New Creek Wind Project 2017 Post-construction Monitoring

Results of April – November 2017 Curtailment Evaluation, Acoustic Bat Monitoring, and Bird and Bat Carcass Surveys

January 31, 2018

Prepared for:

New Creek Wind, LLC

Prepared by:

Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

Executive Summary

The New Creek Wind Project (Project) began commercial operation in December 2016. This report summarizes results of curtailment evaluation, acoustic bat surveys, and bird and bat carcass monitoring that occurred at the Project between April and November 2017. Year 2017 monitoring was designed to evaluate the effectiveness and efficiency of multiple curtailment treatments at reducing bat mortality, characterize conditions during which bats were active at nacelle height, and yield estimates of bird and bat fatality for the Project.

Curtailment Strategies

Four curtailment strategies were implemented between 1 April and 15 November 2017, each designed to avoid impacts to rare bat species and substantially reduce overall bat fatality rates. A cut-in wind speed of 6.9 meters per second (m/s) with no temperature cutoff was applied from 1 April through 30 June. From 1 July through 15 October, 4 subsets of turbines were curtailed below wind speeds of 6.0 m/s or 6.9 m/s, with and without a 10-degree C temperature threshold. From 16 October to 15 November, cut-in speeds were reduced to 4.5 m/s and 5.5 m/s for 2 subsets of turbines and remained at 6.0 or 6.9 m/s for the other 2 subsets. The amount of predicted and actual curtailment varied among turbines according to the curtailment treatment to which turbines were assigned and weather conditions present at individual turbines. The four treatments implemented during 2017 prevented turbine operation for an average of between 3,910 and 5,700 10-minute periods (652–950 hours) per turbine. The predicted energy loss per turbine associated with the most restrictive curtailment treatment was approximately double that of the least restrictive curtailment treatment.

Acoustic Monitoring

Acoustic bat detectors were deployed at 9 of 49 project turbines and recorded a total of 13,691 bat passes during 1,110 detector-nights of surveys. Seven of the detectors operated properly for most of the monitoring period, while 2 detectors malfunctioned for the majority of the study period. Hoary bats (*Lasiurus cinereus*) accounted for 44% of recorded bat passes that were identified to species, with eastern red (*Lasiurus borealis*) and silver-haired bats (*Lasionycteris noctivagans*) accounting for 24% and 26% of identified passes, respectively. Only 6 passes were identified as *Myotis* species, with activity occurring at only 3 turbines between 17 July and 23 September 2017. Seasonal patterns in activity varied among species, with hoary, eastern red, and tri-colored bats (*Perimyotis subflavus*) detected most frequently in August and silver-haired bats and big brown bats (*Eptesicus fuscus*) detected most frequently in early September. Hoary bat activity also peaked in late June. Silver-haired bat activity peaked slightly in May and early June. Although species presence varied among nights, overall timing of bat activity showed similar patterns among detectors and species groups, with most activity occurring during the first few hours past sunset.

Bat activity showed clear relationships with temperature and wind speed measured at corresponding turbine nacelles, with 92% of passes for which weather data were available (n = 11,692) occurring when temperature was greater than 10° C and 54% of passes occurring at wind speeds less than 4.5 m/s. Considering temperature and wind speed together, bat activity occurred disproportionally during calm, warm conditions, and few bat passes were recorded during times with higher wind speeds or cooler temperatures. Also, results suggested an apparent interaction

between the effects of temperature and wind speed on bat activity, with activity during windy conditions occurring primarily at warmer temperatures.

Individual turbines with operating bat detectors (n = 7) were curtailed (RPM < 1) during periods when 61% to 85% of recorded bat passes were detected. Based on weather data from these same turbines, criteria for 4 curtailment treatments (e.g., timing, cut-in speed, and temperature threshold) were met during periods encompassing between 77% and 88% of recorded bat passes. As designed, the curtailment program avoided a consistent proportion of bat activity between April – September, with a higher proportion of bat activity (but lower overall number of bat passes) exposed to operation in October and November.

Bird and Bat Carcass Monitoring and Fatality Estimates

Stantec searched all 49 Project turbines at a weekly interval between 17 April and 15 November, conducting a total of 1,497 turbine searches during 152 days on-site. Individual turbines were searched on 28 – 31 occasions during the survey period. Searchers found 24 bat and 7 bird carcasses during standardized searches, and an additional 9 bat and 7 bird carcasses incidentally. Most carcasses were fresh (fatality estimated to have occurred the previous night), although searchers occasionally found carcasses estimated to be several days up to several weeks old. No federally listed bird or bat species were found during surveys. Long-distance migratory bats accounted for all bat carcasses, with hoary bats and eastern red bats accounting for roughly 45% of carcasses each and silver-haired bats accounting for the remaining amount. Bird carcasses represented 10 species, with no more than 2 of any single species found.

Ground conditions remained favorable for searching (short, sparse vegetation) throughout the monitoring period, contributing to high searcher efficiency (71% for bats, 75% for birds). Good ground visibility may have also contributed to the high scavenging rates documented throughout the monitoring period. Based on log-logistic model, which was most appropriate based on site-specific trials, carcass persistence was between 1 and 2 days for birds and bats, with an estimated 38% of bat carcasses and 31% of bird carcasses persisting through the search interval. Taking into account searcher efficiency, carcass persistence, search interval, and density-weighted area correction factor, based on the Huso estimator, we obtained an estimated overall bird fatality rate of 1.02 birds/turbine (95% CI 0.77–1.40) and an overall bat fatality rate of 2.63 bats/turbine (95% CI 1.82–3.89). Bird and bat mortality estimates did not differ significantly among the four curtailment strategies implemented during 2017 based on overlapping confidence intervals.

Conclusions

Each of the curtailment treatments in place between 1 April and 15 November 2017 prevented turbine operation during periods in which most acoustic bat activity (73% overall) occurred, resulting in low estimated bat fatality rates despite substantial amounts of bat activity at nacelle height. Although the 4 curtailment treatments differed substantially in the number of periods curtailed and associated energy loss, they differed less in terms of acoustic bat activity exposed to turbine operation, and yielded low bat fatality estimates that did not differ significantly among treatments. Because estimated bat mortality did not differ between even the most and least restrictive curtailment treatments, our results suggest that all strategies in place during the 2017 monitoring period were at or above a threshold of protectiveness necessary for maintaining low risk to bats. This suggests ample room for improving the efficiency of curtailment while resulting in little if any increase in bat fatality or risk to rare bat species.

The curtailment treatments in place during the 2017 monitoring period effectively reduced exposure of bats to turbine operation and resulted in low fatality estimates. However, actual turbine curtailment did not always align with the designated conditions, due to a combination of factors related to the design of the curtailment system, such as hysteresis between cut-in and cut-out wind speed and temperature thresholds, occasional programming errors, temporary malfunction of the system, or a combination of these and other factors. Refining the implementation of curtailment during subsequent years should further improve the efficiency of the system and alignment with conditions related to risk.

Acoustic monitoring provided valuable information for comparing the relative effectiveness of multiple curtailment strategies, demonstrating that bats are quite active near the nacelle of operating turbines, but only during certain conditions (warm temperatures and relatively calm winds). Therefore, curtailment systems targeting multiple factors associated with high levels of bat activity can effectively avoid risk to bats while minimizing unnecessary energy loss during conditions with little or no bat activity. By combining acoustic monitoring with traditional carcass searches, we obtained fatality estimates associated with curtailment treatments in place during the 2017 monitoring period, but also obtained a baseline dataset of acoustic activity at nacelle height that can be used to evaluate the potential effectiveness and energy loss associated with alternative curtailment plans for future planning efforts. Our results contribute to a growing body of evidence demonstrating that bat fatality can be maintained at low levels through the use of turbine curtailment, even in regions such as the mid-Atlantic, where apparent risk to bats at wind farms is high. However, our results also suggest that there is substantial room to improve the efficiency of curtailment programs while not necessarily reducing their effectiveness. By incorporating multiple survey methods, the 2017 monitoring period provided a foundation of information upon which responsible and informed management decisions can be made in the future.

1.0 INTRODUCTION

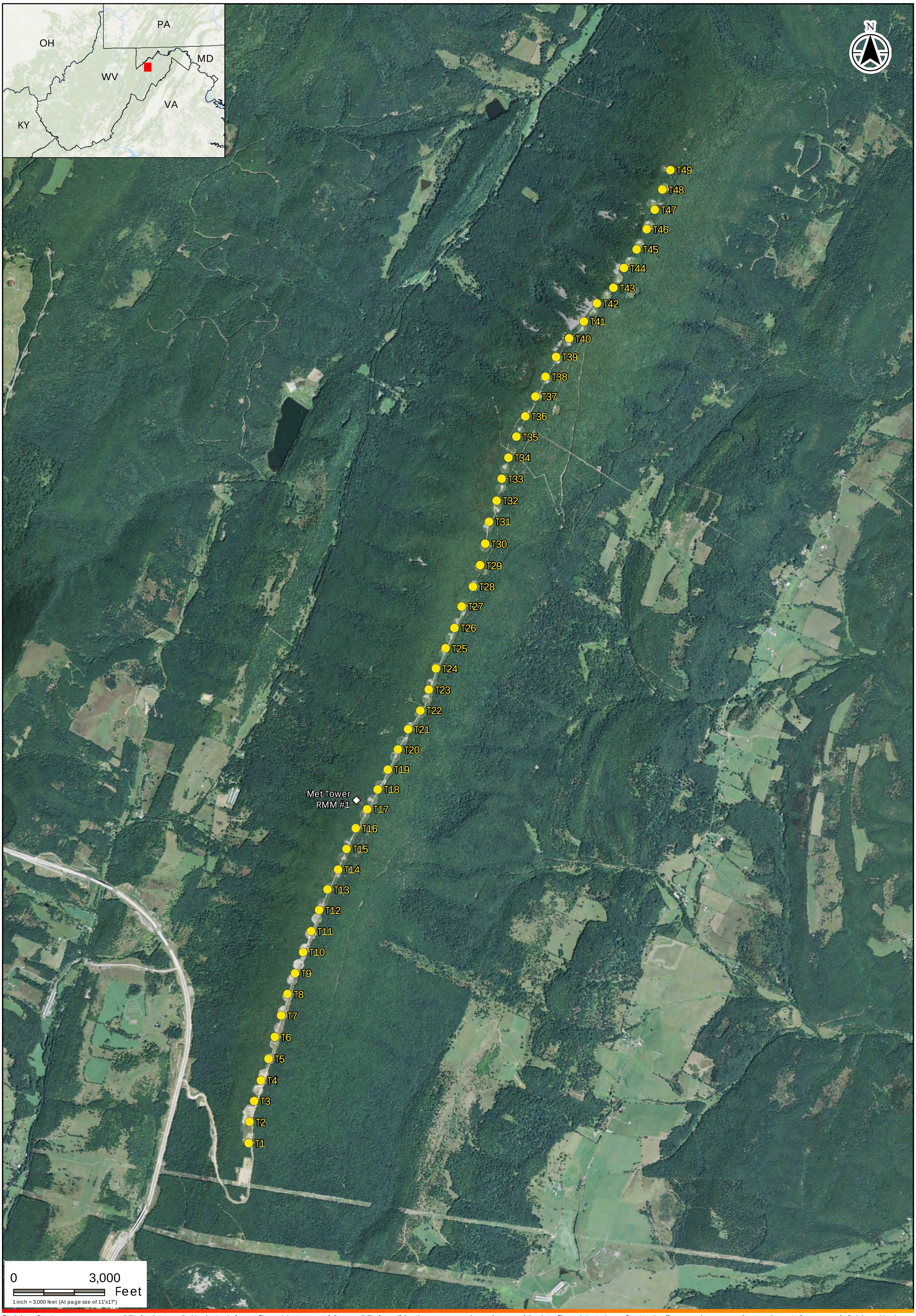
The New Creek Wind Project (Project), operated by New Creek Wind, LLC. (New Creek), an indirect, wholly owned subsidiary of Enbridge Inc. (“Enbridge”), began commercial operation in December 2016. As part of the Bird and Bat Conservation Strategy (BBCS; Stantec 2017) developed for the Project, and as required by the 2009 Public Service Commission of West Virginia order approving Project development, New Creek will conduct at least 1 year and up to 3 years of post-construction bird and bat carcass monitoring. This report summarizes results of the first year of monitoring, which occurred between April and November 2017, and consisted of evaluation of multiple curtailment strategies designed to avoid rare bat mortality, acoustic bat monitoring, and bird and bat carcass searches. The methods and level of effort for year 2017 monitoring were based on conversations between Stantec Consulting Services Inc. (Stantec), Enbridge, the U.S. Fish and Wildlife Service (USFWS), and West Virginia Division of Natural Resources (WVDNR), and described in the Year 1 Post-construction Monitoring Plan (Monitoring Plan) submitted to agencies in March 2017 and included as Appendix A. Results of eagle point counts, which also occurred during the 2017 monitoring period and will be continued through spring 2018, will be summarized and reported separately after the end of the 12-month survey period. Carcass handling and collection associated with the 2017 monitoring period were authorized by a Migratory Bird Special Purpose – Utility Permit issued by the USFWS (permit # MB17012C-0) and a WVDNR Scientific Collecting Permit (permit #2016.193).

1.1 PROJECT DESCRIPTION

The Project has a production capacity of approximately 100 megawatts (MW) and consists of 49 wind turbines and associated infrastructure located on approximately 11 kilometers (km; 7 miles) of forested ridgeline on New Creek Mountain in Grant County southwest of Keyser, West Virginia (Figure 1-1).

The 45 Gamesa G97 and 4 G90, 2.0 MW turbines have a hub height of 78 meters (m; 256 feet [ft]) and total height of approximately 126 m (413 ft). The 49 turbines are arranged in a single string on the center of the ridge, connected by a single access road. The project connects to a previously existing 500 kilovolt transmission line that crosses the ridge from west to east via a substation at the southern end of the yard and a switchyard operated by Dominion Energy. The Project Operations and Management (O&M) building is located off the west side of ridgeline.

New Creek Mountain is a narrow ridgeline with a southwest-northeast orientation and relatively uniform height of approximately 900 m (2,950 ft) above sea level. Elevations in the surrounding valleys are between 450 and 500 m (1,475 to 1,640 ft), resulting in elevation gradients of approximately 400 to 450 m (1,310 to 1,475 ft) between the ridgeline and the surrounding valleys. The mountain drops steeply in elevation on both the east and west sides and forms a narrow, linear ridge typical of those found in the ridge and valley region of West Virginia. This region, which extends from south-central Pennsylvania to southern West Virginia/Virginia border, is also known as the Allegheny Front. The bedrock of New Creek Mountain consists of sandstone, with rocky talus occupying much of the steep western slope of the mountain. In several places, these rocky talus slopes form large openings without forest canopy, although a short tree canopy covers the majority of the western slope. The eastern slope is generally less steep and lacks substantial talus fields. Bands of limestone occur near the bottom of both sides of the mountain.



Disclaimer: Stantec assumes no responsibility for data supplied in electronic format. The recipient accepts full responsibility for verifying the accuracy and completeness of the data. The recipient releases Stantec, its officers, employees, consultants and agents, from any and all claims arising in any way from the content or provision of the data.

195601197

Stantec

30 Park Drive
Topsham, ME USA 04086
Phone (207) 729-1199
Prepared by KWH on 2017-02-24
Reviewed by TSP on 2017-02-24

01197_1-1_Monitoring_RevBBCS.mxd

Legend
- ◇ MET Tower
- ● Existing Turbine

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base Map: ESRI ArcGIS Online NAIP imagery web mapping service.

Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project
Grant County, West Virginia

Figure No.
1-1

Title
Project Location Map
2/24/2017

DRAFT

Forests on the ridgeline of New Creek Mountain are primarily oak-dominated, with a relatively short canopy of scrub oak (*Quercus ilicifolia*) reaching a maximum height of only 5 to 10 m (16–33 ft) in most areas. Portions of the ridgeline also contain pitch pine (*Pinus rigida*) regeneration, especially along the eastern crest of the ridge. Soils are very thin and dry throughout, with a rocky substrate visible in many areas. Wetlands are limited along the ridgeline, with water generally found only in temporary pools along the existing roadways and in a small pond at the southern end of the Project area between the substation and transmission lines that cross the ridge from west to east.

1.2 MONITORING OBJECTIVES

As described in the Monitoring Plan, the first year of post-construction monitoring at the Project was designed to document species composition and seasonal patterns in bird and bat mortality at the Project, estimate rates of bird and bat mortality between 1 April and 15 November for turbines operating according to each of 4 distinct curtailment treatments (modes), and document patterns in bat activity near turbine nacelles using acoustic detectors. Specific objectives included determining:

- Estimated bird and bat fatality rates (per turbine and per MW) for each of 4 operational curtailment modes
- Searcher efficiency (percent of carcasses detected by searchers)
- Carcass persistence (length of time carcasses remained in place before being scavenged and/or decomposing)
- Seasonal patterns in bird and bat mortality (e.g. number of carcasses found per month)
- Species composition of bird and bat fatalities
- Species composition, seasonal, and temporal patterns in bat activity at nacelle height using acoustics
- Relationships between bat activity (measured acoustically), temperature, and wind speed at nacelle height
- Relationships between bat mortality and acoustic activity at nacelle height

2.0 METHODS

2.1 TURBINE OPERATION AND CURTAILMENT EVALUATION

Each of the 49 turbines was operated under 1 of 4 curtailment strategies, all designed to avoid potential impacts to rare bat species and substantially reduce mortality of all bats. Curtailment was initially implemented via software developed in collaboration between Enbridge and Gamesa, although an alternative system managed by SCADA International began on August 4, 2017. Due to complications implementing multiple simultaneous treatments, which required creation of a customized turbine control system for the Project, all turbines were operated according to a single strategy between 1 April and 30 June, whereas the 4 distinct curtailment treatments were implemented between 1 July and 15 November. The 4 curtailment treatments implemented in 2017 are outlined in Table 2-1, with treatments assigned sequentially to turbines (treatment assignments are listed in Table 3-1). All treatments were implemented between sunset and sunrise on a nightly basis, with sunset and sunrise times updated each week.

Table 2-1. Cut-in wind speeds (meters per second [m/s]) and temperatures (Celsius [° C]) during which the 4 curtailment modes were in effect between April and November 2017.

<table>
<tr><th>Curtailment Strategy</th><th>April 1 – June 30*</th><th>July 1 – October 15*</th><th>October 16 – November 15*</th></tr>
<tr><td>Mode 1</td><td rowspan="4">6.9 m/s, all temps</td><td colspan="2">6.9 m/s, all temps</td></tr>
<tr><td>Mode 2</td><td>6.9 m/s, > 10° C</td><td>6.0 m/s, > 10° C</td></tr>
<tr><td>Mode 3</td><td>6.0 m/s, all temps</td><td>5.5 m/s, > 10° C</td></tr>
<tr><td>Mode 4</td><td>6.0 m/s, > 10° C</td><td>4.5 m/s, > 10° C</td></tr>
</table>

*Curtailment modes implemented from sunset to sunrise, updated weekly

Turbine generator speed, wind speed, and temperature were recorded at turbine nacelles for each of the 49 turbines at 10-minute intervals throughout the monitoring period. We calculated turbine rotations per minute (RPM) by dividing generator speed by 120 to account for the 120:1 turbine gear ratio. Stantec coded each 10-minute period as meeting or not meeting the curtailment conditions for the assigned treatments as outlined in Table 2-1. This represented the time periods during which turbines should have been curtailed. We determined whether turbines were in fact curtailed during these periods based on 10-minute RPM, defining 1 RPM as the maximum threshold for curtailment. We differentiated night versus day based on sunset and sunrise times calculated for the location of each turbine using R Package RAtmosphere (version 1.1).

2.2 ACOUSTIC MONITORING

2.2.1 Acoustic Detector Deployment

Enbridge deployed acoustic bat detectors on the nacelles of 9 wind turbines (evenly distributed among the 49 total turbines) to document bat activity in the turbine rotor zone, characterize relationships between bat activity and weather conditions, and determine the amount of bat activity exposed to turbine operation versus protected by the curtailment treatments. Full-spectrum (Wildlife Acoustics SM4) echolocation detectors were fixed to nacelle-mounted anemometer masts and were oriented facing away from the rotor (Figure 2-1). Detectors were programmed to operate continuously from 30 minutes before sunset to 30 minutes after sunrise and were powered by 12-volt battery systems charged by small solar panels. Enbridge or Gamesa staff inspected detectors when possible during the survey period to offload data and check that detectors were operating properly.

Figure 2-1. Photo of acoustic bat detector (in green box) mounted on the nacelle of Turbine 1 at the New Creek Wind Project, 2017

2.2.2 Acoustic Data Analysis and Summary

Recorded audio files were converted to zero-crossing format using Kaleidoscope Pro software (version 3.1.7) and visually inspected in AnalookW software (version 4.2g) to distinguish bat passes from static or other ultrasonic noise. Stantec technicians trained in identifying bat call sequences inspected each zero-crossing file and assigned them to a species category based on parameters such as minimum frequency, slope, time between calls, and the profile of frequency versus time, comparing recorded passes to reference libraries of acoustic bat calls. A Stantec biologist reviewed species category assignments as a quality assurance/quality control of the identification process. This method of visual analysis and comparison to reference libraries, although subjective and dependent on the skill of the analysts, can produce accurate identification (O'Farrell et al. 1999, O'Farrell and Gannon 1999). In Stantec's experience, visual identification is less prone than auto-classification software to mistaking recordings of unusual ultrasonic noises which can be expected for nacelle-mounted detectors) for bat passes.

Bat passes were classified to species whenever possible, and then assigned to one of the 5 following species groups:

- Unknown (UNKN) – All call sequences with less than 5 calls, or poor quality sequences (those with indistinct call characteristics or background static). These sequences were further identified as either "high frequency unknown" (HFUN) for sequences with a minimum frequency above ~30 kHz, or "low frequency unknown" (LFUN) for sequences with a minimum frequency below ~30 kHz.

- Myotis (MYSP) – Bats of the genus *Myotis* that in West Virginia include little brown bat (*Myotis lucifugus*), northern long-eared bat (*Myotis septentrionalis* [federally threatened]), eastern small-footed bat (*Myotis leibii*), and Indiana bat (*Myotis sodalis* [federally endangered]). While there are some general characteristics believed to be distinctive for the species in this genus that occur in West Virginia, these characteristics are not sufficiently consistent to be relied upon for species identification at all times.

- Eastern red bat/tri-colored bat (RBTB) – Eastern red bats (*Lasiurus borealis*, LABO) and tri-colored bats (*Perimyotis subflavus*, PESU). These 2 species can produce distinctive calls. However, significant overlap in the call pulse shape, frequency range, and slope can also occur. In West Virginia, evening bats (*Nycticeius humeralis*) would also be included in this species group.

- Big brown/silver-haired bat (BBSH) – Big brown bats (*Eptesicus fuscus*, EPFU) and silver-haired bats (*Lasionycteris noctivagans*, LANO). The call signatures of these species commonly overlap and are included as 1 species group in this report. In the unlikely event that fragments of Virginia big-eared bats (*Corynorhinus virginianus* [federally endangered] were recorded, they would likely be assigned to this group as they overlap in frequency with feeding buzzes of big brown bats)

- Hoary bat (HB) – Hoary bats (*Lasiurus cinereus*, HB). Calls of hoary bats can usually be distinguished from those of big brown and silver-haired bats by minimum frequency extending below 20 kHz and/or by hook-shaped calls varying widely in minimum frequency across a sequence.

This method of species group identification represents a conservative approach to bat call identification, minimizing the potential of mis-identifying call sequences. All recorded call sequences were included in the species group structure. Since some species sometimes produce calls unique only to that species, all calls were identified to the lowest possible taxonomic level before being assigned to a species group. Tables and figures in the body of this report will reflect those species groups. In addition, since species-specific identification did occur in some cases, each species group will also be briefly discussed with respect to potential species composition of recorded call sequences.

Stantec compiled nightly tallies of detected bat passes and determined overall and monthly detection rates (number of passes/detector-night) for the entire sampling period for each detector. Because bat activity levels are highly variable among individual nights and individual hours (Hayes 1997, Arnett et al. 2006), detection rates were summarized on both of these temporal scales. Nightly detection rates were summarized by detector for the entire sampling period. Hourly detection rates were summarized by hour after sunset, as recommended by Kunz et al. (2007).

Temperature and wind speed measured at the corresponding nacelles were determined for the 10-minute period in which every bat pass occurred. This information was used to document conditions during which bats were most active (and therefore at the greatest risk of collision). Turbine RPM was also determined at the time each bat pass occurred to document what proportion of bat activity was “exposed” to turbine operation. The proportion of curtailed 10-minute intervals (RPM < 1) during which bat activity occurred was calculated as a measure of the effectiveness of each curtailment strategy at reducing risk to bats, as described below.

2.3 BAT ACTIVITY AND TURBINE OPERATION

For each turbine with an acoustic bat detector, Stantec determined the number of bat passes recorded during each 10-minute period by aligning timestamps for bat passes (rounded to 10-minute intervals) and weather data, then determined the proportion of passes that occurred during periods when curtailment conditions were met (predicted avoidance) and when turbines were curtailed (RPM < 1; actual avoidance). Similarly, we predicted energy loss (power generation potential during periods when curtailment conditions were met) and actual energy loss (generation potential when RPM < 1) for each turbine with an acoustic detector.

Because not all curtailment treatments were represented by turbines with acoustic detectors, Stantec also simulated each of the treatments for every 10-minute period for the turbines with detectors. We used this information to calculate the predicted avoidance (percent of bat passes occurring when curtailment conditions were met) and predicted energy loss (power generation potential during periods when curtailment conditions were met) for each curtailment mode as a measure of its relative efficiency and effectiveness.

2.4 STANDARDIZED CARCASS MONITORING

Standardized carcass monitoring occurred on a weekly basis at all 49 Project turbines between 17 April and 15 November 2017. Turbine searches were conducted within the area cleared (full plot searches) at all 49 turbines.

2.4.1 Search Area Mapping and Management

Results from recent mortality monitoring studies indicate that most bird and bat carcasses fall within a distance equal to or less than 50% of the maximum height of turbines (Kerns and Kerlinger 2004; Arnett et al. 2005; Fiedler et al. 2007; Young et al. 2009; Jain et al. 2007, 2008, 2009a b; Piorkowski and O'Connell 2010). Most bat fatalities fall within 30 m to 40 m of turbines (Kerns and Kerlinger 2004, Johnson et al. 2003)[1]. Based on these results, the full plot search area for each of the 49 turbines targeted the cleared area around each turbine up to a 90 m x 90 m square area centered at the base of turbine towers. Rocky talus slopes, rubble, densely vegetated areas, and other ground cover types that prohibited effective or safe searching conditions were excluded from searchable areas. Stantec mapped the extent of the searchable area for each turbine using a Global Positioning System (GPS) unit (Trimble Geo-XH).

Over a period of several-weeks, Enbridge revegetated the cleared turbine pads with grass during summer 2017. Typically, mowing or other similar vegetation management is conducted periodically to improve visibility of the ground and maximize searcher efficiency, which in turn improves the precision of mortality estimates (Sonnenburg and Erickson 2010). However, vegetation remained sparse throughout the 2017 monitoring period, such that mowing was not required (Figure 2-2).

[1]During avian and bat mortality monitoring at the Buffalo Ridge wind facility in Minnesota in which all areas within 50 m (164 ft) of turbines were searched, only 1 of 184 bats were found greater than 30 m (98 ft) from a turbine.

Figure 2-2. Photo of ground conditions and transect markings (orange and blue cairns) at a typical turbine at the New Creek Wind Project, 3 August 2017

2.4.2 Carcass Search Methods

Parallel search transects spaced at 4 m (13 ft) intervals were oriented north-to-south (magnetic) within searchable areas (see Section 2.3.1 Search Area Mapping and Management) at each turbine. Transects were marked using temporary flagging and fluorescent marking paint. Searchers visually scanned the ground on either side of the transacts, walking at an approximate speed of 30 to 50 m per minute, resulting in approximate search times per full plot turbine between 25 and 60 minutes depending on the size of searchable area and survey conditions. Surveyors temporarily marked the location of any bird or bat carcasses found during the search using flagging tape.

After each turbine search, the surveyor returned to any marked carcasses and recorded relevant data as described below. A photograph was taken of the carcass before it was moved. Carcasses were collected in individual re-sealable plastic bags, labeled with a unique identification number according to the date and turbine where they were found. Carcasses were stored in a designated freezer at the Enbridge O&M building throughout the monitoring period for use during searcher efficiency and carcass persistence (bias) trials. All necessary state and federal scientific collection/salvage permits were obtained prior to collecting carcasses. Carcasses not used for on-site bias trials were provided to the WVDNR at the end of the monitoring period.

All intact bird and bat carcasses or remnants of scavenged carcasses (e.g., a cluster of feathers representing more than a molt, or a patch of skin and bone) were documented as fatalities. Carcasses found incidentally within the Project area, either by surveyors or other site personnel, were also documented and collected.

The following information was recorded for each carcass found by the surveyors:

- Date, time, turbine number, and surveyor
- Search type during which carcass was found (i.e., turbine search or incidentally)
- Distance and azimuth (magnetic) of carcass from tower
- Ground cover type, height, and condition (i.e., wet, dry) where carcass was found
- Carcass species identification, age (juvenile or adult), sex, and reproductive condition (to the extent possible)
- Carcass condition (estimated number of days since death, if they were live/injured, intact or scavenged and/or level of scavenging activity)
- Evidence of scavenger activity (e.g., tracks or scat) near of the carcass

Enbridge obtained a “Migratory Bird Special Purpose Utility Permit – Wind” from the USFWS (permit # MB17012C-0) that named its employees and contractors as sub-permittees. Stantec was issued a Scientific Collecting Permit from the WVDNR (permit # 2016.193) that listed Stantec and Enbridge personnel as permittees. Surveyors were trained on the proper handling of injured birds and bats if they were found. Any individual handling live bats was required to maintain an up-to-date rabies vaccination.

Allowed under the conditions of the state and federal collection permits, efforts would have been made to bring injured animals to the closest licensed wildlife rehabilitator able to take that species. A list of local, currently licensed wildlife rehabilitators capable of accepting regional bird and bat species was developed and provided to searchers. The closest rehabilitation facility is the Avian Conservation Center of Appalachia in Morgantown, West Virginia.

Carcasses were retained for subsequent use in validation trials (see Sections 2.3.4 Searcher Efficiency Trials and 2.3.5 Carcass Persistence Trials), unless they were a rare species, in which case they were to be retained for confirmation of identity. All *Myotis* bats were to be provided to WVDNR for inspection, identification verification, and submission to a lab for genetic testing if deemed necessary by agency personnel. The WVDNR and USFWS were to be notified within 48 hours if a suspected or confirmed Indiana bat (*Myotis sodalis*) carcass or any other federally threatened or endangered bird or bat species was found.

2.4.3 Searcher Efficiency Trials

Searcher efficiency rates are variable among studies at wind facilities in the United States and are largely dependent on ground cover conditions. Searcher recovery rates have ranged from 25% to 56% for small carcasses, and as high as 100% for large carcasses (Arnett et al. 2005, Erickson et al. 2003, Jain et al. 2007). Trials were conducted to estimate searcher efficiency rates.

Trials targeted the placement of up to 100 carcasses over the course of the monitoring period. Trial carcasses were used for multiple trials as long as they remained in good condition. Multiple trials were conducted throughout the survey period at arbitrary intervals to account for changes in ground cover conditions. On trial days, between 1 and 4 carcasses were placed at random distances from turbine towers and in a variety of cover types per turbine at one or more turbines scheduled to be searched that day.

