

**2019 Post-Construction Bat
Mortality Monitoring Report
Wildcat Wind Farm**

**Madison and Tipton Counties,
Indiana**

Project #193707045



Prepared for:
Wildcat Wind Farm, LLC
c/o E. ON Climate and Renewables
353 N. Clark, 30th Floor
Chicago, Illinois 60654

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

January 30, 2020

CERTIFICATION

Under penalty of law, I certify that, to the best of my knowledge, after appropriate inquiries of all relevant persons involved in the preparation of this report, the information submitted is true, accurate and complete in all material respects.

Signature: _____

Name: Paul Bowman

Title: Senior Vice President

Table of Contents

1.0	INTRODUCTION	1
1.1	PROJECT DESCRIPTION AND HISTORY	1
1.2	PURPOSE AND OBJECTIVES OF THE STUDY	1
2.0	METHODS.....	3
2.1	MORTALITY STUDY	3
2.1.1	Sample Size	3
2.1.2	Survey Plot Size	3
2.1.3	Survey Schedule	3
2.1.4	Carcass Surveys.....	4
2.1.5	Species Identification	4
2.2	SEARCHER EFFICIENCY TRIALS	5
2.3	CARCASS REMOVAL TRIALS	5
2.4	STATISTICAL METHODS FOR MORTALITY ESTIMATES	5
2.4.1	Mean Observed Number of Casualties (c)	6
2.4.2	Estimation of Searcher Efficiency (p)	6
2.4.3	Estimation of Carcass Removal (t)	6
2.4.4	Estimation of the Probability of Carcass Availability and Detection (π)	7
2.4.5	Area Adjustment (A)	7
2.4.6	Estimation of Facility-Related Mortality (m)	8
2.5	TAKE ESTIMATION FOR COVERED SPECIES	8
3.0	RESULTS	9
3.1	SUMMARY OF SURVEYS	9
3.1.1	Species Composition	9
3.1.2	Age and Sex	10
3.1.3	Temporal Patterns	11
3.1.4	Spatial Patterns.....	12
3.2	SEARCHER EFFICIENCY TRIALS	12
3.3	CARCASS REMOVAL TRIALS	12
3.4	PROBABILITY OF CARCASS AVAILABILITY AND DETECTION	13
3.5	ADJUSTED MORTALITY ESTIMATES.....	13
3.6	INCIDENTAL FINDS	14
3.6.1	Bats	14
3.6.2	Birds.....	15
3.7	ESTIMATED TAKE OF INDIANA BATS AND NORTHERN LONG-EARED BATS	15
4.0	SUMMARY AND CONCLUSIONS	16
4.1	SUMMARY	16
4.2	COMPARISON TO PREVIOUS STUDIES	17
4.3	CONCLUSIONS	18

5.0 LITERATURE CITED 19

LIST OF TABLES

Table 1. Summary and average of previous area adjustments during post-construction surveys, Wildcat Wind Farm, Tipton and Madison counties, Indiana.....7

Table 2. Summary of standardized surveys during the 2019 post-construction monitoring study at the Wildcat Wind Farm, Tipton and Madison counties, Indiana.9

Table 3. Summary of all bat carcasses found incidentally and during standardized carcass surveys during the 2019 post-construction monitoring study at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. 10

Table 4. Sex and age of bat carcasses found during standardized surveys for the 2019 post-construction monitoring study at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. Ages include adults (A), juveniles (J), and unknown (U). 10

Table 5. Searcher efficiency for the 2019 post-construction monitoring study at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. 12

Table 6. Carcass removal during the 2019 post-construction monitoring study (1 August to 14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. 13

Table 7. Carcass availability and detection for the 2019 post-construction monitoring study (1 August to 14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. 13

Table 8. Bat mortality estimates for the 2019 post-construction monitoring study (1 August to 14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. The Project was operating at a cut-in speed of 5.0 m/s during this period..... 14

Table 9. Sex and age of incidental bat carcasses found during 2019 post construction monitoring study (1 August to 14 October) at Wildcat Wind Farm, Tipton and Madison counties, Indiana. Ages include adults (A), juveniles (J), and unknown (U). 14

Table 10. Summary of bird carcasses found during the 2019 post-construction monitoring study (1 August – 14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. 15

Table 11. Summary of Evidence of Absence inputs based on fall monitoring (1 August – 15 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana from 2016 through 2019..... 16

Table 12. Bat mortality estimates by year for the fall migratory period (1 August–14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. 18

LIST OF FIGURES

Figure 1. Turbine and Survey Locations2

Figure 2. Bat carcasses found by week during the 2019 post-construction standardized surveys (1 Aug through 14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. 11

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
WILDCAT WIND FARM
TIPTON AND MADISON COUNTIES, INDIANA

LIST OF APPENDICES

APPENDIX A SAMPLE DATA SHEETS

APPENDIX B REPRESENTATIVE CARCASS PHOTOS

1.0 Introduction

1.1 PROJECT DESCRIPTION AND HISTORY

The Wildcat Wind Farm (Project or Wildcat), developed by Wildcat Wind Farm I, LLC (WWF), is located in Madison and Tipton counties, north of the town of Elwood, Indiana. The Project consists of 125 GE 1.6-megawatt (MW) wind turbine generators and associated access roads and collector line system for a total capacity of 200 MW (Figure 1). The Project is located on lands leased from private landowners who continue their pre-wind farm use of the land. Land use in the area is predominantly agricultural.

Wildcat is located within the range of both the federally endangered Indiana bat (*Myotis sodalis*) and federally threatened northern long-eared bat (*Myotis septentrionalis*). On 19 August 2016, the Project obtained an Incidental Take Permit (ITP) from the United States Fish and Wildlife Service (USFWS), allowing operations under the terms of the Project's Habitat Conservation Plan (HCP), which covers the Indiana bat and northern long-eared bat (covered species), requires curtailing of turbines to 5.0 meters/second (m/s) during the fall migration period (1 August–15 October), and outlines the requirements for post-construction monitoring to ensure permit compliance. The ITP authorizes the take of 162 Indiana bats and 81 northern long-eared bats over the 27 years of project operations, or an average of 6 Indiana bats and 3 northern long-eared bats per year. This is the seventh year of monitoring at the Project, and the results of previous monitoring are outlined in Section 4.2. Previous monitoring under the HCP and ITP included three years of baseline monitoring (2016-2018), and 2019 is the first year of implementation monitoring.

