of carcasses. Searchers were familiar with and able to accurately identify bat species likely to be found at the Projects. Preliminary bat species identifications were made in the field by qualified staff. When carcass condition allowed, sex and age of the carcass were recorded. Forearm length was recorded to facilitate species identification. In addition to the carcass, photographs and data collected for each carcass were used to verify the species identification. Photos of any unknown bats discovered were sent to a Stantec permitted bat biologist with onsite knowledge and experience for all expected bat species at the Projects for positive identification, and carcasses were kept on-site. Any unknown bat or suspected *Myotis* was identified by a Stantec senior bat biologist who holds a USFWS permit for threatened and endangered bats, and/or sent to the Northern Arizona University's Bat Ecology and Genetics Lab[1] for genetic testing.

During searches, searchers walked at a rate of approximately 2 miles per hour (45 to 60 m per minute) while searching 3 m on either side. For each carcass found, the following data were recorded digitally within Survey123 (ESRI, Redlands, CA):

- Date and time
- Initial species identification (this information was updated as needed based on photos, dentition, or expert opinion)
- Sex, age, and reproductive condition (when applicable; sex was updated based on genetic testing)
- Global positioning system location
- Distance and bearing to turbine
- Condition (intact, scavenged, decomposed)
- Any notes on presumed cause of death

A digital photograph of each carcass next to a ruler for scale was taken before the carcass was handled and removed. All bat carcasses were labeled, bagged, and stored in onsite freezers at the Projects' Operations and Maintenance Buildings. Bat carcasses were collected and retained under Empire's Permit and Missouri Department of Conservation Wildlife Collector's Permit #s: 19236, 19275, 19280, 19278, 19171, 19158, 19247, 19228.

Bat carcasses found in non-search areas were coded as incidental finds and documented in a similar fashion to those found in standardized surveys when possible. These included carcasses found during non-search times or outside the monitoring plot. Incidental bat carcasses were collected and stored in the freezer with the carcasses found during standardized surveys. As per industry standard, incidental finds were not included in the fatality estimates.

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[1] https://in.nau.edu/bat-ecology-genetics/

2.1.2 Searcher Efficiency Trials

SE trials were used to estimate the probability of bat carcass detection by the searchers. There was a total of three SE trials, one per season. The searchers did not know when during the monitoring periods the trials were being conducted, at which turbines trial carcasses were placed, or the location or number of trial carcasses placed in any given search plot. Commercially available dark mouse carcasses were used as trial carcasses to represent bats.

All SE trial carcasses were randomly placed by a field lead within the search plots. These were placed in the morning prior to the planned carcass searches for that day and checked after the SE trial to ensure they had not been scavenged. The number of trial carcasses found by the searcher in each plot was recorded and compared to the total number placed in the plots prior to the SE trial.

2.1.3 Carcass Persistence Trials

A CP trial was conducted to estimate the average length of time carcasses remained in the search plots before being removed by scavengers. Mouse carcasses used during the SE trials were left in place, and their locations were discretely marked (i.e., within Survey123). In addition, separate mouse carcasses were placed for the sole purpose of CP trials. Searchers monitored the placed carcasses for up to 28 days. During the CP trials, carcasses were checked every day for the first week, and then regularly checked until missing or 28 days had passed (i.e., 1, 2, 3, 4, 5, 6, 7, 10, 14, 21, and 28), or until no longer detectable).

The condition of each carcass was recorded during each CP trial check. The conditions recorded were defined as follows:

- Intact – complete carcass with no body parts missing
- Scavenged – carcass with some evidence or signs of scavenging
- Fur spot – no carcass, but fur spot remaining
- Missing – no carcass or fur remaining

2.1.4 Acoustic Monitoring

Wildlife Acoustics (Model SM4BAT FS) acoustic bat detectors with SMM-U1 microphones were mounted on 30 WTG nacelles (height of 120 m) and on the turbine mast (20 m) of 10 WTGs in August. The detectors were set to record echolocation calls of bats that fly in proximity (within approximately 30 m) of the detector microphones from 30 minutes before sunset to 30 minutes after sunset each night. Detector locations are shown in Appendix A, Figures A-6 and A-7.

2.2 DATA ANALYSIS – GENEST

Results include summaries of the raw data, including counts of species, the number of searches conducted, and the average search interval (calculated as the sum of the number of visits to a turbine divided by the number of days within a season).

The Generalized Estimator (GenEst; Dalthorp et al. 2018) was used for calculating bias correction factors (SE, CP, and area adjustment) and the overall fatality rate and fatality estimates for all bats at the Projects. Note that throughout the document some estimates may not correspond exactly with subsets of those estimates (e.g., fatality by species may not add up to total fatality). This is because GenEst generates all estimates as a result of 1,000's of iterations of a model (called "bootstraps"). As each iteration yields slightly different results, different repetitions of the analysis will yield slightly different results.

2.2.1 Searcher Efficiency (p)

Searcher efficiency (p) represents the average probability that a carcass was detected by the searcher. This rate was calculated using the data collected during SE trials (Section 2.1.6) by dividing the number of trial carcasses the observer found by the total number which remained available during the trial (i.e., non-scavenged). Analysis includes an evaluation of whether SE differed by searcher, season (spring, summer, fall), or plot type (roads and pads, cleared plots). SE decay (k) was fixed at 0.67. This value represents the decrease in searcher efficiency (p) on subsequent searches (i.e., if a carcass is missed the first time it is available, it is less likely to be found on subsequent searches than a "fresh" carcass).

GenEst returns numerous models depending on the number of variables included in the analysis, as well as Akaike information criterion (AIC) values for each model. The AIC value is a statistical score for the quality of a model fit, where smaller AIC values are considered better models. However, models within 3-4 ΔAIC (the difference between each models AIC and the AIC of the "best" model) are generally considered indistinguishable by this measure (Dalthorp et al. 2018). Therefore, the best model was chosen based on a manual review of models with the lowest AIC values, and a top model was chosen from the models within 3-4 ΔAIC of the top model based on AIC alone. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.2 Carcass Persistence

CP times modeled in GenEst included using censored exponential, Weibull, lognormal, and loglogistic survival models of the data collected as part of the CP trial (Section 2.1.3). GenEst returns numerous models depending on the number of variables included in the analysis, as well as AIC values for each model. The best model was chosen based on a comparison of models with the lowest AIC values, though similar to SE, models were also graphically evaluated to ensure that they are logical, and the top model was chosen from the models within 3-4 ΔAIC of the top model based on AIC alone. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.3 Density-weighted Proportion

The density-weighted proportion (DWP) was calculated based on several parameters, all of which were limited to road and pad plot types:

$$X_i = number\ of\ carcasses\ found\ within\ distance\ band\ i$$

$$a_i = fraction\ of\ ground\ searched\ within\ distance\ band\ i$$

$$\widehat{M}_i = relative\ mortality\ rate\ in\ each\ ring = \frac{X_i}{a_i}$$

$$\hat{p}(M_i) = fraction\ of\ total\ in\ each\ ring = \widehat{M}_i \,/\, \sum\nolimits_i \widehat{M}_i$$

The number of carcasses found within each distance band (X_i) is a total of carcasses found at various distances. When each carcass was found, searchers recorded the location of the carcass using a sub-meter accuracy global positioning system in a digital datasheet (Collector for ArcGIS). The distance between these locations and the nearest turbine were calculated in GIS.

To determine the fraction of ground searched within each distance band (a_i), the turbine roads and pads were digitized, and the proportion of each distance band that included the road and pad was calculated for each of the 138 turbines out to 100 meters from the turbine base. These values were then averaged across all turbines to determine the percentage of each distance band that was searched on roads and pads. For cleared plot turbines, 100% of the area within 60 meters was searched, and 0% of the area beyond 60 meters was searched except for the 8 100-m cleared plot turbines that were searched beginning in the fall. Given that 35% of turbines had cleared plots and 65% were searched only on roads and pads, the weighted average of these values was calculated for each distance band. It was assumed that all carcasses fell within 100 meters of the turbine base.

Using the turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), a turbine-specific DWP was then calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total for that distance band. This varied by season for some turbines as cleared plots changed due to search protocols and land access.

2.2.4 Adjusted Fatality Estimates (GenEst)

GenEst was used to calculate overall fatality rates for the Projects (per turbine, per MW, for all 69 turbines at Kings Point, and for all 69 turbines at North Fork Ridge). All estimates include 90% confidence intervals. "Per turbine estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the number of turbines (69 turbines), and "per MW estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the total MW (149.4 MW).

Fatality estimates were split by season.

2.3 DATA ANALYSIS – EVIDENCE OF ABSENCE

Evidence of Absence (EofA; Dalthorp et al. 2017) was used for estimating the overall detection probability (g) and the estimated take of gray bats (M and λ).

2.3.1 Estimation of Detection Probability (g)

For analysis of the 2021 data, Stantec used the “Multiple Class Module” to combine data from the two search classes (roads and pads and cleared plots) and across the three seasons (spring, summer, and fall). Site-specific monitoring data were used to calculate the g-value for each search class, including the following inputs:

- Search interval (I), calculated as the average time between searches per plot type
- Number of searches, calculated as the average number of times each turbine per plot type was visited
- Temporal coverage (v), set to 1 for the summer and 0.95 for spring and fall since monitoring occurred during the entire period of risk during the summer, and on-site pre-construction acoustic data suggests 95% of gray bat activity occurs after March in the spring and before November in the fall
- SE, calculated using the “carcasses removed after one search” option and inputting the total number of carcasses available and found per plot type and season across all searchers
- Factor by which SE changes with each search (k) was fixed at 0.67
- CP distribution, calculated using field trials to estimate the parameters, and the top model was selected based on results from within EofA.

This input was done for both road and pad searches and for cleared plots to calculate the detection probability (g) within those searched areas. Within the Multiple Class Module, the fraction of total carcasses arriving within each class needs to be assigned to the DWP column. This differs from the DWP calculated in Section 2.2.3, which is the proportion of bats expected to fall within the searched area at a particular turbine, whereas this DWP is the proportion of bats expected to fall within that class. The DWP was calculated for each of the plot types, as well as for an “unsearched” class to account for carcasses that fall outside of the searched area. The DWPs of these three classes (roads and pads, cleared plots and unsearched) must sum to one. The DWPs for roads and pads and cleared plots were calculated based on the DWPs calculated for the turbines within those plots (Section 2.2.3), using the average DWP for the plot type and multiplying it by the proportion of turbines within that plot type. The unsearched class was then calculated as one minus the sum of the DWPs for the searched areas.

Once these inputs were complete, the “Estimate overall detection probability (g)” option was chosen, and the overall detection probability for the survey period was calculated.

3.0 RESULTS

Fatality monitoring was completed for both Kings Point and North Fork Ridge. From March 1 – September 7, 2021 (Kings Point) and March 1 – August 30, 2021 (North Fork Ridge) the WTGs were operating as specified in the TAL (cut-in >8.0 m/s). For the Fall season, both Projects operated under the conditions of the Permit with WTGs at either control cut-in speed (3.0 m/s) or treatment cut-in speed (5.0 m/s). Results for both Projects are presented individually below.

3.1 KINGS POINT

3.1.1 Carcass Searches

A total of 4,046 searches were conducted between April 8 and October 29, under TAL-level monitoring (April 8 – August 22, 2021; 24 60-m cleared plots and 45 road and pad plots) and Permit-level monitoring (August 23 – October 29, 2021; 20 cleared plots to 60 m, 4 cleared plots to 100 m, and 45 roads and pads). Prior to September 7, 2021, the turbines did not operate at night (30 min prior to sunset, 30 min after sunrise) when wind speeds were less than 8.0 m/sec and air temperature was above 50°F. A summary of search effort with total numbers of bats found is presented in Table 3-1.

Table 3-1. Summary of post-construction monitoring conducted between April 8 and October 29, 2021, at Kings Point Wind Project, Barton, Dade, and Lawrence counties, Missouri.

Season	Dates	Number of Searches Conducted	Average Search Interval[1]	Number of bats found in standardized searches	Number of bats found incidentally
Spring (TAL-level monitoring)	April 8 – May 31	1,020	3.65	19	5
Summer (TAL-level monitoring)	June 1 – August 31	1,863	3.40	19	0
Fall (Permit-level monitoring)	September 1 – October 29	1,163	3.62	27	0
Total	April 8 – October 29	4,046	3.53	65	5

A total of 65 bat carcasses were found during standardized carcass searches, and 5 bat carcasses were found incidentally.

3.1.2 Species Composition

A summary of all bat carcasses found during the standardized carcass searches is shown in Table 3-2.

Table 3-2. Summary of bat carcasses found during standardized carcass searches between April 8 and October 29, 2021, during post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Lawrence counties, Missouri.

	Count and Proportion			
	Season			
Species	**Spring**	**Summer**	**Fall**	**Total**
Eastern Red Bat *Lasiurus borealis*	11 57.9%	16 84.2%	17 63.0%	44 67.7%
Evening Bat *Nycticeius humeralis*	2 10.5%	0 0	0 0	2 3.1%
Gray Bat[1, 2] *Myotis grisescens*	0 0	1 5.3%	3 11.1%	4 6.2%
Hoary Bat[1] *Lasiurus cinereus*	3 15.8%	2 10.5%	2 7.4%	7 10.8%
Silver-haired Bat[1] *Lasionycteris noctivagans*	0 0	0 0	4 14.8%	4 6.2%
Tricolored Bat[1] *Perimyotis subflavus*	0 0	0 0	1 3.7%	1 1.5%
Unknown (not Myotis)	3 15.8%	0 0	0 0	3 4.6%
Total	19 29.2%	19 29.2%	27 41.5%	65

[1]Missouri Department of Conservation Species of Conservation Concern
[2]State and Federal listed Endangered

A total of 65 bat carcasses were found during standardized carcass searches, 62 of which were identified to the species level. The three unknown bats were determined to not be a *Myotis* species, and therefore were not genetically identified to the species level. Of the 65 bat carcasses, the most common species found was the eastern red bat (*Lasiurus borealis*; 44 individuals). The hoary bat (*Lasiurus cinereus*; 7) was the second most common species followed by gray bat and silver-haired bat (*Lasionycteris* *noctivagans*) with 4 carcasses each. Incidental finds included 5 bat carcasses during the spring monitoring period: 4 eastern red bats and 1 hoary bat.

3.1.3 Searcher Efficiency

SE trials were conducted during the post-construction monitoring during all three seasons (spring, summer, and fall). Data were analyzed in GenEst, with searcher, season, and plot type as the three predictor variables. The selected model included season, searcher, and plot type as the predictors (Table 3-3). Selected model is shown in bold. The model with the lowest AIC was not selected because it was not significantly different from a simpler model.

Table 3-3. Model comparison results from the top five models for searcher efficiency trials conducted between March 1 and October 31, 2021, at the Kings Point Wind Project, Barton, Dade, and Lawrence counties, Missouri. Selected model shown in bold.

Formula/Model	k	AIC_c	ΔAIC_c
p ~ searcher + plot_type + season + plot_type:season	0.67	226.24	0
p ~ searcher + plot_type + season	**0.67**	**226.64**	**0.4**
p ~ searcher + plot_type + season + searcher:plot_type + plot_type:season	0.67	229.42	3.18
p ~ searcher + plot_type + season + searcher:plot_type	0.67	230.68	4.44
p ~ searcher + season	0.67	232.18	5.94

Searcher efficiency was tested using a total of 141 trial carcasses. Based on the results of the top model, searcher efficiency ranged from 39.6% to 92.9% on cleared plots and ranged from 62.3% to 97.1% on roads and pads for all seasons (Table 3-4). There was variability among searchers, season, and plot type, but searcher efficiency was generally higher on road and pad plots than on cleared plots and higher during fall than the spring and summer seasons.

Table 3-4. Searcher efficiency during 2021 post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri.

Season	Observer	Cleared Plots		Road and Pad Plots	
		Trial Carcasses	Searcher Efficiency (90% CI)	Trial Carcasses	Searcher Efficiency (90% CI)
Spring	1	10	0.558 (0.394 - 0.709)	10	0.761 (0.615 - 0.864)
	2	10	0.396 (0.256 - 0.555)	10	0.623 (0.463 - 0.760)
	3	10	0.929 (0.705 - 0.986)	10	0.971 (0.853 - 0.995)
Summer	1	8	0.596 (0.427 - 0.745)	11	0.788 (0.650 - 0.882)
	2	10	0.434 (0.287 - 0.593)	12	0.659 (0.507 - 0.785)
Fall	1	10	0.818 (0.679 - 0.905)	10	0.919 (0.834 - 0.963)
	2	10	0.700 (0.536 - 0.826)	10	0.855 (0.735 - 0.926)

3.1.4 Carcass Persistence

The top five models for CP in GenEst included only lognormal distributions, with effects of season and/or plot type (Table 3-5). The five best models assumed a lognormal distribution. We selected the model with the lowest AIC which was both the best model and was also the most parsimonious. The selected model is highlighted below.

Table 3-5. Model comparison results from the top five models for carcass persistence trials conducted between March 1 and October 31, 2021, at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AIC_c	ΔAIC_c
lognormal	**l ~ season**	**s ~ season**	**475.4**	**0**
lognormal	l ~ plot_type + season	s ~ season	477.12	1.72
lognormal	l ~ season	s ~ plot_type + season	477.48	2.08
lognormal	l ~ season	s ~ constant	478.66	3.26
lognormal	l ~ plot_type + season	s ~ plot_type + season	479.27	3.87

CP was tested using 122 carcasses across the three seasons. The shortest carcass persistence observed was in the summer, when carcass persistence averaged 2.5 days, compared to spring which averaged 5.5 days and fall which averaged 2.8 days (Table 3-6).

Table 3-6. Carcass persistence during 2021 post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri.

Season	Trial Carcasses	Carcass Persistence (90% CI)
Spring	40	5.49 (4.62 - 6.52)
Summer	42	2.51 (1.93 - 3.27)
Fall	40	2.83 (2.36 - 3.40)

3.1.5 Density-weighted Proportion (DWP)

The 25 bat carcasses found during standardized road and pad searches during the full survey were used to calculate the DWP (Table 3-7).

Table 3-7. Calculation of the Density-weighted Proportion (DWP) at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri based on bat carcasses found between April 8 and October 29, 2021.

Distance Band (meters)	Number of Carcasses	Fraction of Area Searched (%)	Relative Fatality Rate	Fraction of Total (%)	Cumulative Percent of Carcasses
0-10	1	45.3	2.2	0.3	0.3
10-20	1	7.8	12.9	2.0	2.3
20-30	2	7.8	25.7	3.9	6.2
30-40	6	6.0	99.9	15.2	21.4
40-50	4	4.2	94.8	14.4	35.8
50-60	3	3.3	91.2	13.9	49.7
60-70	3	2.6	113.8	17.3	67.0
70-80	5	2.3	216.6	33.0	100.0
80-90	0	2.0	0	0	100.0
90-100	0	1.7	0	0	100.0

Therefore, based on data from carcasses found, it is assumed that 49.7% of all bat carcasses fall within 60 meters of the turbine base and within the 60 m cleared plot searches, and 50.3% fall beyond the 60 m cleared plots.

Using the turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), a turbine-specific DWP was then calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total for that distance band. Therefore, all cleared plot turbines have a DWP of 49.7%, and the DWP for road and pad turbines ranges from 2.3% to 6.2%.

3.1.6 Adjusted Fatality Estimates

Fatality rate estimates were calculated based upon the carcasses found during the standardized carcass searches and did not include any incidental finds. Observed bat mortality estimates were adjusted to account for SE, CP, the search schedule, and the turbine-specific DWPs.

3.1.6.1 Seasonal Fatality Estimates

The total estimated fatality by season is summarized in Table 3-8 and detailed in the following sections.

Table 3-8. Bat fatality rates by season from 2021 post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities
Spring	March 1 – May 31	223.63 (99.83 - 409.17)	3.24 (1.45 - 5.93)	1.50 (0.67 - 2.74)
Summer	June 1 – August 31	541.31 (276.41 - 867.91)	7.85 (4.01 - 12.58)	3.62 (1.85 - 5.81)
Fall	September 1 – November 15	572.17 (307.55 - 919.68)	8.29 (4.46 - 13.33)	3.83 (2.06 - 6.16)
Annual	March 1 – November 15	1,364.95 (950.72 – 1,888.13)	19.78 (13.77 - 27.36)	9.14 (6.36 - 12.64)

A total of 19 bat carcasses were found during standard carcass searches in the spring monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the spring search schedule, results in an overall bat fatality estimate of 223.63 bats (90% CI: 99.83 – 409.17) across all 69 turbines between April 8 and May 31, 2021 – equivalent to 3.24 bats/turbine (90% CI: 1.45 – 5.93) or 1.50 bats/MW (90% CI: 0.67 – 2.74).

A total of 19 bat carcasses were found during standard carcass searches in the summer monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the summer search schedule, results in an overall bat fatality estimate of 541.31 bats (90% CI: 276.41 – 867.91) across all 69 turbines between June 1 and August 31, 2021 – equivalent to 7.85 bats/turbine (90% CI: 4.01 – 12.58) or 3.62 bats/MW (90% CI: 1.85 – 5.81).

At the beginning of the fall period until September 7 ,2021, the turbines operated under TAL conditions. From September 7 through the end of the fall period, turbines operated at either 3.0 m/s or 5.0 m/s cut-in speeds as summarized in Appendix A, Figure A-4. A total of 27 bat carcasses were found during standard carcass searches in the fall monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the fall search schedule, results in an overall bat fatality estimate of 572.17 bats (90% CI: 307.55 – 919.68) across all 69 turbines between September 1 and October 31, 2021 – equivalent to 8.29 bats/turbine (90% CI: 4.46 – 13.33) or 3.83 bats/MW (90% CI: 2.06 – 6.16).

Across all three survey seasons, 65 carcasses were found during standardized searches. Annual fatality estimates, combining all seasons, result in an overall bat fatality estimate of 1,364.95 bats (90% CI: 950.72 – 1,888.13) across all 69 turbines between March 1 and November 15, 2021 – equivalent to 19.78 bats/turbine (90% CI: 13.77 – 27.36) or 9.14 bats/MW (90% CI: 6.36 – 12.64).

3.1.7 Gray Bat Fatality Estimates

3.1.7.1 In-hand Fatalities

Stantec found four gray bats during post-construction fatality monitoring at Kings Point. No other federal or state endangered species were found. The locations of these four gray bat fatalities are shown in **Error! Reference source not found.**A, Figure A-8. Sex of the gray bats found was confirmed through genetic analysis (see Appendix B).Female gray bats were found on 8/16, 9/23, and 9/24 and a male gray bat was found on 9/16.

3.1.7.2 Evidence of Absence

The "Multiple Classes" module was used in EofA. Because searcher efficiency and carcass persistence varied by season and plot type, the module was run four times: once for each season (with separate classes for each plot type plus an unsearched proportion), and once for the entire year (with separate classes for each season, and no unsearched portion since proportion of fatalities occurring outside of searched times was accounted for in each of the seasonal runs).

Detection Probability (g)

The detection probability for the post-construction monitoring season (March 1 – November 15, 2021) was 0.118 (95% CI: 0.100 to 0.137); however, this varied by season as summarized in Table 3-99.

Table 3-9. Summary of detection probability (g) by season and overall, during 2021 post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri.

Season	Detection Probability (g) and 95% CI
Spring	0.146 (0.120 – 0.173)
Summer	0.080 (0.050 – 0.113)
Fall	0.144 (0.112 – 0.179)
Total/Overall	**0.118 (0.100 – 0.137)**

3.1.7.3 **Fatality Estimates (M* and λ)**

Analysis in the EofA "Multiple Years Module" included calculation of the following for gray bats:

- Annual Take Estimate (M_{2021})
- Annual take rate (λ)
- Number of Detected Fatalities (X)

Results are summarized in Table 3-1010.

Table 3-10. Summary of EofA outputs for gray bats from 2021 post-construction monitoring at the Kings Point Wind Project, Barton, Dade, and Jasper counties, Missouri. Analysis done with α=0.5.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2021})	Annual Take Rate (λ) (95% CI)
Gray Bat	4	35	38.6 (11.40 – 82.62)

3.1.8 Acoustic Monitoring

Bat detectors were installed on the nacelles of 15 WTGs during the last two weeks of August, 2021 and 20 m up on the mast of 5 WTG's on August 4, 2021. Nacelle units were demobilized from November 15 through the first week of December, 2021. Mid-tower units were demobilized on December 20, 2021. Preliminary results suggest ~368,000 files were recorded across all units. Analysis of acoustic data is ongoing.

3.2 NORTH FORK RIDGE

3.2.1 Carcass Searches

A total of 4,750 searches were conducted between March 3 and October 29, under TAL-level monitoring (March 3 – August 22, 2021; 24 cleared plots out to 60 m and 45 roads and pads) and Permit-level monitoring (August 23 – October 29, 2021; 20 cleared plots to 60 m, 4 cleared plots to 100 m, and 45 roads and pads). Prior to August 30, 2021, the turbines did not operate at night (30 min prior to sunset, 30 min after sunrise) when wind speeds were less than 8.0 m/sec and air temperature was above 50°F. A summary of search effort with total numbers of bats found is presented in Table 3-1.

Table 3-11. Summary of post-construction monitoring conducted between March 3 and October 31, 2021, at North Fork Ridge Wind Project, Barton and Jasper Counties, Missouri.

Season	Dates	Number of Searches Conducted	Average Search Interval[1]	Number of bats found in standardized searches	Number of bats found incidentally
Spring (TAL-level monitoring)	March 3 – May 31	1,738	3.57	16	2
Summer (TAL-level monitoring)	June 1 – August 31	1,840	3.45	23	3
Fall (Permit-level monitoring)	September 1 – October 29	1,172	3.59	32	2

Season	Dates	Number of Searches Conducted	Average Search Interval[1]	Number of bats found in standardized searches	Number of bats found incidentally
Total	March 3 – October 29	4,750	3.53	71	7

A total of 71 bat carcasses were found during standardized carcass searches, and 7 bat carcasses were found incidentally.

3.2.2 Species Composition

A summary of all bat carcasses found during the standardized carcass searches is shown in Table 3-2.

Table 3-12. Summary of bat carcasses found during standardized carcass searches between March 3 and October 29, 2021, during post-construction monitoring at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri.

	Count and Proportion			
	Season			
Species	**Spring**	**Summer**	**Fall**	**Total**
Big Brown Bat *Eptesicus fuscus*	0 0	1 4.3%	0 0	1 1.4%
Eastern Red Bat *Lasiurus borealis*	10 62.5%	16 69.6%	25 78.1%	51 71.8%
Evening Bat *Nycticeius humeralis*	3 18.8%	0 0	0 0	3 4.2%
Hoary Bat[1] *Lasuirus cinereus*	3 18.8%	6 26.1%	4 12.5%	13 18.3%
Silver-haired Bat[1] *Lasionycteris noctivagans*	0 0	0 0	3 9.4%	3 4.2%
Total	16 22.5%	23 33.4%	32 45.1%	71

[1]Missouri Department of Conservation Species of Conservation Concern
[2]State and Federal listed Endangered

A total of 71 bat carcasses were found during standardized carcass searches, all of which were identified to the species level. Of the 71 bat carcasses, the most common species found was the eastern red bat (*Lasiurus borealis*; 51 individuals). The hoary bat (*Lasiurus cinereus*; 13) was the second most common species. Next were the silver-haired bat (*Lasionycteris noctivagans*) and evening bat (*Nycticeius humeralis*) with 3 carcasses each. Lastly, one big brown bat (*Eptesicus fuscus*) was found during standard carcass searches. Incidental finds included 5 bat carcasses during the spring monitoring period: 4 eastern red bats and 1 hoary bat.

3.2.3 Searcher Efficiency

SE trials were conducted during the post-construction monitoring during all three seasons (spring, summer, and fall). Data were analyzed in GenEst, with searcher, season, and plot type as the three predictor variables. The selected model included season, searcher, and plot type as the predictors (Table 3-13). Selected model is shown in bold. The model with the lowest AIC was not selected for comparability with Kings Point, because searcher was artificially de-valued as a result of post-hoc calculated searcher efficiencies, and because the model types were not appreciably different.

Table 3-13. Model comparison results from the top five models for searcher efficiency trials conducted between March 1 and October 31, 2021, at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri. Selected model shown in bold.

Formula/Model	k	AIC_c	ΔAIC_c
p ~ plot_type + season	0.67	371.3	0
p ~ searcher + plot_type + season	**0.67**	**372.86**	**1.56**
p ~ plot_type + season + plot_type:season	0.67	374.62	3.32
p ~ searcher + plot_type + season + plot_type:season	0.67	376.28	4.98
p ~ searcher + plot_type + season + searcher:plot_type	0.67	383.51	12.21

Based on the results of the top model, searcher efficiency ranged from a low of 39.6% on cleared plots in the summer to a high of 97.1% on roads and pads in the spring (Table 3-14Table 3-4). Searcher efficiency was tested using a total of 141 trial carcasses.

Table 3-14. Searcher efficiency during 2021 post-construction monitoring at North Fork Ridge Wind Project, Barton and Jasper counties, Missouri.

Season	Observer	Cleared Plots		Roads and Pads	
		Trial Carcasses	Searcher Efficiency (90% CI)	Trial Carcasses	Searcher Efficiency (90% CI)
Spring	1	10	0.783 (0.645 – 0.878)	10	0.963 (0.921 – 0.983)
	2	10	0.703 (0.552 – 0.820)	9	0.944 (0.888 – 0.943)
	3	10	0.384 (0.210 – 0.595)	10	0.816 (0.647 – 0.915)
	4	10	0.373 (0.199 – 0.586)	9	0.808 (0.632 – 0.912)
Summer	1	9	0.313 (0.190 – 0.468)	9	0.764 (0.624 – 0.863)
	2	10	0.230 (0.135 – 0.362)	10	0.679 (0.530 – 0.799)
Fall	1	10	0.579 (0.420 – 0.723)	10	0.907 (0.827 – 0.952)
	2	10	0.474 (0.327 – 0.625)	10	0.865 (0.765 – 0.926)

3.2.4 Carcass Persistence

The top five models for CP in GenEst included only lognormal distributions, with effects of season and/or plot type (Table 3-5). The five best models assumed a Weibull distribution. We selected the model with the lowest AIC which was both the best model and was also relatively parsimonious. The selected model is highlighted below.

Table 3-15. Model comparison results from the top five models for carcass persistence trials conducted between March 1 and October 31, 2021, at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AIC_c	ΔAIC_c
Weibull	**l ~ plot_type**	**s ~ season**	**467.05**	**0**
Weibull	l ~ constant	s ~ season	467.06	0.01

Distribution	Location Formula	Scale Formula	AIC_c	ΔAIC_c
Weibull	l ~ season	s ~ season	468.86	1.81
Weibull	l ~ plot_type + season	s ~ season	468.97	1.92
Weibull	l ~ constant	s ~ plot_type + season	469	1.95

CP was tested using 119 carcasses across the three seasons. The shortest carcass persistence observed was in the fall on roads and pads when carcass persistence averaged 2.42 days (Table 3-16). Carcass persistence in the spring ranged from 2.81 days on roads and pads to 3.54 days on full cleared plots. Summer carcass persistence ranged from 2.84 days on roads and pads to 3.57 on full cleared plots.

Table 3-16. Carcass persistence during 2021 post-construction monitoring at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri.

Season	Cleared Plots		Roads and Pads	
	Trial Carcasses	Carcass Persistence (days; 90% CI)	Trial Carcasses	Carcass Persistence (days; 90% CI)
Spring	20	3.54 (2.90 – 4.32)	19	2.81 (2.28 – 3.46)
Summer	20	3.57 (2.87 – 4.39)	20	2.84 (2.32 – 3.46)
Fall	20	3.04 (2.44 – 3.73)	20	2.42 (1.92 – 2.99)

3.2.5 Density-weighted Proportion (DWP)

The 27 bat carcasses found during standardized road and pad searches during the full survey were used to calculate the DWP (Table 3-7).

Table 3-17. Calculation of the Density-weighted Proportion (DWP) at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri based on bat carcasses found between March 3 and October 29, 2021.

Distance Band (meters)	Number of Carcasses	Fraction of Area Searched (%)	Relative Fatality Rate	Fraction of Total (%)	Cumulative Percent of Carcasses
0-10	0	45.3	0.0	0.0	0.0
10-20	4	8.7	46.2	5.2	5.2
20-30	1	6.5	15.4	1.7	6.9
30-40	2	5.1	39.3	4.4	11.4
40-50	4	3.6	112.4	12.7	24.0
50-60	6	3.1	196.3	22.1	46.2
60-70	2	2.4	84.0	9.5	55.7
70-80	5	2.1	238.8	26.9	82.6
80-90	3	1.9	154.3	17.4	100.0
90-100	0	1.6	0.0	0.0	100.0

Therefore, based on data from carcasses found in summer 2021, it is assumed that 46.2% of all bat carcasses fall within 60 meters of the turbine base and within the 60 m cleared plot searches, and 53.8% fall beyond the 60 m cleared plots.

Using the turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), a turbine-specific DWP was then calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total for that distance band. Therefore, all cleared plot turbines have a DWP of 55.6%, and the DWP for road and pad turbines ranges from 2.1% to 6.0%.

3.2.6 Adjusted Fatality Estimates

Fatality rate estimates were calculated based upon the carcasses found during the standardized carcass searches and did not include any incidental finds. Observed bat mortality estimates were adjusted to account for SE, CP, the search schedule, and the turbine-specific DWPs.

3.2.6.1 Seasonal Fatality Estimates

The total estimated fatality by season is summarized in Table 3-8 and detailed in the following sections.

Table 3-18. Bat fatality rates by season from 2021 post-construction monitoring at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities
Spring	March 1 – May 31	401.59 (205.03 – 657.59)	5.82 (2.97 – 9.53)	2.69 (1.37 – 4.40)
Summer	June 1 – August 31	809.51 (459.03 – 1,271.58)	11.73 (6.65 – 18.43)	5.42 (3.07 – 8.51)
Fall	September 1 – November 15	566.32 (317.46 – 931.64)	8.21 (4.60 – 13.50)	3.79 (2.12 – 6.24)
Annual	March 1 – November 15	1826.1 (1296.99 – 2,446.17)	26.47 (18.8 - 35.45)	12.22 (8.68 - 16.37)

A total of 16 bat carcasses were found during standard carcass searches in the spring monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the spring search schedule, results in an overall bat fatality estimate of 401.59 bats (90% CI: 205.03 – 657.59) across all 69 turbines between March 3 and May 31, 2021 – equivalent to 5.82 bat/turbine (90% CI: 2.97 – 9.53) or 2.69 bat/MW (90% CI: 1.37 – 4.40).

A total of 23 bat carcasses were found during standard carcass searches in the summer monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the summer search schedule, results in an overall bat fatality estimate of 809.51 bats (90% CI: 459.03 – 1,271.58) across all 69 turbines between June 1 and August 31, 2021 – equivalent to 11.73 bats/turbine (90% CI: 6.65 – 18.46) or 5.42 bats/MW (90% CI: 3.07 – 8.51).

At the end of the summer period on August 30, 2021, the turbines switched from operating under TAL conditions to operating at either 3.0 m/s or 5.0 m/s cut-in speeds as specified in the Permit. A total of 32 bat carcasses were found during standard carcass searches in the fall monitoring period. Applying the SE rates, CP rates, turbine-specific DWPs, and the fall search schedule, results in an overall bat fatality estimate of 566.32 bats (90% CI: 317.46 – 931.64) across all 69 turbines between September 1 and October 31, 2021 – equivalent to 8.21 bats/turbine (90% CI: 4.60 – 13.50) or 3.79 bat/MW (90% CI: 2.12 – 6.24).

Across all three survey seasons, 71 carcasses were found during standardized searches. Annual fatality estimates, combining all seasons, result in an overall bat fatality estimate of 1,826.10 bats (90% CI: 1,296.99 – 2,446.17) across all 69 turbines between March 1 and November 15, 2021 – equivalent to 26.47 bats/turbine (90% CI: 18.80 – 35.45) or 12.22 bats/MW (90% CI: 8.68 – 16.37).

3.2.7 Gray Bat Fatality Estimates

3.2.7.1 In-hand Fatalities

Stantec found no gray bats during post-construction fatality monitoring at North Fork Ridge. No other federal or state endangered species were found.

3.2.7.2 Evidence of Absence

The "Multiple Classes" module was used in EofA. Because searcher efficiency and carcass persistence varied by season and plot type, the module was run four times: once for each season (with separate classes for each plot type plus an unsearched proportion), and once for the entire year (with separate classes for each season, and no unsearched portion since proportion of fatalities occurring outside of searched times was accounted for in each of the seasonal runs).

Detection Probability (g)

The detection probability for the post-construction monitoring season (March 1 through November 15, 2021) was 0.0.067 (95% CI: 0.050 to 0.086); however, this varied by season as summarized in Table 3-19.

Table 3-19. Summary of detection probability (g) by season and overall, during 2021 post-construction monitoring at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri.

Season	Detection Probability (g) and 95% CI
Spring	0.121 (0.100 – 0.143)
Summer	0.047 (0.022 – 0.080)
Fall	0.074 (0.048 – 0.105)
Total/Overall	**0.067 (0.050 – 0.086)**

3.2.7.3 Fatality Estimates (M* and λ)

Analysis in the EofA "Multiple Years Module" included calculation of the following for gray bats:

- Annual Take Estimate (M_{2021})
- Annual take rate (λ)
- Number of Detected Fatalities (X)

Results are summarized in Table 3-20.

Table 3-20. Summary of EofA outputs for gray bats from 2021 post-construction monitoring at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri. Analysis done with α=0.5.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2021})	Annual Take Rate (λ) (95% CI)
gray bat	0	3	7.66 (0.01 – 38.88)

3.2.8 Acoustic Monitoring

Bat detectors were installed on the nacelles of 15 WTGs during the last two weeks of August, 2021 and 20 m up on the mast of 5 WTG's on August 4, 2021. Nacelle units have yet to be demobilized as of the submission of this report. Mid-tower units were demobilized on December 20, 2021. Acoustic data have not yet been processed.

4.0 DISCUSSION

The results of this first year of bat fatality monitoring for the Projects were presented by season and provide insight into how future monitoring may need to be adjusted to achieve the study goals. The Permit was not issued until late in the summer, therefore only the fall season of monitoring includes data collection methods that will contribute to the study objectives. The spring and summer seasons do, however, provide useful information, particularly carcass persistence and distributions of carcasses around turbines (i.e., DWP), which should be assessed to adjust monitoring methods for the 2022 surveys.

Total bat mortality (all species combined) was higher at North Fork Ridge than at Kings Point; however, gray bat fatalities were only observed at Kings Point. Although no gray bat fatalities were recorded at North Fork Ridge, the EofA annual take estimate was 3 gray bats which is much lower than the annual take estimate of 35 gray bats at Kings Point. This was expected since higher gray bat activity was recorded at Kings Point during pre-construction surveys. Annual take estimates for the Projects are within the limits covered by the Permit.

The Projects' predicted g-values were below the estimated 0.2 target, possibly for a variety of reasons. Searcher efficiency was less than anticipated, carcass persistence times were shorter than expected, and the DWP value was lower than expected based on assumptions made in the study plan (Stantec 2021). The WTGs at the Projects are taller than at other projects where studies have occurred, which may explain the differences measured for DWP. Adjusting the total search area could increase DWP values and adjusting the search interval such that it is less than the average carcass persistence times will result in an increased g-value.

The acoustic data recorded from the WTGs have not yet been analyzed, but when paired with weather data will be useful in understanding gray bat exposure at the Projects. Those analyses are ongoing and results will be presented in the 2022 annual report along with the first full-year of Permit-level monitoring results.

5.0 REFERENCES

Dalthorp, D.H., J. Simonis, L. Madsen, M.M. Huso, P. Rabie, J.M. Mintz, R. Wolpert, J. Studyvin, F. Korner-Nievergelt. 2018. Generalized Mortality Estimator (GenEst) - R code & GUI: U.S. Geological Survey Software Release. Available at https://doi.org/10.5066/P9O9BATL.

Stantec. 2021. 10(a)(1)(A) Permit Application Study Plan - Kings Point & North Fork Ridge Wind Projects. *Activity-based Informed Curtailment Study*. Prepared for: Kings Point Wind Project, LLC, North Fork Ridge Wind Project, LLC. February 2, 2021.

Appendix A FIGURES

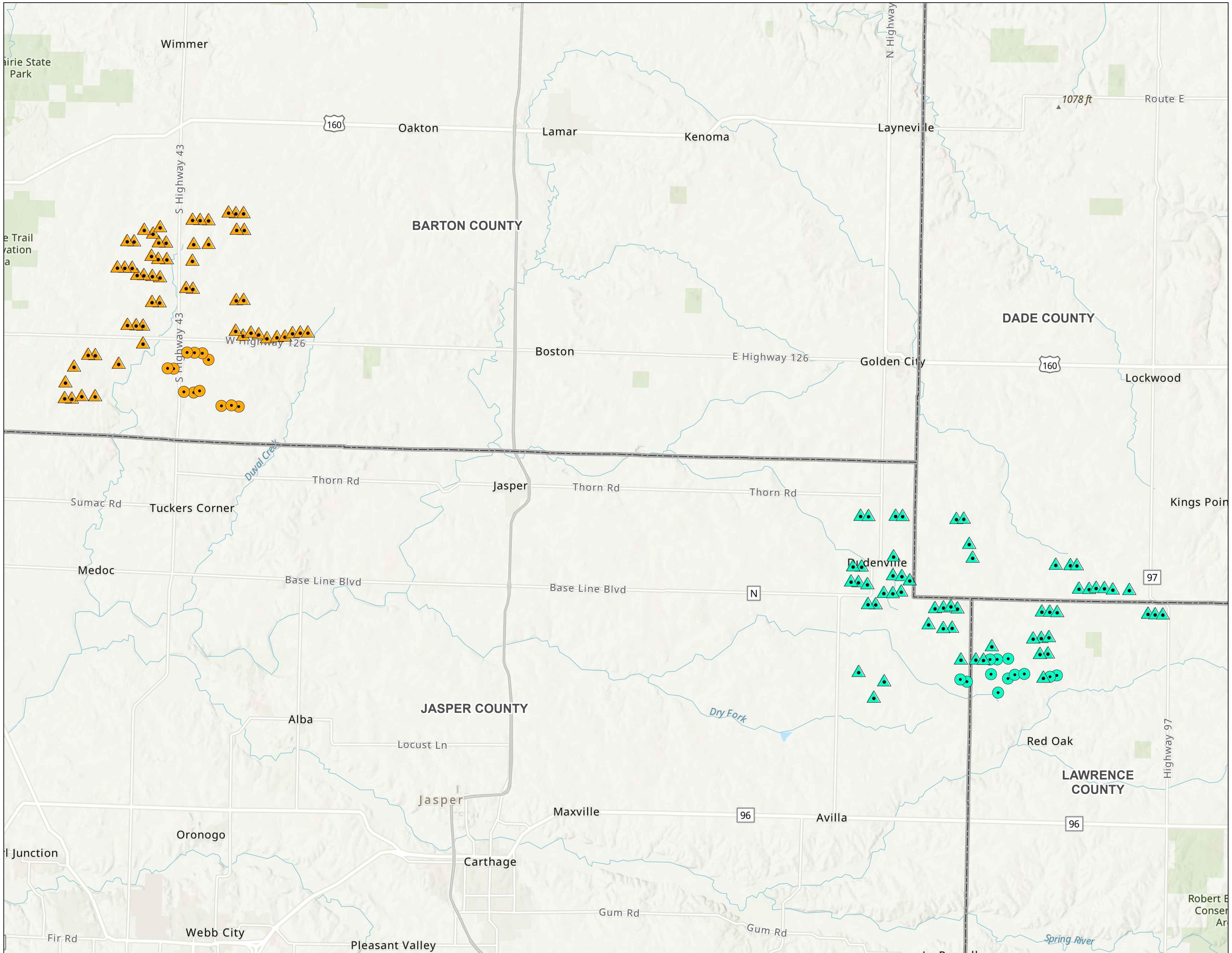

Figure No.

A-1

Title

Kings Point and North Fork Ridge Wind Project Locations

Client/Project 193708398

Empire District Electric Company
Kings Point Wind Project
North Fork Ridge Wind Project

Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 1.5 3 Miles
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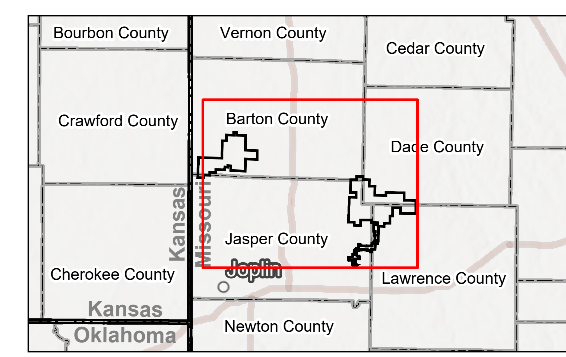
1:190,080

Legend

Kings Point Wind Turbine
- Vestas 110 2.0 MW
- Vestas 120 2.2 MW

North Fork Ridge Wind Turbine
- Vestas 110 2.0 MW
- Vestas 120 2.2 MW



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: Esri Topographic

Stantec

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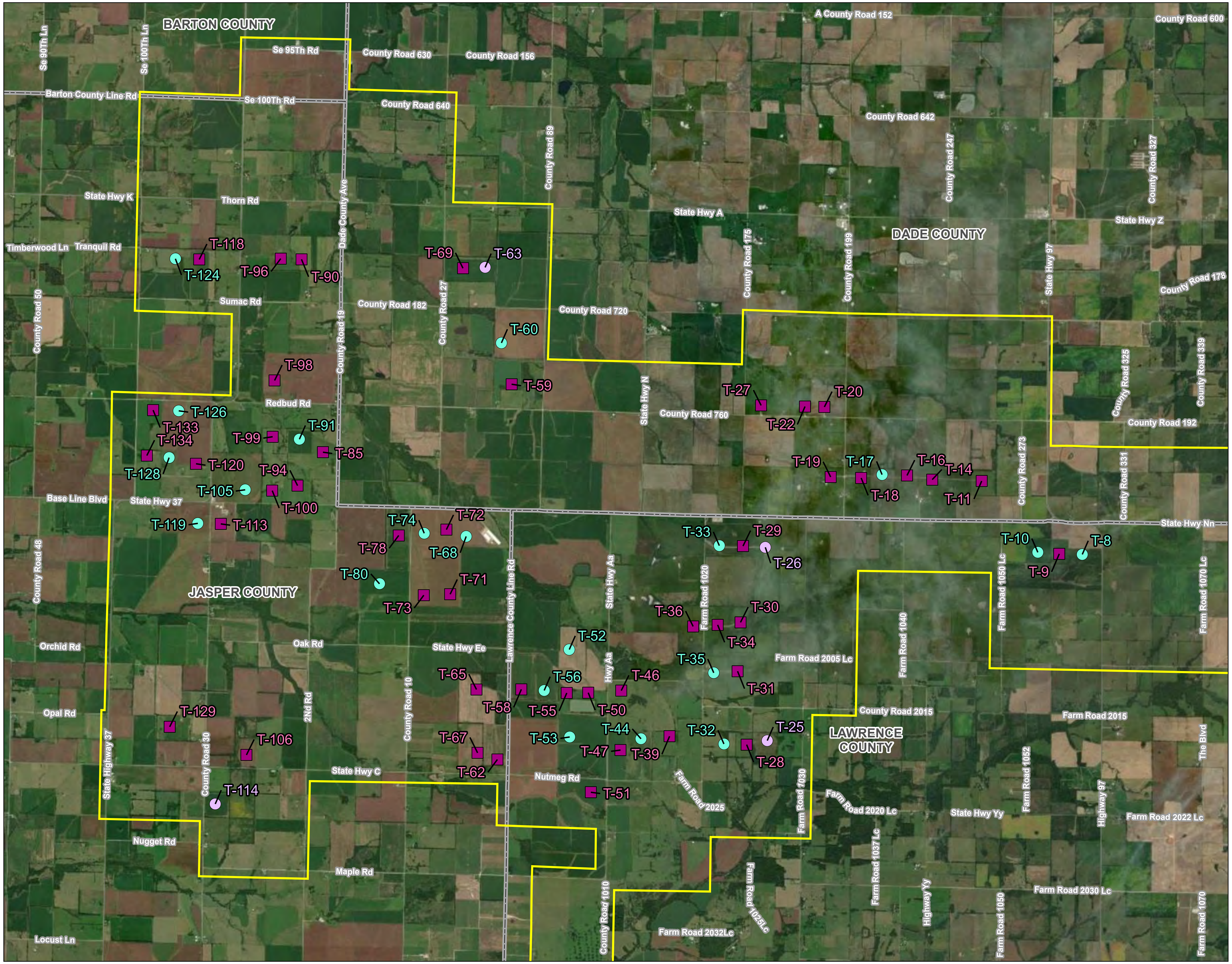


Figure No.

A-2

Title

Kings Point Post Construction Fatality Monitoring Turbine Search Plot Type

Client/Project 193708398

Empire District Electric Company
Kings Point Wind Project

Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 0.5 1 Miles
(At original document size of 11x17)
1:63,360

Legend

Project Boundary

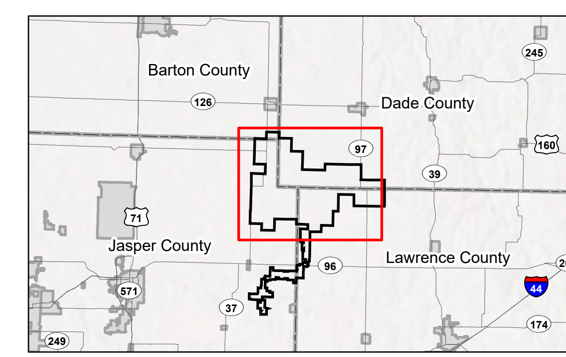
Turbine

Search Plot Type

100 m Cleared Plot

60 m Cleared Plot

Road & Pad



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Stantec

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Figure No.