Small, medium, and large bird carcasses (preferably of native species) and bat carcasses (as carcass availability allowed), in varying stages of decomposition were marked discreetly so that trial carcasses were able to be distinguished from actual fatalities without the surveyor's knowledge. Although searcher efficiency was not estimated separately for carcasses of varying sizes, carcasses used in searcher efficiency trials were, to the extent possible, representative of the range of sizes of birds and bats found on site during mortality surveys. To the extent that was feasible (i.e., carcasses are in good condition and bat carcasses do not show signs of White-Nose Syndrome); carcasses found during mortality searches at the Project were used in trials. If an insufficient number of carcasses from the Project were available, surrogates for native birds (e.g., quail) were used. Surveyors being tested were unaware of trial dates and locations. The trial coordinator placed carcasses at random beneath a search turbine on the evening before, or in the early morning immediately preceding, a turbine search, and made every effort to leave no evidence of trial set-up (i.e., vehicle or foot prints in wet grass or mud). The trial coordinator recorded the following information for each carcass placed:

- Date, time of set-up, trial coordinator
- Turbine number
- Carcass identification
- Carcass distance and direction from tower
- Ground cover type and vegetation height where carcass was placed

After searches were completed on trial days, the trial coordinator determined how many trial carcasses were recovered and how many were possibly scavenged, and removed unobserved carcasses. The presence of the carcass (i.e., availability for detection) was determined immediately following the completion of each searcher efficiency trial.

Searcher efficiency rate is expressed as the proportion of carcasses found by searchers (the number of carcasses found by searchers divided by the total number of carcasses placed during searcher efficiency trials). Estimated searcher efficiency and confidence intervals were calculated using the Huso software, as described below.

2.4.4 Carcass Persistence Trials

Trials were conducted to estimate the percentage of carcasses that were removed by scavengers prior to recovery by surveyors, or the carcass persistence rate. Carcasses in fresh condition were used in trials and were marked discreetly to differentiate them from actual fatalities. Juvenile quail carcasses (surrogate for birds) and bat carcasses found on site (and in as fresh condition as possible) were used for carcass persistence trials. Although carcass persistence was not estimated separately for carcasses of varying sizes, carcasses used in carcass persistence trials were, to the extent possible, representative of the range of sizes of birds and bats found on site during mortality surveys. To the extent that was feasible, carcasses found during mortality searches at the Project were used in trials (i.e., carcasses in good condition and bat carcasses not showing signs of White-Nose Syndrome). Surrogates for native birds (e.g., quail) were used to supplement trials when necessary. Trials were spaced out over the course of the survey year to account for seasonal changes of scavenger activity.

Carcasses were placed at multiple turbines throughout the monitoring area (no more than 1 carcass per turbine) and checked daily for 14 days. On each day the carcass was checked, surveyors indicated whether the carcass was present (intact, or partially scavenged but readily detectable) or absent (completely removed, or with so few feathers or tissue that they are not readily detectable). Carcasses present at the end of the 14-day trial period were collected and disposed of. The following additional information was recorded on standardized datasheets for each trial carcass:

- Date, time of set-up, trial coordinator
- Turbine number
- Carcass identification
- Carcass distance and direction from tower
- Ground cover type and vegetation height where carcass was placed
- Detailed notes describing any scavenging and evidence of scavenger identification

2.4.5 Fatality Estimate Methods

Estimates of total bird and bat fatalities for the entire survey period were generated using the Huso Estimator (Huso 2010, Huso et al. 2012). Separate estimates were generated for each curtailment mode. Fatality estimates are based on:

- Number of carcasses found per turbine (including incidentals found within the survey area but excluding incidentals found beyond the survey transects)
- Searcher efficiency rate, expressed as the percentage of carcasses recovered during searcher efficiency trials
- Carcass persistence rate, expressed as the length of time a carcass is estimated to remain at a turbine and be available for detection by the searchers
- Proportion of searchable area below each turbine
- Distribution of carcasses within search areas

The Huso Estimator is a method that was developed in 2010 based on Thompson (1992). The specific objectives of the Huso Estimator are to attempt to accurately estimate actual bird and bat fatality based on observer detection rates and carcass persistence, and to provide a measure of precision associated with the estimates. The estimator was designed to estimate per-turbine fatality based on a total-site estimate; it was not designed to estimate fatality at individual turbines. A detailed description of the Huso Estimator is available in Huso 2010 and Huso et al. 2012. The Huso Estimator software[2] is run with the statistical program R (R Development Core Team 2011). The formula for Huso's model is, as expressed in Strickland et al. (2011):

- (C) is expressed as the product of the actual number killed (*F*), the proportion of carcasses remaining to be found ($\hat{r}$), and the probability of detection (P_{det})
- $\bar{t}$ is the average carcass removal time
- P_{det} is the probability of detection given that carcass remains
- $\tilde{I}$ is the effective search interval
- $\hat{\pi}$ is the probability of carcass availability and detection

[2] Huso estimator software and supporting documentation is available for download at http://pubs.usgs.gov/ds/729/

- $\hat{s}$ is estimated searcher efficiency rate expressed as the percentage of carcasses recovered during searcher efficiency trials (*p* in Huso model output)
- $\hat{r}$ is estimated carcass persistence rate (r in Huso model output), expressed as the proportion of carcasses estimated to remain during an average persistence interval and available for detection by the searchers

$$C = Frp$$

$$\tilde{I} = -\log(0.01) * \bar{t}$$

$$\hat{s} = \min\left(1, \frac{\tilde{I}}{I}\right)$$

$$\hat{r} = \frac{\bar{t} * \left(1 - e^{\frac{I}{\bar{t}}}\right)}{I}$$

$$\hat{\pi} = P_{det} * \hat{s} * \hat{r}$$

When the size of search plots is limited, it is likely only a fraction of carcasses occurring at a turbine (i) will occur within the searchable area (Huso 2010). Therefore, π(i) is the product of the proportion of fatalities at turbine (i) that is within the searchable area of a plot and probability of including (i) in the sample.

Accounting for 'Carcass Overflow'

The Huso Estimator assumes carcass equilibrium between search intervals, where all carcasses are either found by searchers or scavenged prior to the next search (Manuela Huso pers. comm.). The Huso Estimator assumes a zero probability of searchers observing a carcass on a subsequent search if it was missed on the first search. However, field data indicate that some carcasses that persist for longer than the search interval are found during subsequent searches. To account for this bias (which results in overestimates of fatality), Huso recommends that only those carcasses killed since the previous search (based on stage of decomposition) be input into the model to estimate fatality. The proportion of older carcasses are separately accounted for in the measurement of searcher efficiency (i.e., if searcher efficiency is determined to be 50% then there is a 50% probability of a carcass being missed on the first search). Therefore, only those carcasses aged 7 days or less were input into the fatality model based on the weekly search interval, as is typically done for this type of analysis. It can be difficult to determine exact time of fatality (e.g., between a carcass that is aged greater than or less than 7 days). Therefore, if a carcass's age was questionable, it was included in the fatality model as aged 7 days or less.

Area Corrections

Because turbine towers may not be centered within turbine clearings, and carcasses may land over unsearched areas, the empirical distribution of bird and bat carcass fall distances were determined to apply a density-weighted proportion area searched (DWP) correction in the model. Area corrections were based on methods proposed by Jain et al. (2009a; modified from Fiedler et al. 2007). The proportion of the total birds and bats found during searches were determined per 10 m concentric distance increments radiating out to 63 m (the maximum search radius) from tower bases. The proportion of the area that was searchable (i.e., not cut off by forest edge) within each of these distance bands was determined. The percent area searched per distance band was multiplied by the proportion of bird and bat carcasses found within each distance band to find a DWP value per distance band. The DWP value for each band was summed to find a DWP value for each turbine, for birds and bats separately. Turbine-specific DWP values were input into the model for each bird and bat carcass found. This DWP analysis provides a per-turbine adjustment for the total number of bird and bat carcasses that would have been found within a 63-m radius of the turbine, had that entire area been available to be searched. It should be noted that a small density of carcasses found does not allow for a robust estimate of DWP. For example, if one bat carcasses is found in an outer ring of a search plot, and a small proportion of this ring was searchable, this one bat will inflate the estimate of the number of carcasses that may have occurred within this ring, when the actual distribution of bats indicates that the number of bat carcasses actually drops off in the outer portions of plots.

For the Huso Estimator to calculate estimates of fatality for birds and bats separately, a sample size of at least 10 bird and 10 bat carcasses for both the searcher efficiency and carcass persistence trials is required. Further, there must be a sample size of at least 10 bird or bat carcasses per covariate (e.g., season, carcass size, ground cover type) for other covariates to be incorporated into the model (e.g., to estimate fatality per season, per carcass size, per visibility class).

The results of searcher efficiency trials were categorized as “1” (if the trial carcass was found) and “0” (if trial carcass was not found). These values are distributed as binary random variables within the model, with ‘Found’ indicated by the highest numeric value. A generalized linear model of the binary response was fit to the data, with a modeled response of $\log^e$ (odds of observing a carcass = $\log^e$ (p/1-p)).

The results of carcass persistence trials were input into the model, based on the following trial outcomes:

- Carcass gone at first check on ‘Day 1’ of trial, left censoring = 2
- Carcass still present (visible) on last day of trial, right censoring = 0
- Carcass was removed between checks, interval censoring = 3

Carcass persistence times are modeled with a log-linear parametric accelerated failure time model and are assumed to follow a probability distribution. When persistence time is not known, or is censored, the model is appropriately modified.

Each time the model is run, one of the following distributions of carcass persistence must be selected by the user for the model: exponential, loglogistic, lognormal, or Weibull. Huso recommends running trials of the dataset with each distribution to compare values of AIC (Akaike Information Criterion), the measure of the relative goodness of fit of the model, where k is the number of parameters in the statistical model, and L is the maximized value of the likelihood function for the estimated model.

$$AIC = 2k - \ln(L)$$

The preferred distribution for the dataset is the one with the minimum AIC value.

Thompson (1992) provides a formula for the calculations of variance when the variables of the model (i.e., carcass detectability and persistence) are known. However, because detection bias, persistence bias, and proportion of carcasses within search areas are estimated, Huso uses a bootstrapped estimate of variance based on methods proposed by Erickson et al. 2004, where the fatality adjustment (π) and total fatality (m) are calculated for each bootstrapped sample. The analysis uses 5,000 bootstrap resample iterations, as recommended by Huso et al. (2012). The alpha value was defined as 0.05; therefore, all confidence intervals will be calculated at 95%.

2.4.6 Bat Fatality and Acoustic Activity

Because all turbines were curtailed to substantially reduce bat mortality, the sample size of bat carcasses was insufficient to allow daily (nightly) analyses of bat activity versus number of carcasses. To determine whether the amount of bat activity exposed to turbine operation had a statistically significant relationship to bat fatality, we modeled the number of bat carcasses found per search (calculated for each turbine with an acoustic detector) as a function of the number or recorded bat passes adjusted for survey effort using a linear model.

3.0 RESULTS

3.1 TURBINE OPERATIONS AND CURTAILMENT EVALUATION

Turbine operational data (generator speed, temperature, wind speed) were available for 211 nights for most turbines (data were unavailable during periods when turbines were offline due to maintenance activities and periods when turbines were offline). The complete dataset of turbine operation data consisted of 1,415,574 10-minute data points collected between 1 April and 15 November 2017. The amount of predicted and actual curtailment varied among turbines according to the curtailment treatment to which turbines were assigned and conditions present at individual turbines (Table 3-1). Turbines do not respond immediately to changing conditions, as reflected by comparing the number of 10-minute periods when curtailment conditions were met to the number of periods when conditions were met and turbines were curtailed (RPM was less than 1). Overall, turbines were curtailed during 73% of the 10-minute periods in which curtailment conditions were met. Among curtailment treatments, Mode 1 was most restrictive (Figure 3-1). Similarly, the amount of time curtailment conditions was met and turbines were curtailed varied among months based on conditions and treatments (Figure 3-2).

Table 3-1. Number of 10-minute periods per turbine during which curtailment conditions were met, and during which turbines were curtailed (RPM < 1), New Creek Wind Project, 2017

Turbine	Treatment	# 10-minute Periods				Curtailed/ Conditions Met (%)
		Total	Night Only	Conditions Met	Curtailed	
Turbine 1	Mode 3	29,230	13,131	8,219	6,299	77
Turbine 2	Mode 2	29,274	13,143	8,987	6,979	78
Turbine 3	Mode 4	29,276	13,154	7,741	5,955	77
Turbine 4	Mode 1	29,102	13,108	9,782	7,845	80
Turbine 5	Mode 3	29,248	13,162	7,369	5,624	76
Turbine 6	Mode 2	29,190	13,156	7,927	5,817	73
Turbine 7	Mode 4	29,175	13,163	6,247	4,684	75
Turbine 8	Mode 1	29,031	13,077	8,724	6,746	77

(**Table 3–1 Continued)**

Turbine 9	Mode 3	29,211	13,163	6,026	4,433	74
Turbine 10	Mode 2	29,183	13,163	6,633	4,932	74
Turbine 11	Mode 4	29,203	13,157	5,250	3,967	76
Turbine 12	Mode 1	29,195	13,163	7,348	5,406	74
Turbine 13	Mode 3	29,205	13,163	5,056	3,569	71
Turbine 14	Mode 2	28,427	12,880	5,275	3,963	75
Turbine 15	Mode 4	29,077	13,096	4,969	3,536	71
Turbine 16	Mode 1	29,267	13,163	7,295	5,406	74
Turbine 17	Mode 3	29,108	13,154	5,321	3,980	75
Turbine 18	Mode 2	29,255	13,163	6,118	4,422	72
Turbine 19	Mode 4	29,254	13,163	4,945	3,555	72
Turbine 20	Mode 1	29,298	13,162	7,180	5,412	75
Turbine 21	Mode 3	29,239	13,135	5,407	3,868	72
Turbine 22	Mode 2	29,235	13,162	6,403	4,533	71
Turbine 23	Mode 4	29,301	13,162	5,643	4,006	71
Turbine 24	Mode 1	29,310	13,162	7,723	5,127	66
Turbine 25	Mode 3	29,230	13,161	5,545	3,918	71
Turbine 26	Mode 2	29,286	13,161	6,397	4,571	71
Turbine 27	Mode 4	29,274	13,160	5,738	4,116	72
Turbine 28	Mode 1	29,287	13,159	7,859	5,998	76
Turbine 29	Mode 3	29,304	13,157	6,157	4,426	72
Turbine 30	Mode 2	23,947	10,740	5,582	4,216	76
Turbine 31	Mode 4	29,273	13,130	5,618	3,923	70
Turbine 32	Mode 1	29,288	13,159	6,966	5,272	76
Turbine 33	Mode 3	29,288	13,159	4,988	3,652	73
Turbine 34	Mode 2	29,285	13,147	5,798	4,293	74
Turbine 35	Mode 4	29,264	13,158	4,600	3,100	67
Turbine 36	Mode 1	29,288	13,158	6,618	5,160	78
Turbine 37	Mode 3	29,296	13,157	4,933	3,316	67
Turbine 38	Mode 2	28,966	13,096	5,192	3,795	73
Turbine 39	Mode 4	25,347	11,572	4,609	3,163	69
Turbine 40	Mode 1	29,295	13,156	7,363	5,438	74
Turbine 41	Mode 3	29,287	13,154	5,662	4,008	71
Turbine 42	Mode 2	29,223	13,154	6,121	4,111	67
Turbine 43	Mode 4	29,263	13,154	5,042	3,402	67
Turbine 44	Mode 1	29,287	13,139	7,073	5,234	74
Turbine 45	Mode 3	29,301	13,154	5,577	3,822	69
Turbine 46	Mode 2	22,153	10,086	5,022	3,999	80
Turbine 47	Mode 4	29,283	13,151	5,143	3,523	69
Turbine 48	Mode 1	29,291	13,153	7,379	5,366	73
Turbine 49	Mode 3	29,274	13,152	5,490	3,780	69

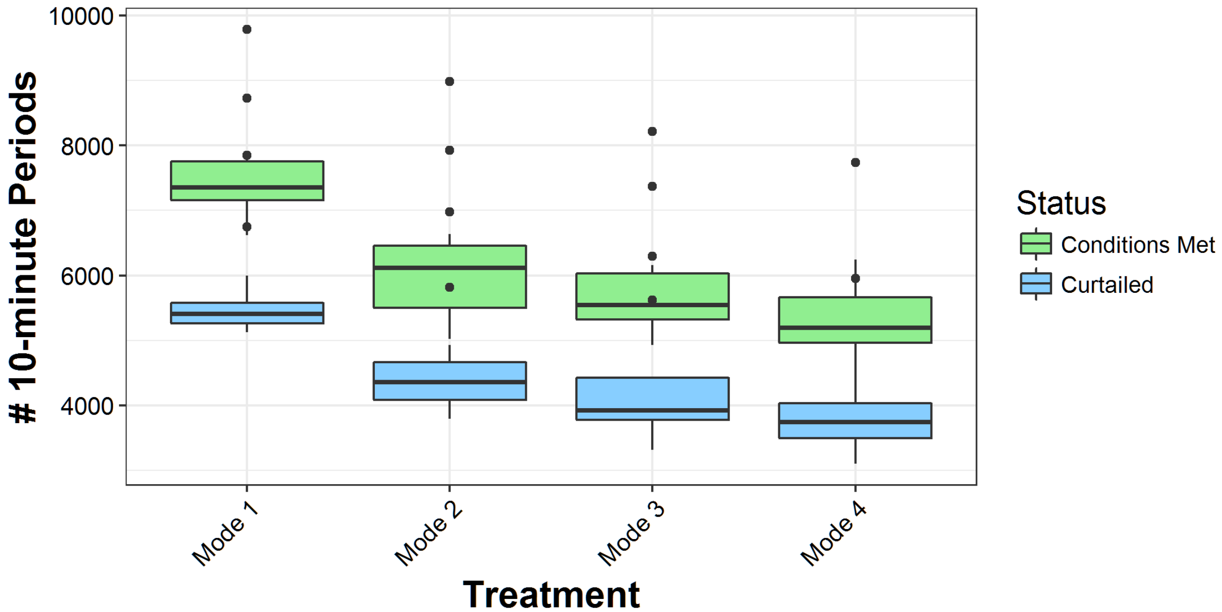


Figure 3-1. Number of periods meeting curtailment conditions (conditions met) and curtailed (RPM <1) by treatment, New Creek Wind Project, 2017

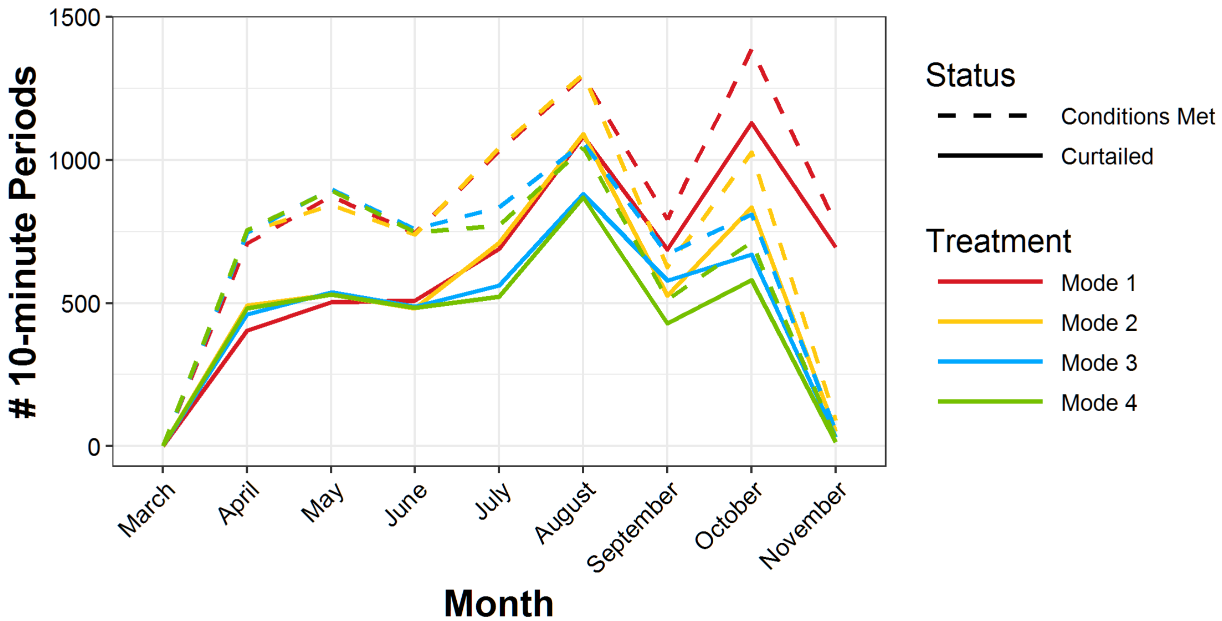


Figure 3-2. Monthly number of periods meeting curtailment conditions (conditions met) and curtailed (RPM <1) by treatment, New Creek Wind Project, 2017

3.2 ACOUSTIC MONITORING

Bat detectors operated for a total of 1,110 out of 1,551 (72%) available detector-nights between 19 May and 30 November 2017. Detectors could not be checked as often as initially anticipated due to limited availability of operations staff authorized to climb turbines, resulting in inability to replace malfunctioning units and loss of all data from Turbine 19 and most data from Turbine 7 (Table 3-2). Nevertheless, the remaining 7 detectors operated properly for most nights, providing good coverage of the full seasons during which bat activity is expected to occur. Bat detectors recorded a total of 13,691 bat passes during this period, yielding an overall activity level of 12.3 passes per detector night (DN). The 7 detectors with more than 100 detector nights, recorded between 581 to 4,402 bat passes, with corresponding activity rates ranging from 3.8 passes per DN at Turbine 13 to 25.3 passes per DN at Turbine 1 (Table 3-2).

Table 3-2. Acoustic survey effort and results, New Creek Wind Project, 2017

Turbine	Survey Dates	Calendar Nights	Detector Nights (DN)	Bat Passes	Rate (passes per DN)	Maximum Passes per Night
Turbine 1	June 8 - November 28	174	174	4,402	25.3	166
Turbine 7	June 8 - November 15	161	6	16	2.7	5
Turbine 13	June 8 - November 15	161	151	581	3.8	27
Turbine 19	June 8 - November 15	161	0	-	-	-
Turbine 25	May 19 - November 15	181	178	2,103	11.8	82
Turbine 31	May 19 - November 30	196	104	605	5.8	51
Turbine 37	May 19 - November 30	196	176	1,583	9.0	71
Turbine 43	June 10 - November 19	163	163	2,224	13.6	127
Turbine 49	June 9 - November 13	158	158	2,177	13.8	204
Total		1,551	1,110	13,691	12.3	-

Of the 13,691 recorded bat passes, Stantec identified 7,878 (58%) to species or species group, and categorized the remainder as high frequency or low frequency unknown passes. Hoary bats were the most commonly identified species at all detectors, besides Turbine 31 where silver-haired bats were the most commonly identified. Overall, hoary bats accounted for 44% of passes identified to species (Table 3-3). Eastern red and silver-haired bats accounted for 24% and 26% of identified passes, respectively. Together, these 3 long-distance migratory species accounted for 94% of passes identified to species or species group, with this pattern occurring consistently among detectors. Only 6 passes were identified as *Myotis* species, with activity occurring at only 3 turbines.

Table 3-3. Species composition of recorded bat activity, New Creek Wind Project, 2017

Turbine	Big brown/ silver-haired			Hoary bat	*Myotis*	Eastern Red/ Tri-colored Bat			Unknown		Total
	Big Brown	Silver-haired	BBSH			Eastern Red	Tri-colored	RBTB	High Frequency	Low Frequency	
Turbine 1	29	545	77	1,150	3	487	13	28	417	1,653	4,402
Turbine 7	0	0	0	5	0	0	0	0	0	11	16
Turbine 13	7	88	31	140	0	88	4	9	58	156	581
Turbine 25	20	290	39	562	1	309	13	0	194	675	2,103
Turbine 31	2	179	5	92	0	80	4	7	54	182	605
Turbine 37	12	269	9	349	0	256	10	14	156	508	1,583
Turbine 43	8	344	4	606	2	336	23	22	220	659	2,224
Turbine 49	5	343	3	556	0	357	13	30	238	632	2,177
Total	**83**	**2,058**	**168**	**3,460**	**6**	**1,913**	**80**	**110**	**1,337**	**4,476**	**13,691**

Seasonal patterns in activity varied among species, with hoary, eastern red, and tri-colored bats detected most frequently in August and silver-haired bats and big brown bats detected most frequently in early September (Figure 3-3). Hoary bat activity also peaked in late June. Silver-haired bat activity peaked slightly in May and early June. Although species presence varied among nights, overall timing of bat activity showed similar patterns among detectors and species groups, with most activity occurring during the first few hours past sunset (Figure 3-4). Appendix B includes plots of overall species composition, nightly bat activity and detector operation, and timing of bat activity recorded at each turbine.

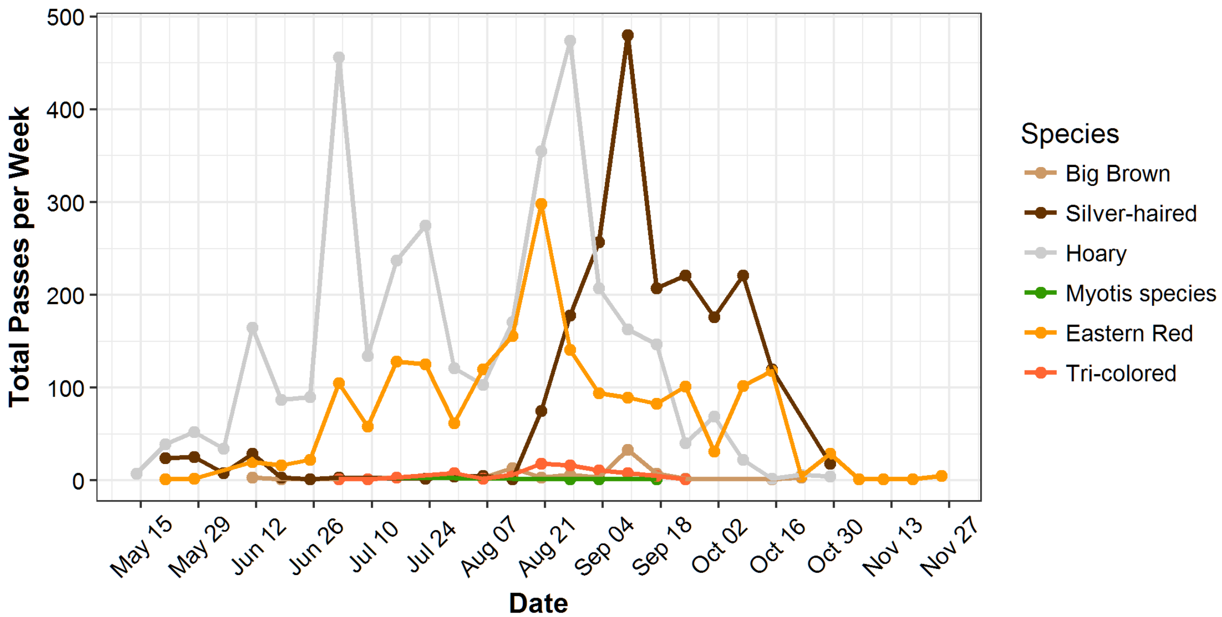


Figure 3-3. Total bat passes identified to species per week, New Creek Wind Project, 2017

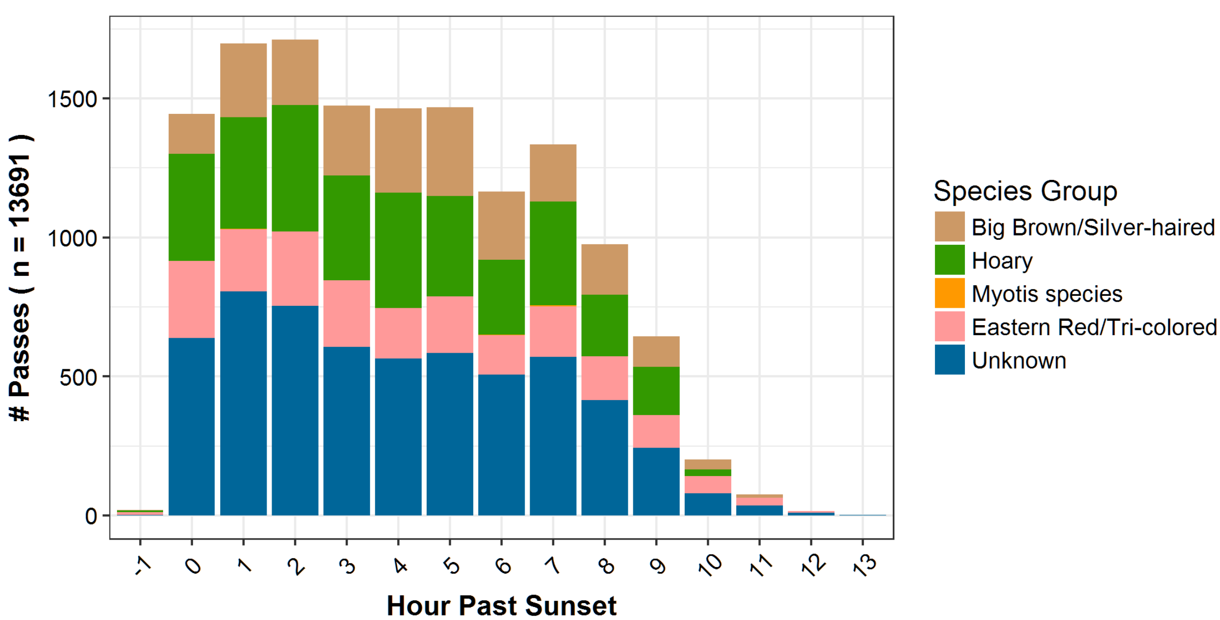


Figure 3-4. Overall timing of bat activity recorded at turbine nacelles, New Creek Wind Project, 2017

3.2.1 Bat Activity and Weather

Bat activity showed clear relationships with temperature and wind speed measured at corresponding turbine nacelles, with 92% of passes for which weather data were available (n = 11,692) occurring when temperature was greater than 10° C and 54% of passes occurring at wind speeds less than 4.5 m/s (Figure 3-5, Figure 3-6). Considering temperature and wind speed together, bat activity occurred disproportionally during calm, warm conditions, and few bat passes were recorded during times with higher wind speeds or cooler temperatures (Figure 3-7). Also, Figure 3-7 suggests an apparent interaction between the effects of temperature and wind speed on bat activity, with activity during windy conditions occurring primarily at warmer temperatures.