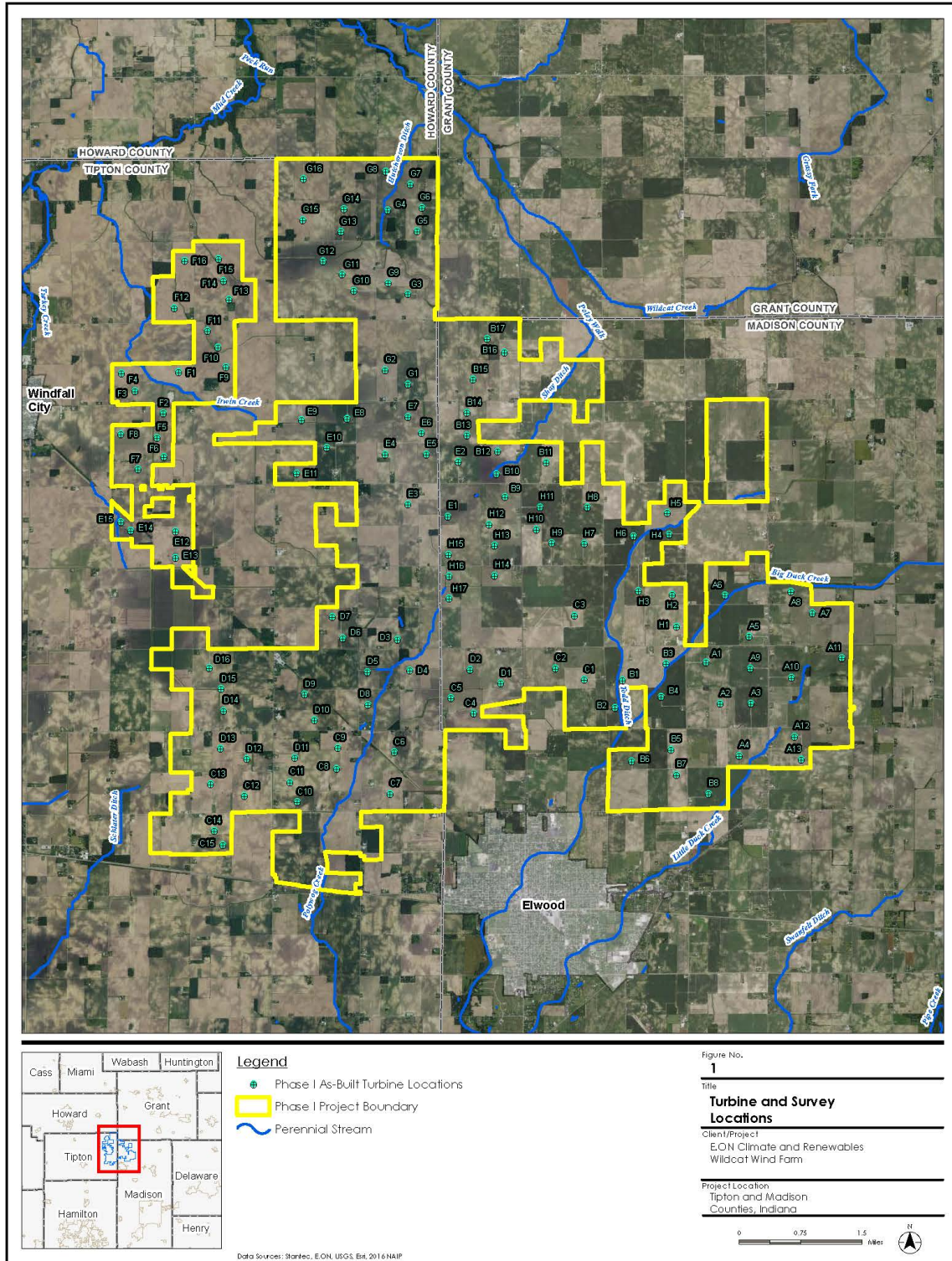
1.2 PURPOSE AND OBJECTIVES OF THE STUDY

Post-construction mortality monitoring was conducted as part of the implementation monitoring process under the HCP post-construction monitoring plan to:

1. Provide a means of monitoring and ensuring the Project's compliance with the take limits authorized in the ITP
2. Assess the effectiveness of the HCP in meeting the biological objective of minimizing direct mortality of Indiana and northern long-eared bats

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
 WILDCAT WIND FARM
 TIPTON AND MADISON COUNTIES, INDIANA

Figure 1. Turbine and Survey Locations



2.0 Methods

The post-construction monitoring included the following components:

1. Standardized carcass surveys to systematically search turbines for bat casualties attributable to the turbines
2. Searcher efficiency trial to estimate the percentage of bat casualties that were found by the searcher
3. Carcass removal trial to estimate the persistence time of carcasses on-site before scavengers removed them

2.1 MORTALITY STUDY

Carcass surveys were conducted from 1 August through 14 October during the 2019 year of project operation. The Project was operating at a 5.0 m/s cut-in speed, per the HCP.

2.1.1 Sample Size

Post-construction monitoring was conducted at 100% of the turbines. This study design provides full coverage of the facility and will serve as a control to which subsequent monitoring results can be compared.

2.1.2 Survey Plot Size

Surveys consisted of searching roads and pads out to 262 feet (ft; 80 meters [m]) at 100% of the turbines (n=125).

Previous post-construction studies have indicated that the majority of bat carcasses typically fall within 100 ft (30 m) of the turbine or within 50% of the maximum height of the turbine (Kerns and Kerlinger 2004, Arnett et al. 2005, Young et al. 2009, Jain et al. 2007, Piorkowski and O'Connell 2010, USFWS 2012). The plot size used for this study exceeds one-half the maximum turbine rotor height of the project turbines (246 ft [75 m]).

2.1.3 Survey Schedule

All turbines were searched weekly. 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 different periods throughout the day. A weekly search interval for fatality monitoring was deemed adequate by Kunz et al. (2007), and other studies have demonstrated that a weekly search interval provides effective mortality monitoring and adequately estimates impacts from wind energy facilities (Gruver et al. 2009, Young et al. 2009), such that the added effort associated with more frequent intervals is not warranted.