A-3

Title

North Fork Ridge Post Construction Fatality Monitoring Turbine Search Plot Type

Client/Project 193708398

Empire District Electric Company
North Fork Ridge Wind Project

Project Location
Barton and Jasper Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 2,000 4,000 US Feet
(At original document size of 11x17)
1:48,000

Legend

Project Boundary

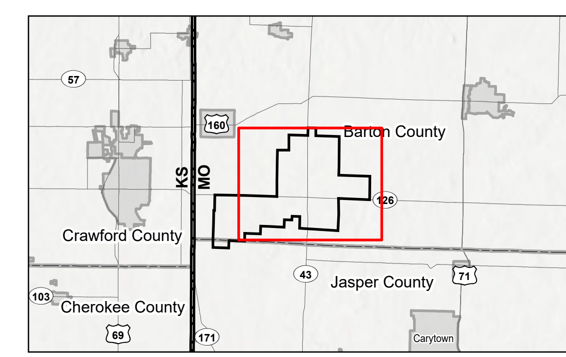
Turbine

Search Plot Type

100 m Cleared Plot

60 m Cleared Plot

Road & Pad



Notes

1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Stantec

\\Corp.ads\data\Virtual_Workspace\workgroup\1937\Active\193708398_northforkridge\03_data\gis_cad\gis\mxds\NorthForkRidge_PCM_Pro\NorthForkRidge_PCM_Pro.aprx Revised: 2022-01-28 By: sperry

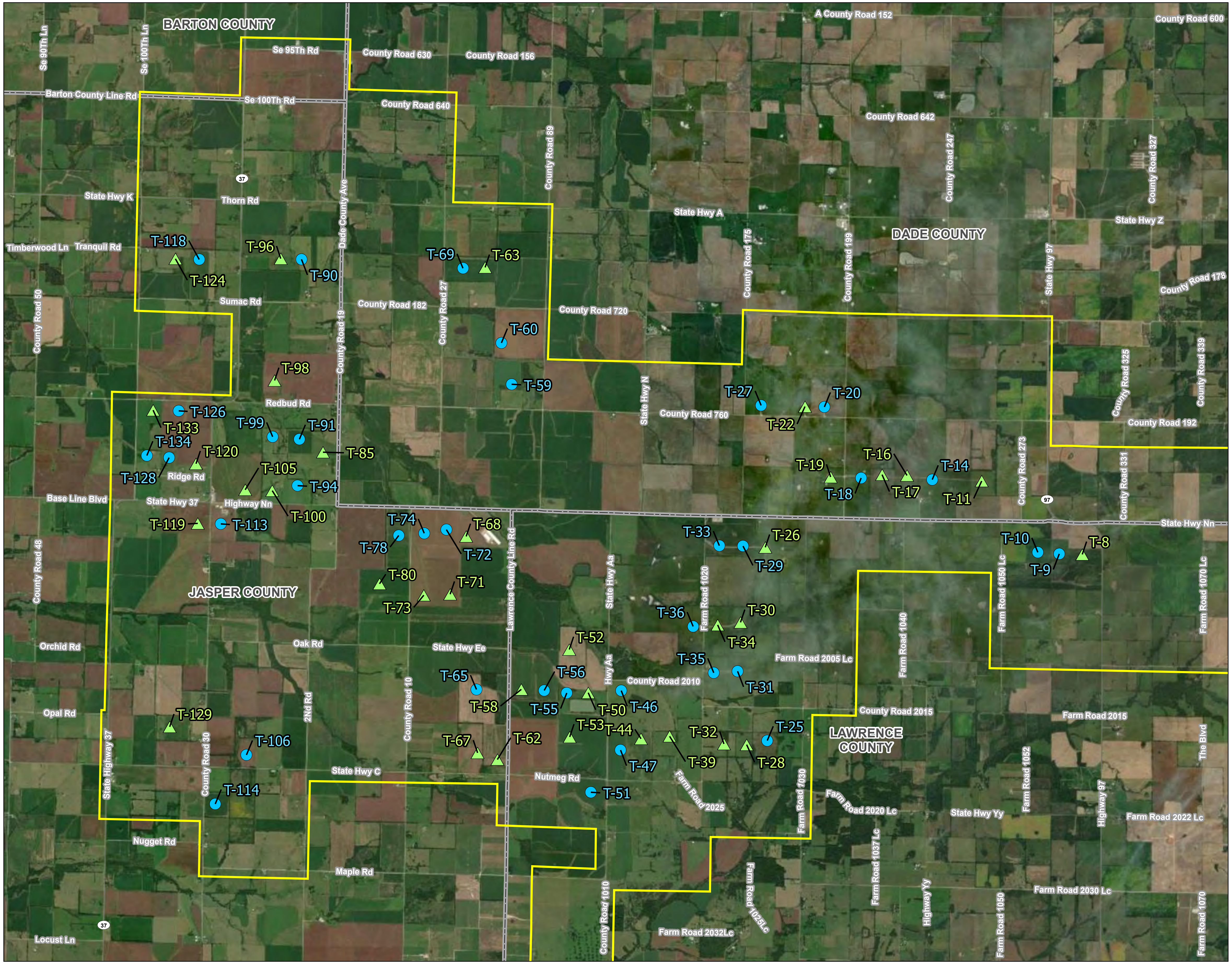


Figure No.
A-4

Title
Kings Point Turbine Operational Curtailment

Client/Project
193708398
Empire District Electric Company
Kings Point Wind Project

Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 0.5 1 Miles
(At original document size of 11x17)
1:63,360

Legend
Project Boundary
Turbine
Cut-in Speed
Control (3 m/s)
Treatment (5 m/s)

Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Stantec

\\Corp.ads\data\Virtual_Workspace\workgroup\1937\Active\193708398_northforkridge\03_data\gis_cad\gis\mxds\NorthForkRidge_PCM_Pro\NorthForkRidge_PCM_Pro.aprx Revised: 2022-01-28 By: sperry

Figure No.
A-5

Title
North Fork Ridge Turbine Operational Curtailment

Client/Project 193708398
Empire District Electric Company
North Fork Ridge Wind Project

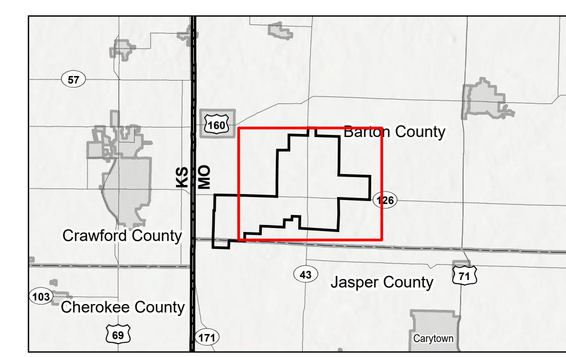
Project Location
Barton and Jasper Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 2,000 4,000 US Feet
(At original document size of 11x17)
1:48,000

Legend
Project Boundary
Turbine
Cut-in Speed
Control (3 m/s)
Treatment (5 m/s)



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Stantec

\\Corp.ads\data\Virtual_Workspace\workgroup\1937\Active\193708398_northforkridge\03_data\gis_cad\gis\mxds\NorthForkRidge_PCM_Pro\NorthForkRidge_PCM_Pro.aprx Revised: 2022-01-28 By: sperry

Figure No.
A-6

Title
Kings Point Post Construction Fatality Monitoring Turbine Bat Detector Type

Client/Project 193708398
Empire District Electric Company
Kings Point Wind Project

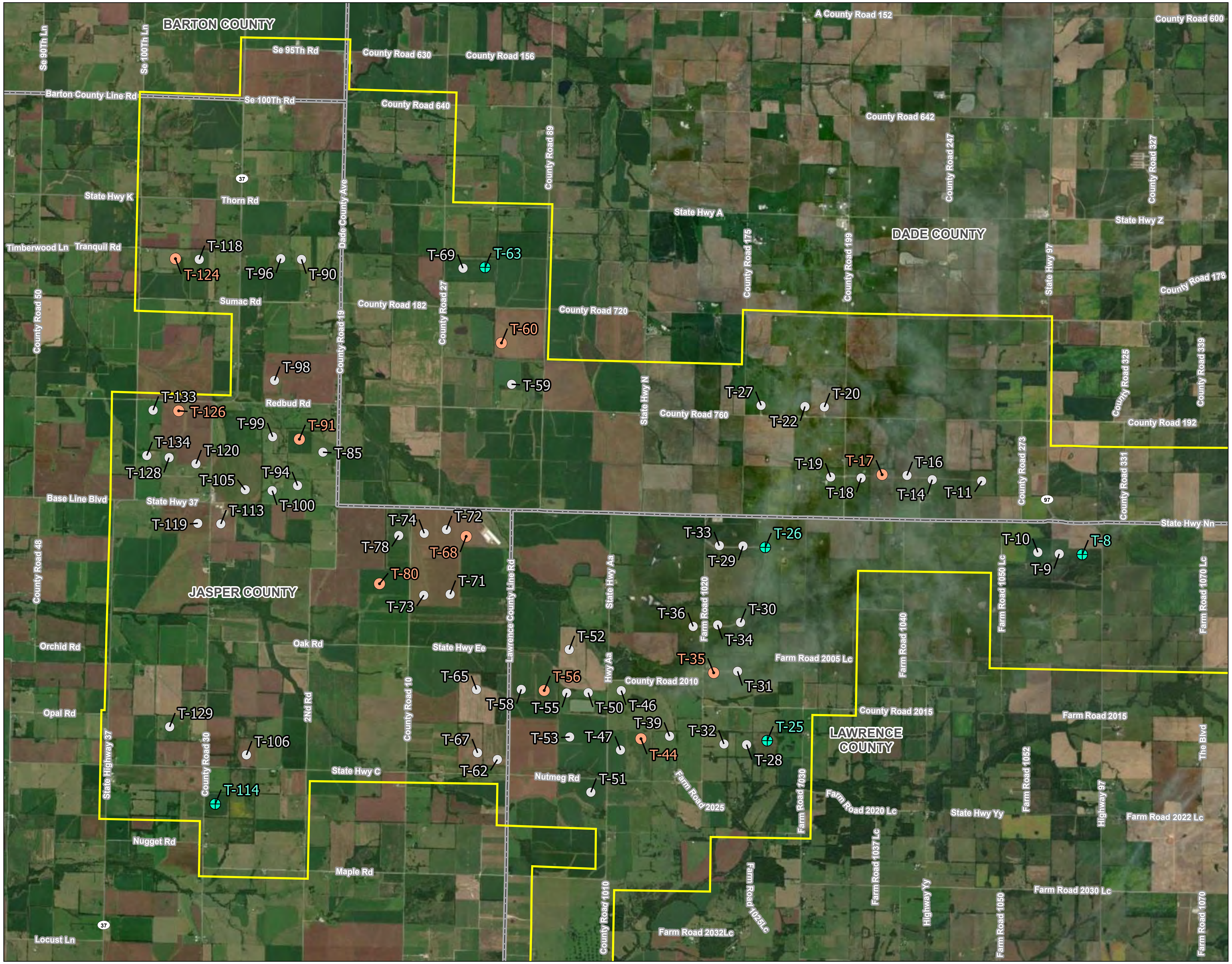
Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

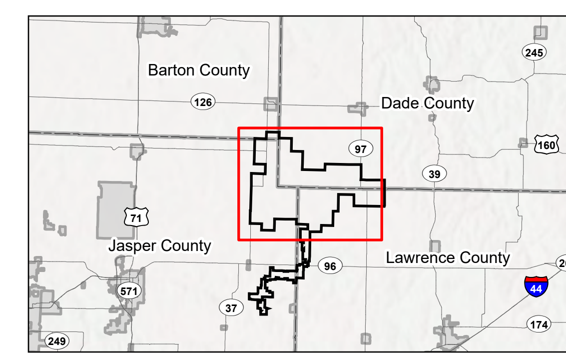
Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 0.5 1 Miles
(At original document size of 11x17)
1:63,360

Legend
Project Boundary
Turbine
Detector Type
Nacelle
Nacelle and Mid-Tower
No Detector





Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Stantec

\\Corp.ads\data\Virtual_Workspace\workgroup\1937\Active\193708398_northforkridge\03_data\gis_cad\gis\mxds\NorthForkRidge_PCM_Pro\NorthForkRidge_PCM_Pro.aprx Revised: 2022-01-28 By: sperry

Figure No.
A-7

Title
North Fork Ridge Post Construction Fatality Monitoring Turbine Bat Detector Type

Client/Project 193708398
Empire District Electric Company
North Fork Ridge Wind Project

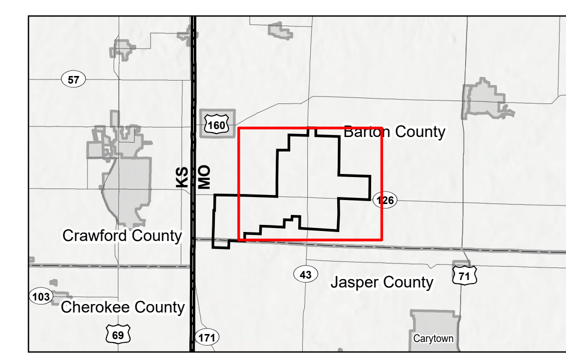
Project Location
Barton and Jasper Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 2,000 4,000 US Feet
(At original document size of 11x17)
1:48,000

Legend
Project Boundary
Turbine
Detector Type
Nacelle
Nacelle and Mid-Tower
No Detector



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Stantec

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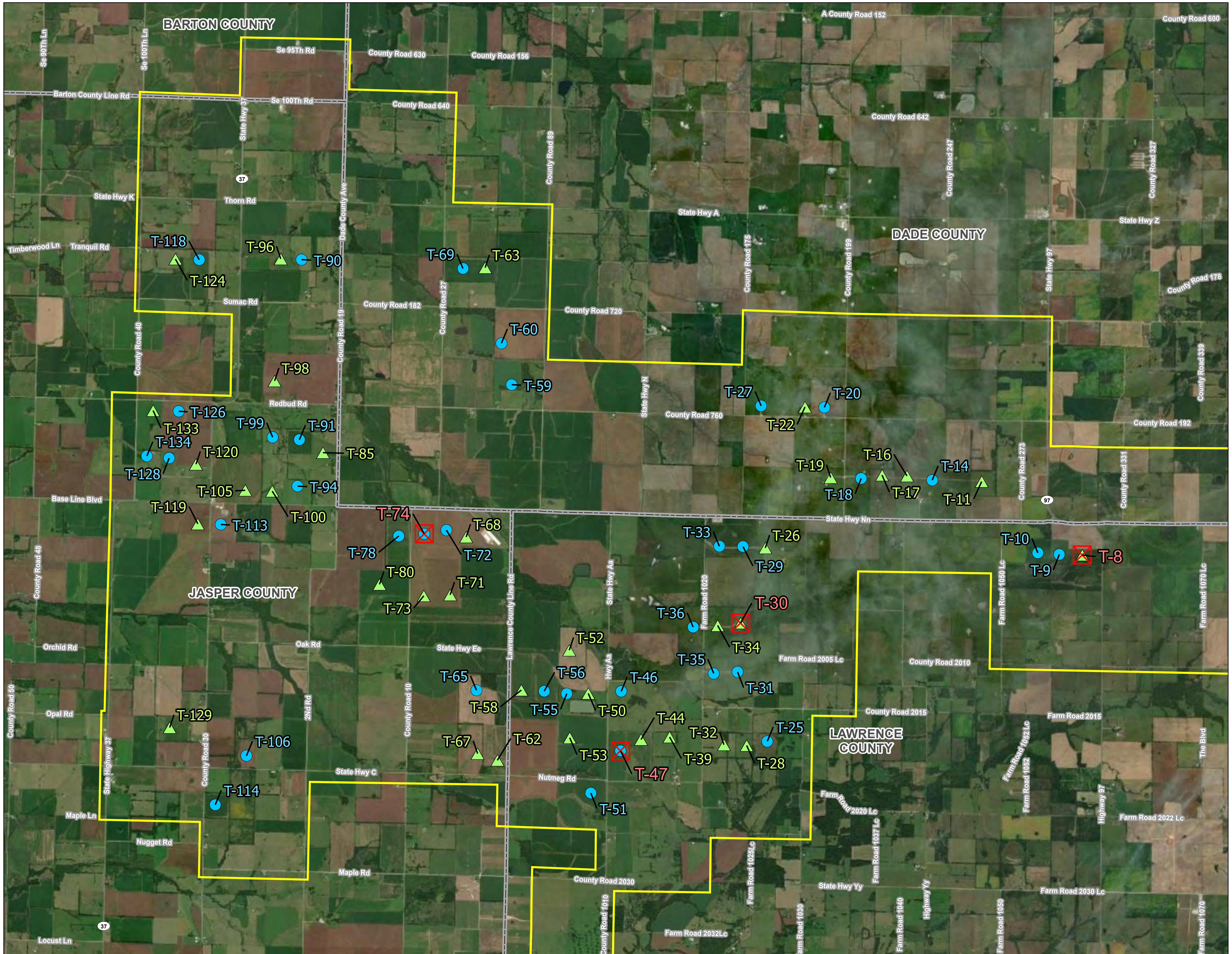


Figure No.

A-8

Title

Kings Point Post Construction Fatality Monitoring Gray Bat Observations

Client/Project 193708398

Empire District Electric Company
Kings Point Wind Project

Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

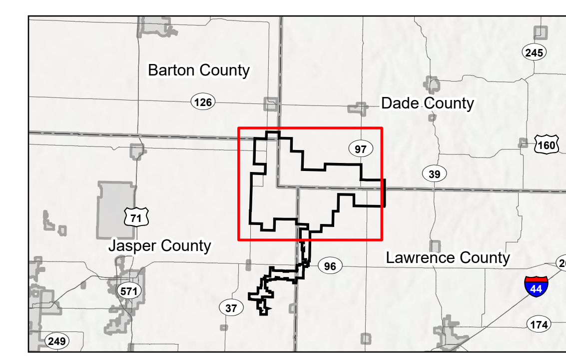
0 0.5 1 Miles
(At original document size of 11x17)
1:63,360

Legend

- Project Boundary
- Gray Bat Observation

Turbine Cut-in Speed

- Control (3 m/s)
- Treatment (5 m/s)



Notes

1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

Stantec

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Appendix B GENETICS RESULTS

NORTHERN ARIZONA UNIVERSITY

School of Forestry

BAT ECOLOGY & GENETICS LAB

Genetic ID of Bat Sex

Client: Adam Rusk (Adam.Rusk@stantec.com), Stantec;
Invoice number 20211213_2.

Samples: We received four bat carcasses. After DNA extraction, we tested the sex of the individuals using the methods of Korstian et al. 2013. All non-template controls were negative for amplification and the positives controls amplified correctly.

Test date: 01/21/2022

Report date: 01/25/2022

Sample ID	Sex
T-030	Female
T-074	Male
8	Female
47	Female

10(a)(1)(A) Permit # ESPER0011726 Annual Report - 2022

Kings Point Wind Project and North Fork Ridge Wind Project

Barton, Dade, Jasper, and Lawrence Counties, Missouri

January 31, 2023

Prepared for:

Empire District Electric Company
602 S Joplin Avenue
Joplin, MO 64802

Prepared by:

Stantec Consulting Services Inc
6800 College Boulevard, Suite 750
Overland Park, KS 66211

Prepared by **Adam Rusk** CE, ABW, PSM

Approved by ____

(signature)

Josh Flinn Associate Wildlife Biologist/Project Manager

Table of Contents

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Abbreviations, Parameters, and Definitions

a_i	fraction of ground searched within each distance band
AIC	Akaike information criterion
control	3.0 m/s cut-in speed
CP	carcass persistence
DWP	density-weighted proportion
Empire	Empire District Electric Company
ft	feet
GenEst	Generalized Estimator
g-value	detection probability
I	search interval
k	SE decay
Kings Point	Kings Point Wind Project
m	meters
mph	miles per hour
m/s	meters per second
MW	megawatt
North Fork Ridge	North Fork Ridge Wind Project
p	Searcher efficiency
Permit	10(a)(1)(A) Permit # ESPER0011726
SE	searcher efficiency
TAL	Technical Assistance Letter
treatment	5.0 m/s cut-in speed
USFWS	U. S. Fish and Wildlife Service
v	temporal coverage
WTGs	Wind Turbine Generators
X_i	number of carcasses found within each distance band

1.0 INTRODUCTION

1.1 PROJECT DESCRIPTION AND HISTORY

Empire District Electric Company (Empire) developed and is currently operating two wind power facilities in southwest Missouri. Kings Point Wind Project (Kings Point) is located in Barton, Dade, and Lawrence Counties, Missouri and North Fork Ridge Wind Project (North Fork Ridge) in located in Barton County, Missouri. These two wind projects are collectively referred to as "the Projects" throughout this report. The Projects each consist of 69 Vestas wind turbine generators (WTGs; 12 Vestas V-110 2.0 megawatt [MW], 57 Vestas V-120 2.2-MW) with an approximate capacity of 149.4 MW for each Project. Total, the Projects include 138 WTGs. A map showing the location of the WTGs for the Projects is provided in Appendix A, Figure A-1.

Due to the potential risk of take of the federally endangered gray bat (*Myotis grisescens*) during operations, Empire applied for a Native Endangered Species Recovery Permit under Section 10(a)(1)(A) of the Endangered Species Act (Permit) to evaluate the effectiveness of smart curtailment on reducing gray bat fatalities. The application included a study plan outlining a 4-year research study that was developed through coordination with the U.S Fish and Wildlife Service (USFWS) Columbia, Missouri Ecological Services Field Office and the Missouri Department of Conservation (Stantec 2021). The study plan included both post-construction fatality monitoring for bats, as well as acoustic monitoring for bat activity. The Permit (ESPER0011726) was issued on August 6, 2021. Prior to issuance of the Permit, the Projects operated in accordance with terms outlined in Technical Assistance Letters (TALs) issued by the USFWS on May 10, 2019 for Kings Point and June 6, 2019 for North Fork Ridge. This report summarizes the operations and post-construction fatality monitoring at the Projects for 2022 and is intended to satisfy Condition L (Annual Reporting) of the Permit. This report also includes the results of acoustic monitoring from 2021 and 2022.

1.1.1 Previous Monitoring (2021)

1.1.1.1 Spring and Summer 2021 - TAL

Operations and monitoring during the spring and summer of 2021 were in accordance with the TALs for the Projects. Conditions of the TALs required feathering of all turbine blades below 8.0 meters per second (m/s) when ambient temperature was above 50 degrees Fahrenheit during the gray bat active season (March 1 through November 15) from 30 minutes prior to sunset through 30 minutes after sunrise. Bat fatality monitoring began March 3, 2021 for North Fork Ridge and April 8, 2021 for Kings Point. Bat fatality monitoring included search efforts expected to achieve a detection probability (g-value) of 0.2 based on Evidence of Absence (EofA; Dalthorp et al. 2017). Fatality monitoring included twice weekly searches at all WTGs on graveled roads and pads out to 100 meters (m) from the turbine base and 60-m radius cleared plots around 48 WTGs. Searcher efficiency and carcass persistence trials were completed in accordance with the TALs.

1.1.1.2 Fall 2021 – 10(a)(1)(A) Permit

After receiving the Permit, fatality monitoring and operational curtailment were adjusted, and acoustic monitoring was added at the Projects to begin collecting data to address the research objectives outlined in the study plan (Stantec 2021) for the Permit. Fatality monitoring efforts included an expansion of 8 of the search plots from 60-m radius cleared plots to 100-m radius cleared plots on August 23, 2021. On September 7, 2021 (Kings Point) and August 30, 2021 (North Fork Ridge) the Projects began operating half of their turbines at 3.0 m/s (control) and half at 5.0 m/s (treatment) cut-in speeds (i.e., turbines are "feathered" below this wind speed to minimize blade movement, based on the wind speed measured at each turbine's nacelle). Acoustic bat monitors were installed on 30 WTGs in August 2021. Details of the monitoring effort and survey results for the monitoring from 2021 are available in the 2021 annual report (Stantec 2022).

1.1.2 Spring, Summer, Fall 2022 – 10(a)(1)(A), P1Y1

Bat fatality monitoring and acoustic bat activity monitoring was completed at the Projects during the spring, summer, and fall of 2022. Turbine control and treatment operations were the same as they were during the fall 2021 monitoring period, but the bat fatality monitoring effort was increased for 2022 to include searches 3 times per week for all turbines and the addition of 8, 60-m radius cleared plots. The 2022 monitoring period represents the first full year of the study under the Permit and is defined as Phase 1, Year 1 in the Study Plan (Stantec 2021).

1.2 PURPOSE AND OBJECTIVES OF THE STUDY

The goal of this study is to evaluate and understand gray bat fatality rates at the Projects to develop and test an optimal curtailment strategy for reducing impacts. This will aid in the recovery of the gray bat by providing a basis of understanding for gray bat and wind turbine interactions. The study will span 4 years and combines acoustic bat monitoring on WTG nacelles, fatality monitoring beneath WTGs, and operational curtailment treatments applied to WTGs to achieve 4 study objectives:

- Objective 1: Quantify turbine-related fatality rates for gray bats
- Objective 2: Quantify relationship between exposed gray bat activity and fatality
- Objective 3: Quantify effectiveness of blanket curtailment turbine operation (e.g., 5.0 m/s cut-in speed from April 1 – October 31 at temperatures above 50 degrees Celsius, 30 minutes before sunset through 30 minutes after sunrise) for reducing gray bat fatality
- Objective 4: Demonstrate use of nacelle-based acoustic and weather data to optimize turbine operational curtailment and evaluate its effectiveness at reducing gray bat fatality

2.0 METHODS

Survey methods for carcass searches, searcher efficiency (SE) trials, carcass persistence (CP) trials, and acoustic monitoring followed those specified in the Permit conditions and as outlined in the study plan (Stantec 2021), with the following exceptions: search effort was increased from twice per week to three times per week, and additional cleared plots were added in an effort to increase the g-value. Post-construction monitoring included the following components:

- Standardized carcass searches to systematically search plots at all WTGs for bat fatalities attributable to the WTGs;
- SE trials to estimate the percentage of bat carcasses that were found by the searcher(s);
- CP trials to estimate the persistence time of carcasses on-site before scavengers removed them; and
- Acoustic monitoring to assess total bat activity and gray bat activity at nacelle height on WTGs within the rotor-sweep and beneath the rotor-sweep.

2.1 FIELD METHODS

2.1.1 Standardized Carcass Searches

Standardized carcass searches were completed at 100% of the Projects' WTGs between April 4 and October 31, 2022. Standardized carcass searches consisted of searching search plots at each turbine on either (1) the graveled areas of turbine pads and access roads out to 100 m (road and pad searches), (2) within a 60-m radius of turbines (60-m cleared plot) or (3) within a 100-m radius of turbines (100-m cleared plot) during spring, summer, and fall. Figures A-2 and A-3 (see Appendix A) show the search plot types by turbine location for Kings Point and North Fork Ridge, respectively. The distribution of the search plots was as follows:

- Kings Point – 41 WTGs with road and pad searches, 24 WTGs with 60-m cleared plot searches, 4 WTGs with 100-m cleared plot searches; and
- North Fork Ridge – 41 WTGs with road and pad searches, 24 WTGs with 60-m cleared plot searches, 4 WTGs with 100-m cleared plot searches.

[redacted]

Standardized carcass searches were conducted by qualified searchers trained in fatality search methods, including proper handling and reporting of carcasses. Searchers were familiar with and able to accurately identify bat species likely to be found at the Projects. Preliminary bat species identifications were made in the field by qualified staff. When carcass condition allowed, sex and age of the carcass were recorded.

Forearm length was recorded to facilitate species identification. In addition to the carcass, photographs and data collected for each carcass were used to verify the species identification. Photos of any bat carcass unable to be identified to the species level were sent to a Stantec permitted bat biologist for positive identification, and carcasses were kept on-site. Any unknown bat or suspected *Myotis* was identified by a Stantec senior bat biologist who holds a USFWS permit for threatened and endangered bats, and/or was sent to the Northern Arizona University's Bat Ecology and Genetics Lab[1] for genetic testing.

During searches, searchers walked at a rate of approximately 2 miles per hour (45 to 60 m per minute) while searching 3 m on either side. For each carcass found, the following data were recorded digitally within Survey123 (ESRI, Redlands, CA):

- Date and time
- Initial species identification (this information was updated as needed based on photos, dentition, or expert opinion)
- Sex, age, and reproductive condition (when applicable; sex was updated based on genetic testing when applicable)
- Global positioning system location
- Distance and bearing to turbine
- Condition (intact, scavenged, decomposed)
- Any notes on presumed cause of death

A digital photograph of each carcass next to a ruler for scale was taken before the carcass was handled and removed. All bat carcasses were labeled, bagged, and stored in onsite freezers at the Projects' Operations and Maintenance Buildings. Bat carcasses were collected and retained under the Permit and Missouri Department of Conservation Wildlife Collector's Permit #s: 19773, 19774, 19775, 19776, 19777, 19778, 19779.

Bat carcasses found in non-search areas were coded as incidental finds and documented in a similar fashion to those found in standardized surveys when possible. These included carcasses found during non-search times or outside the monitoring plot. Incidental bat carcasses were collected and stored in the freezer with the carcasses found during standardized surveys. As per industry standard, incidental finds were not included in the fatality estimates.

2.1.2 Searcher Efficiency Trials

SE trials were used to estimate the probability of bat carcass detection by the searchers. Trials were spread out across Projects, seasons, searchers, and search plot types. The searchers did not know when during the monitoring periods the trials were being conducted, at which turbines trial carcasses were placed, or the location or number of trial carcasses placed in any given search plot. Bat carcasses previously collected during the 2021 surveys were used for the trials.

[1] https://in.nau.edu/bat-ecology-genetics/

All SE trial carcasses were randomly placed by a field lead within the search plots. These were placed in the morning prior to the planned carcass searches for that day and checked after the SE trial to ensure they had not been scavenged. The number of trial carcasses found by the searcher in each plot was recorded and compared to the total number placed in the plots prior to the SE trial.

2.1.3 Carcass Persistence Trials

A CP trial was conducted to estimate the average length of time carcasses remained in the search plots before being removed by scavengers. Carcass persistence trials were maintained separate from searcher efficiency trials to facilitate timeliness of persistence checks (e.g., all carcasses had "day 2 check" on the same day) but were also randomly placed in the field within the search plots. Trials took place in all three seasons and across the plot types to determine if CP varied by season or plot type, and trials were conducted separately for each Project. Searchers monitored the CP trial carcasses for up to 28 days. During the CP trials, carcasses were checked every day for the first week, and then regularly checked until missing or 28 days had passed (i.e., approximately days 1, 2, 3, 4, 5, 6, 7, 10, 14, 21, and 28), or until no longer detectable.

The condition of each carcass was recorded during each CP trial check. The conditions recorded were defined as follows:

- Intact – complete carcass with no body parts missing
- Scavenged – carcass with some evidence or signs of scavenging
- Fur spot – no carcass, but fur spot remaining
- Missing – no carcass or fur remaining

2.1.4 Acoustic Monitoring

Wildlife Acoustics (Model SM4BAT FS) acoustic bat detectors with SMM-U1 microphones were mounted on 30 WTG nacelles (height of 120 m; 15 per project) and on the turbine mast (height of 20 m; 5 per project) of 10 WTGs from August 2021 through December 2021, and then redeployed for the 2022 season between February and November. The detectors were set to record echolocation calls of bats that fly in proximity (within approximately 30 m) of the detector microphones from 45 minutes before sunset to 45 minutes after sunset each night of the 2022 monitoring season. Detector locations are shown in Appendix A, Figures A-6 and A-7.

2.2 DATA ANALYSIS – GENEST

Results include summaries of the raw data, including counts of species, the number of searches conducted, and the average search interval (calculated as the sum of the number of visits to a turbine divided by the number of days within a season).

The Generalized Estimator (GenEst; Dalthorp et al. 2018) was used for calculating bias correction factors (SE, and CP) and the overall fatality rate and fatality estimates for all bats at the Projects. Note that throughout the document some estimates may not correspond exactly with subsets of those estimates (e.g., fatality by species may not add up to total fatality). This is because GenEst generates all estimates as a result of 1,000's of iterations of a model (called "bootstraps"). As each iteration yields slightly different results, different repetitions of the analysis will yield slightly different results.

2.2.1 Searcher Efficiency (p)

Searcher efficiency (p) represents the average probability that a carcass was detected by the searcher. This rate was calculated using the data collected during SE trials (Section 2.1.2) by dividing the number of trial carcasses the observer found by the total number which remained available during the trial (i.e., non-scavenged). Analysis included an evaluation of whether SE differed by searcher, season (spring, summer, fall), or plot type (roads and pads, cleared plots). It was assumed that the size of the cleared plot (i.e., 60-m or 100-m radius) did not influence SE, since both plot types were maintained to the same visibility [redacted]. Trials across both projects were combined for each searcher (i.e., SE was assumed to not vary by Project). SE decay (k) was fixed at 0.67. This value represents the decrease in searcher efficiency (p) on subsequent searches (i.e., if a carcass is missed the first time it is available, it is less likely to be found on subsequent searches than a "fresh" carcass).

GenEst returns numerous models depending on the number of variables included in the analysis, as well as Akaike information criterion (AIC) values for each model. The AIC value is a statistical score for the quality of a model fit, where smaller AIC values are considered better models. However, models within 4 ΔAIC (the difference between each models AIC and the AIC of the "best" model) are generally considered indistinguishable by this measure (Dalthorp et al. 2018). Therefore, the best model was chosen based on a manual review of models with the lowest AIC values, and a top model was chosen from the models within 4 ΔAIC of the top model. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.2 Carcass Persistence

CP represents the average amount of time (in days) that a carcass persists on the landscape after arriving, before being scavenged or decaying. A CP model is generated in GenEst using the data collected as part of the CP trials (Section 2.1.3). CP models in GenEst include censored exponential, Weibull, lognormal, and loglogistic distributions. CP was calculated separately for each Project. Analysis included an evaluation of whether CP varied by season and/or plot type.

GenEst returns numerous models depending on the number of variables included in the analysis, as well as AIC values for each model. The best model was chosen based on a comparison of models with the lowest AIC values, though similar to SE, models were also graphically evaluated to ensure that they are logical, and the top model was chosen from the models within 4 ΔAIC of the top model based on AIC alone. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.3 Density-weighted Proportion (DWP)

The density-weighted proportion (DWP) was calculated based on several parameters described below. Data used included four seasons of data (fall 2021, spring-fall of 2022) across both Projects from road and pad plot types as well as the 100 m cleared plots (i.e., only plot types that searched out to the full 100-m, thus excluding the 60-m full plots). The following parameters and equations were then used:

$$X_i = number\ of\ carcasses\ found\ within\ distance\ band\ i$$

$$a_i = fraction\ of\ ground\ searched\ within\ distance\ band\ i$$

$$\widehat{M}_i = relative\ mortality\ rate\ in\ each\ ring = \frac{X_i}{a_i}$$

$$\hat{p}(M_i) = fraction\ of\ total\ in\ each\ ring = \widehat{M}_i \ / \sum_i \widehat{M}_i$$

The number of carcasses found within each distance band (X_i) is the total of carcasses found within that distance band at road and pad or 100-m full plot turbines. When each carcass was found, searchers recorded the location of the carcass using a sub-meter accuracy global positioning system in a digital datasheet (Collector for ArcGIS). The distance between these locations and the nearest turbine were calculated in GIS, and these values were used to calculate the DWP.

To determine the fraction of ground searched within each distance band (a_i), the turbine roads and pads were digitized, and the proportion of each distance band that included the road and pad was calculated for each of the 82 road and pad plots out to 100 m from the turbine base. These values were then averaged across all road and pad turbines to determine the percentage of each distance band that was searched on roads and pads. For 100-m cleared plot turbines, 100% of the area within 100 meters was searched. It was assumed that all carcasses fell within 100 meters of the turbine base. The weighted average of these values was then calculated for each distance band based on the proportion of road and pad plots to 100-m full plot turbines.

Once the fraction of total mortality in each ring ($\hat{p}(M_i)$) was calculated, turbine-specific DWPs were calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total mortality for that distance band. This utilized the turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), and then 100% of the area within 60 m of the turbine base was searched for 60-m full plot turbines, and 0% beyond that.

2.2.4 Adjusted Fatality Estimates (GenEst)

GenEst was used to calculate overall fatality rates for the Projects (per turbine, per MW, for all 69 turbines at Kings Point, and for all 69 turbines at North Fork Ridge). All estimates include 90% confidence intervals. "Per turbine estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the number of turbines (69 turbines), and "per MW estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the total MW (149.4 MW) for each project.

Fatality estimates were split by season.

2.3 DATA ANALYSIS – EVIDENCE OF ABSENCE

EofA (Dalthorp et al. 2017) was used for estimating the overall detection probability (g) and the estimated take of gray bats (M and λ).

2.3.1 Estimation of Detection Probability (g)

For analysis of the 2022 data, Stantec used the "Multiple Class Module" to combine data from the two search classes (roads and pads and cleared plots) and across the three seasons (spring, summer, and fall). Site-specific monitoring data were used to calculate the g-value for each search class, including the following inputs:

- Search interval (I), calculated as the average time between searches per plot type
- Number of searches, calculated as the average number of times each turbine per plot type was visited
- Spatial coverage (a), set to the average DWP for that search class (i.e., roads and pads or the weighted average of the cleared plots combining both 100-m and 60-m plot sizes)
- Temporal coverage (v), set to 1 for the summer and 0.925 for spring and fall since monitoring occurred during the entire period of risk during the summer, and on-site pre-construction acoustic data suggests 95% of gray bat activity occurs after March in the spring and before November in the fall
- SE, calculated using the "carcasses removed after one search" option and inputting the total number of carcasses available and found per plot type and season across all searchers
- Factor by which SE changes with each search (k) was fixed at 0.67
- CP distribution calculated using field trials to estimate the parameters, and the top model was selected based on results from within EofA.

This input was done for both road and pad searches and for cleared plots to calculate the detection probability (g) within those searched areas. Within the Multiple Class Module, the fraction of total carcasses arriving within each class needs to be assigned to the DWP column. This differs from the DWP calculated in Section 2.2.3, which is the proportion of bats expected to fall within the searched area at a particular turbine, whereas this DWP is the proportion of bats expected to fall within that class. The DWP was calculated for each of the plot types, as well as for an "unsearched" class to account for carcasses that fall outside of the searched areas. The DWPs of these three classes (roads and pads, cleared plots and unsearched) must sum to one. The DWPs for roads and pads and cleared plots were calculated based on the DWPs calculated for the turbines within those plots (Section 2.2.3), using the average DWP for the plot type and multiplying it by the proportion of turbines within that plot type. The unsearched class was then calculated as one minus the sum of the DWPs for the searched areas.

Once these inputs were complete, the "Estimate overall detection probability (g)" option was chosen, and the overall detection probability for the survey period was calculated.

2.3.2 Estimation of Gray Bat Fatalities

For analysis of the 2022 data, the “Multiple Years Module” was used with the results of the detection probability (g) obtained as described in Section 2.3.1, along with the number of observed gray bat fatalities. This analysis was run separately for each Project to determine the total estimated mortality (M), and the annual fatality rate (λ) for gray bats. Credible intervals were evaluated assuming α=0.5.

2.4 DATA ANALYSIS – ACOUSTIC MONITORING AND TURBINE OPERATION

Stantec processed acoustic bat data collected at the Projects using Kaleidoscope Pro (KPro; Wildlife Acoustics, Inc.; version 5.4.0 or later) to eliminate noise (e.g., insects, rain, wind) and assign automated identifications of species to files using the Bats of North America classifier (version 5.4.0; 0 Balanced [Neutral] setting). Trained bat biologists visually reviewed all files in AnalookW (version 4.4n or newer) to confirm they contained a bat pass (i.e., at least 2 bat echolocation call pulses). Files that did not contain a bat pass were manually removed and not analyzed further. We also reviewed files categorized as noise and files not identified as a species to search for any misclassification of bat passes. We also visually vetted all files classified by KPro as species of interest, including federally endangered gray bats and the candidate species tricolored bats (*Perimyotis subflavus*), along with files labeled as other species that could potentially be confused with these species.

We extracted file-level information from all bat passes using the CountLabels tool in AnalookW software and attributed all bat passes with timestamp (rounded to the nearest 10-minute interval), species, and metadata including Project, turbine number, detector position (nacelle or mid-tower), operational treatment. We evaluated all turbine data files to determine whether detectors were functioning properly on a nightly basis.

Stantec obtained turbine rotor speed, ambient air temperature, and wind speed averaged across 10-minute intervals for the duration of the monitoring period at the nacelle of each Project turbine at which acoustic detectors were deployed. We categorized every 10-minute interval as meeting or not meeting curtailment conditions based on the parameters assigned to that turbine during the particular time period and categorized turbines as curtailed if rotor speed was less than 1 rpm during a 10-minute interval in which curtailment conditions were met. For each 10-minute interval in which acoustic detectors were operating, we calculated the number of bat passes per species detected. Bat passes recorded during 10-minute intervals in which turbine rotor speed exceeded 1 rpm were categorized as “exposed” to turbine operation. We compared acoustic exposure as a proportion of total bat activity and a rate of exposed passes per detector-night per turbine to bat fatality data per turbine to assess spatial patterns, per week to assess temporal patterns, and also overall per operational treatment, combining data from Kings Point and North Fork Ridge.

3.0 RESULTS

Fatality monitoring was completed for both Kings Point and North Fork Ridge. From April 1 – October 31, 2022, the WTGs at the Projects were operating as specified in the Permit at either control cut-in speed (3.0 m/s) or treatment cut-in speed (5.0 m/s). Figures A-4 and A-5 (see Appendix A) show the control and treatment assignments for Kings Point and North Fork Ridge, respectively. Results for both Projects are presented below.

3.1 SHARED RESULTS

Calculations for SE and DWP were shared between projects. Searchers were regularly shared between projects but not always to a degree that warranted testing on a project-specific basis. Additionally, combining both projects and all available seasons allowed for a more robust estimation of DWP.

3.1.1 Searcher Efficiency

SE trials were conducted during the post-construction monitoring during all three seasons (spring, summer, and fall) in 2022 using a total of 481 trial carcasses. Data were analyzed in GenEst, with searcher, season, and plot type as the three predictor variables. The selected model included season, searcher, plot type, and an interaction between season and plot type as the predictors (Appendix B, Table B-1). This resulted in a total of 84 searcher efficiency estimates that were used in fatality estimation. A summary of these estimates is provided below.

Based on the results of the top model, searcher efficiency ranged from 9.4% to 86.2% on cleared plots and ranged from 30.5% to 97.3% on roads and pads for all seasons. The average searcher efficiency ranged from 27.0% (spring) to 48.4% (fall) on cleared plots and from 56.5% (spring) to 82.2% (summer) on roads and pads (Table 3-1). There was variability among all combinations of covariates, but searcher efficiency was generally higher on road and pad plots than on cleared plots and higher on average during fall than the spring and summer seasons.

Table 3-1. Searcher efficiency during 2022 post-construction monitoring at the Kings Point and North Fork Ridge Wind Projects.

Season	Cleared Plots Trial Carcases	Cleared Plots Searcher Efficiency (90% CI)	Road and Pad Plots Trial Carcasses	Road and Pad Plots Searcher Efficiency (90 % CI)
Spring	64	0.270 (0.035 – 0.886)	65	0.565 (0.143 – 0.970)
Summer	88	0.328 (0.044 – 0.897)	88	0.822 (0.358 - 992)
Fall	86	0.484 (0.091 – 0.956)	90	0.758 (0.273 - 988)

3.1.2 Density-weighted Proportion (DWP)

Stantec used the 235 bats found during standardized searches on road and pad and 100 m cleared plots at both Projects to calculate DWP (Table 3-2).

Table 3-2. Calculation of the Density-weighted Proportion (DWP) at the Kings Point and North Fork Ridge Wind Projects based on bat carcasses found between September 1, 2021 and October 31, 2022 (excluding winter).

Distance Band (meters)	Number of Carcasses	Fraction of Area Searched (%)	Relative Fatality Rate	Fraction of Total	Cumulative Percent of Carcasses
0-10	10	49.9%	20.0	1.1%	1.1%
10-20	14	16.1%	87.2	4.6%	5.7%
20-30	19	15.1%	125.9	6.7%	12.3%
30-40	35	13.6%	256.6	13.6%	25.9%
40-50	49	12.1%	404.7	21.4%	47.3%
50-60	35	11.4%	305.7	16.2%	63.5%
60-70	27	10.8%	249.4	13.2%	76.6%
70-80	27	10.5%	256.0	13.5%	90.2%
80-90	11	10.3%	106.5	5.6%	95.8%
90-100	8	10.1%	79.4	4.2%	100.0%

Therefore, based on data from carcasses found, it is assumed that 63.5% of all bat carcasses fall within 60 m of the turbine base and within the 60 m cleared plot searches, and 36.5% fall beyond the 60 m cleared plots.

Using the turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), a turbine-specific DWP was then calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total for that distance band. Therefore, all cleared plot turbines have a DWP of 63.5% (60 m cleared) or 100% (100 m cleared), and the DWP for road and pad turbines ranges from 2.9% to 7.1%.

3.2 KINGS POINT

3.2.1 Carcass Searches

A total of 5,906 searches were conducted between April 4 and October 31, 2022. A summary of search effort by season with total numbers of bats found is presented in Table 3-3. A total of 273 bat carcasses were found during standardized carcass searches, and 4 bat carcasses were found incidentally.

Table 3-3. Summary of bat fatality monitoring conducted between April 4 and October 31, 2022, at the Kings Point Wind Project.

Season	Dates	Number of Searches Conducted	Average Search Interval	Number of bats found in standardized searches	Number of bats found incidentally
Spring	April 4 – May 31	1,690	2.49	19	1
Summer	June 1 – August 31	2,533	2.51	183	2
Fall	September 1 – October 31	1,683	2.50	71	1
Total	April 4 – October 31	5,906	2.50	273	4

3.2.2 Species Composition

All 273 bat carcasses found during standardized carcass searches were identified to the species level. A summary of species composition by season for bats found during the standardized carcass searches is shown in Table 3-4. Of the 273 bat carcasses, the most common species found was the eastern red bat (*Lasiurus borealis*; 193 individuals). The hoary bat (*Lasiurus cinereus*; 41) was the second most common species followed by evening bat (*Nycticieus humeralis*; 20). Tricolored bats (*Perimyotis subflavus*) made up 2.2% (6) of overall carcasses. Gray bats and silver-haired bats (*Lasionycteris noctivagans*) comprised 1.8% of total finds with 5 carcasses each. Incidental finds included 1 hoary bat in the spring, 2 eastern red bats in the summer, and 1 eastern red bat in the fall.

Table 3-4. Summary of bat carcasses found during standardized carcass searches between April 4 and October 31, 2022, during post-construction monitoring at the Kings Point Wind Project.

Species	Spring	Summer	Fall	Total
Big Brown Bat *Eptesicus fuscus*	0 0.0%	1 0.5%	2 2.8%	3 1.1%
Eastern Red Bat *Lasiurus borealis*	8 42.1%	145 79.2%	40 56.3%	193 70.7%
Evening Bat *Nycticeius humeralis*	5 26.3%	0 0.0%	15 21.1%	20 7.3%
Gray Bat[1, 2] *Myotis grisescens*	0 0.0%	3 1.6%	2 2.8%	5 1.8%
Hoary Bat[1] *Lasuirus cinereus*	3 15.8%	28 15.3%	10 14.1%	41 15.0%
Silver-haired Bat[1] *Lasionycteris noctivagans*	3 15.8%	1 0.5%	1 1.4%	5 1.8%
Tricolored Bat[1] *Perimyotis subflavus*	0 0.0%	5 2.7%	1 1.4%	6 2.2%
Total	19 7.0%	183 67.0%	71 26.0%	273

[1]Missouri Department of Conservation Species of Conservation Concern
[2]State and Federal listed Endangered

3.2.3 Carcass Persistence

CP was tested using 60 carcasses across the 3 seasons, with 10 trials for each combination of plot type and season. The top models for CP in GenEst included Weibull and exponential distributions, with effects of season and/or plot type (Appendix B, Table B-2). We selected the model with the lowest AIC which was both the best model and also the most parsimonious. The selected model had a Weibull distribution and included season as a variable (no effect of plot type). Carcass persistence was shortest in the summer, which averaged 1.83 days, compared to spring which averaged 7.02 days, and fall which averaged 2.69 days (Table 3-5).

Table 3-5. Carcass persistence during 2022 post-construction monitoring at the Kings Point Wind Project.

Season	Trial Carcasses	Carcass Persistence (90% CI)
Spring	20	7.02 (5.35 – 9.09)
Summer	20	1.83 (1.04 – 3.09)
Fall	20	2.69 (1.60 – 4.49)

3.2.4 Adjusted Fatality Estimates

Fatality rate estimates were calculated based upon the carcasses found during the standardized carcass searches and did not include any incidental finds. Observed bat fatality estimates were adjusted to account for SE, CP, the search schedule, and the turbine-specific DWPs.

3.2.4.1 Seasonal Fatality Estimates

Across all three survey seasons, 273 carcasses were found during standardized searches at the Kings Point Wind Project. The total estimated fatality for all bats was highest during the summer season (3,104 bats), followed by fall (1,222 bats), and lowest in the spring (208 bats) as summarized in Table 3-6 and Figure 3-1. Annual fatality estimates, combining all seasons, results in an overall bat fatality estimate of 4,640 bats (90% CI: 3,495 – 6,273) across all 69 turbines between March 1 and November 15, 2021 – equivalent to 67 bats/turbine (90% CI: 51 – 91) or 31 bats/MW (90% CI: 23 – 42).

Table 3-6. Bat fatality rates by season from 2022 post-construction monitoring at the Kings Point Wind Project.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities
Spring	March 1 – May 31	208.28 (102.75 – 364.50)	3.02 (1.49 – 5.28)	1.39 (0.69 – 2.44)
Summer	June 1 – August 31	3,104.46 (2,222.17 – 4,609.28)	44.99 (32.21 – 66.80)	20.78 (14.87 – 30.85)
Fall	September 1 – November 15	1,221.58 (780.00 – 1865.32)	17.70 (11.30 – 27.03)	8.18 (5.22 – 12.49)
Annual	March 1 – November 15	4,639.86 (3,495.27 – 6,273.46)	67.24 (50.66 – 90.92)	31.06 (23.40 – 41.99)

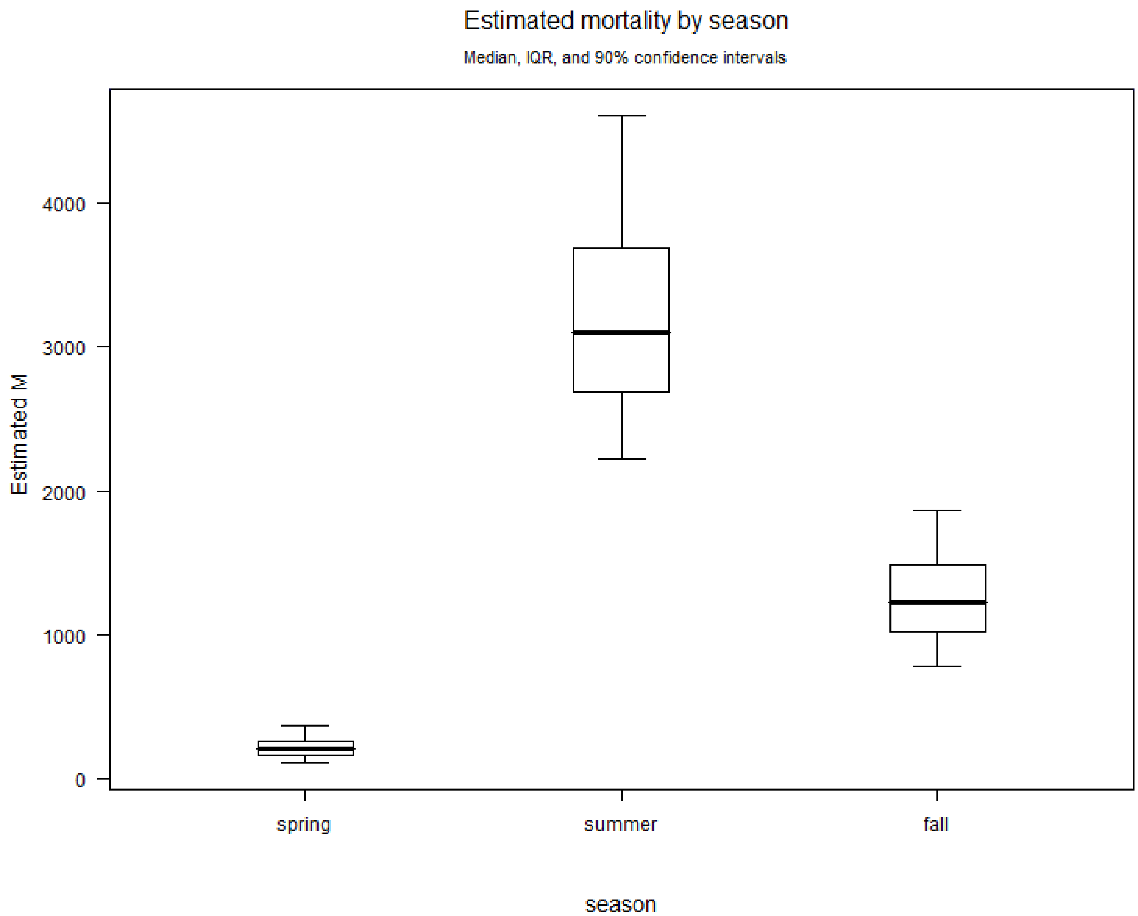

Figure 3-1. Seasonal all bat fatality estimates for 2022 at the Kings Point Wind Project.

3.2.4.2 Control Vs. Treatment Fatality Estimates

Annual fatality estimates were higher for control turbines (3.0 m/s cut-in) than for treatment turbines (5.0 m/s cut-in). Annual bat fatality was 2,848.99 (90% CI: 2,034.11 – 3,931.71) at control turbines and 1,759.14 (90% CI: 1224.15 – 2630.55) at treatment turbines. Per turbine estimates are 81.40 (90% CI: 58.12 – 112.33) for control turbines and 51.74 (90% CI: 36.00 – 77.37) for treatment turbines. Per MW estimates are 37.49 (90% CI: 26.76 – 51.73) for control turbines and 23.97 (90% CI: 16.68 – 35.84) for treatment turbines.

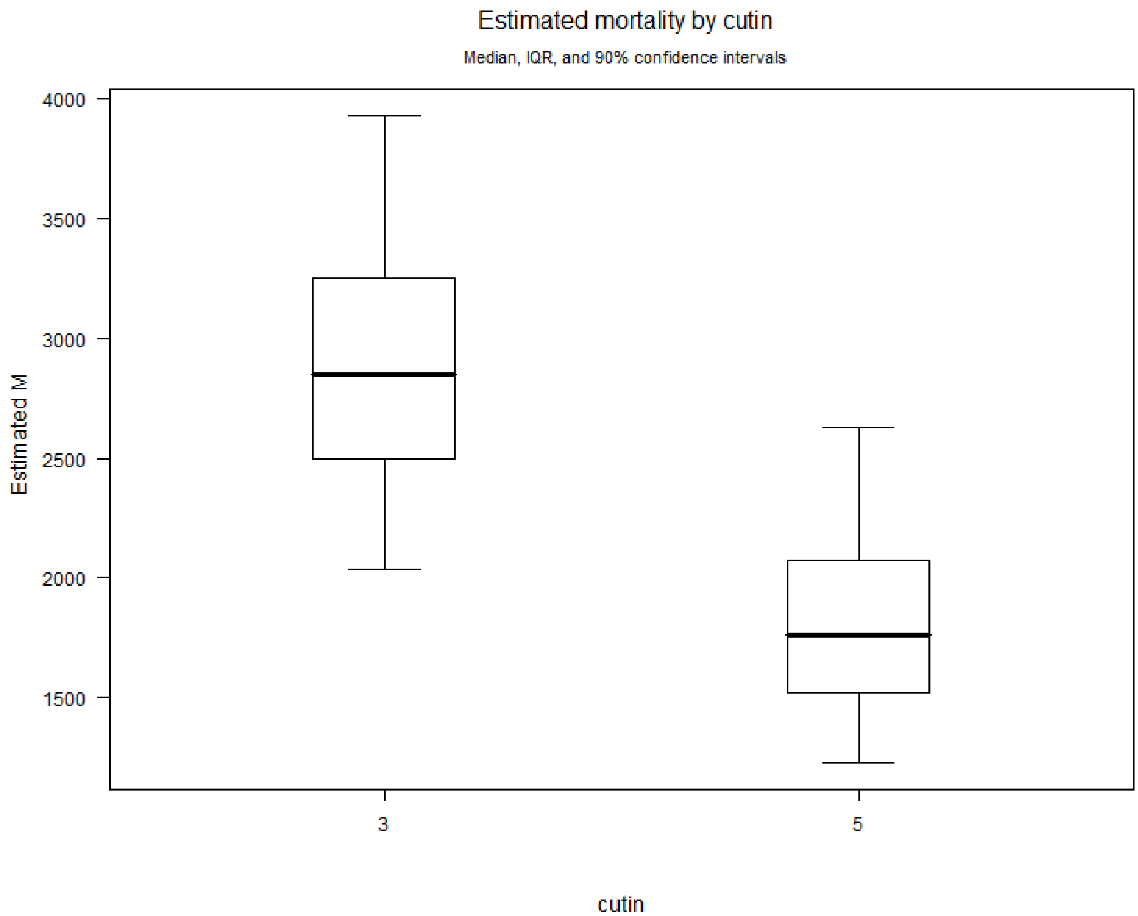

Figure 3-2. All bat fatality estimates at control (3 m/s) vs. treatment (5 m/s) turbines for 2022 at the Kings Point Wind Project.

3.2.5 Gray Bat Fatality Estimates

3.2.5.1 In-hand Fatalities

Stantec found five gray bats during post-construction fatality monitoring at Kings Point. No other federal or state endangered species were found. The locations of these five gray bat fatalities are shown in Appendix A, Figure A-8. Sex for all the gray bats found was confirmed to be female through genetic analysis (see Appendix C). Female gray bats were found on 6/29, 7/26, 7/28, 9/6, and 10/5. Gray bats were found at both control (n=3) and treatment turbines (n=2).

3.2.5.2 Evidence of Absence

The "Multiple Classes" module was used in EofA. Because searcher efficiency and carcass persistence varied by season and plot type, the module was run four times: once for each season (with separate classes for each plot type plus an unsearched proportion), and once for the entire year (with separate classes for each season, and no unsearched portion since proportion of fatalities occurring outside of searched times was accounted for in each of the seasonal runs).

Detection Probability (g)

The detection probability (g) for the post-construction monitoring season (March 1 – November 15, 2022) was 0.124 (95% CI: 0.093 to 0.158); however, this varied by season as summarized in Table 3-7.

Table 3-7. Summary of detection probability (g) by season and overall, during 2022 post-construction monitoring at the Kings Point Wind Project.

Season	Detection Probability (g) and 95% CI
Spring	0.143 (0.076 – 0.156)
Summer	0.117 (0.077 – 0.165)
Fall	0.149 (0.109 – 0.194)
Total/Overall	0.124 (0.093 – 0.158)

3.2.5.3 Fatality Estimates (M* and λ)

Analysis in the EofA "Multiple Years Module" included calculation of the annual take estimate (M_{2022}) and the annual take rate (λ) for gray bats based on the five gray bat carcasses found during monitoring. Results are summarized in Table 3-8.

Table 3-8. Summary of EofA outputs for gray bats from 2022 post-construction monitoring at the Kings Point Wind Project. Analysis done with α=0.5.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2022})	Annual Take Rate (λ) (95% CI)
Gray Bat	5	42	45.7 (15.2 – 94.72)

3.2.6 Acoustic Monitoring

3.2.6.1 2021 Monitoring

Bat detectors were installed on the nacelles of 15 WTGs and 20 m up on the mast of 5 WTGs at Kings Point. Installation occurred between August 4, 2021, and August 27, 2021, and detectors were demobilized for winter between November 17, 2021, and December 20, 2021.

Acoustic detectors recorded a total of 30,998 bat passes during 1,834 successful detector-nights (81% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) and mid-tower detectors (n = 5) recorded 4.3 and 44.0 bat passes per detector-night, respectively, during the 2021 monitoring period (Table 3-9).

Table 3-9. Acoustic survey effort at the Kings Point Wind Project from August through November 2021.

