2022 Post-Construction Bat Mortality Monitoring Report Pioneer Trail Wind Farm

Ford and Iroquois Counties, Illinois

Project #193708913

Prepared for:
Pioneer Trail Wind Farm, LLC
353 N. Clark, 30th Floor
Chicago, IL 60654

Prepared by:
Stantec Consulting Services, Inc.
2300 Swan Lake Boulevard Suite 202
Independence, Iowa 50644

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1.0 Introduction

1.1 PROJECT DESCRIPTION

The Pioneer Trail Wind Farm (Project or Pioneer Trail) developed by Pioneer Trail Wind Farm, LLC (PTWF), is located in Ford and Iroquois counties, just east of the towns of Paxton and Loda, Illinois. The Project consists of 94 1.6-megawatt (MW) wind turbine generators, operations and maintenance building, access roads, collector line system, and substation for a total capacity of approximately 150 MWs (Figure 1). The Project became operational in January 2012. The Project is located on lands leased from private landowners, who continue their existing use of the land. Land use in the area is predominantly agricultural.

Pioneer Trail is located within the range of both the federally and Illinois endangered Indiana bat (*Myotis sodalis*) and the federally and Illinois threatened northern long-eared bat (*Myotis septentrionalis*)[1]. PTWF developed a Habitat Conservation Plan (HCP) in accordance with the requirements set forth under section 10(a)(1)(B) of the Endangered Species Act of 1973 (ESA), as amended, and applicable U.S. Fish and Wildlife Service (USFWS) guidance documents, in support of its application for an incidental take permit (ITP) for these species under section 10(a)(1)(B) of the ESA. On June 26, 2015, the USFWS issued ITP No. TE66598B-0 to PTWF for the Project. On the basis of the HCP and certain additional information submitted to the Illinois Department of Natural Resources (IDNR), the IDNR issued an Incidental Take Authorization (ITA) to PTWF for the Project on October 8, 2015. The federal ITP for the Project sets a take limit of 129 Indiana bats and 86 northern long-eared bats over the course of the 43-year permit term, or an estimated 3 Indiana bats and 2 northern long-eared bats per year.

1.2 PURPOSE AND OBJECTIVES OF THE STUDY

The HCP for the Project outlines the following measures required as a condition of the federal ITP and state ITA:

- Avoidance measures to avoid take of listed species;
- Minimization measures to minimize take of listed species, as well as all bats;
- Mitigation to mitigate for unavoidable take of listed species;
- Post-construction monitoring protocols to measure effectiveness of avoidance and minimization measures; and
- Adaptive management to adjust minimization measures as necessary.

[1] The northern-long-eared bat will be up listed to endangered, effective January 2023.

The HCP and federal ITP require PTWF to perform post-construction monitoring during the fall season curtailment window (August 15 through October 15) for the first two years of operation post-ITP issuance, and every five years thereafter. The state ITA also required PTWF to perform mortality monitoring for the first two years following ITA issuance during the fall curtailment window, plus an extended period prior to the curtailment window beginning on July 15. Therefore, PTWF conducted post-construction monitoring from July 15 through October 15 in 2016 and 2017. The ITP and ITA require that fall season monitoring be repeated every 5 years beginning in 2022, and spring season monitoring (April 1 through May 15) is required in 2022 and every 10 years thereafter, unless the results of spring monitoring indicate a need for spring monitoring to be conducted every 5 years as well, as set forth in the HCP.

The HCP requires annual reporting to the USFWS of the results of the post-construction monitoring conducted at the Project. The state ITA requires that these results also be reported to the IDNR within 60 days of survey completion. This Post-Construction Bat Mortality Monitoring Report has been prepared to satisfy those requirements.

The primary objectives of the post-construction study were to:

1. Determine overall bat mortality rates from the Project;
2. Estimate Indiana and northern long-eared bat mortality at the species level to ensure compliance with the federal ITP and state ITA; and
3. Evaluate the circumstances under which fatalities occur.

The study included the following components:

1. Standardized carcass searches to systematically search plots at turbines for bat casualties attributable to the turbines;
2. Searcher efficiency trials to estimate the percentage of bat casualties that were found by the searcher(s); and
3. Carcass removal trials to estimate the persistence time of carcasses on-site before they were removed by scavengers.