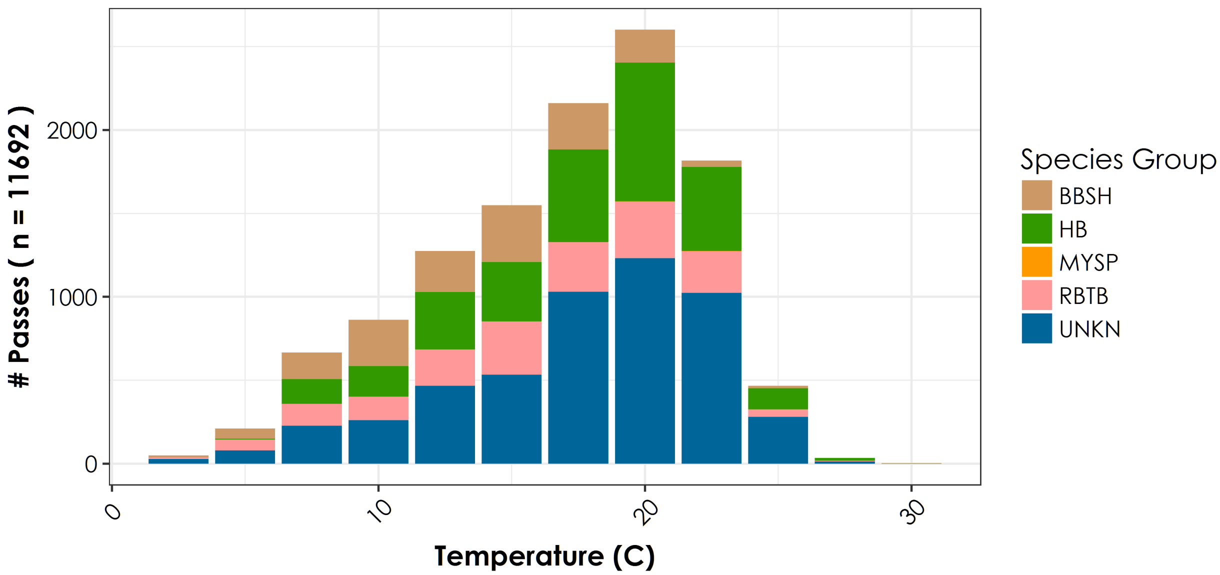


Figure 3-5. Bat activity by temperature bin (2.5 degrees C) recorded at turbine nacelles, New Creek Wind Project, 2017

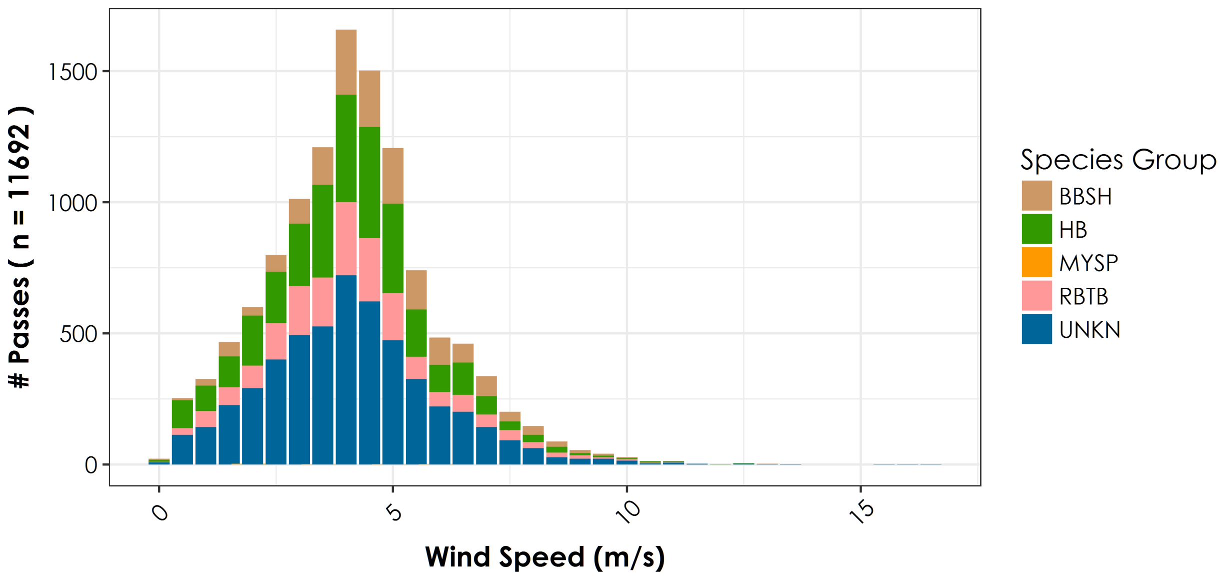


Figure 3-6. Bat activity by wind speed bin (0.5 m/s) recorded at turbine nacelles, New Creek Wind Project, 2017

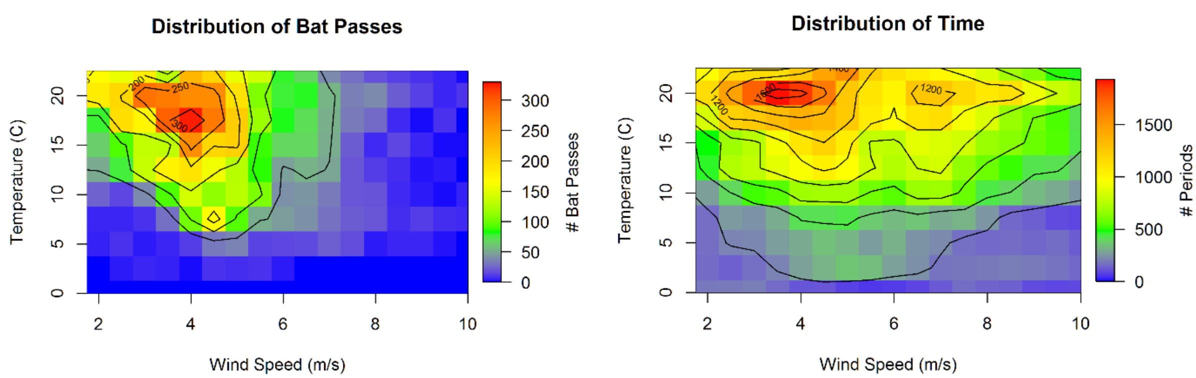


Figure 3-7. Distribution of bat passes (left) and time periods (right) as a function of wind speed and temperature based on nacelle-mounted acoustic detectors, New Creek Wind Project, 2017

3.2.2 Bat Activity and Turbine Operation

The 7 turbines with bat detectors that operated successfully were assigned to only 2 curtailment treatments (5 were assigned to Mode 3 and 2 were assigned to Mode 4). However, conditions present at individual turbines dictated the amount of time during which individual turbines were curtailed. By turbine, curtailment conditions were met during periods encompassing between 72% and 87% of recorded bat passes, and turbines were effectively curtailed (RPM < 1) during periods encompassing between 61% and 85% of recorded bat passes (Table 3-4, Figure 3-8). The predicted energy loss (potential energy production during time periods when curtailment conditions were met) versus actual energy loss (potential energy production during time periods when RPM < 1) was variable among turbines, although not all turbine down-time was necessarily the result of turbine curtailment (Figure 3-9). As designed, the curtailment program avoided a consistent proportion of bat activity between May and September, with a higher proportion of bat activity (but lower overall number of bat passes) exposed to operation in October and November (Figure 3-10).

Table 3-4. Predicted avoidance (passes recorded when curtailment conditions were met) versus actual avoidance (passes recorded when RPM < 1) of bat activity at nacelle height, New Creek Wind Project, 2017

Turbine	Treatment	# Passes with Weather and Turbine Operation Data	Predicted Avoidance (%)	Actual Avoidance (%)
Turbine 1	Mode 3	3,689	87	74
Turbine 13	Mode 3	509	73	61
Turbine 25	Mode 3	1,828	81	74
Turbine 31	Mode 4	440	72	85
Turbine 37	Mode 3	1,352	80	70
Turbine 43	Mode 4	1,954	73	74
Turbine 49	Mode 3	1,904	80	69
Total		**11,676**	**80**	**73**

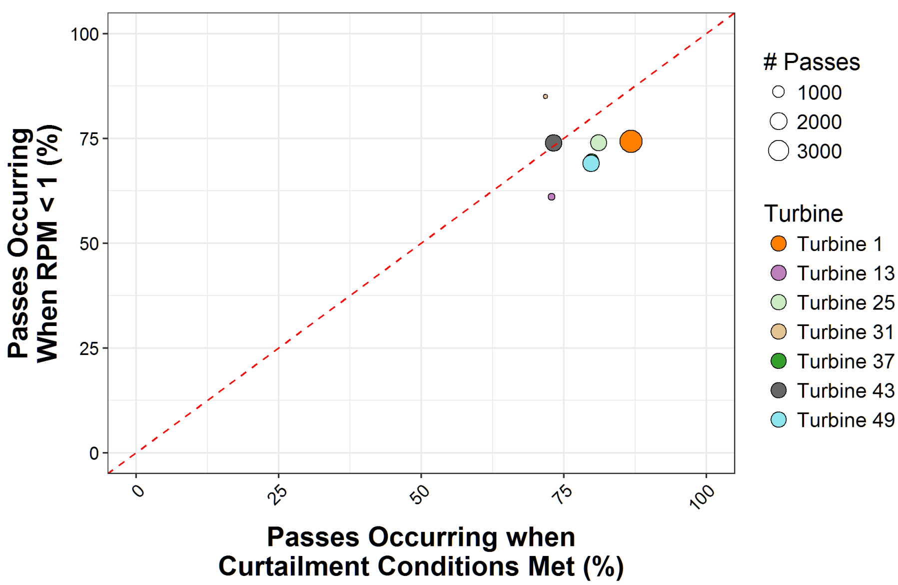


Figure 3-8. Predicted avoidance (passes recorded when curtailment conditions were met) versus actual avoidance (passes recorded when RPM < 1) of bat activity at nacelle height, New Creek Wind Project, 2017

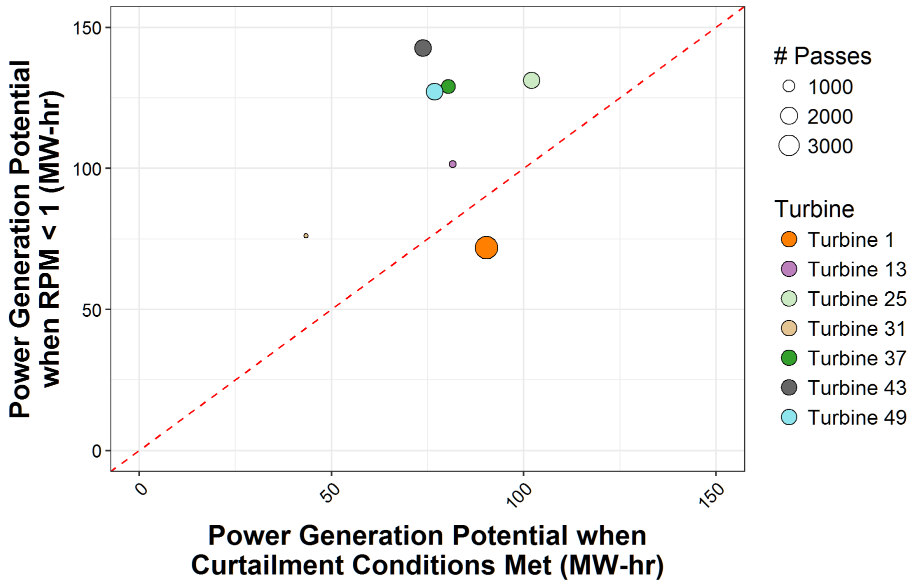


Figure 3-9. Predicted energy loss (energy production potential during periods when curtailment conditions were met) versus actual energy loss (energy production potential during periods when RPM < 1) measured at 7 turbines with acoustic bat detectors, New Creek Wind Project, 2017

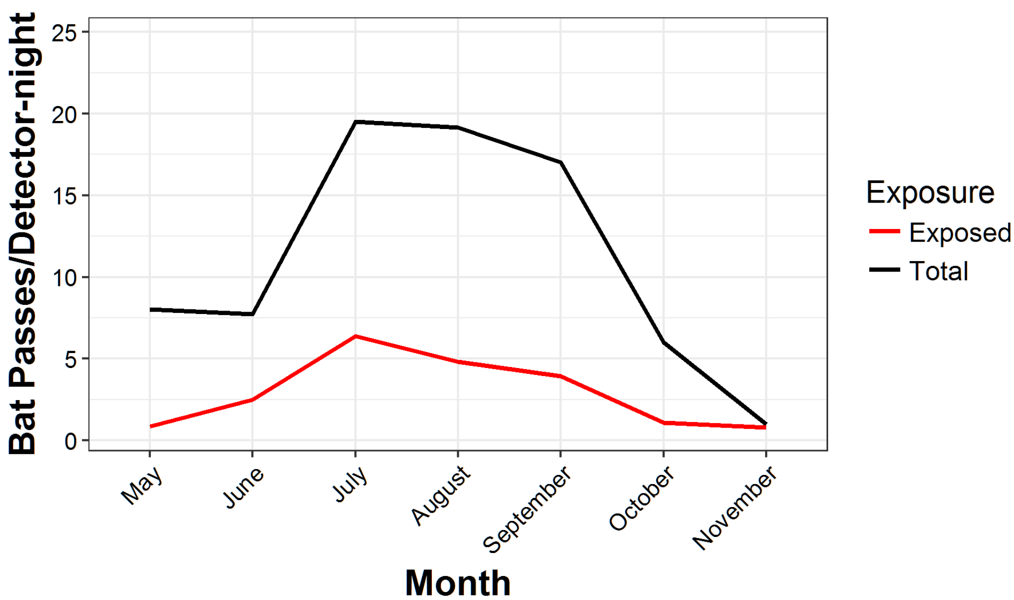


Figure 3-10. Total and exposed (occurring when turbine RPM > 1) bat activity by month, adjusted for survey effort based on 7 nacelle-mounted acoustic detectors at the New Creek Wind Project during 2017

Based on data from the 7 turbines with operating acoustic detectors, turbines were curtailed (RPM < 1) during 23,476 (18%) of 132,185 time periods, during which bats were detected within 4,582 periods (20% of curtailed periods; Table 3-5). Turbines were curtailed during 4,582 (71%) of the 6,461 total periods in which bat activity occurred, which in turn represented 5% of total available time periods.

We were unable to measure actual avoidance of bat activity associated with each of the curtailment treatments because acoustic detectors were deployed on turbines detectors representing only 2 treatments. However, we predicted energy loss and avoidance of bat activity for each of the 4 treatments based on power generation potential and bat activity occurring during periods in which curtailment conditions would have been met. The 4 treatments implemented in 2017 differed by just 12% in terms of the amount of predicted avoidance of bat activity, although the most restrictive treatment (Mode 1) resulted in approximately double the predicted energy loss per turbine compared to the least restrictive treatment (Figure 3-11).

Table 3-5. Number of time periods per turbine with and without bat activity during which turbines were curtailed, New Creek Wind Project, 2017

Turbine	Total Periods	Bat Activity Recorded			Bat Activity Not Recorded		
		Curtailed	Not Curtailed	Total	Curtailed	Not Curtailed	Total
Turbine 1	19,985	1,331	522	1,853	3,484	14,648	18,132
Turbine 13	18,821	253	160	413	2,639	15,769	18,408
Turbine 25	22,656	762	328	1,090	3,021	18,545	21,566
Turbine 31	11,108	255	58	313	1,703	9,092	10,795
Turbine 37	20,035	578	283	861	2,667	16,507	19,174
Turbine 43	19,729	730	340	1,070	2,591	16,068	18,659
Turbine 49	19,851	673	368	1,041	2,789	16,021	18,810
Total	**132,185**	**4,582**	**2,059**	**6,641**	**18,894**	**106,650**	**125,544**

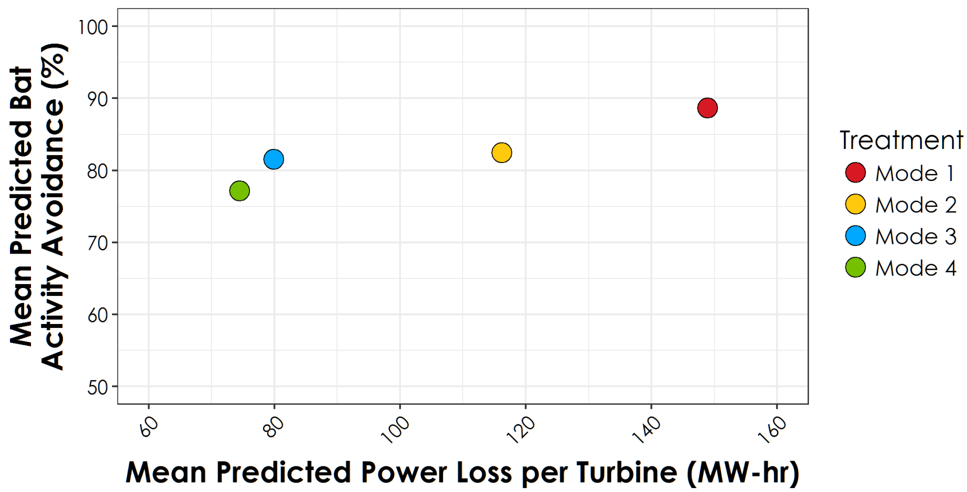


Figure 3-11. Predicted energy loss and avoidance of bat activity associated with each curtailment treatment implemented at the New Creek Wind Project during 2017, based on 7 turbines with nacelle-mounted acoustic detectors

3.3 BIRD AND BAT FATALITY SURVEYS

Stantec conducted a total of 1,497 turbine searches during 152 days on-site between 17 April and 15 November 2017. Stantec searched all 49 turbines at a 7-day interval unless the schedule was disrupted by hazards such as lightning or blade icing or construction/repair work that prevented safe access to a turbine. In such cases, turbine searches were typically made up during the day following the interruption. Stantec surveyors were on site Monday through Friday throughout the entirety of the monitoring season. Individual turbines were searched on 28 to 31 occasions during the survey period. The average search time among the 49 study turbines ranged from 31 to 38 minutes with an overall average of 34.4 minutes.

Stantec found 24 bat and 7 bird carcasses during standardized searches at the 49 study turbines, and an additional 9 bat and 7 bird carcasses incidentally at those turbines. Including incidentals, Stantec found 0 to 4 bat carcasses and 0 to 2 bird carcasses per turbine (Table 3-6). Most carcasses were fresh (fatality estimated to have occurred the previous night), although searchers occasionally found carcasses estimated to be several days up to several weeks old. Appendix C includes details of all carcasses found during the 2017 monitoring period.

Table 3-6. Survey effort per turbine, curtailment treatment assignments, and bird and bat carcasses (incidentals in parentheses) found at each of the 49 turbines at the New Creek Wind Project between 17 April and 15 November 2017

Turbine	Treatment	# Searches	Bat	Bird	Total
1	Mode 3	31	3 (1)	1	4 (1)
2	Mode 2	31	0	(2)	(2)
3	Mode 4	30	1	(1)	1 (1)
4	Mode 1	30	2	1	3
5	Mode 3	30	0	0	0
6	Mode 2	31	1	0	1
7	Mode 4	31	1	0	1
8	Mode 1	31	0	0	0
9	Mode 3	30	(3)	(1)	(4)
10	Mode 2	30	0	0	0
11	Mode 4	31	0	(1)	(1)
12	Mode 1	31	0	(1)	(1)
13	Mode 3	31	0	1	1
14	Mode 2	30	0	0	0
15	Mode 4	30	0	0	0
16	Mode 1	31	3	0	3
17	Mode 3	31	0	0	0
18	Mode 2	31	2 (1)	0	2 (1)
19	Mode 4	30	(1)	0	(1)
20	Mode 1	30	0	(1)	(1)
21	Mode 3	31	0	0	0
22	Mode 2	31	0	1	1
23	Mode 4	31	0	0	0
24	Mode 1	30	1	0	1
25	Mode 3	28	1	0	1
26	Mode 2	31	0	1	1
27	Mode 4	31	(1)	1	1 (1)
28	Mode 1	31	0	0	0
29	Mode 3	30	1	0	1
30	Mode 2	30	(1)	0	(1)
31	Mode 4	31	0	0	0
32	Mode 1	31	0	0	0
33	Mode 3	31	0	0	0
34	Mode 2	30	0	0	0
35	Mode 4	30	0	0	0
36	Mode 1	31	1	1	2
37	Mode 3	31	0	0	0
38	Mode 2	31	2	0	2
39	Mode 4	30	1	0	1
40	Mode 1	30	0	0	0
41	Mode 3	31	(1)	0	(1)
42	Mode 2	31	0	0	0
43	Mode 4	31	0	0	0
44	Mode 1	30	0	0	0
45	Mode 3	30	1	0	1
46	Mode 2	31	0	0	0
47	Mode 4	31	0	0	0
48	Mode 1	31	1	0	1
49	Mode 3	30	2	0	2
Total		**1,497**	**24 (9)**	**7 (7)**	**31 (16)**

3.3.1 Seasonal and Spatial Fatality Patterns

Bat carcasses were found between 20 April and 9 November and bird carcasses were found between 1 May and 6 November 2017. By month, most bat carcasses were found in May (n = 11; 33%), and carcasses were found during every month except September (Figure 3-12). Most bird carcasses were found in May (n = 6; 43%), with birds being found during every month except April (Figure 3-12).

No more than 1 bat carcass was found per turbine during an individual search, except on one occasion on 31 May when 3 incidental hoary bats were found at Turbine 9. No more than 1 bird carcass was found per turbine. Bat carcasses were found between 5 and 55 m from turbines, and bird carcasses were found between 1 and 55 m from turbines (Figure 3-13). Appendix D includes a map of each turbine showing the extent of searchable area and location of all bird and bat carcasses.

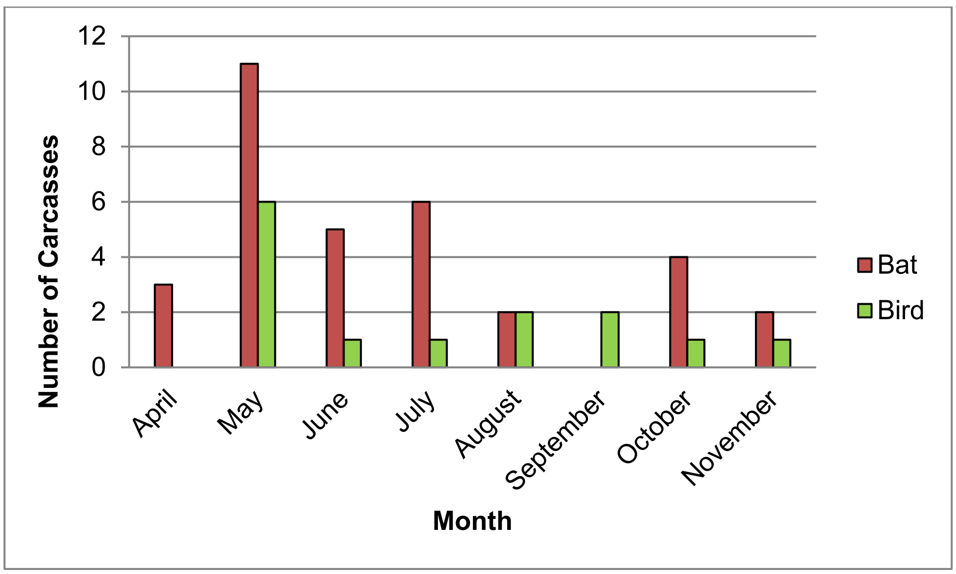


Figure 3-12. Bat and bird carcasses found per month at all 49 study turbines (including incidentals) at the New Creek Wind Project from 17 April – 15 November 2017

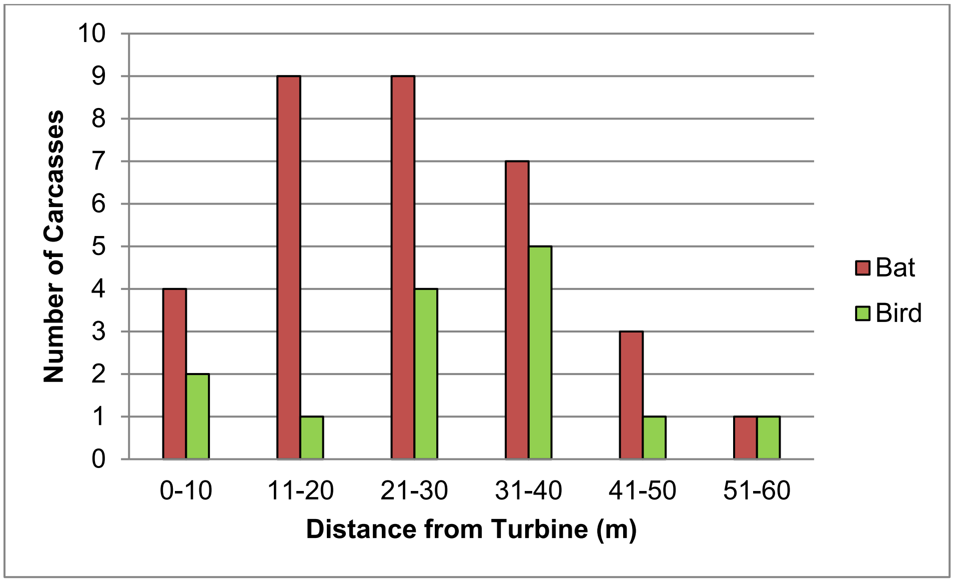


Figure 3-13. Bat and bird carcasses found according to distance from turbine at 49 study turbines (including incidentals) at the New Creek Wind Project from 17 April to 15 November

3.3.2 Species Composition

Including all carcasses found in 2017 at the 49 study turbines, 33 bat and 14 bird carcasses were collected at the Project. Three bat species were documented: eastern red bat, silver-haired bat, and hoary bat (Table 3-7). Long-distance migratory species accounted for 100% of bat carcasses found in 2017. No *Myotis* species bats were found. Of the 33 total bat carcasses, 19 (58%) were male, 4 (12%) were female, and 10 (30%) were of unknown sex. Ten bird species were found at the Project (Table 3-8). One warbler that could not be identified to species was found (Table 3-8). No threatened or endangered bird or bat species were found during 2017 surveys.

Table 3-7. Species composition of bat carcasses (incidentals bounded by parentheses) found at the New Creek Wind Project between 17 April–15 November 2017

Common Name	Species	Total	Percent
eastern red bat	*Lasiurus borealis*	14 (2)	48.5%
hoary bat	*Lasiurus cinereus*	8 (7)	45.5%
silver-haired bat	*Lasionycteris noctivagans*	2	6.1%
Total		24 (9)	100%

Table 3-8. Species composition of bird carcasses (incidentals bounded by parentheses) found by at the New Creek Wind Project between 17 April–15 November 2017

Common Name	Species	Total	Percent
black-billed cuckoo	*Coccyzus erythropthalmus*	(1)	7.1%
blackburnian warbler	*Setophaga fusca*	1 (1)	14.3%
blackpoll warbler	*Setophaga striata*	(1)	7.1%
common yellowthroat	*Geothlypis trichas*	1	7.1%
northern rough-winged swallow	*Stelgidopteryx serripennis*	(1)	7.1%
ovenbird	*Seiurus aurocapilla*	1	7.1%
red-eyed vireo	*Vireo olivaceus*	1 (1)	14.3%
ruby-crowned kinglet	*Regulus calendula*	2	14.3%
turkey vulture	*Cathartes aura*	(1)	7.1%
unidentified warbler	*Parulidae (gen, sp)*	1	7.1%
yellow-billed cuckoo	*Coccyzus americanus*	(1)	7.1%
Total		**7 (7)**	**100%**

3.3.3 Searcher Efficiency Trials

Stantec conducted searcher efficiency trials using 58 bat carcasses and 60 bird carcasses during the 2017 monitoring period. Bat trials consisted of carcasses found on site, supplemented by bat carcasses provided by the WVDNR at the beginning of the 2017 study period. Because the USFWS salvage permit did not authorize use of bird carcasses for searcher efficiency trials, Stantec obtained juvenile quail from a lab supply company to serve as surrogates for bird carcasses.

During trials, carcasses were placed in a representative sample of available ground cover conditions, and at variable distances and azimuths from turbines to accurately represent the range of ground cover types and conditions present at searched turbines. Trials were conducted on 11 separate occasions, with carcasses placed at 46 of the 49 turbines. Searchers found 41 bat trial carcasses (71%) and 45 bird trial carcasses (75%) during the 2017 monitoring period (Table 3-9).

Table 3-9. Searcher efficiency trial results with mean searcher efficiency by type and confidence intervals generated by the Huso estimator

Category	# Trials	# Found	Mean Searcher Efficiency (95% CI)
Bats	58	41	0.71 (0.59 - 0.83)
Birds	60	45	0.75 (0.63 - 0.85)

3.3.4 Carcass Persistence Trials

Stantec conducted 103 carcass persistence trials during the 2017 monitoring period using 47 bat carcasses and 56 bird (quail) carcasses in good condition. Carcass persistence trials occurred at each of the 49 turbines, and were started on 8 separate occasions between 1 May and 23 October 2017, each lasting 14 days. Of the 103 carcasses placed, 74 (72%) were removed on the first day of the trial period, 93 (90%) were removed by day 7, and 99 (96%) were removed before day 14 of the trial period. Carcasses were removed by scavengers between day 1 and day 12 of trials. Two bat carcasses and 2 bird carcasses remained throughout the entire 14-day trial period.

Carcass persistence was modeled using 4 separate statistical distributions, and we selected the distribution with the lowest corresponding AICc value as the best model for carcass persistence, which was log-logistic for birds and bats (Table 3-10). Based on these models, carcass persistence was between 1 and 2 days for birds and bats, with an estimated 38% of bat carcasses and 31% of bird carcasses persisting through the search interval.

Table 3-10. Estimated carcass persistence and associated confidence intervals for birds and bats based on each model within the Huso estimator

Type	# Trials	Model	AICc	Δ AICc	Carcass Persistence Estimate in Days (95% CI)	Proportion Carcasses Persisting through Search Interval (95% CI)
Bats	47	**log-logistic**	**190.29**	**-**	**1.84 (1.23 - 2.57)**	**0.38 (0.29 - 0.47)**
		lognormal	190.81	0.52	1.82 (1.21 - 2.54)	0.38 (0.29 - 0.47)
		Weibull	192.23	1.94	2.97 (2.01 - 4.26)	0.39 (0.29 - 0.48)
		exponential	192.43	2.14	3.27 (2.2 - 4.65)	0.41 (0.30 - 0.52)
Birds	56	**log-logistic**	**199.77**	**-**	**1.40 (0.97 - 1.92)**	**0.31 (0.24 - 0.39)**
		lognormal	200.79	1.02	1.39 (0.94 - 1.91)	0.31 (0.23 - 0.39)
		Weibull	203.59	3.82	2.20 (1.51 - 3.19)	0.32 (0.23 - 0.40)
		exponential	205.86	6.09	2.53 (1.68 - 3.64)	0.34 (0.24 - 0.44)

Stantec deployed automatic game cameras at selected trials occasionally during the 2017 monitoring period and recorded videos of American crows (*Corvus brachyrhynchos*), common ravens (*Corvus corax*), and turkey vultures removing carcasses (Figure 3-14). Cameras also documented activity of other potential scavengers including black bears and bobcats, although none were observed removing carcasses.

Figure 3-14. Turkey vulture removing a trial carcass (quail) from Turbine 18 on 20 October 2017

3.3.5 Estimated Fatality Rates

Stantec estimated fatality rates for birds and bats separately, using the Huso estimator, for each of the curtailment treatments, and for all turbines combined. We included carcasses found incidentally within search areas for all mortality estimates. Confidence intervals for bird and bat mortality estimates overlapped among all treatments, indicating lack of significant differences in mortality estimates among treatments (Table 3-11). To calculate fatality estimates for individual curtailment modes including incidental carcasses, we entered adjusted dates for the last turbine search to ensure that the estimator applied the proper (7 day) search interval, although this was not necessary for combined estimates. Combining treatments, estimated fatality rates for the 17 April to 15 November 2017 monitoring period were 2.63 (95% CI 1.82–3.89) bats per turbine and 1.02 (95% CI 0.77–1.4) birds per turbine (Table 3-11). Extrapolating these estimates to all Project turbines suggest that 129 bat (95% CI 89–191) and 50 bird (95% CI 38–69) fatalities occurred at the Project during the 2017 monitoring period. Fatality estimates were based on the number of bird and bat carcasses found within search areas during standardized searches and incidentally at the 49 study turbines, accounting for search interval, searcher efficiency, carcass persistence, and a density-weighted area correction factor based on carcass distribution and percent area searched beneath turbines (as described in Section 2.4.5 Fatality Estimate Methods).