[redacted]	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	4-Aug	18-Nov	107	189	159	7,368	68.9
[redacted]	20-Aug	20-Dec	123	5	12	529	4.3
[redacted]	20-Aug	17-Nov	70	4	1	185	2.6
[redacted]	4-Aug	20-Dec	122	217	167	4,377	35.9
[redacted]	20-Aug	20-Dec	0	-	-	-	-
[redacted]	4-Aug	20-Dec	119	210	107	3,415	28.7
[redacted]	19-Aug	10-Dec	114	4	6	453	4.0
[redacted]	18-Aug	9-Dec	114	8	7	456	4.0
[redacted]	18-Aug	18-Dec	123	3	8	469	3.8
[redacted]	12-Aug	20-Dec	14	0	0	14	1.0
[redacted]	20-Aug	4-Dec	73	11	1	442	6.1
[redacted]	4-Aug	20-Dec	121	188	159	4,800	39.7
[redacted]	26-Aug	18-Nov	69	5	1	308	4.5
[redacted]	26-Aug	10-Dec	107	1	0	300	2.8
[redacted]	27-Aug	18-Nov	84	1	4	440	5.2
[redacted]	19-Aug	5-Dec	109	1	2	498	4.6
[redacted]	4-Aug	25-Nov	114	166	179	5,684	49.9
[redacted]	27-Aug	5-Dec	95	1	2	286	3.0
[redacted]	19-Aug	30-Nov	32	1	3	329	10.3
[redacted]	19-Aug	20-Dec	124	1	1	645	5.2
Nacelle Detectors, 2021	-	-	1,251	46	48	5,354	4.3
Mid-tower Detectors, 2021	-	-	583	970	771	25,644	44.0
Total, 2021	-	-	1,834	1,016	819	30,998	16.9

3.2.6.2 2022 Monitoring

Acoustic detectors were redeployed on turbine nacelles in mid-February 2022 and mid-tower locations in mid-April, 2022 and demobilized between mid-November and early December 2022. Acoustic detectors recorded a total of 46,374 bat passes during 3,431 successful detector-nights (68% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) and mid-tower detectors (n = 5) recorded 4.0 and 37.2 bat passes per detector-night, respectively, during the 2022 monitoring period (Table 3-10).

Table 3-10. Acoustic survey effort at the Kings Point Wind Project from February through November 2022.

Turbine and Position	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	19-Apr	17-Nov	202	307	93	7,229	35.8
[redacted]	28-Feb	27-Nov	273	7	12	1,414	5.2
[redacted]	28-Feb	27-Nov	193	6	8	642	3.3
[redacted]	19-Apr	17-Nov	202	437	173	8,488	42.0
[redacted]	15-Mar	27-Nov	141	5	8	640	4.5
[redacted]	19-Apr	17-Nov	192	282	119	5,990	31.2
[redacted]	20-Feb	27-Nov	190	1	3	576	3.0
[redacted]	8-Mar	27-Nov	261	3	1	95	0.4
[redacted]	19-Feb	27-Nov	102	3	1	695	6.8
[redacted]	11-Apr	27-Nov	123	0	5	588	4.8
[redacted]	15-Mar	27-Nov	77	5	2	247	3.2
[redacted]	19-Apr	17-Nov	191	253	201	7,801	40.8
[redacted]	15-Mar	27-Nov	108	2	3	678	6.3
[redacted]	15-Mar	27-Nov	102	3	3	623	6.1
[redacted]	16-Mar	27-Nov	147	4	4	535	3.6
[redacted]	16-Mar	27-Nov	251	2	6	1,259	5.0
[redacted]	19-Apr	17-Nov	199	165	150	7,130	35.8
[redacted]	27-Feb	27-Nov	178	1	3	628	3.5
[redacted]	16-Mar	27-Nov	106	0	2	815	7.7
[redacted]	19-Feb	27-Nov	193	0	0	301	1.6
Nacelle Detectors, 2022	-	-	2,445	42	61	9,736	4.0
Mid-tower Detectors, 2022	-	-	986	1,444	736	36,638	37.2
Total, 2022	-	-	3,431	1,486	797	46,374	13.5

3.2.6.3 Acoustic Results

Gray bats and tricolored bats were detected at most detectors during the 2021 and 2022 monitoring periods, with most detections occurring at mid-tower detectors (Figure 3-3).

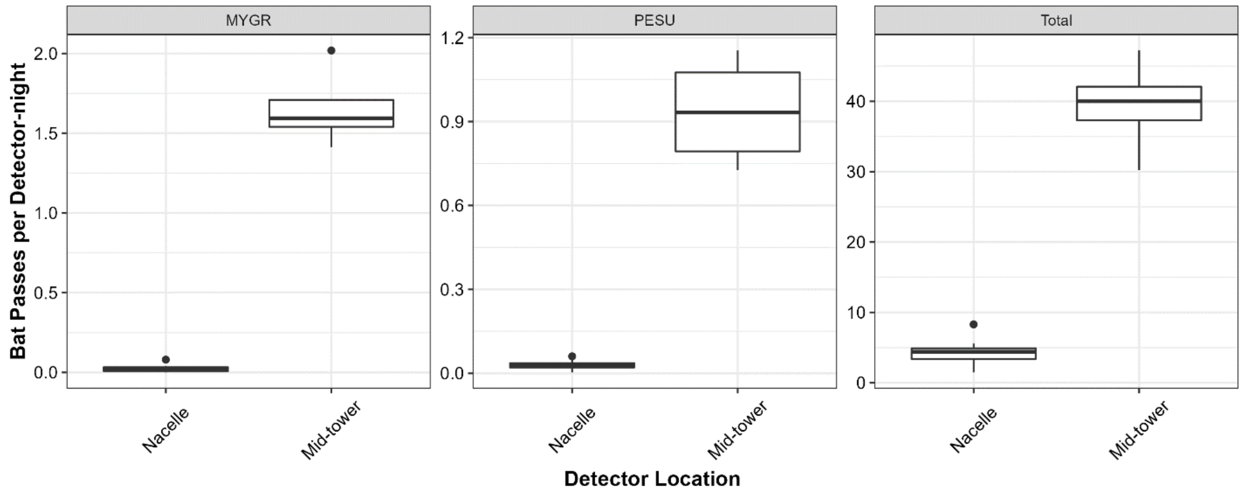

Figure 3-3. Gray bat (MYGR), tricolored bat (PESU), and all bat passes (Total) recorded per detector night at nacelle-mounted versus mid-tower detectors during 2021 and 2022 monitoring at the Kings Point Wind Project. Note differing y-axis scales among plot facets.

Acoustic bat activity followed similar seasonal patterns at nacelle and mid-tower detectors, with a slight peak in activity in mid-May and a pronounced peak in mid-August (Figure 3-4). Although timing of bat activity varied among nights, overall timing of bat activity peaked 1–3 hours after sunset at nacelle and mid-tower detectors for all bat species and the subset of passes identified as gray bats and tricolored bats (Figure 3-5, Figure 3-6, Figure 3-7).

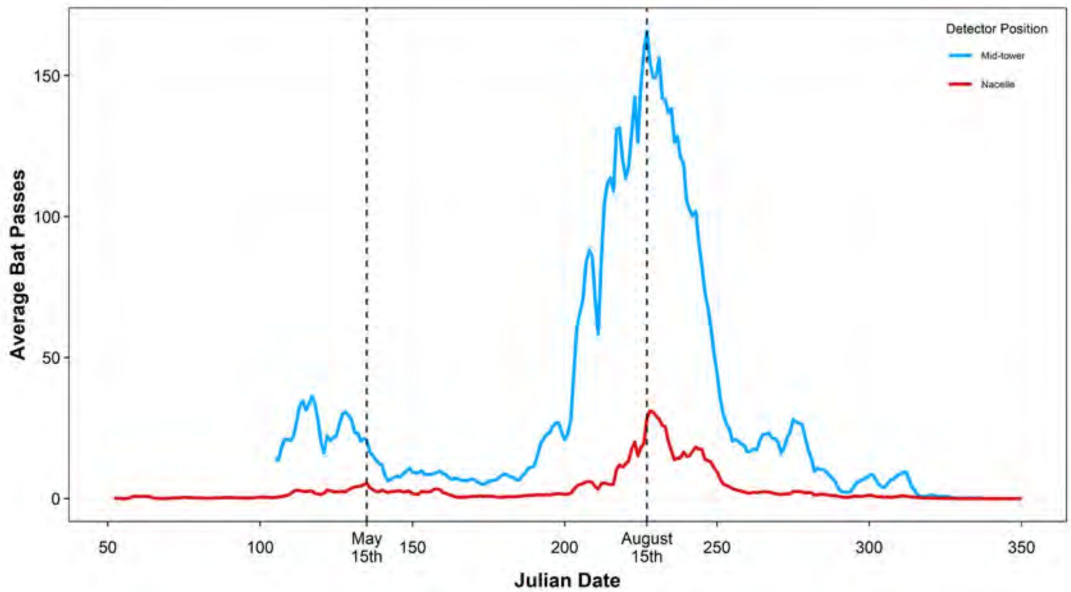

Figure 3-4. 7-day moving average (BP/DN) of acoustic bat activity (all species) detected during the 2021 and 2022 monitoring periods at the Kings Point Wind Project. Data from both years were combined and displayed by Julian date (days since January 1; May 15th and August 15th are displayed on the figure for reference to bat maternity season).

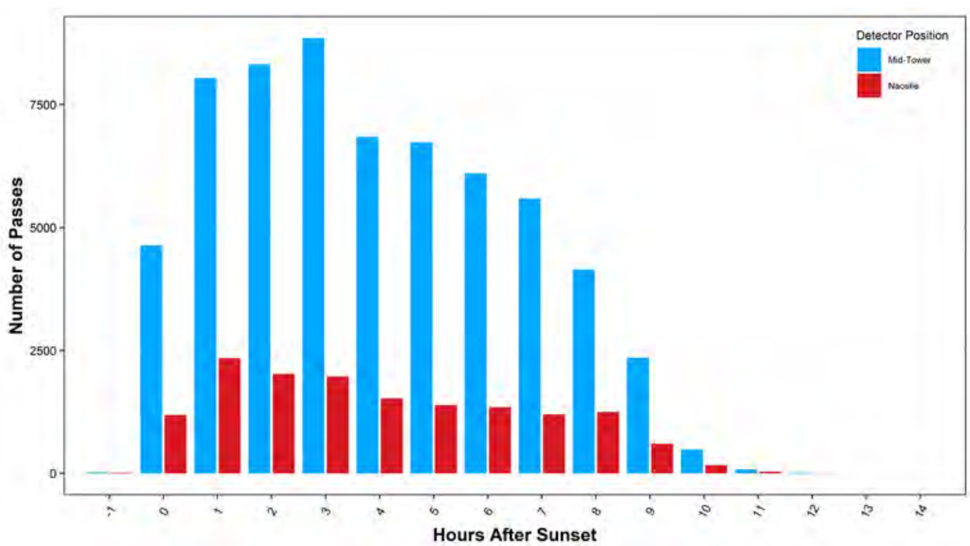

Figure 3-5. Nightly timing of total bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods at the Kings Point Wind Project.

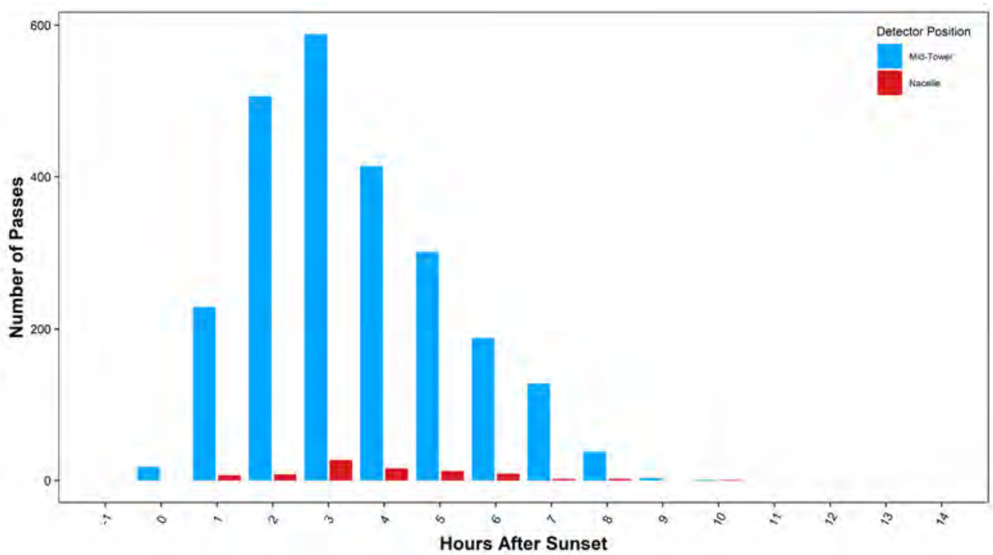

Figure 3-6. Nightly timing of gray bat (*Myotis grisescens*) bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods at the Kings Point Wind Project.

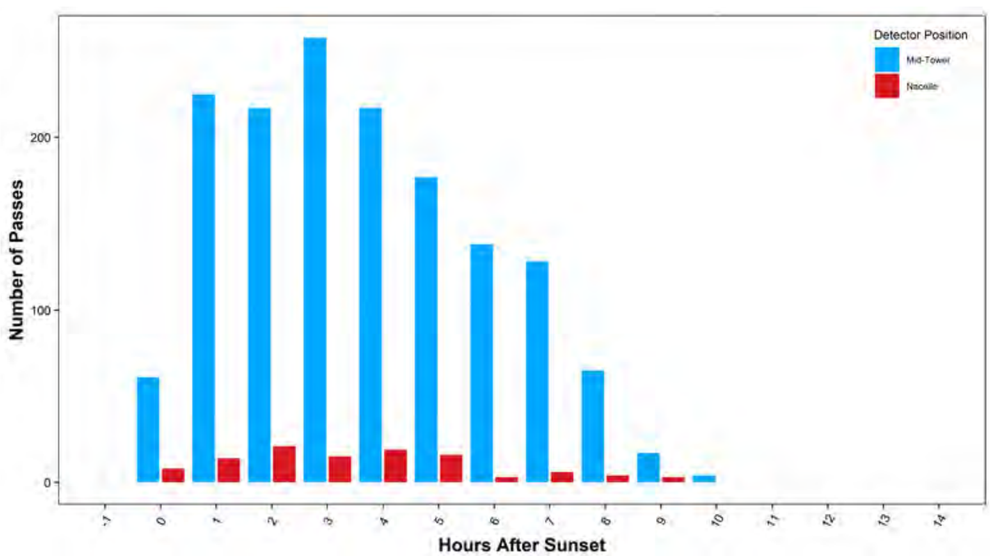

Figure 3-7. Nightly timing of tricolored bat (*Perimyotis subflavus*) bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods at the Kings Point Wind Project.

Temperature, wind speed, and turbine rotor speed data were available during 10-minute intervals in which 75,227 bat passes (97% of 77,327 total bat passes) were detected at Kings Point in 2021 and 2022. We used these data to evaluate the distribution of bat activity as a function of temperature and wind speed and to calculate the percent and rate (passes per detector night) of bat passes exposed to turbine operation. Most bat passes occurred during relatively warm conditions with wind speeds less than 8 m/s (Figure 3-8, Figure 3-9, Figure 3-10).

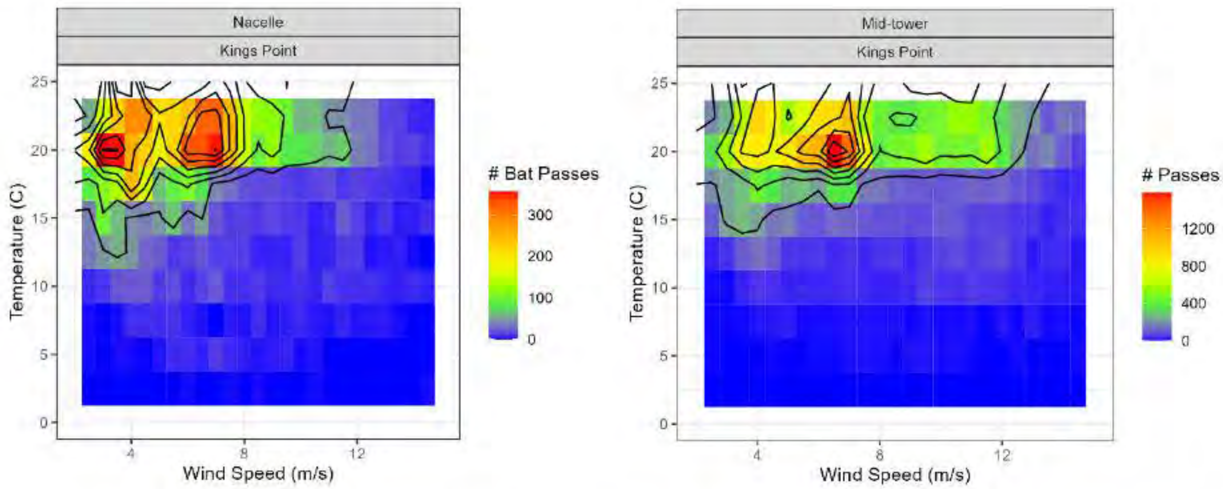

Figure 3-8. Distribution of all bat passes (all species) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the Kings Point Wind Energy Project.

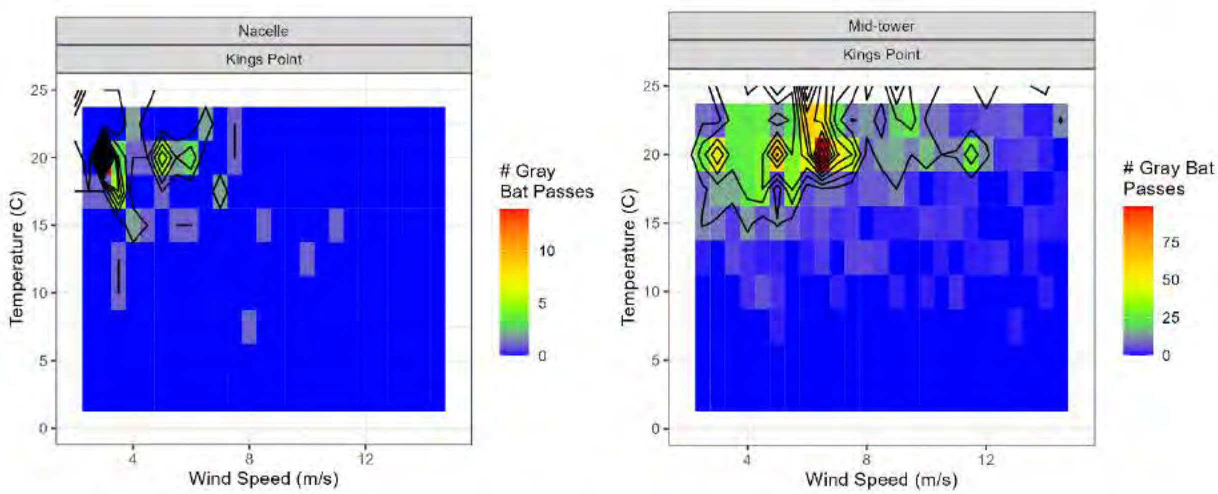

Figure 3-9. Distribution of gray bat passes (*Myotis grisescens*) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the Kings Point Wind Energy Project.

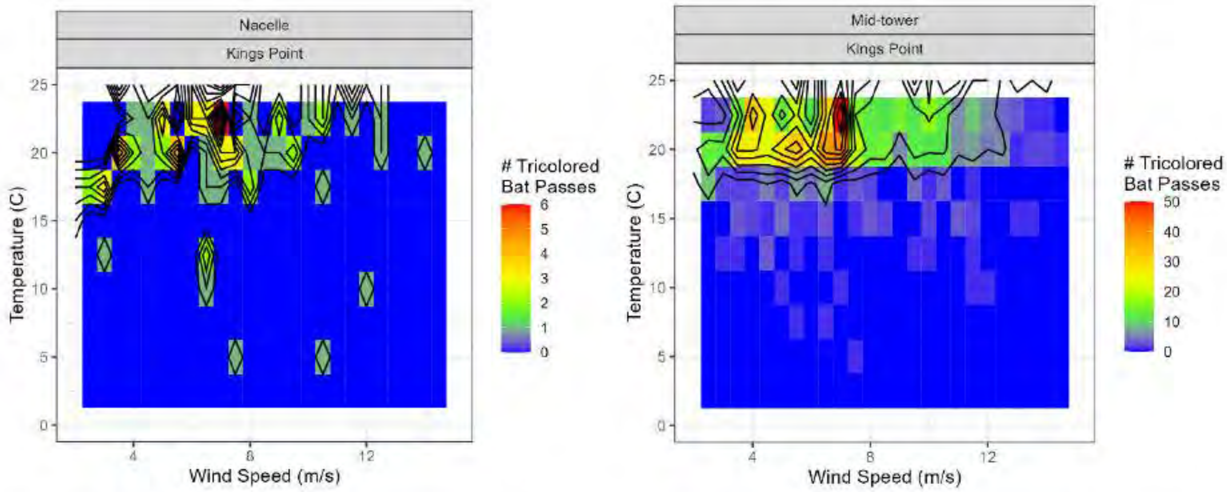

Figure 3-10. Distribution of tricolored bat passes (*Perimyotis subflavus*) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the Kings Point Wind Energy Project.

Acoustic monitoring at Kings Point in 2021 and 2022 encompassed periods in which three turbine operational treatments were implemented. Before September 7, 2021, all turbines were operated according to an interim (TAL) curtailment strategy with an 8 m/s cut-in speed. From September 7 – October 31, 2021 and April 1–October 31, 2022, approximately half of the 69 turbines (n = 34) were operated according to a treatment blanket curtailment strategy with 5.0 m/s cut-in speed, and the remaining 35 turbines were feathered below manufacturer's cut-in speed (3.0 m/s) to provide an operational control. The 15 turbines monitored for acoustic bat activity included 8 from the treatment group (5.0 m/s) and 7 from the control group (3.0 m/s).

The interim (TAL) curtailment strategy implemented before September 7, 2021 exposed 23% of bat passes recorded at nacelles and 47% of bat passes recorded at mid-tower detectors to turbine operation (exposed passes are defined as those detected when 10-minute turbine rotor speed exceeded 1 rpm). The 5.0 m/s treatment blanket curtailment strategy resulted in exposure of 53–55% of bat passes detected at nacelles and 57–65% of passes detected at mid-tower units in 2021 and 2022 compared to exposure of 82–87% of passes detected at feathered control turbines (Table 3-11, Figure 3-11). Exposure of gray bat and tricolored bat passes to turbine operation generally followed similar trends among treatments at both detector positions during the 2021 and 2022 monitoring period (Table 3-11).

Table 3-11. Acoustic exposure of gray bat (MYGR), tricolored bat (PESU), and all bat passes to turbine operation (detection when turbine rotor speed > 1 rpm) associated with operational treatments implemented during the 2021 and 2022 monitoring period at the Kings Point Wind Energy Project.

Year	Detector Position	Treatment	# Turb.	Bat Passes MYGR	Bat Passes PESU	Total Bat Passes	Exposed Bat Passes (%) MYGR	Exposed Bat Passes (%) PESU	Total Exposed Bat Passes (%)
2021	Nacelle	8.0 m/s interim TAL	15	22	36	3,756	0 (0%)	15 (42%)	867 (23%)
2021	Nacelle	5.0 m/s Treatment	8	16	7	971	6 (38%)	4 (57%)	514 (53%)
2021	Nacelle	3.0 m/s Control	6	8	5	564	5 (63%)	4 (80%)	469 (83%)
2021	Mid-tower	8.0 m/s interim TAL	5	710	700	21,173	235 (33%)	254 (36%)	10,005 (47%)
2021	Mid-tower	5.0 m/s Treatment	3	171	37	2,467	117 (68%)	24 (65%)	1,403 (57%)
2021	Mid-tower	3.0 m/s Control	2	87	34	1,795	83 (95%)	31 (91%)	1,535 (86%)
2022	Nacelle	5.0 m/s Treatment	8	26	35	5693	9 (35%)	26 (74%)	3,147 (55%)
2022	Nacelle	3.0 m/s Control	7	12	22	3427	5 (42%)	15 (68%)	2,798 (82%)
2022	Mid-tower	5.0 m/s Treatment	3	807	408	19,952	476 (59%)	276 (68%)	12,999 (65%)
2022	Mid-tower	3.0 m/s Control	2	589	318	14,681	511 (87%)	284 (89%)	12,742 (87%)

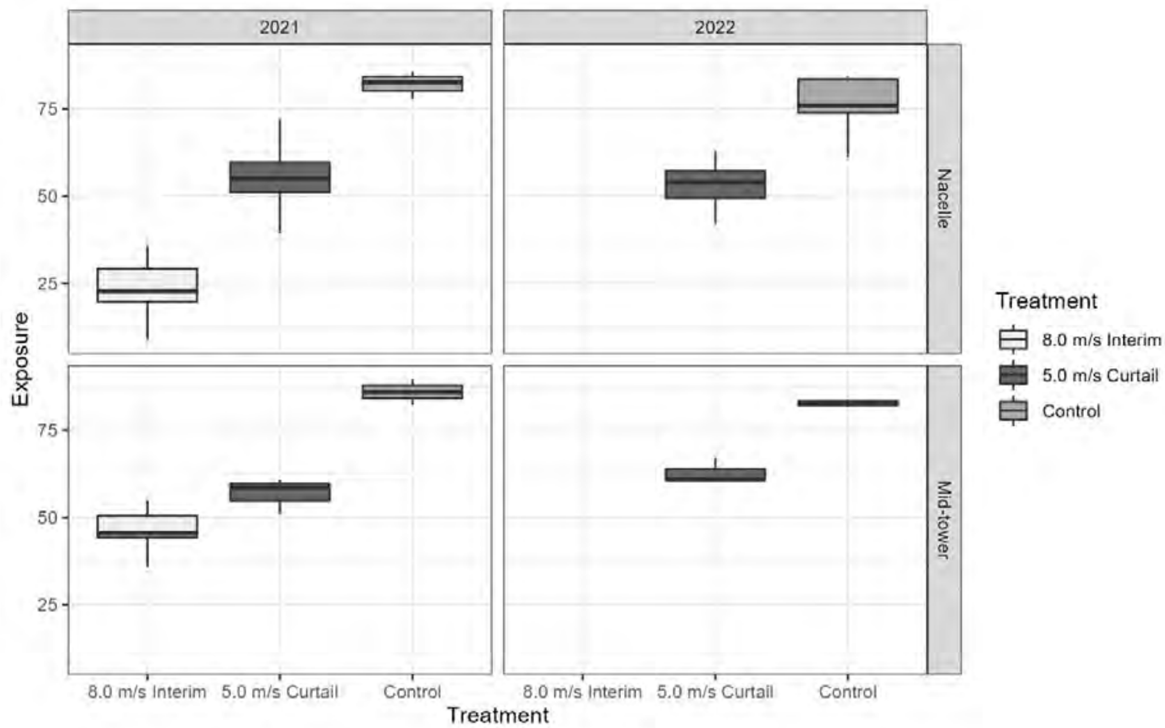

Figure 3-11. Acoustic exposure (percent of bat passes detected when turbine rotor speed was 1 rpm or greater) by operational treatment and detector position during 2021 and 2022 acoustic monitoring at the Kings Point Wind Energy Project. Note that the 8.0 m/s treatment did not occur in 2022.

3.3 NORTH FORK RIDGE

3.3.1 Carcass Searches

A total of 5,930 searches were conducted between April 4 and October 31, 2022, at the North Fork Ridge Wind Project. A summary of search effort by season with total numbers of bats found is presented in Table 3-12. A total of 255 bat carcasses were found during standardized carcass searches, and 3 bat carcasses were found incidentally.

Table 3-12. Summary of post-construction monitoring conducted between April 4 and October 31, 2022, at the North Fork Ridge Wind Project.

Season	Dates	Number of Searches Conducted	Average Search Interval	Number of bats found in standardized searches	Number of bats found incidentally
Spring	April 4 – May 31	1,718	2.33	19	0
Summer	June 1 – August 31	2,515	2.52	206	2
Fall	September 1 – October 31	1,697	2.48	30	1
Total	April 4 – October 31	5,930	2.46	255	3

3.3.2 Species Composition

Of the 255 bat carcasses found during standardized carcass searches, the most common species was the eastern red bat (204 individuals; 80%). The hoary bat (32 individuals; 12.5%) was the second most common species. Next were the big brown bat (8) evening bat (5) and silver-haired bat (4). Lastly, one gray bat and one tri-colored bat were found during standard carcass searches. A summary of all bat carcasses found during the standardized carcass searches is shown in Table 3-13.

Table 3-13. Summary of bat carcasses found during standardized carcass searches between April 4 and October 31, 2022 at the North Fork Ridge Wind Project.

Species	Spring	Summer	Fall	Total
Big Brown Bat *Eptesicus fuscus*	0 0.0%	7 3.4%	1 3.3%	8 3.1%
Eastern Red Bat *Lasiurus borealis*	11 57.9%	172 83.5%	21 70.0%	204 80.0%
Evening Bat *Nycticeius humeralis*	2 10.5%	2 1.0%	1 3.3%	5 2.0%
Gray Bat[1, 2] *Myotis grisescens*	0 0.0%	0 0.0%	1 3.3%	1 0.4%
Hoary Bat[1] *Lasiurus cinereus*	4 21.1%	23 11.2%	5 16.7%	32 12.5%
Silver-haired Bat[1] *Lasionycteris noctivagans*	2 10.5%	1 0.5%	1 3.3%	4 1.6%
Tricolored Bat[1] *Perimyotis subflavus*	0 0.0%	1 0.5%	0 0.0%	1 0.4%

Species	Spring	Summer	Fall	Total
Total	19 7.5%	206 80.8%	30 11.8%	255

[1]Missouri Department of Conservation Species of Conservation Concern
[2]State and Federal listed Endangered

3.3.3 Carcass Persistence

The top five models for CP in GenEst included weibull and exponential distributions, with effects of season and/or plot type (Appendix B, Table B-3). The best model was a Weibull distribution with no effect of plot type or season. We selected this model since it had the lowest AIC and was parsimonious.

CP was tested using 61 carcasses (~10 per plot type per season) and median persistence for the year was 2.38 days (90% CI: 1.74 to 3.22). The results presented in Table 3-14 below are for a model (ΔAICc 1.81) which shows variability in CP between seasons and plot types (Appendix B, Table B-3). Table 3-14 is for reference only and was not used in the final model.

Table 3-14. Carcass persistence during 2022 post-construction monitoring at the Kings Point Wind Project.

Season	Trial Carcasses	Carcass Persistence (90% CI)
Spring	20	2.68 (1.91 – 3.70)
Summer	20	2.22 (1.55 – 3.07)
Fall	21	2.55 (1.86 – 3.44)

3.3.4 Adjusted Fatality Estimates

Fatality rate estimates were calculated based upon the carcasses found during the standardized carcass searches and did not include any incidental finds. Observed bat fatality estimates were adjusted to account for SE, CP, the search schedule, and the turbine-specific DWPs.

3.3.4.1 Seasonal Fatality Estimates

Across all three survey seasons, 255 carcasses were found during standardized searches. The total estimated fatality for all bats was highest during the summer season (2,265 bats), followed by spring (365 bats), and lowest in the fall (321 bats) as summarized in Table 3-15 and Figure 3-12. Annual fatality estimates, combining all seasons, results in an overall bat fatality estimate of 2,968 bats (90% CI: 2,340 – 3,785) across all 69 turbines between March 1 and November 15, 2021 – equivalent to 43 bats/turbine (90% CI: 34 – 55) or 20 bats/MW (90% CI: 16 – 25).

Table 3-15. Bat fatality rates by season from 2022 post-construction monitoring at the North Fork Ridge Wind Project.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities
Spring	March 1 – May 31	364.64 (179.77 – 635.35)	5.28 (2.61 – 9.21)	2.44 (1.20 – 4.25)
Summer	June 1 – August 31	2,265.05 (1,723.34 – 2,977.34	32.83 (24.98 – 43.16)	15.16 (11.54 – 19.93)
Fall	September 1 – November 15	320.61 (165.54 – 511.43)	4.65 (2.40 – 7.41)	2.15 (1.11 – 3.42)
Annual	March 1 – November 15	2,967.78 (2,339.95 – 3,784.5)	43.01 (33.91 – 54.85)	19.86 (15.66 – 25.33)

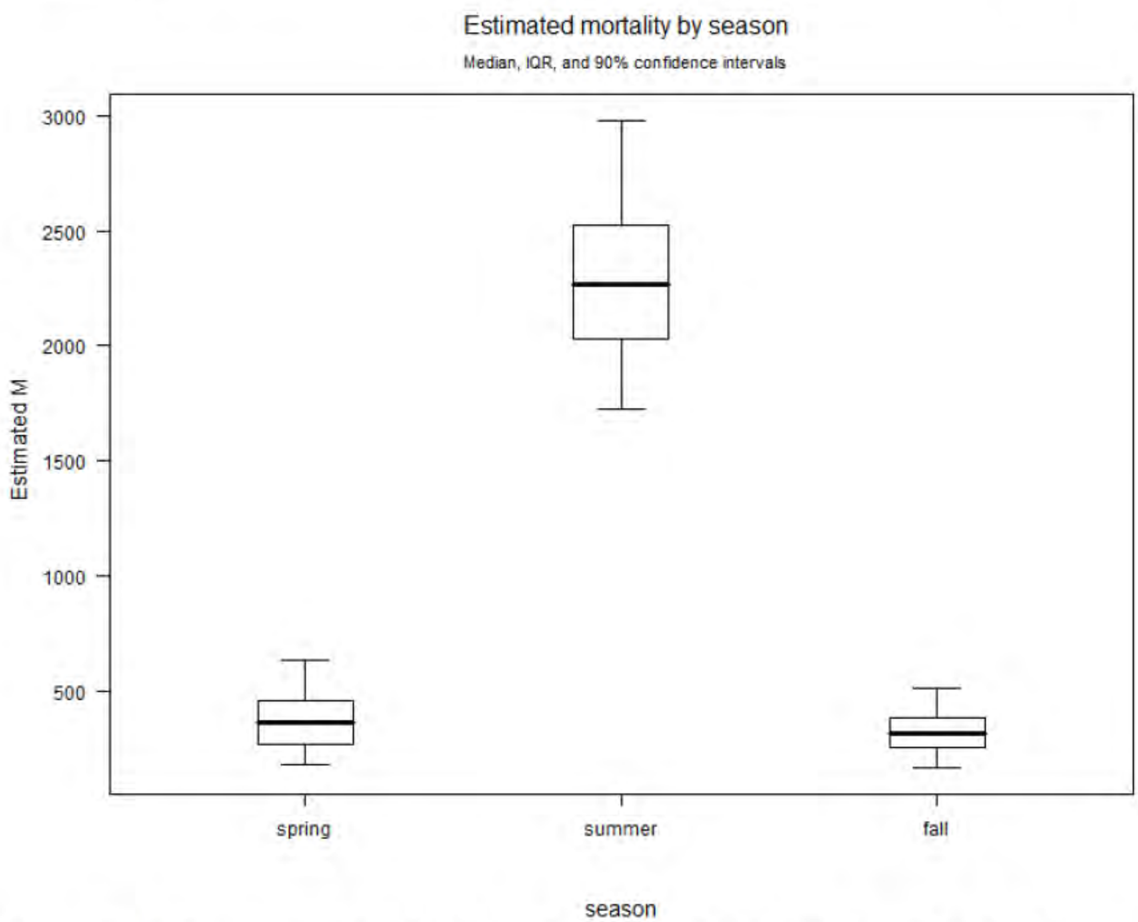

Figure 3-12. Seasonal all bat fatality estimates for 2022 at the North Fork Ridge Wind Project.

3.3.4.2 Control Vs. Treatment Fatality Estimates

Annual fatality estimates were higher for control turbines (3.0 m/s cut-in) than for treatment turbines (5.0 m/s cut-in). Estimated annual bat fatality was 1,688.75 (90% CI: 1,258.2 – 2,260.17) at control turbines and 1,266.91 (90% CI: 930.79 – 1,694.62) at treatment turbines (Figure 3-13). Per turbine estimates are 48.25 (90% CI: 35.95 – 64.58) for control turbines and 37.26 (90% CI: 27.38 – 49.84) for treatment turbines. Per MW estimates are 22.22 (90% CI: 16.56 – 29.74) for control turbines and 17.26 (90% CI: 12.68 – 23.09) for treatment turbines.

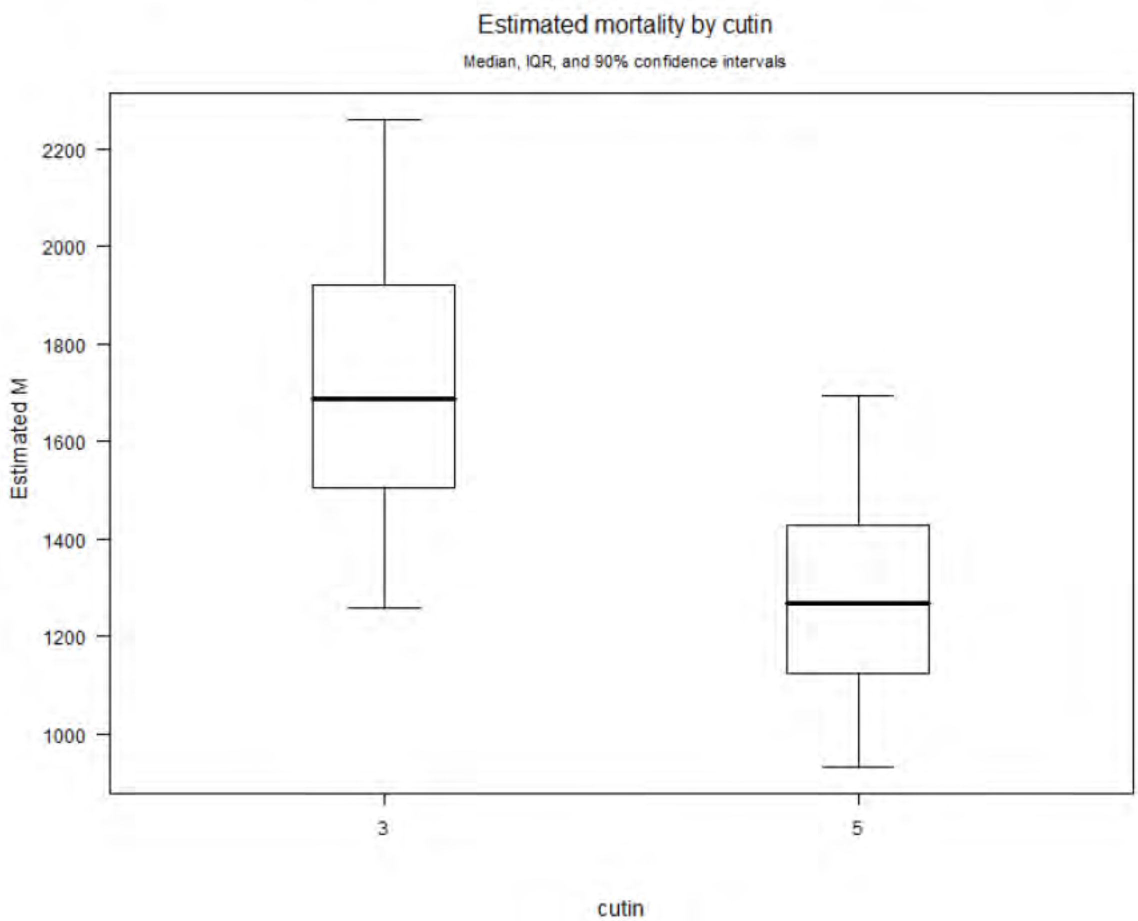

Figure 3-13. All bat fatality estimates at control (3 m/s) vs. treatment (5 m/s) turbines for 2022 at the North Fork Ridge Wind Project.

3.3.5 Gray Bat Fatality Estimates

3.3.5.1 In-hand Fatalities

Stantec found one female gray bat at T103 (treatment turbine) on 9/15/2022 during post-construction fatality monitoring at North Fork Ridge (Appendix A, Figure A-9). No other federal or state endangered species were found.

3.3.5.2 Evidence of Absence

The "Multiple Classes" module was used in EofA. Because searcher efficiency varied by season and plot type, the module was run four times: once for each season (with separate classes for each plot type plus an unsearched proportion), and once for the entire year (with separate classes for each season, and no unsearched portion since proportion of fatalities occurring outside of searched times was accounted for in each of the seasonal runs).

Detection Probability (g)

The detection probability (g) for the post-construction monitoring season (March 1 through November 15, 2022) was 0.143 (95% CI: 0.118 to 0.171); however, this varied by season as summarized in Table 3-16.

Table 3-16. Summary of detection probability (g) by season and overall, during 2022 post-construction monitoring at the North Fork Ridge Wind Project.

Season	Detection Probability (g) and 95% CI
Spring	0.177 (0.132 – 0.226)
Summer	0.147 (0.115 – 0.181)
Fall	0.112 (0.079 – 0.149)
Total/Overall	0.143 (0.118 – 0.171)

3.3.5.3 Fatality Estimates (M* and λ)

Analysis in the EofA "Multiple Years Module" included calculation of the annual take estimate (M_{2022}) and the annual take rate (λ) for gray bats based on the one gray bat carcass found during monitoring. Results are summarized in Table 3-17.

Table 3-17. Summary of EofA outputs for gray bats from 2022 post-construction monitoring at the North Fork Ridge Wind Project. Analysis done with α=0.5.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2022})	Annual Take Rate (λ) (95% CI)
Gray Bat	1	8	10.6 (0.755 – 33.4)

3.3.6 Acoustic Monitoring

3.3.6.1 2021 Monitoring

Bat detectors were installed on the nacelles of 15 WTGs and 20 m up on the mast of 5 WTG's at North Fork Ridge. Installation occurred between August 4, 2021 and August 23, 2021, and detectors were demobilized for winter between December 20, 2021 and early January 2022 (though data analysis here is limited to the period through December 31, 2021).

Acoustic detectors recorded a total of 31,799 bat passes during 2,367 successful detector-nights (88% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) and mid-tower detectors (n = 5) recorded 3.7 and 43.2 bat passes per detector-night, respectively, during the 2021 monitoring period (Table 3-18).

Table 3-18. Acoustic survey effort at the North Fork Ridge Wind Project from August through November 2021.

Turbine and Position	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	23-Aug	31-Dec	131	0	3	277	2.1
[redacted]	20-Aug	31-Dec	134	0	7	273	2.0
[redacted]	23-Aug	31-Dec	131	0	4	259	2.0
[redacted]	4-Aug	20-Dec	115	19	158	3278	28.5
[redacted]	23-Aug	31-Dec	131	0	1	231	1.8
[redacted]	4-Aug	20-Dec	113	23	128	4107	36.3
[redacted]	24-Aug	31-Dec	130	0	3	260	2.0
[redacted]	20-Aug	31-Dec	82	0	1	296	3.6
[redacted]	20-Aug	31-Dec	134	0	1	333	2.5
[redacted]	18-Aug	31-Dec	136	0	5	514	3.8
[redacted]	20-Aug	31-Dec	134	0	2	495	3.7
[redacted]	20-Aug	31-Dec	134	1	6	383	2.9
[redacted]	3-Aug	20-Dec	118	20	116	5257	44.6
[redacted] N [redacted]	16-Aug	31-Dec	100	0	3	758	7.6

Turbine and Position	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	19-Aug	31-Dec	135	0	3	429	3.2
[redacted]	4-Aug	20-Dec	123	37	238	6194	50.4
[redacted]	16-Aug	31-Dec	78	1	12	1070	13.7
[redacted]	4-Aug	20-Dec	116	113	512	6414	55.3
[redacted]	20-Aug	31-Dec	58	4	3	534	9.2
[redacted]	20-Aug	31-Dec	134	0	2	437	3.3
Nacelle Detectors, 2021	-	-	1,782	6	56	6,549	3.7
Mid-tower Detectors, 2021	-	-	585	212	1,152	25,250	43.2
Total, 2021	-	-	2,367	218	1,208	31,799	13.4

3.3.6.2 2022 Monitoring

Acoustic detectors were redeployed on turbine nacelles in mid-February 2022 and mid-tower locations in mid-April, 2022 and demobilized between mid-November and early December 2022. Acoustic detectors recorded a total of 55,919 bat passes during 3,510 successful detector-nights (69% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) and mid-tower detectors (n = 5) recorded 3.6 and 48.5 bat passes per detector-night, respectively, during the 2022 monitoring period (Table 3-19). Gray bats and tricolored bats were detected at most detectors during the 2022 monitoring period, with most detections occurring at mid-tower detectors (Table 3-19).

Table 3-19. Acoustic survey effort at the North Fork Ridge Wind Project from February through December 2022.

Turbine and Position	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	28-Feb	20-Nov	266	4	13	1,380	5.2
[redacted]	28-Feb	6-Dec	123	0	2	203	1.7
[redacted]	28-Feb	20-Nov	181	0	2	258	1.4
[redacted]	19-Apr	12-Nov	206	40	216	7,202	35.0
[redacted]	28-Feb	27-Nov	217	0	0	215	1.0
[redacted]	19-Apr	9-Nov	203	90	238	10,371	51.1
[redacted]	28-Feb	6-Dec	282	11	0	1,752	6.2
[redacted]	28-Feb	20-Nov	208	2	2	999	4.8
[redacted]	28-Feb	27-Nov	273	1	8	948	3.5
[redacted]	28-Feb	6-Dec	89	1	1	152	1.7
[redacted]	2-Mar	20-Nov	225	2	3	450	2.0
[redacted]	28-Feb	21-Nov	91	0	0	88	1.0

Turbine and Position	Start Date	End Date	Detector Nights (DN)	MYGR Bat Passes	PESU Bat Passes	Total Bat Passes	Overall Rate (bat passes/DN)
[redacted]	19-Apr	9-Nov	160	20	149	8,213	51.3
[redacted]	2-Mar	21-Nov	114	3	0	176	1.5
[redacted]	2-Mar	20-Nov	81	0	0	240	3.0
[redacted]	19-Apr	6-Nov	199	76	190	12,244	61.5
[redacted]	28-Feb	21-Nov	267	2	4	1,640	6.1
[redacted]	19-Apr	7-Nov	199	204	662	8,856	44.5
[redacted]	28-Feb	21-Nov	19	0	0	107	5.6
[redacted]	2-Mar	6-Dec	107	1	5	425	4.0
Nacelle Detectors, 2022	-	-	2,543	27	40	9,033	3.6
Mid-tower Detectors, 2022	-	-	967	430	1,455	46,886	48.5
Total, 2022	-	-	3,510	457	1,495	55,919	15.9

3.3.6.3 Acoustic Results

Gray bats and tricolored bats were detected at most detectors during the 2021 and 2022 monitoring periods, with most detections occurring at mid-tower detectors (Figure 3-14).

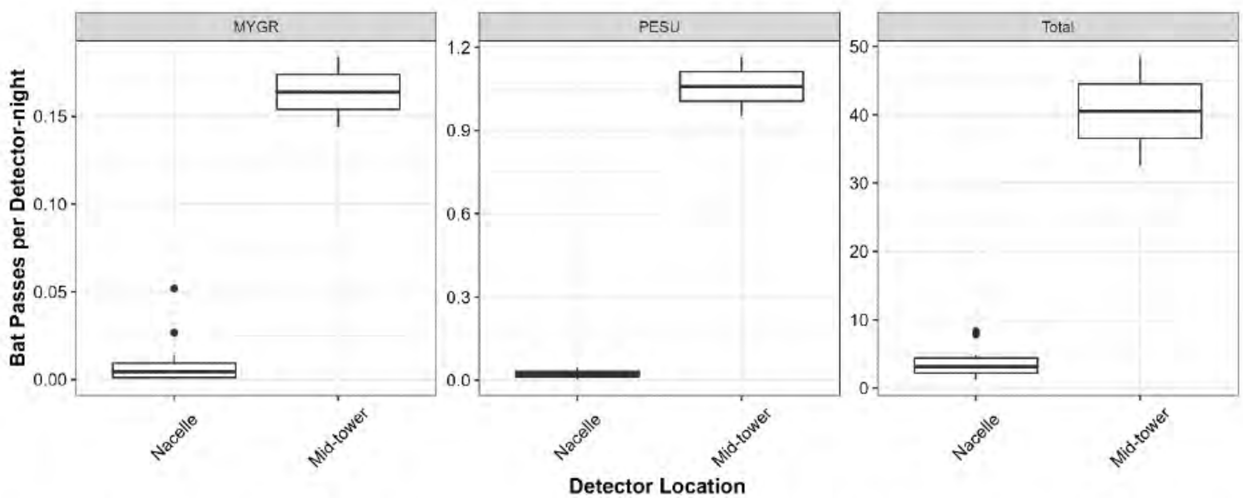

Figure 3-14. Gray bat (MYGR), tricolored bat (PESU), and all bat passes (Total) recorded per detector night at nacelle-mounted versus mid-tower detectors during 2021 and 2022 monitoring at the North Fork Ridge Wind Project. Note differing y-axis scales among plot facets.

Acoustic bat activity followed similar seasonal patterns at nacelle and mid-tower detectors, with a slight peak in activity in mid-May and a pronounced peak in mid-August (Figure 3-15). Although timing of bat activity varied among nights, overall timing of bat activity peaked 1–3 hours after sunset at nacelle and mid-tower detectors for all bat species and the subset of passes identified as gray bats and tricolored bats (Figure 3-16, Figure 3-17, Figure 3-18).

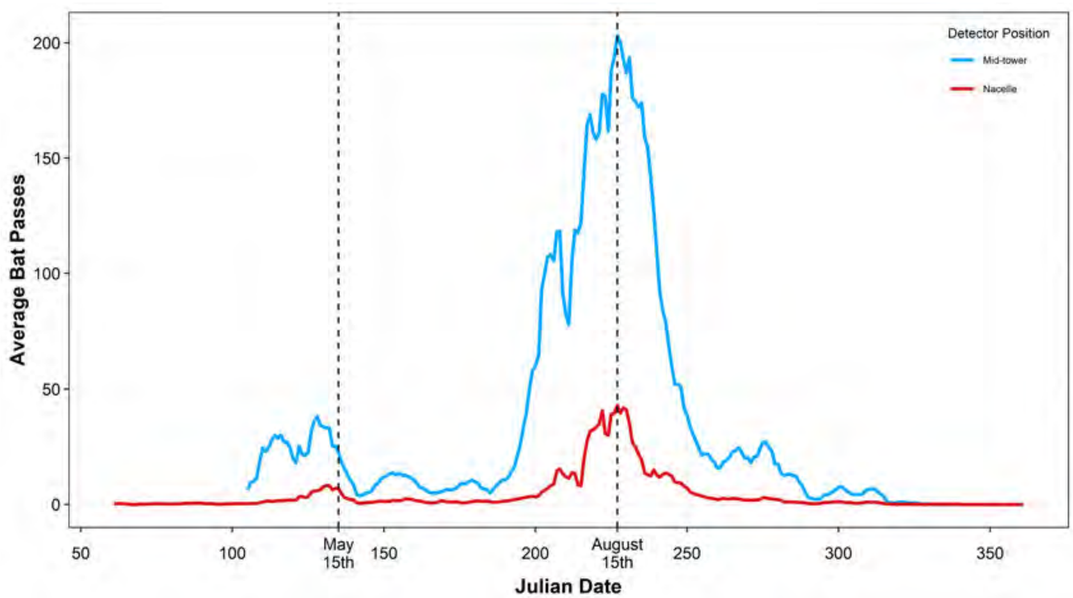

Figure 3-15. 7-day moving average (BP/DN) of acoustic bat activity (all species) detected during the 2021 and 2022 monitoring periods at the North Fork Ridge Wind Project. Data from both years were combined and displayed by Julian date (days since January 1; May 15th and August 15th are displayed on the figure for reference to bat maternity season).

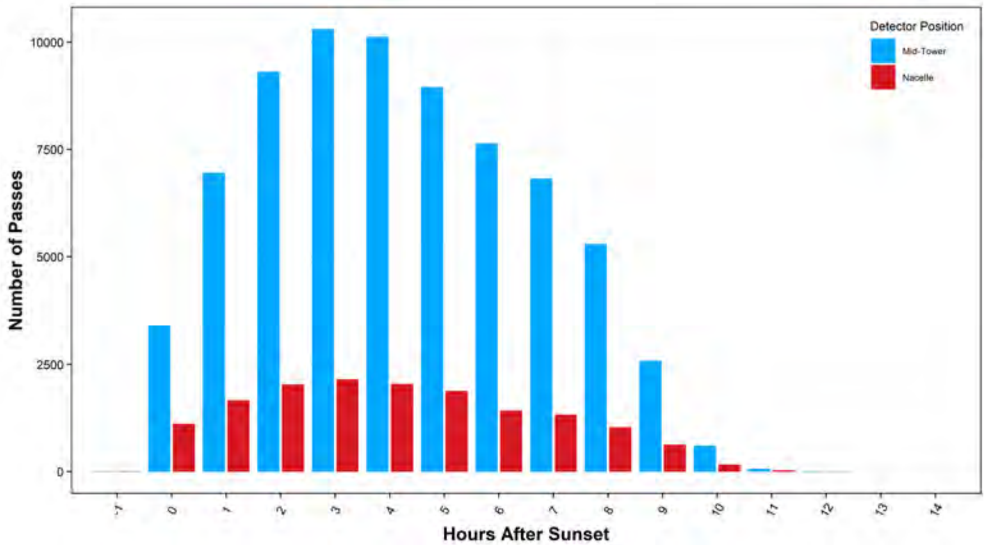

Figure 3-16. Nightly timing of total bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods the North Fork Ridge Wind Project.

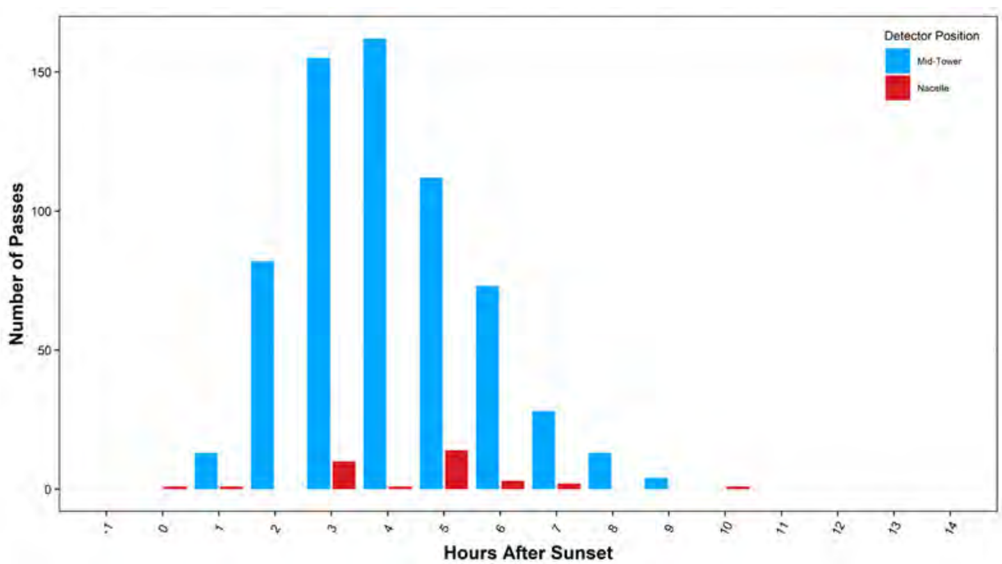

Figure 3-17. Nightly timing of gray bat (*Myotis grisescens*) bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods at the North Fork Ridge Wind Project.