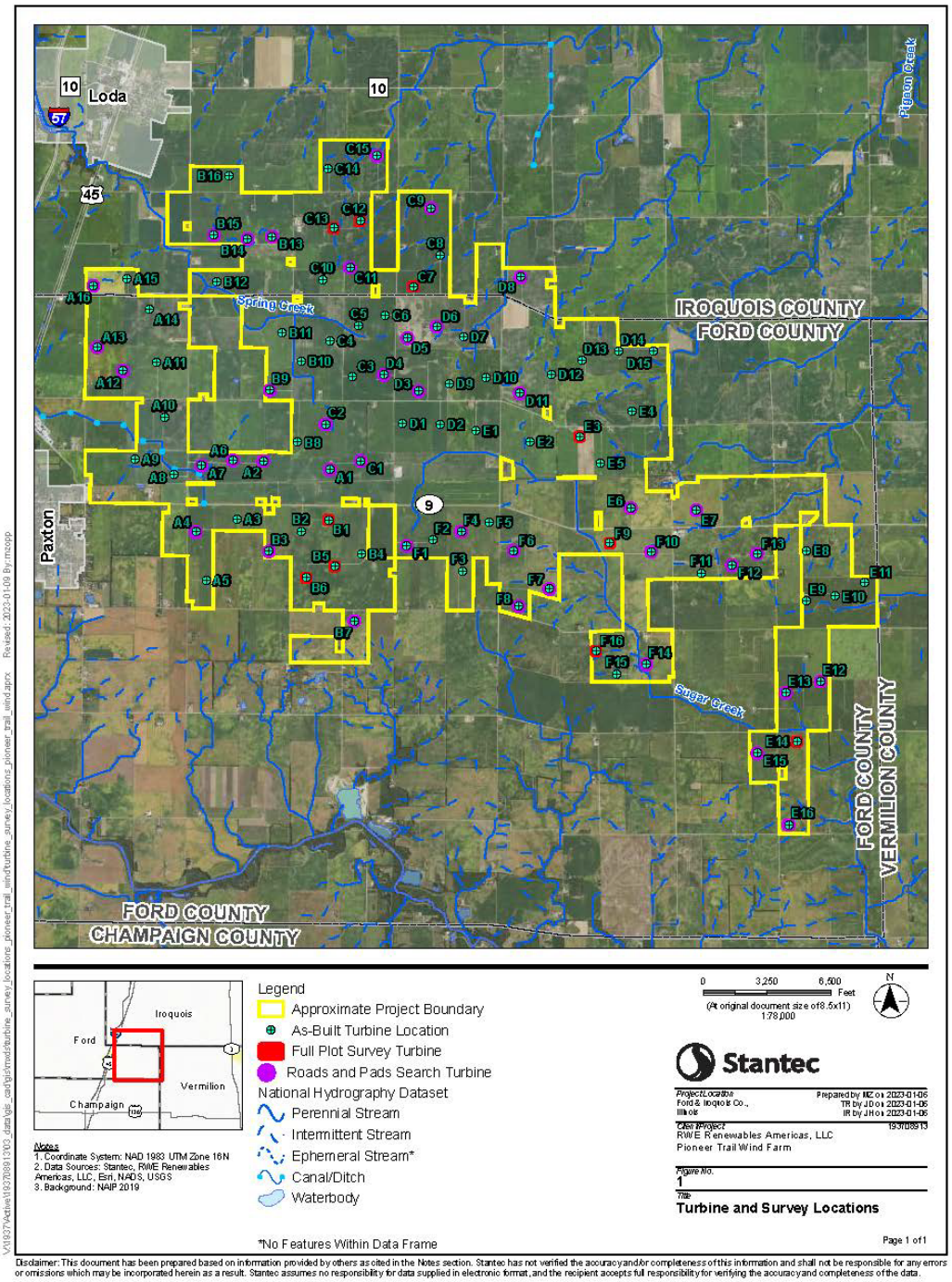

Figure 1. Turbine and Survey Locations

2.0 Methods

2.1 MORTALITY STUDY

Carcass searches were conducted during the following time periods:

1. Spring Monitoring Period – April 1 to May 16. This spring monitoring period was a condition set forth by the HCP. Turbines are feathered below manufacturer's rated cut-in speeds during this period.

2. Fall Monitoring Period – August 15 to October 18. This was identified in the Project's HCP as the period of risk for Indiana and northern long-eared bats and is the monitoring period required by the federal ITP. It represents the period of turbine curtailment under both the federal ITP and the state ITA.

This year (2022) was the eighth year of Project operation under the federal ITP, but because the state ITA was not issued until late in 2015, it was the seventh full year that the Project operated at a cut-in speed of 5.0 m/s during the federal ITP monitoring period. In previous fall seasons prior to ITA issuance, PTWF continued to operate the Project with a cut-in speed of 6.9 m/s during the federal ITP monitoring period to avoid take of both the Indiana and northern long-eared bat that would not have been authorized under Illinois law.

2.1.1 Sample Size

Post-construction monitoring was conducted at 50 of the 94 turbines (53%). This sample size optimizes field survey effort while maximizing expected confidence in the data and associated results. This approach meets the study objective of detecting and analyzing overall bat fatalities at the facility by providing sufficient sample size to support reliable data analysis and related interpretations and conclusions.

2.1.2 Search Plot Size

At 80% (n=40) of the 50 surveyed turbines, only the turbine pads and roads out to 328 feet (ft.; 100 meters[m]) from the turbine were searched. This method targets the areas with the highest searcher efficiency while greatly reducing the financial and logistical constraints associated with clearing and searching large study plots, enabling much broader coverage of the facility. At the remaining 20% (n=10) of the 50 surveyed turbines, 262-ft. x 262-ft. (80-m x 80-m) plots were cleared and searched using a full-coverage transect approach. Each 80-m x 80-m plot was centered on a turbine location, and vegetation was periodically mowed and cleared as needed to improve searcher efficiency.

2.1.3 Search Schedule

The search interval for all turbines was once weekly during the respective monitoring periods. An individual turbine was searched on the same day each week when conditions allowed. Within a day, the turbine search schedule and order were randomized, so that each turbine's search plot was sampled at differing periods during the day.