2.1.4 Carcass Surveys

Carcass surveys were conducted by searchers experienced and/or 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 in the project area. Any unknown bats discovered were positively identified by a permitted bat biologist either through photos or visual observation in person, and carcasses were kept on-site. During surveys, searchers walked at a rate of approximately 2 miles per hour (mph; 45 to 60 m per minute) while searching 10 ft (3 m) on either side.

For each carcass found, the following data were recorded (a sample data form is included in Appendix A):

- Date and time
- Initial species identification
- Sex, age, and reproductive condition (when possible)
- Global positioning system (GPS) location
- Distance and bearing to turbine
- Substrate/ground cover conditions
- Condition (intact, scavenged, decomposed)
- Any notes on presumed cause of death

A digital photograph of each carcass found was taken before the carcass was handled and removed. Representative digital photographs are included in Appendix B. All carcasses were labeled with a unique number, bagged, and stored in a freezer (with a copy of the original data sheet) at the Project Operations and Maintenance Building. Bat carcasses were collected and retained under Indiana Department of Natural Resources Special Purpose Salvage Permit No. 18-032.

Bat carcasses found in non-search areas and any bird carcasses found were coded as incidental finds and documented in a similar fashion to those found in standardized surveys when possible. This included carcasses found during non-search times and decomposed carcasses found during the first week of searches that were deemed to have been killed prior to the post-construction monitoring period based on the level of decomposition. Maintenance personnel were informed of the standardized surveys and were trained in collision event reporting protocol in the case of an incidental find. Bird carcasses were photographed and documented, but they were not collected and were left as found. Incidental bat carcasses were collected and stored in the freezer with the carcasses found during standardized surveys. Incidental finds were not included in the mortality estimates.

2.1.5 Species Identification

Preliminary bird and bat species identifications were made in the field by qualified staff. When carcass condition allowed, sex, age, and reproductive condition of the carcass were recorded. For bat carcasses, forearm length was recorded to facilitate species identification. Any unknown

bat was identified by a permitted 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

A searcher efficiency trial was used to estimate the probability of bat carcass detection by the searcher. The searcher 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. These were placed in the morning prior to the planned carcass surveys for that day. The number of trial carcasses found by the searcher during the mortality surveys 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. A sample data form is included in Appendix A.

2.3 CARCASS REMOVAL TRIALS

A carcass removal trial was conducted to estimate the average length of time carcasses remained in the search plots (i.e., were available to find) before being removed by scavengers. The carcass removal trial was conducted following the searcher efficiency trials during post-construction monitoring. Mouse carcasses used during the searcher efficiency trials were left in place, and their locations were discretely marked. Searchers monitored the trial carcasses over a period of up to 30 days. During the carcass removal trial, carcasses were checked every day for the first week, and then on days 10, 14, 20, and 30.

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

A sample data form is included in Appendix A. Any carcasses remaining at the end of the 30-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, the method used to calculate the mortality estimates largely follows 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 surveyed areas or at times other than during mortality surveys) were not included in this calculation or in the estimated fatality rate.

2.4.2 Estimation of Searcher Efficiency (p)

Searcher efficiency (p) represents the average probability that a carcass was detected by the surveyor. The searcher efficiency rate was calculated by dividing the number of trial carcasses the observer found by the total number which remained available during the trial (non-scavenged).

2.4.3 Estimation of Carcass Removal (t)

Carcass removal rates 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 30. This estimator is the maximum likelihood (conservative) estimator assuming the removal times follow an exponential distribution and that there is right-censoring of the data. Any trial carcasses remaining after 30 days were collected, yielding censored observations at 30 days.

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 survey 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.

2.4.5 Area Adjustment (A)

Since only roads and pads were searched during 2019, the average area adjustment from the previous three years of post-construction monitoring was used to calculate mortality estimates for 2019 (Table 1).

Table 1. Summary and average of previous area adjustments during post-construction surveys, Wildcat Wind Farm, Tipton and Madison counties, Indiana.

Year	# carcasses found on full plots	π_{FP}	# carcasses found on road and pad plots	π_{RP}	Area Adjustment for Roads and Pads
2016	72	0.69	19	0.76	5.45
2017	40	0.46	21	0.66	3.57
2018	57	0.74	27	0.81	3.02
Average	n/a	n/a	n/a	n/a	4.01

Approximation of A, the adjustment for areas which were not surveyed, was calculated using data from 2016, 2017, and 2018 (when turbines were operating at 5.0 m/s) 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_{RP} was calculated to represent the adjustment for the proportion of carcasses which likely fell outside of the area searched at roads and pads turbines. The value for A_{RP} was approximated using the following equation:

$$A_{RP} = \frac{C_{FP}}{\pi_{FP}} \bigg/ \frac{C_{RFP}}{\pi_{RP}} * A_{FP}$$

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
WILDCAT WIND FARM
TIPTON AND MADISON COUNTIES, INDIANA

where π_{FP} is the π value calculated for full plot searches. C_{FP} is the number of observed casualties on full plots, π_{RP} is the π value calculated for roads and pads searches, and C_{RPP} is the number of observed casualties on roads and pads of the full plot turbines. A_{RP} was calculated separately for each year, and then averaged for a value to use for 2019.

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-foot x 262-foot (80-m x 80-m) square plots.

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 surveyor, and then multiplying by A , the adjustment for the area within which bats may have fallen but which was not surveyed.

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

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.

2.5 TAKE ESTIMATION FOR COVERED SPECIES

The Evidence of Absence (EOA) software developed by Dalthorp et al. (2014, 2017) was used to estimate the probability of detection (g). This value represents the probability of detecting a carcass of either covered species that occurs at the site based on the post-construction monitoring effort performed that season.

The estimate of the overall probability of detection (g) is a function of several factors, including carcass persistence, searcher efficiency, area adjustment, search interval, and other factors (Dalthorp et al. 2014, 2017). These bias correction factors were calculated utilizing the methods described in Section 2.4 and input into the EOA model to calculate a probability of detection (g). The HCP set a goal of having a detection probability (g) between 0.25 and 0.30 during implementation monitoring.

Then, utilizing the EOA "Multi-Year Total" tool, the probability of detection (g) and the number of covered carcasses found (X) are input to determine, with a certain degree of confidence, that the number of fatalities of a covered species did not exceed the cumulative total authorized take and to estimate the annual take rate.