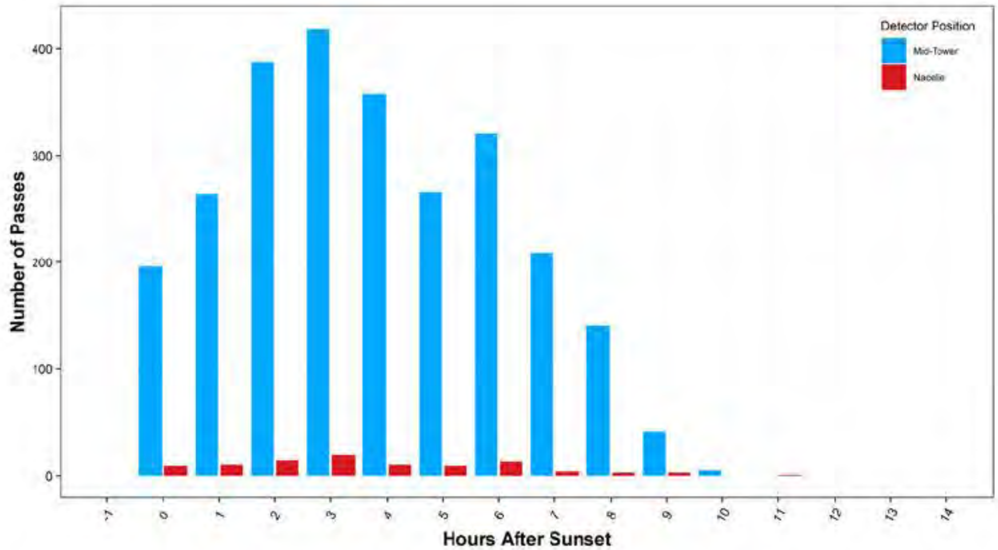

Figure 3-18. Nightly timing of tricolored bat (*Perimyotis subflavus*) bat activity (by hour past sunset) detected at nacelle and mid-tower detectors during the 2021 and 2022 monitoring periods at the North Fork Ridge Wind Project.

Temperature, wind speed, and turbine rotor speed data were available during 10-minute intervals in which 83,048 bat passes (95% of 87,718 total bat passes) were detected at North Fork Ridge in 2021 and 2022. We used these data to evaluate the distribution of bat activity as a function of temperature and wind speed and to calculate the percent and rate (passes per detector night) of bat passes exposed to turbine operation. Most bat passes occurred during relatively warm conditions with wind speeds less than 8 m/s (Figure 3-19, Figure 3-20, Figure 3-21).

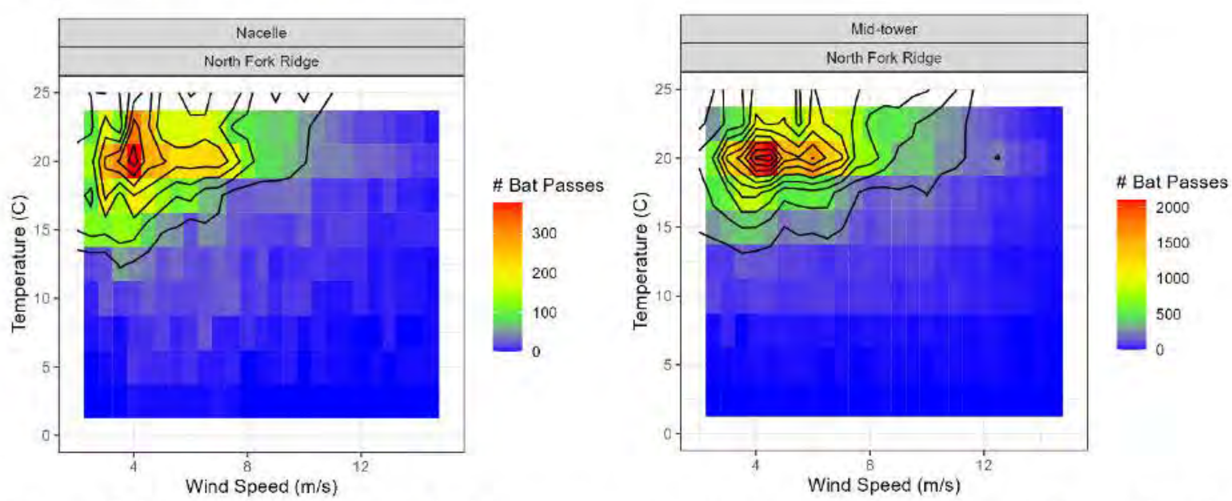

Figure 3-19. Distribution of all bat passes (all species) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the North Fork Ridge Wind Project.

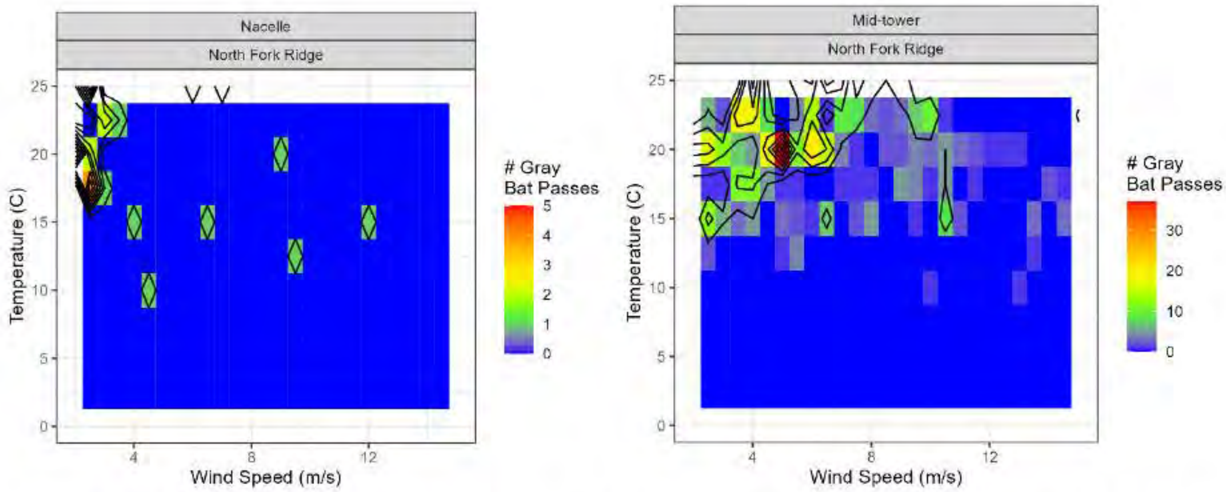

Figure 3-20. Distribution of gray bat passes (Myotis grisescens) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the North Fork Ridge Wind Project.

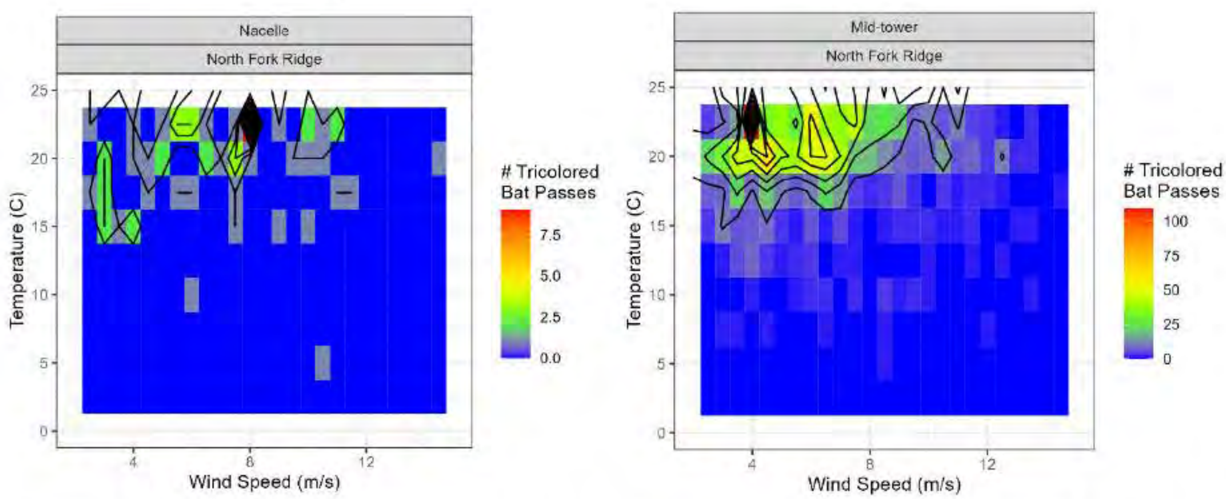

Figure 3-21. Distribution of tricolored bat passes (Perimyotis subflavus) as a function of wind speed and temperature by detector position during 2021 and 2022 acoustic monitoring at the North Fork Ridge Wind Project.

Acoustic monitoring at North Fork Ridge in 2021 and 2022 encompassed periods in which three turbine operational treatments were implemented. Before August 30, 2021, all turbines were operated according to an interim (TAL) curtailment strategy with an 8 m/s cut-in speed. From August 30 – October 31, 2021 and April 1–October 31, 2022, approximately half of the 69 turbines (n = 34) were operated according to a treatment blanket curtailment strategy with 5.0 m/s cut-in speed, and the remaining 35 turbines were feathered below manufacturer's cut-in speed (3.0 m/s) to provide an operational control. The 15 turbines monitored for acoustic bat activity included 8 from the treatment group (5.0 m/s) and 7 from the control group (3.0 m/s).

The interim (TAL) curtailment strategy implemented before August 30, 2021 exposed 38% of bat passes recorded at nacelles and 40% of bat passes recorded at mid-tower detectors to turbine operation (exposed passes are defined as those detected when 10-minute turbine rotor speed exceeded 1 rpm). The 5.0 m/s blanket curtailment strategy resulted in exposure of 46–55% of bat passes detected at nacelles and 54–61% of passes detected at mid-tower units in 2021 and 2022 compared to exposure of 79–86% of passes detected at feathered control turbines (Table 3-20,Figure 3-22). Exposure of gray bat and tricolored bat passes to turbine operation generally followed similar trends among treatments at both detector positions during the 2021 and 2022 monitoring period (Table 3-20).

Table 3-20. Acoustic exposure of gray bat (MYGR), tricolored bat (PESU), and all bat passes to turbine operation (detection when turbine rotor speed > 1 rpm) associated with operational treatments implemented during the 2021 and 2022 monitoring period at the North Fork Ridge Wind Project.

Year	Detector Position	Treatment	# Turb.	Bat Passes MYGR	Bat Passes PESU	Total Bat Passes	Exposed Bat Passes (%) MYGR	Exposed Bat Passes (%) PESU	Total Exposed Bat Passes (%)
2021	Nacelle	8.0 m/s TAL	15	1	39	4,666	0 (0%)	16 (41%)	1,771 (38%)
2021	Nacelle	5.0 m/s Treatment	8	5	7	957	0 (0%)	5 (71%)	529 (55%)
2021	Nacelle	3.0 m/s Control	7	0	8	738	n/a	6 (75%)	587 (80%)
2021	Mid-tower	8.0 m/s TAL	5	112	1051	20,651	51 (46%)	311 (30%)	8,193 (40%)
2021	Mid-tower	5.0 m/s Treatment	3	76	75	2,658	45 (59%)	42 (56%)	1,609 (61%)
2021	Mid-tower	3.0 m/s Control	2	24	25	1,688	20 (83%)	23 (92%)	1,387 (82%)
2022	Nacelle	5.0 m/s Treatment	8	8	9	2,410	1 (13%)	7 (78%)	1,108 (46%)
2022	Nacelle	3.0 m/s Control	7	19	30	5,654	9 (47%)	29 (97%)	4,441 (79%)
2022	Mid-tower	5.0 m/s Treatment	3	247	814	22,190	140 (57%)	427 (52%)	11,926 (54%)
2022	Mid-tower	3.0 m/s Control	2	153	390	20,628	129 (84%)	306 (78%)	17,825 (86%)

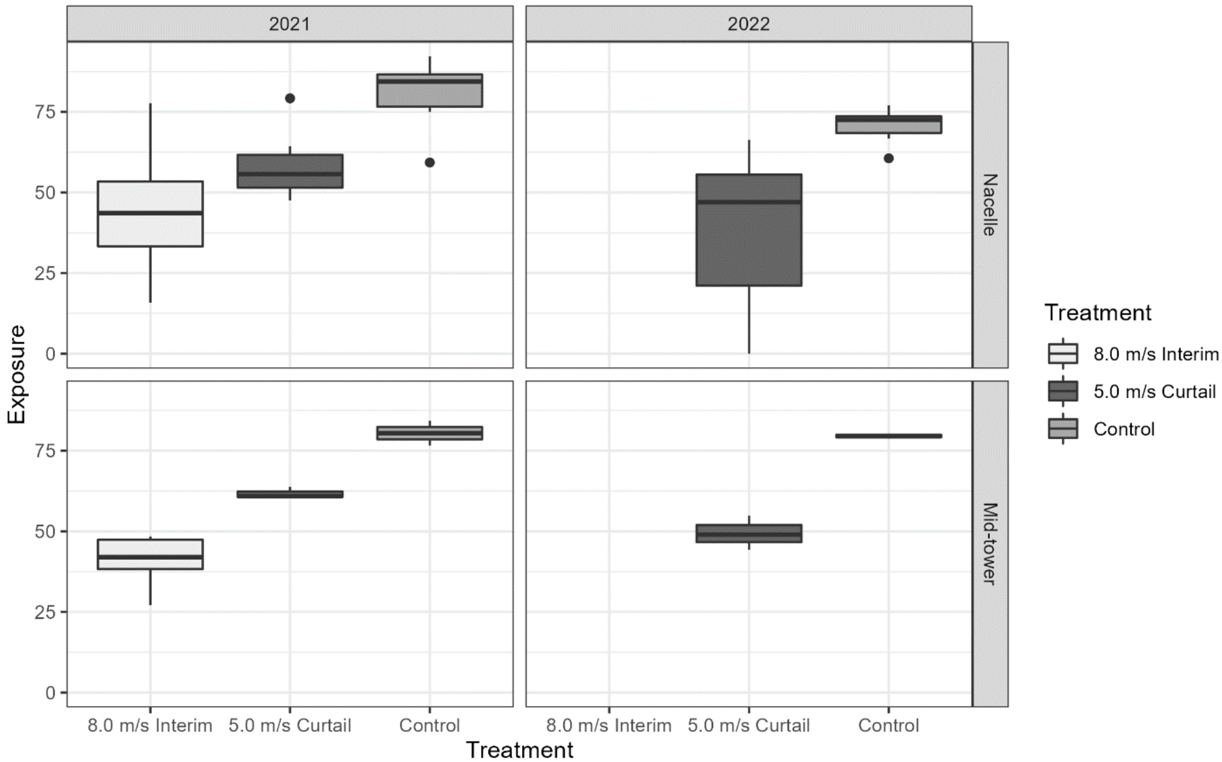

Figure 3-22. Acoustic exposure (percent of bat passes detected when turbine rotor speed was 1 rpm or greater) by operational treatment and detector position during 2021 and 2022 acoustic monitoring at the North Fork Ridge Wind Energy Project. Note that the 8.0 m/s treatment did not occur in 2022.

3.4 ACOUSTIC EXPOSURE AND FATALITY

The median bat fatality for the blanket 5.0 m/s curtailment treatment was 38% and 25% lower than that for the feathered control strategy at Kings Point and North Fork Ridge, respectively, during the 2022 monitoring period. For the same period, percent of bat passes exposed to turbine operation was 32% and 40% lower at the 5.0 m/s curtailment strategy than the feathered control at Kings Point and North Fork Ridge, respectively, based on nacelle-height acoustic detectors (Table 3-21). Mid-tower detectors documented a 25% decrease in exposure at Kings Point and 38% decrease in exposure at North Fork Ridge at the 5.0 m/s treatment compared to the feathered control strategy. Overall, the percent of bat passes exposed to turbine operation was similar between the two Projects for corresponding treatments (Table 3-21).

Table 3-21. Estimated bat fatality and acoustic exposure during the 2022 monitoring period at the Kings Point and North Fork Ridge Wind Projects.

Site	Treatment	# Bat Carcasses	Median Fatality Est.	Nacelle Acoustic Exposure Exposed Passes/DN	Nacelle Acoustic Exposure Percent	Mid-tower Acoustic Exposure Exposed Passes/DN	Mid-tower Acoustic Exposure Percent
Kings Point	Control (3.0 m/s)	150	2,849	1.73	82.0%	17.42	86.9%
Kings Point	Treatment (5.0 m/s)	123	1,759	1.6	55.9%	12.24	65.5%
North Fork Ridge	Control (3.0 m/s)	170	1,689	1.95	78.8%	23.18	86.5%
North Fork Ridge	Treatment (5.0 m/s)	85	1,267	0.84	47.1%	11.66	53.9%

Bat activity levels and the corresponding rate of acoustic exposure varied substantially among weeks, following consistent seasonal patterns at Kings Point and North Fork Ridge in 2022, with the highest levels occurring in mid-August through mid-September (Figure 3-23, Figure 3-24).

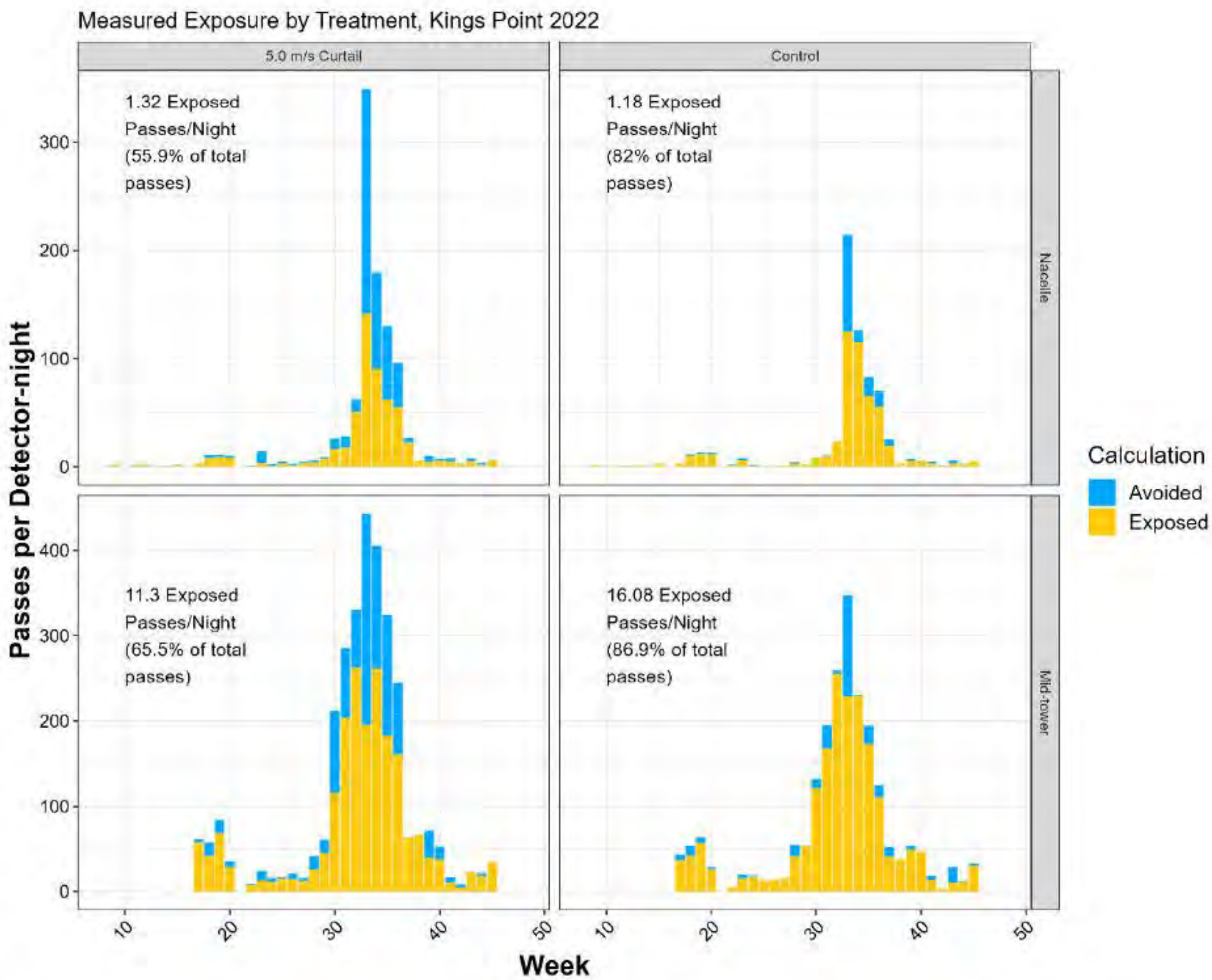

Figure 3-23. Rate of acoustic exposure (bat passes detected when turbine rotor speed was 1 rpm or greater) calculated per detector-night on a weekly basis by operational treatment and detector position during 2022 acoustic monitoring at the Kings Point Wind Energy Project.

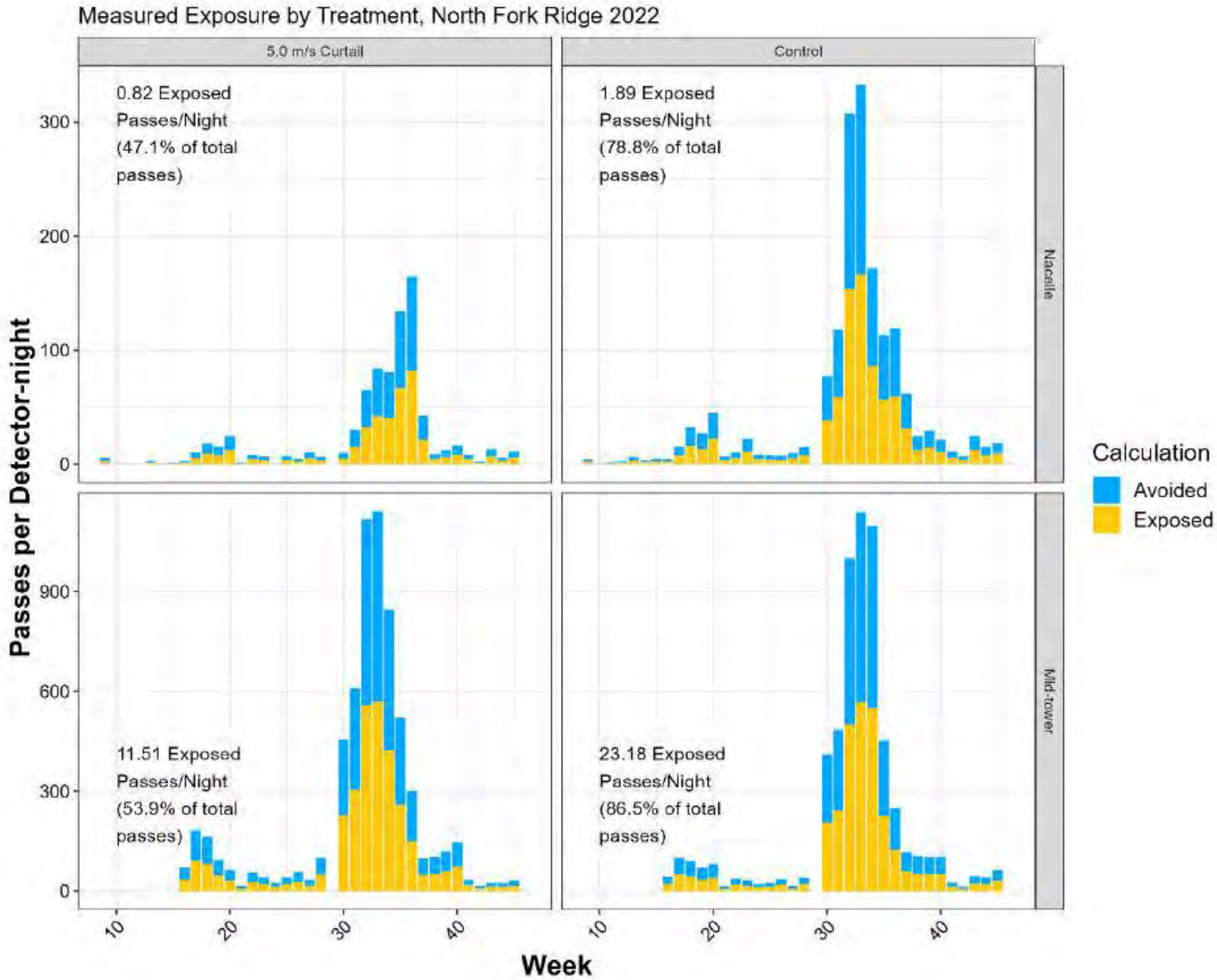

Figure 3-24. Rate of acoustic exposure (bat passes detected when turbine rotor speed was 1 rpm or greater) calculated per detector-night on a weekly basis by operational treatment and detector position during 2022 acoustic monitoring at the North Fork Ridge Wind Energy Project. The gap in data during week 29 was due to a project-wide shutdown that prevented collection of weather and turbine rpm data with which to determine acoustic exposure.

The amount of exposed bat activity measured per week explained a significant amount of variation in the number of bat carcasses found per turbine search when fatalities and acoustic data were pooled across turbines (Figure 3-25). The relationship was similar between Projects and was evident using datasets from nacelle and mid-tower acoustic detectors.

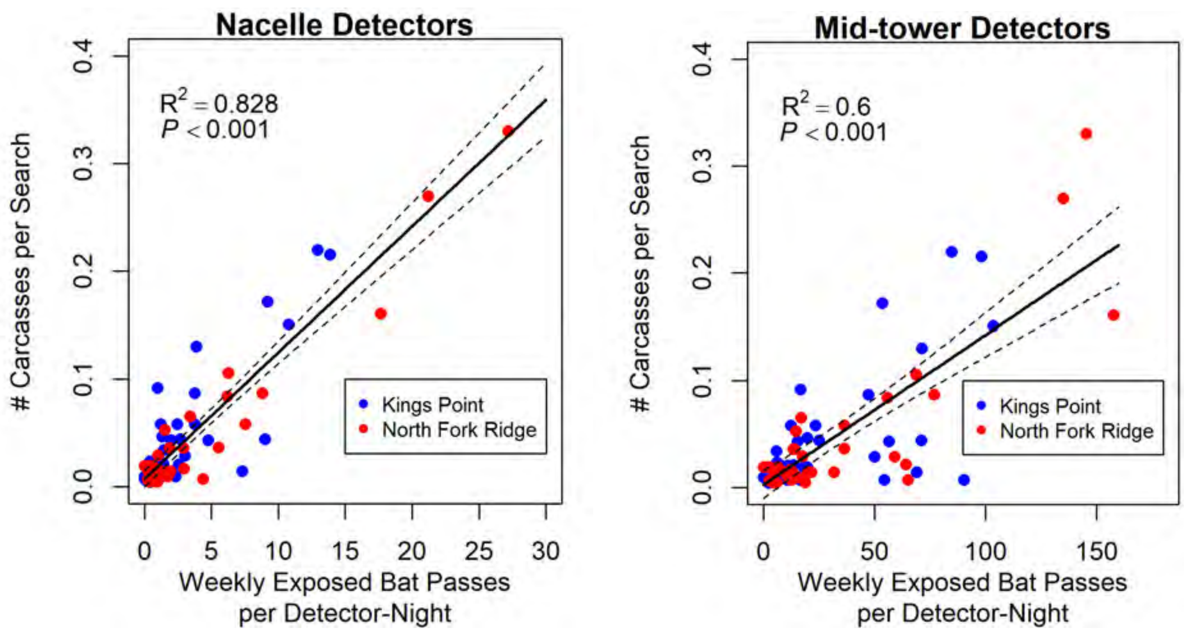

Figure 3-25. Bat carcasses found per search per week as a function of the number of bat passes exposed to turbine operation per week during 2022 monitoring at the Kings Point and North Fork Ridge Wind Energy Projects.

The number of bat carcasses found per turbine, when multiplied by the number or searches and the density-weighted proportion of carcass distribution at corresponding turbines to generate, also showed a positive relationship with the exposed rate of bat passes measured per turbine, although this relationship was weaker than the correlation between weekly exposure and carcass counts (Figure 3-26).

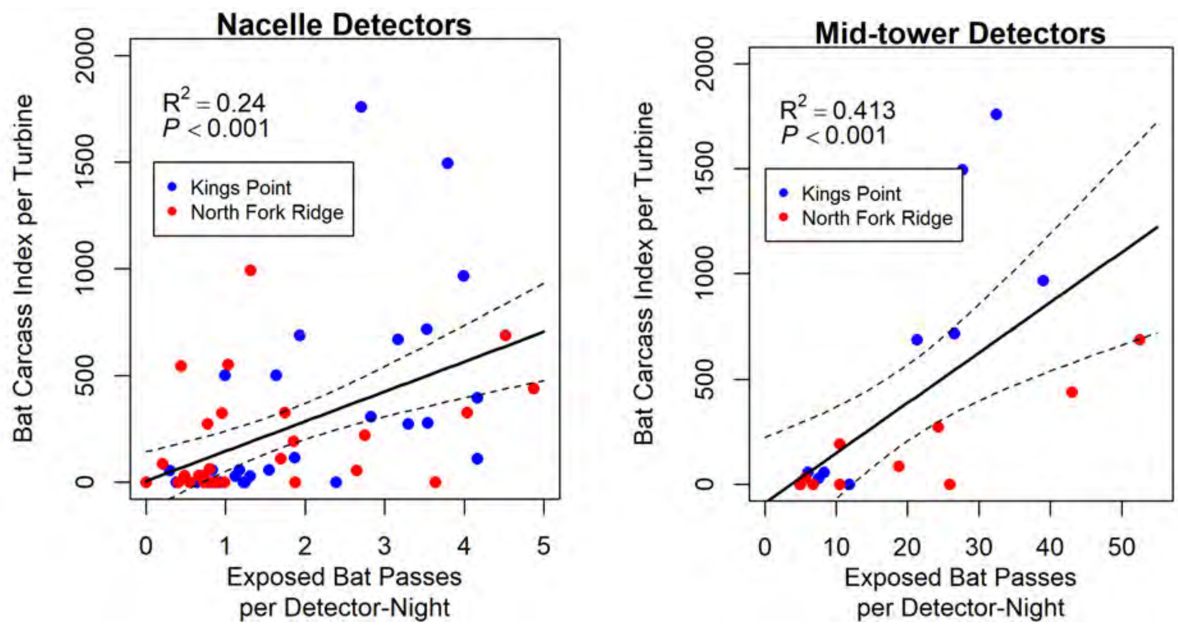

Figure 3-26. Index of bat carcasses per turbine as a function of the number of bat passes exposed to turbine operation per week during 2022 monitoring at the Kings Point and North Fork Ridge Wind Energy Projects.

4.0 DISCUSSION

This report includes the results of the 2022 post-construction fatality monitoring, and the results of the 2021 and 2022 acoustic survey. These surveys are ongoing, and additional data will be collected in 2023-2025 which will further inform the study objectives. Although only one full year of monitoring has been completed for the study (2022; Phase 1, Year 1), results from monitoring in 2021 and 2022 provide insight about gray bat activity and fatality at two operational wind farms. Ten gray bat fatalities have been recorded at the Projects in 2021 and 2022 (Table 4-1).

Table 4-1. Summary of gray bat fatalities observed in 2021 and 2022 at Kings Point Wind Project and North Fork Ridge Wind Project

Project	Date	Turbine	Treatment	Sex
Kings Point	8/16/2021	[redacted]	8.0 m/s	Female
Kings Point	9/16/2021	[redacted]	5.0 m/s	Female
Kings Point	9/23/2021	[redacted]	3.0 m/s	Male
Kings Point	9/24/2021	[redacted]	5.0 m/s	Female
Kings Point	6/29/2022	[redacted]	3.0 m/s	Female
Kings Point	7/26/2022	[redacted]	3.0 m/s	Female
Kings Point	7/28/2022	[redacted]	5.0 m/s	Female
Kings Point	9/6/2022	[redacted]	5.0 m/s	Female
Kings Point	10/5/2022	[redacted]	3.0 m/s	Female
North Fork Ridge	9/15/2022	[redacted]	5.0 m/s	Female

The gray bat fatality trend can be summarized as being highest during late summer and fall and mostly composed of females (90%). Maternity colonies are present in proximity to the Projects, which may explain the prevalence of females as observed fatalities. No gray bat fatalities were observed during the spring season (April 1 – May 31), 40% of fatalities occurred during the summer season (June 1 – August 31) and 60% of the fatalities occurred during the fall season (September 1 – October 31).

4.1 TURBINE-RELATED FATALITY RATES FOR GRAY BATS

Annual turbine-related gray bat fatality rates varied by year and by Project and ranged from 7.66 gray bats at North Fork Ridge in 2021 to 45.7 gray bats at Kings Point in 2022 (Table 4-2). Annual gray bat take rates have been 4-5 times higher at Kings Point compared to North Fork Ridge. Take rates at both Projects were higher in 2022 than they were in 2021 which is likely due to differences in the curtailment strategy.

Table 4-2. Summary of turbine-related gray bat fatality rates from 2021 and 2022 at Kings Point Wind Project and North Fork Ridge Wind Project.

Project	Year	Curtailment	Annual Take Rate
Kings Point	2021	8 m/s, 5 m/s, 3 m/s	38.6 (11.40 – 82.62)
Kings Point	2022	5 m/s, 3 m/s	45.7 (15.2 – 94.72)
North Fork Ridge	2021	8 m/s, 5 m/s, 3 m/s	7.66 (0.01 – 38.88)
North Fork Ridge	2022	5 m/s, 3 m/s	10.6 (0.755 – 33.4)

4.2 RELATIONSHIP BETWEEN EXPOSED BAT ACTIVITY AND FATALITY

Acoustic detectors deployed at 15 turbines at Kings Point and 15 turbines at North Fork Ridge documented pronounced seasonal patterns in bat activity that were consistent between sites and provided a quantitative metric of exposure that was positively correlated with bat fatality rates on multiple temporal and spatial scales. At both sites, curtailing turbine operation at wind speeds below 5.0 m/s reduced estimated bat fatality rates and the percent of bat passes exposed to turbine operation by a similar relative margin (See Section 3.4). Bat fatality and acoustic exposure were strongly correlated at the weekly level, suggesting that variation in acoustic exposure provides a useful indicator of fatality risk on fine temporal scales (Figure 3-25). The positive relationship between acoustic exposure and bat fatality on a per-turbine basis also suggests that acoustic exposure may be useful for understanding variation in risk on spatial scales, although this relationship was weaker, potentially due to the large number of factors that could affect spatial variation in risk to bats.

Acoustic monitoring in 2021 and 2022 provides an early indication that acoustic exposure is a useful indicator of risk to bats that can be analyzed at fine temporal scales and on a species-specific basis. Although monitoring has focused on nacelle-height detectors, mid-tower detectors provided a useful supplement and yielded substantially higher sample sizes for rare species. Mid-tower detectors confirmed that substantially more bat activity occurs near ground level compared to at nacelle height, aligning with results from similar surveys conducted at other wind projects (Stantec, unpublished data) and in pre-construction surveys. Additional monitoring at Kings Point and North Fork Ridge from 2023 through 2025 will enable more rigorous evaluation of relationships between acoustic exposure and bat fatality rates on multiple temporal and spatial scales.

5.0 REFERENCES

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Dalthorp, D.H., J. Simonis, L. Madsen, M.M. Huso, P. Rabie, J.M. Mintz, R. Wolpert, J. Studyvin, F. Korner-Nievergelt. 2018. Generalized Mortality Estimator (GenEst) - R code & GUI: U.S. Geological Survey Software Release. Available at https://doi.org/10.5066/P9O9BATL.

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Appendix A FIGURES

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08398

-01-27
-01-28
-01-28

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[redacted]

Figure No.
A-4

Title
Kings Point Turbine Operational Curtailment

Client/Project 193708398
Empire District Electric Company
Kings Point Wind Project

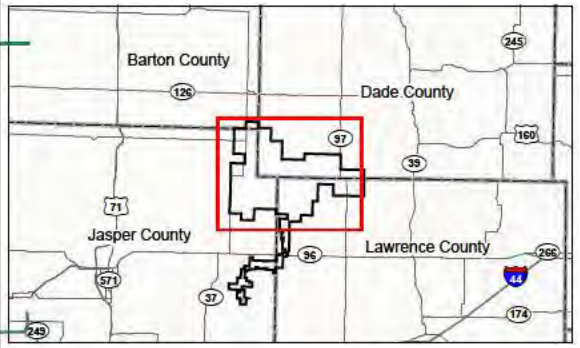
Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 0 5 1 Miles
(At original document size of 11x17)
1 63,360

Legend
Project Boundary
Turbine
Cut-in Speed
Control (3 m/s)
Treatment (5 m/s)



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

for verifying the accuracy and completeness of the data.

[redacted]

Figure No.
A-5

Title
North Fork Ridge Turbine Operational Curtailment

Client/Project 193708398
Empire District Electric Company
North Fork Ridge Wind Project

Project Location
Barton and Jasper Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 2,000 4,000
US Feet
(At original document size of 11x17)
1:48,000

Legend
Project Boundary
Turbine
Cut-in Speed
Control (3 m/s)
Treatment (5 m/s)

Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

[redacted]

Figure No.

A-6

Title

Kings Point Post Construction Fatality Monitoring Turbine Bat Detector Type

Client/Project 193708398

Empire District Electric Company
Kings Point Wind Project

Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 0.5 1 Miles

(At original document size of 11x17)
1:63,360

Legend

Project Boundary

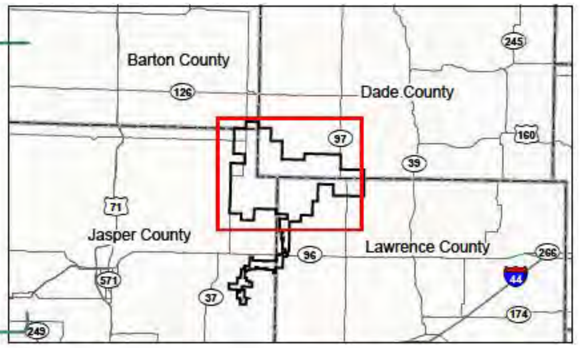
Turbine

Detector Type

Nacelle

Nacelle and Mid-Tower

No Detector



Notes

1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

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[redacted]

Figure No.
A-7

Title
North Fork Ridge Post Construction Fatality Monitoring Turbine Bat Detector Type

Client/Project 193708398
Empire District Electric Company
North Fork Ridge Wind Project

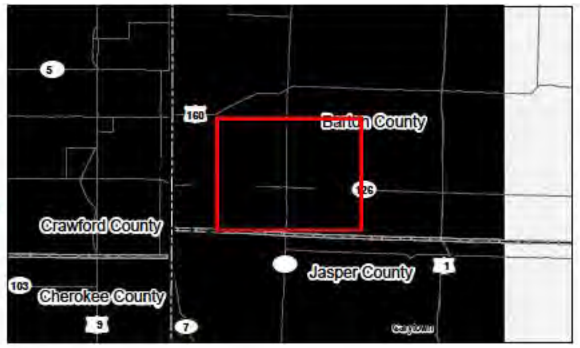
Project Location
Barton and Jasper Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

N

0 2,000 4,000 US Feet
(At original document size of 11x17)
1:48,000

Legend
Project Boundary
Turbine
Detector Type
Nacelle
Nacelle and Mid-Tower
No Detector



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
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[redacted]

Figure No.
A-8

Title
Kings Point Post Construction Fatality Monitoring Gray Bat Observations

Client/Project 193708398
Empire District Electric Company
Kings Point Wind Project

Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

Prepared by SP on 2023-01-26
TR by ML on 2023-01-26
IR by XX on 2023-XX-XX

N

0 0 5 1 Miles
(At original document size of 11x17)
1 63,360

Legend

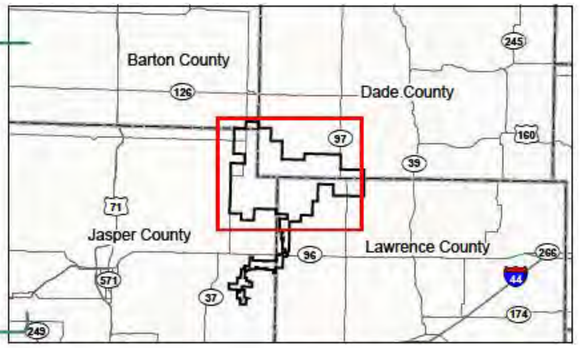
Project Boundary

Gray Bat Observation

Turbine Cut-in Speed

Control (3 m/s)

Treatment (5 m/s)



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

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[redacted]

Figure No.

A-9

Title

North Fork Ridge Post Construction Fatality Monitoring Gray Bat Observations

Client/Project 193708398

Empire District Electric Company
North Fork Ridge Wind Project

Project Location
Barton and Jasper Co., MO

Prepared by SP on 2023-01-26
TR by ML on 2023-01-26
IR by XX on 2023-XX-XX

N

0 2,000 4,000 US Feet
(At original document size of 11x17)
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Legend

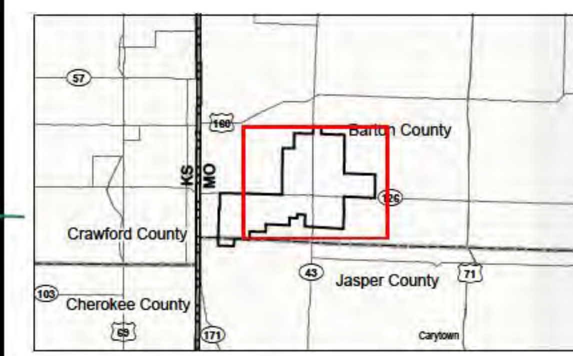
Project Boundary

Gray Bat Observation

Turbine
Cut-in Speed

Control (3 m/s)

Treatment (5 m/s)



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2020 NAIP

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Appendix B GENEST MODEL RESULTS

Table B-1. Model comparison results for searcher efficiency trials conducted 2022 at the Kings Point and North Fork Ridge Wind Projects. Selected model shown in bold.

p Formula	k Formula	AICc	deltaAICc
p ~ searcher + plot_type + season + plot_type:season	**k fixed at 0.67**	**578.93**	**0**
p ~ searcher + plot_type + season	k fixed at 0.67	580.61	1.68
p ~ plot_type + season	k fixed at 0.67	582.93	4

Table B-2. Model comparison results for carcass persistence trials conducted in 2022 at the Kings Point Wind Project. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AICc	deltaAICc
weibull	**l ~ season**	**s ~ season**	**259.98**	**0**
exponential	l ~ plot_type + season	NULL	260.27	0.29
exponential	l ~ season	NULL	260.29	0.31
exponential	l ~ plot_type * season	NULL	261.87	1.89
weibull	l ~ plot_type + season	s ~ constant	262.18	2.2
weibull	l ~ plot_type * season	s ~ season	262.36	2.38
weibull	l ~ plot_type + season	s ~ season	262.38	2.4
weibull	l ~ season	s ~ constant	262.38	2.4
weibull	l ~ season	s ~ plot_type + season	262.55	2.57
weibull	l ~ plot_type * season	s ~ constant	263.31	3.33

Table B-3. Model comparison results for carcass persistence trials conducted in 2022 at the North Fork Ridge Wind Project. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AICc	deltaAICc
weibull	**l ~ constant**	**s ~ constant**	**262.92**	**0**
exponential	l ~ constant	NULL	262.93	0.01
weibull	l ~ constant	s ~ plot_type	264.72	1.8
weibull	l ~ constant	s ~ season	264.73	1.81
exponential	l ~ plot_type	NULL	265.04	2.12
weibull	l ~ plot_type	s ~ constant	265.12	2.2
exponential	l ~ season	NULL	265.88	2.96
weibull	l ~ season	s ~ constant	266.31	3.39

Appendix C GENETICS RESULTS

NORTHERN ARIZONA UNIVERSITY

School of Forestry

BAT ECOLOGY & GENETICS LAB

Genetic Species ID Results

Client: Adam Rusk (Adam.Rusk@stantec.com), Stantec. Invoice 20221209_4.

Samples: We received eight bat samples. After DNA extraction, we PCR-amplified the DNA using our Species from Feces primers (Walker et al. 2016, 2019). We sequenced and identified species using NCBI BLAST. All non-template controls were negative for amplification and the positives controls amplified and sequenced correctly.

Sequencing: 01/09/2023

Report date: 01/12/2023

Results:

Number	Sample Name	Sex	Species
1	20220812-T-090-02	Male	Eptesicus fuscus
2	20220524-T-013-01	Male	Lasionycteris noctivagans
3	20220915-T-013-01	Female	
4	20220728-T-053-01	Female	
5	20220629-T-118-01	Female	
6	20220906-T-080-01	Female	
7	20221005-T-069-01	Female	
8	20220726-T-056-01	Female	

Bat Ecology & Genetics Lab, School of Forestry, NAU, P.O. Box 15018, Flagstaff, AZ 86011

10(a)(1)(A) Permit # ESPER0011726 Annual Report 2024

Kings Point Wind Project and North Fork Ridge Wind Project
Barton, Dade, Jasper and Lawrence Counties, Missouri

January 31, 2025

Prepared for:

The Empire District Electric Company d/b/a Liberty

602 S Joplin Avenue

Joplin, MO 64802

Prepared by:

Stantec Consulting Services Inc

6800 College Boulevard, Suite 750

Overland Park, KS 66211

Stantec

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Prepared by: ______________________________

Signature

Trevor Peterson, Sydney Edwards

Reviewed by: ______________________________

Signature

Natasha Brown

Approved by: ______________________________

Signature

Josh Flinn

Table of Contents

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Acronyms / Abbreviations

Acronym / Abbreviation	Full Name
ΔAIC	difference between statistical models evaluated using AIC
80-m cleared plot	mowed 80-m radius plot around a turbine
ai	fraction of ground searched within each distance band
AIC	Akaike information criterion
control	3.0 m/s cut-in speed
CP	carcass persistence
d/b/a	doing business as
DWP	density-weighted proportion
EofA	Evidence of absence
GenEst	Generalized Estimator
g-value	detection probability
I	search interval
k	searcher efficiency decay
Kings Point	Kings Point Wind Project
Liberty	The Empire District Electric Company d/b/a Liberty
m	meters
m/s	meters per second
MW	megawatt
North Fork Ridge	North Fork Ridge Wind Project
Permit	10(a)(1)(A) Permit # ESPER0011726
rpm	revolutions per minute
SE	searcher efficiency
road and pad	graveled areas of turbine pads and access roads out to 100 m
TAL	Technical Assistance Letter
TCBA 10	tricolored bat 10.0 m/s cut-in curtailment strategy
USFWS	U. S. Fish and Wildlife Service
v	temporal coverage
WEST	Western EcoSystems Technology, Inc.
WTGs	wind turbine generators
Xi	number of carcasses found within each distance band

1 Introduction

1.1 Project Description and History

The Empire District Electric Company d/b/a Liberty (Liberty) developed and is currently operating two wind power facilities in southwest Missouri. Kings Point Wind Project (Kings Point) is located in Barton, Dade, Jasper and Lawrence counties, Missouri and North Fork Ridge Wind Project (North Fork Ridge) in located in Barton County, Missouri. These two wind projects are collectively referred to as "the Projects" throughout this report. The Projects each consist of 69 Vestas wind turbine generators (WTGs; 12 Vestas V-110 2.0-megawatt [MW], 57 Vestas V-120 2.2-MW) with an approximate capacity of 149.4 MW for each Project. Total, the Projects include 138 WTGs. A map showing the location of the WTGs for the Projects is provided in Figure A-1 of Appendix A.

Due to the potential risk of take of the federally endangered gray bat (*Myotis grisescens*) during operations, Liberty applied for a Native Endangered Species Recovery Permit under Section 10(a)(1)(A) of the Endangered Species Act (Permit) to evaluate the effectiveness of smart curtailment on reducing gray bat fatalities. The application included a study plan outlining a 4-year research study that was developed through coordination with the U.S. Fish and Wildlife Service (USFWS) Columbia, Missouri Ecological Services Field Office and the Missouri Department of Conservation (Stantec 2021).

The study plan included both post-construction fatality monitoring for bats, as well as acoustic monitoring for bat activity. The Permit (ESPER0011726) was issued on August 6, 2021, and the first full year of the study under the Permit began in March 2022. To date, three full years of the study have been completed which concludes Phase I of the study (2022 and 2023) and includes the first year of Phase II of the study (2024). Phase II of the study will be completed in 2025. This report summarizes the third full year of operations and post-construction fatality monitoring completed at the Projects in 2024 and is intended to satisfy Condition L (Annual Reporting) of the Permit.

Revisions to the study plan were made in spring 2024 to include a 60% minimization target compared to baseline uncurtailed operations rather than an equivalent reduction to what was achieved with the 5.0 meters per second (m/s) blanket curtailment. The revised study plan was submitted to USFWS for approval April 8, 2024 (Stantec 2024b) and the revised Permit (ESPER0011726:V1) was issued April 12, 2024.

Additionally, the EchoPITCH curtailment strategy that was proposed for 2024 (Stantec 2024a) was modified, per request of the USFWS, to focus on minimizing exposure during the high-risk period for tricolored bats (*Perimyotis subflavus*) and used a 10.0 m/s cut-in speed from July 18 – September 7 at North Fork Ridge and from July 25 – September 7 at Kings Point. The revised strategies were reviewed within the EchoPITCH framework and were estimated to achieve a >60% reduction for gray bats and tricolored bats for each project, compared to simulated uncurtailed operation. Because the strategy included a 10.0 m/s cut-in speed and was designed to also be effective for tricolored bats, the curtailment strategy was named “TCBA 10”, or “TCBA” for short.

There were modifications to the TCBA 10 curtailment that happened within the high-risk season and included reduction of the cut-in speeds at both projects from 10.0 m/s to 6.5-7.5 m/s. Those reductions were made in coordination with the USFWS and approved through written correspondence between Liberty and USFWS. The curtailment that ultimately happened at the treatment turbines in 2024 is named “Implemented 2024” and was slightly different for each project as outlined in Section 1.1.4, below.

1.1.1 Monitoring Periods (2021 – 2024)

1.1.1.1 Spring and Summer 2021 – Technical Assistance Letters

Operations and monitoring during the spring and summer of 2021 were in accordance with the Technical Assistance Letters (TALs) for the Projects. Conditions of the TALs required feathering of all turbine blades below 8.0 m/s when ambient temperature was above 50 degrees Fahrenheit during the gray bat active season (March 1 through November 15) from 30 minutes prior to sunset through 30 minutes after sunrise. Bat fatality monitoring began March 3, 2021 for North Fork Ridge and April 8, 2021 for Kings Point. Bat fatality monitoring included search efforts expected to achieve a detection probability (g-value or “g”) of 0.2 based on Evidence of Absence (EofA; Dalthorp et al. 2017). Fatality monitoring included twice weekly searches at all WTGs on graveled roads and pads out to 100 meters (m) from the turbine base and 60-m radius cleared plots around 48 WTGs. Searcher efficiency (SE) and carcass persistence (CP) trials were completed in accordance with the TALs.

1.1.1.2 Fall 2021 – 10(a)(1)(A) Permit

After receiving the Permit, fatality monitoring and operational curtailment were adjusted, and acoustic monitoring was added at the Projects to begin collecting data to address the research objectives outlined in the study plan (Stantec 2021) for the Permit. Fatality monitoring efforts included an expansion of 8 of the search plots from 60-m radius cleared plots to 100-m radius cleared plots on August 23, 2021. On September 7, 2021 (Kings Point) and August 30, 2021 (North Fork Ridge) the Projects began operating half of their turbines at 3.0 m/s (control) and half at 5.0 m/s (treatment) cut-in speeds (i.e., turbines are “feathered” below this wind speed to minimize blade movement, based on the wind speed measured at each turbine’s nacelle) from 30 minutes before sunset to 30 minutes after sunrise each night. Acoustic bat monitors were installed on 30 WTGs in August 2021. Details of the monitoring effort and survey results for the monitoring from 2021 are available in the 2021 annual report (Stantec 2022).

1.1.2 Spring, Summer, Fall 2022 – 10(a)(1)(A); Phase 1, Year 1

Bat fatality monitoring and acoustic bat activity monitoring was completed at the Projects from April 1 – October 31, 2022. Turbine control and treatment operations were the same as they were during the fall 2021 monitoring period, but the bat fatality monitoring effort was increased for 2022 to include searches 3 times per week for all turbines and the addition of 8, 60-m radius cleared plots. The 2022 monitoring period represents the first full year of the study under the Permit and is defined as Phase 1, Year 1 in the Study Plan (Stantec 2021). Results from the 2022 monitoring are available in Stantec (2023).

1.1.3 Spring, Summer, Fall 2023 – 10(a)(1)(A); Phase 1, Year 2

Bat fatality monitoring and acoustic bat activity monitoring was completed at the Projects from April 1 to October 31 during the spring (April – May), summer (June – August), and fall (September – October) of 2023. Turbine control and treatment operations were the same as they were during the 2022 monitoring period, but the 2023 bat fatality monitoring effort was increased to include searches 3 times per week for all turbines and an increase in plot size from 60-m radius cleared plots to 80-m radius cleared plots. The 2023 monitoring period represents the second full year of the study under the Permit and is defined as Phase 1, Year 2 in the Study Plan (Stantec 2021). Results from the 2023 monitoring are available in Stantec (2024a).

1.1.4 Spring, Summer, Fall 2024 – 10(a)(1)(A); Phase 2, Year 1

Bat fatality monitoring and acoustic bat activity monitoring was completed at the Projects from April 1 to October 31 during the spring (April – May), summer (June – August), and fall (September – October) of 2024. In 2024, turbines at each site were assigned to either a control treatment (feathering below 3.0 m/s) or a curtailment treatment. Kings Point had 35 control turbines and 34 treatment turbines, and North Fork Ridge had 34 control turbines and 34 treatment turbines. As stated in Section 1.1, the curtailment treatment group's curtailment strategy that was proposed for 2024 (Stantec 2024a) was modified, per request of the USFWS, to focus on minimizing exposure during the high-risk period for tricolored bats and proposed a 10.0 m/s cut-in speed from July 18 – September 7 at North Fork Ridge and from July 25 – September 7 at Kings Point. The 10.0 m/s strategies were reviewed within the EchoPITCH framework and were estimated to achieve a >60% reduction for gray bats and tricolored bats for each project, compared to simulated uncurtailed operation. There were modifications to the curtailment treatment group's curtailment strategy that happened within the high-risk season and included reduction of the cut-in speeds at both projects from 10.0 m/s to 6.5-7.5 m/s. Those reductions were made in coordination with the USFWS and approved through written correspondence between Liberty and the USFWS. The curtailment that ultimately happened at the treatment turbines in 2024 is outlined below and referenced as "Implemented 2024":

North Fork Ridge:

- April 1 – October 31: 3.0 m/s cut-in speed from 30 minutes before sunset – 30 minutes after sunrise (feathering baseline)
- July 18 – August 9: 10.0 m/s cut-in speed from 30 minutes after sunset – 30 minutes before sunrise at temperatures above 10° C
- August 10 – August 20: 7.5 m/s cut-in from 30 minutes after sunset – 30 minutes before sunrise at temperatures above 10° C
- August 21 – September 7: 6.5 m/s cut-in from 30 minutes after sunset – 30 minutes before sunrise at temperatures above 10° C

Kings Point:

- April 1 – October 31: 3.0 m/s cut-in speed from 30 minutes before sunset – 30 minutes after sunrise (feathering baseline)
- July 25 – August 9: 10.0 m/s cut-in speed from 30 minutes after sunset – 30 minutes before sunrise at temperatures above 10° C
- August 10 – September 7: 7.5 m/s cut-in from 30 minutes after sunset – 30 minutes before sunrise at temperatures above 10° C

1.2 Purpose and Objectives of the Study

The goal of this study is to evaluate and understand gray bat fatality rates at the Projects and to develop and test an optimal curtailment strategy for reducing impacts to the species. This will aid in the recovery of the gray bat by providing a basis of understanding for gray bat and wind turbine interactions. The study will span 4 full years and combines acoustic bat monitoring on WTG nacelles, fatality monitoring beneath WTGs, and operational curtailment treatments applied to WTGs to achieve 4 study objectives:

- Objective 1: Quantify turbine-related fatality rates for gray bats
- Objective 2: Quantify relationship between exposed gray bat activity and fatality
- Objective 3: Quantify effectiveness of blanket curtailment turbine operation (e.g., 5.0 m/s cut-in speed from April 1 – October 31 at temperatures above 50 degrees Celsius, 30 minutes before sunset through 30 minutes after sunrise) for reducing gray bat fatality
- Objective 4: Demonstrate use of nacelle-based acoustic and weather data to optimize turbine operational curtailment and evaluate its effectiveness at reducing gray bat fatality

While the study was initially designed to focus on gray bat recovery, the study objectives are also applicable to the tricolored bat (*Perimyotis subflavus*), which was proposed to be listed as endangered by the USFWS in 2022. A final rule listing the species has not yet been issued; however, where possible, results specific to tricolored bats are included in this report.