2.1.4 Carcass Searches

Carcass searches were conducted by biologists, operating under applicable state and federal permits and experienced and/or trained in post-construction monitoring search methods, including proper handling and reporting of carcasses. The biologist was familiar with and able to accurately identify the bat species likely to be found in the Project area, and photos of any unknown bat discovered were sent to an expert for positive identification, and the carcasses were retained on-site. Bird carcasses were identified in the field. Digital photographs and location information of all bird carcasses were taken and used for confirming identification, when necessary, but bird carcasses were left in place and were not collected. Carcasses (birds and bats) were photographed from several angles to provide the best chance of photographic identification. During searches, the biologist walked at a rate of approximately 2 miles per hour (45 to 60 m per minute) while searching 10 ft. (3 m) on either side of each transect.

For each carcass found (for the purposes of this analysis, live or injured bats were considered a carcass), 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 results of genetic testing]
- Sex, age, and reproductive condition (when possible) [sex was updated based on genetic testing, if applicable]
- Global positioning system (GPS) location
- Distance and bearing to turbine
- Condition (intact [I], scavenged [S], decomposed [D])
- Any notes on presumed cause of death

A digital photograph of each detected carcass was taken before the carcass was handled and removed. All bat carcasses were labeled with a unique number, bagged, and stored frozen (with a copy of the original data sheet) at the Project Operations and Maintenance Building. Bat carcasses were collected and retained under the IDNR Permit Number NH22.6588, and listed species (Indiana bat and northern long-eared bats) under IDNR Permit Type S, Permit Number 14-

864 (up to 3 of each listed species). Raw data for all bat carcasses found are included in Appendix A.

Bat carcasses found in non-search areas and any bird carcasses found were coded as incidental finds and documented as much as possible in a similar fashion to those found in standardized searches. Bird carcasses were not collected but left in place after data collection. Maintenance personnel were informed of the standardized searches and were trained in collision event reporting protocol in the case of an incidental find. Incidental finds are not included in the mortality estimates because the lack of standardized search effort and search area as well as the lack of searcher efficiency and carcass removal trials prohibits calculations to account for bias and extrapolate incidental carcasses found to estimated fatalities.

2.1.5 Species Identification

Preliminary bird and bat species identifications were made in the field by qualified staff. When carcass condition allowed, data collected also included the sex of the carcass. For bat carcasses, forearm length was recorded to facilitate identification. Any unknown bat, or potential Indiana or northern long-eared bat, was identified by a Stantec bat biologist. In addition to the carcass, photographs and data collected for each carcass were used to verify the species identification.

2.2 SEARCHER EFFICIENCY TRIALS

Searcher efficiency trials were used to estimate the probability of bat carcass detection by the biologist. One searcher efficiency trial was conducted during each monitoring period (i.e., one in spring and one in fall). The biologist 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 brown mouse carcasses were used as trial carcasses to represent bats.

All searcher efficiency trial carcasses were randomly placed by the field lead within the search plots prior to the carcass searches for that day. The number of trial carcasses found by the biologist during the mortality searches in each plot was recorded and compared to the total number of trial carcasses placed in the plot and not scavenged prior to the mortality search.

2.3 CARCASS REMOVAL TRIALS

Carcass removal trials were conducted to estimate the average length of time bat carcasses remained in the search plots (i.e., were available to find) before being removed by scavengers. The carcass removal trials were conducted following the searcher efficiency trials. Mouse carcasses used during the searcher efficiency trial were left in place and their locations were discretely marked. The biologist monitored the trial carcasses over a period of up to 36 days. During the carcass removal trial, carcasses were checked every day for the first week, and then regularly on the weekly visit when possible.

The condition of each carcass was recorded during each 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.

Any carcasses remaining at the end of the 36-day trial period were removed from the field.

2.4 STATISTICAL METHODS FOR MORTALITY ESTIMATES

In an effort to make results comparable with other post-construction mortality studies (including previous years at this Project), the methods used to calculate the mortality estimates largely followed the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimate of the total number of turbine-related casualties was based on three components: (1) observed number of casualties, (2) searcher efficiency, and (3) carcass removal rates. The 90% confidence intervals were calculated using bootstrapping methods (Erickson et al. 2003 and Manly 1997 as presented in Young et al. 2009).

2.4.1 Mean Observed Number of Casualties (c)

The estimated mean observed number of casualties (c) per turbine per monitoring period was calculated as:

$$c = \frac{\sum_{j=1}^{n} c_j}{n}$$

where n is the number of turbines searched, and c_j is the number of casualties found during mortality searches. Incidental carcass finds (those found outside of the searched areas or at times other than during mortality searches) were not included in this calculation, or in the estimated mortality rate. Mean number of observed casualties was calculated separately for each search type (roads and pads, full plots) and season.

2.4.2 Estimation of Searcher Efficiency (p)

Searcher efficiency (p) represents the average probability that a carcass was detected by the biologist. The searcher efficiency was calculated by dividing the number of trial carcasses observers found by the total number which remained available during the trial (non-scavenged). Searcher efficiency was calculated separately for each search type (roads and pads, full plots) and season.