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
 WILDCAT WIND FARM
 TIPTON AND MADISON COUNTIES, INDIANA

These estimates (cumulative total take and average annual take rate) are then used to determine whether either of the following two adaptive management triggers outlined in the Project's HCP have been triggered:

1. Short-term trigger – is actual average annual take rate larger than expected? This trigger would be an annual take rate of 6 Indiana bats or 3 northern long-eared bats or more, and it is calculated using a significance level of $\alpha=0.01$.
2. Long-term trigger – does total cumulative take exceed the long-term authorized amount? This trigger would be an estimated cumulative mortality of 162 Indiana bats or 81 northern long-eared bats or more, and it is calculated using a significance level of $\alpha=0.50$.

3.0 Results

3.1 SUMMARY OF SURVEYS

A total of 1,251 carcass searches were conducted over 12 weeks in the fall (1 Aug – 14 October) (Table 2). Due to weather conditions and maintenance at turbines, the average time between surveys was 7.5 days during the post-construction monitoring period (Table 2).

Table 2. Summary of standardized surveys during the 2019 post-construction monitoring study at the Wildcat Wind Farm, Tipton and Madison counties, Indiana.

Season	Date Range	Length (Weeks)	Road and Pad Turbines	Total number of searches conducted	Search Interval	Bat Carcasses Found ¹
Fall	1 Aug–14 October	12	125	1,251	7.5	33

¹This includes all carcasses found during standardized searches (within roads and pads on a scheduled search day), with the exception of decomposed carcasses found during the first week of searches, which were determined to have been killed prior to August 1, and are thus considered incidental.

A total of 33 individual bat carcasses were found during standardized carcass searches. An additional six individual bat carcasses were found incidentally (see Section 3.6.1).

3.1.1 Species Composition

A summary of all bat carcasses found incidentally and during the standardized carcass surveys during post-construction monitoring is shown in Table 3. Of the 39 bat carcasses found at the site, the eastern red bat (*Lasiurus borealis*) was the most common species detected (n=18; 46.2% of all bat carcasses found). Silver-haired bat (*Lasionycteris noctivagans*) was the next most common species (n=12; 30.8%), followed by hoary bat (*Lasiurus cinereus*; n=7; 17.9%), big brown bat (*Eptesicus fuscus*; n=1; 2.6%), and one unknown *Lasiurus* spp. (n=1; 2.6%). All bat carcasses were

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
 WILDCAT WIND FARM
 TIPTON AND MADISON COUNTIES, INDIANA

identified to the species level when possible. Two bat species and an unknown *Lasiurus* spp. were found incidentally during the 2019 post-construction monitoring. No bat species federally listed as threatened or endangered under the Endangered Species Act of 1973 (ESA), as amended, were found. The silver-haired bat, eastern red bat, and hoary bat are all listed as special concern species in the state of Indiana, but none of these species receive any legal protection under the Indiana Nongame and Endangered Species Conservation Act.

Table 3. Summary of all bat carcasses found incidentally and during standardized carcass surveys during the 2019 post-construction monitoring study at the Wildcat Wind Farm, Tipton and Madison counties, Indiana.

Species	Number Found (percent of total)
Eastern Red Bat	18 (46.2%)
Silver-haired Bat	12 (30.8%)
Hoary Bat	7 (17.9%)
Big Brown Bat	1 (2.6%)
Unknown (<i>Lasiurus</i> spp.)	1 (2.6%)
Total	39

3.1.2 Age and Sex

A summary of the age and sex of all bat carcasses found during the standardized post-construction monitoring is shown in Table 4. Of the 33 bat carcasses found during the standardized searches, 10 were adult females (30.3%), 1 was a juvenile female (3.0%), 2 were females of unknown age (6.1%), 4 were adult males (12.1%), 1 was a juvenile male (3.0%), 1 was an adult of unknown sex (3.0%), 1 was a juvenile of unknown sex (3.0%), and 13 bats were of unknown age and unknown sex (39.4%; Table 4).

Table 4. Sex and age of bat carcasses found during standardized surveys for the 2019 post-construction monitoring study at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. Ages include adults (A), juveniles (J), and unknown (U).

Species	Female			Male			Unknown		
	A	J	U	A	J	U	A	J	U
Eastern Red Bat	6	1	2	0	0	0	0	1	6

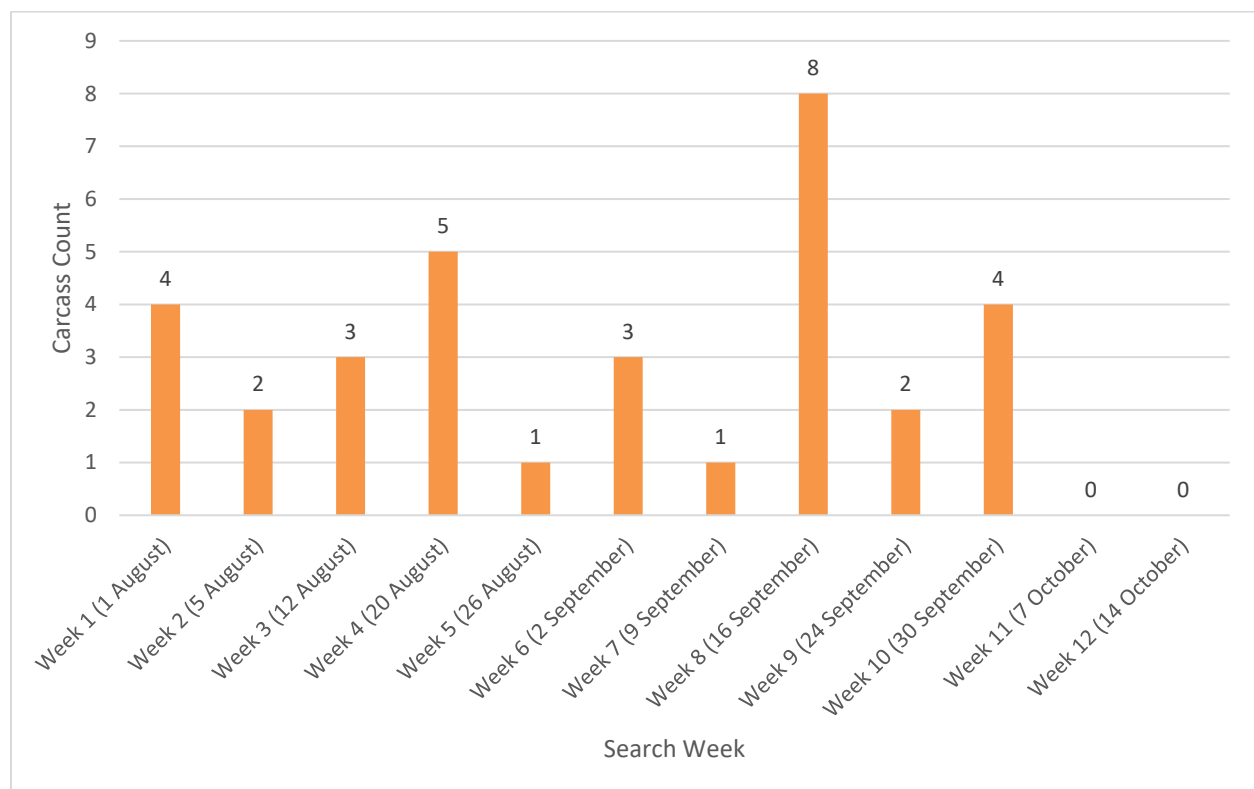
2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
 WILDCAT WIND FARM
 TIPTON AND MADISON COUNTIES, INDIANA