2 Methods

Survey methods for carcass searches, SE trials, CP trials, and acoustic monitoring followed those specified in the Permit conditions, as outlined in the revised study plan (Stantec 2024b), and through consultation with the USFWS. Notable revisions to methods from the initial study plan include increased search efforts characterized by larger radius search plots, more cleared search plots, and the addition of Western EcoSystems Technology, Inc. (WEST) as a collaborator bringing detection dog search teams to enhance the detection probability (g-value) and study design and statistical support. The methods and results presented here are comprehensive for the Stantec and WEST 2024 surveys, and additional information about search methods, SE and CP trials for dog teams are available in Pierro et al. (2025a, 2025b). Post-construction monitoring included the following components:

- Standardized carcass searches to systematically search plots at all WTGs for bat fatalities attributable to the WTGs;
- SE trials to estimate the percentage of bat carcasses that were found by the searcher(s);
- CP trials to estimate the persistence time of carcasses on-site before scavengers removed them; and
- Acoustic monitoring to assess total bat activity, gray bat activity and tricolored bat activity at nacelle height on WTGs within the rotor-sweep.

2.1 Field Methods

2.1.1 Standardized Carcass Searches

Standardized carcass searches were completed at all Projects' WTGs between April 1 and October 31, 2024. Standardized carcass searches consisted of surveying search plots at each turbine on either (1) the graveled areas of turbine pads and access roads out to 100 m (road and pad searches) or (2) within an 80-m radius of turbines (80-m cleared plot) during spring, summer, and fall. WEST detection dog teams searched 24 80-m cleared plots at each Project from July through September 30, 2023. Figures A-2 and A-3 (see Appendix A) show the search plot types by turbine location for Kings Point and North Fork Ridge, respectively. The distribution of the search plots was as follows:

- Kings Point – 41 WTGs with road and pad searches, 28 WTGs with 80-m cleared plot searches; and

- North Fork Ridge – 40 WTGs with road and pad searches, 28 WTGs with 80-m cleared plot searches[1].

The 80-m cleared plots were mowed periodically with the goal of maintaining vegetation below 5 inches for plots searched by human searchers and below 10 inches for plots searched by detection dog teams during the survey period.

Standardized carcass searches were conducted by qualified searchers trained in fatality search methods, including proper handling and reporting of carcasses. Searchers were familiar with and able to accurately identify bat species likely to be found at the Projects. Preliminary bat species identifications were made in the field. When carcass condition allowed, sex, age and reproductive status of the carcass were recorded. When possible, forearm length was recorded to facilitate species identification. In addition to the carcass, photographs and data collected for each carcass were used to verify the species identification. Photos of bat carcasses unable to be identified to the species level in the field were sent to a Stantec/WEST permitted bat biologist for positive visual identification, and carcasses were kept on-site. Bats that could not be positively identified and had potential to be a gray bat or tricolored bat were submitted to a USFWS-approved laboratory (the Dr. Jane Huffman Wildlife Genetics Institute at East Stroudsburg University) for identification and sex determination using molecular and genetic testing.

During searches, human searchers targeted a walking rate of approximately 45 to 60 m per minute while searching 3 m on either side of transects spaced 6 m apart within the search plots. Search methods for the detection dog search teams are described in Pierro et al. (2025a, 2025b). For each carcass found, the following data were recorded digitally within Survey123 (esri, Redlands, CA):

- Date and time
- Initial species identification (this information was updated as needed based on photos, dentition, or expert opinion)
- Sex, age, and reproductive condition (when applicable; sex was updated based on genetic testing when applicable)
- Global positioning system location
- Distance and bearing to turbine
- Condition and Disposition (condition being a result of collision, disposition being a result of persistence on the ground. Conditions included complete, dismembered, injured, alive – uninjured while dispositions included states of decomposition or scavenging).
- Any notes on presumed cause of death

[1] One of the 69 North Fork Ridge turbines was non-operational for the entire 2024 period and was therefore excluded from searches

A digital photograph of bat carcasses next to a ruler for scale was taken before the carcasses were handled and removed. Bat carcasses were labeled, bagged, and stored in onsite freezers at the Projects' Operations and Maintenance Buildings. Bat carcasses were collected and retained under the Permit and Missouri Department of Conservation Wildlife Collector's Permit #s: (Stantec: 63642, 64629, 64630, 64631, and 64632; WEST: 65395, 64782, 66775, 65296, and 64783).

Bat carcasses found in non-search areas were coded as incidental finds and documented in a similar fashion to those found in standardized surveys when possible. These included carcasses found during non-search times or outside the monitoring plot. Incidental bat carcasses were collected and stored in the freezer with the carcasses found during standardized surveys. As per industry standard, incidental finds were not included in the fatality estimates.

During a year, turbines become non-operational for a variety of reasons including maintenance, damage, and planned site-wide shutdowns. Searches continued when possible, according to the proposed survey schedule, but were suspended if it was determined that a turbine was non-operational (rpm <1 for more than a week) as confirmed by turbine operations staff. All searches and calculated risk periods that occurred during non-operational periods were evaluated post hoc and eliminated from analysis where appropriate.

2.1.2 Searcher Efficiency Trials

SE trials were used to estimate the probability of bat carcass detection by the searchers. Trials were spread out across Projects, seasons, searchers, and search plot types. The searchers did not know when trials were being conducted, at which turbines trial carcasses were placed, or the location or number of trial carcasses placed in any given search plot during monitoring periods (i.e., blind trials). Bat carcasses collected during the 2023 and 2024 surveys were used for the trials.

All SE trial carcasses for human searchers were randomly placed by a field lead within the search plots. Trial carcasses were placed in the morning prior to the planned carcass searches for that day and checked after the planned carcass search to verify they were still available to be found. Trial carcasses removed prior to the scheduled search were not included in analyses. The number of trial carcasses found by the searcher in each plot was recorded and compared to the total number placed in the plots prior to the SE trial. Methods for the SE trials for the detection dog teams are presented in Pierro et al. (2025a, 2025b).

2.1.3 Carcass Persistence Trials

CP trials were conducted to estimate the average length of time carcasses remained in the search plots before being removed by scavengers or other means (e.g., mowed over, tilled under). CP trials were randomly placed within the search plots and were conducted separately for the detection dog search teams and for the human search teams. Trials took place in all three seasons and across plot types to determine if CP varied by season or plot type, and trials were conducted separately for each Project. During the CP trials, carcasses were checked every day for the first week, and then regularly checked until missing, the season ended, or the carcass was no longer detectable (i.e., approximately days 1, 2, 3, 4, 5, 6, 7, 10, 14, 21, 28, and weekly thereafter).

The condition of each carcass was recorded during each CP trial check. The conditions recorded were defined as follows:

- Intact – complete carcass with no body parts missing
- Scavenged – carcass with some evidence or signs of scavenging
- Fur spot – no carcass, but fur spot remaining
- Missing – no carcass or fur remaining

Carcasses indicated as intact, scavenged, or fur spot were considered still present and detectable for analysis while missing carcasses represented removals or absences.

2.1.4 Acoustic Monitoring

Wildlife Acoustics (Model SM4BAT FS) acoustic bat detectors with SMM-U1 microphones were mounted on 30 WTG nacelles (height of 120 m; 15 per Project) for the 2024 season between March and December. As in 2023, detectors were connected to 120-v AC power inside the nacelle, equipped with 2 high-capacity SD cards, and programmed to record from 45 minutes before sunset to 45 minutes after sunrise on a nightly basis. The detector microphones were mounted to anemometer masts outside the nacelle, oriented horizontally and pointed downwind from the turbine rotor. Detectors were programmed to use default audio triggering settings, recording all echolocation pulses within range of the detector (approximately 30 m) throughout the monitoring season. Detector locations are shown in Appendix A, Figures A-4 and A-5. Turbines equipped with acoustic detectors were assigned to both operational treatments (n = 7–8 turbines per treatment).

2.2 Data Analysis – GenEst

The Generalized Estimator (GenEst; Dalthorp et al. 2018) was used for calculating bias correction factors (SE, and CP) and fatality estimates. GenEst generates all estimates through iterative modeling (i.e., “bootstrapping”) and each iteration can yield slightly different results; thus, subsets of GenEst estimates are not additive and should be interpreted individually (e.g., fatality by season may not add up to total fatality).

2.2.1 Searcher Efficiency

SE represents the average probability that a carcass was detected by the searcher. This rate was calculated using the data collected during SE trials (Section 2.1.2) by dividing the number of trial carcasses the observer found by the total number which remained available during the trial (i.e., non-scavenged). Analysis included an evaluation of whether SE differed by searcher or search team, season (spring, summer, fall), or plot type (roads and pads, 80-m cleared plots). Trials across both projects were combined because the same searchers conducted searches at both projects (i.e., SE was assumed to not vary by Project since searchers consistently and systematically searched turbines at both projects). SE decay (k) was fixed at 0.67. This value represents the decrease in SE on subsequent searches (i.e., if a carcass is missed the first time it is available, it is less likely to be found on subsequent searches than a “fresh” carcass).

GenEst returns numerous models depending on the number of variables included in the analysis following a model selection approach, applying Akaike information criterion (AIC) values for each model. The AIC value is a parsimonious statistical score for the quality of a model fit, where smaller AIC values are considered better models. However, models within 5 ΔAIC (the difference between each models AIC value) are generally considered indistinguishable by this measure (Dalthorp et al. 2018). Therefore, “best” model selection was based on a manual review of models with the lowest AIC values, and a “best” model was chosen from the models within 5 ΔAIC of the top model. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.2 Carcass Persistence

CP represents the average amount of time (in days) that a carcass persists on the landscape after arriving, before being scavenged or decaying, or the probability that a carcass persists on the ground until the next search interval. A CP model is generated in GenEst using the data collected as part of the CP trials (Section 2.1.3). CP models in GenEst include censored exponential, Weibull, lognormal, and loglogistic distributions. CP was calculated separately for each Project. Analysis included an evaluation of whether CP varied by season and/or plot type.

CP model selection was done using similar methods to SE model selection (see Section 2.2.1) with the following modifications. Graphical evaluation was used by comparing modeled persistence probabilities to the "step curve" and identifying models that appeared to have closest fit to decay pattern. If two models had similar graphical fits and were within 5 ΔAIC values, the most parsimonious model was chosen. Confidence intervals were generated using 1,000 bootstrapped iterations.

2.2.3 Density-weighted Proportion (DWP)

The density-weighted proportion (DWP) is an area correction factor calculated using several parameters, described below. Data used included four sampling seasons of data (fall 2021, spring, summer, and fall of 2022) across both Projects for road and pad plot types as well as the 100-m cleared plots (i.e., only plot types that searched out to the full 100-m, thus excluding the 60-m full plots). The following parameters and equations were then used:

$$X_i = number\ of\ carcasses\ found\ within\ distance\ band\ i$$

$$a_i = fraction\ of\ ground\ searched\ within\ distance\ band\ i$$

$$\widehat{M}_i = relative\ mortality\ rate\ in\ each\ distance\ band = \frac{X_i}{a_i}$$

$$\hat{p}(M_i) = fraction\ of\ total\ in\ each\ distance\ band = \hat{M}_i \ / \sum_i \hat{M}_i$$

The number of carcasses found within each distance band (X_i) is the total number of carcasses found within that distance band at road and pad or 100-m full plot turbines. When each carcass was found, searchers recorded the location of the carcass using a sub-meter accuracy global positioning system in a digital datasheet (Collector for ArcGIS). The distance between these locations and the nearest turbine were calculated in GIS, and these values were used to calculate the DWP.

To determine the fraction of ground searched within each distance band (a_i), the turbine roads and pads were digitized, and the proportion of each distance band that included the road and pad was calculated for each of the 82 road and pad plots out to 100 m from the turbine base. These values were then averaged across all road and pad turbines to determine the percentage of each distance band that was searched on roads and pads. For 100-m cleared plot turbines, 100% of the area within 100 m was searched. It was assumed that all carcasses fell within 100 m of the turbine base. The weighted average of these values was then calculated for each distance band based on the proportion of road and pad plots to 100-m full plot turbines.

In 2023, Stantec used the distribution of the 195 bats found during standardized searches from 2021 and 2022 searches on road and pad and 100-m cleared plots at both Projects to calculate the fraction of total mortality in each distance band $(\hat{p}(M_i))$ for bat carcasses found at control turbines (3.0 m/s) and treatment turbines (5.0 m/s) – see Table 2-1 and Table 2-2. Based on data from carcasses found, it is assumed that, on average, 95% of all bat carcasses fall within 80 m of the turbine base (and therefore within the 80-m cleared plot searches) when turbines are operating at 3.0 m/s and 85% of all bat carcasses when turbines are operating at 5.0 m/s. Thus, on average, 5% fall beyond the 80-m cleared plots at control turbines and 15% fall beyond the 80-m cleared plots at treatment turbines.

Table 2-1. Calculation of the fraction of total mortality in each distance band for control turbines (3.0 m/s) for use in Density-weighted Proportion (DWP) calculations at the Kings Point and North Fork Ridge Wind Projects based on bat carcasses found during the Permit period of 2021 and 2022 (excluding winter).

Distance Band (meters)	Number of Carcasses	Percent of Distance Band Searched	Relative Fatality Rate	Relative Fraction of Total Mortality	Cumulative Fraction of Total Mortality
0-10	3	49.9%	6.0	0.7%	0.7%
10-20	35	16.1%	217.9	24.7%	25.4%
20-30	7	15.1%	46.4	5.3%	30.6%
30-40	14	13.6%	102.6	11.6%	42.2%

Distance Band (meters)	Number of Carcasses	Percent of Distance Band Searched	Relative Fatality Rate	Relative Fraction of Total Mortality	Cumulative Fraction of Total Mortality
40-50	24	12.1%	198.2	22.4%	64.7%
50-60	12	11.4%	104.8	11.9%	76.5%
60-70	9	10.8%	83.1	9.4%	86.0%
70-80	9	10.5%	85.3	9.7%	95.6%
80-90	4	10.3%	38.7	4.4%	100.0%
90-100	0	10.1%	0.0	0.0%	100.0%

Table 2-2. Calculation of the fraction of total mortality in each distance band for turbines operating at 5.0 m/s for use in Density-weighted Proportion (DWP) calculations at the Kings Point and North Fork Ridge Wind Projects based on bat carcasses found during the Permit period of 2021 and 2022 (excluding winter).

Distance Band (meters)	Number of Carcasses	Fraction of Area Searched (%)	Relative Fatality Rate	Relative Fraction of Total Mortality	Cumulative Fraction of Total Mortality
0-10	1	49.9%	2.0	0.3%	0.3%
10-20	25	16.1%	155.7	25.6%	26.0%
20-30	6	15.1%	39.8	6.5%	32.5%
30-40	5	13.6%	36.7	6.0%	38.5%
40-50	8	12.1%	66.1	10.9%	49.4%
50-60	8	11.4%	69.9	11.5%	60.9%
60-70	10	10.8%	92.4	15.2%	76.1%
70-80	6	10.5%	56.9	9.4%	85.5%
80-90	5	10.3%	48.4	8.0%	93.5%
90-100	4	10.1%	39.7	6.5%	100.0%

Once the fraction of total mortality in each distance band $(\hat{p}(M_i))$ was calculated, 2024 turbine-specific DWPs were calculated by multiplying the fraction of each distance band searched at a particular turbine by the fraction of the total mortality for that distance band. This utilized the 2024 turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine) and turbine-specific searchable areas (eliminating unsearchable land cover types [e.g., trees, water, swales]) within 80 m of the turbine base for 80-m cleared plots.

2.2.4 Adjusted Fatality Estimates (GenEst)

GenEst was used to calculate overall fatality rates for the Projects (per turbine, per MW, for all operational turbines at Kings Point and North Fork Ridge). All estimates include 90% confidence intervals. "Per turbine estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the number of operational turbines, and "per MW estimates" were calculated by dividing the GenEst estimate (and confidence intervals) by the total MW of operational turbines for each Project. Fatality estimates were split by season and by treatment type. Fatality estimates were also split by season for the bat species of interest (gray bats and tricolored bats) found at the Projects. Gray bat and tricolored bat fatality estimates were also split by treatment type, where possible[2].

2.3 Data Analysis – Evidence of Absence

EofA (Dalthorp et al. 2017) was used for estimating the overall detection probability (g) and the estimated take of gray bats and tricolored bats (M* and λ). These analyses were completed to evaluate if take is within the limits allowed by the Permit and to provide estimates of fatality when sample sizes were small or zero. All data for detection dog teams used in this analysis were obtained from Pierro et. al (2025a and 2025b).

2.3.1 Estimation of Detection Probability (g)

For this analysis, 2024 monitoring data was split into distinct strata. Stratum followed date periods within which the monitoring protocols (i.e., number of turbines, ratio of plot types) were equal. Date periods were split to account for changes in turbine operations during the monitoring season that influenced the relative risk to bats and to account for monthly differences in arrivals. This resulted in four distinct sub-seasons in summer and three distinct sub-seasons in fall. In addition, sub-seasons when treatment turbines and control turbines were operated under different operational protocols were split out by treatment type, resulting in 11 distinct strata (see Table 2-3.).

[2] GenEst cannot calculate an estimate if zero carcasses are found; therefore, if zero carcasses of a target species were found at turbines of a particular treatment group (control or treatment), then no estimate can be calculated for that treatment group.

Table 2-3. Dates and Turbine Operations status for Evidence of Absence strata used in the 2024 detection probability and take estimation analysis at Kings Point and North Fork Ridge

Strata Name	Season	Start Date	End Date	Turbine Operations
Spring	Spring	2024-04-01	2024-05-31	Normal
June	Summer	2024-06-01	2024-06-30	Normal
July 1	Summer	2024-07-01	2024-07-25	Normal
July 2_norm	Summer	2024-07-26	2024-07-31	Normal
July 2_curtailed				Curtailed
August_norm	Summer	2024-08-01	2024-08-31	Normal
August_curtailed				Curtailed
September 1_norm	Fall	2024-09-01	2024-09-08	Normal
September 1_curtailed				Curtailed
September 2	Fall	2024-09-09	2024-09-30	Normal
October	Fall	2024-10-01	2024-10-31	Normal

Each stratum consisted of searches conducted at three different plot types (i.e., classes): road and pad plots searched by humans (roads and pads), cleared full plots searched by humans (full human plots), and cleared plots searched by detection dog teams (full dog plots); except for spring and October when only road and pads and full human plots were searched. Stantec used the EofA "Multiple Classes Module" to combine searches at the different plot types within each stratum to estimate $g_{stratum}$.

Site-specific monitoring data were used to calculate the g-value and associated beta parameters for each stratum, including the following inputs:

- Search interval (I), calculated as the average time between searches per plot type.
- Number of searches, calculated as the average number of times each turbine was visited.
- Temporal coverage (v), set to 1 since monitoring occurred during the strata's entire date range.
- SE, calculated using the "carcasses removed after one search" option and inputting the total number of carcasses available and found per plot type across all searchers.
- Factor by which SE changes with each search (k) was fixed at 0.67.
- CP distribution calculated using field trials to estimate the parameters, and the top model was selected based on results from within EofA.

The DWP in EofA's Multiple Classes Module represents the fraction of the total carcasses expected to arrive in a given class and are used to combine detection probabilities. DWPs for each class within each stratum were calculated by multiplying the proportion of each plot type by the site-specific average DWP area correction for all combinations of Project, plot type, and treatment type. The unsearched class's DWP was set to 1 minus the sum of the individual class DWPs to account for unsearched areas (e.g., unsearchable areas within full plots, areas outside of road and pad plots that were not searched, unsearched turbines) since EofA requires DWP to sum to 1 to reflect the distribution of each $g_{stratum}$.

Stratum, sub-seasons, and seasons were combined as shown in Table 2-4 using the appropriate weights. The weights are used to calculate the DWP which directs how the detection probabilities should be combined and are described further below.

Table 2-4. Evidence of Absence strata used in the 2024 detection probability and take estimation analysis at Kings Point and North Fork Ridge.

<table>
<tr><th>Strata[1]</th><th>Sub-Season</th><th>Season</th><th>Year</th></tr>
<tr><td>Spring (April and May)</td><td>Spring</td><td>Spring</td><td rowspan="11">2024</td></tr>
<tr><td>June</td><td>June</td><td rowspan="6">Summer</td></tr>
<tr><td>July 1</td><td>July 1</td></tr>
<tr><td>July 2 normal</td><td rowspan="2">July 2</td></tr>
<tr><td>July 2 curtailed</td></tr>
<tr><td>August normal</td><td rowspan="2">August</td></tr>
<tr><td>August curtailed</td></tr>
<tr><td>September 1 normal</td><td rowspan="2">September 1</td><td rowspan="4">Fall</td></tr>
<tr><td>September 1 curtailed</td></tr>
<tr><td>September 2</td><td>September 2</td></tr>
<tr><td>October</td><td>October</td></tr>
<tr><td colspan="4">[1]normal and curtailed refer to turbine operations implemented where normal indicates control treatment operations (i.e., 3.0 m/s blanket curtailment) and curtailed indicated treatment turbine operations (increased cut-in speeds as shown in Section 1.1.4; “Implemented 2024”)</td></tr>
</table>

2.3.1.1 Arrival Proportions

Arrival proportions represent the proportion of annual fatalities expected to occur within a given season. Arrival proportions were based on 2023 acoustic data and were broken down into the following categories: Spring (0.066), June (0.035) and July/August (0.671) (together, summer), and September

(0.12) and October (0.059) (together, fall). As previously stated, due to when turbine curtailment was implemented and monthly differences in weights, the summer season was split into four sub-seasons and fall was split into three sub-seasons. The arrival proportion weights were rescaled to each sub-season based on the number of days within the season, assuming uniform carcass arrival within each time period (Table 2-5). The arrival proportions in Table 2-5 do not sum to 1 because approximately 4.9% of carcasses are expected to arrive outside of April – October. Arrival proportions were used to combine sub-seasons and seasons.

Table 2-5. Arrival proportions by sub-season for the 2024 Evidence of Absence detection probability and take estimation analysis at Kings Point and North Fork Ridge.

Sub-season	Start Date	End Date	Arrival Proportion
Spring	2024-04-01	2024-05-31	0.066
June	2024-06-01	2024-06-30	0.035
July 1	2024-07-01	2024-07-25	0.271
July 2	2024-07-26	2024-07-31	0.065
August	2024-08-01	2024-08-31	0.336
September 1	2024-09-01	2024-09-08	0.032
September 2	2024-09-09	2024-09-30	0.088
October	2024-10-01	2024-10-31	0.059

2.3.1.2 Minimization Weights

Minimization weights represent the fraction of risk remaining after minimization techniques are implemented and are calculated as the percent of exposed bat passes. Simulated acoustic exposure was calculated by applying the 2024 curtailment strategy (increased cut-in speeds from mid to late July, depending on the Project, through September 7) and the control curtailment strategy (blanket 3.0 m/s) to the pooled acoustic data from 2022 and 2023 to obtain separate minimization weights for each strategy. Minimization weights were calculated monthly for each treatment group by dividing the number of exposed bat calls (those that occurred at a wind speed when curtailment was not enacted and therefore may be subject to turbine blade strike) by the total number of bat calls to combine detection probability distributions across strata, sub-seasons, and seasons. Minimization weights were calculated for each sub-season and season where treatment and control turbines operated under different parameters (i.e., 3.0 m/s for control and raised cut-in speeds for treatment) by dividing the number of exposed bat calls across treatment groups by the total number of bat calls across treatment groups to account for differences in treatments and combine detection probability distributions across sub-seasons and seasons.

2.3.2 Estimation of Gray Bat and Tricolored Bat Fatalities

For analysis of the 2024 data, the “Multiple Years Module” was used with the results of the overall 2024 g-value (see Section 2.3.1), along with the number of observed gray bat and tricolored bat fatalities. This analysis was run separately for each Project and each treatment to determine the total estimated mortality (M), and the annual fatality rate (λ) for gray bats and for tricolored bats by Project and treatment group. Credible intervals were evaluated assuming α=0.8.

2.4 Data Analysis – Acoustic Monitoring and Turbine Operation

Stantec processed acoustic bat data collected at the Projects using Kaleidoscope Pro (KPro; Wildlife Acoustics, Inc.; version 5.4.0 or later) to eliminate noise (e.g., insects, rain, wind) and assign automated identifications of species to files using the Bats of North America classifier (version 5.4.0; 0 Balanced [Neutral] setting). Trained bat biologists visually reviewed all files in AnalookW (version 4.4n or newer) to confirm they contained a bat pass (i.e., at least 2 bat echolocation call pulses). Files that did not contain a bat pass were manually removed and not analyzed further. Files not attributed to species were reviewed to identify possible misclassifications of bat passes. All files classified by KPro as species of interest, including federally endangered gray bats and the proposed endangered tricolored bat, along with files labeled as other species that could potentially be confused with these species were manually vetted by a trained bat biologist.

File-level information from all bat passes was extracted using the CountLabels tool in AnalookW software and attributed all bat passes with timestamp (rounded to the nearest 10-minute interval), species, and metadata including Project, turbine number, and operational treatment. All turbine data files were evaluated to determine whether detectors were functioning properly on a nightly basis.

Acoustic exposure refers to the subset of bat passes recorded when wind turbines are operating (rotor speed > 1 revolutions per minute [rpm]) and is the metric by which curtailment was evaluated. To assess acoustic exposure, wind speed, temperature, and rotor speed data were recorded at 10-minute intervals at each of the 15 turbines in which acoustic detectors were deployed. The number of bat passes per 10-minute interval for each turbine was calculated using program R. Intervals were defined as meeting or not meeting the criteria of each curtailment strategy as implemented and categorized as whether the turbine rotor speed was less than 1 rpm during the corresponding interval. The resulting two distinct metrics for acoustic exposure were “measured exposure”, which indicates bat passes detected when turbine rotor speed was above 1 rpm, and “simulated exposure”, which indicates bat passes detected when curtailment conditions were not met (i.e., when turbines should be spinning based on wind speed, temperature, and time of year). Simulated exposure enables comparing effectiveness of curtailment alternatives beyond those that were actually implemented and allowed assessment of the reduction in risk relative to turbine operation without any operational curtailment or feathering applied. In this case, simulated exposure for uncurtailed turbines provides a baseline to which curtailment alternatives can be compared. Threshold wind speed (above which exposure would occur) as the median wind speed at which turbine rotor speed exceeded 1 rpm more than 50% of the time was calculated, limiting analyses to daytime periods. Alternatives were compared, targeting a 60% reduction in exposure for gray bats and tricolored bats relative to uncurtailed turbine operation.

Following methods used to compare acoustic exposure and fatalities previously at Kings Point and North Fork Ridge, cumulative rate of biweekly exposure was used to compare acoustic exposure among sites and treatments. Cumulative biweekly exposure was calculated as the number of exposed bat passes recorded per detector-night within biweekly intervals (pooling data among detectors per site and treatment, as appropriate), summed across the monitoring period. We compared cumulative biweekly exposure as measured at each site by curtailment treatment and also for all turbines as if they had been operated according to different simulated curtailment strategies. This provided an opportunity to directly measure reductions in acoustic exposure at each site and also compare how different curtailment alternatives would have performed during the 2024 season. Previous comparisons of fatality and acoustic exposure at Kings Point and North Fork Ridge also used biweekly exposure and cumulative biweekly exposure; we did not analyze biweekly relationships between acoustic exposure and fatalities in 2024 but did compare overall fatality rates and acoustic exposure by site and treatment.

3 Results

Results include summaries of the raw data, including counts of species, the number of searches conducted, and the average search interval (calculated as the number of operational turbine days within a season divided by the sum of the number of visits to a turbine).

3.1 Non-operational Periods

Fatality monitoring was completed for both Kings Point and North Fork Ridge. From April 3 – October 31, 2024, the WTGs at the Projects were operating as specified in the Permit at either control cut-in speed (3.0 m/s) or treatment cut-in speed (see Section 1.1.4) except for when mechanical issues or WTG maintenance occurred. Figures A-4 and A-5 (see Appendix A) show the control and treatment assignments for Kings Point and North Fork Ridge, respectively. While retrospective review of operations data and cross checking with operations staff indicated several WTGs at each Project had long periods of inactivity (i.e., blade rpm <1), this was not always known to the search teams on the ground at the time of non-operation and therefore searches often continued at non-operational turbines well into the shutdown period or through the entire period. Long-term non-operational periods were accounted for in the data analysis.

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3.2 Shared Results

Calculations for SE and DWP were shared between Projects[3]. Searchers rotated through turbine searches systematically at both Projects and generally did not exclusively search only one of the Projects. Therefore, SE was evaluated and combined for both projects. Additionally, combining projects allowed for a more robust estimation of DWP.

3.2.1 Searcher Efficiency

SE trials were conducted during all three seasons (spring, summer, and fall) in 2024 and included a total of 341 trials across the two Projects. The unmodeled (i.e., raw) searcher efficiency trial results are shown in Table 3-1. Data were analyzed in GenEst, with searcher, season, and plot type as the three potential predictor variables. For this analysis, SE decay (k) was fixed at 0.67.

Table 3-1. Raw Searcher efficiency results during 2024 post-construction monitoring at the Kings Point and North Fork Ridge Wind Projects

Plot Type	Spring		Summer		Fall	
	Available	Found	Available	Found	Available	Found
80-m Cleared Plot (Detection Dog Teams)	N/A	N/A	116	79	95	88
80-m Cleared Plot (Human Searchers)	37	19	10	5	12	4
Road and Pad (Human Searchers)	23	21	24	20	24	20

[3] DWPs were unique to each individual turbine; however, data from both projects were used to determine the fraction of total mortality expected to occur within each distance band (see Section 3.1.2).

The model with the lowest AIC was selected which included season and plot type as factors (Appendix B, Table B-1). This resulted in a total of eight SE estimates that were used in fatality estimation[4]. A summary of these estimates is provided below.

Based on the results of the top model, SE was highest on average at road and pad plots searched by humans (86.0%), followed by 80-m cleared plots searched by detection dog teams (80.3%), and 80-m cleared plots searched by humans (43.3%, see Table 3-2). SE was also generally higher in spring and fall than summer (Table 3-2).

Table 3-2. GenEst Modeled Searcher efficiency during 2024 post-construction monitoring at the Kings Point and North Fork Ridge Wind Projects.

Plot Type	**Searcher Efficiency (90% CI)**		
	Spring	**Summer**	**Fall**
80-m Cleared Plot (Detection Dog Teams)	N/A	0.721 (0.651 – 0.782)	0.885 (0.827 – 0.925)
80-m Cleared Plot (Human Searchers)	0.517 (0.391 – 0.641)	0.265 (0.149 – 0.426)	0.517 (0.346 – 0.683)
Road and Pad (Human Searchers)	0.907 (0.811 – 0.957)	0.766 (0.636 – 0.860)	0.907 (0.830 – 0.951)

3.2.2 Density-weighted Proportion (DWP)

While treatment turbines in 2024 operated at various cut-in speeds above 3.0 m/s, due to very small sample sizes at these various raised cut-in speeds, updated fractions of total mortality in each distance band were unable to be calculated; therefore, the fraction of total mortality in each distance band from the 2021 and 2022 data at 5.0 m/s was used for treatment turbines during periods when cut-in speeds were raised above 3.0 m/s.

DWPs were calculated using turbine-specific GIS data from the digitized roads and pads (since the road and pad configuration can vary by turbine), as well as removing digitized unsearchable areas from full plots to determine the fraction of each distance band searched at a particular turbine. These values were multiplied by the values presented in Table 2-1 and Table 2-2. Individual turbines in the treatment group had both a “control” and “treatment” DWP calculated so that the different DWPs could be applied

[4] While GenEst estimated a SE for dog teams in the spring, no dog teams conducted searches in the spring and therefore that value is not reported.

throughout the year based on when cut-in speeds were raised above 3.0 m/s. DWP varied by treatment type, plot type, and Project due to differences in site-specific road and pad configurations. Results indicate that overall, cleared plot turbines have a DWP ranging from 79.6% to 95.6% and road and pad turbines have a DWP ranging from 3.4% to 9.5%. On average, DWP at Kings Point was 0.05 for roads and pads when turbines were operating at 3.0 m/s, 0.047 for roads and pads under treatment operations, 0.95 for full plots when turbines were operating at 3.0 m/s, and 0.85 for full plots under treatment operations. At North Fork Ridge, DWP averaged 0.05 for roads and pads when turbines were operating at 3.0 m/s and under treatment operations, 0.95 for full plots when turbines were operating at 3.0 m/s, and 0.85 for full plots under treatment operations.

3.3 Kings Point

3.3.1 Carcass Searches

A total of 3,397 searches were completed between April 1 and October 31, 2024. A summary of search effort by season with total numbers of bats found is presented in Table 3-3. A total of 565 bat carcasses were found during standardized carcass searches, and 15 bat carcasses were found incidentally.

Table 3-3. Summary of bat fatality monitoring completed between April 1 and October 31, 2024, at the Kings Point Wind Project.

Season	Dates	Number of Searches Conducted	Average Search Interval	Number of bats found in standardized searches	Number of bats found incidentally
Spring	April 1 – May 31	615	6.84	33	1
Summer	June 1 – August 31	1,725	4.02	407	11
Fall	September 1 – October 31	1,057	3.92	125	3
Total	April 1 – October 31	3,397	4.50	565	15

3.3.2 Species Composition

Of the 565 bat carcasses found during standardized carcass searches, 16 were unidentified *Lasiurus* species and the other bats were identified to a species or species group. A summary of species composition by season for bats found during the standardized carcass searches is shown in Table 3-4. Of the 565 bat carcasses, the most common species found was the eastern red bat (*Lasiurus borealis*; 407 individuals). The hoary bat (*Lasiurus cinereus*; 66 individuals) was the second most common species followed by evening bat (*Nycticieus humeralis*; 26 individuals). Silver-haired bats (*Lasionycteris* *noctivagans)* made up 1.6% (9) of overall carcasses. Gray bats and tricolored bats comprised 4.4% of total finds with 12 and 13 carcasses each, respectively.

Table 3-4. Summary of bat carcasses found during standardized carcass searches between April 1 and October 31, 2024, at the Kings Point Wind Project.

Species	Spring	Summer	Fall	Total
Big Brown Bat *Eptesicus fuscus*	0 0.0%	6 1.5%	0 0.0%	6 1.1%
Eastern Red Bat *Lasiurus borealis*	18 54.5%	305 74.9%	82 65.6%	405 71.7%
Evening Bat *Nycticeius humeralis*	6 18.2%	12 2.9%	8 6.4%	26 4.6%
Gray Bat[1, 2] *Myotis grisescens*	1 3.0%	9 2.2%	2 1.6%	12 2.1%
Hoary Bat[1] *Lasuirus cinereus*	8 24.2%	41 10.1%	17 13.6%	66 11.6%
Silver-haired Bat[1] *Lasionycteris noctivagans*	0 0.0%	1 0.2%	8 6.4%	9 1.6%
Tricolored Bat[1] *Perimyotis subflavus*	0 0.0%	9 2.2%	4 3.2%	13 2.3%
Seminole Bat *Lasiurus seminolus*	0 0.0%	0 0.0%	1 0.8%	1 0.2%
Eastern Red or Seminole Bat	0 0.0%	9 2.2%	2 1.6%	11 1.9%
Unidentified *Lasiurus* Bat	0 0.0%	15 3.7%	1 0.8%	16 2.8%
Total	33 5.8%	407 72.0%	125 22.1%	565 100.0%

[1]Missouri Department of Conservation Species of Conservation Concern
[2]State and Federal listed Endangered

3.3.3 Carcass Persistence

CP was tested using 108 bat carcasses across the 3 seasons, with a minimum of 10 trials for each combination of plot type and season. The top models for CP in GenEst included Weibull and lognormal distributions with effects for season and/or plot type (Appendix B, Table B-2). The model with the lowest AIC was selected which was a Weibull distribution with an effect for season. Median CP was highest in the spring at 8.29 days, followed by summer at 4.94 days, and fall at 2.92 days (Table 3-5).

Table 3-5. Carcass persistence during 2024 post-construction monitoring at the Kings Point Wind Project.

Season	Trial Carcasses	Carcass Persistence (90% CI)
Spring	24	8.29 (4.40 – 15.51)
Summer	42	4.94 (3.07 – 7.83)
Fall	42	2.92 (1.81 – 4.63)

3.3.4 Adjusted Fatality Estimates - GenEst

Fatality rate estimates were calculated based upon the carcasses found during the standardized carcass searches within the search plots and did not include any incidental finds. Observed bat fatality estimates were adjusted to account for SE, CP, the search schedule, and the turbine-specific DWP area corrections.

3.3.4.1 Seasonal Fatality Estimates

Across all three survey seasons, 565 carcasses were found during standardized searches at the Kings Point Wind Project. The total estimated fatality for all bats was highest during the summer season (1,839 bats), followed by fall (585 bats), and lowest in the spring (246 bats) as summarized in Table 3-6 and shown in Figure 3-1.

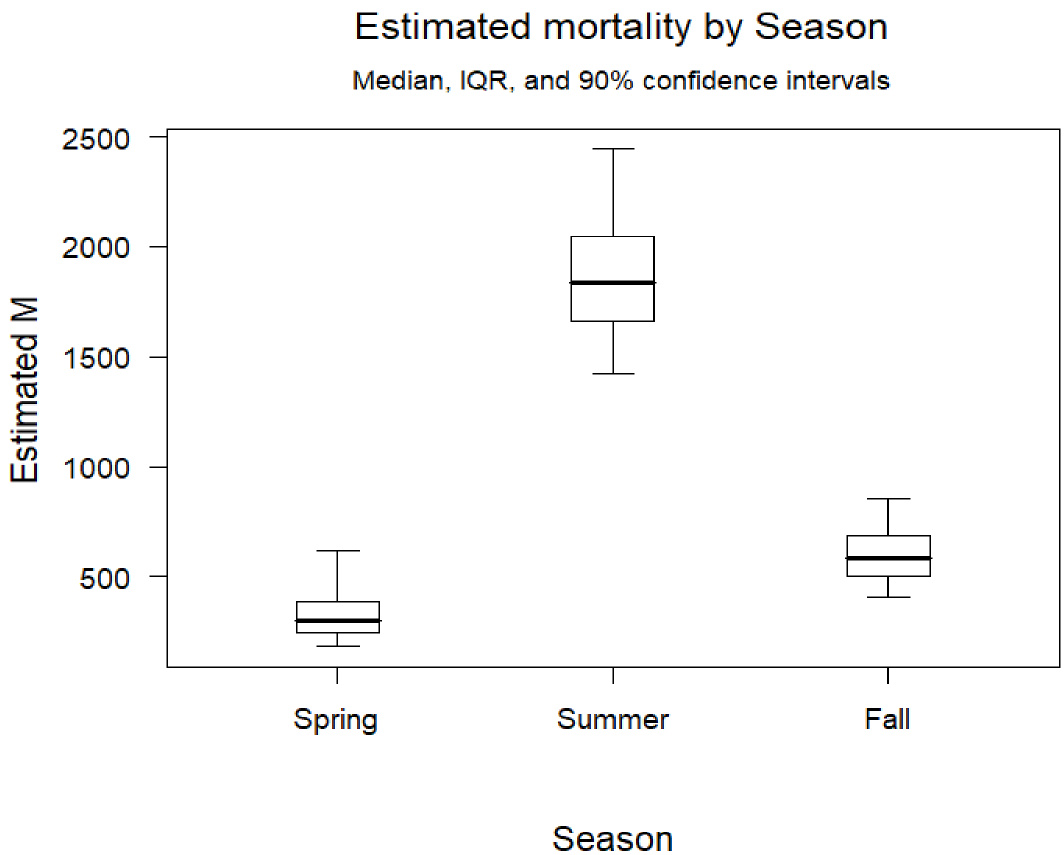

Figure 3-1 Seasonal all bat fatality estimates for 2024 at the Kings Point Wind Project.

Table 3-6. Bat fatality rates by season estimated using GenEst from the 2024 post-construction monitoring data at the Kings Point Wind Project.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities (90% CI)
Spring	April 1 – May 31	301.57 (182.84 – 618.06)	4.37 (2.65 – 8.96)	2.02 (1.22 – 4.14)
Summer	June 1 – August 31	1,839.22 (1,425.11 – 2,443.03)	26.66 (20.65 – 35.41)	12.31 (9.54 – 16.35)
Fall	September 1 – October 31	585.09 (405.51 – 853.95)	8.48 (5.88 – 12.38)	3.92 (2.71 – 5.72)
Annual	April 1 – October 31	2,746.83 (2,176.14 – 3,609.84)	39.81 (31.54 – 52.32)	18.39 (14.57 – 24.16)

3.3.4.2 Control Vs. Treatment Fatality Estimates

Median annual fatality estimates for all bats were similar for control turbines (3.0 m/s cut-in) and treatment turbines (Implemented 2024) and had overlapping confidence intervals. Annual bat fatality was 1,327.93 (90% CI: 1,067.57 – 1,668.38) at control turbines and 1,398.68 (90% CI: 975.54 – 2,158.56) at treatment turbines (see Figure 3-2). Per turbine estimates are 37.94 (90% CI: 30.50 – 47.67) for control turbines and 41.14 (90% CI: 28.69 – 63.49) for treatment turbines. Per MW estimates are 17.47 (90% CI: 14.05 – 21.95) for control turbines and 19.06 (90% CI: 13.29 – 29.41) for treatment turbines.

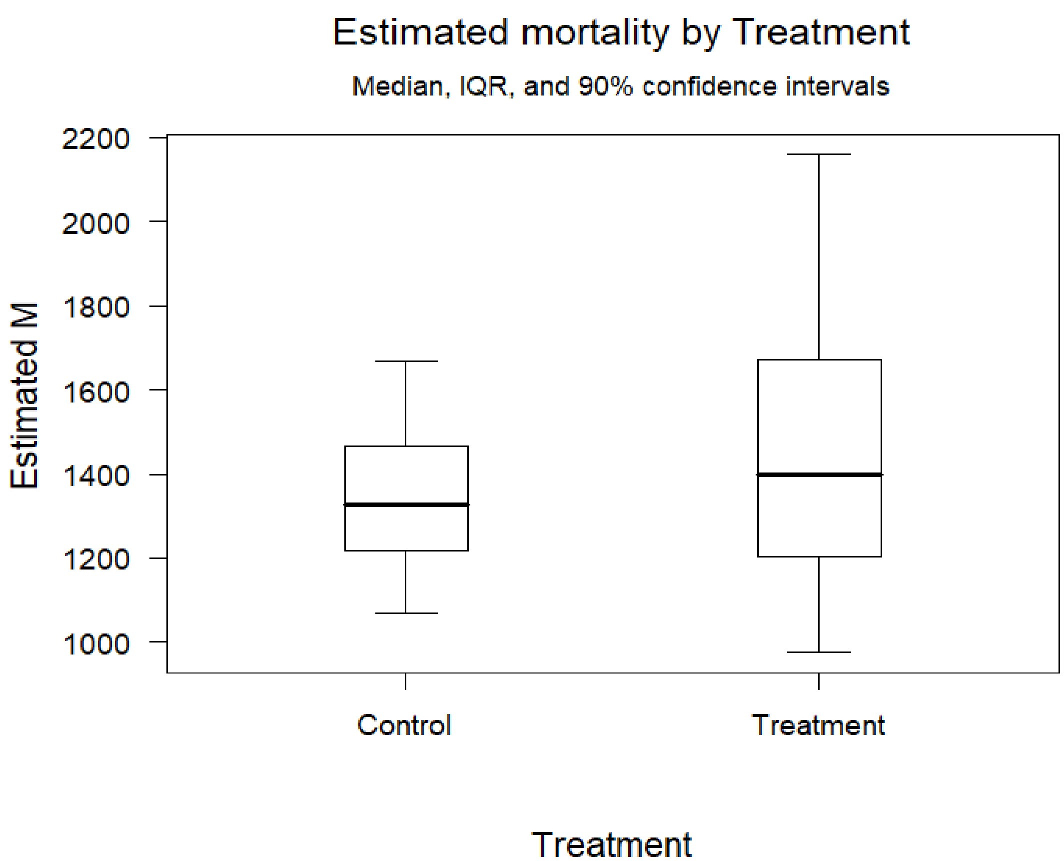

Figure 3-2. Annual all bat fatality estimates at control (3 m/s) vs. treatment (Implemented 2024) turbines for 2024 at the Kings Point Wind Project.

3.3.5 Gray Bat and Tricolored Bat Fatality Estimates - EofA

3.3.5.1 Bat In-hand Fatalities

Stantec and WEST found 12 gray bats and 13 tricolored bats during standardized searches at Kings Point. An additional tricolored bat was found as an incidental observation (i.e. not during a scheduled search) and was not included in fatality estimates. No other federal or state endangered species were found. The locations of the gray bat and tricolored bat fatalities are shown in Appendix A, Figure A-4. See Table 3-7 for a summary of the details for gray bats and tricolored bats found.

Table 3-7. Gray bats and tricolored bats found during 2024 at the Kings Point Wind Project.

Species	Date Found	Est. Time Since Death	Season	Turbine	Sex	Plot Type	Cut-in Speed (m/s)
Gray Bat	4/11/2024	0-1 days	Spring	T-025	Female	80-m Human	3
	6/21/2024	0-1 days	Summer	T-060	Female	80-m Detection Dog	3
	6/25/2024	4-7 days	Summer	T-119	Female	80-m Detection Dog	3
	7/5/2024	4-7 days	Summer	T-017	Male	80-m Human	3
	7/18/2024	2-3 days	Summer	T-056	Female	80-m Detection Dog	3
	7/19/2024	2-3 days	Summer	T-074	Male	80-m Detection Dog	3
	7/23/2024	4-7 days	Summer	T-090	Female	80-m Detection Dog	3
	7/23/2024	2-3 days	Summer	T-126	Female	80-m Detection Dog	3
	8/5/2024	2-3 days	Summer	T-060	Female	80-m Detection Dog	3
	8/23/2024	2-3 days	Summer	T-034	Male	80-m Detection Dog	3
	9/3/2024	4-7 days	Fall	T-074	Female	80-m Detection Dog	3
	9/24/2024	1-2 days	Fall	T-080	Female	80-m Detection Dog	3
	8/2/2024	0-1 days	Summer	T-033	Male	80-m Detection Dog	3

Species	Date Found	Est. Time Since Death	Season	Turbine	Sex	Plot Type	Cut-in Speed (m/s)
Tricolored Bat	8/5/2024	2-3 days	Summer	T-035	Male	80-m Detection Dog	3
	8/6/2024	0-1 days	Summer	T-128	Female	80-m Human	3
	8/15/2024	0-1 days	Summer	T-028	Female	80-m Detection Dog	7.5
	8/16/2024	2-3 days	Summer	T-032	Female	80-m Detection Dog	7.5
	8/16/2024	0-1 days	Summer	T-090	Female	80-m Detection Dog	3
	8/16/2024	4-7 days	Summer	T-091	Male	80-m Detection Dog	3
	8/16/2024	0-1 days	Summer	T-114	Male	80-m Detection Dog	3
	8/23/2024	4-7 days	Summer	T-126	Male	80-m Detection Dog	3
	9/3/2024	8-14 days	Fall	T-091	Female	80-m Detection Dog	3
	9/9/2024	2-3 days	Fall	T-036	Male	80-m Detection Dog	3
	9/15/2024	0-1 days	Fall	T-036	Female	80-m Detection Dog	3
	9/16/2024	4-7 days	Fall	T-033	Female	80-m Detection Dog	3
	8/19/2024	4-7 days	Summer	T-025	Male	80-m Detection Dog	3 (incidental)

3.3.5.2 Evidence of Absence

3.3.5.2.1 Detection Probability (g)

EofA inputs and outputs for the Multiple Classes Module runs are provided in Appendix B. The detection probability (g) for the bat active season (March 1 through November 15, 2024) was 0.24 (95% CI: 0.22 – 0.25) and varied by season (Table 3-8).

Table 3-8. Seasonal and Annual Detection Probability for the King's Point Wind Project from the 2024 post-construction monitoring season.

Season	g-value (95% CI)
Spring	0.18 (0.13-0.23)
Summer	0.26 (0.24-0.28)
Fall	0.17 (0.15-0.19)
Annual	**0.23 (0.22-0.25)**

3.3.5.2.2 Annual Fatality Estimates (M and λ)*

Analysis in the EofA "Multiple Years Module" included calculation of the annual take estimate (M_{2024}) and the annual take rate (λ) for gray bats and tricolored bats based on the 12 and 13 carcasses found, respectively, for each species during standardized monitoring and the detection probability (g) from the 2024 study. Results are summarized in Table 3-9.

Table 3-9. Summary of EofA outputs for gray bats from 2024 post-construction monitoring at the Kings Point Wind Project. Analysis done with α=0.8.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2024})	Annual Take Rate (λ) (95% CI)
Gray Bat	12	63	53.4 (27.9 – 87.1)
Tricolored Bat	13	68	57.7 (31 – 92.6)

Treatment vs. Control Turbines

Annual fatality estimates were also split by treatment using the EofA "Multiple Classes Module" and the eight (8) distinct strata identified. G-values differed between treatment and control turbines during the time periods in which cut-in speeds were raised (July 2, August, and September 1 sub-seasons; see Table 2-5) due to differences in minimization during those periods. DWPs for this analysis were calculated using arrival and minimization weights specific to the treatment vs. control strategy. Results are summarized in Table 3-10.

Table 3-10. Summary of EofA outputs for gray bats and tricolored bats from 2024 post-construction monitoring at the Kings Point Wind Project. Analysis done with α=0.8.

Species	Control Turbines			Treatment Turbines		
	Number of detected fatalities (X)	Annual Take Estimate (M2024)	Annual Take Rate (λ) (95% CI)	Number of detected fatalities (X)	Annual Take Estimate (M2024)	Annual Take Rate (λ) (95% CI)
Gray Bat	9	48	39.2 (18.3-68.03)	3	21	15.6 (3.75, 35.68)
Tricolored Bat	11	57	47.5 (24, 78.87)	2	15	11.1 (1.85, 28.59)

3.3.6 Acoustic Monitoring

3.3.6.1 2021 – 2023 Monitoring

The results of the acoustic monitoring from 2021, 2022, and 2023 are available in the 2023 annual report (Stantec 2024) but were combined where applicable with the 2024 data to provide a comprehensive analysis of acoustic bat activity as it relates to exposure and bat fatality.

3.3.6.2 2024 Monitoring

Acoustic bat detectors were deployed at the same turbines as were monitored during the 2023 monitoring period. Detector installation on turbine nacelles began on February 20, 2024, and all but one detector was in place as of March 1 (the final detector was deployed on May 21). Detectors were demobilized between December 12–14. Acoustic detectors recorded a total of 11,072 bat passes during 3,414 successful detector-nights (80% of nights when detectors were deployed). Nacelle-mounted detectors (n = 15) recorded 3.24 bat passes per detector-night during the 2024 monitoring period (Table 3-11).

Table 3-11. Acoustic survey effort at the Kings Point Wind Project from March through November 2024.

Turbine and Position	Start Date	End Date	Detector Nights (DN)	#Passes, Species of Interest		Total Bat Passes	Overall Rate (bat passes/DN)
				Gray Bat	Tricolored Bat		
Turbine 008 Nacelle	29-Feb	14-Dec	253	6	12	629	2.49
Turbine 017 Nacelle	21-Feb	12-Dec	271	14	5	1,378	5.08
Turbine 025 Nacelle	28-Feb	14-Dec	174	10	1	274	1.57
Turbine 026 Nacelle	20-Feb	14-Dec	283	20	11	1,250	4.42
Turbine 035 Nacelle	29-Feb	14-Dec	275	13	7	1,001	3.64
Turbine 044 Nacelle	29-Feb	12-Dec	178	12	8	280	1.57

Turbine and Position	Start Date	End Date	Detector Nights (DN)	#Passes, Species of Interest		Total Bat Passes	Overall Rate (bat passes/DN)
				Gray Bat	Tricolored Bat		
Turbine 056 Nacelle	29-Feb	12-Dec	224	5	1	254	1.13
Turbine 060 Nacelle	1-Mar	14-Dec	186	9	5	670	3.6
Turbine 063 Nacelle	29-Feb	14-Dec	259	30	11	1,023	3.95
Turbine 068 Nacelle	2-Mar	11-Dec	162	9	5	245	1.51
Turbine 080 Nacelle	1-Mar	14-Dec	276	15	10	1,036	3.75
Turbine 091 Nacelle	1-Mar	12-Dec	121	12	7	393	3.25
Turbine 114 Nacelle	1-Mar	14-Dec	277	2	10	915	3.3
Turbine 124 Nacelle	21-May	14-Dec	196	28	6	1,130	5.77
Turbine 128 Nacelle	23-Feb	12-Dec	279	8	12	594	2.13
Total	20-Feb	14-Dec	3,414	193	111	11,072	3.24

3.3.6.3 Acoustic Results

As in previous years, acoustic bat activity at Kings Point was relatively low from March through early July and increased rapidly in mid-July, peaking in mid-August, before dropping back to low levels in mid-September (Figure 3-3). The biweekly peak in eastern red bat activity was slightly earlier than that of hoary bats, although all species were most commonly detected between late July and early September (Appendix C, Figure C-1). The seasonal peak in bat activity documented at Kings Point in 2024 was slightly earlier than in previous years. Gray bats and tricolored bats followed a similar biweekly pattern in activity to all bat activity, though represented a small proportion of detected passes throughout the monitoring period (Figure 3-4).

Although timing of bat activity varied among nights, overall timing of bat activity during each monitoring year peaked 2–4 hours after sunset and was consistent among years (Figure 3-5) and species (Appendix C, Figure C-3). The hourly distribution of gray bat and tricolored bat activity was more variable among years, although this is attributable to fewer counts recorded for these species (Figure 3-6).