Table 3-11. Fatality estimates for birds and bats at New Creek and for each curtailment mode based on year 2017 monitoring data

Type	Carcass Persistence Model	Treatment	# Turbines	# Carcasses	Per-turbine Estimate (95% CI)	Per-MW Estimate (95% CI)
Bats	log-logistic	Mode 1	12	7	2.62 (1.5 - 4.56)	1.31 (0.75 - 2.28)
		Mode 2	12	6	2.19 (1.34 - 3.4)	1.10 (0.67 - 1.7)
		Mode 3	13	11	4.01 (2.24 - 6.45)	2.01 (1.12 - 3.225)
		Mode 4	12	5	1.85 (1.42 - 2.55)	0.93 (0.71 - 1.275)
		Combined	**49**	**29***	**2.63 (1.82 - 3.89)**	**1.32 (0.91 - 1.945)**
Birds	log-logistic	Mode 1	12	3	1.28 (0.96 - 1.75)	0.64 (0.48 - 0.875)
		Mode 2	12	3	1.22 (0.73 - 1.93)	0.61 (0.365 - 0.965)
		Mode 3	13	3	1.3 (0.99 - 1.75)	0.65 (0.495 - 0.875)
		Mode 4	12	3	1.28 (0.98 - 1.72)	0.64 (0.49 - 0.86)
		Combined	**49**	**12***	**1.02 (0.77 - 1.4)**	**0.51 (0.385 - 0.7)**

*Carcasses older than 7 days (n = 3 bats, 1 bird) and found incidentally outside survey plots (n = 1 bat, 1 bird) were omitted from the dataset used to estimate bird and bat fatality.

3.3.6 Bat Fatality and Acoustic Activity

Stantec found 7 bat carcasses at the 7 turbines with acoustic datasets. Based on these turbines, the total number of bat carcasses found per turbine search was significantly higher at turbines with higher levels of acoustic data (Figure 3-15). Because all turbines were curtailed throughout the monitoring period, an insufficient sample size of bat carcasses was available for more detailed analyses of bat activity versus fatality (e.g., nightly analyses).

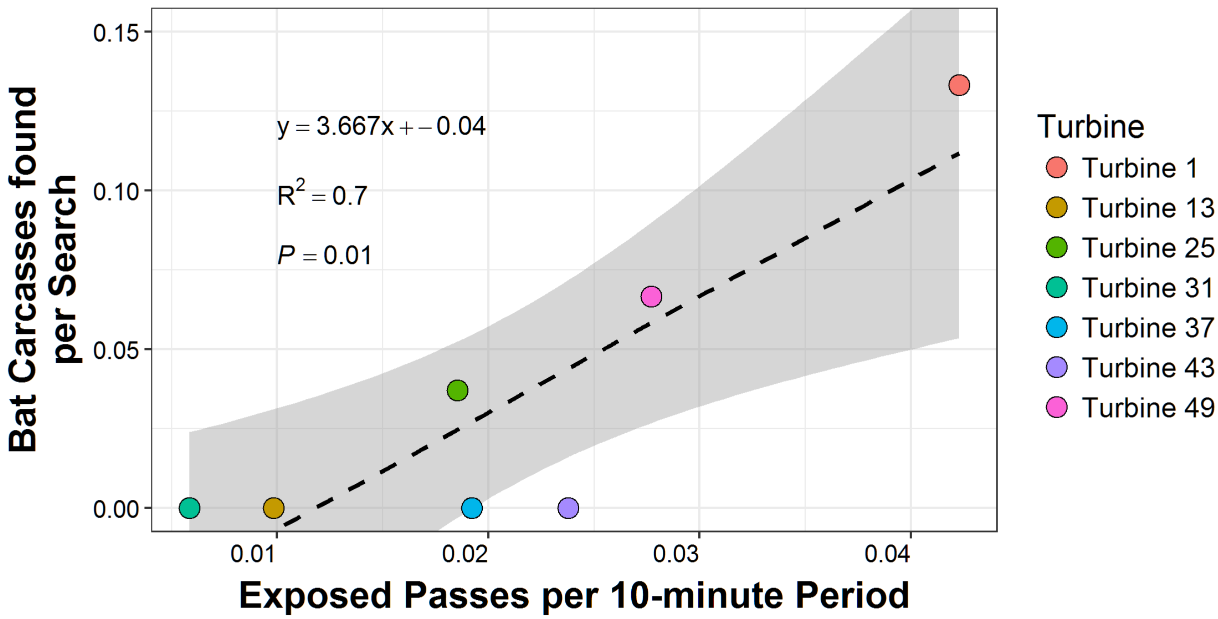


Figure 3-15. Relationship between bat activity (passes per 10-minute period) and fatality (carcasses found per search) for the 7 turbines with operating acoustic detectors, New Creek Wind Project, 2017

4.0 DISCUSSION

The automatic curtailment system in place between 1 April and 15 November 2017 prevented turbine operation during periods in which most acoustic bat activity (73% overall) occurred, resulting in low estimated bat fatality rates despite substantial amounts of bat activity at nacelle height. Only 8 bat carcasses were found during July to September, when bat activity was highest overall. Although the 4 curtailment treatments differed substantially in the number of periods curtailed and associated energy loss, each treatment yielded low bat fatality estimates that did not differ significantly among treatments.

Bat fatality is difficult to estimate with precision, particularly when small numbers of carcasses are found, as is often the case when curtailment strategies are in place as was the case for this Project. However, nacelle-mounted acoustic detectors provided valuable data enabling us to document subtle differences in the amount of bat activity avoided by each of the 4 curtailment modes. The significant positive relationship between the amount of exposed bat activity and the number of bat carcasses found per turbine suggests that comparing the amount of protected bat activity could provide a reliable means of evaluating effectiveness of curtailment strategies. By simulating each of the 4 curtailment modes for the dataset of operational and acoustic data from 7 turbine nacelles, we showed that the most restrictive treatment (Mode 1) would have avoided 89% of bat passes whereas the least restrictive treatment (Mode 4) would still have avoided 77% of bat passes. In terms of cost of curtailment, the amount of energy loss predicted for Mode 1 was approximately double that for Mode 4. Because estimated bat mortality did not differ between even the most and least restrictive curtailment mode, our results suggest that all strategies in place during the 2017 monitoring period were at or above a threshold of protectiveness necessary for maintaining low risk to bats.

This suggests ample room for improving the efficiency of curtailment while resulting in little if any increase in bat fatality or risk to rare bat species.

Acoustic monitoring provided valuable information for comparing the relative effectiveness of multiple curtailment strategies, but also documented seasonal patterns in bat activity and species composition that were typical for the region. Overall, species composition of acoustic activity suggested that long-distance migratory species comprise most bat activity at nacelle height. Three migratory species (eastern red bat, hoary bat, and silver-haired bat) accounted for over 90% of recorded bat activity and 100% of carcasses found during the 2017 monitoring period. Importantly, acoustic surveys demonstrated that bats are quite active near the nacelle of operating turbines, but only during certain conditions (warm temperatures and relatively calm winds). Therefore, curtailment systems targeting multiple factors associated with high levels of bat activity can effectively avoid risk to bats while minimizing unnecessary energy loss during conditions with little or no bat activity.

Despite the effectiveness of the curtailment treatments in place during the 2017 monitoring period, turbines were not curtailed during all times when the designated curtailment conditions were met. This may be due to a combination of factors related to the design of the curtailment system, such as hysteresis between cut-in and cut-out wind speed and temperature thresholds and the time scale on which curtailment decisions were made, temporary malfunction of the system (Gamesa reported several instances to Enbridge in which the curtailment system was inactive), or a combination of these and other factors. If such factors can be identified and modified such that turbines are curtailed during all conditions where criteria are met, the curtailment treatments implemented in 2017 would be able to avoid additional bat activity based on data collected in 2017 without changing parameters such as cut-in speeds. Whether such changes would further reduce bat fatality estimates cannot be predicted based on existing data. While the 2017 results suggest room for improving curtailment to align more closely and/or quickly with conditions at nacelle height, each curtailment mode implemented by the system appeared highly effective at substantially reducing risk to bats.

Estimated bird and bat fatality rates were low compared to similar studies conducted in the region (Figure 4-1, Figure 4-2). Appendix E includes data used to generate Figures 4-1 and 4-2 and provides associated references. Low bat fatality rates are presumably the result of turbine curtailment. Bird fatality appears highly linked with presence of artificial lighting, which has been minimized throughout the Project area, possibly contributing to the low bird fatality estimate.

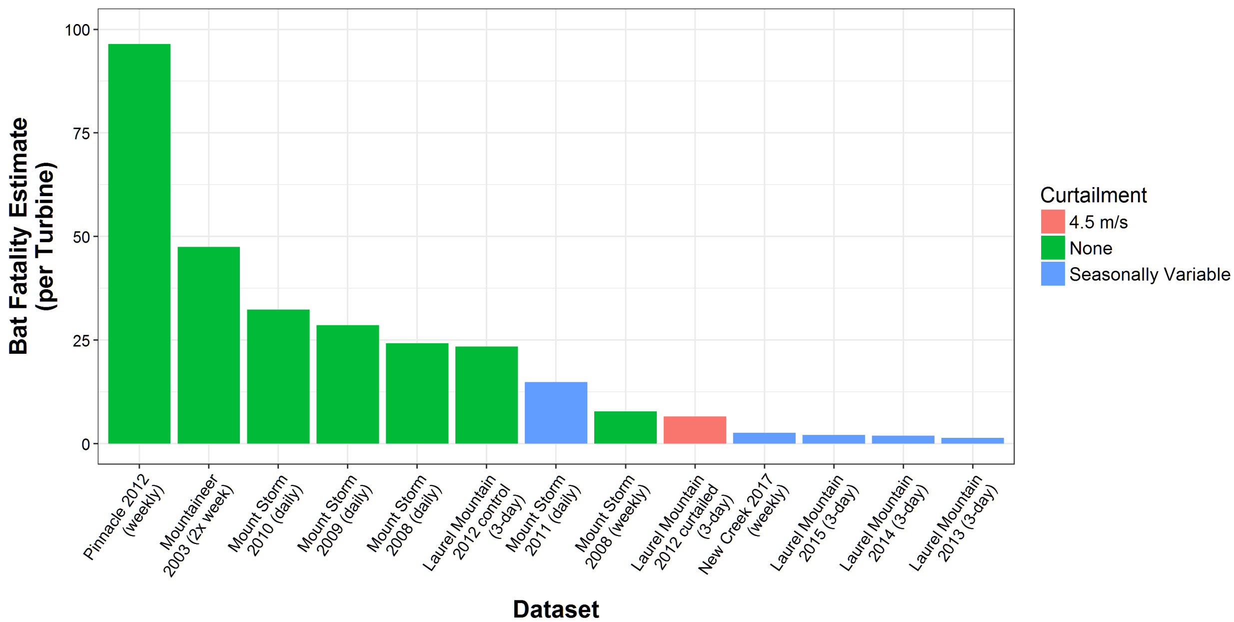


Figure 4-1. New Creek bat fatality estimates compared to publicly available estimates from West Virginia Wind projects

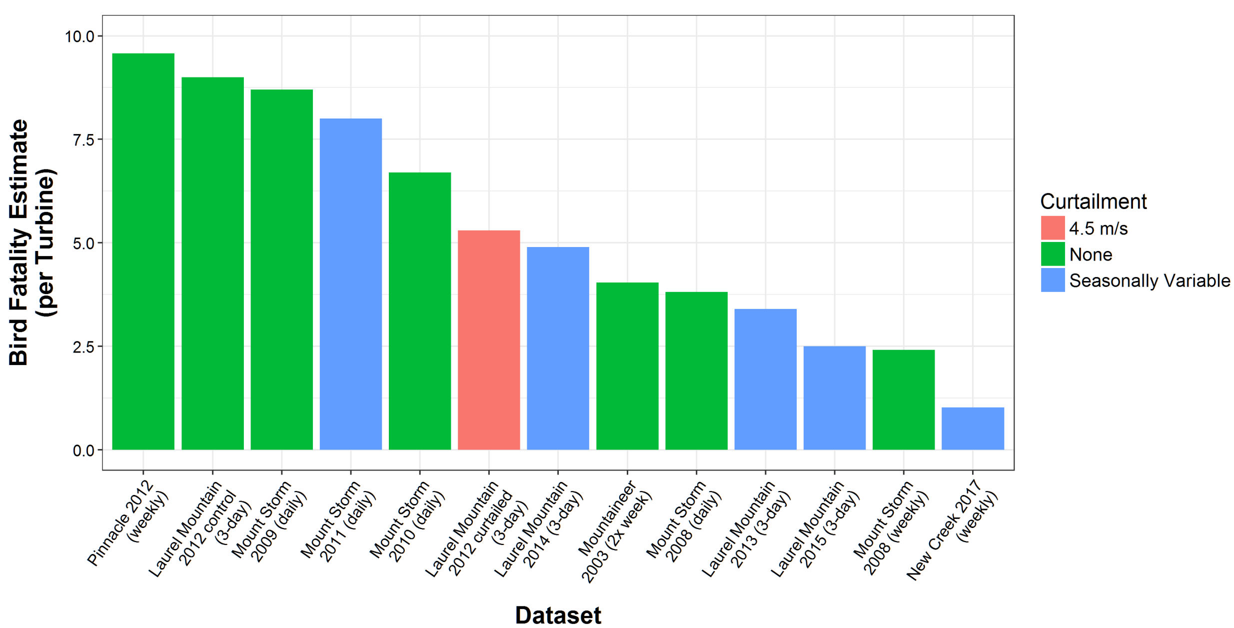


Figure 4-2. New Creek bird fatality estimates compared to publicly available estimates from West Virginia Wind projects

The search interval used in 2017 carcass searches (7 days) was substantially longer than estimated carcass persistence for bats (1.8 days) and birds (1.4 days), resulting in a relatively low estimated proportion of carcasses persisting through the search interval. Short carcass persistence relative to search interval suggests that a substantial number of bird and bat carcasses were likely removed by scavengers before they could be found by searchers. Surveyors noted frequent presence of bird scavengers (mostly raven, crow, and turkey vulture) and recorded multiple videos of trial carcasses being removed by birds. However, a shorter survey period is not necessarily required to obtain reliable fatality estimates. Carcass persistence is accounted for within the Huso estimator, and high searcher efficiency estimates contributed to reasonably narrow confidence intervals surrounding fatality estimates. We also included incidental carcasses in our fatality estimates which should mean that our estimates represent a “worst case scenario” given available data.

By combining acoustic monitoring with traditional carcass searches, we obtained fatality estimates associated with curtailment treatments in place during the 2017 monitoring period, but also obtained a baseline dataset of acoustic activity at nacelle height which can be used to evaluate the potential effectiveness and energy loss associated with alternative curtailment plans for future planning efforts. Our results contribute to a growing body of evidence demonstrating that bat fatality can be maintained at low levels using turbine curtailment, even in regions such as the mid-Atlantic, where apparent risk to bats at wind farms is high. However, our results also suggest that there is substantial room to improve the efficiency of curtailment programs while not necessarily reducing their effectiveness. By incorporating multiple survey methods, the 2017 monitoring period provided a foundation of information upon which responsible and informed management decisions can be made in the future.

5.0 REFERENCES

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. Bats and Wind Energy Cooperative.

Arnett, E.B., J.P. Hayes, and M.M.P. Huso. 2006. An evaluation of the use of acoustic monitoring to predict bat fatality at a proposed wind facility in south central Pennsylvania. An annual report submitted to the Bats and Wind Energy Cooperative. Bat Conservation International. Austin, Texas, USA.

Erickson, W.P., J. Jeffrey, K. Kronner, and K. Bay. 2003. Stateline Wind Project Wildlife Monitoring Annual Report, Results for the Period July 2001 December 2002. FPL Energy, the Oregon Office of Energy, and the Stateline Technical Advisory Committee, Salem, USA.

Erickson, W.P., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project wildlife monitoring final report, July 2001 - December 2003. Technical report peer-reviewed by and submitted to FPL Energy, the Oregon Energy Facility Siting Council, and the Stateline Technical Advisory Committee. WEST, Inc., Cheyenne, Wyoming, USA.

Fiedler, J.K., T.H. Henry, R.D. Tankersley, and C.P. Nicholson. 2007. Results of Bat and Bird Mortality Monitoring at the Expanded Buffalo Mountain Windfarm, 2005. June 28, 2007. Prepared for Tennessee Valley Authority.

Hayes, J.P. 1997. Temporal variation in activity of bats and the design of echolocation-monitoring studies. Journal of Mammalogy 78:514-524.

Huso, M.M.P. 2010. An Estimator of Wildlife Fatality from Observed Carcasses. Environmetrics. Wiley Blackwell. DOI:10.1002/env.1052.

Huso, M., N. Som, and L. Ladd. 2012. Fatality estimator user's guide: U.S. Geological Survey Data Series 729, 22 p.

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. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA. <http://www.wind-watch.org/documents/wp-content/uploads/maple_ridge_report_2006_final.pdf>. Accessed 1 December 2007.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study-2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2009*a.* Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study-2008. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009*b*. Annual report for the Noble Clinton Windpark, LLC. Post-construction bird and bat fatality study - 2008. Curry and Kerlinger, Cape May Point, New Jersey, USA.

Johnson G.D., W.P. Erickson, M.D. Strickland, M. F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2003. Mortality of bats at a largescale wind power development at Buffalo Ridge, Minnesota. American Midland Naturalist 150: 332–342.

Kerns, J, and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia. Curry and Kerlinger, LLC, McLean, Virginia, USA.

Kunz, T.H., E.B. Arnett, B.P. 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.

O’Farrell, M.J., and W.L. Gannon. 1999. A comparison of acoustic versus capture techniques for the inventory of bats. Journal of Mammalogy 80(1):24–30.

O’Farrell, M.J., B.W. Miller, and W.L. Gannon. 1999. Qualitative identification of free-flying bats using the anabat detector. Journal of Mammalogy 80(1):11–23.

Piorkowski, M.P. and T.J. O'Connell. 2010. Spatial patterns of summer bat mortality from collisions with wind turbines in mixed-grass prairie. American Midland Naturalist 164:260-269.

R Development Core Team. 2011. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria, URL https://www.R-project.org/

Sonnenburg, M., and W. Erickson 2010. Fatality study simulations results. Prepared for Horizon Wind Energy and Iberdrola Renewables. WEST, Inc., Cheyenne, Wyoming, USA.

Strickland M.D., E.B. Arnett, W.P. Erickson, D.H. Johnson, G.D. Johnson, M.D. Morrison, J.A. Shaffer, and W. Warren-Hicks.2011. Comprehensive guide to studying wind energy/wildlife interactions. Prepared for the National Wind Coordinating Collaborative, Washington, DC.

Thompson, S.K. 1992. Sampling. John Wiley & Sons, Inc. New York.

Young, D.P., W.P. Erickson, K. Bay, S. Normani, and W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1: Post-construction avian and bat monitoring. Prepared for NedPower LLC., Mount Storm, West Virginia, USA.

APPENDICES

Appendix A NEW CREEK WIND PROJECT 2017 POST-CONSTRUCTION MONITORING PLAN

Year 1 Post-construction Monitoring Plan New Creek Wind Energy Project

Proposed Work Scope for Year 1 Carcass Monitoring, Aerial Eagle Nest Survey, and Acoustic Monitoring

Prepared for:
New Creek Wind, LLC

Prepared by:
Stantec Consulting Services Inc.
30 Park Drive
Topsham, ME 04086

March 2017

March 2017

Table of Contents

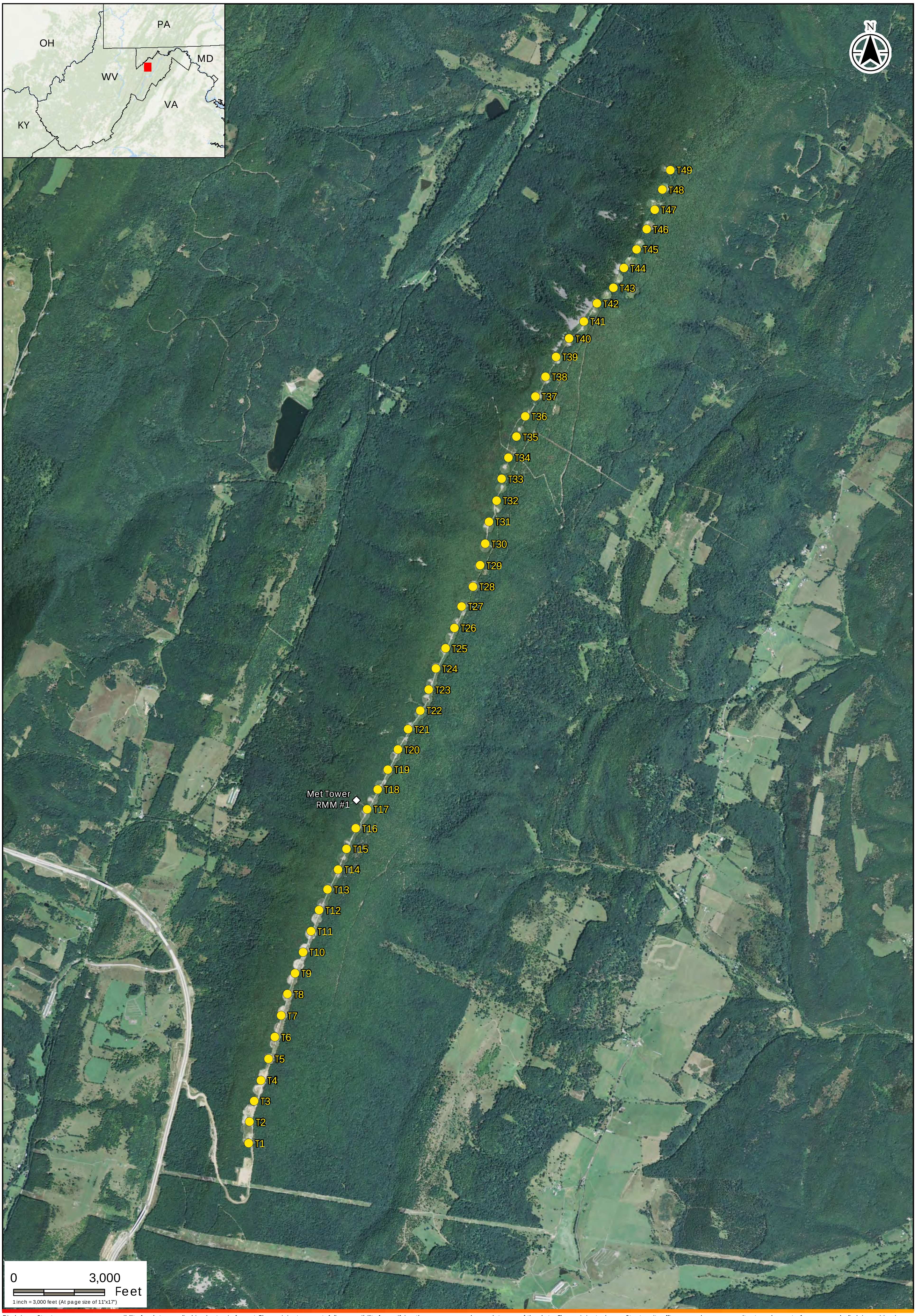
March 2017

1.0 Introduction

The New Creek Wind Energy Project (Project), operated by New Creek Wind, L.L.C. (New Creek), an indirect, wholly owned subsidiary of Enbridge Inc. ("Enbridge"), has a production capacity of approximately 100 megawatts (MW) and consists of 49 wind turbines and associated infrastructure located on approximately 11 kilometers (km; 7 miles) of forested ridgeline in Grant County southwest of Keyser, West Virginia (see Figure 1-1). The 45 Gamesa G97 and 4 G90, 2.0 MW turbines have a hub height of 78 meters (m) and total height of approximately 126 m with an interconnection into an existing 500 kilovolt (kV) transmission line located within the Project area.

As part of the Bird and Bat Conservation Strategy (BBCS; Stantec 2016) developed for the Project, and as required by the 2009 Public Service Commission of West Virginia order, New Creek will conduct at least 1 year and up to 3 years of post-construction bird and bat carcass monitoring. This document outlines a proposed level of monitoring effort and describes field methods and analysis for the first year of post-construction monitoring, anticipated to begin in April 2017. This monitoring plan is based on conversations between Stantec Consulting Services Inc. (Stantec), Enbridge, the U.S. Fish and Wildlife Service (USFWS), and West Virginia Division of Natural Resources (WVDNR). Stantec has based the proposed level of effort and approach on the specific goals and objectives of the BBCS, our experience conducting similar surveys in West Virginia and elsewhere in the Northeast, and our understanding of the expectations and goals of the USFWS and WVDNR.

The first year of post-construction monitoring at the Project is intended to estimate rates of bird and bat mortality between 1 April – 15 November associated with 4 curtailment modes. No turbines will be operated without curtailment, such that monitoring will not provide a baseline for comparison, but will enable evaluation of the relative effectiveness and cost of the 4 curtailment strategies. The proposed monitoring period encompasses the bulk of the spring migration, summer breeding, and fall migration periods for songbirds and bat species at risk of turbine-related impacts. The first year of monitoring will provide additional reference points for adaptive management, enabling data-driven modifications of avoidance and minimization measures based on the extent, species composition, and timing of bird and bat mortality documented at the site. As such, the proposed monitoring includes standardized carcass searches at all Project turbines, aerial eagle nest surveys in the Project area and a surrounding buffer, and acoustic bat monitoring designed to document combinations of temperature and wind speed at which bats are active in the rotor zone. The first year of monitoring will also include eagle point count surveys consistent with the USFWS Eagle Conservation Plan Guidance (ECP Guidance) to document eagle activity within the Project area.



195601197

Stantec

30 Park Drive
Topsham, ME USA 04086
Phone (207) 729-1199

Prepared by KWH on 2017-02-24
Reviewed by TSP on 2017-02-24

01197_1-1_Monitoring_RevBBCS.mxd

Legend

◇ MET Tower

● Existing Turbine

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Base Map: ESRI ArcGIS Online NAIP imagery web mapping service.

Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project
Grant County, West Virginia

Figure No.
1-1

Title
Project Location Map
2/24/2017

2.0 Standardized Carcass Monitoring

Standardized carcass monitoring will occur on a weekly basis at all 49 Project turbines between 1 April and 15 November 2017. Turbine searches will occur within the area cleared (full plot searches) at all 49 turbines.

2.1.1 Turbine Operation

Each of the 49 turbines will all be operated under 1 of 4 curtailment strategies, which will be assigned sequentially prior to 1 April and remain consistent through 15 November. The 4 curtailment modes are as described in Table 2-1.

Table 2-1. Cut-in wind speeds and temperatures during which the 4 curtailment modes will be in effect between April and November 2015.

Mode	April 1 – May 15	May 16 – June 30	July 1 – October 15	October 16 – November 15
1	6.9 m/s, all temps	6.9 m/s, all temps	6.9 m/s, all temps	6.9 m/s, all temps
2	6.0 m/s, > 50° F	6.9 m/s, > 50° F	6.9 m/s, > 50° F	6.0 m/s, > 50° F
3	5.5 m/s, > 50° F	5.5 m/s, > 50° F	6.0 m/s, all temps	5.5 m/s, > 50° F
4	4.5 m/s, > 50° F	4.5 m/s, > 50° F	6.0 m/s, > 50° F	4.5 m/s, > 50° F

2.1.2 Search Area

Wind facilities located largely on forested ridgelines, such as the Project, present difficult searching conditions. Searches will therefore be focused within areas where successful detection is most probable. Search areas will be delineated by the area around each turbine that is clear of forested habitat, shrubs, large rock or rubble, or other cover types or conditions that otherwise prohibit effective or safe searching conditions.

Results from recent mortality monitoring studies indicate that the majority of bird and bat carcasses fall within 50 percent of the maximum height of turbines (Kerns and Kerlinger 2004; Arnett et al. 2005; Fiedler et al. 2007; Young et al. 2009; Jain et al. 2007, 2008, 2009a b; Piorkowski and O'Connell 2010). Most bat fatalities fall within 30 m to 40 m of turbines (Kerns and Kerlinger 2004, Johnson et al. 2003)[1]. Based on these results, the full plot search area will target the

[1]During avian and bat mortality monitoring at the Buffalo Ridge wind facility in MN in which all areas within 50 m (164 ft) of turbines were searched, only 1 of 184 bats were found greater than 30 m (98 ft) from a turbine.

cleared area around each turbine up to a 90 m x 90 m square area centered at the base of turbine towers.

2.1.3 Vegetation Management and Mapping

Although required to revegetate the cleared turbine pads, Enbridge will periodically maintain vegetation within the cleared turbine pads. Vegetation maintenance will maximize the ability for searchers to locate carcasses, thus increasing the precision of mortality estimates (Sonnenburg and Erickson 2010). Vegetation will be monitored on a regular basis during the survey period through field notes and representative photographs. Any significant changes in ground cover type will be noted. Enbridge or its contractors will map the extent of the search area at each Project turbine, noting the turbine category (full plot versus road and pad).

2.1.4 Weather Monitoring

Enbridge will record standard meteorological data (wind speed, wind direction, and temperature) at 10-minute intervals at each Project turbine and the meteorological (met) tower. Precipitation and barometric pressure will be obtained from nearby weather stations, and field staff conducting carcass searches will record qualitative weather observations such as cloud cover, and precipitation type. Weather data will be compiled in spreadsheets and/or databases for comparison to carcass data and/or acoustic bat survey results.

2.1.5 Carcass Search Methods

Parallel search transects spaced at 4 m (13 ft) intervals will be oriented north-to-south (magnetic) within searchable areas (see Section 2.1.1 – Search Area) at each turbine. Transects will be marked using temporary flagging, paint, or stakes. Searchers will visually scan the ground on either side of the transacts, walking at an approximate speed of 30 to 50 m per minute, resulting in approximate search times per full plot turbine between 25 and 60 minutes depending on the size of searchable area and survey conditions. Surveyors will temporarily mark the location of any bird or bat carcasses found during the search using pin flags, orange cones, or flagging tape.

At the conclusion of the turbine search, the surveyor will return to any marked carcasses and collect relevant data as described below. A photograph will be taken of the carcass before it is moved. Carcasses will be collected in individual re-sealable plastic bags, labeled with a unique identification number according to the date and turbine where they were found[2]. Carcasses will be stored in an off-site freezer throughout the monitoring period for use during validation trials. Any carcasses not used for on-site validation trials will be provided to the WVDNR at the conclusion of the monitoring period.

---

[2] Carcass collection and storage will be contingent on receipt of necessary state and federal scientific collection/salvage permits, for which Enbridge will apply prior to the monitoring period.

To the extent possible, turbine-related fatalities will be distinguished from observations of those that occurred as a result of collisions with the met tower, electrical collection lines, vehicles, or other sources of mortality. Intact bird and bat carcasses or remnants of scavenged carcasses (e.g., a cluster of feathers representing more than a molt, or a patch of skin and bone) will be documented as fatalities. Carcasses found incidentally within the Project area, either by surveyors or other site personnel, will be documented and collected, but reported separately from those found during planned searches. Operations and maintenance personnel will be trained on the protocol to report and document incidental findings in accordance with the BBCS.

The following information will be recorded for each carcass found by the surveyors:

- Date, time, and surveyor identification;
- Search type during which carcass was found (i.e., turbine search or incidentally);
- Distance and compass direction of carcass from tower;
- Ground cover type, height, and condition (i.e., wet, dry) where carcass was found;
- Carcass species identification, age (juvenile or adult), sex, and reproductive condition (to the extent possible);
- Carcass condition (estimated number of days since death, if they are live/injured, intact or scavenged and/or level of scavenging activity); and
- Evidence of scavenger activity (e.g., tracks or scat) in the vicinity of the carcass.