2.4.3 Estimation of Carcass Removal (t)

Mean carcass removal times were estimated to adjust the observed number of casualties to account for scavenger activity at the site. Mean carcass removal time (t) represents the average length of time a trial carcass remained at the site before it was removed by scavengers. Mean carcass removal time was calculated as:

$$t = \frac{\sum_{i=1}^{S} t_i}{s - s_c}$$

where s is the number of carcasses placed in the carcass removal trials and s_c is the number of carcasses remaining at day 35 during the spring and day 36 during the fall. This estimator is the maximum likelihood (conservative) estimator assuming the removal times follow an exponential distribution, and there is right-censoring of the data. Any trial carcasses still remaining at 35 days (in the spring) or 36 days (in the fall) were collected, yielding censored observations at 35 or 36 days. Carcass removal times were calculated separately for each search type (i.e., roads and pads, full plots) and season.

2.4.4 Estimation of the Probability of Carcass Availability and Detection (π)

Searcher efficiency and carcass removal rates were combined to represent the overall probability (π) that a casualty incurred at a turbine was reflected in the mortality search results. This probability was calculated as:

$$\pi = \frac{t \cdot p}{I} \cdot \left[\frac{\exp(I/t) - 1}{exp\,(I/t) - 1 + p} \right]$$

where I is the interval between searches.

The estimation of the probability of carcass availability and detection was calculated separately for each search type (roads and pads, full plots), and then averaged for the study using a weighted average as:

$$\pi = (0.8 * \pi_{RP}) + (0.2 * \pi_{FP})$$

2.4.5 Area Adjustment (A)

Approximation of the area adjustment (A), which adjusts for areas not searched, was calculated following methods and data collected during post-construction monitoring studies at Fowler Ridge Wind Farm in Indiana (Good et al. 2011). For this study, A was calculated to represent the adjustment for the proportion of carcasses which likely fell outside of the search area at surveyed turbines. The value for A was approximated using the following equation:

$$A = \frac{\frac{C_{RP}}{\pi_{RP} * S_{RP}} + \frac{C_{FP}}{\pi_{FP} * S_{FP}}}{\frac{C_{RP}}{\pi_{RP}} + \frac{C_{FP}}{\pi_{FP}}} * A_{FP}$$

where C_{RP} is the number of observed casualties on roads and pads, C_{FP} is the number of observed casualties on full plots, π_{RP} is the probability of carcass availability and detection on roads and pads, π_{FP} is the probability of carcass availability and detection on full plots, S_{RP} is the proportion of roads and pads searched across all study turbines, and S_{FP} is the proportion of full plots searched across all study turbines. For this study, S_{RP} = 0.8 and S_{FP} = 0.2, as only roads and pads were searched at 80% of the study turbines and full plot searches were conducted at the remaining 20% of the study turbines.

The value for A_{FP} used was equal to the correction factor calculated for the Fowler study (A_{FP}=1.305) as the Fowler study estimated that 23.4% of fatalities fall outside of the 262-ft. x 262-ft. (80-m x 80-m) square plots. This number was calculated together for the spring and fall monitoring periods.

2.4.6 Estimation of Facility-Related Mortality (m)

Mortality estimates were calculated using the estimator proposed by Erickson et al. (2003), as modified by Young et al. (2009). The estimated mean number of bat casualties/turbine/monitoring period (m) was calculated by dividing the mean observed number of bat casualties/turbine/monitoring period (c) by π, an estimate of the probability a carcass was not removed by scavengers and was detected by the biologist, and then multiplying by A, the adjustment for the area within which bats may have fallen but which was not searched.

$$m = \mathrm{A} * \frac{c}{\pi}$$

Where A is the area adjustment, C is the number of carcasses found per turbine, and π is the probability of carcass detection and availability (weighted average of π_{RP} and π_{FP} based on 80% of searches being roads and pads and 20% of searches being full plots). This number was calculated separately for the spring monitoring period and the fall monitoring period.

3.0 Results

3.1 SUMMARY OF SEARCHES

A total of 848 carcass searches were conducted over 7 weeks in the spring and 10 weeks in the fall. The average time between searches was 6.6 days in the spring and 6.5 days in the fall. A total of 17 individual bat carcasses were found during standardized carcass searches, 2 during the spring monitoring period (April 1 – May 16) and 15 during the fall monitoring period (August 15 –

October 18). No additional bat carcasses were found incidentally, either outside of the search plot areas or on a non-scheduled search day during carcass removal checks.

3.1.1 Species Composition

A summary of all bat carcasses found during standardized post-construction searches is shown in Table 1. Of the 17 bat carcasses found during standardized searches, 9 were silver-haired bats (*Lasionycteris noctivagans*; 52.9%), 5 were eastern red bats (*Lasiurus borealis*; 29.4%), and 3 were hoary bats (*Lasiurus cinereus*; 17.6%). No bat species listed as threatened or endangered under the ESA, or by the State of Illinois were found during the searches.

Eastern red bats and silver-haired bats were found during both the spring monitoring period (April 1 – May 16) as well as during the fall monitoring period (August 15 – October 18). Hoary bats were found only during the fall monitoring period.

Table 1. Summary of all bat carcasses found during the 2022 spring and fall standardized post-construction searches at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

Species	Spring Monitoring Period (April 1 – May 15)	Fall Monitoring Period (August 15 – October 18)	Total	Percent of All Bats Found
Silver-Haired Bat	1	8	9	52.9%
Eastern red bat	1	4	5	29.4%
Hoary Bat	0	3	3	17.7%
Total	**2**	**15**	**17**	100%

3.1.2 Sex

A summary of the sex of all bat carcasses found during the standardized post-construction monitoring is shown in Table 2. Of the 17 bat carcasses found, there were 5 females (1 found during spring surveys, 4 during fall surveys), 6 males (1 found during spring surveys, 5 during fall surveys), and 6 bats of unknown sex (all found during fall surveys; Table 2).