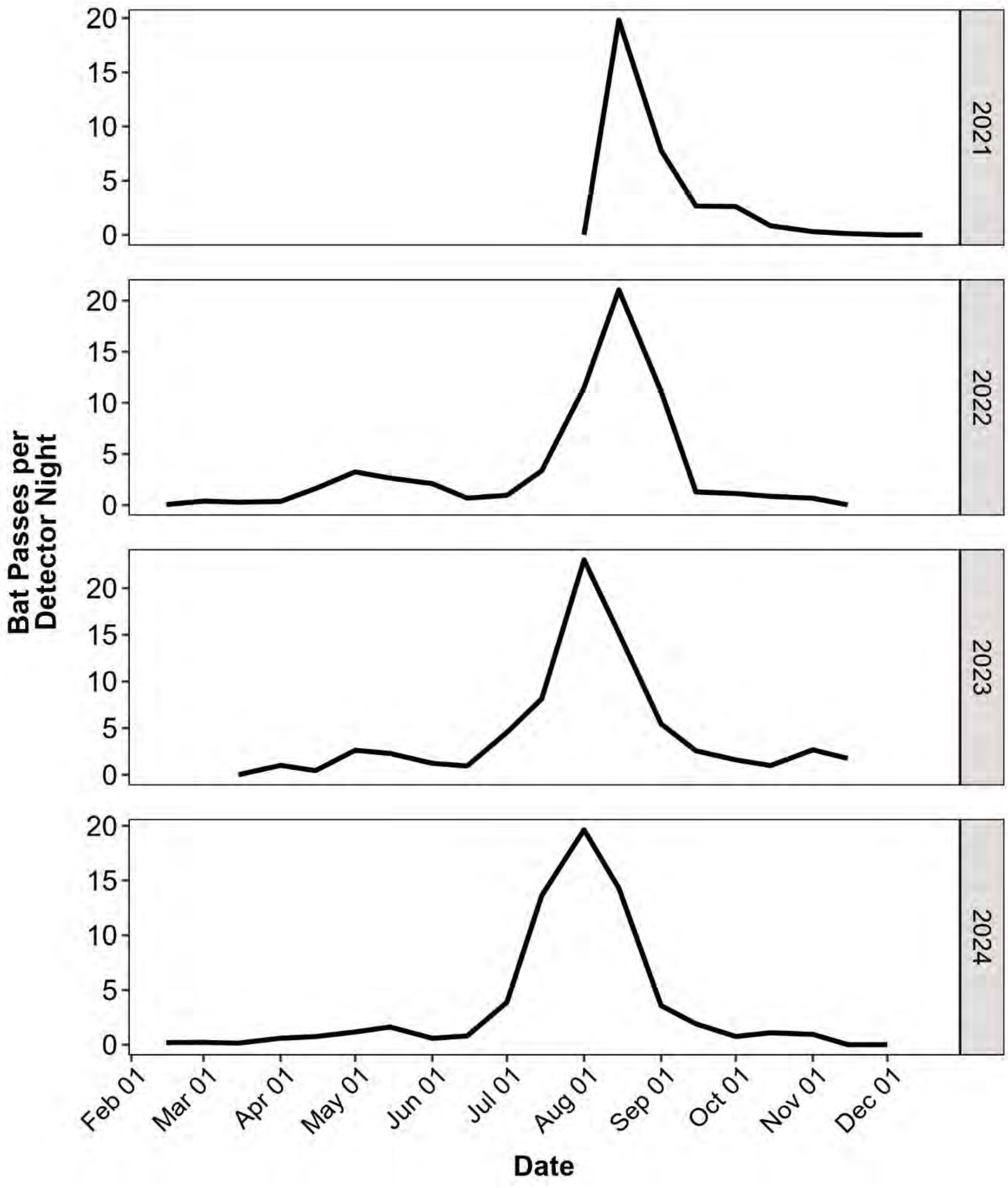

Figure 3-3. Biweekly acoustic bat activity detected at nacelle-height detectors the 2021–2024 monitoring periods at the Kings Point Wind Project.

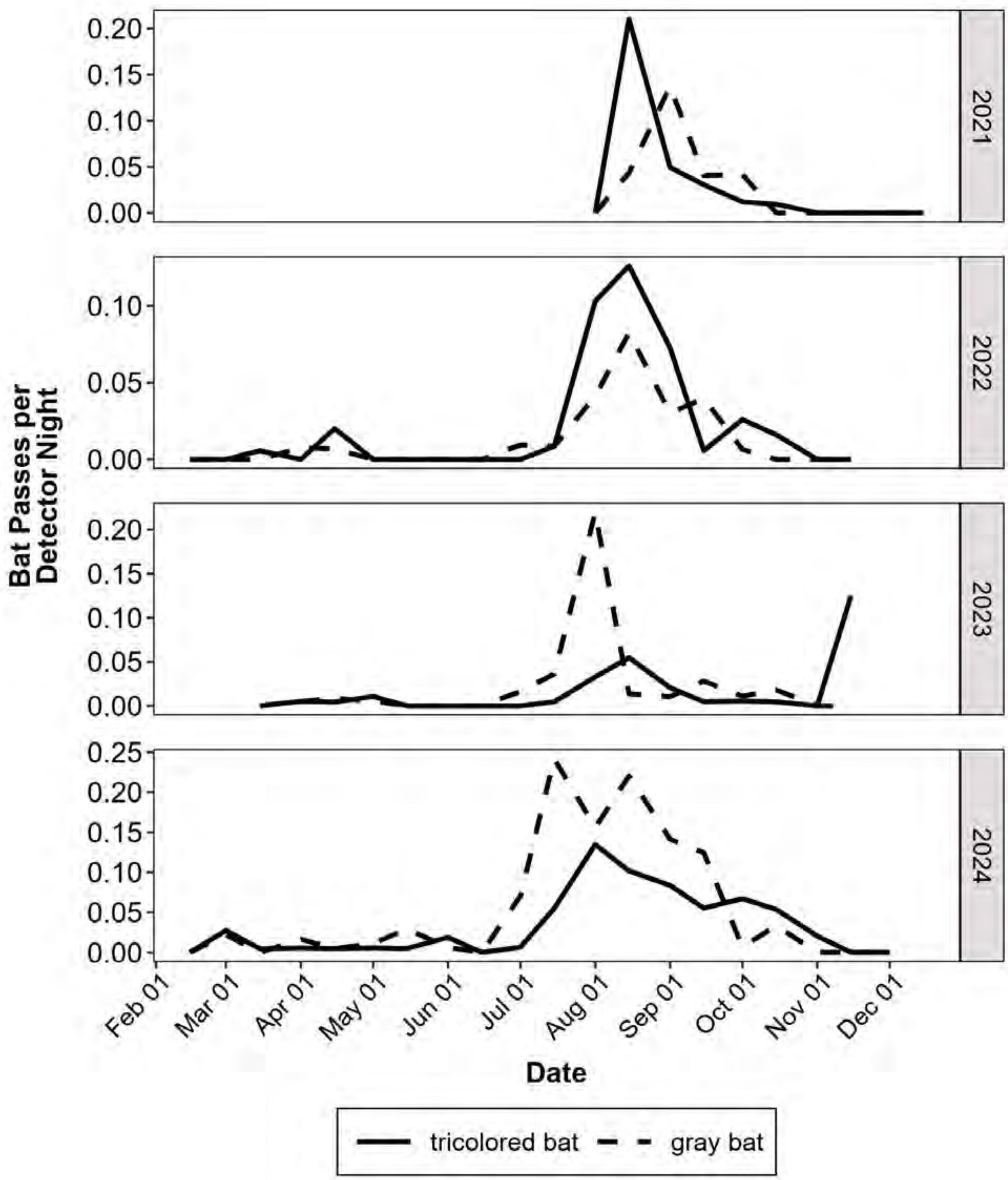

Figure 3-4. Biweekly acoustic bat activity for gray bats and tricolored bats detected at nacelle-height detectors during the 2021–2024 monitoring periods at the Kings Point Wind Project.

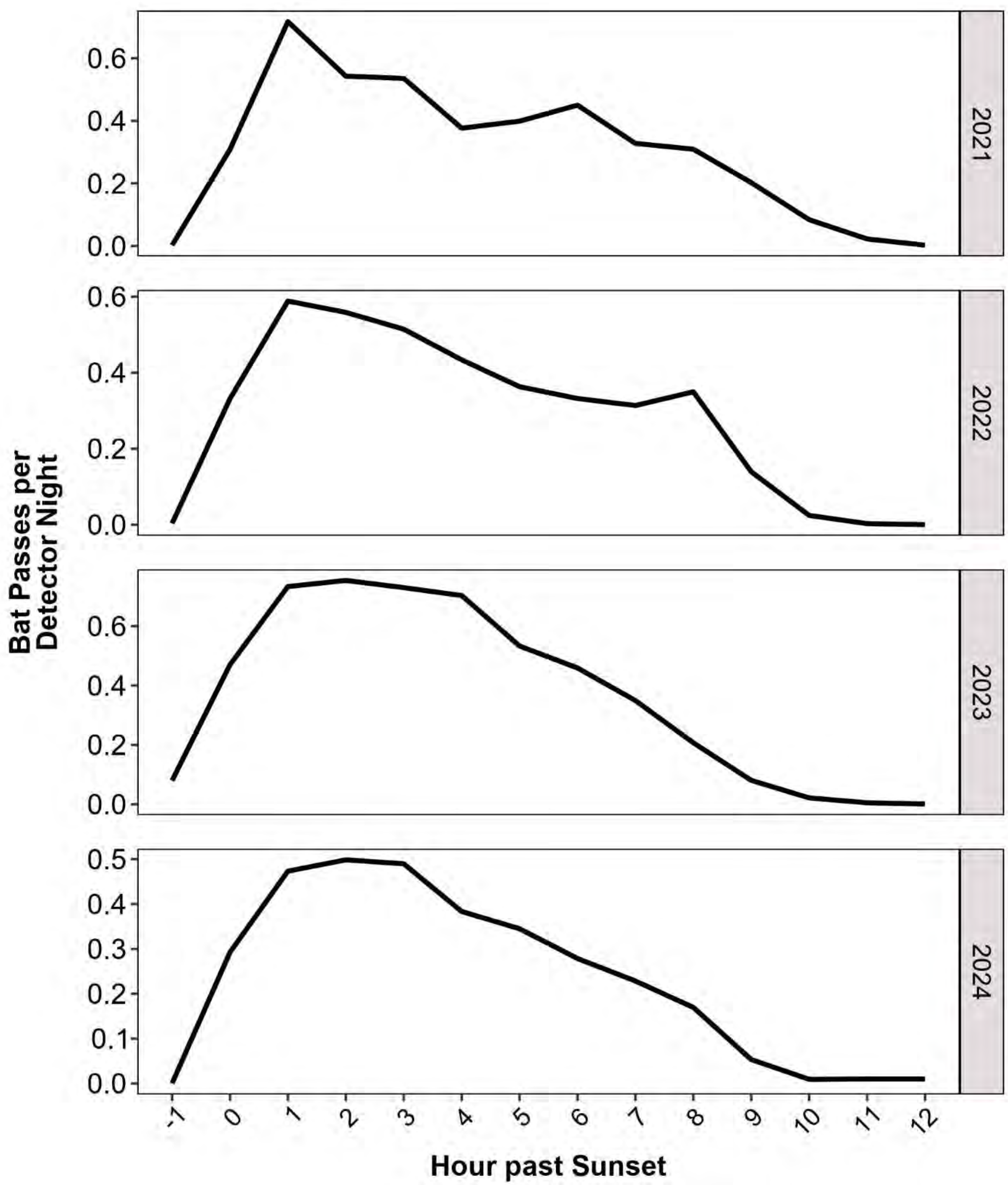

Figure 3-5. Nightly timing of bat activity (by hour past sunset) detected at nacelle detectors during the 2021 – 2024 monitoring periods at the Kings Point Wind Project.

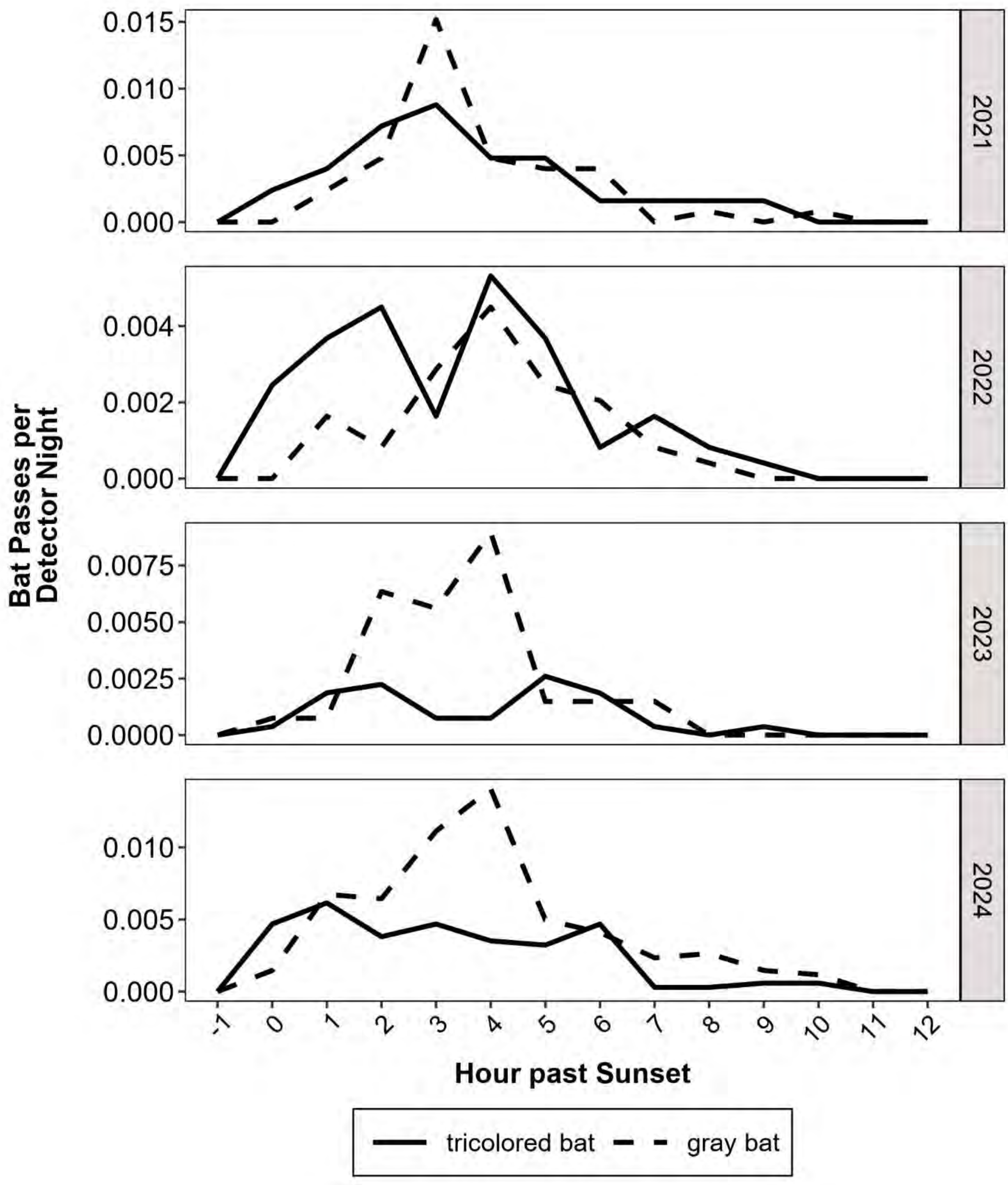

Figure 3-6. Nightly timing of gray bat and tricolored bat activity (by hour past sunset) detected at nacelle detectors during the 2021 – 2024 monitoring periods at the Kings Point Wind Project.

Temperature, wind speed, and turbine rotor speed data measured at nacelle height were available during 10-minute intervals in which 11,049 bat passes (99.8% of 11,072 total bat passes) were detected at Kings Point in 2024. Data were used to measure acoustic exposure associated with the two operational treatments implemented at Kings Point in 2024. Of the 4,096 bat passes with operations data recorded at control turbines in 2024, 3,309 (81%) were recorded during intervals when turbine rotor speed exceeded 1 rpm. For the curtailment treatment, 2,826 (41%) of 6,953 bat passes were exposed to turbine operation. A higher proportion of tricolored bats was exposed to turbine operation than gray bats at both treatments at Kings Point in 2024, although the proportion of bats exposed to turbine operation was substantially reduced for all bats, gray bats, and tricolored bats (Table 3-12). Cumulative biweekly acoustic exposure remained low for both treatments through early July, but the rate of increase was reduced at the treatment group once the increased cut-in speed was applied on July 25. Curtailment resulted in a slightly lower cumulative biweekly rate of acoustic exposure at the curtailed turbines (23.2) versus control turbines (30.7) despite a higher overall rate of bat activity occurring at turbines in the curtailment treatment (Figure 3-7). Slightly higher levels of acoustic exposure occurred at curtailed versus control turbines for gray bats and tricolored bats at Kings Point in 2024, though sample sizes were small (Figure 3-8).

Table 3-12. Acoustic exposure of gray bat, tricolored bat, and all bat passes to turbine operation (detection when turbine rotor speed > 1 rpm) associated with operational treatments implemented during the 2024 monitoring period at the Kings Point Wind Project.

Year	Treatment	# Turb.	All Bats		Gray Bats		Tricolored Bats	
			Total Passes	Exposed Passes (%)	Total Passes	Exposed Passes (%)	Total Passes	Exposed Passes (%)
2024	Control	7	4,101	3,309 (80.69%)	59	33 (55.93%)	43	36 (83.72%)
2024	Implemented 2024	8	6,971	2,826 (40.54%)	134	41 (30.60%)	68	43 (63.24%)

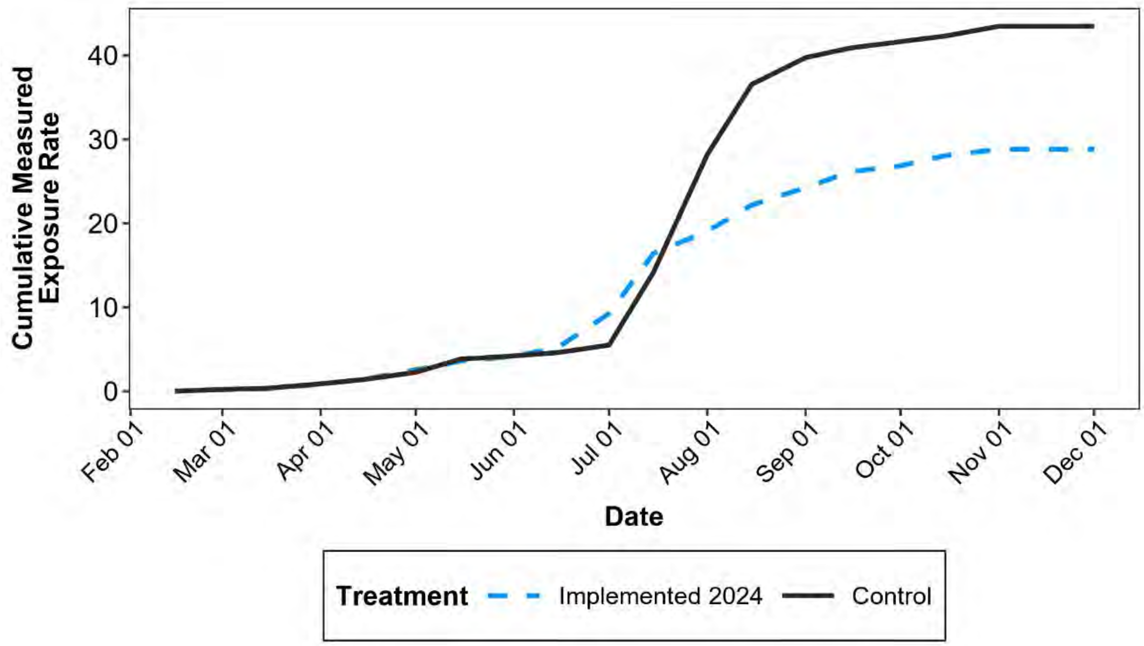

Figure 3-7. Cumulative biweekly acoustic exposure (measured) of bat activity recorded by nacelle height detectors at turbines operating with 3.0 m/s (control) and according to the 2024 curtailment strategy implemented at the Kings Point Wind Project.

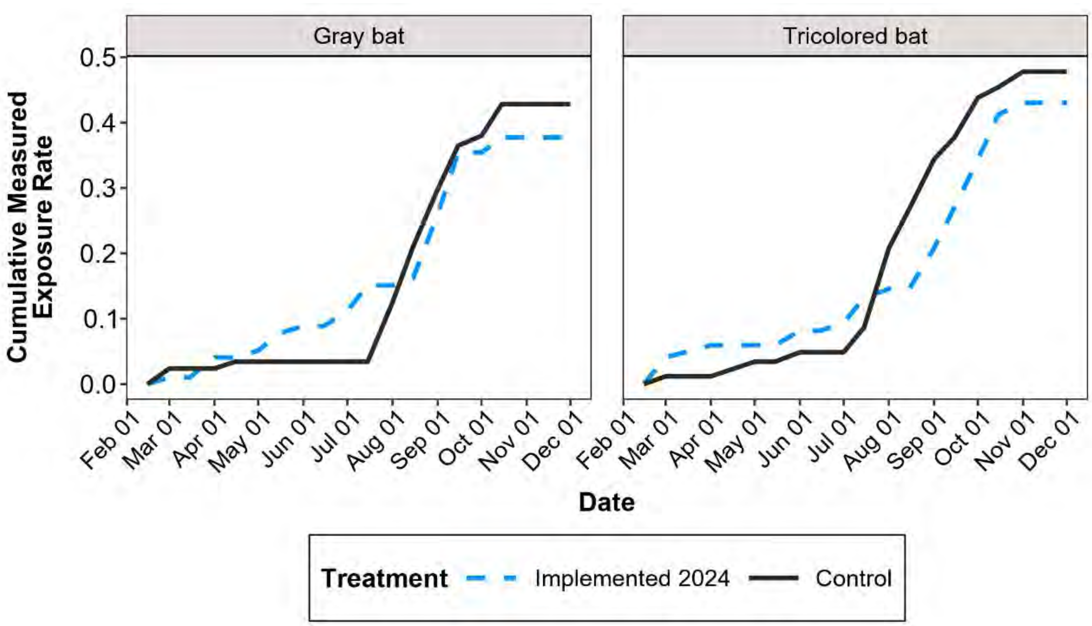

Figure 3-8. Cumulative biweekly acoustic exposure (measured) of gray bat and tricolored activity recorded by nacelle height detectors at turbines operating with 3.0 m/s (control) and according to the 2024 curtailment strategy implemented at the Kings Point Wind Project.

3.4 North Fork Ridge

3.4.1 Carcass Searches

A total of 3,251 searches were completed between April 1 and October 31, 2024, at the North Fork Ridge Wind Project. A summary of search effort by season with total numbers of bats found is presented in Table 3-13. A total of 534 bat carcasses were found during standardized carcass searches, and 20 bat carcasses were found incidentally.

Table 3-13. Summary of post-construction monitoring completed between April 1 and October 31, 2024, at the North Fork Ridge Wind Project.

Season	Dates	Number of Searches Conducted	Average Search Interval	Number of bats found in standardized searches	Number of bats found incidentally
Spring	April 1 – May 31	596	6.86	30	4
Summer	June 1 – August 31	1,634	3.70	366	8
Fall	September 1 – October 31	1,021	3.85	138	8
Total	April 1 – October 31	3,251	4.33	534	20

3.4.2 Species Composition

There were 534 bat carcasses found during standardized carcass searches including 18 unidentified *Lasiurus* species. The most common species was the eastern red bat (419 individuals; 78.5%), and the hoary bat (58 individuals; 10.9%) was the second most common species. One gray bat and three tri-colored bats were found during standard carcass searches. A summary of all bat carcasses found during the standardized carcass searches is shown in Table 3-14.

Table 3-14. Summary of bat carcasses found during standardized carcass searches between April 1 and October 31, 2024 at the North Fork Ridge Wind Project.

Species	Spring	Summer	Fall	Total
Big Brown Bat *Eptesicus fuscus*	0 0.0%	15 4.1%	0 0.0%	15 2.8%
Eastern Red Bat *Lasiurus borealis*	23 76.7%	303 82.9%	93 67.4%	419 78.5%

Species	Spring	Summer	Fall	Total
Evening Bat *Nycticeius humeralis*	2 6.7%	3 0.8%	5 3.6%	10 1.9%
Gray Bat[1, 2] *Myotis grisescens*	0 0.0%	1 0.3%	0 0.0%	1 0.2%
Hoary Bat[1] *Lasiurus cinereus*	5 16.7%	27 7.4%	26 18.8%	58 10.9%
Silver-haired Bat[1] *Lasionycteris noctivagans*	0 0.0%	0 0.0%	4 2.9%	4 0.7%
Tricolored Bat[1] *Perimyotis subflavus*	0 0.0%	3 0.8%	0 0.0%	3 0.6%
Seminole Bat *Lasiurus seminolus*	0 0.0%	0 0.0%	1 0.7%	3 0.2%
Eastern Red or Seminole Bat	0 0.0%	3 0.8%	2 1.4%	5 0.9%
Unidentified *Lasiurus* Bat	0 0.0%	11 3.0%	7 5.1%	18 3.4%
Total	30 5.6%	366 68.5%	138 25.8%	534 100.0%

[1]Missouri Department of Conservation Species of Conservation Concern
[2]State and Federal listed Endangered

3.4.3 Carcass Persistence

CP was tested using 110 bat carcasses distributed among plot type and season. The top model for CP in GenEst included a lognormal distribution with no effects for plot type or season (Appendix B, Table B-3). That model was selected, and the median CP was 4.37 days (90% CI: 3.38 – 5.65).

3.4.4 Adjusted Fatality Estimates - GenEst

Fatality rate estimates were calculated based upon the carcasses found during the standardized carcass searches within the search plots and did not include any incidental finds. Observed bat fatality estimates were adjusted to account for SE, CP, the search schedule, and the turbine-specific DWP area corrections.

3.4.4.1 Seasonal Fatality Estimates

Across all three survey seasons, 534 bat carcasses were found during standardized searches. The total estimated fatality for all bats was highest during the summer season (1,195 bats), followed by fall (384 bats), and lowest in the spring (382 bats) as summarized in Table 3-15 and Figure 3-9. The median annual fatality estimate, combining all seasons, resulted in an overall bat fatality estimate of 1,975.33

bats (90% CI: 1,614.28 – 2,407.56) across all 67 operational turbines (145 MW; Turbines T-002 and T-004 were both 2.2 MW WTGs that were non-operational for the entire study period) between April 1 and October 31, 2024 – equivalent to 29.48 bats/turbine (90% CI: 24.09 – 35.93) or 13.62 bats/MW (90% CI: 11.14 – 16.60).

Table 3-15. Bat fatality rates by season from 2024 post-construction monitoring at the North Fork Ridge Wind Project.

Season	Dates	Facility-wide Estimated Fatalities (90% CI)	Per-turbine Estimated Fatalities (90% CI)	Per-MW Estimated Fatalities
Spring	April 1 – May 31	381.90 (253.91 – 566.27)	5.70 (3.79 – 8.45)	**2.63** (1.75 – 3.91)
Summer	June 1 – August 31	1,195.08 (947.08 – 1,489.67)	17.84 (14.14 – 22.23)	**8.24** (6.53 – 10.27)
Fall	September 1 – October 31	383.73 (267.53 – 540.21)	5.73 (3.99 – 8.06)	**2.65** (1.85 – 3.73)
Annual	**April 1 – October 31**	**1,975.33** **(1,614.28 – 2,407.56)**	**29.48** **(24.09 – 35.93)**	**13.62** **(11.14 – 16.60)**

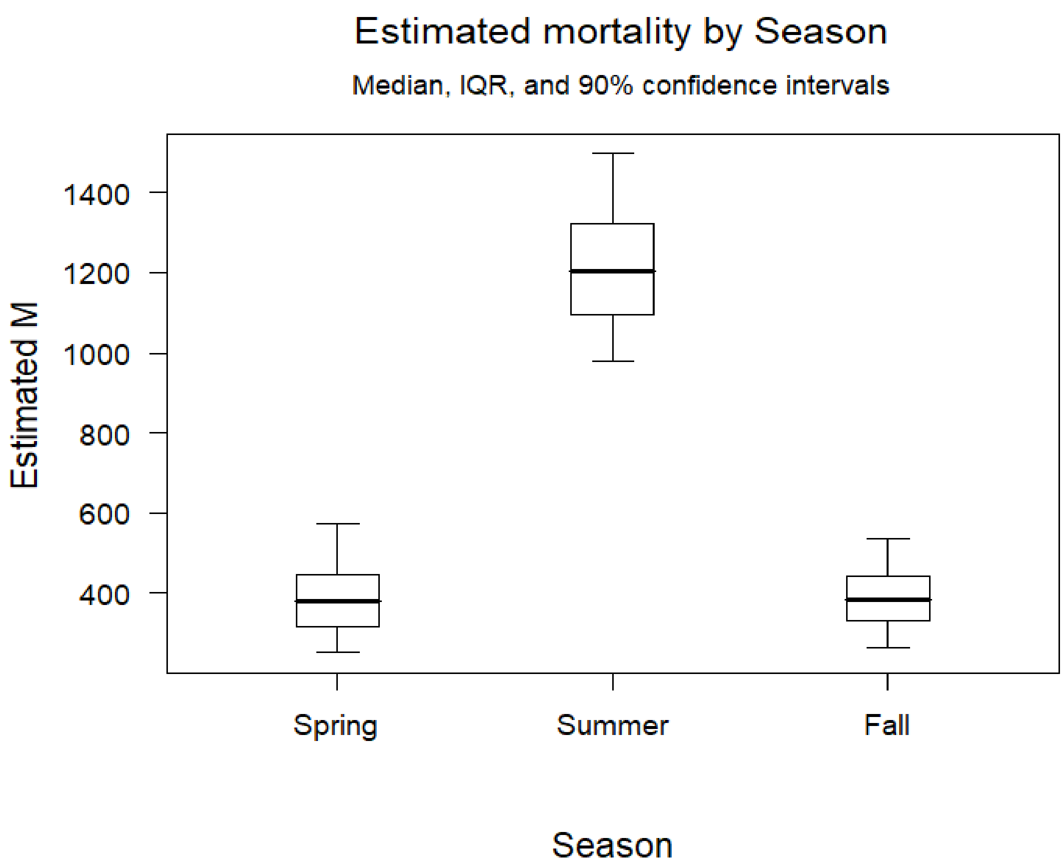

Figure 3-9. Seasonal all bat fatality estimates for 2024 at the North Fork Ridge Wind Project.

3.4.4.2 Control Vs. Treatment Fatality Estimates

Annual fatality estimates were higher for control turbines (3.0 m/s cut-in) than for treatment turbines (Implemented 2024). Estimated annual bat fatality was 991.62 (90% CI: 813.67 – 1,237.46) at control turbines and 970.48 (90% CI: 736.53 – 1,295.21) at treatment turbines (Figure 3-10). Per turbine estimates are 29.17 (90% CI: 23.93 – 36.40) for control turbines and 29.41 (90% CI: 22.32 – 39.25) for treatment turbines. Per MW estimates are 13.47 (90% CI: 11.06 – 16.81) for control turbines and 13.59 (90% CI: 10.32 – 18.14) for treatment turbines.

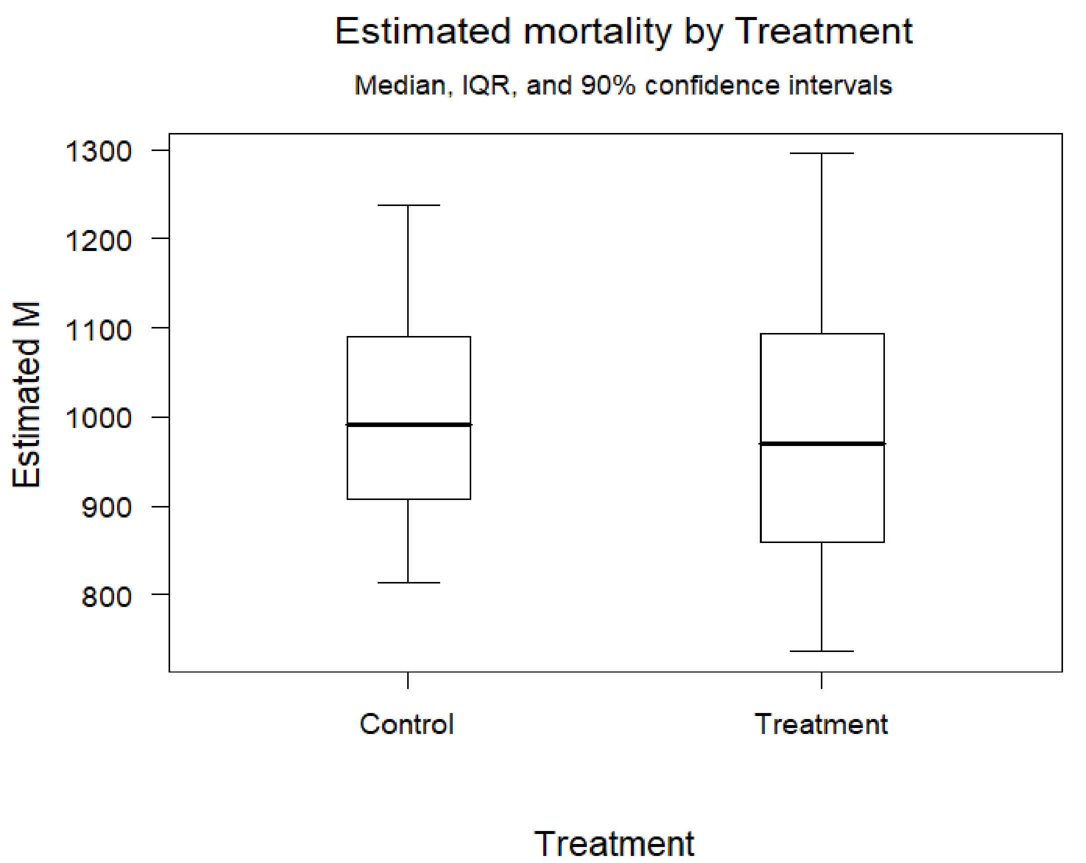

Figure 3-10. All bat fatality estimates at control (3 m/s) vs. treatment (Implemented 2024) turbines for 2024 at the North Fork Ridge Wind Project.

3.4.5 Gray Bat and Tricolored Bat Fatality Estimates - EofA

3.4.5.1 Bat In-hand Fatalities

Stantec and WEST found 1 gray bat and 3 tricolored bats in 2024 during standardized searches at North Fork Ridge (Appendix A, Figure A-5). A summary of the details for the gray bat and tricolored bats found is available in Table 3-16.

Table 3-16. Gray bat and tricolored bats found during 2024 at the North Fork Ridge Wind Project.

Species	Date Found	Est. Time Since Death	Season	Turbine	Sex	Plot Type	Cut-in Speed (m/s)
Gray Bat	7/24/2024	0-1 days	Summer	T-097	Male	80-m Detection Dog	3
Tricolored Bat	8/12/2024	2-3 days	Summer	T-009	Female	80-m Detection Dog	3
	8/16/2024	8-14 days	Summer	T-060	Male	80-m Detection Dog	3
	8/26/2024	2-3 days	Summer	T-024	Female	80-m Detection Dog	3

3.4.5.2 Evidence of Absence

3.4.5.2.1 Detection Probability (g)

EofA inputs and outputs for the Multiple Classes Module runs are provided in Appendix B. The detection probability (g) for the bat active season (March 1 through November 15, 2024) was 0.23 (95% CI: 0.22 – 0.25) and varied by season (Table 3-17).

Table 3-17. Seasonal and Annual Detection Probability for the North Fork Ridge Wind Project from the 2024 post-construction monitoring season.

Season	g-value (95% CI)
Spring	0.14 (0.11-0.18)
Summer	0.25 (0.23-0.26)
Fall	0.22 (0.19-0.56)
Annual	**0.23 (0.22-0.25)**

3.4.5.2.2 Annual Fatality Estimates (M and λ)*

Analysis in the EofA "Multiple Years Module" included calculation of the annual take estimate (M_{2024}) and the annual take rate (λ) for the gray bats and tricolored bats found during standardized searches and the overall detection probability from the 2024 study. Results are summarized in Table 3-18 and Table 3-19.

Table 3-18. Summary of EofA outputs for gray bats and tricolored bats from 2024 post-construction monitoring at the North Fork Ridge Wind Project. Analysis done with α=0.8.

Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2024})	Annual Take Rate (λ) (95% CI)
Gray Bat	1	9	6.5 (0.5 – 20.3)
Tricolored Bat	3	20	15.2 (3.7 – 34.7)

Annual Fatality Estimates at Treatment vs. Control Turbines

Table 3-19. Summary of EofA outputs for gray bats and tricolored bats from 2024 post-construction monitoring at the North Fork Ridge Wind Project. Analysis done with α=0.8.

	Control Turbines			Treatment Turbines		
Species	Number of detected fatalities (X)	Annual Take Estimate (M_{2024})	Annual Take Rate (λ) (95% CI)	Number of detected fatalities (X)	Annual Take Estimate (M_{2024})	Annual Take Rate (λ) (95% CI)
Gray Bat	1	9	6.39 (0.459, 19.94)	0	3	2.34 (0.002, 11.76)
Tricolored Bat	3	20	14.9 (3.59, 34.19)	0	3	2.34 (0.002, 11.76)

3.4.6 Acoustic Monitoring

3.4.6.1 2021 – 2023 Monitoring

The results of the acoustic monitoring from 2021, 2022, and 2023 are available in the 2023 annual report (Stantec 2024) but were combined where applicable with the 2024 data to provide a comprehensive analysis of acoustic bat activity as it relates to exposure and bat fatality.

3.4.6.2 2024 Monitoring

Acoustic bat detectors were deployed at the same turbines as were monitored during the 2023 monitoring period. Detector installation on turbine nacelles began on February 15, 2024, and all but one detector was in place as of February 29 (the final detector was deployed on June 4). Two detectors (Turbine 44, Turbine 24) were not installed properly during the 2024 monitoring period and were excluded from analysis. Detectors were demobilized between November 20 and December 10. Acoustic detectors recorded a total of 10,533 bat passes during 3,116 successful detector-nights (80% of nights when detectors were deployed). Nacelle-mounted detectors (n = 14) recorded 3.3 bat passes per detector-night during the 2024 monitoring period (Table 3-20).

Table 3-20. Acoustic survey effort at the North Fork Ridge Wind Project, Barton and Jasper counties, Missouri from February through November 2024.

Turbine and Position	Start Date	End Date	Detector Nights (DN)	#Passes, Species of Interest		Total Bat Passes	Overall Rate (bat passes/DN)
				Gray Bat	Tricolored Bat		
Turbine 009 Nacelle	22-Feb	6-Dec	273	8	14	599	2.19
Turbine 013 Nacelle	22-Feb	6-Dec	232	3	7	463	2
Turbine 017 Nacelle	22-Feb	20-Nov	180	0	2	648	3.6
Turbine 024 Nacelle	22-Feb	24-Nov	0	-	-	-	-
Turbine 032 Nacelle	22-Feb	10-Dec	275	16	9	429	1.56
Turbine 041 Nacelle	29-Feb	22-Nov	128	0	7	277	2.16
Turbine 058 Nacelle	21-Feb	4-Dec	272	9	18	920	3.38
Turbine 059 Nacelle	4-Jun	4-Dec	168	9	17	926	5.51
Turbine 061 Nacelle	21-Feb	10-Dec	277	14	17	902	3.26
Turbine 069 Nacelle	20-Feb	6-Dec	275	9	13	988	3.59
Turbine 078 Nacelle	20-Feb	6-Dec	275	12	12	949	3.45
Turbine 084 Nacelle	21-Feb	22-Nov	258	8	25	1,119	4.34
Turbine 093 Nacelle	15-Feb	6-Dec	279	10	23	1,402	5.03
Turbine 103 Nacelle	20-Feb	6-Dec	274	16	25	911	3.32
Total	15-Feb	10-Dec	3,166	114	189	10,533	3.33

3.4.6.3 Acoustic Results

As in previous years, acoustic bat activity at North Fork Ridge was low from March through early July and increased rapidly in mid-July, peaking in mid-August, before dropping back to low levels in mid-September (Figure 3-11). The biweekly peak in eastern red bat activity was slightly earlier than that of hoary bats, although all species were most commonly detected between late July and early September

(Appendix C, Figure C-2). Gray bats and tricolored bats followed a similar biweekly pattern in activity to all bat activity, though represented a small proportion of detected passes throughout the monitoring period (Figure 3-12). Although timing of bat activity varied among nights, overall timing of bat activity during each monitoring year peaked 2–4 hours after sunset and was consistent among years (Figure 3-13) and species (Appendix C, Figure C-4). The hourly distribution of gray bat and tricolored bat activity was more variable among years, although this is attributable to smaller sample sizes recorded for these species (Figure 3-14).

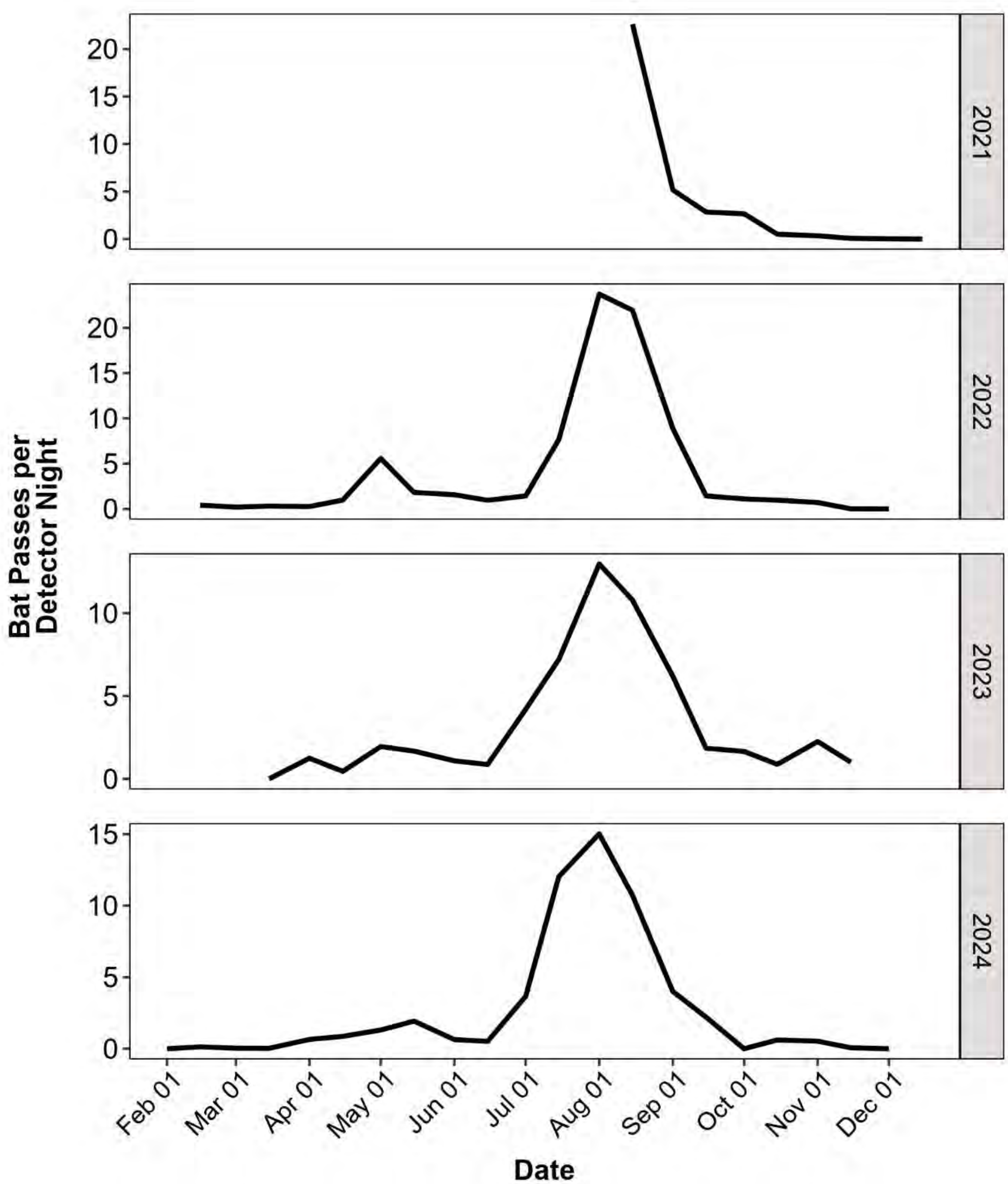

Figure 3-11. Biweekly acoustic bat activity detected at nacelle-height detectors during the 2021–2024 monitoring periods at the North Fork Ridge Wind Project. Spring/Summer monitoring did not occur in 2021.

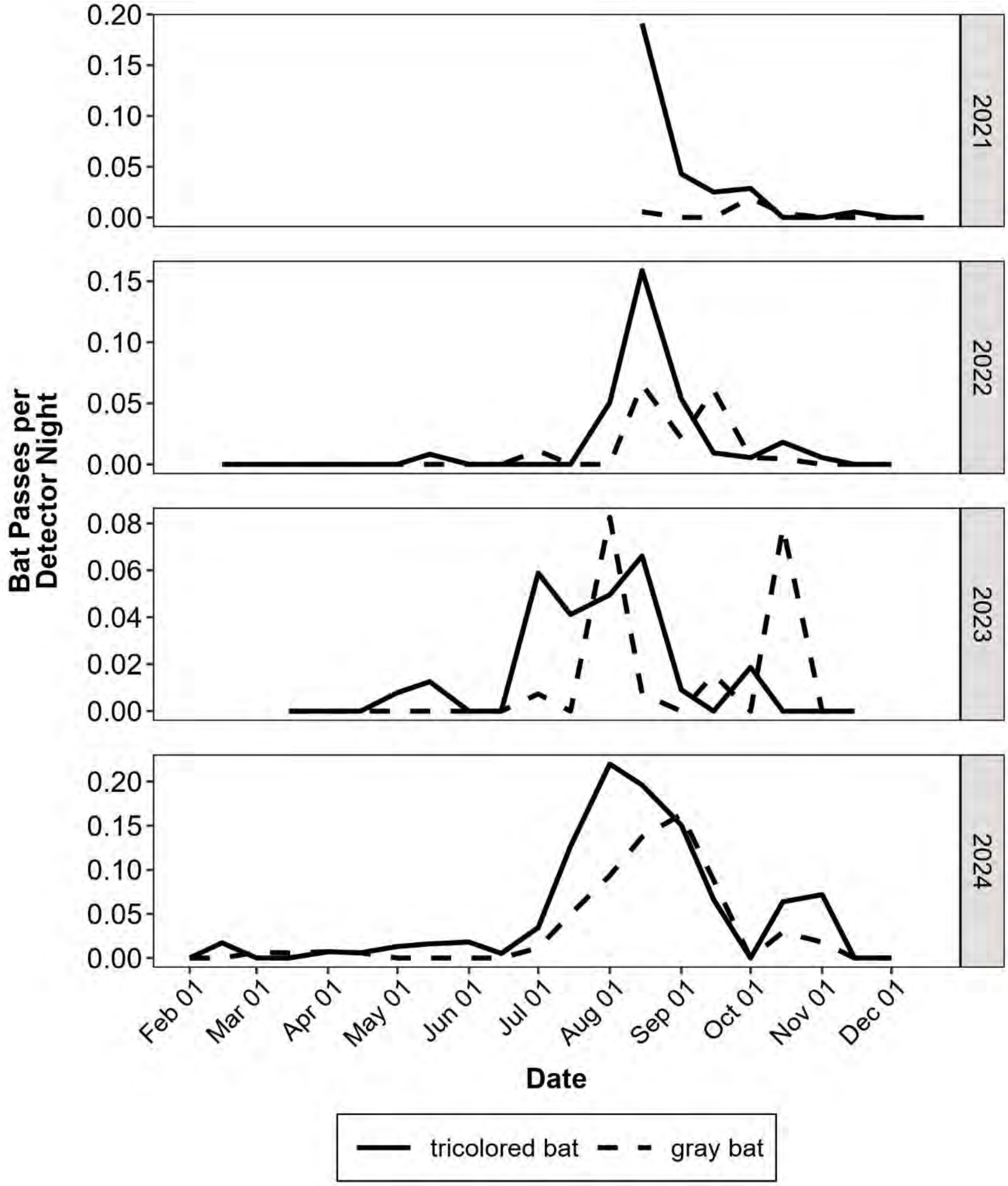

Figure 3-12. Biweekly acoustic bat activity for gray bats and tricolored bats detected at nacelle-height detectors during the 2021–2024 monitoring periods at the North Fork Ridge Wind Project. Spring/Summer monitoring did not occur in 2021.

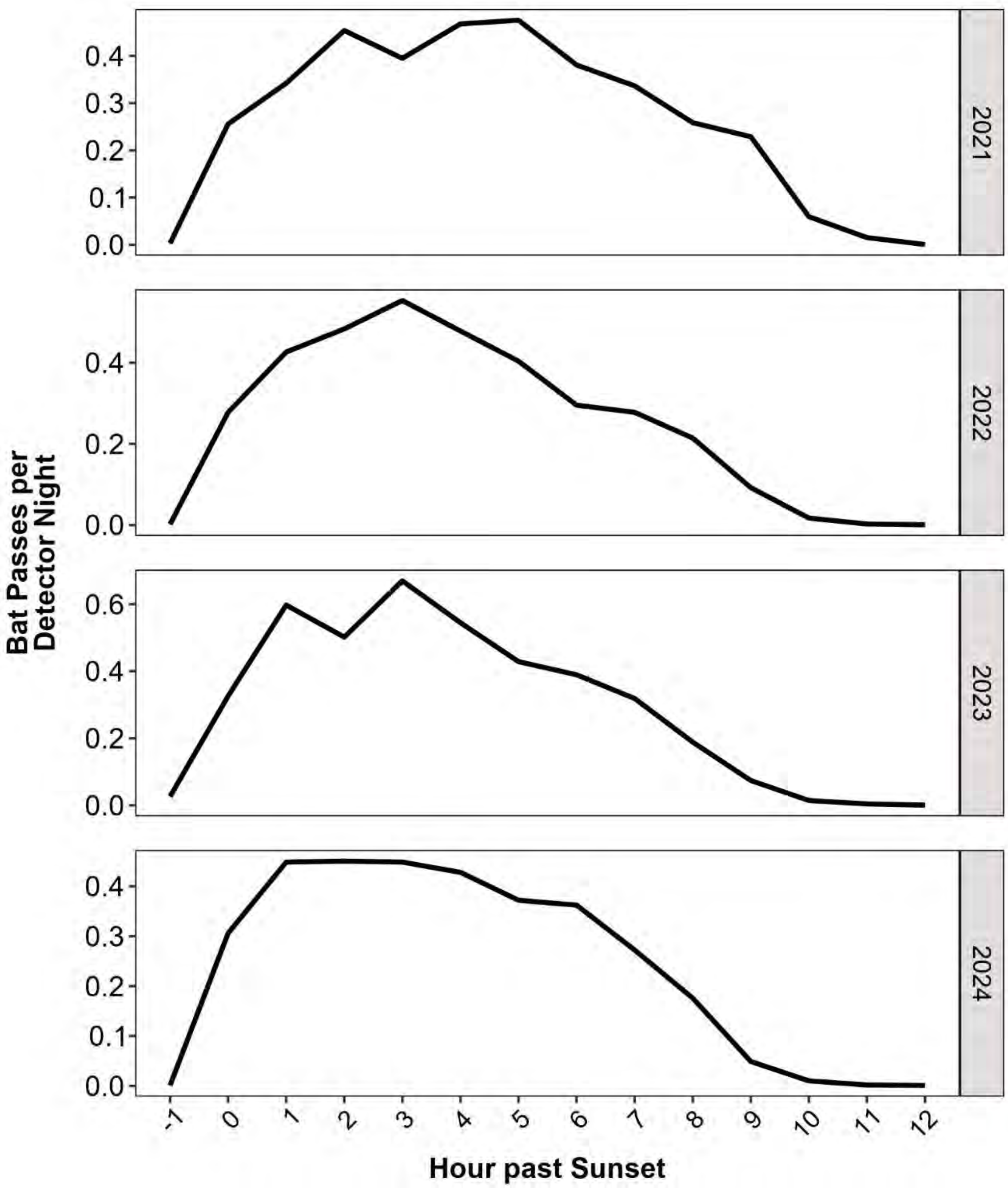

Figure 3-13. Nightly timing of bat activity (by hour past sunset) detected at nacelle detectors during the 2021–2024 monitoring periods at the North Fork Ridge Wind Project.

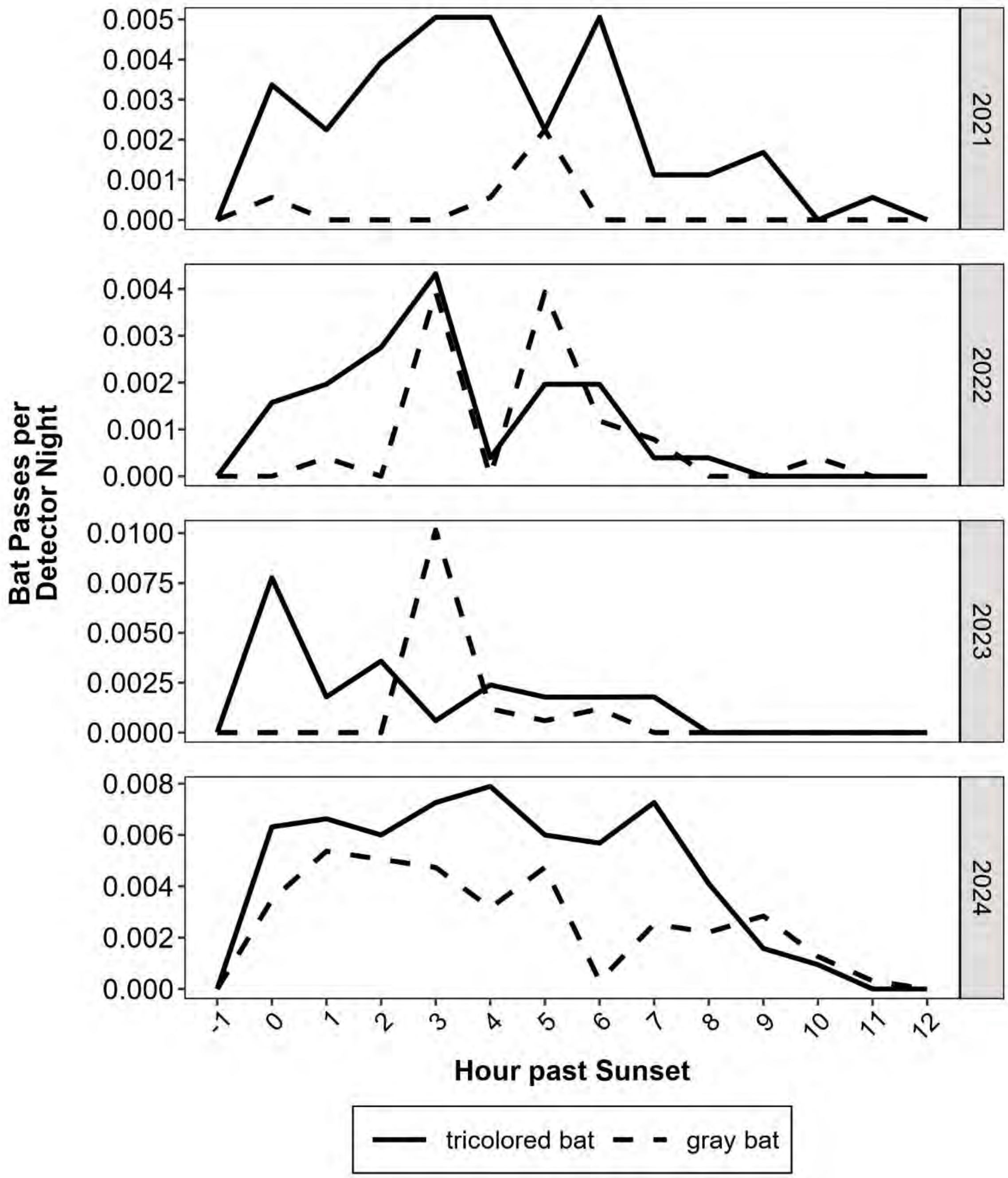

Figure 3-14. Nightly timing of gray bat and tricolored bat activity (by hour past sunset) detected at nacelle detectors during the 2021–2024 monitoring periods at the North Fork Ridge Wind Project.