Species	Female			Male			Unknown		
	A	J	U	A	J	U	A	J	U
Silver-haired Bat	4	0	0	4	0	0	0	0	4
Hoary Bat	0	0	0	0	0	0	1	0	3
Big Brown Bat	0	0	0	0	1	0	0	0	0
Total	10	1	2	4	1	0	1	1	13

3.1.3 Temporal Patterns

During the post-construction monitoring period, bats were found during every week of searches except weeks 11 and 12 (Figure 2). The greatest number of bats found during a single week occurred the week of 16 September (week 8; n=8; 24.2%), followed by week 4 (20 August; n=5; 15.2%). The fewest number of bats found during a single week occurred during weeks 11 and 12 (7 October and 14 October, respectively) when no bats were found.

Figure 2. Bat carcasses found by week during the 2019 post-construction standardized surveys (1 Aug through 14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana.



3.1.4 Spatial Patterns

During the standardized searches, bats were found at 29 of the 125 turbines (23.2%).

The number of carcasses found per turbine for the season varied from zero to two, with the following breakdown:

- 2 carcasses – 4 turbines
- 1 carcass – 25 turbines
- 0 carcasses – 96 turbines

Carcasses were found at turbines located throughout the project area.

3.2 SEARCHER EFFICIENCY TRIALS

One searcher efficiency trial was conducted during the post-construction monitoring for one searcher.

A total of 23 mouse carcasses were placed for the searcher efficiency trial during the post-construction monitoring period. Scavengers removed 2 of the trial carcasses prior to the searcher efficiency trial.

Searcher efficiency was 100% on the roads and pads (Table 5).

Table 5. Searcher efficiency for the 2019 post-construction monitoring study at the Wildcat Wind Farm, Tipton and Madison counties, Indiana.

Parameter	Value
Number of Carcasses Placed	23
Number of Carcasses Scavenged Prior	2
Number of Carcasses Available	21
Number of Carcasses Found	21
(p) Searcher Efficiency Mean (90% CI)	1 (1, 1)

3.3 CARCASS REMOVAL TRIALS

Mouse carcasses used in the searcher efficiency trials were left for up to 30 days and checked each day for the first week and then on days 10, 14, 20, and 30 of the trial. Twenty-five

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
 WILDCAT WIND FARM
 TIPTON AND MADISON COUNTIES, INDIANA

mouse carcasses were used during the post-construction monitoring period (the 23 placed as part of the searcher efficiency trials, plus two additional carcasses). Carcasses persisted for an average of 11.0 days (Table 6).

Table 6. Carcass removal during the 2019 post-construction monitoring study (1 August to 14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana.

Parameter	Value
Number of Carcasses Placed	25
Number of Carcasses Scavenged within 30 days	21
Mean Carcass Persistence time in days (90% CI)	11.0 (6.7, 18.0)

3.4 PROBABILITY OF CARCASS AVAILABILITY AND DETECTION

The probability of carcass availability and detection was estimated to be 70% (Table 7).

Table 7. Carcass availability and detection for the 2019 post-construction monitoring study (1 August to 14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana.

Parameter	Estimate (90% CI)
(p) Mean Searcher Efficiency	1 (1, 1)
(t) Mean Carcass Persistence time in days	11.0 (6.7, 18.0)
(π) Probability of carcass availability and detection	0.7 (0.6, 0.8)

3.5 ADJUSTED MORTALITY ESTIMATES

Mortality rate estimates were calculated based upon the carcasses found during the mortality surveys and did not include any incidental finds. 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 the following sections by season.

The estimated bat mortality was 1.46 bats/turbine, or 183 bats over the entire facility (Table 8).

Table 8. Bat mortality estimates for the 2019 post-construction monitoring study (1 August to 14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana. The Project was operating at a cut-in speed of 5.0 m/s during this period.

Parameter	Estimate
(c) Observed bats/turbine	0.26
(A) Area Adjustment	4.01
(m) Estimated bats/turbine (90% CI)	1.46 (1.03, 1.99)
Estimated bats/MW (90% CI)	0.91 (0.64, 1.24)
Estimated bats/facility (90% CI)	183 (129, 249)

3.6 INCIDENTAL FINDS

3.6.1 Bats

Six incidental bats were discovered during the 2019 standardized post-construction monitoring period, all during the first week of searches (and considered incidental due to the level of decomposition, indicating that they were killed prior to the start of the search season on August 1). Species found include, eastern red bat (n=2), hoary bat (n=3), and an unknown *Lasiurus* spp (n=1). Bats found during this week were considered incidental, if the condition of the carcass was decomposed, indicating that they had been killed prior to the start of curtailment on August 1. Fresh carcasses were included in the mortality estimate, and are described in Section 3.1. The incidental bats are summarized in Table 3, and the sex and age of incidental bat carcasses is summarized in Table 9.

Table 9. Sex and age of incidental bat carcasses found during 2019 post construction monitoring study (1 August to 14 October) at Wildcat Wind Farm, Tipton and Madison counties, Indiana. Ages include adults (A), juveniles (J), and unknown (U).