Table 2. Sex of all bat carcasses found during the 2022 spring and fall standardized post-construction searches at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

	Species	Female	Male	Unknown
Spring Monitoring Period (April 1 – May 16)	Silver-Haired Bat	1	0	0
	Eastern Red Bat	0	1	0
Fall Monitoring Period (August 15 – October 18)	Silver-Haired Bat	3	4	1
	Eastern Red Bat	0	1	3
	Hoary Bat	1	0	2
	Total	**5**	**6**	**6**

3.1.3 Temporal Patterns

Bat carcasses were found in 9 of the 17 survey weeks in 2022 (Figure 2). The greatest number of bat carcasses found in a single week was five (5), found during week 8 (week of August 15), the first week of curtailment and fall monitoring, which went into effect on August 15. After week 12 (week of September 12), the number of carcasses discovered dropped sharply, with no carcasses found in weeks 13, 14, and 16 and only one carcass in each of weeks 15 and 17.

Only two carcasses were found during the entire spring season, with none detected in weeks 1-5, and only one carcass each detected in weeks 6 and 7.

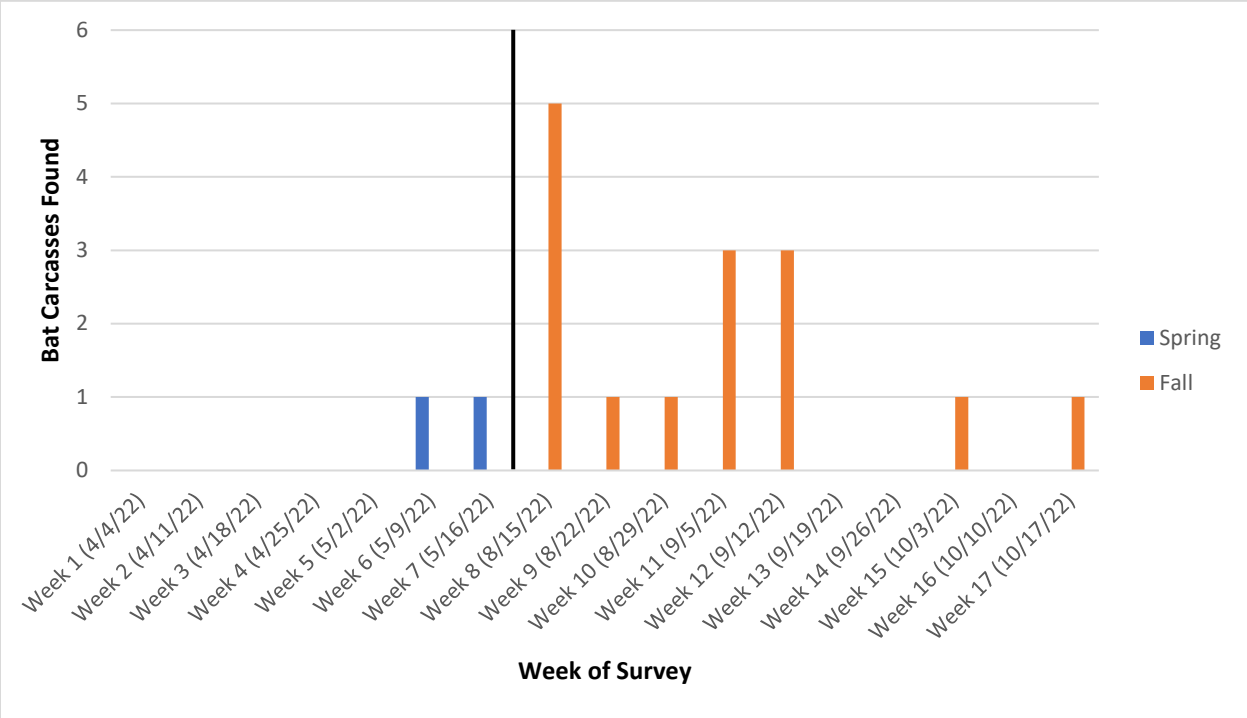

Figure 2. Bat carcasses found by week during the 2022 spring and fall standardized post-construction searches at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois. Turbines were feathered below manufacturer's cut-in speed for weeks 1 through 7 and at 5.0 m/s for weeks 8 through 17.

3.1.4 Spatial Patterns

Bat carcasses were found at 11 of 50 (22%) of the monitored turbines during the 2022 survey period. The greatest number of carcasses found at a single turbine was 4, at turbine F9 (full plot, Figure 1).

Over the entire monitoring period (spring and fall), 5 bats were found at turbines where only roads and pads were searched, and 12 bats were found at turbines where cleared plots were searched. During the fall monitoring period, when turbines were curtailed at 5.0 m/s, 4 bats were found at roads and pads, and 11 bats were found at full plots, whereas for the spring monitoring period (April 1 – May 16), just 1 bat was found at roads and pads sites and 1 bat was found at full plot sites.