Temperature, wind speed, and turbine rotor speed data measured at nacelle height were available during 10-minute intervals in which 10,490 bat passes (99.6% of 10,533 total bat passes) were detected at North Fork Ridge in 2024. We used these data to measure acoustic exposure associated with the two operational treatments implemented at North Fork Ridge in 2024. Of the 3,368 bat passes with operations data recorded at control turbines in 2024, 2,814 (83.6%) were recorded during intervals when turbine rotor speed exceeded 1 rpm. For the curtailment treatment, 2,066 (29.0%) of 7,122 bat passes were exposed to turbine operation. The proportion of tricolored bats and gray bats exposed to turbine operation was similar to all bats for the control treatment, but slightly higher for the curtailment treatment at North Fork Ridge in 2024; as was the case at Kings Point, however, curtailment reduced the proportion of bats exposed to turbine operation substantially for all bats, gray bats, and tricolored bats (Table 3-21). Cumulative biweekly acoustic exposure remained low for both treatments through early July, but the rate of increase was reduced at the treatment group once the increased cut-in speed was applied on July 18. Curtailment resulted in a lower cumulative biweekly rate of acoustic exposure at the curtailed turbines (16.8) versus control turbines (30.3) despite a higher overall rate of bat activity occurring at turbines in the curtailment treatment (Figure 3-15). Cumulative biweekly exposure (measured) of tricolored bats was higher than that of gray bats at North Fork Ridge, and a higher rate of exposure occurred for gray bats at the curtailed turbines than control turbines, though sample sizes were small (Figure 3-16).

Table 3-21. Acoustic exposure of gray bat, tricolored bat, and all bat passes to turbine operation (detection when turbine rotor speed > 1 rpm) associated with operational treatments implemented during the 2024 monitoring period at the North Fork Ridge Wind Project.

Year	Treatment	# Turb.	All Bats		Gray Bats		Tricolored Bats	
			Total Passes	Exposed Passes (%)	Total Passes	Exposed Passes (%)	Total Passes	Exposed Passes (%)
2024	Control	6	3,378	2,814 (83.3%)	28	22 (78.57%)	71	56 (78.87%)
2024	Implemented 2024	8	7,155	2,066 (28.9%)	86	39 (45.35%)	117	55 (47.01%)

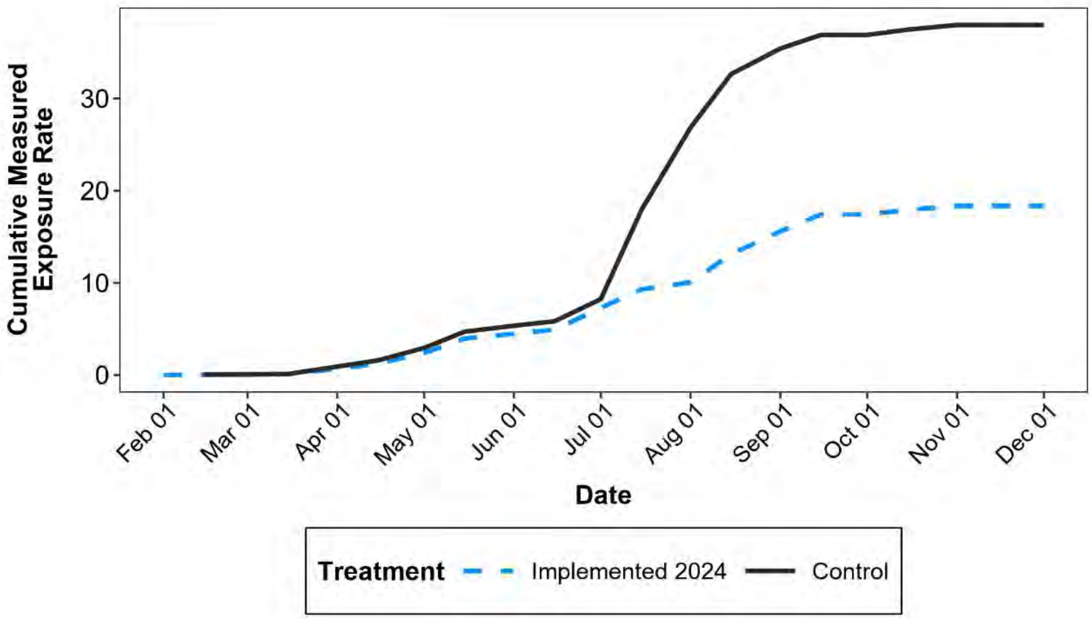

Figure 3-15. Cumulative biweekly acoustic exposure (measured) of bat activity recorded by nacelle height detectors at turbines operating with 3.0 m/s (control) and according to the 2024 curtailment strategy implemented at the North Fork Ridge Wind Project.

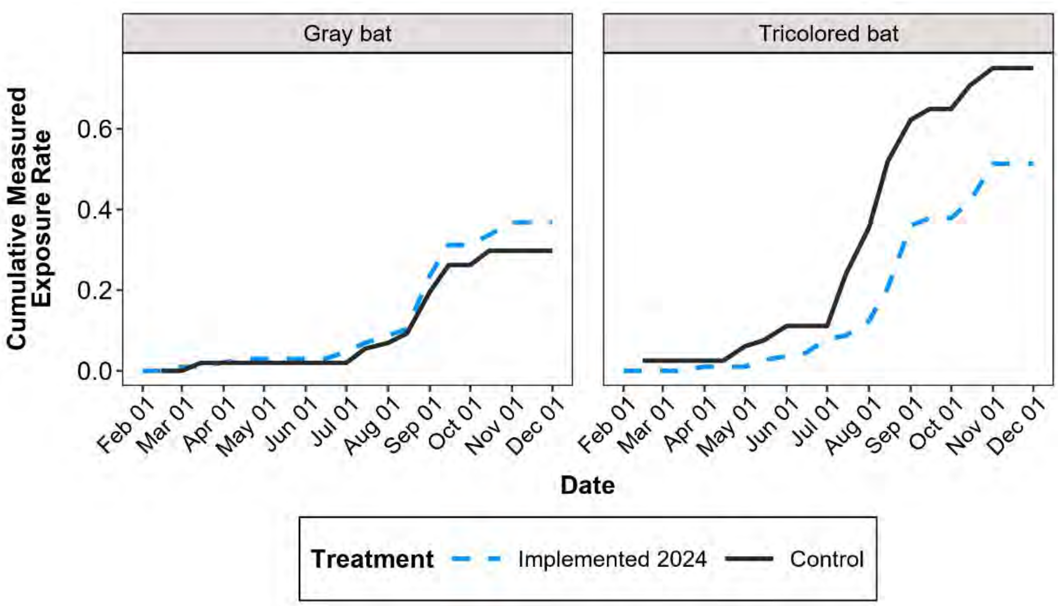

Figure 3-16. Cumulative biweekly acoustic exposure (measured) of gray bat and tricolored bat activity recorded by nacelle height detectors at turbines operating with 3.0 m/s (control) and according to the 2024 curtailment strategy implemented at the North Fork Ridge Wind Project.

3.5 Simulated Acoustic Exposure and Curtailment Evaluation

Based on a comparison of the alignment between measured and simulated exposure, curtailment treatments were operated as assigned at Kings Point and North Fork Ridge in 2024, with the exception of turbine 114 at Kings Point, which was offline for a substantial part of the monitoring period in July (Figure 3-17). As such, we were therefore able to simulate different curtailment alternatives and evaluate how effectively they would have reduced acoustic exposure. The goal of the 2024 curtailment strategy was to reduce acoustic exposure by 60% relative to uncurtailed turbines (i.e., no feathering or curtailment). We simulated uncurtailed turbine operation, Control (feathering below manufacturer's cut-in of 3.0 m/s), a 10.0 m/s blanket curtailment strategy that was initially proposed for 2024 (TCBA 10; 10.0 m/s from July 18–September 7 at North Fork Ridge and July 25–September 7 at Kings Point), and the 2024 curtailment strategy as implement ("Implemented 2024") and calculated the cumulative biweekly acoustic exposure for each of these strategies as if they had been applied at all turbines in 2024.

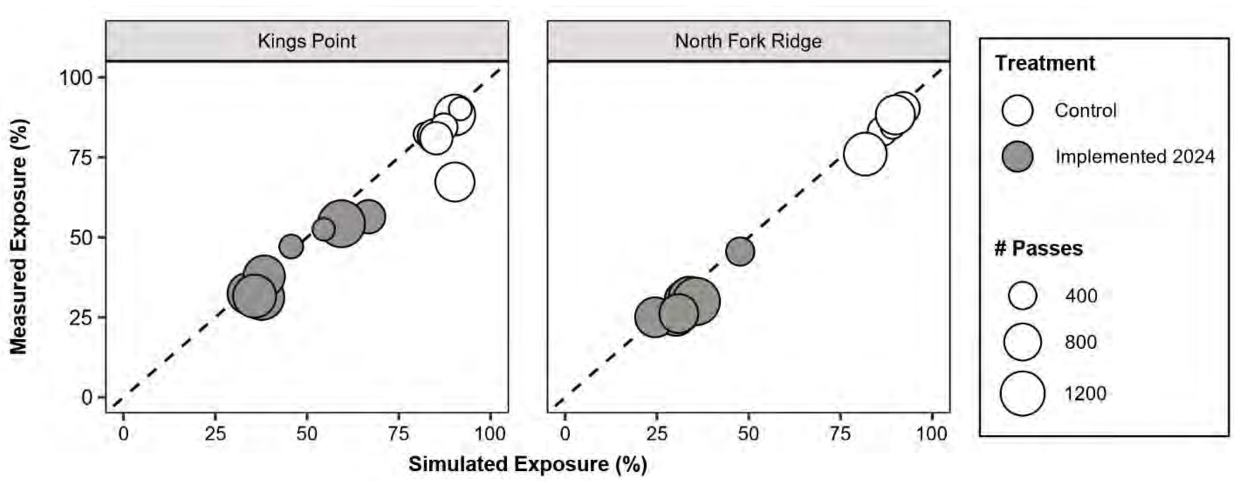

Figure 3-17. Measured versus simulated acoustic exposure calculated per turbine and treatment based on nacelle height acoustic monitoring at Kings Point and North Fork Ridge Wind Energy Projects in 2024.

The simulated cumulative biweekly exposure for the Implemented 2024 curtailment strategy was 51.9% and 60.1% lower than that for uncurtailed operation at Kings Point and North Fork Ridge, respectively (Table 3-22). The 10.0 m/s blanket strategy initially planned for 2024 (TCBA 10) would have reduced cumulative biweekly exposure by 59% at Kings Point and 66.4% at North Fork Ridge (Table 3-22). The slightly later date at which the cut-in speed was increased at Kings Point was evident in plots of cumulative biweekly exposure for simulated curtailment strategies (Table 3-18). The general patterns in acoustic exposure for simulated curtailment strategies were similar among years for all species (Figure 3-19), gray bats (Figure 3-20), and tricolored bats (Figure 3-21).

Table 3-22. Cumulative biweekly acoustic exposure for simulated curtailment strategies based on 2024 monitoring at Kings Point and North Fork Ridge.

Site	Simulated Treatment	All Bats		Gray Bats		Tricolored Bats	
		Cumulative Exposure	Percent Reduction	Cumulative Exposure	Percent Reduction	Cumulative Exposure	Percent Reduction
Kings Point	Uncurtailed	62.2	--	0.89	--	0.63	--
	Control	59.6	4.2%	0.74	16.6%	0.61	2.7%
	Implemented 2024	29.9	51.9%	0.39	56.2%	0.43	30.7%
	TCBA 10	25.5	59%	0.34	61.6%	0.36	42.9%
North Fork Ridge	Uncurtailed	52.9	--	0.57	--	0.96	--
	Control	49.7	5.9%	0.55	4.0%	0.86	10.3%
	Implemented 2024	21.1	60.1%	0.32	44.8%	0.54	43.4%
	TCBA 10	17.8	66.4%	0.27	52.6%	0.43	55.6%

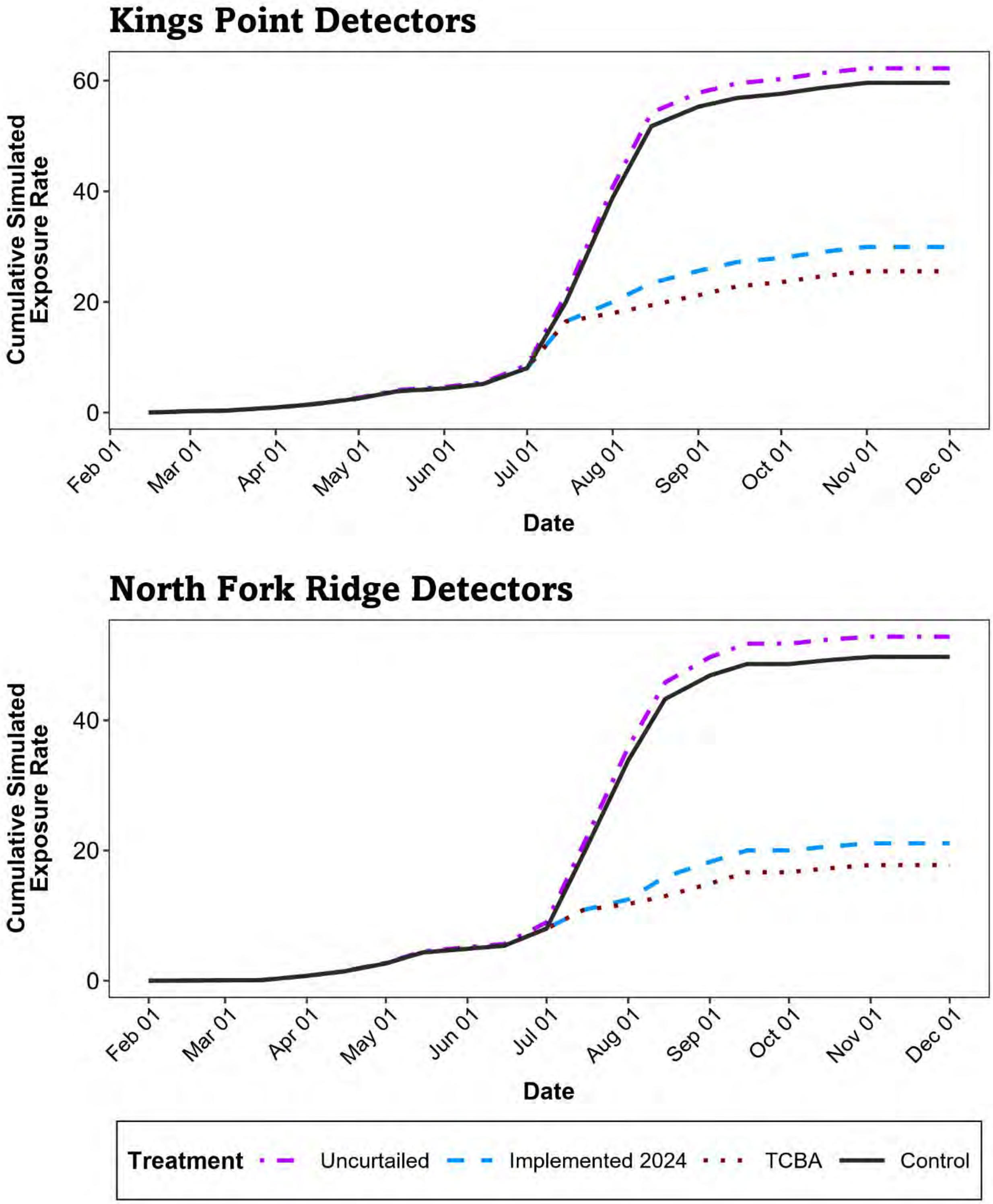

Figure 3-18. Cumulative biweekly acoustic exposure for simulated operational treatment based on nacelle height monitoring in 2024 at Kings Point and North Fork Ridge.

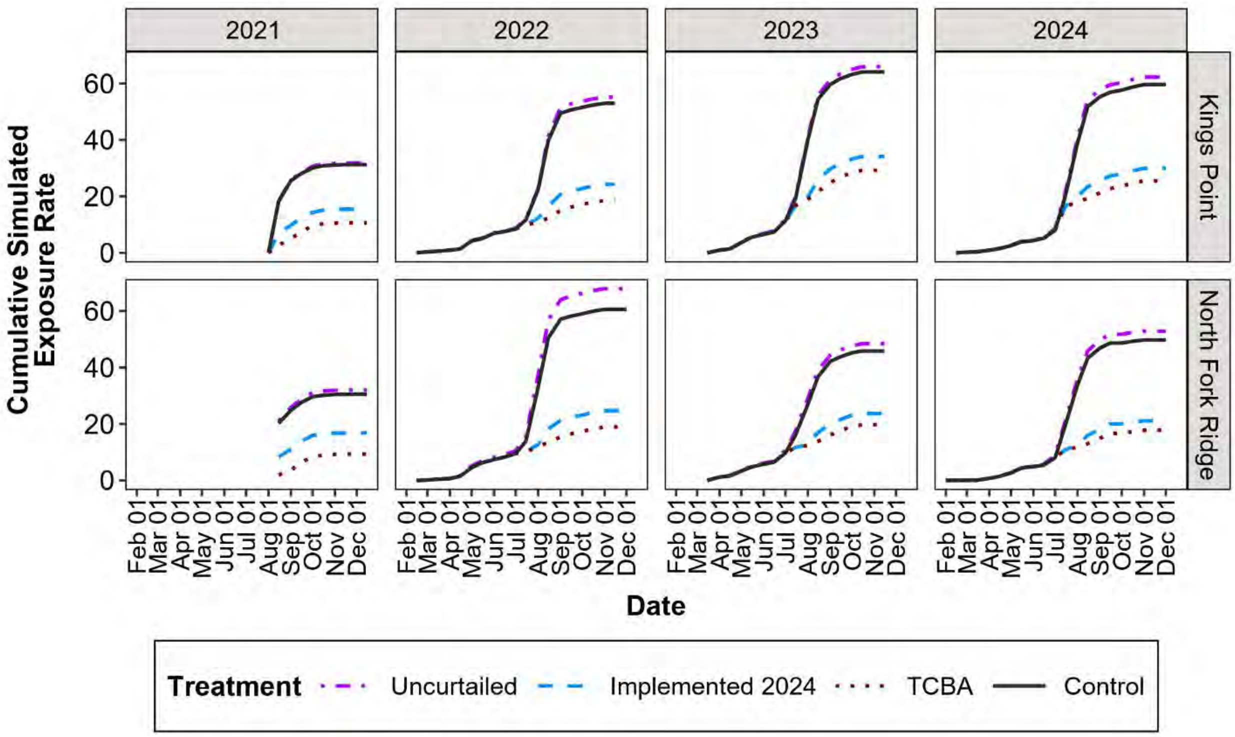

Figure 3-19. Biweekly acoustic exposure (bat passes detected when turbine rotor speed was 1 rpm or greater) for all bat species simulated by operational treatment on nacelle height monitoring in 2021–2024 at Kings Point and North Fork Ridge Wind Projects.

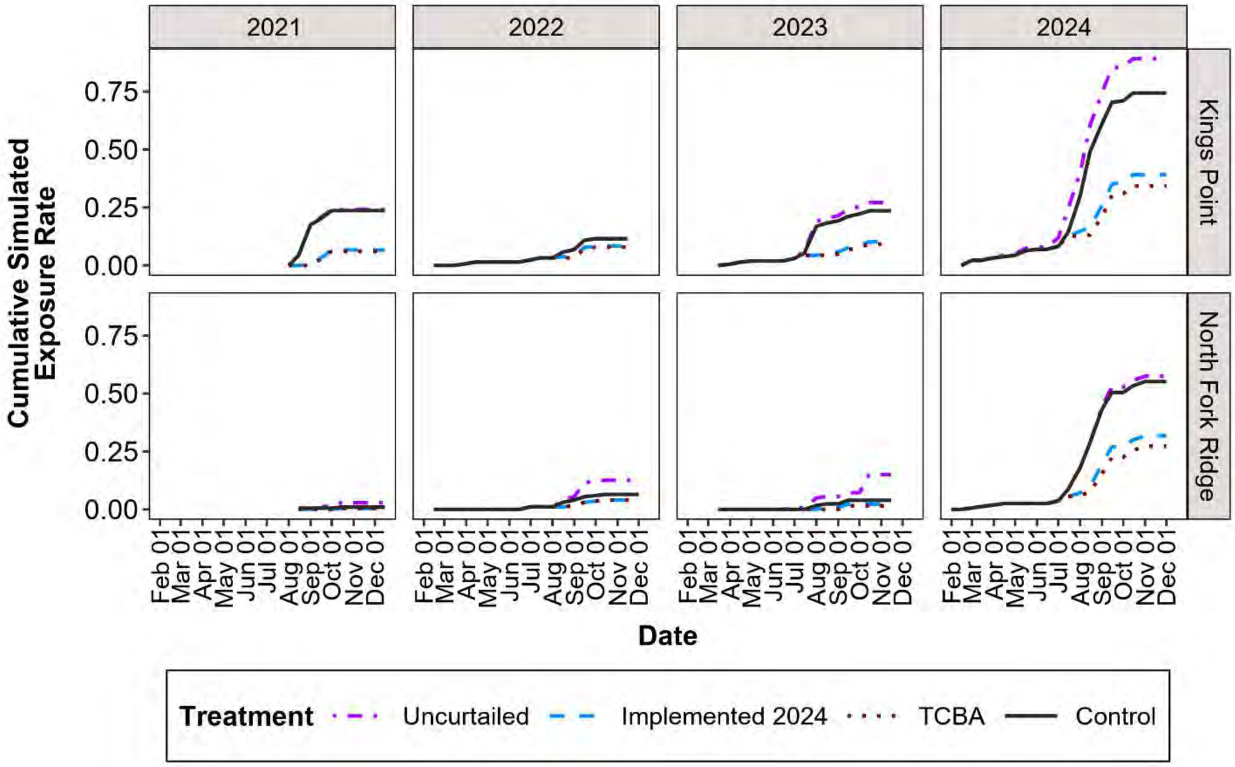

Figure 3-20. Biweekly acoustic exposure (bat passes recorded when turbine rotor speed was 1 rpm or greater) for gray bats simulated by operational treatment based on nacelle height monitoring in 2021–2024 at Kings Point and North Fork Ridge Wind Projects.

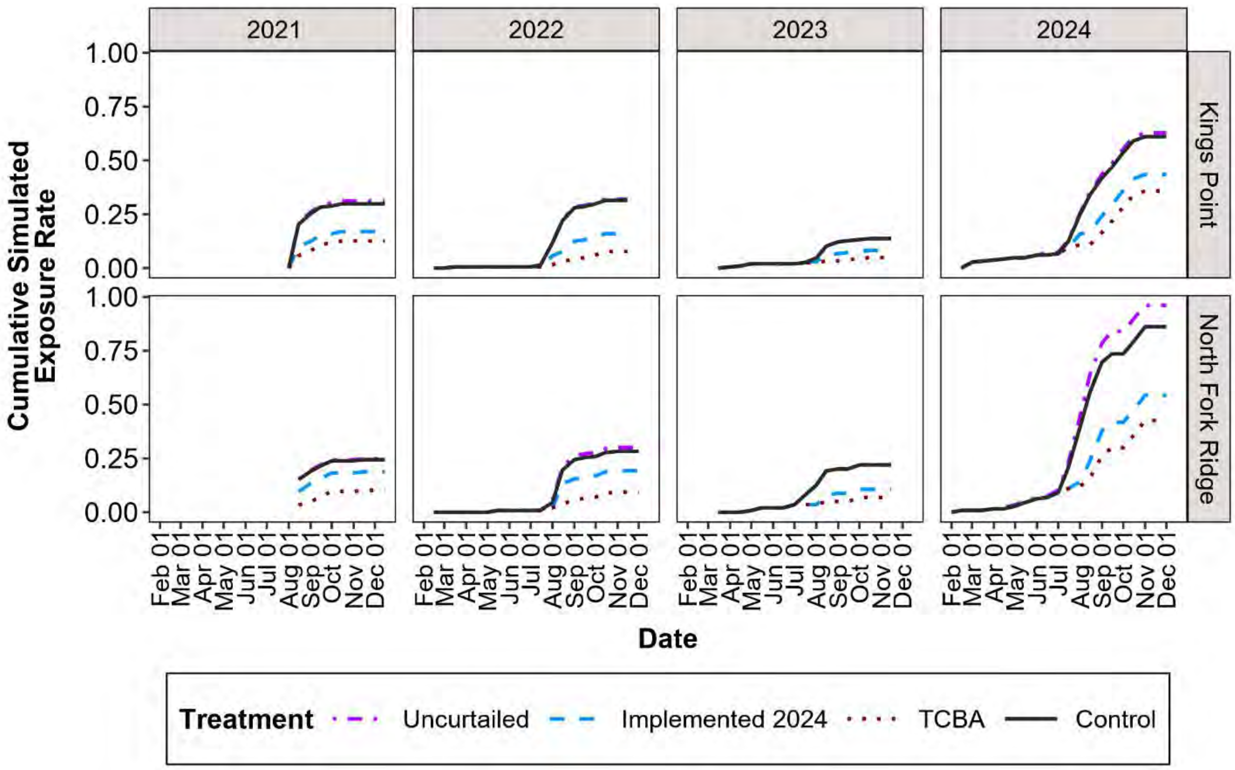

Figure 3-21. Biweekly acoustic exposure (bat passes recorded when turbine rotor speed was 1 rpm or greater) for tricolored bats simulated by operational treatment based on nacelle height monitoring in 2021–2024 at Kings Point and North Fork Ridge Wind Projects.

4 Discussion

This report includes the results of the post-construction fatality monitoring and acoustic monitoring from 2024 as well as data from previous years, where applicable, and concludes Year 1, Phase II of the study. The study is ongoing, and additional data will be collected in 2025 which will further inform the study objectives outlined for Phase II including a test of a revised curtailment strategy designed to achieve a ~60% reduction in gray bat and tricolored bat fatalities.

The 60% targeted reduction in fatalities for gray bats and tricolored bats was achieved at both projects using the Implemented 2024 curtailment. At Kings Point, annual fatality rates at treatment turbines for gray bats were 60.2% lower than at control turbines (15.6 gray bats/year at treatment turbines and 39.2 gray bats/year at control turbines) and 76.6% lower for tricolored bats (11.1 tricolored bats/year at treatment turbines and 47.5 tricolored bats/year at control turbines). At North Fork Ridge, annual fatality rates at treatment turbines for gray bats were 63.4% lower than at control turbines (2.3 gray bats/year at treatment turbines and 6.4 gray bats/year at control turbines) and 84.3% lower for tricolored bats (2.3 tricolored bats/year at treatment turbines and 14.9 tricolored bats/year at control turbines).

4.1 Turbine-Related Fatality Rates for Gray bats

Annual turbine-related gray bat fatality rates have varied by year and by Project and ranged from 6.5 gray bats at North Fork Ridge in 2024 to 53.4 gray bats at Kings Point in 2024 (Table 4-1). Annual gray bat take rates have been 2-5 times higher at Kings Point compared to North Fork Ridge during Phase 1 of the study, but the difference between the Project's median annual fatality rates was least pronounced in 2023.

Table 4-1. Summary of turbine-related gray bat fatality rates from 2021 - 2024 at Kings Point Wind Project and North Fork Ridge Wind Project.

Project	Year	Curtailment Regime Implemented	Annual Take Rate
Kings Point	2021	8 m/s, 5 m/s, 3 m/s	38.6 (11.40 – 82.62)
	2022	5 m/s, 3 m/s	45.7 (15.2 – 94.72)
	2023	5 m/s, 3 m/s	44.6 (24.6 – 70.54)
	2024	10 m/s, 7.5 m/s, 3.0 m/s	53.4 (27.9 – 87.1)
North Fork Ridge	2021	8 m/s, 5 m/s, 3 m/s	7.66 (0.01 – 38.88)
	2022	5 m/s, 3 m/s	10.6 (0.755 – 33.4)
	2023	5 m/s, 3 m/s	17.2 (5.98 – 37.41)
	2024	10.0 m/s, 7.5 m/s, 6.5 m/s, 3.0 m/s	6.5 (0.5 – 20.3)

4.2 Curtailment Evaluation

Acoustic detectors deployed at 15 turbines at Kings Point and 14 turbines at North Fork Ridge provided quantitative feedback on the effectiveness of the curtailment strategies implemented at the projects during the 2024 monitoring period, which were intended to reduce risk to bats by 60% compared to uncurtailed turbine operation. The study design allowed us to compare so-called “measured acoustic exposure”, based on actual turbine rotor speed between curtailment and control treatments at each site, and “simulated acoustic exposure” based on how turbines would have operated according to different curtailment alternatives. Measured exposure is useful in that it reflects actual turbine operation and provides a quantitative indication of bat fatality, but this metric is limited to evaluating curtailment strategies as they were implemented and cannot differentiate reductions in exposure due specifically to bat-related curtailment versus turbine downtime for other reasons. Simulated exposure provides greater flexibility in comparing effectiveness of multiple curtailment strategies, including strategies that were not implemented and allows data from all turbines with detectors to be used in calculations.

The 2024 curtailment strategy, as implemented, reduced the relative measured acoustic exposure for all bats by approximately 33.7% at Kings Point and 52.6% at North Fork Ridge as compared to the control strategy, which feathered turbines below the manufacturer’s cut-in speed (3.0 m/s). The rate of acoustic exposure was reduced by 57% at North Fork Ridge and a smaller margin at Kings Point (30%), due to higher rates of bat activity documented at turbines in the treatment group. The higher rates of bat activity at treatment turbines may have corresponded to increased fatality risk at the curtailment treatment in 2024, possibly explaining the lack of difference in estimated bat fatalities between the treatments in 2024. In other words, curtailment effectively reduced risk to bats at the treatment turbines, but the baseline levels of risk appeared to have been higher at these turbines in 2024 at both projects.

The management objective for 2024 was to reduce acoustic exposure and associated fatality risk by 60% relative to uncurtailed turbine operation; this required comparison of simulated acoustic exposure for the 2024 strategy compared to simulated uncurtailed operation. At Kings Point, the curtailment strategy implemented in 2024 reduced the simulated cumulative biweekly rate of acoustic exposure for all bats by 51.9% compared to uncurtailed operation; had the 2024 strategy been implemented as originally designed (10.0 m/s blanket cut-in speed from July 25–September 7), cumulative acoustic exposure would have been reduced by 59%. At North Fork Ridge, the 2024 curtailment strategy, as implemented, reduced simulated cumulative biweekly exposure for all bats by 60.1%, whereas the initially planned strategy (10.0 m/s from July 18–September 7) would have reduced exposure by 66.4%. Simulated exposure reductions were slightly lower for gray bats and tricolored bats at both projects, although the sample sizes of passes that could be identified to species were much smaller than the overall bat metrics and provide a less reliable indicator of curtailment effectiveness.

Acoustic monitoring in 2024 indicated that the 2024 curtailment implemented at North Fork Ridge achieved the targeted level of reduction in acoustic exposure, whereas the Kings Point strategy fell somewhat short of the target. The seasonal peak in bat activity at Kings Point began slightly earlier in 2024 than in previous years, and while much of this early season activity was identified as eastern red bats, data from 2024 suggest that the seasonal window for curtailment should be extended earlier at

Kings Point to achieve targeted reductions in acoustic exposure. Details of the curtailment strategies, including the cut-in speed and times of night in which curtailment is applied, could be further adjusted to improve the efficiency of curtailment (e.g., ratio of energy loss for given levels of acoustic exposure). For example, a lower cut-in speed applied earlier in July could be as effective as applying a higher cut-in speed later in the month while resulting in less energy loss.

5 References

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Appendix A Figures

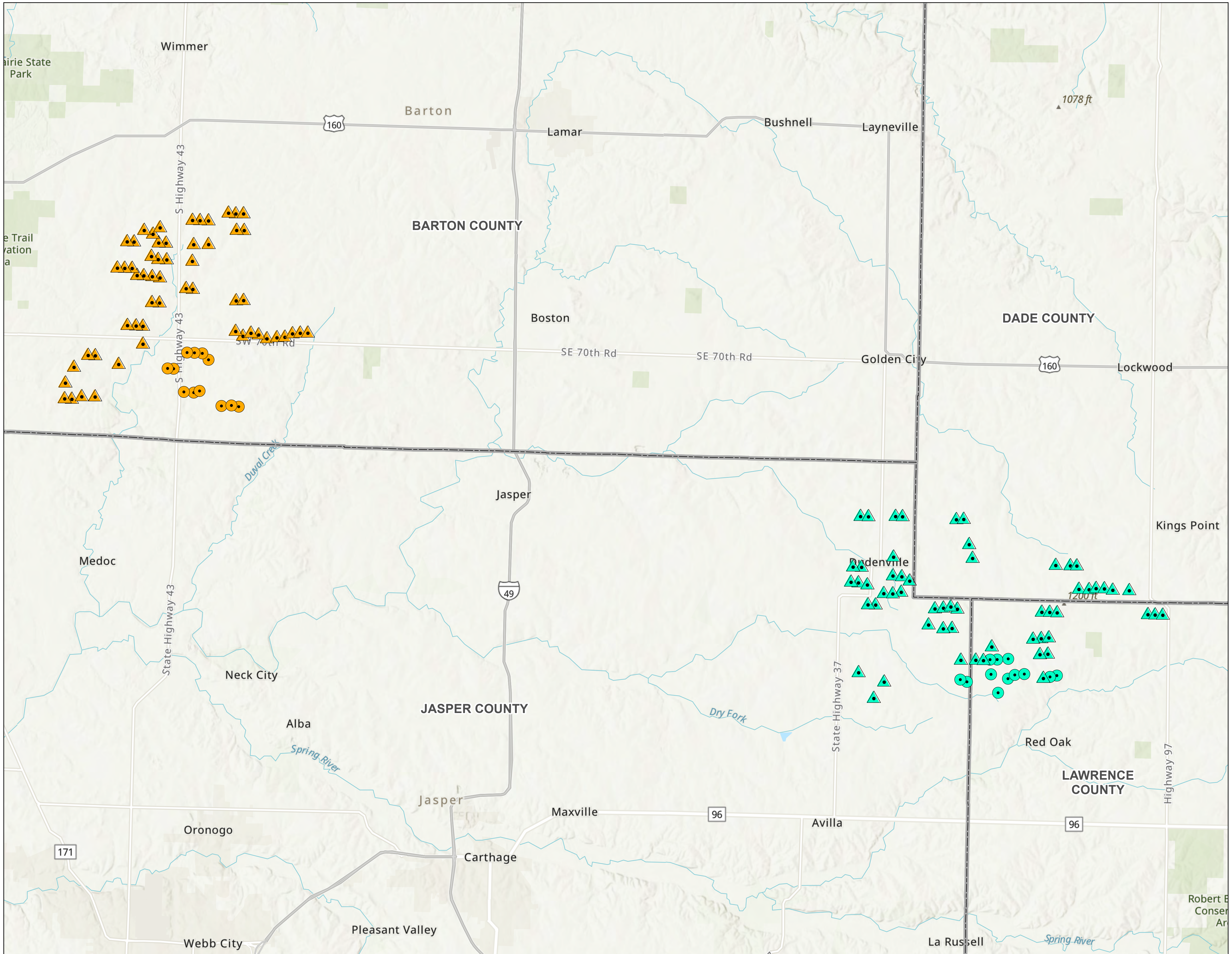


Figure No.

A-1

Title

Kings Point and North Fork Ridge Wind Project Locations

Client/Project 193708398

Empire District – Liberty Utilities Central
Kings Point Wind Project
North Fork Ridge Wind Project

Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

Prepared by SP on 2022-01-27
TR by RA on 2022-01-28
IR by JF on 2022-01-28

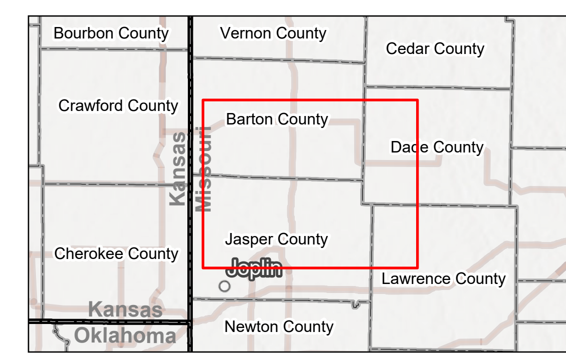
N

0 1.5 3 Miles
(At original document size of 11x17)
1:190,080

Legend

Kings Point Wind Turbine
- Vestas 110 2.0 MW
- Vestas 120 2.2 MW

North Fork Ridge Wind Turbine
- Vestas 110 2.0 MW
- Vestas 120 2.2 MW



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2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: Esri Topographic

Stantec

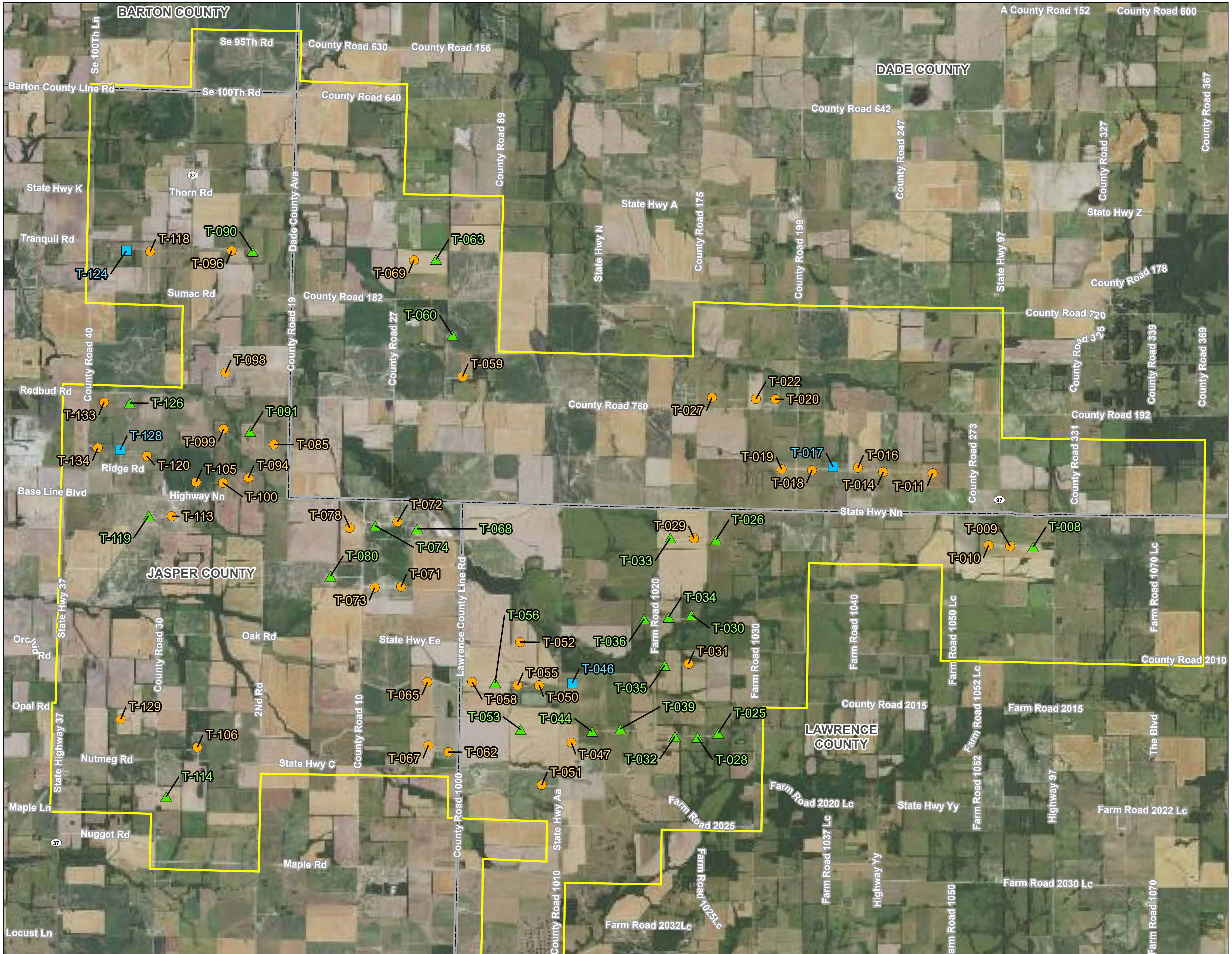

Figure No.

A-2

Title

Post Construction Fatality Monitoring Turbine Plot Type – 2024

Client/Project 193710448

Empire District - Liberty Utilities Central
Kings Point Wind Project

Project Location
Barton, Dade, Jasper, and Lawrence Co., MO

Prepared by SP on 2025-01-21
TR by SF on 2025-01-21
IR by JF on 2025-01-27

N

0 0.5 1 Miles

(At original document size of 11x17)
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Legend

Project Boundary

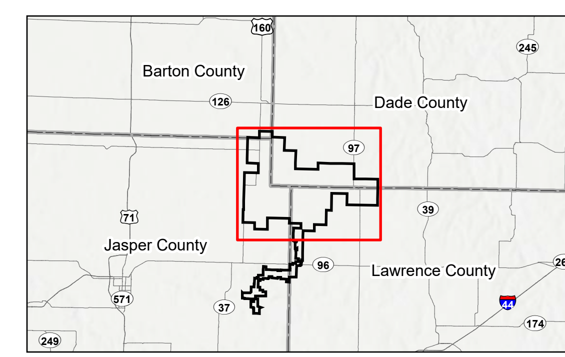
Turbine

Search Plot Type

80-m Cleared Plot (Human Searchers)

80-m Cleared Plot (Dog Searchers)

Road and Pad (Human Searchers)



Notes

1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2022 NAIP

Stantec

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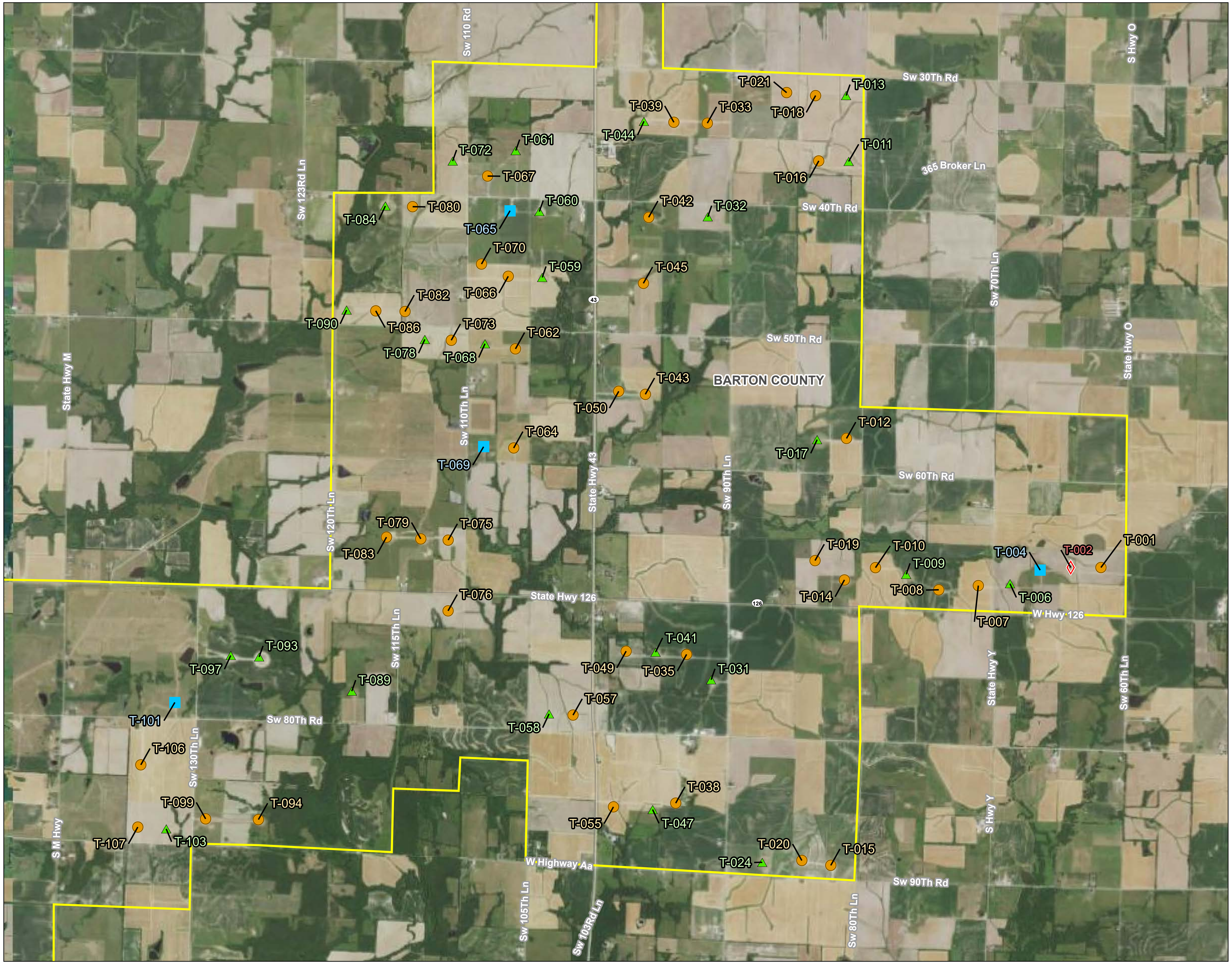


Figure No.
A-3

Title
Post Construction Fatality Monitoring Turbine Plot Type - 2024

Client/Project 193710448
Empire District - Liberty Utilities Central
North Fork Ridge Wind Project

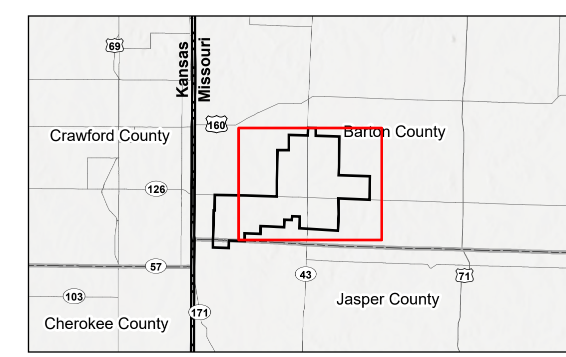
Project Location
Barton and Jasper Co., MO

Prepared by SP on 2025-01-21
TR by SF on 2025-01-21
IR by JF on 2025-01-27

N

0 2,000 4,000 US Feet
(At original document size of 11x17)
1:48,000

Legend
Project Boundary
Turbine
Search Plot Type
80-m Cleared Plot (Human Searchers)
80-m Cleared Plot (Dog Searchers)
80-m Cleared Plot (Dog Searchers)
No Searches (Inoperable Turbine)



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2. Data Sources: Empire, Stantec, Esri, NADS
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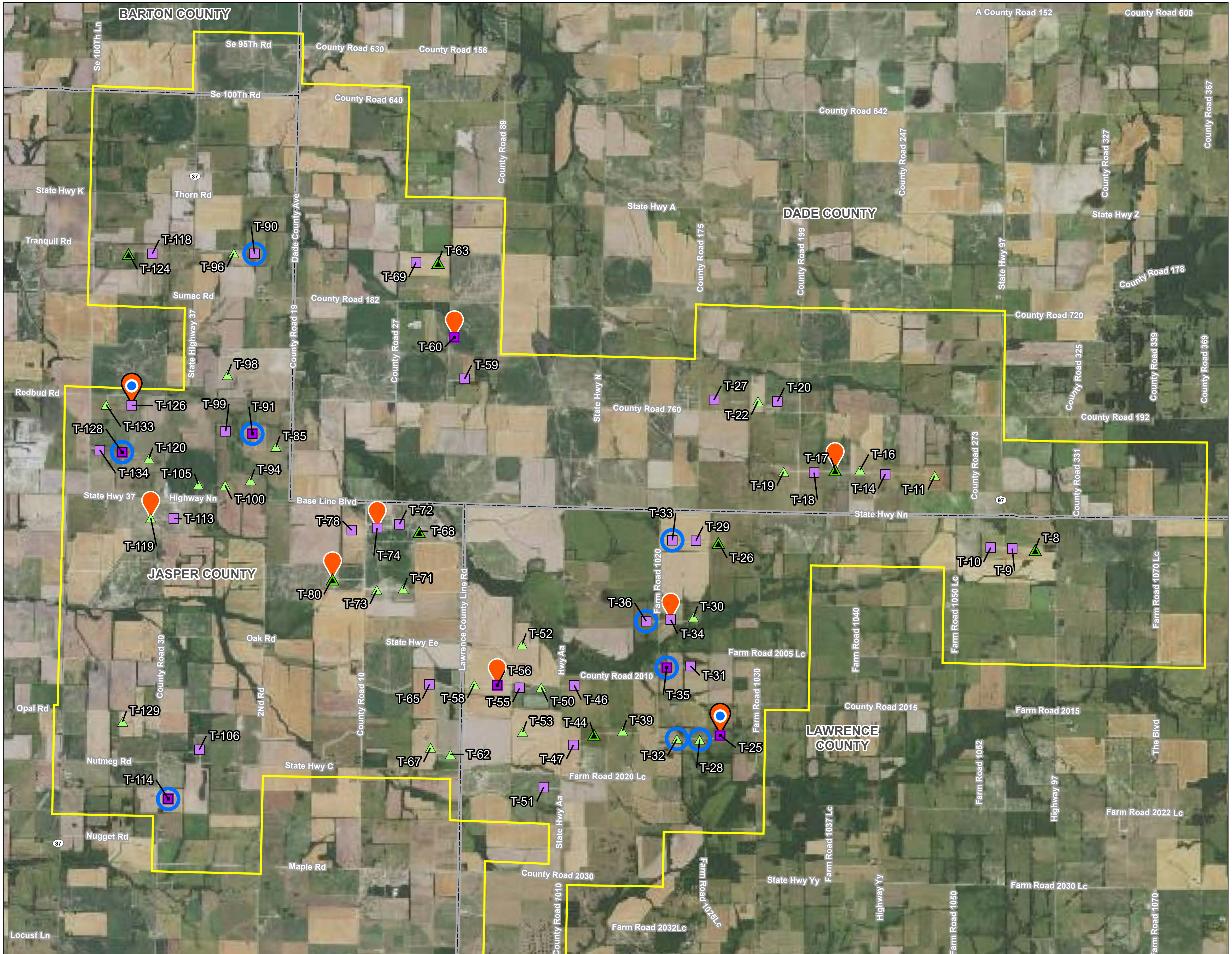


Figure No.

A-4

Title

Kings Point Turbine Curtailment - 2024 Gray Bat and Tricolored Bat Carcass Observations

Client/Project 193710448

Empire District - Liberty Utilities Central
Kings Point Wind Project

Project Location
Barton, Dade, Jasper,
and Lawrence Co., MO

Prepared by SP on 2025-01-21
TR by SF on 2025-01-21
IR by JF on 2025-01-27

N

0 0.5 1 Miles
(At original document size of 11x17)
1:63,360

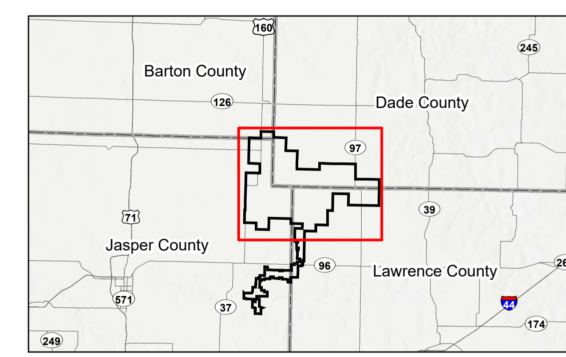
Legend

Project Boundary

Turbine

Detector Type and Cut in Speed

- No Bat Detector - Control Cut-in Speed (3m/s)
- Nacelle-mounted - Control Cut-in Speed (3m/s)
- No Bat Detector - Treatment Cut-in Speed (TCBA 10)
- Nacelle-mounted - Treatment Cut-in Speed (TCBA 10)
- Gray Bat Carcass Observed
- Tricolored Bat Carcass Observed
- Gray Bat and Tricolored Bat Carcass Observed



Notes
1. Coordinate System: NAD 1983 StatePlane Missouri West FIPS 2403 Feet
2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2022 NAIP

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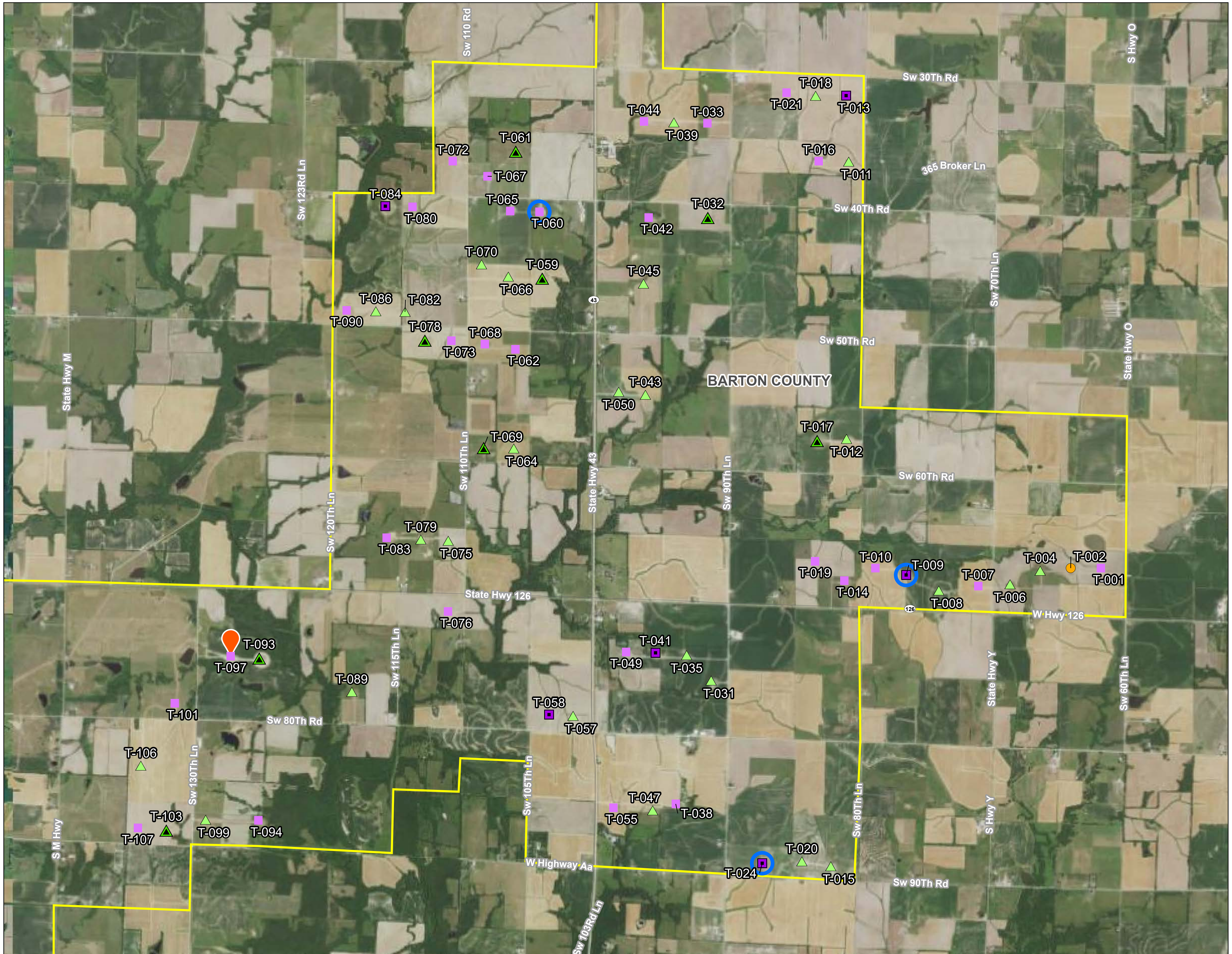


Figure No.