Enbridge will apply for a "Migratory Bird Special Purpose Utility Permit – Wind" from the USFWS that names its employees and contractors as sub-permittees. Prior to initiating monitoring activities, Enbridge will also apply for and be issued a scientific collection permit from the West Virginia Division of Natural Resources (WVDNR) that lists its contractors as sub-permittees. Surveyors will be trained on the proper handling of injured birds and bats in the event that they are found. Any individual that handles live bats will maintain an up-to-date rabies vaccination.

If allowed under the conditions of state and federal collection permits, efforts will be made to bring injured animals to the closest licensed wildlife rehabilitator able to take that species. A list of local, currently licensed wildlife rehabilitators that are capable of accepting regional bird and bat species will be developed and provided to searchers. The closest rehabilitation facility is the Avian Conservation Center of Appalachia in Morgantown, WV. Every attempt will be made for timely transportation of injured animals to a rehabilitation center so that the animal has the best chance of survival. If successful rehabilitation is not likely, then the individual will be humanely euthanized. If the species in question is a state or federally protected species or a raptor, the appropriate agency will be contacted within 24 hours and before the individual is euthanized.

Carcasses will be retained for subsequent use in validation trials (see Section 2.6 – Estimated Mortality Rates), unless they are a rare species, in which case they will be retained for confirmation of identity. All *Myotis* bats will be provided to WVDNR for inspection and identification verification. Genetic testing may be performed if the species of a bat is unclear and the USFWS deems it necessary to confirm the carcass identification. The WVDNR and USFWS will be notified within 48 hours if a suspected or confirmed Indiana bat (*Myotis sodalis*) carcass or any other federally or state threatened or endangered bird or bat species is found.

2.1.6 Estimated Mortality Rates

2.1.6.1 Searcher Efficiency Trials

Searcher efficiency rates are variable among studies at wind facilities in the United States and are largely dependent on ground cover conditions. Searcher recovery rates have ranged from 25–56% for small carcasses, and as high as 100% for large carcasses (Arnett et al. 2005, Erickson 2003, Jain et al. 2007). Trials will be conducted to estimate searcher efficiency rates.

Trials will target the placement of up to 100 carcasses over the course of the monitoring period. The same individual carcasses may be re-used (as long as they remain in usable condition) in multiple trials over the course of the study period; 1–15 carcasses may be used on a single trial day. Multiple trials will be conducted throughout the survey period at arbitrary intervals to account for changes in ground cover conditions. On trial days, carcasses will be placed at one or more turbines scheduled to be searched that day and will be placed at random distances from turbine towers and in a variety of cover types.

Small, medium, and large bird carcasses (preferably of native species) and bat carcasses (as carcass availability allows), in varying stages of decomposition will be marked discreetly so that trial carcasses may be distinguished from actual fatalities without the surveyor's knowledge. Although searcher efficiency will not be estimated separately for carcasses of varying sizes, carcasses used in searcher efficiency trials will, to the extent possible, be representative of the range of sizes of birds and bats found on site during mortality surveys. To the extent that it is feasible (i.e., carcasses are in good condition and bat carcasses do not show signs of White-Nose Syndrome), carcasses found during mortality searches at the Project will be used in trials. If an insufficient number of carcasses from the Project are available, surrogates for native birds (e.g., quail) and bats (e.g., brown mice) may be used. Surveyors being tested will be unaware of trial dates and locations. The trial coordinator will place carcasses at random beneath a search turbine on the evening before, or in the early morning immediately preceding, a turbine search, and will make every effort to leave no evidence of trial set-up (i.e., vehicle or foot prints in wet grass or mud). The trial coordinator will record the following information for each carcass placed:

- Date, time of set-up, trial coordinator;
- Turbine number;
- Carcass identification;
- Carcass distance and direction from tower; and
- Ground cover type and vegetation height where carcass was placed.

After searches are completed on trial days, the trial coordinator will determine how many trial carcasses were recovered, and will remove unobserved carcasses. The presence of the carcass (i.e., availability for detection) will be determined immediately following the completion of each searcher efficiency trial.

Searcher efficiency rate will be expressed as the proportion of carcasses found by searchers (the number of carcasses found by searchers divided by the total number of carcasses placed during searcher efficiency trials). If alternative formulas are developed, the formula determined to be most applicable to the Project and most accurate at the time of analysis will be used. Separate searcher efficiency rates will be developed for small, medium, and large birds and for all bats, as carcasses are available and as sample sizes allow.

2.1.6.2 Carcass Persistence Trials

Trials will be conducted to estimate the percentage of carcasses that are removed by scavengers prior to recovery by surveyors, or the carcass persistence rate. Trials will target placement of 100 carcasses over the course of the monitoring period. Carcasses in fresh condition will be used in trials and will be marked discreetly to differentiate them from actual fatalities. Small, medium, and large bird carcasses (preferably of native species) and bat carcasses (as carcass availability allows), in as fresh condition as possible will be used for carcass persistence trials. Although carcass persistence will not be estimated separately for carcasses of varying sizes, carcasses used in carcass persistence trials will, to the extent possible, be representative of the range of sizes of birds and bats found on site during mortality surveys. To the extent that it is feasible (i.e., carcasses are in good condition and bat carcasses do not show signs of White-Nose Syndrome), carcasses found during mortality searches at the Project will be used in trials. If an insufficient number of carcasses from the Project are available, surrogates for native birds (e.g., quail) and bats (e.g., brown mice) may be used. There will be a target of performing a minimum of 1 trial (involving multiple carcasses) per month during the course of the survey year in order to account for seasonal changes of scavenger activity.

Carcasses will be placed at multiple turbines throughout the monitoring area and will be checked daily for 14 days. On each day the carcass is checked, surveyors will indicate whether the carcass is present (intact, or partially scavenged but readily detectable) or absent (completely removed, or with so few feathers or tissue that they are not readily detectable). Carcasses present at the end of the 14-day trial period will be collected and disposed of. The following additional information will be recorded on standardized datasheets for each trial carcass:

- Date, time of set-up, trial coordinator;
- Turbine number;
- Carcass identification;
- Carcass distance and direction from tower;
- Ground cover type and vegetation height where carcass was placed; and
- Detailed notes describing any scavenging and evidence of scavenger identification.

2.1.7 Data Analysis

Estimates of total annual bird and bat fatalities will be generated using the Huso Estimator (Huso 2010, Huso et al. 2012). Separate estimates will be generated for each curtailment mode. Fatality estimates will be based on:

- Number of carcasses found per turbine;
- Searcher efficiency rate, expressed as the percentage of carcasses recovered during searcher efficiency trials;
- Carcass persistence rate, expressed as the length of time a carcass is estimated to remain at a turbine and be available for detection by the searchers;
- Proportion of searchable area below each turbine; and
- Distribution of carcasses within search areas.

The Huso Estimator is a method that was developed in 2010 based on Thompson (1992). The specific objectives of the Huso Estimator are to attempt to accurately estimate bird and bat fatality based on observer detection rates and carcass persistence, and to provide a measure of precision associated with the estimates. The estimator was designed to estimate per-turbine fatality based on a total-site estimate; it was not designed to estimate fatality at individual turbines. A detailed description of the Huso Estimator is available in Huso 2010 and Huso et al. 2012. The Huso Estimator software, available at http://pubs.usgs.gov/ds/729/, is run with the statistical program R (R Development Core Team 2011). The formula for Huso's model is available in Strickland et al. 2011:

- (C) is expressed as the product of the actual number killed (*F*), the proportion of carcasses remaining to be found ($\hat{r}$), and the probability of detection (P_{det});
- $\bar{t}$ is the average carcass removal time;
- P_{det} is the probability of detection given that carcass remains;
- $\tilde{I}$ is the effective search interval;
- $\hat{\pi}$ is the probability of carcass availability and detection;
- $\hat{s}$ is estimated searcher efficiency rate expressed as the percentage of carcasses recovered during searcher efficiency trials (*p* in Huso model output); and
- $\hat{r}$ is estimated carcass persistence rate (r in Huso model output), expressed as the proportion of carcasses estimated to remain during an average persistence interval and available for detection by the searchers.

$$C = Frp$$

$$\tilde{I} = -\log(0.01) * \bar{t}$$

$$\hat{s} = \min\left(1, \frac{\tilde{I}}{I}\right)$$

$$\hat{r} = \frac{\bar{t} * \left(1 - e^{\frac{I}{\bar{t}}}\right)}{I}$$

$$\hat{\pi} = P_{det} * \hat{s} * \hat{r}$$

When the size of search plots is limited, it is likely only a fraction of carcasses occurring at a turbine (i) will occur within the searchable area (Huso 2010). Therefore, π(i) is the product of the proportion of fatalities at turbine (i) that is within the searchable area of a plot and probability of including (i) in the sample.

Accounting for 'Carcass Overflow'

The Huso Estimator assumes carcass equilibrium between search intervals, where all carcasses are either found by searchers or scavenged prior to the next search (Huso pers. comm.). The Estimator assumes a zero probability of searchers observing a carcass on a subsequent search if it was missed on the first search. However, field data indicate that some carcasses do persist on the ground for longer than a single interval and that searchers find some of these carcasses. To account for this bias (which results in overestimates of fatality), Huso is now recommending that only those carcasses killed since the previous search (based on stage of decomposition) be input into the model to estimate fatality. The proportion of older carcasses are separately accounted for in the measurement of searcher efficiency (i.e., if searcher efficiency is determined to be 50% then there is a 50% probability of a carcass being missed on the first search). Therefore, only those carcasses aged 7 days or less will be input into the fatality model based on the weekly search interval. It can be difficult to determine exact time of fatality (e.g., between a carcass that is aged greater than or less than 7 days); therefore, if a carcass's age is questionable, it will be included in the fatality model as aged 7 days or less.

Area Corrections

Because turbine towers may not be centered within turbine clearings, and carcasses may land over unsearched areas, the empirical distribution of bird and bat carcass fall distances will be determined in order to apply a density-weighted proportion area searched (DWP) correction in the model. Area corrections will be based on methods proposed by Jain et al. (2009; modified from Fiedler et al. 2007). The proportion of the total birds and bats found during searches will be determined per 10 m concentric distance increments radiating out to a distance of 80 m (the maximum search radius) from tower bases. The proportion of the area that was searchable (i.e., not cut off by forest edge) within each of these distance bands will be determined. The percent area searched per distance band will be multiplied by the proportion of bird and bat carcasses found within each distance band to find a DWP value per distance band. The DWP value for each band will be summed to find a DWP value for each turbine, for birds and bats separately. Turbine-specific DWP values will be input into the model for each bird and bat carcass found. This DWP analysis provides a per-turbine adjustment for the total number of bird and bat carcasses that would have been found within an 80-m radius of the turbine, had that entire area been available to be searched. It should be noted that a small density of carcasses found does not allow for a robust estimate of DWP; for example, if one bat carcasses is found in an outer ring of a search plot, and a small proportion of this ring was searchable, this one bat will inflate the estimate of the number of carcasses that may have occurred within this ring, when the actual distribution of bats indicates that the number of bat carcasses actually drops off in the outer portions of plots.

In order for the Huso Estimator to calculate estimates of fatality for birds and bats separately, a sample size of at least 10 bird and 10 bat carcasses for both the searcher efficiency and carcass persistence trials is required. Further, there must be a sample size of at least 10 bird or bat carcasses per covariate (e.g., season, carcass size, ground cover type) for other covariates to be incorporated into the model (e.g., to estimate fatality per season, per carcass size, per visibility class).

The results of searcher efficiency trials will be input into the model as 1 (if the trial carcass was found) and 0 (if trial carcass was not found). These values are distributed as binary random variables within the model, with 'Found' indicated by the highest numeric value. A generalized linear model of the binary response is fit to the data, with a modeled response of $\log^e$ (odds of observing a carcass = $\log^e$ (p/1-p)).

The results of carcass persistence trials will be input into the model, based on the following trial outcomes:

- Carcass gone at first check on 'Day 1' of trial, left censoring = 2;
- Carcass still present (visible) on last day of trial, right censoring = 0; and
- Carcass was removed between checks, interval censoring = 3.

Carcass persistence times are modeled with a log-linear parametric accelerated failure time model and are assumed to follow a probability distribution. When persistence time is not known or is censored, the model is appropriately modified.

Each time the model is run, one of the following distributions of carcass persistence must be selected by the user for the model: Exponential, Loglogistic, Lognormal, or Weibull. Huso recommends running trials of the dataset with each distribution to compare values of AIC (Akaike Information Criterion), the measure of the relative goodness of fit of the model, where k is the number of parameters in the statistical model, and L is the maximized value of the likelihood function for the estimated model.

$$AIC = 2k - \ln(L)$$

The preferred distribution for the dataset is the one with the minimum AIC value.

Thompson (1992) provides a formula for the calculations of variance when the variables of the model (i.e., carcass detectability and persistence) are known. However, because detection bias, persistence bias, and proportion of carcasses within search areas are estimated, Huso uses a bootstrapped estimate of variance based on methods proposed by Erickson et al. 2004, where the fatality adjustment (π) and total fatality (m) are calculated for each bootstrapped sample. The analysis will use 5,000 bootstrap resample iterations, as recommended by Huso et al. (2012). The alpha value will be defined as 0.05; therefore, all confidence intervals will be calculated at 95%.

3.0 Aerial Eagle Nest Survey

Enbridge or its consultants will conduct an aerial survey for eagle nests in the Project area and a surrounding 10-mile buffer. This survey will occur before leaf-out when nest visibility would be greatest. The survey will be conducted from a fixed-wing aircraft by biologists experienced conducting aerial nest surveys. Any nests observed during the aerial survey will be mapped using either a handheld GPS or the airplane's navigation system. Locations of known eagle nests will be obtained from the USFWS and/or WVDNR prior to conducting aerial surveys.

4.0 Eagle Activity Survey

Enbridge or its consultants will conduct standardized eagle activity surveys following point count survey methods and level of effort described in the USFWS ECP Guidance during the first year of operation. As described in the ECP Guidance, point counts are the primary method to generate exposure data for models predicting rates of eagle collision. Following the ECP Guidance, survey effort will be determined based on the following metrics:

- Area within 1 km of 49 turbines encompasses 24.64 km^2
- 30% of this area = 7.4 km^2
- Number of 800-m radius (each with an area of 2 km^2) point count plots = 3.7, rounded up to 4
- Points to be distributed throughout the Project area at areas with unobstructed visibility of the airspace surrounding adjacent turbines (approximately 7 turbines will be within the area of each point count
- Points will be surveyed for 1 – 2 hours per visit, 1-2 visits per month for a period of 12 months (18 total visits anticipated)

During each point count, eagle observations will be recorded on standardized datasheets, tracking the flight height, behavior, and whether the eagle was inside or outside the point count radius. Any observation below 200 m above ground level will be considered with the rotor-swept zone. The total number of eagle minutes observed will be tracked and entered into the eagle collision risk modeling software described in Appendix D of the ECP Guidance. The model output (expressed as a predicted number of eagle collisions per year) will be compared to results of standardized carcass monitoring conducted during the same time period at the Project.

5.0 Acoustic Bat Monitoring

Enbridge or its consultants will deploy acoustic bat detectors on the nacelles of 9 wind turbines (evenly distributed among the 12 full plot turbines and including at least 3 turbines operating under each curtailment strategy) at the Project to document weather conditions during which bats are active in the turbine rotor zone. Full-spectrum (e.g. Wildlife Acoustics SM4) or zero-crossing (e.g. Anabat SD2) echolocation detectors will be mounted to a suitable structure on the nacelles of the turbines (such as the anemometer mast) and oriented facing away from the rotor. Detectors will be programmed to operate continuously from sunset to sunrise, plus a ~30 minute buffer on either side and will be powered by 12-volt battery systems charged by small solar panels. If feasible, detectors may be configured to remotely transmit data and diagnostic operational data wirelessly. Recorded call files will be analyzed either visually or using suitable automated software to distinguish bat passes from static and other ultrasonic noise.

The temperature and wind speed (10-minute averages) measured at the corresponding nacelle will be determined for every bat pass. These data will be used to document conditions during which bats are most active (and therefore at greatest risk of collision). The turbine RPM will also be determined at the time each bat pass occurs to document what proportion of bat activity is "exposed" to turbine operation.

Enbridge will use the combination of acoustic bat data, temperature and wind speed, and turbine RPM to adaptively manage risk of turbine-related mortality at the Project. Enbridge will first determine the amount of bat activity occurring when turbines are feathered versus operating under each minimization strategy (A & B). Enbridge will also calculate the proportion of curtailed 10-minute intervals during which bat activity occurred as a measure of the efficiency of each minimization strategy. Enbridge will then determine whether alternative minimization strategies can be designed that expose a similar or lesser amount of bat activity while enabling increased power output. Such strategies may include variable cut-in speeds for different temperatures, or varying combinations of temperature and wind speed during which turbines are feathered by month, or time of night. As such, acoustic bat monitoring at nacelle height should provide a reliable and data-driven means of adaptively managing risk of turbine-related bat mortality while enabling Enbridge to design an effective yet efficient minimization strategy and document its effectiveness.

6.0 Reporting and Consultation Process

Enbridge will review results of post-construction monitoring at New Creek in consultation with the USFWS, and WVDNR. An end of the year report describing methods and results of carcass monitoring, aerial eagle nest surveys, acoustic monitoring, and minimization efforts will be submitted to the WVDNR, and USFWS no later than 60 days after completion of field surveys and resulting data analysis. A separate report summarizing results of the eagle activity surveys will be submitted within 60 days of the conclusion of the eagle use surveys. An annual meeting will be held with the USFWS and WVDNR at a time convenient to the parties (January) to review the results of the previous year's monitoring and the need for additional monitoring.

Decisions regarding whether additional post-construction monitoring will occur at the Project, and if so, whether methods or intensity would be modified, will be based on a combination of mortality rates, species composition, spatial distribution of carcasses (among turbines), and the proposed operational minimization strategy. If Enbridge modifies the operational strategy, if baseline mortality levels exceed acceptable levels as determined through coordination with the USFWS and/or WVDNR, or if other factors suggest the need for continued monitoring after the first year, additional surveys will likely be required to demonstrate the continued effectiveness of such measures. The scope and intensity of surveys will be adjusted as appropriate to address specific questions and objectives of the continued monitoring. If bat and bird mortality rates are determined to be acceptable, species composition and other patterns in mortality are typical for projects in the region, and if Enbridge is able to continue implementation of the same operational strategy in subsequent years, no additional monitoring will be conducted. Enbridge will make such decisions in coordination with the USFWS and WVDNR as part of the adaptive management process described in the BBCS.

7.0 References 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. Bats and Wind Energy Cooperative.

Erickson, W. P., J. Jeffrey, K. Kronner, and K. Bay. 2003. Stateline Wind Project Wildlife Monitoring Annual Report, Results for the Period July 2001 – December 2002. Technical report submitted to FPL Energy, the Oregon Office of Energy, and the Stateline Technical Advisory Committee.

Erickson, W. P., J. Jeffrey, K. Kronner, and K. Bay. 2004. Stateline Wind Project wildlife monitoring final report, July 2001 - December 2003. Technical report peer-reviewed by and submitted to FPL Energy, the Oregon Energy Facility Siting Council, and the Stateline Technical Advisory Committee. WEST, Inc., Cheyenne, Wyoming, USA.

Fiedler, J. K., T. H. Henry, R. D. Tankersley, and C. P. Nicholson 2007. Results of bat and bird mortality monitoring at the expanded Buffalo Mountain Windfarm, 2005 June 28, 2007. Tennessee Valley Authority, Knoxville, USA.

Huso, M. M. P. 2010. An estimator of wildlife fatality from observed carcasses. Environmetrics 22:318-329.

Huso, M., N. Som, and L. Ladd. 2012. Fatality estimator user's guide: U.S. Geological Survey Data Series 729, 22 p.

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. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA. <http://www.wind-watch.org/documents/wp-content/uploads/maple_ridge_report_2006_final.pdf>. Accessed 1 December 2007.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2008. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study-2007. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.

Jain, A., P. Kerlinger, R. Curry, and L. Slobodnik. 2009*a*. Annual report for the Maple Ridge wind power project post-construction bird and bat fatality study-2008. Annual report prepared for PPM Energy and Horizon Energy. Curry and Kerlinger, Cape May Point, New Jersey, USA.

Jain, A., P. Kerlinger, R. Curry, L. Slobodnik, J. Histed, and J. Meacham. 2009*b*. Annual report for the Noble Clinton Windpark, LLC. Post-construction bird and bat fatality study - 2008. Curry and Kerlinger, Cape May Point, New Jersey, USA.

Johnson G.D., W.P.Erickson, M.D. Strickland, M. F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2003. Mortality of bats at a largescale wind power development at Buffalo Ridge, Minnesota. American Midland Naturalist 150: 332–342.

Kerns, J, and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia. Curry and Kerlinger, McLean, Virginia, USA.

Piorkowski, M. P. and T. J. O'Connell. 2010. Spatial patterns of summer bat mortality from collisions with wind turbines in mixed-grass prairie. American Midland Naturalist 164:260-269.

R Development Core Team (2011). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL http://www.R-project.org/.

Shoenfeld, P. S. 2004. Suggestions regarding avian mortality extrapolation. <http://www.wvhighlands.org/Pages/WinPow.html>. Accessed 1 October 2010.

Sonnenburg, M., and W. Erickson 2010. Fatality study simulations results. Prepared for Horizon Wind Energy and Iberdrola Renewables. WEST, Inc., Cheyenne, Wyoming, USA.

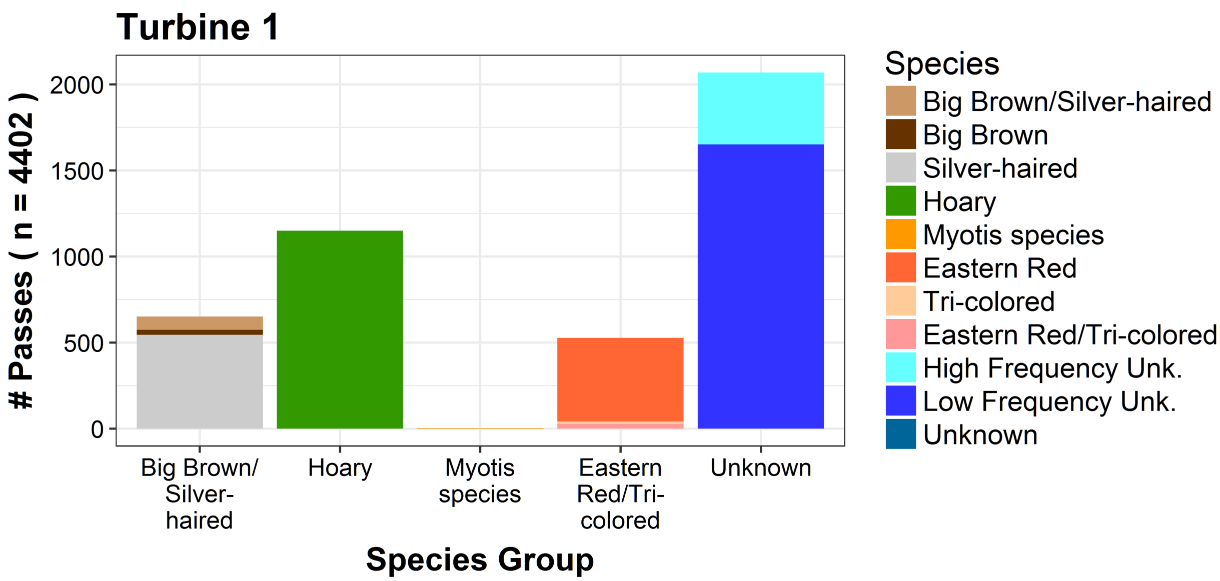
Thompson, S. K. 1992. Sampling. John Wiley & Sons, Inc.: New York.

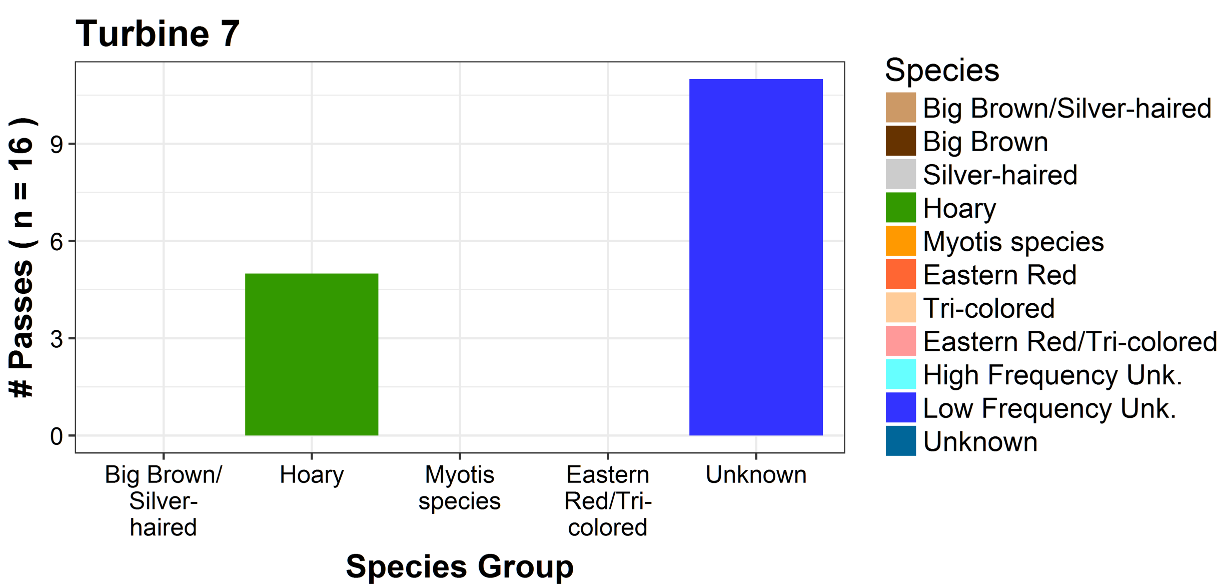
Tidhar, D. 2009. Post-construction wildlife monitoring study; study plan and spring 2009 interim report. Lempster Wind Project, Sullivan County, New Hampshire. Prepared for Lempster Wind LLC Lempster Wind Technical Advisory Committee, Iberdrola Renewables. WEST, Inc. Waterbury, Vermont, USA.

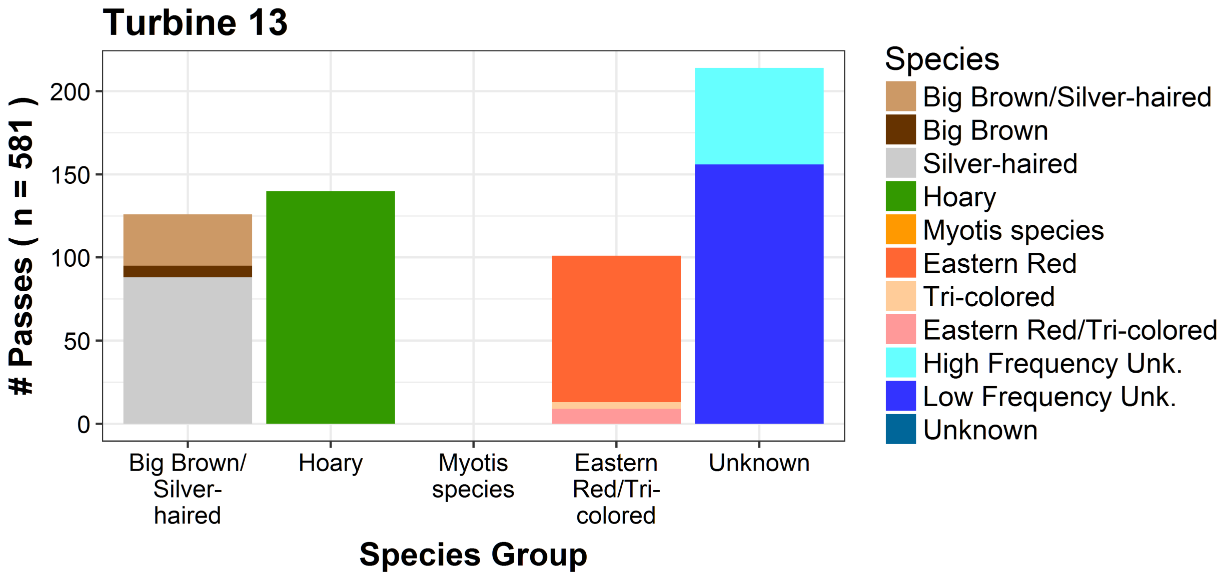
Young, D. P., W. P. Erickson, K. Bay, S. Normani, and W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1: Post-construction avian and bat monitoring. Prepared for NedPower LLC., Mount Storm, West Virginia, USA.