Species	Female			Male			Unknown		
	A	J	U	A	J	U	A	J	U
Eastern Red Bat	0	0	0	0	0	0	0	0	2
Hoary Bat	0	0	0	0	0	0	0	0	3
Unknown (<i>Lasiurus</i> spp.)	0	0	0	0	0	0	0	0	1
Total	0	0	0	0	0	0	0	0	6

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
 WILDCAT WIND FARM
 TIPTON AND MADISON COUNTIES, INDIANA

3.6.2 Birds

A total of six bird carcasses representing five species were found at six different turbines during the 2019 post-construction studies (Table 10).

Table 10. Summary of bird carcasses found during the 2019 post-construction monitoring study (1 August – 14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana.

Date	Species	Turbine
1 August	Dickcissel (<i>Spiza americana</i>)	G7
20 August	Horned lark (<i>Eremophila alpestris</i>)	B17
23 September	American robin (<i>Turdus migratorius</i>)	D4
23 September	Mourning Dove (<i>Zenaida macroura</i>)	C12
24 September	Horned lark	B15
24 September	Ruby-throated hummingbird (<i>Archilochus colubris</i>)	H17

The bird finds included two horned lark (*Eremophila alpestris*; n=2, 33.3%), one dickcissel (*Spiza americana*; 16.7%), one American robin (*Turdus migratorius*; 16.7%), one mourning dove (*Zenaida macroura*), and one ruby-throated hummingbird (*Archilochus colubris*; 16.7%) (Table 10).

3.7 ESTIMATED TAKE OF INDIANA BATS AND NORTHERN LONG-EARED BATS

There were no Indiana bats or northern long-eared bats found during the 2019 post-construction monitoring surveys. The following inputs were used to calculate the probability of detection (g) for the 2019 post-construction monitoring using the EOA software:

- Searcher efficiency: 1.0
- Coverage (a): 0.25 (1 divided by 4.01)
- Search interval: 7.5
- Factor by which searcher efficiency changes with each search (k): 0.8 (EOA default)
- Persistence Distribution: exponential with a mean persistence of 11.24 days (95 % CI: 7 to 18)

This resulted in a probability of detection (g) of 0.179 (95% CI: 0.153 to 0.206). The “Multi-Year Module” tool was then used, with the corresponding inputs from the initial three years of monitoring under the ITP (Table 11).

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
 WILDCAT WIND FARM
 TIPTON AND MADISON COUNTIES, INDIANA

Table 11. Summary of Evidence of Absence inputs based on fall monitoring (1 August – 15 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana from 2016 through 2019.

Year	Number of Indiana bats found	Number of northern long-eared bats found	Detection Probability (g)
2016	0	0	0.267 ($B_a = 139.4113$, $B_b = 383.4858$)
2017	0	0	0.206 ($B_a = 21.865$, $B_b = 84.2986$)
2018	0	0	0.293 ($B_a = 151.0874$, $B_b = 363.702$)
2019	0	0	0.179 ($B_a = 133.47$, $B_b = 610.949$)

Which resulted in an estimated cumulative total take of 0 Indiana bats and 0 northern long-eared bats and an estimated annual take rate of 0.531 for both species (95% CI: 0.000525, 2.67). Since neither the Indiana bat nor northern long-eared bat have been found at the Project, the estimates are the same for both species. Thus, neither the short-term nor long-term triggers for adaptive management have been met.

4.0 Summary and Conclusions

4.1 SUMMARY

- A total of 1,251 standardized carcass surveys were conducted over 12 weeks from 1 August to 14 October 2019.
- A total of 33 bat carcasses were found during standardized carcass searches, with an additional 6 incidental bat carcasses and 6 incidental bird carcasses.
- No bird or bat species listed as federally threatened or endangered under the ESA were found during this study.
- Three Indiana special concern bat species (silver-haired bat, eastern red bat, and hoary

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
WILDCAT WIND FARM
TIPTON AND MADISON COUNTIES, INDIANA

bat) were found during this study.

- No Indiana special concern bird species were found during this study.
- Bat species found during standardized surveys and incidentally included eastern red bat (18), silver-haired bat (12), hoary bat (7), big brown bat (1), and unknown *Lasiurus* spp. (1).

4.2 COMPARISON TO PREVIOUS STUDIES

A Post-Construction Mortality Minimization and Monitoring Proposal (MMMP) was developed in June 2012, revised in June 2015 (Stantec 2015), and is consistent with methods and the recommendations of the USFWS Land-Based Wind Energy Guidelines (USFWS 2012). From 2013 through June 2015, the Project operated under the terms of a Technical Assistance Letter (TAL) dated 18 June 2012, that established an operational scenario under which no take of Indiana bats was expected to occur (i.e., 6.9 m/s cut-in speed during the fall migration period [1 August–15 October]).

From July 2015 to 18 August 2016, the Project operated under the terms of a second TAL secured on 2 July 2015 that established a revised operational scenario under which no take of Indiana bats or northern long-eared bats was expected to occur. This second TAL required curtailment to 6.9 m/s during the fall migration period (1 August–15 October) and 5.0 m/s during the spring migration period (15 March–15 May). On 19 August 2016, the Project obtained an ITP from the USFWS, allowing operations under the terms of the Project's HCP, including curtailment to 3.5 m/s during the spring migration period (1 April–15 May) and curtailment to 5.0 m/s during the fall migration period (1 August–15 October). Due to this, the 2016 data were analyzed separately for the time periods before and after 19 August due to the differing operational protocols that the turbines were operating under.

Post-construction monitoring has been conducted for seven 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 fatality 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 TAL or ITP requirements.

As described above, for the first three years of project operations, the turbines operated under the terms of TALs, with a cut-in speed of 6.9 m/s. The mean bat fatality estimate ranged from 88 to 188 bats during the fall period, compared to 328.8 bats during the 2016 fall season, when the Project was operating at a cut-in speed of 5.0 m/s after 19 August (Table 11). From 2017 through 2019, the Project has operated at 5.0 m/s for the entire fall period, and the mean bat fatality estimate for the facility has ranged from 183 to 284 bats (Table 12).

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
 WILDCAT WIND FARM
 TIPTON AND MADISON COUNTIES, INDIANA

Table 12. Bat mortality estimates by year for the fall migratory period (1 August–14 October) at the Wildcat Wind Farm, Tipton and Madison counties, Indiana.