A-5

Title

North Fork Ridge Turbine Curtailment - 2024 Gray Bat and Tricolored Bat Carcass Observations

Client/Project 193710448

Empire District - Liberty Utilities Central
North Fork Ridge Wind Project

Project Location
Barton and Jasper Co., MO

Prepared by SP on 2025-01-21
TR by SF on 2025-01-21
IR by JF on 2025-01-27

N

0 2,000 4,000
US Feet
(At original document size of 11x17)
1:48,000

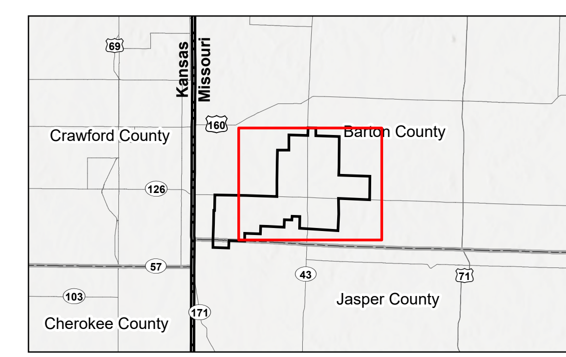
Legend

- Project Boundary

Turbine

Detector Type and Cut in Speed

- No Bat Detector - No Searches (Turbine Non-Operational)
- No Bat Detector - Control Cut-in Speed (3m/s)
- Nacelle-mounted - Control Cut-in Speed (3m/s)
- No Bat Detector - Treatment Cut-in Speed (TCBA 10)
- Nacelle-mounted - Treatment Cut-in Speed (TCBA 10)
- Gray Bat Carcass Observed
- Tricolored Bat Carcass Observed



Notes
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2. Data Sources: Empire, Stantec, Esri, NADS
3. Background: 2022 NAIP

Stantec

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Appendix B GenEst and EofA Model Results

Table B-1. Model comparison results for searcher efficiency trials conducted 2024 at the Kings Point and North Fork Ridge Wind Projects. Selected model shown in bold.

p Formula	k Formula	AICc	deltaAICc
p ~ Season + Plottype	k fixed at 0.67	348.91	0
p ~ Searcher	k fixed at 0.67	351.77	2.86
p ~ Plottype	k fixed at 0.67	358.34	9.43
p ~ Season	k fixed at 0.67	373.47	24.56
p ~ constant	k fixed at 0.67	382.19	33.28

Table B-2. Model comparison results for carcass persistence trials conducted in 2024 at the Kings Point Wind Project. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AICc	deltaAICc
weibull	**l ~ Season**	**s ~ constant**	**501.05**	**0**
weibull	l ~ Season + Plottype	s ~ constant	501.69	0.64
weibull	l ~ constant	s ~ constant	502.18	1.13
weibull	l ~ Plottype	s ~ constant	502.96	1.91
weibull	l ~ Season	s ~ Season	504.77	3.72
weibull	l ~ Season + Plottype	s ~ Plottype	504.96	3.91
weibull	l ~ constant	s ~ Plottype	505.12	4.07
lognormal	l ~ Season + Plottype	s ~ constant	505.51	4.46
weibull	l ~ Season + Plottype	s ~ Season	505.6	4.55
weibull	l ~ Plottype	s ~ Plottype	505.74	4.69
lognormal	l ~ Season	s ~ constant	505.74	4.69
weibull	l ~ constant	s ~ Season	506.05	5

Table B-3. Model comparison results for carcass persistence trials conducted in 2024 at the North Fork Ridge Wind Project. Selected model is shown in bold.

Distribution	Location Formula	Scale Formula	AICc	deltaAICc
lognormal	**l ~ constant**	**s ~ constant**	**530.56**	**0**

Distribution	Location Formula	Scale Formula	AICc	deltaAICc
loglogistic	l ~ constant	s ~ constant	531	0.44
lognormal	l ~ Plottype	s ~ constant	532.97	2.41
loglogistic	l ~ Plottype	s ~ constant	533.32	2.76
lognormal	l ~ Season	s ~ constant	533.82	3.26
lognormal	l ~ constant	s ~ Plottype	534.23	3.67
lognormal	l ~ constant	s ~ Season	534.24	3.68
loglogistic	l ~ Season	s ~ constant	534.28	3.72
loglogistic	l ~ constant	s ~ Plottype	534.61	4.05
loglogistic	l ~ constant	s ~ Season	534.71	4.15
weibull	l ~ constant	s ~ constant	536.2	5.64

KINGS POINT

Strata Multiple Classes Inputs

Table B-4. Inputs for EofA multiple classes model run to combine detection probabilities across strata at the Kings Point Wind Project

strata	Plot Type	turbine operation	# of Turbines	% of turbines	Search Interval (days)	Average Number of Searches	Average area correction	DWP	Searcher Efficiency		Carcass Persistence			
									Carcasses Available	Carcasses Found	Distribution	Shape (α)	Scale (β)	β CI (95%)
spring	full_human	normal	28	0.406	6.75	9	0.95	0.386	37	19	exponential	0.12	8.64	5.313, 14.03
	RP	normal	41	0.594	6.75	9	0.05	0.030	23	21	exponential	0.12	8.64	5.313, 14.03
	unsearched							0.585						
June	full_human	normal	4	0.058	3.75	8	0.95	0.055	10	5	weibull	0.69	7.47	4.503, 12.4
	RP	normal	41	0.594	3.75	8	0.05	0.030	24	20	weibull	0.69	7.47	4.503, 12.4
	full_dogs	normal	24	0.348	3.5	8	0.95	0.330	116	79	weibull	1.08	10.77	6.22, 18.63
	unsearched							0.585						
July 1	full_human	normal	4	0.058	3.5	7	0.95	0.055	10	5	weibull	0.69	7.47	4.503, 12.4
	RP	normal	41	0.594	3.5	7	0.05	0.030	24	20	weibull	0.69	7.47	4.503, 12.4
	full_dogs	normal	24	0.348	3.5	7	0.95	0.330	116	79	weibull	1.08	10.77	6.22, 18.63
	unsearched							0.585						
July 2 Normal	full_human	normal	2	0.057	3.25	2	0.95	0.054	10	5	weibull	0.69	7.47	4.503, 12.4
	RP	normal	21	0.600	3.25	2	0.05	0.030	24	20	weibull	0.69	7.47	4.503, 12.4
	full_dogs	normal	12	0.343	3.5	2	0.95	0.326	116	79	weibull	1.08	10.77	6.22, 18.63
	unsearched							0.590						
July 2 Curtailed	full_human	curtailed	2	0.059	3.25	2	0.85	0.050	10	5	weibull	0.69	7.47	4.503, 12.4
	RP	curtailed	20	0.588	3.25	2	0.047	0.028	24	20	weibull	0.69	7.47	4.503, 12.4
	full_dogs	curtailed	12	0.353	3.5	2	0.85	0.300	116	79	weibull	1.08	10.77	6.22, 18.63
	unsearched							0.622						
August Normal	full_human	normal	2	0.057	4.75	8	0.95	0.054	10	5	weibull	0.69	7.47	4.503, 12.4
	RP	normal	21	0.600	4.75	8	0.05	0.030	24	20	weibull	0.69	7.47	4.503, 12.4
	full_dogs	normal	12	0.343	3.5	9	0.95	0.326	116	79	weibull	1.08	10.77	6.22, 18.63
	unsearched							0.590						
August Curtailed	full_human	curtailed	2	0.059	4.75	8	0.85	0.050	10	5	weibull	0.69	7.47	4.503, 12.4
	RP	curtailed	20	0.588	4.75	8	0.047	0.028	24	20	weibull	0.69	7.47	4.503, 12.4
	full_dogs	curtailed	12	0.353	3.5	9	0.85	0.300	116	79	weibull	1.08	10.77	6.22, 18.63

strata	Plot Type	turbine operation	# of Turbines	% of turbines	Search Interval (days)	Average Number of Searches	Average area correction	DWP	Searcher Efficiency		Carcass Persistence			
									Carcasses Available	Carcasses Found	Distribution	Shape (α)	Scale (β)	β CI (95%)
	unsearched							0.622						
September 1 Normal	full_human	normal	2	0.057	4.25	2	0.95	0.054	12	4	weibull	0.69	7.47	2.195, 6.653
	RP	normal	21	0.600	4.25	2	0.05	0.030	24	20	weibull	0.69	7.47	2.195, 6.653
	full_dogs	normal	12	0.343	3.5	2	0.95	0.326	95	88	weibull	1.08	10.77	6.22, 18.63
	unsearched							0.590						
September 1 Curtailed	full_human	curtailed	2	0.059	4.25	2	0.85	0.050	12	4	weibull	0.69	7.47	2.195, 6.653
	RP	curtailed	20	0.588	4.25	2	0.047	0.028	24	20	weibull	0.69	7.47	2.195, 6.653
	full_dogs	curtailed	12	0.353	3.5	2	0.85	0.300	95	88	weibull	1.08	10.77	6.22, 18.63
	unsearched							0.622						
September 2	full_human	normal	4	0.058	3.75	6	0.95	0.055	12	4	weibull	0.64	3.82	2.195, 6.653
	RP	normal	41	0.594	3.75	6	0.05	0.030	24	20	weibull	0.64	3.82	2.195, 6.653
	full_dogs	normal	24	0.348	3.5	7	0.95	0.330	95	88	weibull	0.42	10.77	6.22, 18.63
	unsearched							0.585						
October	full_human	normal	28	0.406	7.5	4	0.95	0.386	12	4	weibull	0.64	3.82	2.195, 6.653
	RP	normal	41	0.594	7.5	4	0.05	0.030	24	20	weibull	0.64	3.82	2.195, 6.653
	unsearched							0.585						

Strata Multiple Classes Weights

Table B-5. Weights for the EofA multiple classes model to combine detection probabilities across strata at the Kings Point Wind Project

Strata	Turbine Operations	Sampling Weight	Minimization Weight	DWP
July 2 Normal	Normal	0.51	0.94	0.59
July 2 Curtailed	Curtailed	0.49	0.68	0.41
August Normal	Normal	0.51	0.89	0.80
August Curtailed	Curtailed	0.49	0.23	0.20
September 1 Normal	Normal	0.51	0.89	0.61
September 1 Curtailed	Curtailed	0.49	0.58	0.39

Strata Multiple Classes Inputs

Table B-6. Data inputs for EofA multiple classes model to combine detection probabilities across strata at the Kings Point Wind Project

Strata	Turbine Operations	DWP	Ba	Bb	g-hat (95% CI)
July 2 Normal	Normal	0.59	567.3157	1895.991	0.23 (0.21-0.25)
July 2 Curtailed	Curtailed	0.41	581.8066	2158.842	0.212 (0.20-0.23)
August Normal	Normal	0.80	178.4066	491.068	0.266 (0.23-0.30)
August Curtailed	Curtailed	0.20	183.7606	564.4969	0.246 (0.22-0.28)
September 1 Normal	Normal	0.61	411.3883	1497.205	0.216 (0.20-0.23)
September 1 Curtailed	Curtailed	0.39	420.9668	1698.719	0.199 (0.18-0.22)

Sub-season Multiple Classes Weights

Table B-7. Weights for the EofA multiple classes model to combine detection probabilities across sub-seasons at the Kings Point Wind Project

Sub-season	Season	Minimization Weight	Arrival proportion	DWP
Spring (April - May)	Spring	0.88	0.066	1
June	Summer	0.91	0.035	0.06
July 1		0.81	0.271	0.45
July 2		0.81	0.065	0.11
August		0.56	0.336	0.38
September 1	Fall	0.73	0.032	0.166
September 2		0.73	0.088	0.455
October		0.91	0.059	0.379

Sub-season Multiple Classes Inputs

Table B-8. Data inputs for EofA multiple classes model to combine detection probabilities across sub-seasons at the Kings Point Wind Project

Sub-season	Season	DWP	Ba	Bb	g-hat
Spring (April - May)	Spring	1	35.33	163.86	0.18 (0.13-0.23)
June	Summer	0.06	166.74	448.29	0.27 (0.24-0.31)

Sub-season	Season	DWP	Ba	Bb	g-hat
July 1		0.45	175.89	474.10	0.27 (0.24-0.31)
July 2		0.11	1093.92	3813.33	0.22 (0.21-0.24)
August		0.38	258.52	727.12	0.26 (0.24-0.29)
September 1	Fall	0.166	778.22	2946.46	0.21 (0.20-0.22)
September 2		0.455	281.53	927.41	0.23 (0.21-0.26)
October		0.379	8.19	102.24	0.07 (0.03-0.13)

Season Multiple Classes Weights

Table B-9. Weights for the EofA multiple classes model to combine detection probabilities across seasons at the Kings Point Wind Project

Season	Minimization Weight	Arrival proportion	DWP
Spring (April – May)	0.88	0.066	0.091
Summer (June – August)	0.63	0.706	0.694
Fall (September – October)	0.77	0.179	0.215

Season Multiple Classes Inputs

Table B-10. Data inputs for EofA multiple classes model to combine detection probabilities across seasons at the Kings Point Wind Project

Season	DWP	Ba	Bb	g-hat
Spring (April – May)	0.091	35.33	163.86	0.18 (0.13-0.23)
Summer (June – August)	0.694	555.4138	1562.6401	0.26 (0.24-0.28)
Fall (September – October)	0.215	196.594	968.413	0.17 (0.15-0.19)

Annual g-value and species of interest take estimation inputs

Table B-11. Data inputs for EofA multiple years model to estimate take of tricolored and gray bats at the Kings Point Wind Project

Year	ρ	Gray Bat Fatalities (X)	Tricolored Bat Fatalities (X)	Ba	Bb	g-hat
2024	1	12	13	756.7926	2471.7334	0.23 (0.22-0.25)

Treatment vs. Control Weights

Control Weights

Table B-12. Weights for EofA multiple classes model to combine detection probabilities across sub-seasons for control turbines at the Kings Point Wind Project

Sub-season	Minimization Weight	Arrival proportion	DWP
Spring (April - May)	0.88	0.066	0.067
June	0.91	0.035	0.037
July 1	0.94	0.271	0.294
July 2	0.94	0.065	0.071
August	0.89	0.336	0.345
September 1	0.89	0.032	0.033
September 2	0.89	0.088	0.091
October	0.91	0.059	0.062

Treatment Weights

Table B-13. Weights for EofA multiple classes model to combine detection probabilities across sub-seasons for treatment turbines at the Kings Point Wind Project

Sub-season	Minimization Weight	Arrival proportion	DWP
Spring (April - May)	0.88	0.066	0.112
June	0.91	0.035	0.062
July 1	0.68	0.271	0.355
July 2	0.68	0.065	0.085
August	0.23	0.336	0.149
September 1	0.58	0.032	0.036
September 2	0.58	0.088	0.099
October	0.9	0.059	0.103

Treatment vs. Control Inputs

Control Inputs

Table B-14. Data inputs for EofA multiple classes model to combine detection probabilities across sub-seasons and estimate tricolored bat and gray bat take for control turbines at the Kings Point Wind Project

Sub-season	Gray Bat Fatalities	Tricolored Bat Fatalities	DWP	Ba	Bb	g-hat
Spring (April - May)	1	0	0.067	35.33	163.86	0.18 (0.13-0.23)
June	1	0	0.037	166.74	448.29	0.27 (0.24-0.31)
July 1	4	0	0.294	175.89	474.10	0.27 (0.24-0.31)
July 2	0	0	0.071	567.32	1895.99	0.23 (0.21-0.25)
August	2	7	0.345	178.41	491.07	0.27 (0.23-0.30)
September 1	1	1	0.033	411.39	1497.21	0.22 (0.20-0.23)
September 2	0	3	0.091	281.53	927.41	0.23 (0.21-0.26)
October	0	0	0.062	8.19	102.24	0.07 (0.03-0.13)

Treatment Inputs

Table B-15. Data inputs for EofA multiple classes model to combine detection probabilities across sub-seasons and estimate tricolored bat and gray bat take for treatment turbines at the Kings Point Wind Project

Sub-season	Gray Bat Fatalities	Tricolored Bat Fatalities	DWP	Ba	Bb	g-hat
Spring (April - May)	0	0	0.112	35.33	163.86	0.18 (0.13-0.23)
June	1	0	0.062	166.74	448.29	0.27 (0.24-0.31)
July 1	1	0	0.355	175.89	474.10	0.27 (0.24-0.31)
July 2	0	0	0.085	581.8066	2159	0.21 (0.20-0.23)
August	0	2	0.149	183.7606	564.5	0.25 (0.22-0.28)
September 1	0	0	0.036	420.9668	1699	0.20 (0.18-0.22)
September 2	1	0	0.099	281.53	927.41	0.23 (0.21-0.26)
October	0	0	0.103	8.19	102.24	0.07 (0.03-0.13)

North Fork Ridge

Table B-16. Inputs for EofA multiple classes model run to combine detection probabilities across strata at the North Fork Ridge Wind Project

strata	Plot Type	turbine operation	# of Turbines	% of turbines	Search Interval (days)	Average Number of Searches	Average area correction	DWP	Searcher Efficiency		Carcass Persistence			
									Carcasses Available	Carcasses Found	Distribution	Shape (α)	Scale (β)	β CI (95%)
spring	full_human	normal	28	0.41	7	9	0.95	0.391	37	19	weibull	0.802	6.041	4.627, 7.888
	RP	normal	40	0.59	7	9	0.05	0.029	23	21	weibull	0.802	6.041	4.627, 7.888
	unsearched							0.579						
June	full_human	normal	4	0.06	4	8	0.95	0.056	10	5	weibull	0.802	6.041	4.627, 7.888
	RP	normal	40	0.59	4	8	0.05	0.029	24	20	weibull	0.802	6.041	4.627, 7.888
	full_dogs	normal	24	0.35	3.5	8	0.95	0.335	116	79	exponential	N/A	8.360	5.42, 12.9
	unsearched							0.579						
July 1	full_human	normal	4	0.06	3.25	6	0.95	0.056	10	5	weibull	0.802	6.041	4.627, 7.888
	RP	normal	40	0.59	3.25	6	0.05	0.029	24	20	weibull	0.802	6.041	4.627, 7.888
	full_dogs	normal	24	0.35	3.5	5	0.95	0.335	116	79	exponential	N/A	8.360	5.42, 12.9
	unsearched							0.579						
July 2 Normal	full_human	normal	2	0.06	4.5	3	0.95	0.056	10	5	weibull	0.802	6.041	4.627, 7.888
	RP	normal	20	0.59	4.5	3	0.05	0.029	24	20	weibull	0.802	6.041	4.627, 7.889
	full_dogs	normal	12	0.35	3.5	3	0.95	0.335	116	79	exponential	N/A	8.360	5.42, 12.9
	unsearched							0.579						
July 2 Curtailed	full_human	curtailed	2	0.06	4.5	3	0.85	0.050	10	5	weibull	0.802	6.041	4.627, 7.888
	RP	curtailed	20	0.59	4.5	3	0.05	0.029	24	20	weibull	0.802	6.041	4.627, 7.890
	full_dogs	curtailed	12	0.35	3.5	3	0.85	0.300	116	79	exponential	N/A	8.360	5.42, 12.9
	unsearched							0.621						
August Normal	full_human	normal	2	0.06	3.5	8	0.95	0.056	10	5	weibull	0.802	6.041	4.627, 7.890
	RP	normal	20	0.59	3.5	8	0.05	0.029	24	20	weibull	0.802	6.041	4.627, 7.890
	full_dogs	normal	12	0.35	3.5	8	0.95	0.335	116	79	exponential	N/A	8.360	5.42, 12.9
	unsearched							0.579						
August Curtailed	full_human	curtailed	2	0.06	3.5	8	0.85	0.052	10	5	weibull	0.802	6.041	4.627, 7.890
	RP	curtailed	20	0.61	3.5	8	0.05	0.030	24	20	weibull	0.802	6.041	4.627, 7.890
	full_dogs	curtailed	11	0.33	3.5	8	0.85	0.283	116	79	exponential	N/A	8.360	5.42, 12.9

strata	Plot Type	turbine operation	# of Turbines	% of turbines	Search Interval (days)	Average Number of Searches	Average area correction	DWP	Searcher Efficiency		Carcass Persistence			
									Carcasses Available	Carcasses Found	Distribution	Shape (α)	Scale (β)	β CI (95%)
	unsearched		1					0.635						
September 1 Normal	full_human	normal	2	0.06	4.25	2	0.95	0.056	12	4	weibull	0.802	6.041	4.627, 7.890
	RP	normal	20	0.59	4.25	2	0.05	0.029	24	20	weibull	0.802	6.041	4.627, 7.890
	full_dogs	normal	12	0.35	3.5	2	0.95	0.335	95	88	exponential	N/A	8.360	5.42, 12.9
	unsearched							0.579						
September 1 Curtailed	full_human	curtailed	2	0.06	4.25	2	0.85	0.052	12	4	weibull	0.802	6.041	4.627, 7.890
	RP	curtailed	20	0.61	4.25	2	0.05	0.030	24	20	weibull	0.802	6.041	4.627, 7.890
	full_dogs	curtailed	11	0.33	3.5	2	0.85	0.283	95	88	exponential	N/A	8.360	5.42, 12.9
	unsearched		1					0.635						
September 2	full_human	normal	4	0.06	3.5	6	0.95	0.056	12	4	weibull	0.802	6.041	4.627, 7.890
	RP	normal	40	0.59	3.5	6	0.05	0.029	24	20	weibull	0.802	6.041	4.627, 7.890
	full_dogs	normal	23	0.34	3.5	7	0.95	0.321	95	88	exponential	N/A	8.360	5.42, 12.9
	unsearched		1					0.593						
October	full_human	normal	27	0.40	4	8	0.95	0.377	12	4	weibull	6.0414	4.627, 7.888	4.627, 7.888
	RP	normal	40	0.59	4	8	0.05	0.029	24	20	weibull	6.0414	4.627, 7.888	4.627, 7.888
	unsearched		1					0.593						

Strata Multiple Classes Weights

Table B-17. Weights for the EofA multiple classes model to combine detection probabilities across strata at the North Fork Ridge Wind Project

Strata	Turbine Operations	Sampling Weight	Minimization Weight	DWP
July 2 Normal	Normal	0.50	0.84	0.71
July 2 Curtailed	Curtailed	0.50	0.35	0.29
August Normal	Normal	0.50	0.85	0.80
August Curtailed	Curtailed	0.49	0.22	0.20
September 1 Normal	Normal	0.50	0.87	0.63
September 1 Curtailed	Curtailed	0.49	0.52	0.37

Strata Multiple Classes Inputs

Table B-18. Data inputs for EofA multiple classes model to combine detection probabilities across strata at the North Fork Ridge Wind Project

Strata	Turbine Operations	DWP	Ba	Bb	g-hat (95% CI)
July 2 Normal	Normal	0.71	178.55	567.18	0.24 (0.21-0.27)
July 2 Curtailed	Curtailed	0.29	186.68	678.43	0.22 (0.19-0.24)
August Normal	Normal	0.80	146.67	426.38	0.26 (0.22-0.29)
August Curtailed	Curtailed	0.20	157.36	553.67	0.22 (0.19-0.25)
September 1 Normal	Normal	0.63	527.60	1283.87	0.29 (0.27-0.31)
September 1 Curtailed	Curtailed	0.37	577.62	1728.15	0.25 (0.23-0.27)

Sub-season Multiple Classes Weights

Table B-19. Weights for the EofA multiple classes model to combine detection probabilities across sub-seasons at the North Fork Ridge Wind Project

Sub-season	Season	Minimization Weight	Arrival proportion	DWP
Spring (April - May)	Spring	0.87	0.066	1
June	Summer	0.89	0.035	0.076
July 1		0.59	0.195	0.282
July 2		0.59	0.141	0.204
August		0.54	0.336	0.438
September 1	Fall	0.70	0.032	0.16
September 2		0.70	0.088	0.45
October		0.91	0.059	0.39

Sub-season Multiple Classes Inputs

Table B-20. Data inputs for EofA multiple classes model to combine detection probabilities across sub-seasons at the North Fork Ridge Wind Project

Sub-season	Season	DWP	Ba	Bb	g-hat
Spring (April - May)	Spring	1	45.26	271.11	0.14 (0.11-0.18)
June	Summer	0.076	160.08	488.18	0.25 (0.22-0.28)
July 1		0.282	176.10	519.82	0.25 (0.22-0.29)

Sub-season	Season	DWP	Ba	Bb	g-hat
July 2		0.204	297.62	982.07	0.23 (0.21-0.26)
August		0.438	209.52	631.87	0.25 (0.22-0.28)
September 1	Fall	0.16	979.55	2567.23	0.28 (0.26-0.29)
September 2		0.45	275.32	694.06	0.28 (0.26-0.31)
October		0.39	10.72	71.05	0.13 (0.07-0.21)

Season Multiple Classes Weights

Table B-21. Weights for the EofA multiple classes model to combine detection probabilities across seasons at the North Fork Ridge Wind Project

Season	Minimization Weight	Arrival proportion	DWP
Spring (April – May)	0.87	0.066	0.098
Summer (June – August)	0.56	0.706	0.681
Fall (September – October)	0.72	0.179	0.221

Season Multiple Classes Inputs

Table B-22. Data inputs for EofA multiple classes model to combine detection probabilities across seasons at the North Fork Ridge Wind Project

Season	DWP	Ba	Bb	g-hat
Spring (April – May)	0.098	45.26	271.11	0.14 (0.11-0.18)
Summer (June – August)	0.681	639.7128	1953.995	0.25 (0.23-0.26)
Fall (September – October)	0.221	152.5243	531.0579	0.22 (0.19-0.26)

Annual g-value and species of interest take estimation inputs

Table B-23. Data inputs for EofA multiple years model to estimate take of tricolored and gray bats at the North Fork Ridge Wind Project

Year	ρ	Gray Bat Fatalities (X)	Tricolored Bat Fatalities (X)	Ba	Bb	g-hat
2024	1	1	3	834.1273	2772.246	0.23(0.22-0.25)

Treatment vs. Control Weights

Control Weights

Table B-24. Weights for EofA multiple classes model to combine detection probabilities across sub-seasons for control turbines at the North Fork Ridge Wind Project

Sub-season	Minimization Weight	Arrival proportion	DWP
Spring (April - May)	0.87	0.066	0.095
June	0.89	0.035	0.051
July 1	0.59	0.195	0.191
July 2	0.59	0.141	0.138
August	0.54	0.336	0.297
September 1	0.70	0.032	0.037
September 2	0.70	0.088	0.101
October	0.91	0.059	0.089

Treatment Weights

Table B-25. Weights for EofA multiple classes model to combine detection probabilities across sub-seasons for treatment turbines at the North Fork Ridge Wind Project

Sub-season	Minimization Weight	Arrival proportion	DWP
Spring (April - May)	0.87	0.066	0.146
June	0.89	0.035	0.080
July 1	0.35	0.195	0.174
July 2	0.35	0.141	0.126
August	0.22	0.336	0.189
September 1	0.52	0.032	0.043
September 2	0.52	0.088	0.117
October	0.83	0.059	0.125

Treatment vs. Control Inputs

Control Inputs

Table B-26 Data inputs for EofA multiple classes model to combine detection probabilities across sub-seasons and estimate tricolored bat and gray bat take for control turbines at the North Fork Ridge Wind Project

Sub-season	Gray Bat Fatalities	Tricolored Bat Fatalities	DWP	Ba	Bb	g-hat
Spring (April - May)	0	0	0.095	45.26	271.11	0.14 (0.11-0.18)
June	0	0	0.051	160.08	488.18	0.25 (0.22-0.28)
July 1	0	0	0.191	176.10	519.82	0.25 (0.22-0.29)
July 2	1	0	0.138	178.55	567.18	0.24 (0.21-0.27)
August	0	3	0.297	146.67	426.38	0.26 (0.22-0.29)
September 1	0	0	0.037	527.60	1283.87	0.29 (0.27-0.31)
September 2	0	0	0.101	275.32	694.06	0.28 (0.26-0.31)
October	0	0	0.089	10.72	71.05	0.13 (0.07-0.21)

Treatment Inputs

Table B-27. Data inputs for EofA multiple classes model to combine detection probabilities across sub-seasons and estimate tricolored bat and gray bat take for treatment turbines at the North Fork Ridge Wind Project

Sub-season	Gray Bat Fatalities	Tricolored Bat Fatalities	DWP	Ba	Bb	g-hat
Spring (April - May)	0	0	0.146	45.26	271.11	0.14 (0.11-0.18)
June	0	0	0.080	160.08	488.18	0.25 (0.22-0.28)
July 1	0	0	0.174	176.10	519.82	0.25 (0.22-0.29)
July 2	0	0	0.126	186.68	678.43	0.22 (0.19-0.24)
August	0	0	0.189	157.36	553.67	0.22 (0.19-0.25)
September 1	0	0	0.043	577.62	1728.15	0.25 (0.23-0.27)
September 2	0	0	0.117	275.32	694.06	0.28 (0.26-0.31)
October	0	0	0.125	10.72	71.05	0.13 (0.07-0.21)

Appendix C Acoustic Bat Activity Figures

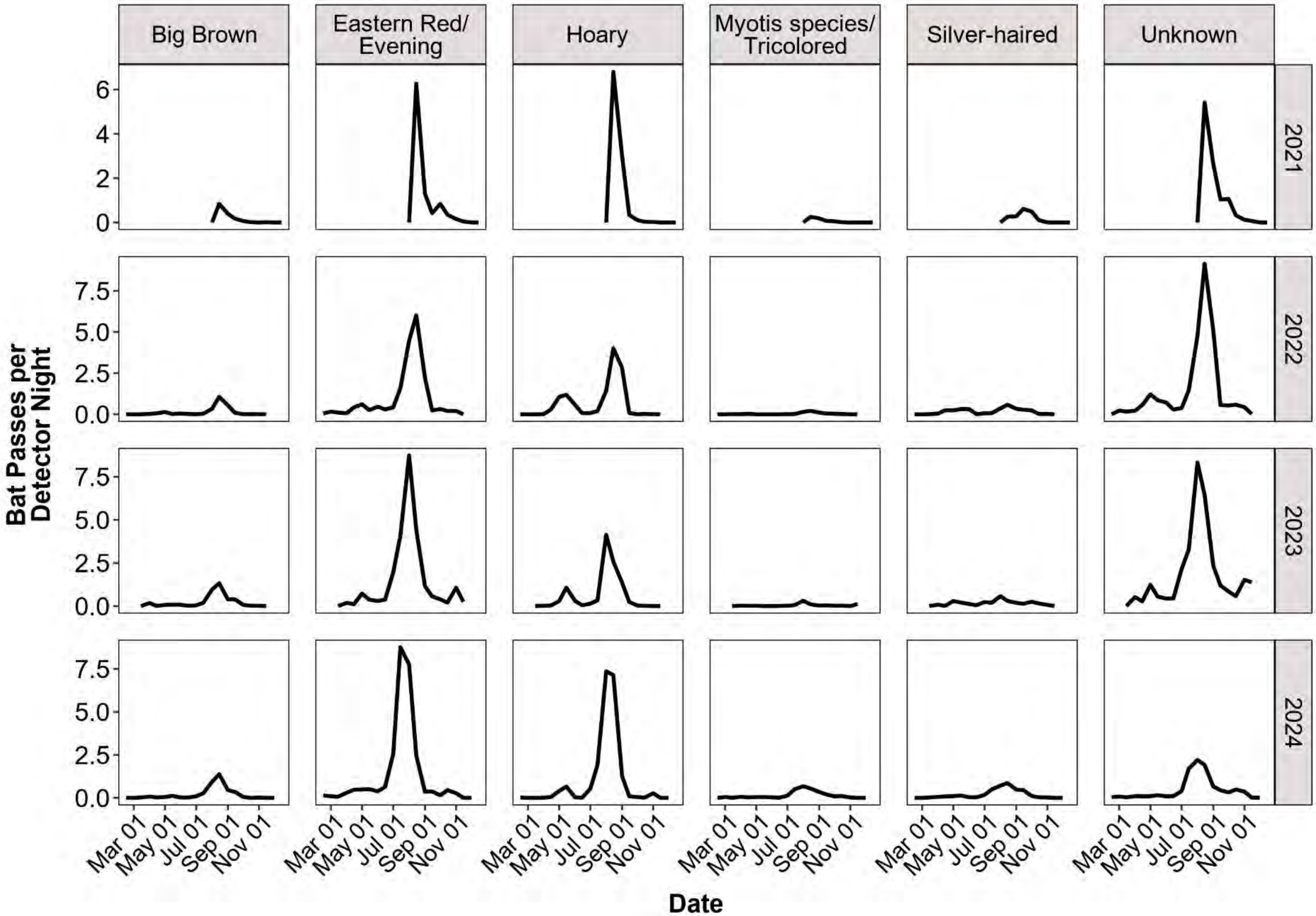

Figure C-1. Biweekly acoustic bat activity of each species or species group detected at nacelle-height detectors the 2021–2024 monitoring periods at the Kings Point Wind Project.

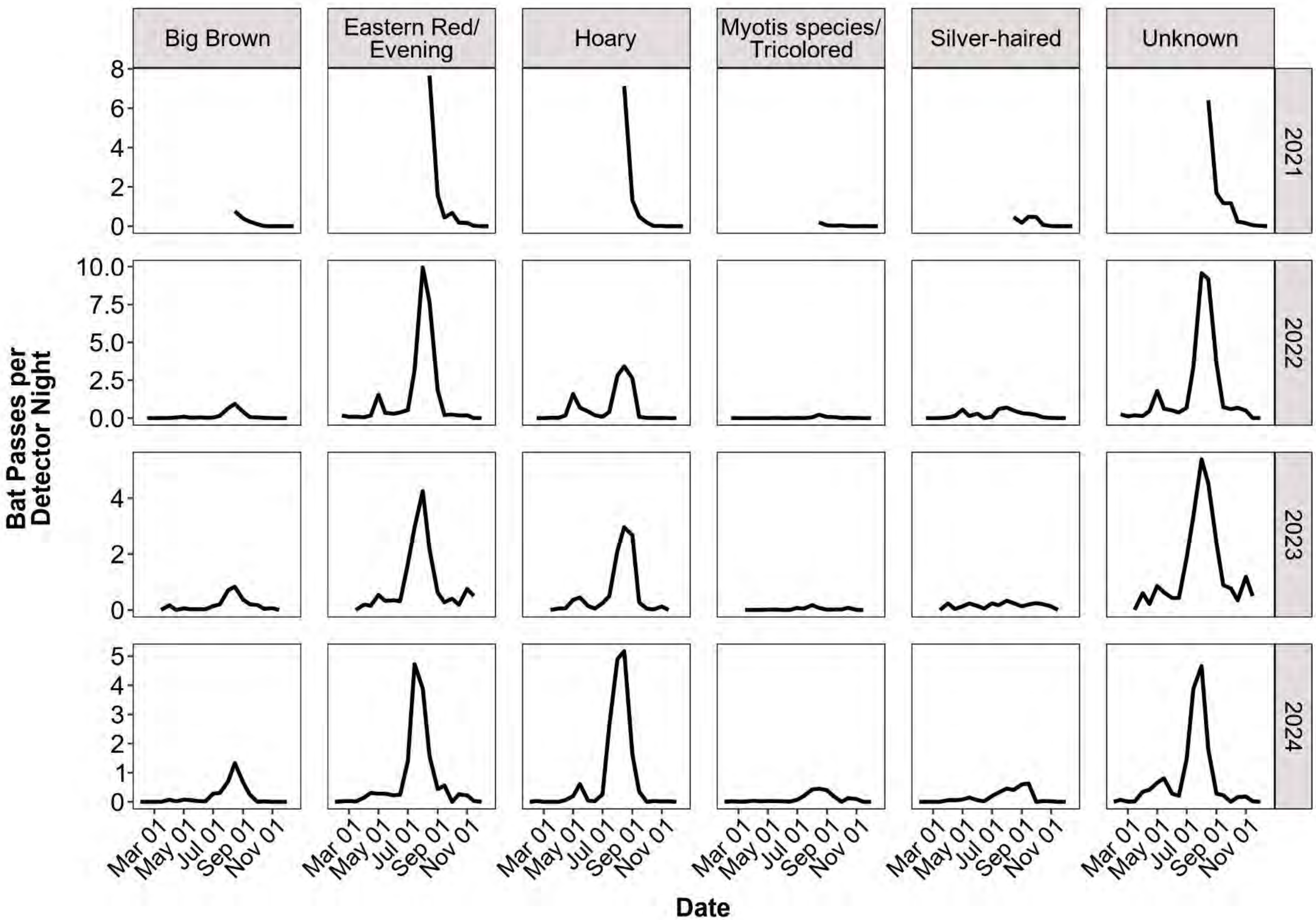

Figure C-2. Biweekly acoustic bat activity of each species or species group detected at nacelle-height detectors the 2021–2024 monitoring periods at the North Fork Ridge Wind Project.

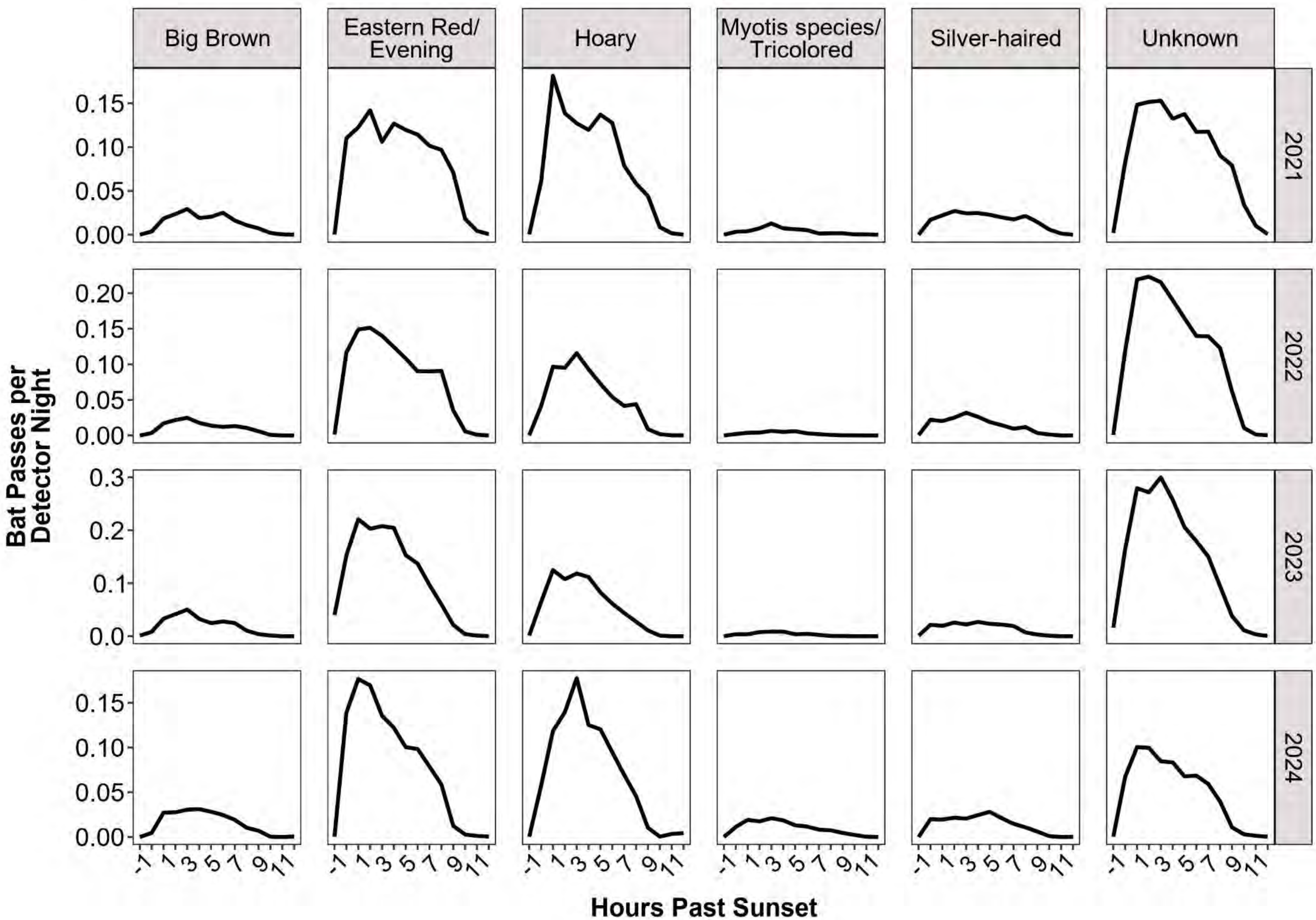

Figure C-3. Nightly timing of bat activity by species (by hour past sunset) detected at nacelle detectors during the 2021 – 2024 monitoring periods at the Kings Point Wind Project.

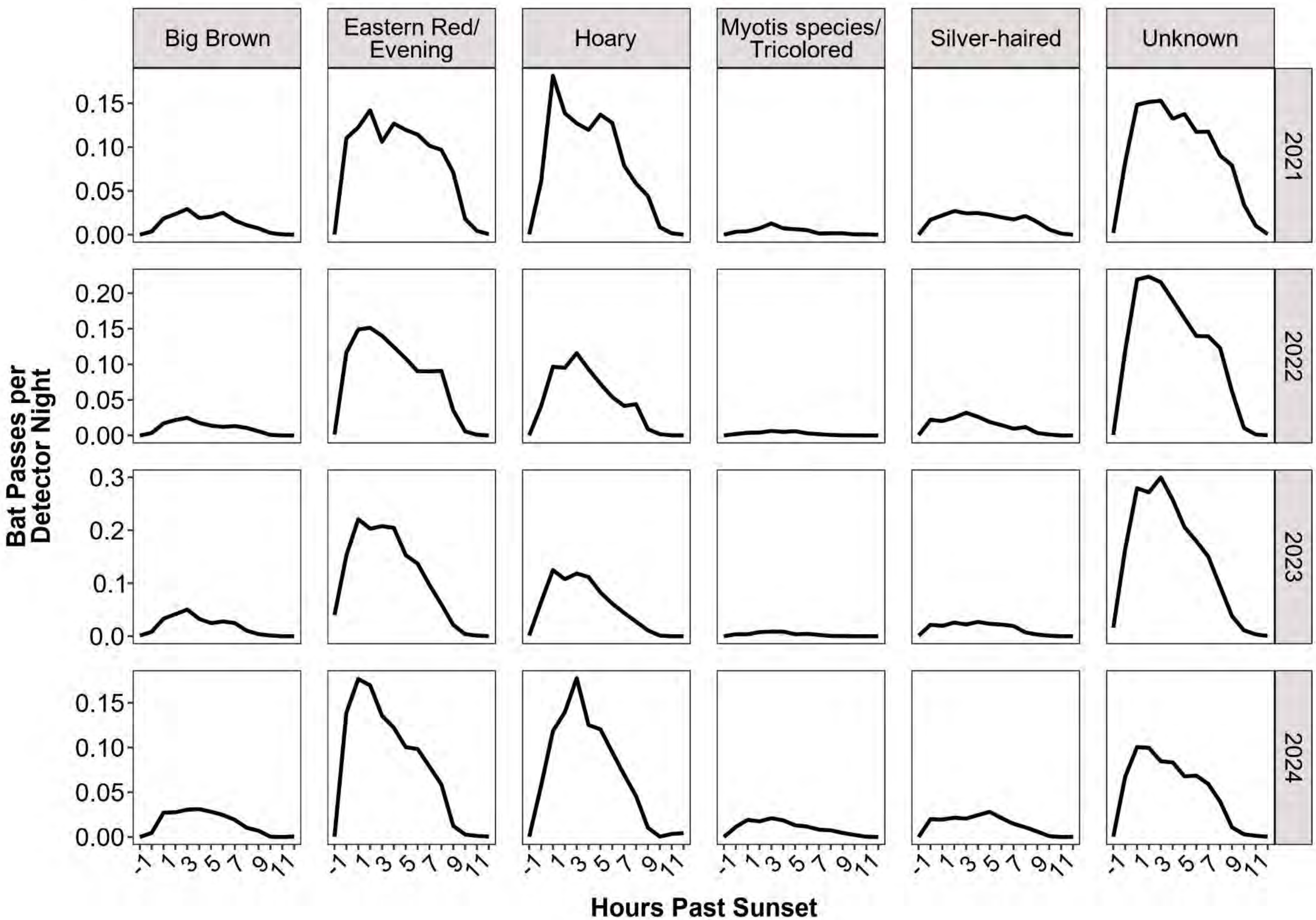

Figure C-4. Nightly timing of bat activity by species (by hour past sunset) detected at nacelle detectors during the 2021 – 2024 monitoring periods at the North Fork Ridge Wind Project

Appendix D Genetics Results

Dr. Jane Huffman Wildlife Genetics Institute
East Stroudsburg University, 562 Independence Road, suite 114,
East Stroudsburg, PA 18301
570-422-7892

DNA EVALUATION REPORT

September 12, 2024

Submitted by:
Peter Kappes
Nicole Pierro
Western EcoSystems Technology
415 W. 17th St. Suite 200
Cheyenne WY, 82001

Laboratory ID # WY-UNK-NF-123
Services Requested: Species Identification and Gender Identification
Date Received at DNA Lab: August 15, 2024

Description of Sample Submitted: Samples were submitted to the Dr. Jane Huffman Wildlife Genetics Institute on August 15, 2024. Samples included: (Items 1-29) all items submitted for analysis were labeled WY-UNK-NF-123 with unique numbers, each sample item highlighted in detail within Table 1.

Summary of Methods: Samples submitted to the Dr. Jane Huffman Wildlife Genetics Institute were evaluated. Following laboratory standards of practice, a DNA extraction was performed using a Qiagen DNeasy Blood and Tissue kit. To confirm species, a portion of the mitochondrial cytochrome oxidase subunit 1 (CO1) gene and cytochrome b (cytb) gene were targeted. Successful sequence fragments were analyzed using the National Centers for Biotechnology Information (BLAST) database and Barcode of Life Database (BOLD). To determine gender, the zinc finger Y-chromosomal protein (ZFY) gene was used to target the Y chromosome. Successful amplification of Y chromosome was visualized using gel electrophoresis.

Summary of Results and Conclusion: To confirm species, DNA was successfully extracted from sample items 1-20 and 22-29. Sample item 21 failed to isolate mammal DNA as a result of decomposition. Final DNA analysis, species and gender identification is highlighted in detail within Table 1.

Table 1: Results of species and gender identification for sample items 1-29 submitted for testing.

Lab ID	Casualty ID	Species ID	Gender
WY-UNK-NF-123-1	062124-GRBA-KP60-1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-123-2	062524-GRBA-KP119-1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-123-3	071824-GRBA-KP56-1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-123-4	071924-GRBA-KP74-1	*Myotis grisescens* (Gray bat)	Male
WY-UNK-NF-123-5	072324-GRBA-KP126-1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-123-6	072324-GRBA-KP90-1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-123-7	0724324-GRBA-NFR97-1	*Myotis grisescens* (Gray bat)	Male
WY-UNK-NF-123-8	080224-TRBA-KP33-1	*Perimyotis subflavus* (Tricolored bat)	Male
WY-UNK-NF-123-9	080524-UNMY-KP60-1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-123-10	071224-UNBA-NFR90-1	*Eptesicus fuscus* (Big brown bat)	Female
WY-UNK-NF-123-11	071224-UNBA-NFR32-1	*Eptesicus fuscus* (Big brown bat)	Female
WY-UNK-NF-123-12	071524-UNBA-KP56-1	*Lasiurus borealis* (Eastern red bat)	Male
WY-UNK-NF-123-13	071624-UNBA-NFR32-2	*Lasiurus borealis* (Eastern red bat)	Female
WY-UNK-NF-123-14	071824-UNBA-NFR78-1	*Lasiurus borealis* (Eastern red bat)	Female
WY-UNK-NF-123-15	072324-UNBA-KP68-1	*Lasiurus borealis* (Eastern red bat)	Male
WY-UNK-NF-123-16	072524-UNBA-KP114-1	*Lasiurus borealis* (Eastern red bat)	Male
WY-UNK-NF-123-17	072924-UNBA-NFR97-1	*Lasiurus cinereus* (Hoary Bat)	Male
WY-UNK-NF-123-18	073124-UNBA-NFR78-1	*Lasiurus borealis* (Eastern red bat)	Female
WY-UNK-NF-123-19	080224-UNBA-NFR58-1	*Lasiurus borealis* (Eastern red bat)	Male
WY-UNK-NF-123-20	080524-UNBA-KP63-1	*Lasiurus borealis* (Eastern red bat)	Female
WY-UNK-NF-123-21	080524-UNBA-KP33-1	Failed Sample Analysis	N/A
WY-UNK-NF-123-22	080524-UNBA-KP35-1	*Perimyotis subflavus* (Tricolored bat)	Male
WY-UNK-NF-123-23	080624-UNBA-NFR44-1	*Nycticeius humeralis* (Evening bat)	Male
WY-UNK-NF-123-24	081224-UNBA-NFR9-1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-123-25	081224-UNBA-NFR9-2	*Lasiurus borealis* (Eastern red bat)	Female
WY-UNK-NF-123-26	081224-UNBA-KP25-1	*Nycticeius humeralis* (Evening bat)	Male
WY-UNK-NF-123-27	2024 GRBA-1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-123-28	2024 GRBA-2	*Myotis grisescens* (Gray bat)	Male
WY-UNK-NF-123-29	2024 TRBA	*Perimyotis subflavus* (Tricolored bat)	Female

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DNA EVALUATION REPORT

October 28, 2024

Submitted by:
Peter Kappes
Nicole Pierro
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Cheyenne WY, 82001

Laboratory ID # WY-UNK-NF-133
Services Requested: Species Identification and Gender Identification
Date Received at DNA Lab: September 19, 2024

Description of Sample Submitted: Samples were submitted to the Dr. Jane Huffman Wildlife Genetics Institute on September 19, 2024. Samples included: (Items 1-21) all items submitted for analysis were labeled WY-UNK-NF-133 with unique numbers, each sample item highlighted in detail within Table 1.

Summary of Methods: Samples submitted to the Dr. Jane Huffman Wildlife Genetics Institute were evaluated. Following laboratory standards of practice, a DNA extraction was performed using a Qiagen DNeasy Blood and Tissue kit. To confirm species, a portion of the mitochondrial cytochrome oxidase subunit 1 (CO1) gene and cytochrome b (cytb) gene were targeted. Successful sequence fragments were analyzed using the National Centers for Biotechnology Information (BLAST) database and Barcode of Life Database (BOLD). To determine gender, the zinc finger Y-chromosomal protein (ZFY) gene was used to target the Y chromosome. Successful amplification of Y chromosome was visualized using gel electrophoresis.

Summary of Results and Conclusion: To confirm species, DNA was successfully extracted from sample items 1-21. Final DNA analysis, species identification, and gender identification is highlighted in detail within Table 1.

Table 1: Results of species and gender identification for sample items 1-21 submitted for testing.

Lab ID	Casualty ID	Species ID	Gender
WY-UNK-NF-133-1	081524-TRBA-KP28-1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-133-2	081624-TRBA-NFR60-1	*Perimyotis subflavus* (Tricolored bat)	Male
WY-UNK-NF-133-3	081624-TRBA-KP91-1	*Perimyotis subflavus* (Tricolored bat)	Male
WY-UNK-NF-133-4	081624-TRBA-KP90-1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-133-5	081624-TRBA-KP32-1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-133-6	081624-TRBA-KP114-1	*Perimyotis subflavus* (Tricolored bat)	Male
WY-UNK-NF-133-7	081924-TRBA-KP25-1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-133-8	082324-TRBA-KP126-1	*Perimyotis subflavus* (Tricolored bat)	Male
WY-UNK-NF-133-9	082624-TRBA-NFR24-1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-133-10	090924-TRBA-KP36-1	*Perimyotis subflavus* (Tricolored bat)	Male
WY-UNK-NF-133-11	091524-TRBA-KP36-1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-133-12	091624-TRBA-KP33-1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-133-13	090324-GRBA-KP74-1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-133-14	082324-GRBA-KP34-1	*Myotis grisescens* (Gray bat)	Male
WY-UNK-NF-133-15	082024-UNBA-KP114-1	*Lasionycteris noctivagans* (Silver-haired bat)	Female
WY-UNK-NF-133-16	083024-UNBA-NFR44-1	*Eptesicus fuscus* (Big brown bat)	Male
WY-UNK-NF-133-17	090224-UNBA-KP56-1	*Lasiurus borealis* (Eastern red bat)	Female
WY-UNK-NF-133-18	090324-UNBA-KP91-1	*Perimyotis subflavus* (Tricolored bat)	Female
WY-UNK-NF-133-19	091624-UNBA-KP8-1	*Lasiurus borealis* (Eastern red bat)	Male
WY-UNK-NF-133-20	091624-UNBA-KP60-1	*Lasionycteris noctivagans* (Silver-haired bat)	Male
WY-UNK-NF-133-21	080524-UNBA-KP33-1	*Lasiurus borealis* (Eastern red bat)	Female

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DNA EVALUATION REPORT

October 29, 2024

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Laboratory ID # WY-UNK-NF-142
Services Requested: Species Identification and Gender Identification
Date Received at DNA Lab: October 8, 2024

Description of Sample Submitted: Samples were submitted to the Dr. Jane Huffman Wildlife Genetics Institute on October 8, 2024. Samples included: (Items 1-2) all items submitted for analysis were labeled WY-UNK-NF-142 with unique numbers, each sample item highlighted in detail within Table 1.

Summary of Methods: Samples submitted to the Dr. Jane Huffman Wildlife Genetics Institute were evaluated. Following laboratory standards of practice, a DNA extraction was performed using a Qiagen DNeasy Blood and Tissue kit. To confirm species, a portion of the mitochondrial cytochrome oxidase subunit 1 (CO1) gene and cytochrome b (cytb) gene were targeted. Successful sequence fragments were analyzed using the National Centers for Biotechnology Information (BLAST) database and Barcode of Life Database (BOLD). To determine gender, the zinc finger Y-chromosomal protein (ZFY) gene was used to target the Y chromosome. Successful amplification of Y chromosome was visualized using gel electrophoresis.

Summary of Results and Conclusion: To confirm species, DNA was successfully extracted from sample items 1-2. Final DNA analysis, species identification, and gender identification is highlighted in detail within Table 1.

Table 1: Results of species and gender identification for sample items 1-2 submitted for testing.

Lab ID	Casualty ID	Species ID	Gender
WY-UNK-NF-142-1	092424-GRBA-KP80-1	*Myotis grisescens* (Gray bat)	Female
WY-UNK-NF-142-2	092924-UNBA-NFR93-1	*Nycticeius humeralis* (Evening bat)	Female

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