Appendix B ACOUSTIC BAT SURVEY RESULTS BY TURBINE

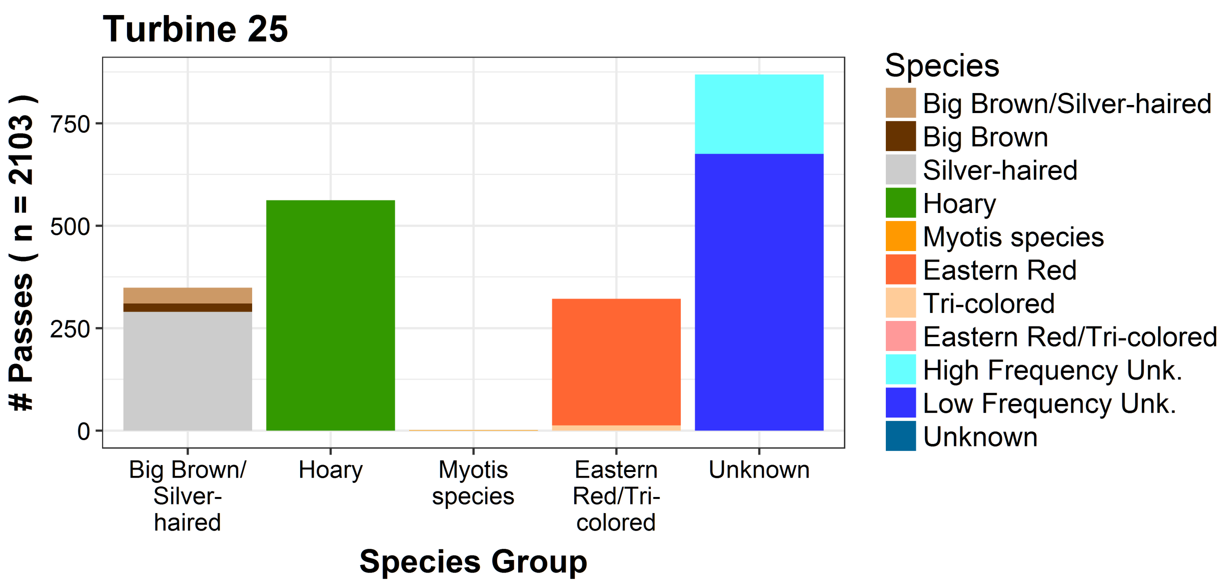
Appendix B Figure 1. Species composition of bat activity detected by turbine, New Creek Wind Project, 2017



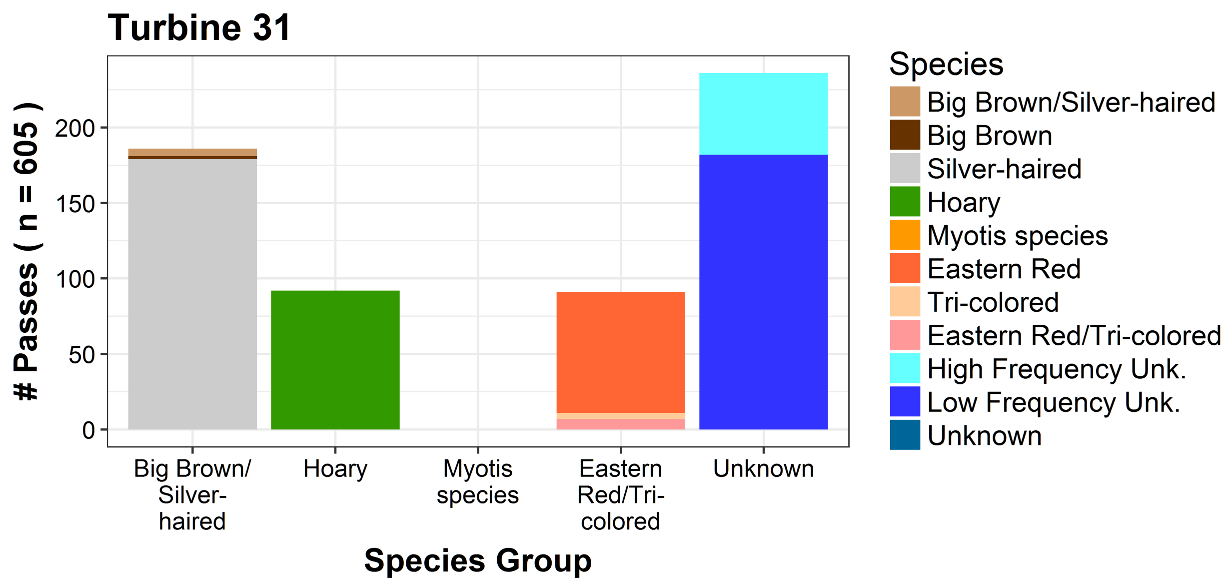


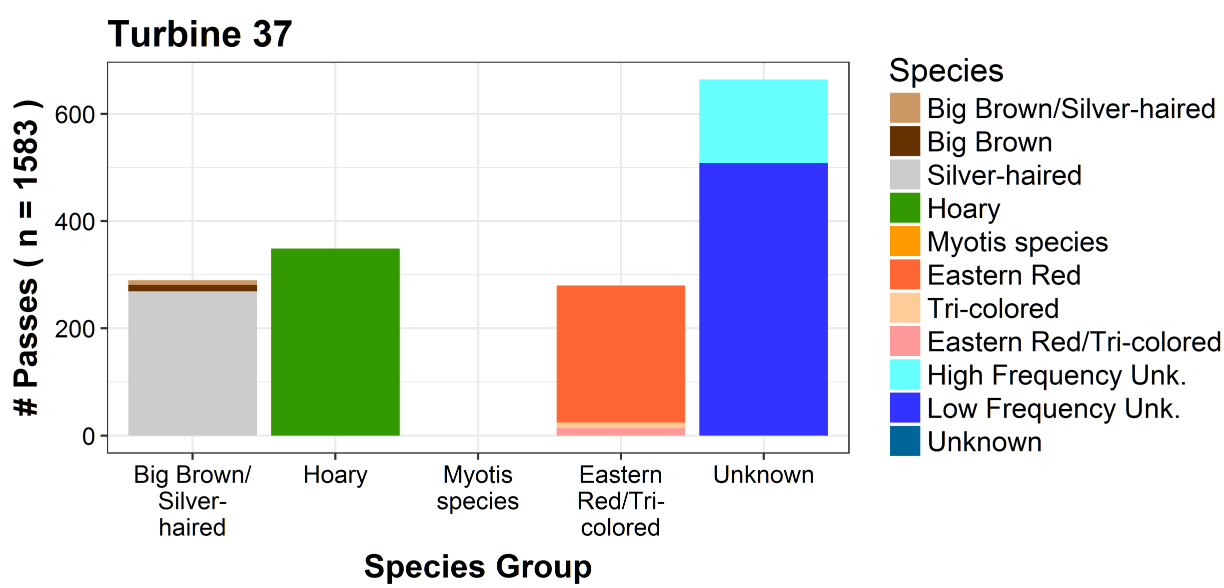


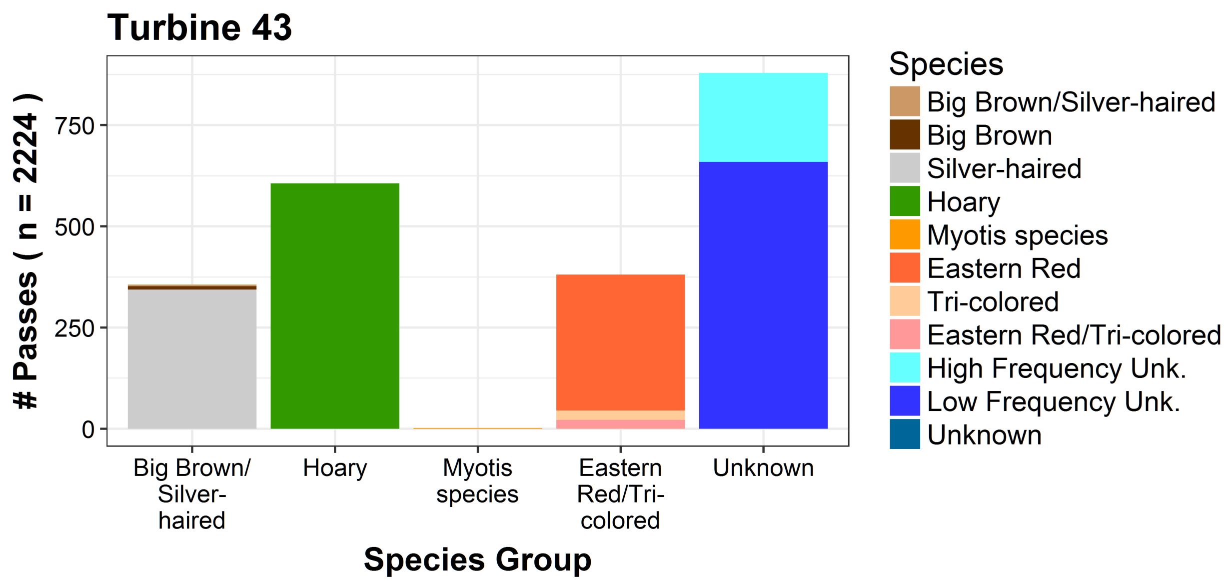
Turbine 13
Passes (n = 581)
200
150
100
50
0
Big Brown/ Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown
Species Group
Species
Big Brown/Silver-haired
Big Brown
Silver-haired
Hoary
Myotis species
Eastern Red
Tri-colored
Eastern Red/Tri-colored
High Frequency Unk.
Low Frequency Unk.
Unknown

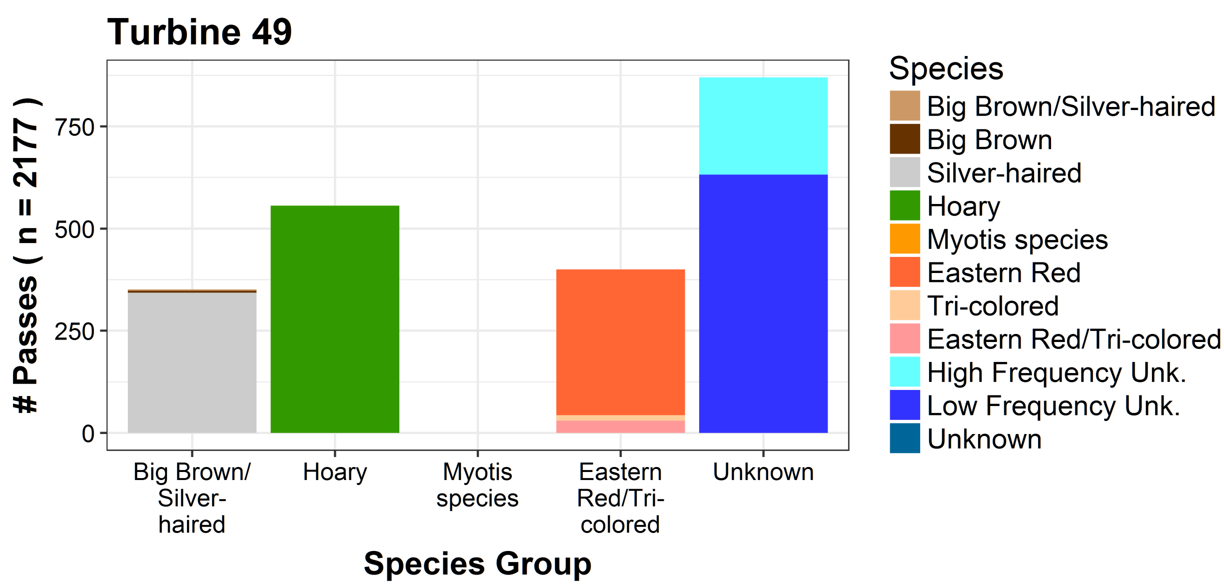


Turbine 25
Passes (n = 2103)
750
500
250
0
Big Brown/ Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown
Species Group
Species
Big Brown/Silver-haired
Big Brown
Silver-haired
Hoary
Myotis species
Eastern Red
Tri-colored
Eastern Red/Tri-colored
High Frequency Unk.
Low Frequency Unk.
Unknown

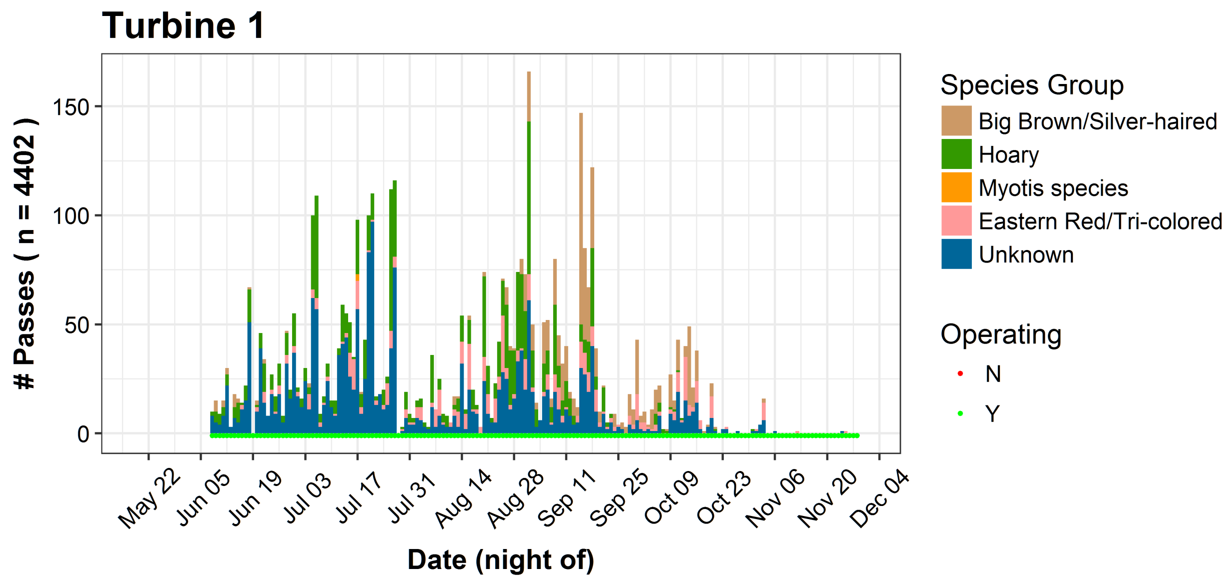

Turbine 31
Passes (n = 605)
0
50
100
150
200
Big Brown/ Silver- haired
Hoary
Myotis species
Eastern Red/Tri- colored
Unknown
Species Group
Species
Big Brown/Silver-haired
Big Brown
Silver-haired
Hoary
Myotis species
Eastern Red
Tri-colored
Eastern Red/Tri-colored
High Frequency Unk.
Low Frequency Unk.
Unknown

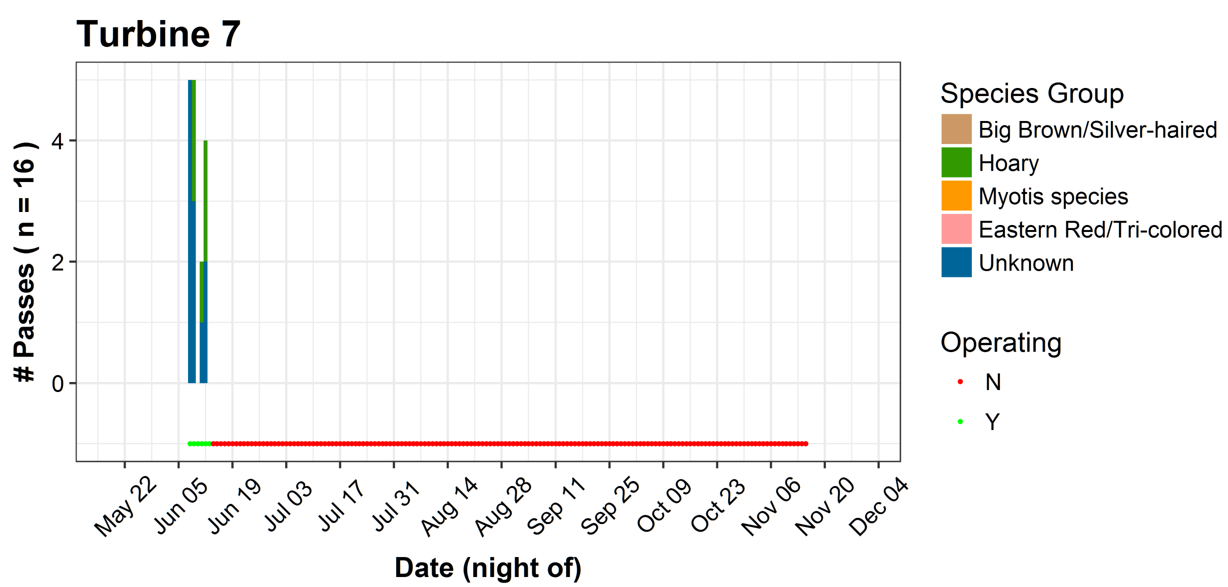

Turbine 37
Passes (n = 1583)
0
200
400
600
Big Brown/ Silver- haired
Hoary
Myotis species
Eastern Red/Tri- colored
Unknown
Species Group
Species
Big Brown/Silver-haired
Big Brown
Silver-haired
Hoary
Myotis species
Eastern Red
Tri-colored
Eastern Red/Tri-colored
High Frequency Unk.
Low Frequency Unk.
Unknown

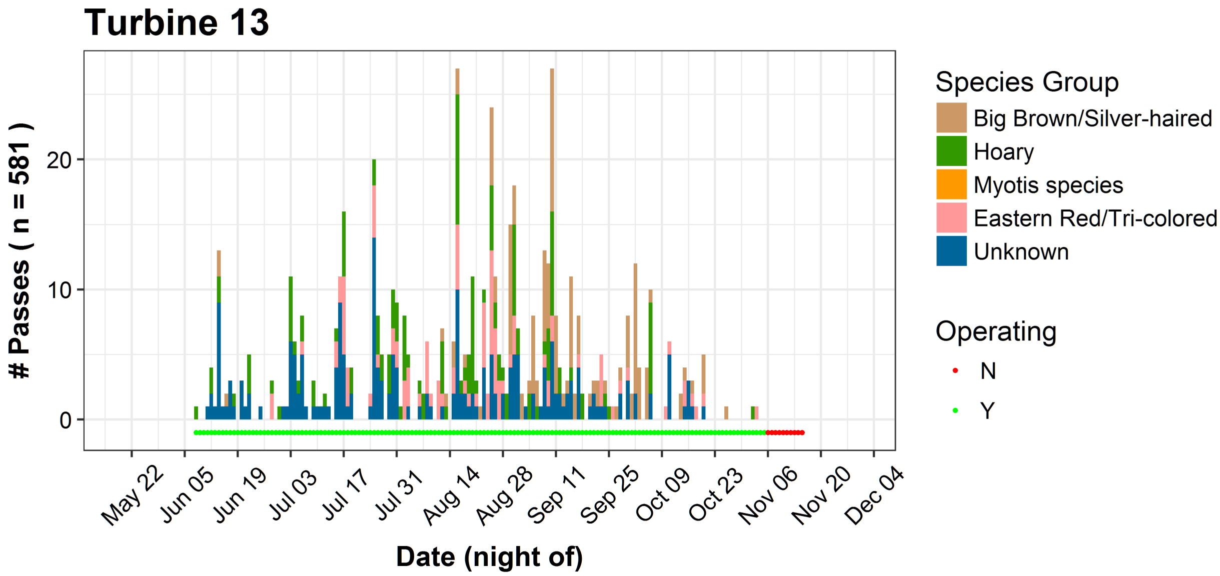

Turbine 43
Passes (n = 2224)
0
250
500
750
Big Brown/ Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown
Species Group
Species
Big Brown/Silver-haired
Big Brown
Silver-haired
Hoary
Myotis species
Eastern Red
Tri-colored
Eastern Red/Tri-colored
High Frequency Unk.
Low Frequency Unk.
Unknown

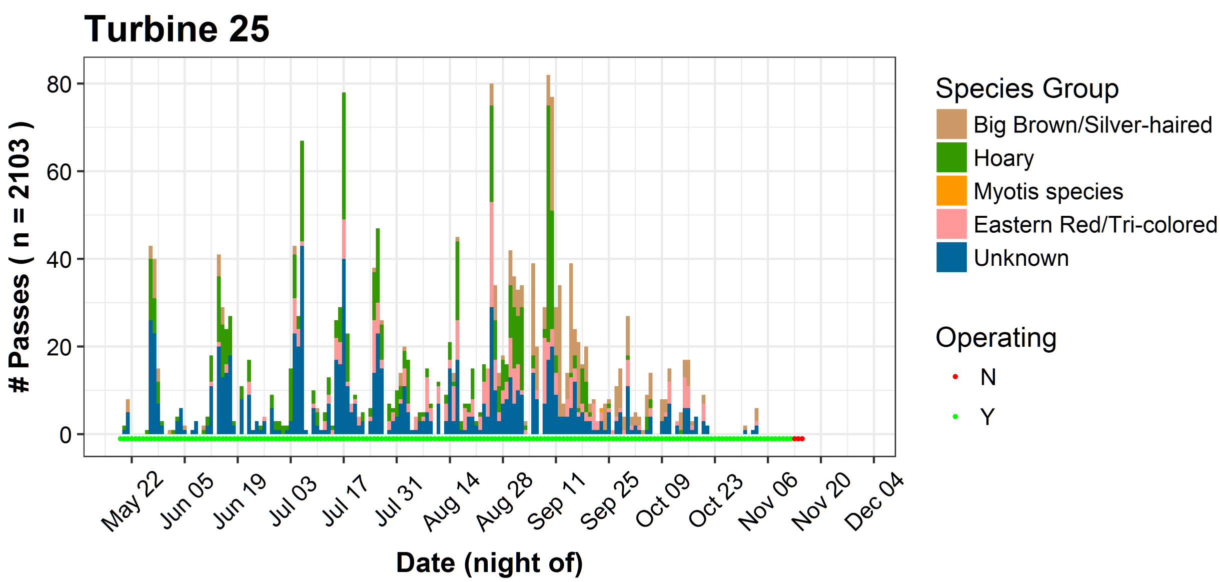

Turbine 49
Passes (n = 2177)
0
250
500
750
Big Brown/ Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown
Species Group
Species
Big Brown/Silver-haired
Big Brown
Silver-haired
Hoary
Myotis species
Eastern Red
Tri-colored
Eastern Red/Tri-colored
High Frequency Unk.
Low Frequency Unk.
Unknown

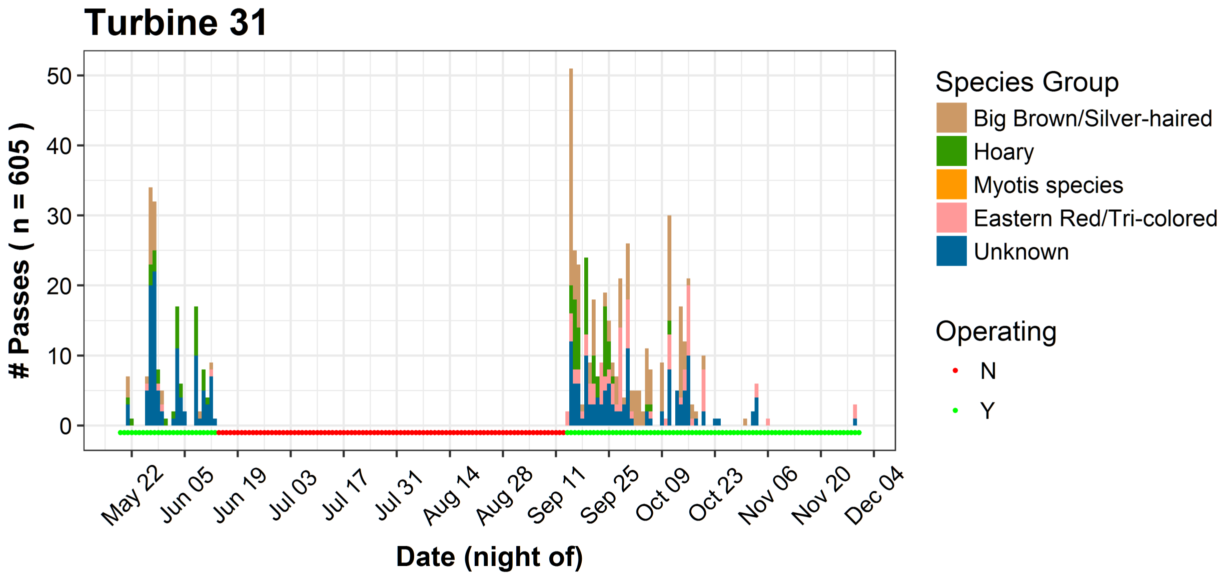
Appendix B Figure 2. Nightly bat activity and detector operation by turbine, New Creek Wind Project, 2017

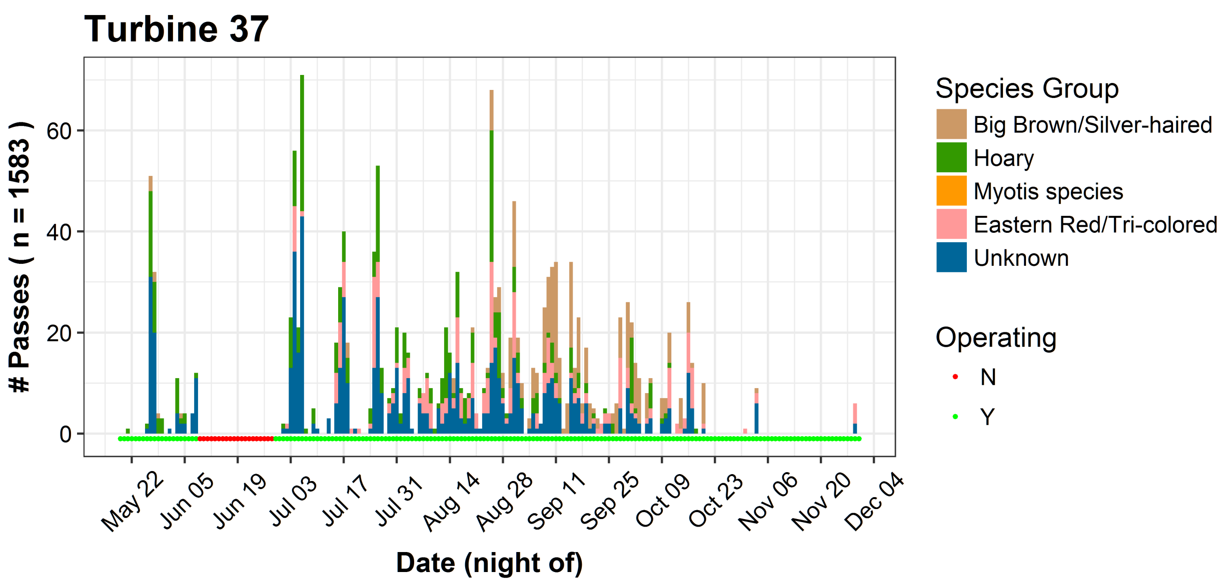


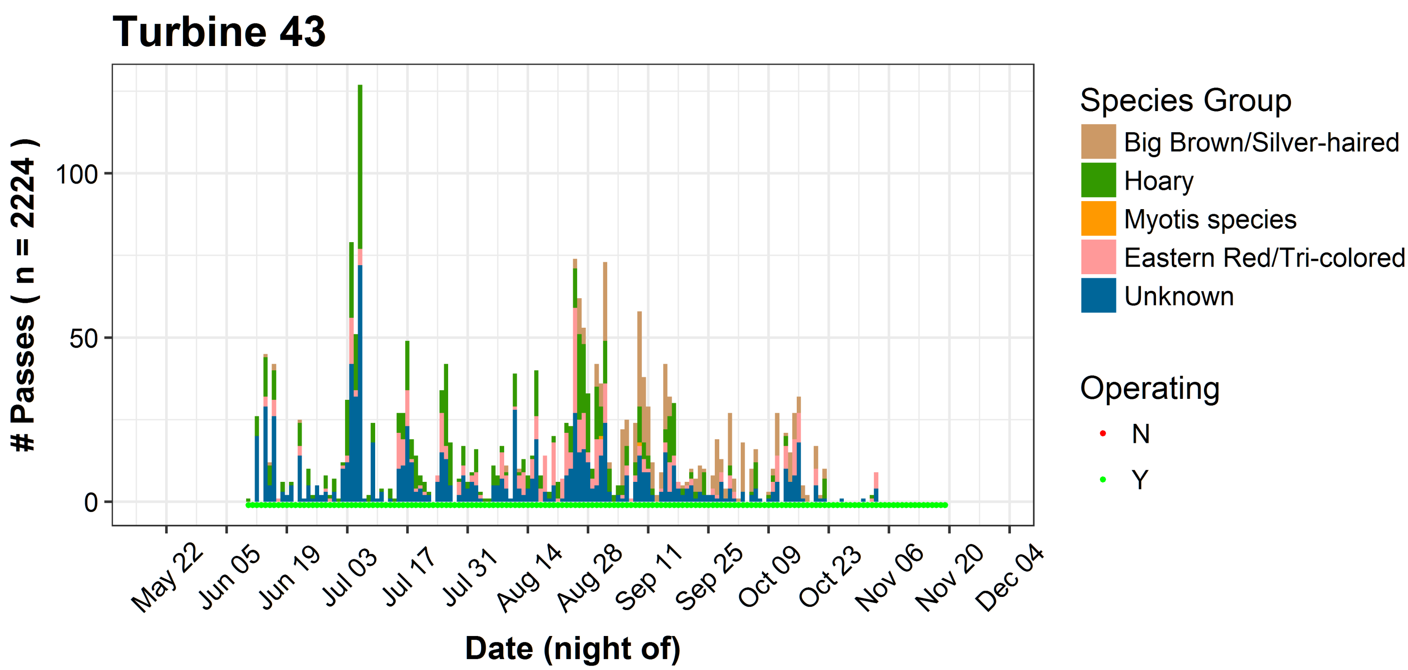


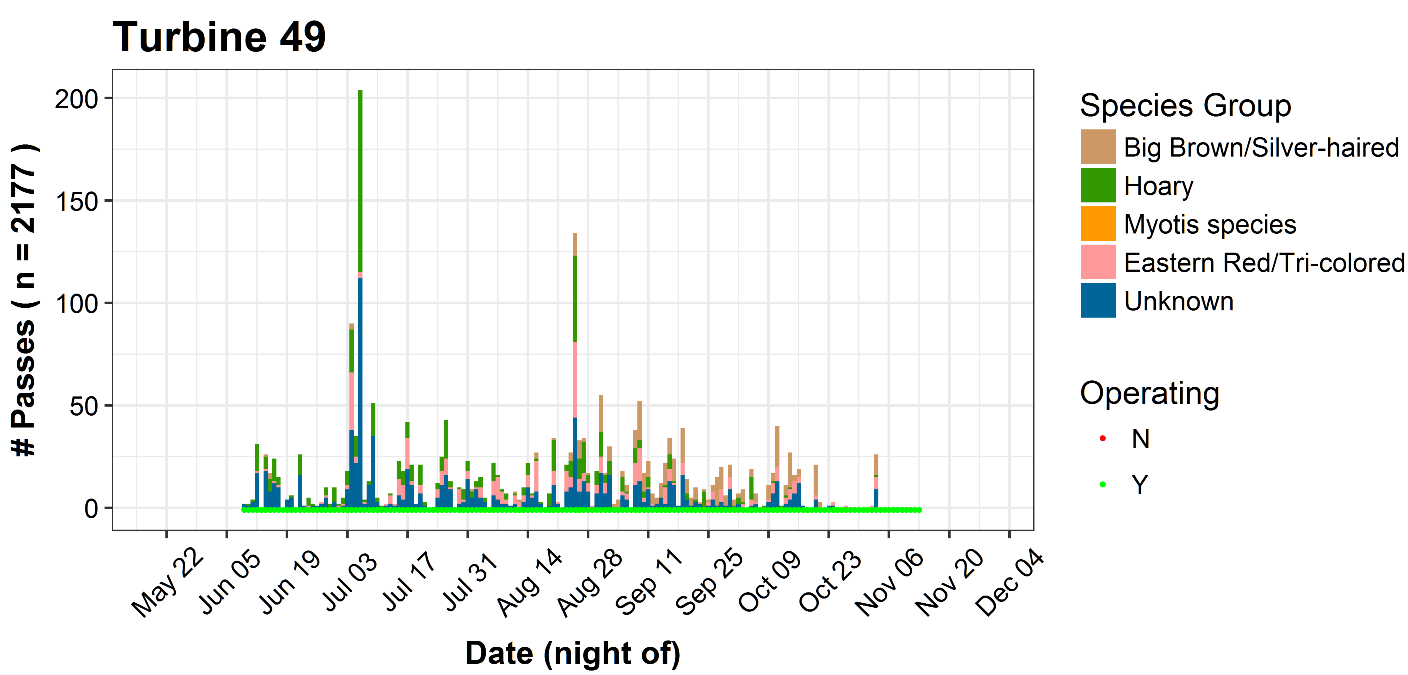

Turbine 13
Passes (n = 581)
0
10
20
May 22
Jun 05
Jun 19
Jul 03
Jul 17
Jul 31
Aug 14
Aug 28
Sep 11
Sep 25
Oct 09
Oct 23
Nov 06
Nov 20
Dec 04
Date (night of)
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown
Operating
N
Y


Turbine 25
Passes (n = 2103)
0
20
40
60
80
May 22
Jun 05
Jun 19
Jul 03
Jul 17
Jul 31
Aug 14
Aug 28
Sep 11
Sep 25
Oct 09
Oct 23
Nov 06
Nov 20
Dec 04
Date (night of)
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown
Operating
N
Y