3.2 SEARCHER EFFICIENCY TRIALS

A total of 50 mouse carcasses were placed for searcher efficiency trials during the monitoring periods (24 in spring, 26 in fall). However, 9 mouse carcasses in the fall searcher efficiency trial were scavenged prior to the search and therefore were not included in analyses, resulting in a total of 17 carcasses being used for searcher efficiency trials in the fall monitoring period. In the spring, the search efficiency ranged from 66.7% at full plots to 91.7% at roads and pads. In the fall, the search efficiency ranged from 90.0% at full plots to 100% at roads and pads.

Table 3. Searcher efficiency by season and plot type for the 2022 post-construction searches at the Pioneer Trail Wind Farm Ford and Iroquois counties, Illinois.

	Spring Monitoring April 1 – May 16		Fall Monitoring August 15 – October 18	
	Full Plots	**Roads and Pads**	**Full Plots**	**Roads and Pads**
# Carcasses placed and available to be found	12	12	10	7
# Carcasses found	8	11	9	7
Mean Searcher Efficiency (90% CI)	**0.7** (0.4, 0.9)	**0.9** (0.8, 1.0)	**0.9** (0.7, 1.0)	**1.0** (1.0, 1.0)

3.3 CARCASS REMOVAL TRIALS

Mouse carcasses used in the searcher efficiency trials were left in place for up to 35 days in the spring and 36 days in the fall. In the spring they were checked on days 1-4, 7, 14, 24, 28 and 35 of the trial. In the fall they were checked on days 1-4, 7, 17, 29, and 36 of the trial. In the spring, 24 mouse carcasses were used during the monitoring period, 12 at full plots, and 12 at roads and pads. In the fall, 26 mouse carcasses were used during the monitoring period, 15 at full plots, and 11 at roads and pads. In the spring, carcasses persisted for an average of 4.3 days on roads and pads and an average of 7.0 days on full plots. In the fall, carcasses persisted for an average of 1.7 days on roads and pads and an average of 7.6 days on full plots (Table 4).

Table 4. Carcass removal by plot type during the 2022 spring and fall post-construction searches at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

	Spring Monitoring April 1 – May 16		Fall Monitoring August 15 – October 18	
	Full Plots	**Roads and Pads**	**Full Plots**	**Roads and Pads**
# Carcasses Placed	12	12	15	11
# Carcasses Scavenged within 28 days	11	12	14	11
Mean Carcass Persistence time in days (90% CI)	**7.0** (2.9, 15.4)	**4.3** (2.5, 6.3)	**7.6** (4.1, 11.5)	**1.7** (1.0, 2.5)

3.4 ADJUSTED MORTALITY ESTIMATES

Mortality rate estimates were calculated based upon the carcasses found during the mortality searches and did not include any incidental finds (of which there were none). Observed bat mortality estimates were adjusted to account for searcher efficiency, carcass removal, and an area adjustment using the methods described in Section 2.4. Results are summarized in Table 5.

Table 5. Bat mortality estimates for the 2022 standardized post-construction searches at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois.

	Spring Monitoring April 1 – May 16 (feathered below manufacturer's rated cut-in speed)		**Fall Monitoring August 15 – October 18 (5.0 m/s cut-in)**	
	Full Plots	**Roads and Pads**	**Full Plots**	**Roads and Pads**
(c) Observed bats/turbine/season	0.1	0.025	1.1	0.1
(π) Probability of Carcass Availability and Detection (90% CI)	0.5 (0.2, 0.7)	0.5 (0.3, 0.6)	0.6 (0.4, 0.7)	0.3 (0.2, 0.4)
(A) Area Adjustment	4.1		4.1	
(m) Estimated bats/turbine/monitoring period	0.3 (0, 0.9)		3.5 (1.7, 6.0)	
Estimated bats/MW/monitoring period	0.2 (0, 0.6)		2.2 (1.1, 4.6)	
Estimated bats/facility/monitoring period	28.2 (0, 84.6)		329.0 (159.8, 564.0)	
Estimated Indiana bats/facility/monitoring period[1]	<0.1 (0, 0.1)		0.5 (0.3, 0.9)	
Estimated northern long-eared bats/facility/monitoring period[1]	<0.1 (0, 0.1)		0.3 (0.1, 0.5)	

[1]Calculated based upon percentage of Indiana and northern long-eared bats to all bat carcasses found (0.16% and 0.08%, respectively), based upon research done at Fowler Ridge Wind Farm (Western Ecosystems Technology, Inc. 2013).

3.5 INCIDENTAL FINDS

No incidental bat carcasses were found during the 2022 standardized post-construction searches.

Four bird carcasses were found during the 2022 post-construction searches. One bird carcass was the black-billed cuckoo (*Coccyzus erythropthalmus*), which is state-threatened in Illinois. The IDNR was contacted and an ITA for the species is currently being developed. Species and locations are as follows:

- April 7, Killdeer (*Charadrius vociferus*) on full plot at C12
- May 9, Black-billed Cuckoo on full plot at C7
- August 15, Eastern Kingbird (*Tyrannus tyrannus*) on road and pad at B3
- September 13, American Robin (*Turdus migratorius)*on full plot at B6

4.0 Summary and Conclusions

4.1 COMPARISON TO PREVIOUS STUDIES

Post-construction monitoring has been conducted in previous years at the Project. While the surveys differed in level of effort (search interval, search area) and bias correction factors (searcher efficiency, carcass persistence, area adjustments), all surveys had overall mortality estimates corrected for these differences, allowing for comparison of results. In addition, the Project operated under different cut-in speed adjustments between years based on the previous Technical Assistance Letters (TALs), federal ITP, or state ITA requirements. Comparisons are shown in the following sections.