	Year and Cut-in Speed							
	2013 (6.9 m/s)	2014 (6.9 m/s)	2015 (6.9 m/s)	2016		2017 (5.0 m/s)	2018 (5.0 m/s)	2019 (5.0 m/s)
				(6.9 m/s until 19 August)	(5.0 m/s after 19 August)			
(m) Estimated bats/turbine	0.7	1.0	1.5	0.43	2.2	2.17	2.27	1.46
Estimated bats/MW	0.4	0.6	0.9	0.27	1.38	1.36	1.42	0.91
Estimated bats/facility	88	125	188	53.8	275	271	284	183

4.3 CONCLUSIONS

No Indiana bat or northern long-eared bat fatalities were detected during 2019, and neither the long-term trigger nor the short-term trigger were reached for either species when analyzed using EOA. Thus, no adaptive management actions will be implemented. The bias-correction parameters from the 2019 post-construction monitoring period (e.g., searcher efficiency, carcass persistence, area adjustment, etc.) will be used in the design of protocols for additional implementation monitoring, in accordance with the ITP and HCP, to be conducted in 2020.

5.0 Literature Cited

- Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships Between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality, and Behavioral Interactions with Wind Turbines. Final Report prepared for the Bats and Wind Energy Cooperative. Bat Conservation International, Austin, Texas. June 2005.
- Arnett, E.B., W.K. Brown, W.P. Erickson, J.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J. Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connell, M.D. Piorkowski, and R.D. Tankersley. 2008. Patterns of bat fatalities at wind energy facilities in North America. *Journal of Wildlife Management* 72: 61-78.
- Dalthorp, D., Huso, M., Dail, D, and Kenyon, J. 2014. Evidence of Absence Software User Guide. U.S. Department of the Interior, U.S. Geological Survey. Data Series 881.
- Erickson, W.P., Gritski, B., and K. Kronner. 2003. Nine Canyon Wind Power Project Avian and Bat Monitoring Report, August 2003. Technical report submitted to energy Northwest and the Nine Canyon Technical Advisory Committee.
- Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2007. Annual Report for the Maple Ridge Wind Power Project: Post-Construction Bird and Bat Fatality Study – 2006. Final report. Prepared for PPM Energy and Horizon Energy and Technical Advisory Committee (TAC) for the Maple Ridge Project Study.
- Good, R. E., Erickson, W., Merrill, A., Simon, S., Murray, K., Bay, K., & Fritchman, C. 2011. Bat monitoring studies at the Fowler Ridge Wind Energy Facility, Benton County, Indiana, April 13–October 15, 2010. Prepared for Fowler Ridge Wind Farm, by Western EcoSystems Technology, Inc. Cheyenne, WY, USA.
- Gruver, J., K. Bay, and W. Erickson. 2009. Post-construction bat and bird fatality study, Blue Sky Green Field Wind Resource Area, Fond du Lac County, Wisconsin. Interim Report prepared for We Energies, Milwaukee, Wisconsin.
- Kerns, J., and P. Kerlinger. 2004. A Study of Bird and Bat Collisions at the Mountaineer Wind Energy Center, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. Technical report prepared by Curry and Kerlinger, LLC. February 14, 2004. 39 pp. <http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf>.
- Kunz, T.H., E.B. Arnett, B.M. Cooper, W.P. Erickson, R.P. Larkin, T. Mabee, M.L. Morrison, M.D. Strickland, and J.M. Szewczak. 2007. Assessing Impacts of Wind-Energy Development on Nocturnally Active Birds and Bats: A Guidance Document. *Journal of Wildlife Management* 71:2449-2486.

2019 POST-CONSTRUCTION BAT MORTALITY MONITORING REPORT
WILDCAT WIND FARM
TIPTON AND MADISON COUNTIES, INDIANA

Manly, B.F.J. 1997. *Randomization, Bootstrap, and Monte Carlo Methods in Biology*. Second edition. Chapman and Hall, New York. 399 pp.

Piorkowski, M.D., and T. J. O'Connell. 2010. Spatial Pattern of Summer Bat Mortality from Collisions with Wind Turbines in Mixed-grass Prairie. *Am. Midl. Nat.* 164:260-269.

US Fish and Wildlife Service (USFWS). 2012. *Land-based Wind Energy Guidelines*. March 2012. 71 pp.

Young, D. P., Erickson, W.P., Bay, K., Nomani, S., and W. Tidhar. 2009. *Mount Storm Wind Energy Facility, Phase I Post-Construction Avian and Bat Monitoring, July-October 2008*. Prepared for NedPower Mount Storm, LLC, by Western EcoSystems Technology, Inc. 40pp.

APPENDIX A

Sample Data Sheets

TURBINE NO. ¹	PLOT TYPE ²	CARCASS NO. ³	FROM TURBINE		ON ROAD/PAD?	GPS COORDINATES	SPECIES ⁴	FOREARM LENGTH OF BAT (mm)	AGE ⁵	SEX ⁶	CAUSE OF DEATH ⁷	CONDITION ⁸	CHECK IF COMMENTS (write on back) ⁹
			DISTANCE (m)	AZIMUTH (DEGREES)									
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	
												/	

¹ TURBINE – ENTER NUMBER OF TURBINE. ALSO SEARCH THE TURBINE PAD AND ACCESS ROAD IN ADDITION TO THE STUDY PLOT.

² PLOT TYPE – R=ROADS AND PADS, F=FULL PLOT

³ CARCASS NO. – NUMBER CARCASSES IN THE ORDER THEY ARE FOUND.

⁴ SPECIES – IF UNKNOWN, SPECIFY UNKNOWN BAT OR UNKNOWN BIRD.

⁵ AGE – IF IDENTIFIABLE: ADULT = A; JUVENILE = J; UNKNOWN = U

⁶ SEX – IF IDENTIFIABLE: FEMALE = F; MALE = M, UNKNOWN = U

⁷ CAUSE OF DEATH – COLLISION WITH TURBINE = T; PREDATION = P; UNKNOWN = U (ADD EXPLANATION IN COMMENTS IF NECESSARY).

⁸ CONDITION – ENTER F=FRESH OR D=DECOMPOSED AND WHOLE =W; MOST OF BODY WITH SOME MISSING = M; PIECES = P (E.G., WING ONLY); FEATHER SPOT = F (EXAMPLE: F/W)

⁹ COMMENTS – INCLUDING: REPRODUCTIVE CONDITION, IF IDENTIFIABLE: PREGNANT = P; LACTATING = L; POST-LACTATING = PL; NON-REPRODUCTIVE = NR; TESTES DESCENDED = T; UNKNOWN = U; B= BREEDING (BIRDS).