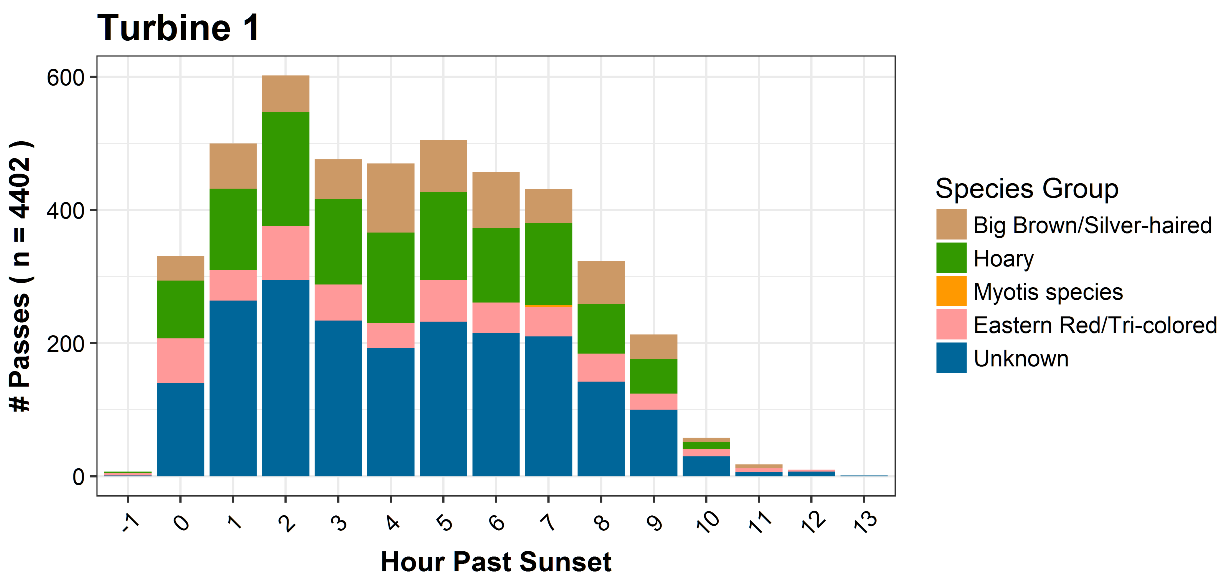

Turbine 31
Passes (n = 605)
50
40
30
20
10
0
May 22
Jun 05
Jun 19
Jul 03
Jul 17
Jul 31
Aug 14
Aug 28
Sep 11
Sep 25
Oct 09
Oct 23
Nov 06
Nov 20
Dec 04
Date (night of)
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown
Operating
N
Y

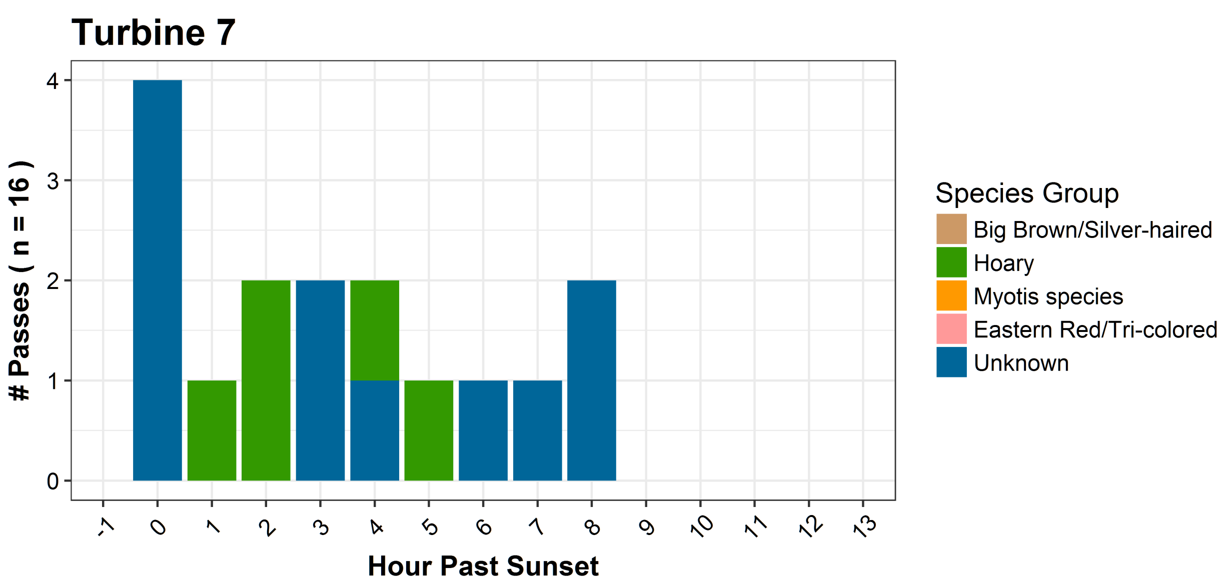

Turbine 37
Passes (n = 1583)
60
40
20
0
May 22
Jun 05
Jun 19
Jul 03
Jul 17
Jul 31
Aug 14
Aug 28
Sep 11
Sep 25
Oct 09
Oct 23
Nov 06
Nov 20
Dec 04
Date (night of)
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown
Operating
N
Y

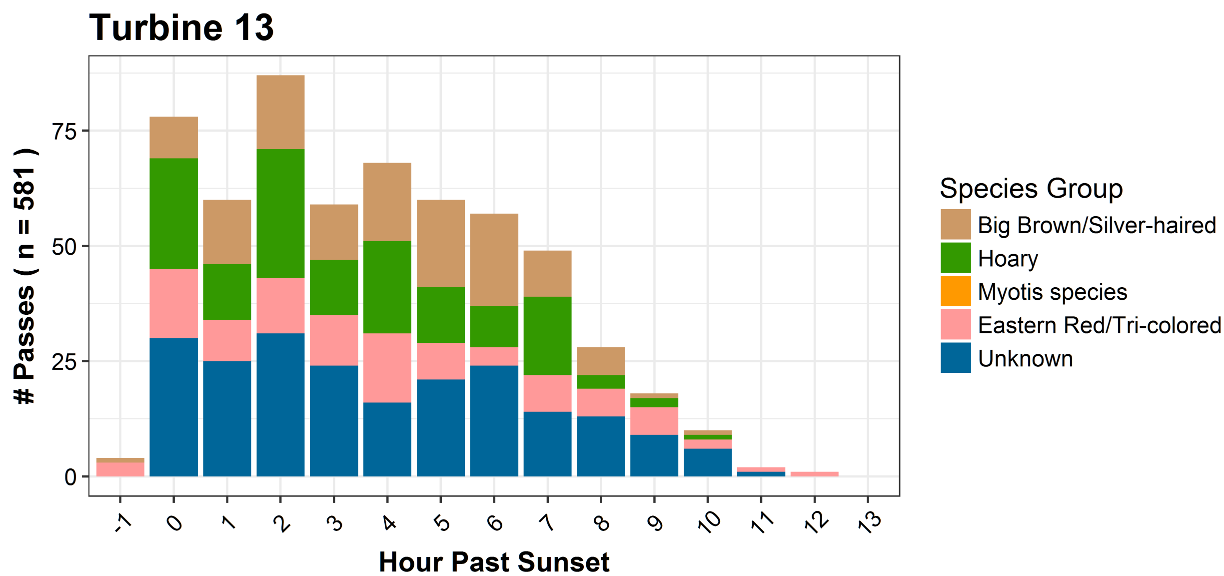

Turbine 43
Passes (n = 2224)
0
50
100
May 22
Jun 05
Jun 19
Jul 03
Jul 17
Jul 31
Aug 14
Aug 28
Sep 11
Sep 25
Oct 09
Oct 23
Nov 06
Nov 20
Dec 04
Date (night of)
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown
Operating
N
Y

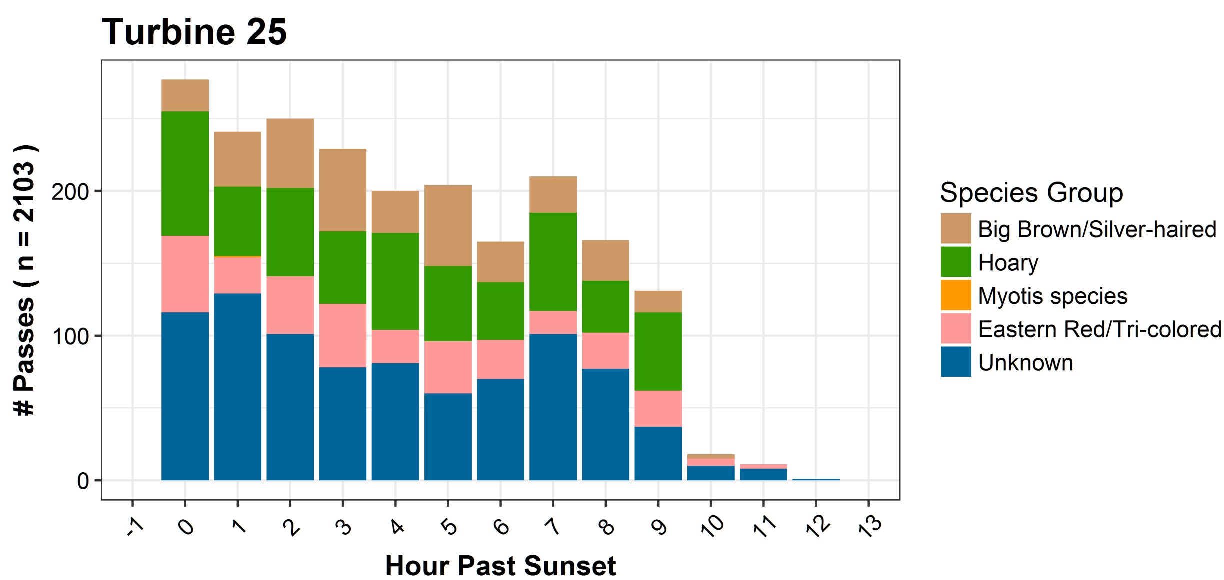

Turbine 49
Passes (n = 2177)
0
50
100
150
200
May 22
Jun 05
Jun 19
Jul 03
Jul 17
Jul 31
Aug 14
Aug 28
Sep 11
Sep 25
Oct 09
Oct 23
Nov 06
Nov 20
Dec 04
Date (night of)
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown
Operating
N
Y

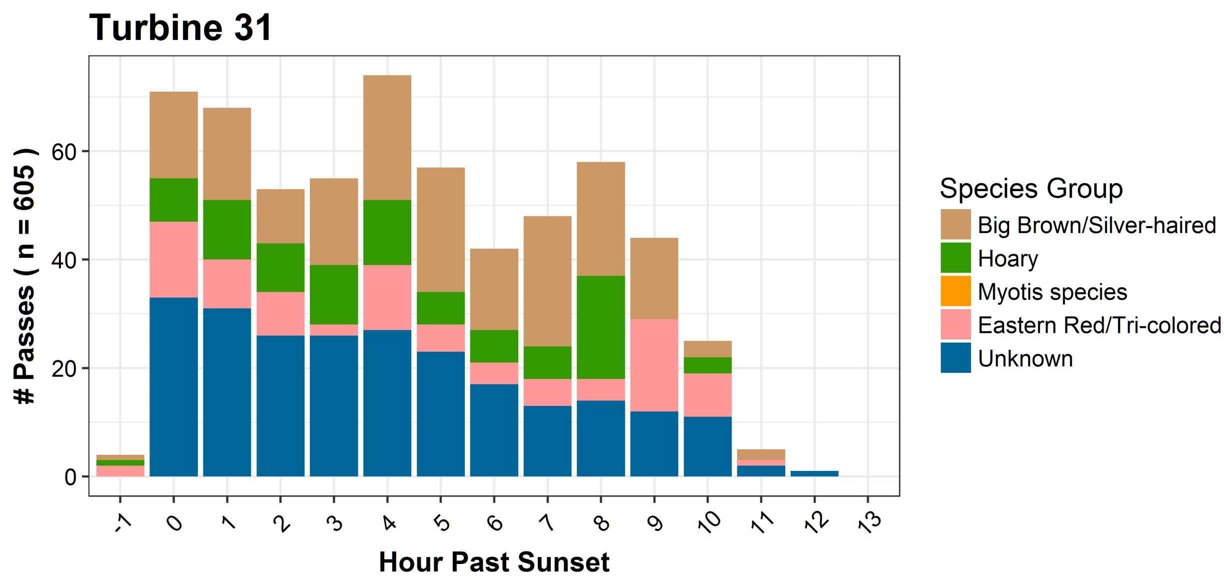
Appendix B Figure 3. Overall hourly timing bat activity by species group for each turbine, New Creek Wind Project, 2017

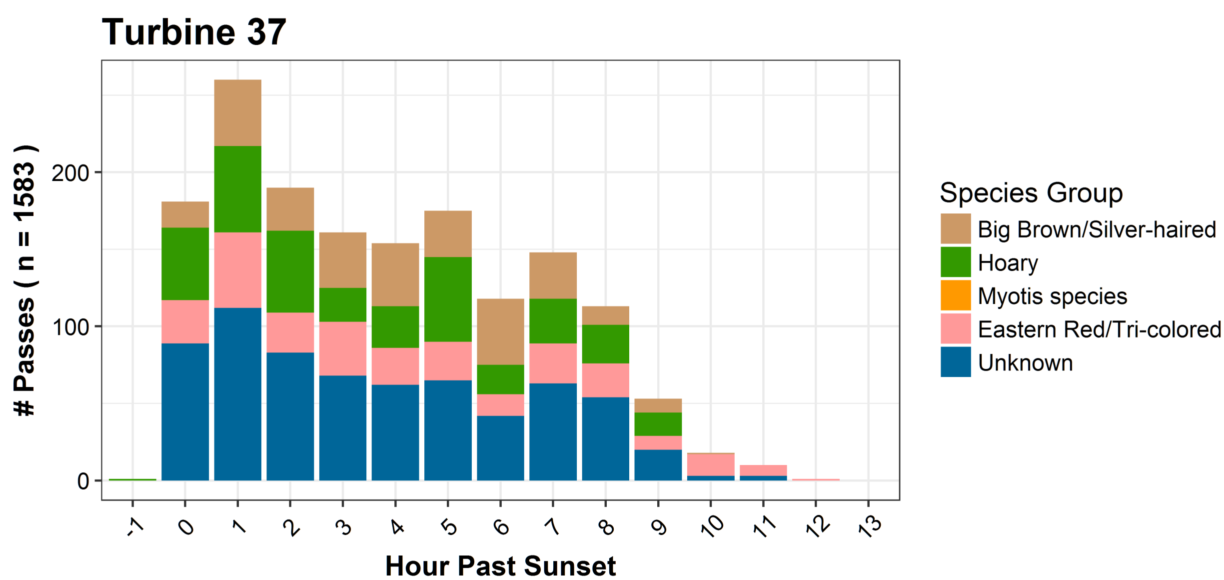


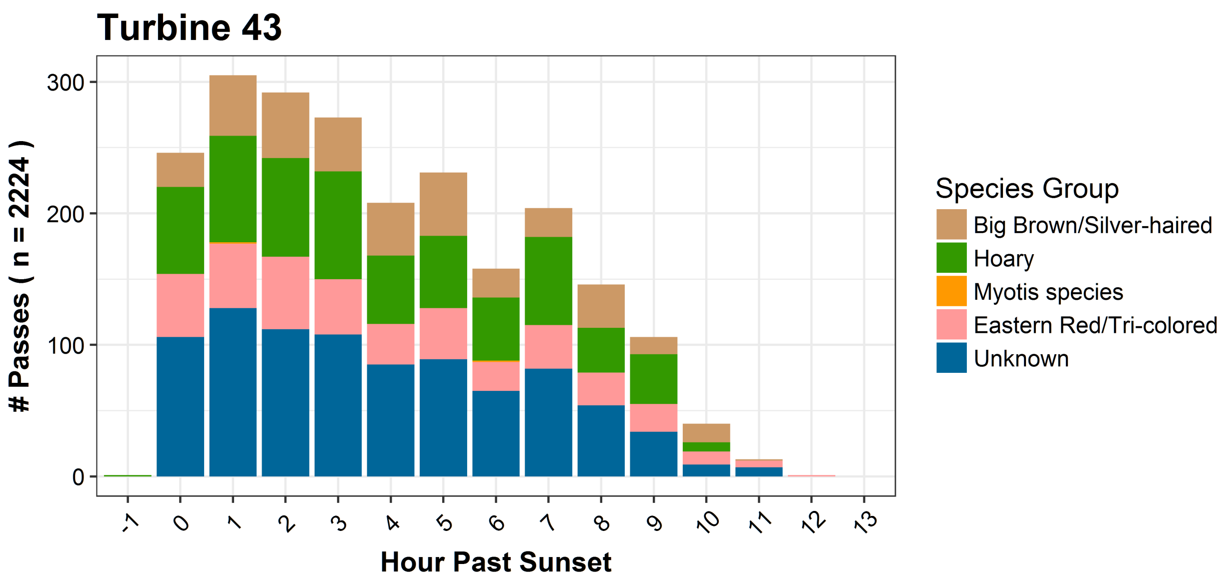


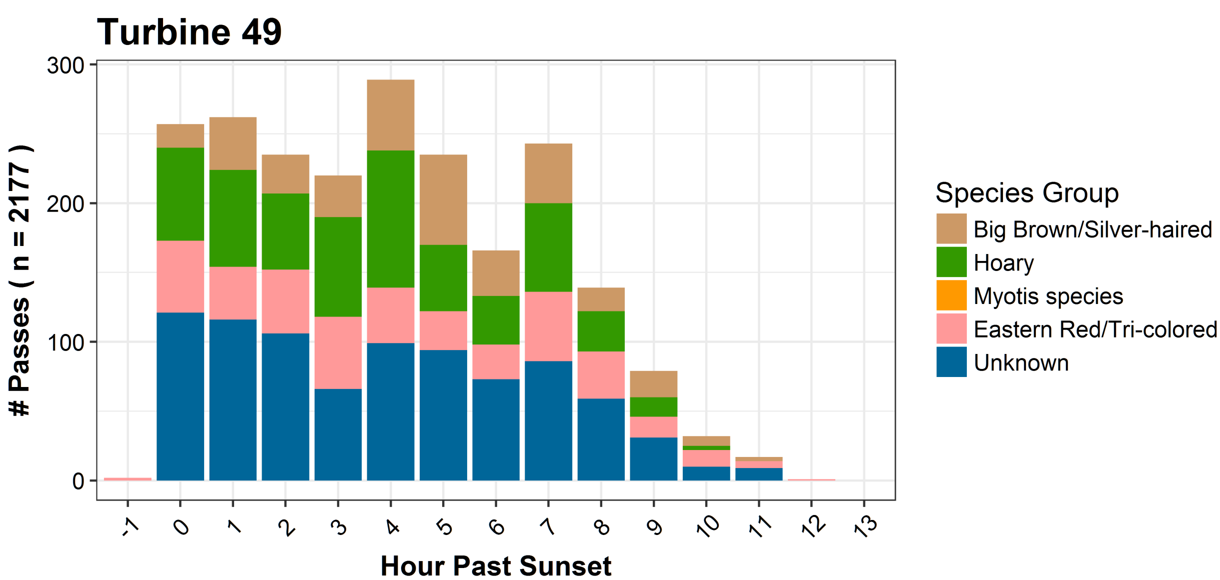

Turbine 13
Passes (n = 581)
75
50
25
0
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Hour Past Sunset
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown


Turbine 25
Passes (n = 2103)
200
100
0
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Hour Past Sunset
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown


Turbine 31
Passes (n = 605)
60
40
20
0
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Hour Past Sunset
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown


Turbine 37
Passes (n = 1583)
200
100
0
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Hour Past Sunset
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown


Turbine 43
Passes (n = 2224)
300
200
100
0
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Hour Past Sunset
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown


Turbine 49
Passes (n = 2177)
300
200
100
0
-1
0
1
2
3
4
5
6
7
8
9
10
11
12
13
Hour Past Sunset
Species Group
Big Brown/Silver-haired
Hoary
Myotis species
Eastern Red/Tri-colored
Unknown

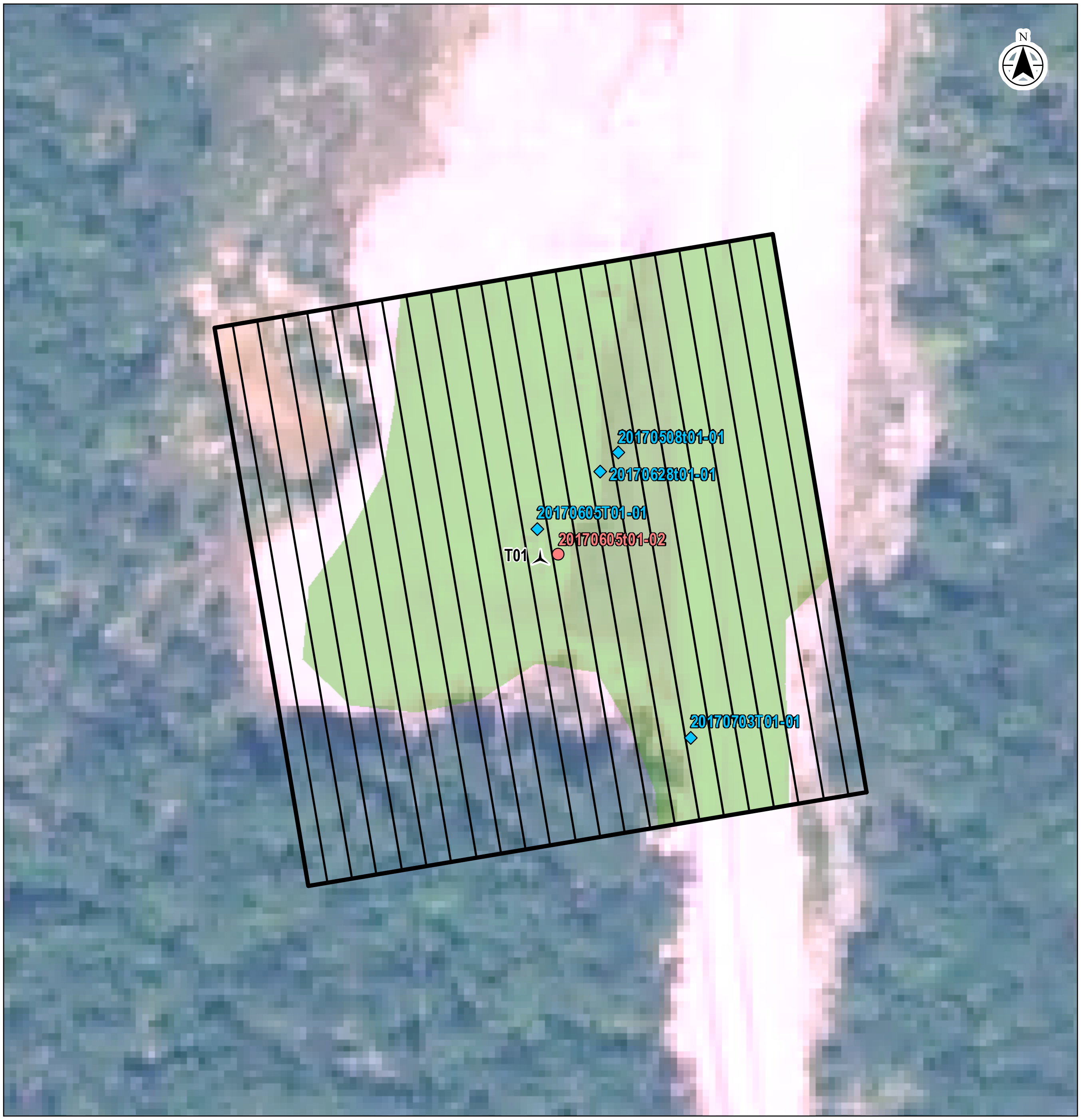
Appendix C 2017 BIRD AND BAT CARCASS DATA

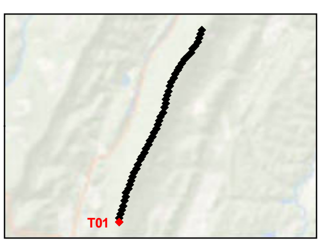
Carcass ID	How Found	Date	Type	Common Name	Species	Surveyor	Turbine	Distance from Turbine (m)	Azimuth from Turbine (°)	Ground Cover	Transect	Condition	Forearm Length (mm; bats)	Sex	Age	Estimated Time Since Fatality
20170420t39-01	Search	4/20/2017	Bat	eastern red bat	*Lasiurus borealis*	DTB	T39	30	194	Bare Ground	3	Fresh	40.2	Male	Adult	Last Night
20170428T25-01	Search	4/28/2017	Bat	eastern red bat	*Lasiurus borealis*	DTB	T25	20	44	Bare Ground	5	Decomposing - Early Flesh Mostly Present	39.23	Unknown	Adult	2-3 Days
20170504t04-01	Search	5/4/2017	Bat	hoary bat	*Lasiurus cinereus*	RGP	T04	37	20	Bare Ground	4	Decomposing - late Flesh Mostly Absent	48	Unknown	Adult	7-14 Days
20170508t01-01	Search	5/8/2017	Bat	hoary bat	*Lasiurus cinereus*	DTB	T01	21	37	Bare Ground	4	Fresh	50.77	Male	Adult	Last Night
20170509t27-01	Search	5/9/2017	Bird	ovenbird	*Seiurus aurocapilla*	RGP	T27	32	110	Bare Ground	9	Fresh	N/A	Unknown	Adult	Last Night
20170510t18-01	Search	5/10/2017	Bat	hoary bat	*Lasiurus cinereus*	DTB	T18	23	96	Bare Ground	7	Fresh	52.56	Male	Adult	Last Night
20170515t16-01	Search	5/15/2017	Bat	hoary bat	*Lasiurus cinereus*	RGP	T16	7	320	Bare Ground	3	Fresh	55	Male	Adult	Last Night
20170515t26-01	Search	5/15/2017	Bird	unidentified warbler	*Parulidae (gen, sp)*	DTB	T26	26	76	Bare Ground	6	Desiccated	N/A	Unknown	Unknown	> 2 Weeks
20170517t13-01	Search	5/17/2017	Bird	common yellowthroat	*Geothlypis trichas*	RGP	T13	31	80	Bare Ground	8	Fresh	N/A	Male	Adult	2-3 Days
20170517t18-01	Search	5/17/2017	Bat	eastern red bat	*Lasiurus borealis*	RGP	T18	42	130	Bare Ground	10	Fresh	40	Female	Adult	Last Night
20170517t38-01	Search	5/17/2017	Bat	hoary bat	*Lasiurus cinereus*	DTB	T38	20	70	Bare Ground	6	Decomposing - Early Flesh Mostly Present	53.2	Male	Adult	2-3 Days
20170605T01-01	Search	6/5/2017	Bat	eastern red bat	*Lasiurus borealis*	DTB	T01	5	356	Bare Ground	1	Fresh	38.66	Male	Adult	Last Night
20170605t01-02	Search	6/5/2017	Bird	red-eyed vireo	*Vireo olivaceus*	DTB	T01	3	76	Bare Ground	1	Fresh	N/A	Unknown	Adult	Last Night
20170619t06-01	Search	6/19/2017	Bat	hoary bat	*Lasiurus cinereus*	DTB	T06	15	123	Bare Ground	3	Fresh	55.29	Male	Adult	Last Night
20170628t38-01	Search	6/28/2017	Bat	eastern red bat	*Lasiurus borealis*	DTB	T38	42	119	Bare Ground	11	Decomposing - Early Flesh Mostly Present	39.75	Male	Adult	2-3 Days
20170703T01-01	Search	7/3/2017	Bat	eastern red bat	*Lasiurus borealis*	DTB	T01	37	141	Bare Ground	7	Fresh	40.05	Male	Adult	Last Night
20170717t16-01	Search	7/17/2017	Bat	eastern red bat	*Lasiurus borealis*	DTB	T16	40	218	Bare Ground	7	Decomposing - Early Flesh Mostly Present	39.25	Male	Adult	2-3 Days
20170717t36-01	Search	7/17/2017	Bat	hoary bat	*Lasiurus cinereus*	RGP	T36	22	43	Bare Ground	4	Fresh	52	Female	Adult	2-3 Days
20170717t45-01	Search	7/17/2017	Bat	eastern red bat	*Lasiurus borealis*	RGP	T45	8	18	Bare Ground	1	Fresh	40	Male	Adult	Last Night
20170727t04-01	Search	7/27/2017	Bat	hoary bat	*Lasiurus cinereus*	RGP	T04	8	115	Bare Ground	2	Fresh	53	Male	Adult	Last Night
20170816t03-01	Search	8/16/2017	Bat	eastern red bat	*Lasiurus borealis*	DTB	T03	32	230	Grassland	7	Desiccated	40.07	Unknown	Adult	4-7 Days
20170829t07-01	Search	8/29/2017	Bat	eastern red bat	*Lasiurus borealis*	DTB	T07	13	323	Bare Ground	2	Fresh	45	Male	Adult	Last Night
20170907t04-01	Search	9/7/2017	Bird	blackburnian warbler	*Setophaga fusca*	RGP	T04	1	6	Bare Ground	1	Fresh	N/A	Male	Adult	Last Night
20171005t49-01	Search	10/5/2017	Bat	silver-haired bat	*Lasionycteris noctivagans*	DTB	T49	16	63	Bare Ground	5	Fresh	42.76	Female	Adult	Last Night
20171016t16-01	Search	10/16/2017	Bat	eastern red bat	*Lasiurus borealis*	AS	T16	12	30	Grassland	1	Fresh	40	Unknown	Adult	Last Night
20171019t49-01	Search	10/19/2017	Bat	eastern red bat	*Lasiurus borealis*	DTB	T49	14	194	Bare Ground	1	Decomposing - Early Flesh Mostly Present	40.01	Male	Adult	2-3 Days
20171026T29-01	Search	10/26/2017	Bat	eastern red bat	*Lasiurus borealis*	AS	T29	36	65	Grassland	9	Decomposing - late Flesh Mostly Absent	40	Unknown	Adult	7-14 Days
20171031t22-01	Search	10/31/2017	Bird	ruby-crowned kinglet	*Regulus calendula*	AS	T22	16	65	Bare Ground	5	Fresh	N/A	Male	Adult	Last Night
20171102t24-01	Search	11/2/2017	Bat	silver-haired bat	*Lasionycteris noctivagans*	AS	T24	45	50	Grassland	2	Fresh	0	Unknown	Adult	Last Night

Carcass ID	How Found	Date	Type	Common Name	Species	Surveyor	Turbine	Distance from Turbine (m)	Azimuth from Turbine (°)	Ground Cover	Transect	Condition	Forearm Length (mm; bats)	Sex	Age	Estimated Time Since Fatality
20171106T36-01	Search	11/6/2017	Bird	ruby-crowned kinglet	*Regulus calendula*	AS	T36	25	360	Bare Ground	2	Decomposing - Early Flesh Mostly Present	N/A	Unknown	Adult	2-3 Days
20171109T48-01	Search	11/9/2017	Bat	eastern red bat	*Lasiurus borealis*	AS	T48	30	50	Bare Ground	10	Fresh	36	Unknown	Adult	2-3 Days
20170427t18-01	Incidental	4/27/2017	Bat	hoary bat	*Lasiurus cinereus*	SCS	T18	14	80	Bare Ground	4e	Decomposing - Early Flesh Mostly Present	52	Unknown	Adult	7-14 Days
20170501t12-01	Incidental	5/1/2017	Bird	blackpoll warbler	*Setophaga striata*	DTB	T12	55	66	Bare Ground	Road	Fresh	N/A	Male	Adult	Last Night
20170502t11-01	Incidental	5/2/2017	Bird	red-eyed vireo	*Vireo olivaceus*	SCS	T11	40	45	Grassland	8e	Fresh	N/A	Unknown	Adult	2-3 Days
20170515t20-01	Incidental	5/15/2017	Bird	black-billed cuckoo	*Coccyzus erythropthalmus*	DTB	T20	30	149	Bare Ground	4e	Fresh	N/A	Unknown	Adult	Last Night
20170517t27-01	Incidental	5/17/2017	Bat	eastern red bat	*Lasiurus borealis*	DTB	T27	27	156	Bare Ground	4e	Fresh	41.31	Male	Adult	Last Night
20170518t41-01	Incidental	5/18/2017	Bat	hoary bat	*Lasiurus cinereus*	DTB	T41	55	82	Bare Ground	Road	Fresh	53.45	Male	Adult	Last Night
20170531T09-1RGP_Incidental	Incidental	5/31/2017	Bat	hoary bat	*Lasiurus cinereus*	RGP	T09	24	170	Bare Ground	2e	Fresh	55	Female	Adult	Last Night
20170531T09-2RGP_Incidental	Incidental	5/31/2017	Bat	hoary bat	*Lasiurus cinereus*	RGP	T09	22	88	Bare Ground	6e	Fresh	54	Unknown	Adult	2-3 Days
20170531T09-3RGP_Incidental	Incidental	5/31/2017	Bat	hoary bat	*Lasiurus cinereus*	RGP	T09	37	108	Bare Ground	9e	Fresh	54	Unknown	Adult	2-3 Days
20170612t19-01	Incidental	6/12/2017	Bat	hoary bat	*Lasiurus cinereus*	RGP	T19	38	98	Bare Ground	Road	Fresh	51	Male	Adult	Last Night
20170628t01-01	Incidental	6/28/2017	Bat	hoary bat	*Lasiurus cinereus*	RGP	T01	17	35	Bare Ground	3e	Fresh	53	Male	Adult	Last Night
20170703T30-01	Incidental	7/3/2017	Bat	eastern red bat	*Lasiurus borealis*	RGP	T30	28	62	Bare Ground	6e	Fresh	40	Male	Adult	Last Night
20170721t02-01	Incidental	7/21/2017	Bird	northern rough-winged swallow	*Stelgidopteryx serripennis*	DTB	T02	25	122	Bare Ground	5E	Fresh	N/A	Unknown	Adult	Last Night
20170816t09-02	Incidental	8/16/2017	Bird	turkey vulture	*Cathartes aura*	RGP	T09	36	42	Grassland	8e	Fresh	N/A	Unknown	Adult	Last Night
20170831T02-01	Incidental	8/31/2017	Bird	yellow-billed cuckoo	*Coccyzus americanus*	DTB	T02	31	78	Bare Ground	7e	Fresh	N/A	Unknown	Juvenile	Last Night
20170904t03-01	Incidental	9/4/2017	Bird	blackburnian warbler	*Setophaga fusca*	RGP	T03	45	66	Bare Ground	Road	Fresh	N/A	Female	Adult	2-3 Days