4.1.1 Spring Monitoring Period

The comparisons shown in Table 6 are only for the time period from April 1 to May 15 (the spring monitoring period). For the first two years (2013, and 2014) of Project operations in the spring, the turbines operated under the terms of a TAL, with a cut-in speed of 3.5 m/s. The Project also operated at 3.5 m/s for the entire 2022 spring monitoring period. The mean bat mortality estimate ranged from 28.2 bats in 2022 to 52.64 bats in 2014 (Table 6).

Table 6. Bat mortality estimates by year for the spring monitoring period (April 1 – May 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois (ARCADIS 2013, 2014, Stantec Consulting Services 2017b).

	Year[1] and Cut-in Speed		
	2013 (3.5 m/s)	**2014** (3.5 m/s)	**2022** (3.5 m/s)
(m) Estimated bats/turbine	0.40	0.56	0.3
Estimated bats/MW	0.25	0.35	0.2
Estimated bats/facility	37.60[2]	52.64[2]	28.2
Estimated Indiana bats	0.03	0.05	<0.1

	Year[1] and Cut-in Speed		
	2013 (3.5 m/s)	**2014** (3.5 m/s)	**2022** (3.5 m/s)
Estimated northern long-eared bats	Not reported	0.02	<0.1

[1]Post-construction monitoring in the spring was not required or conducted from 2015-2021.

[2]The estimated bats/facility was adjusted for 2013 and 2014 compared to published reports because the published reports only multiplied the bats/turbine rate by the number of turbines sampled (50) rather than the facility size of 94 turbines

4.1.2 Fall Monitoring Period

The comparisons shown in Table 7 are only for the time period from August 15 to October 15 (the federal ITP fall monitoring period). For the first three years of Project operations the turbines operated under the terms of a TAL, with a cut-in speed of 6.9 m/s. In 2015, the Project operated under the terms of the TAL for the majority of the season, until October 9, when the state ITA was issued, and the Project began operations under the federal ITP at 5.0 m/s. The Project operated at 5.0 m/s for the entire 2016, 2017, and 2022 fall monitoring periods. The mean bat mortality estimate ranged from 71.4 to 256.6 bats during the fall period when operating at 6.9 m/s, compared to 244.4 to 742.6 bats when the Project was operating at a cut-in speed of 5.0 m/s (Table 7).

Table 7. Bat mortality estimates by year for the fall federal ITP monitoring period (August 15 – October 15) at the Pioneer Trail Wind Farm, Ford and Iroquois counties, Illinois (ARCADIS 2013, 2014, Stantec Consulting Services 2015, 2017a, 2017b).

	Year[1] and Cut-in Speed					
	2012 (6.9 m/s)	**2013** (6.9 m/s)	**2015** (6.9 m/s until October 9, then 5.0 m/s)	**2016** (5.0 m/s)	**2017** (5.0 m/s)	**2022** (5.0 m/s)
(m) Estimated bats/turbine	0.76	2.73	1.1	2.6	7.9	3.5
Estimated bats/MW	0.48	1.71	0.7	1.6	4.9	2.2
Estimated bats/facility	71.4[2]	256.6[2]	103.4	244.4	742.6	329.0
Estimated Indiana bats	n/a[3]	n/a[3]	0.17	0.4	1.2	0.5

	Year[1] and Cut-in Speed					
	2012 (6.9 m/s)	**2013** (6.9 m/s)	**2015** (6.9 m/s until October 9, then 5.0 m/s)	**2016** (5.0 m/s)	**2017** (5.0 m/s)	**2022** (5.0 m/s)
Estimated northern long-eared bats	n/a[3]	n/a[3]	0.08	0.2	0.6	0.3

[1]Post-construction monitoring was not required or conducted in 2014, 2018, 2019, 2020, or 2021.

[2]The estimated bats/facility was adjusted for 2012 and 2013 compared to published reports because the published reports only multiplied the bats/turbine rate by the number of turbines sampled (50) rather than the facility size of 94 turbines

[3]Project was operating at avoidance, assume no Indiana bats or northern long-eared bats were taken.

4.2 SUMMARY

- A total of 848 carcass searches were conducted over 7 weeks from April 1 to May 16 and 10 weeks from August 15 to October 18.
- A total of 17 bat carcasses were found during standardized searches. Of these 17 carcasses, 2 were found during the spring monitoring period (April 1 – May 16) and 15 were found during the fall monitoring period (August 15 – October 18).
- No bat species listed as threatened or endangered under the ESA or by the State of Illinois was found during the study. One bird species, listed as threatened by the State of Illinois, a black-billed cuckoo, was found during the study. A state ITA is being pursued for this species.
- Bat species found during standardized searches included silver-haired bats (9), eastern red bats (5), and hoary bats (3). No bats were found incidentally.
- Estimated bat mortality between April 1 and May 16 was 28.2 bats (90% CI: 0 to 84.6), compared to an estimated bat mortality between August 15 and October 18 of 329.0 bats (90% CI: 159.8 to 564.0). Turbines were feathered below manufacturer's rated cut-in speeds for the period from April 1 to May 15, and at a cut-in speed of 5.0 m/s from August 15 to October 15.
- No Indiana bat carcasses were found during the 2022 study. Estimated mortality of the federally and state endangered Indiana bat was <0.1 Indiana bat during the spring monitoring period and 0.5 Indiana bat during the fall monitoring period.
- No northern long-eared bat carcasses were found during the 2022 study. Estimated mortality of the federally and state threatened northern long-eared bat was <0.1 northern long-eared bat during the spring monitoring period and 0.3 northern long-eared bat during the fall monitoring period.