BAND COLOR/No. – IF BANDED, RECORD COLOR OF BAND (OR METAL), AND NUMBER.

OTHER COMMENTS. INCLUDE CARCASS NUMBER NEXT TO ALL COMMENTS.

PHOTOS: WHERE POSSIBLE, PHOTOGRAPH FOR BATS: BACK, BREAST, MUZZLE, TRAGUS, RULER BEHIND EAR, RULER NEXT TO FOREARM, FOOT, TOEHAIRS, CALCAR (IF EXPOSED).

FOR BIRDS: BACK, BREAST, HEAD, FEET, UNDERSIDE OF WINGS (FOR RAPTORS).

ADDITIONAL COMMENTS (record carcass number next to associated comment; include any identifiers and bands, if present):

CARCASS SEARCH SUMMARY SHEET

WILDCAT WIND FARM 193707045

DATE: _____ **BIOLOGIST:** _____

WEATHER: % CLOUD COVER _____ **TEMPERATURE (° F)** _____ **PRECIP** _____

WIND _____ **SITE DESCRIPTION/COMMENTS:** _____

TURBINE NUMBER	PLOT TYPE (Full or Roads/Pads)	SURVEY TIME (MILITARY)		CARCASSES FOUND (#BIRD, #BAT, NONE)
		START	END	

Carcass ID ¹	Placement				Species	Condition ⁴ When Checked, Checked By ⁵										
	GPS Coordinates	Time (Military)	Turbine ²	Placed By ³		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 10	Day 14	Day 20	Day 30

¹ Carcass ID – Identification number marked inside carcass.

² Turbine – Turbine number where carcass placed.

³ Placed By – Initials of the person who placed the carcass.

⁴ Condition – Record the condition the carcass was in when checked. Intact = I, Signs of scavenging = S, Feather/Fur Spot = F, Missing or < 10 feathers = 0

⁵ Checked by – Record the initials of the person who checked on the carcass.

Comments: _____

More data on back? Yes No

Carcass ID ¹	Placement				GPS Coordinates	From Turbine		Species	Trial Result		
	Time (Military)	Turbine ²	Placed By ³	On Road/Pad?		Distance (m)	Azimuth (degrees)		Found By ⁴	Not Found	Scavenged Prior to Search

Comments (record carcass number next to associated comment, include any identifiers and bands, if present):

¹ Carcass ID – Use carcass ID from when it was originally found. If no ID, just number.
² Turbine – Turbine should be labeled with the turbine number where it was placed.
³ Placed By – Initials of the person who placed the carcass.
⁴ Found By – Record the initials of the person who found the carcass.

More data on back? Yes No

APPENDIX B

Representative Carcass Photos



Photo 1. Representative photo of an eastern red bat (*Lasiurus borealis*) found during road and pad surveys at turbine B7 at the Wildcat Wind Farm (August 14, 2019).



Photo 2. Representative photo of a hoary bat (*Lasiurus cinereus*) found during road and pad surveys at turbine B6 at the Wildcat Wind Farm (August 27, 2019).

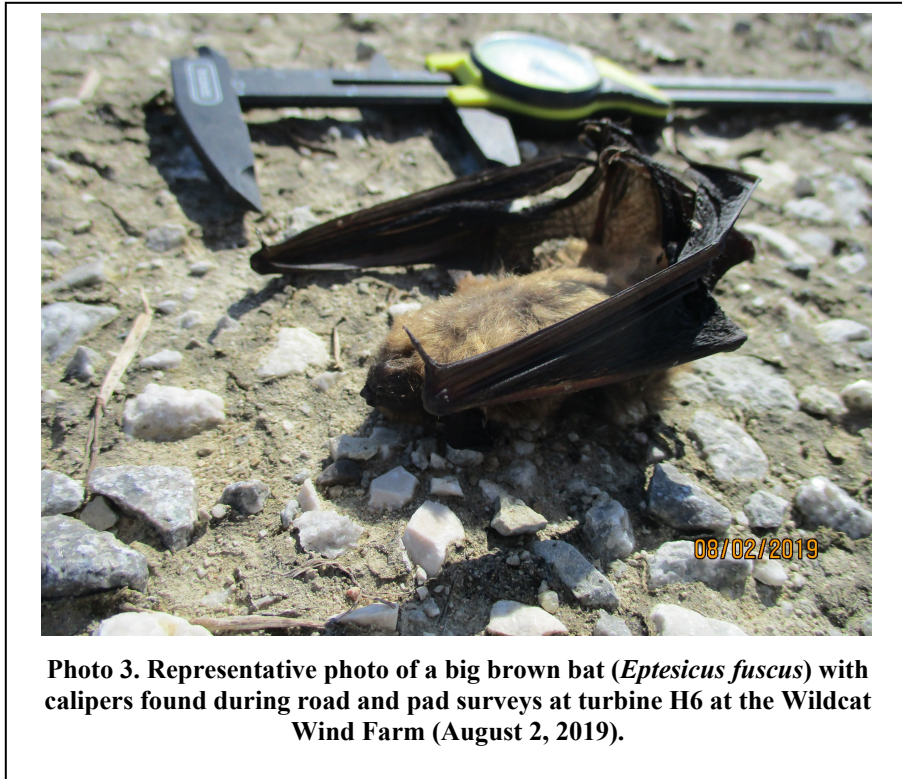




Photo 5. Representative photo of a dickcissel (*Spiza americana*) found during road and pad surveys at turbine G7 at the Wildcat Wind Farm (August 1, 2019).



Photo 6. Representative photo of a horned lark (*Eremophila alpestris*) found during road and pad surveys at turbine B17 at the Wildcat Wind Farm (August 20, 2019).



Photo 7. Representative photo of a ruby-throated hummingbird (*Archilochus colubris*) found during road and pad surveys at turbine G7 at Wildcat Wind Farm (September 24, 2019).



Photo 8. Representative photo of an American robin (*Turdus migratorius*) found during road and pad surveys at turbine D4 at Wildcat Wind Farm post-construction monitoring surveys (September 23, 2019).



Photo 9. Representative photo of a mourning dove (*Zenaida macroura*) found during road and pad surveys at turbine C12 at Wildcat Wind Farm (September 23, 2019).