- No Indiana or northern long-eared bat carcasses have been found at the Project since it commenced operations in 2012.

4.3 CONCLUSIONS

Estimated Indiana bat and northern long-eared bat fatalities were below the annual take limits set forth in both the federal ITP and state ITA. Because estimated Indiana bat mortality was less than two and estimated northern long-eared bat mortality was less than one in each of the last three years of monitoring (2016, 2017, and 2022), the federal ITP and state ITA provide PTWF the option to lower cut-in speeds by 1.1 mph (0.5 m/s) in future years. A reduction in cut-in speeds would be accompanied by two additional years of baseline monitoring. PTWF will provide prior written notice to the USFWS and IDNR if it elects to implement this adaptive management change.

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Appendix A Raw Data

2022 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
PIONEER TRAIL WIND FARM
FORD AND IROQUOIS COUNTIES, ILLINOIS

Date	Turbine	Search Type (Full, R/P, Incidental)	On Road/Pad? (Y or N)	Carcass Type	Latitude	Longitude	Distance	Azimuth	Common Name	Species	Forearm Length (mm)	Age	Sex	Cause of Death	Condition	Incidental	Comments
4/7/2022	C12	Full	N	Bird	40.49926	-88.0285	42	30	Killdeer	*Charadrius vociferus*	NA	A	U	T	S	no	
5/9/2022	C7	Full	N	Bird	40.48964	-88.0193	42	230	Black-billed Cuckoo	*Coccyzus erythropthalmus*	NA	A	U	T	D	no	Missing lower half of body. One wing and head l
5/9/2022	F1	R/P	Y	Bat	40.45402	-88.0197	51	345	Eastern Red Bat	*Lasiurus borealis*	40	A	M	T	I	no	
5/16/2022	F9	Full	N	Bat	40.45445	-87.9825	30	310	Silver-haired Bat	*Lasionycteris noctivagans*	41	A	F	T	S	no	
8/15/2022	B14	R/P	Y	Bat	40.49634	-88.0493	5	350	Eastern Red Bat	*Lasiurus borealis*	39	U	U	T	S	no	
8/15/2022	E14	Full	N	Bat	40.42688	-87.948	29	300	Hoary Bat	*Lasiurus cinereus*	56	A	F	T	I	no	
8/15/2022	E14	Full	N	Bat	40.42685	-87.9479	19	300	Hoary Bat	*Lasiurus cinereus*	52	U	U	T	S	no	
8/15/2022	B1	Full	N	Bat	40.45708	-88.0339	0	45	Eastern Red Bat	*Lasiurus borealis*	40	U	U	T	S	no	
8/15/2022	B3	R/P	Y	Bird	40.45253	-88.0447	2	150	Eastern Kingbird	*Tyrannus tyrannus*	NA	A	U	T	I	no	
8/22/2022	F9	Full	N	Bat	40.45397	-87.9825	34	200	Eastern Red Bat	*Lasiurus borealis*	41	A	U	T	S	no	
8/29/2022	F9	Full	N	Bat	40.45429	-87.9822	17	50	Eastern Red Bat	*Lasiurus borealis*	39	A	M	T	S	no	
9/6/2022	C13	Full	N	Bat	40.49798	-88.0338	13	320	Silver-haired Bat	*Lasionycteris noctivagans*	41	A	M	T	I	no	
9/6/2022	C12	Full	N	Bat	40.49875	-88.0288	20	190	Silver-haired Bat	*Lasionycteris noctivagans*	39	A	F	T	S	no	
9/6/2022	F6	R/P	Y	Bat	40.45303	-87.9999	5	100	Silver-haired Bat	*Lasionycteris noctivagans*	38	A	M	T	I	no	
9/13/2022	A2	R/P	Y	Bat	40.46518	-88.0459	5	135	Silver-haired Bat	*Lasionycteris noctivagans*	41	A	M	T	I	no	
9/13/2022	F9	Full	N	Bat	40.4546	-87.9821	43	25	Silver-haired Bat	*Lasionycteris noctivagans*	41	A	F	T	S	no	
9/13/2022	F4	R/P	Y	Bat	40.45586	-88.0095	24	10	Silver-haired Bat	*Lasionycteris noctivagans*	41	A	M	T	S	no	
9/13/2022	B6	Full	N	Bird	40.449	-88.0374	37	80	American Robin	*Turdus migratorius*	NA	J	U	T	S	no	
10/5/2022	E15	Full	Y	Bat	40.42508	-87.9549	0	0	Silver-haired Bat	*Lasionycteris noctivagans*	40	U	U	T	I	no	Found on steps of the turbine
10/18/2022	C13	Full	N	Bat	40.49781	-88.0334	24	110	Silver-haired Bat	*Lasionycteris noctivagans*	38	A	F	T	I	no	