Appendix D NEW CREEK TURBINE MAPS

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Bat Carcass Location
- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

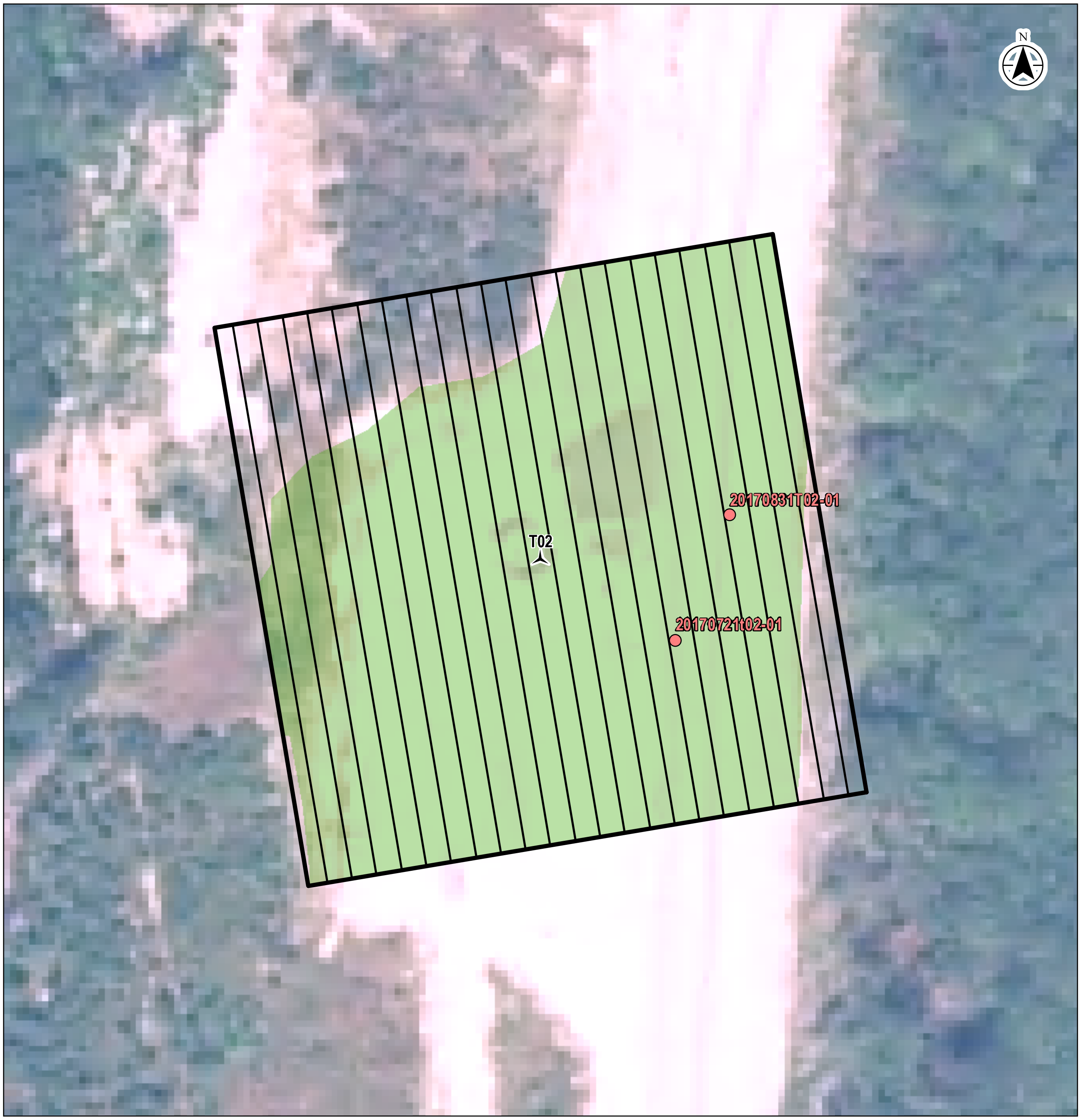
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

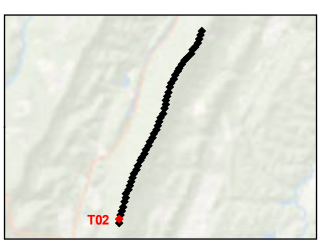
Figure No.
1

Title
Turbine 1 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

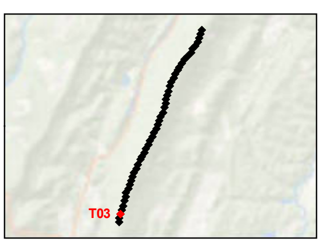
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
2

Title
Turbine 2 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter



Legend

- Bat Carcass Location
- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location 195601197
Grant County, West Virginia
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

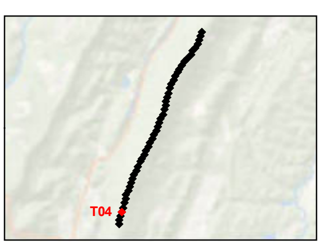
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
3

Title
Turbine 3 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter



Legend

- Bat Carcass Location
- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

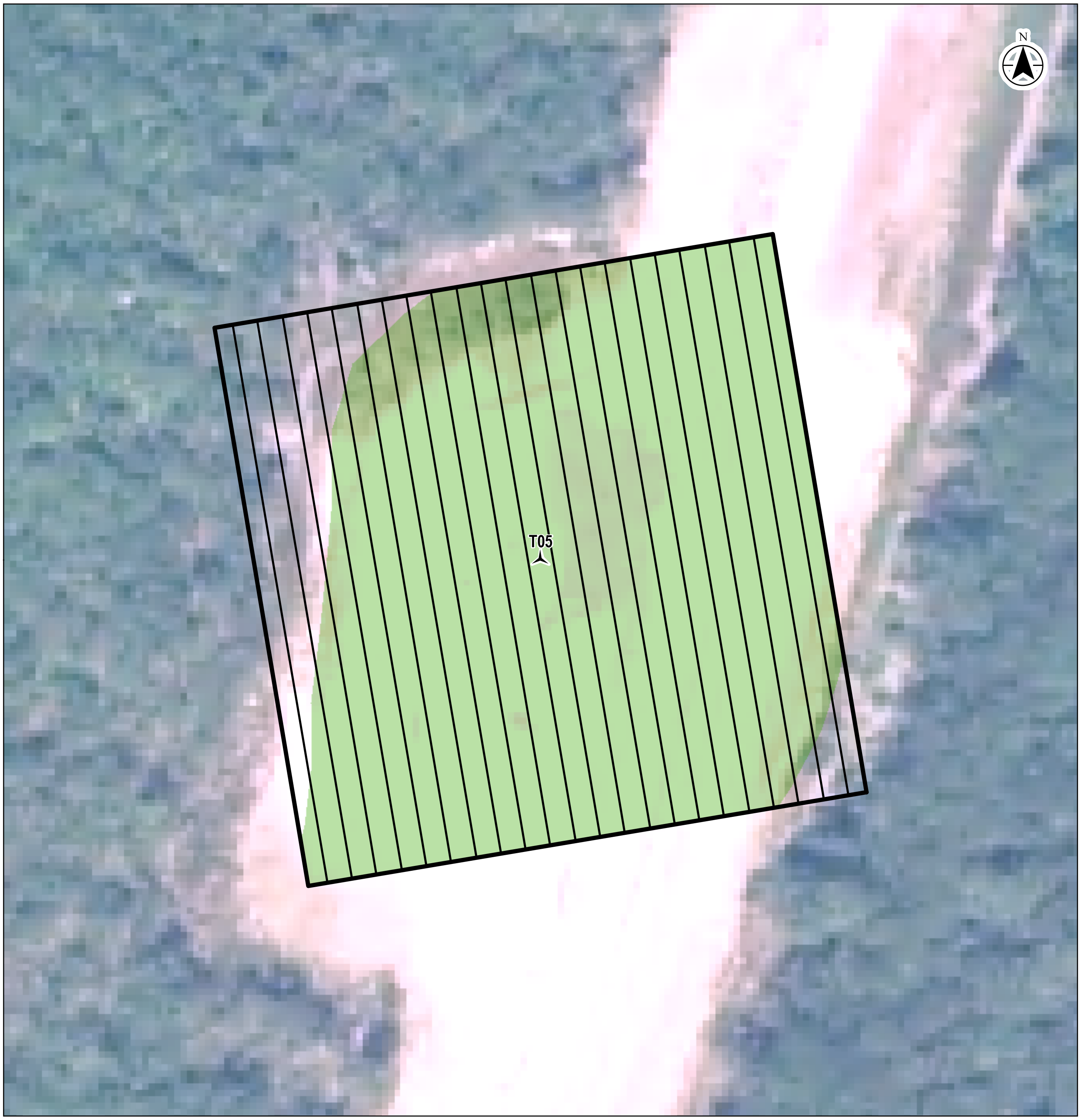
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

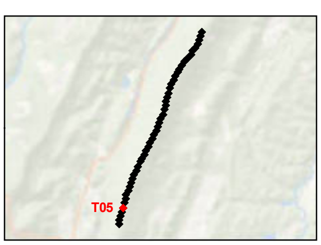
Figure No.
4

Title
Turbine 4 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location 195601197
Grant County, West Virginia
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

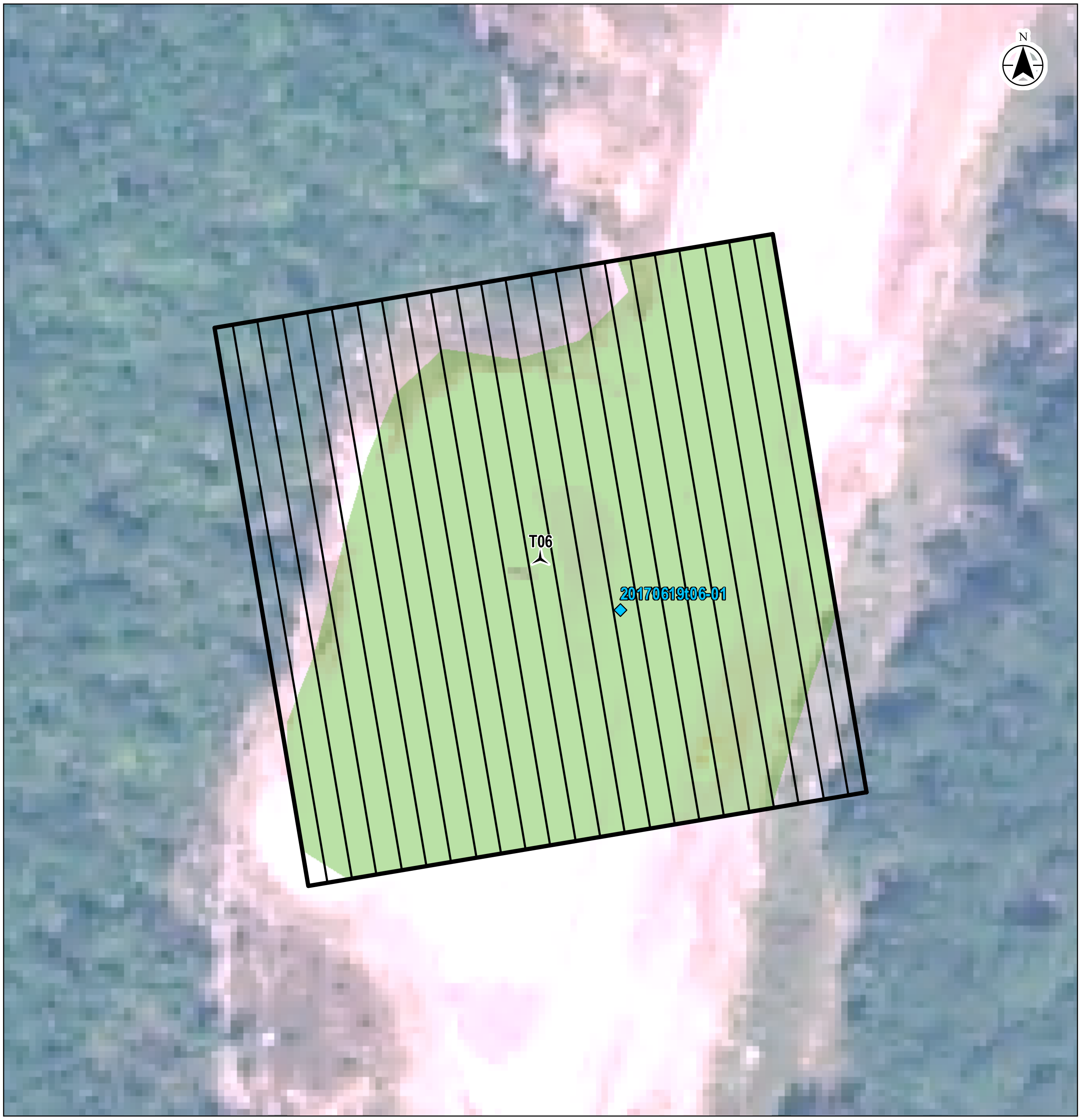
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

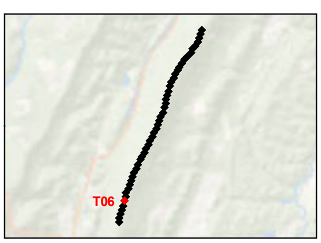
Figure No.
5

Title
Turbine 5 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

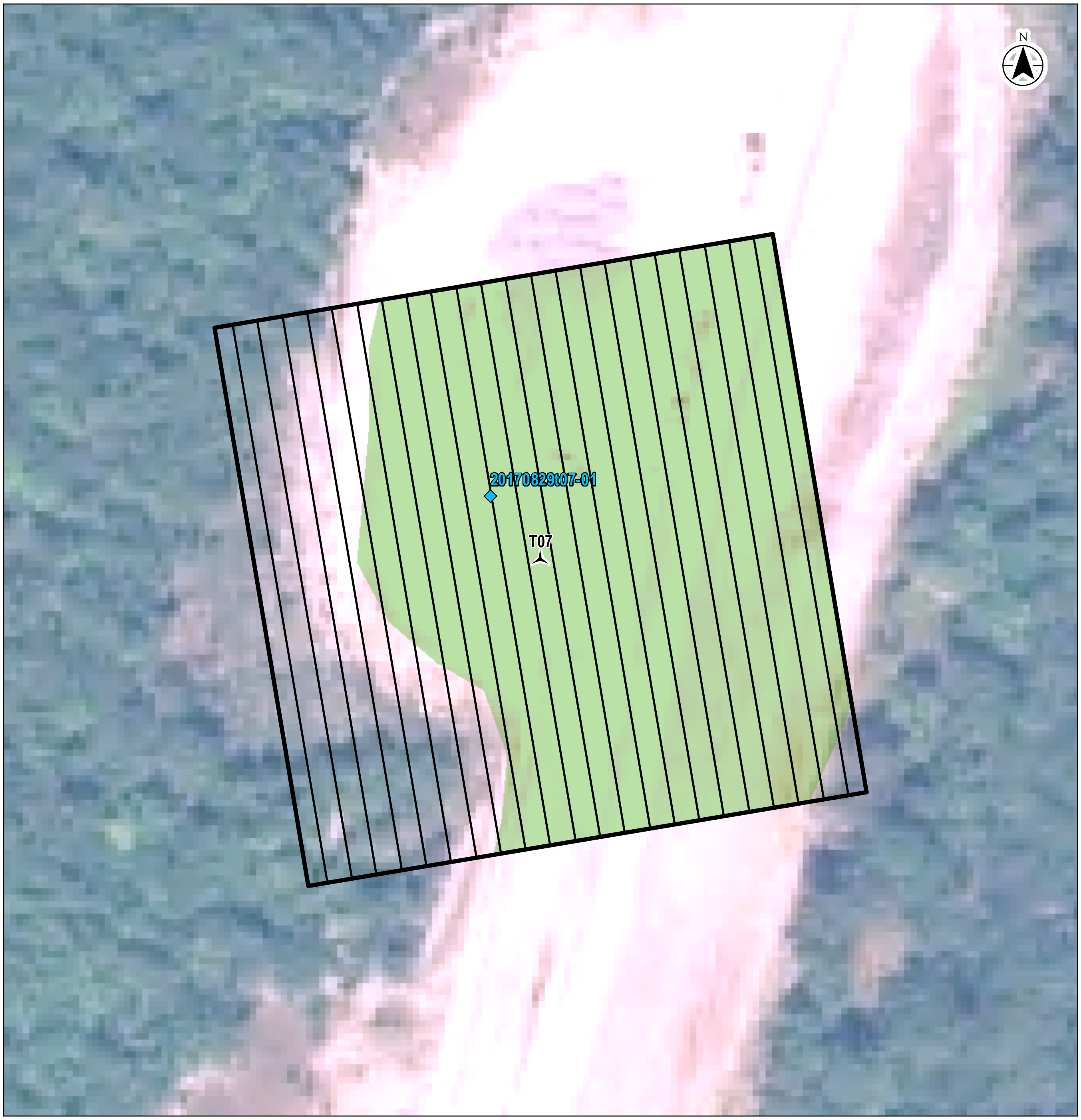
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

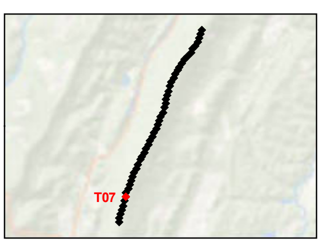
Figure No.
6

Title
Turbine 6 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

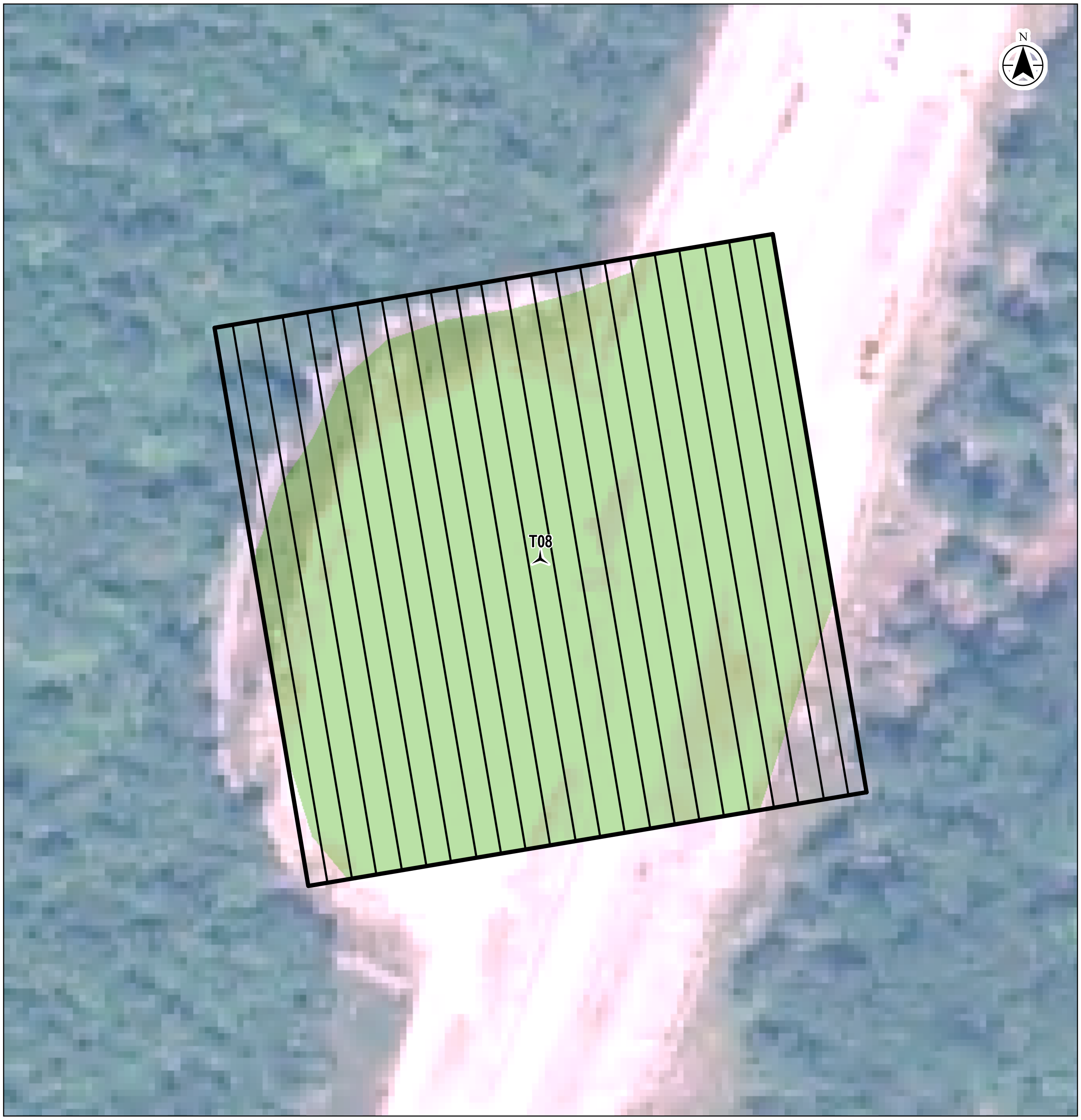
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

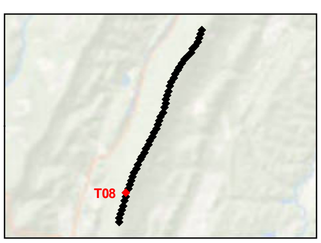
Figure No.
7

Title
Turbine 7 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

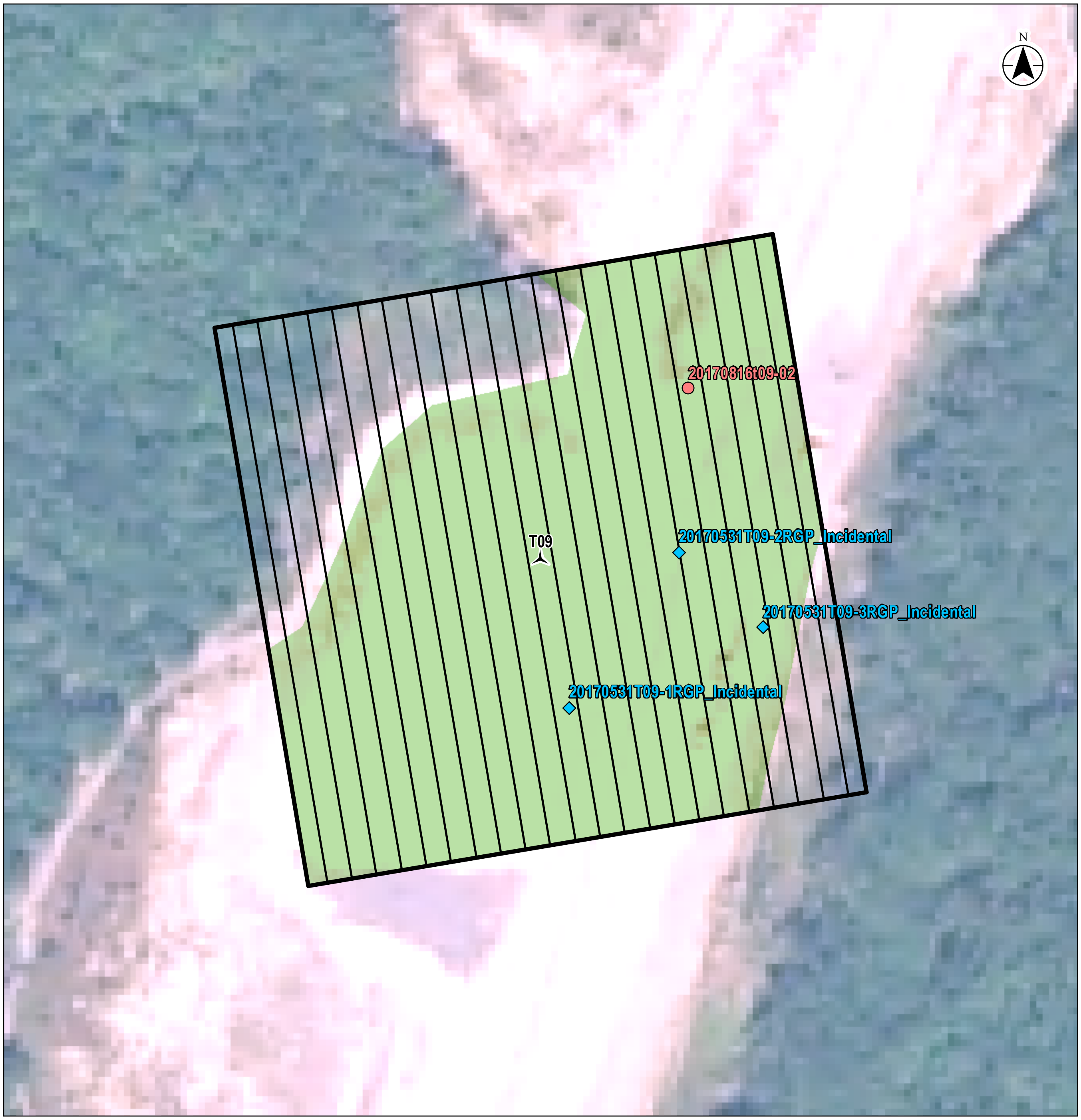
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

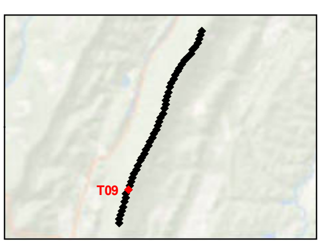
Figure No.
8

Title
Turbine 8 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Bat Carcass
- Bird Carcass
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

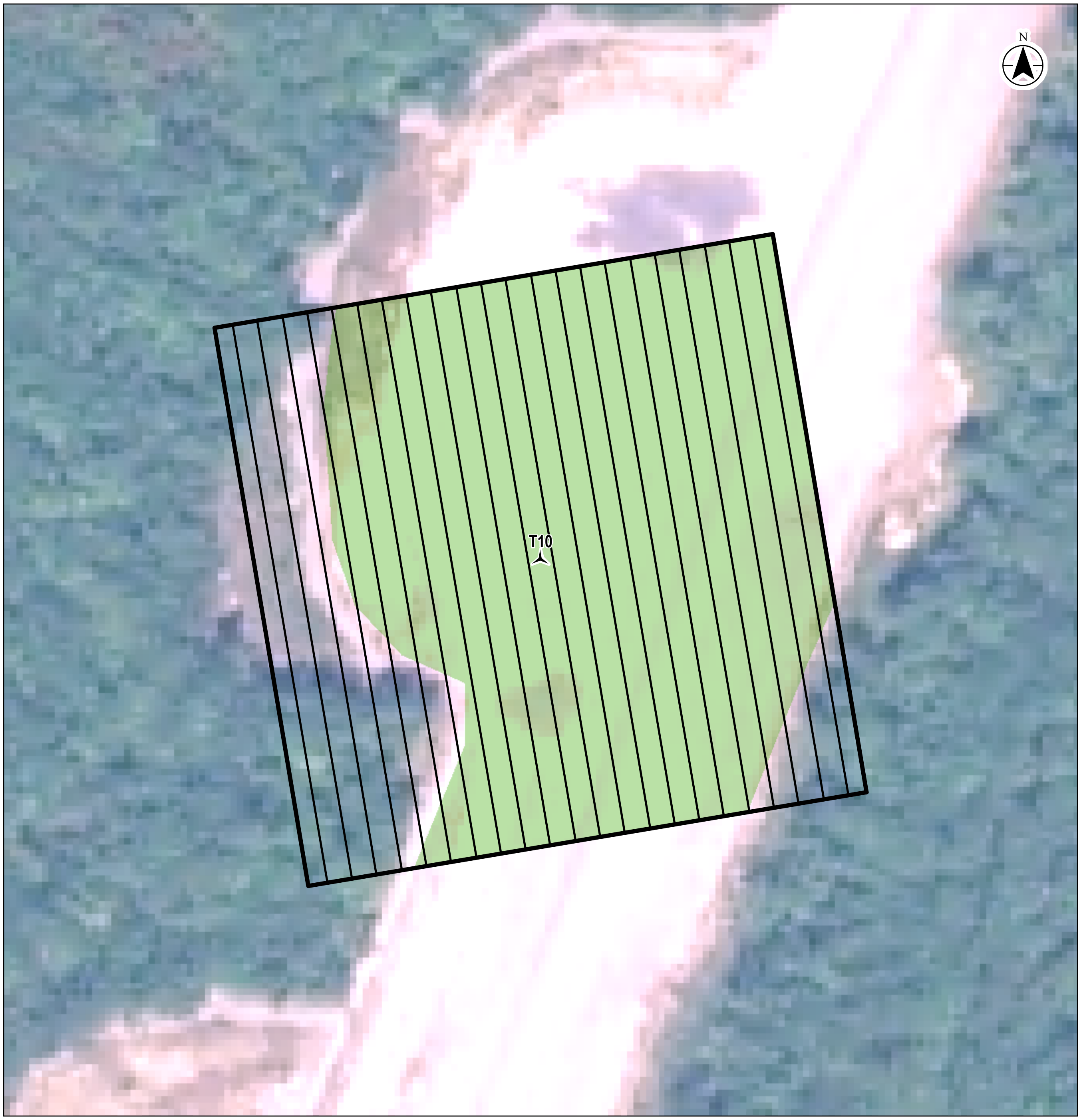
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

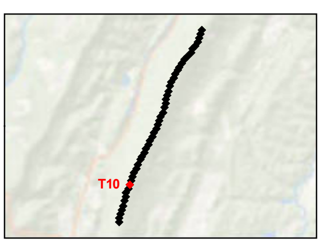
Figure No.
9

Title
Turbine 9 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

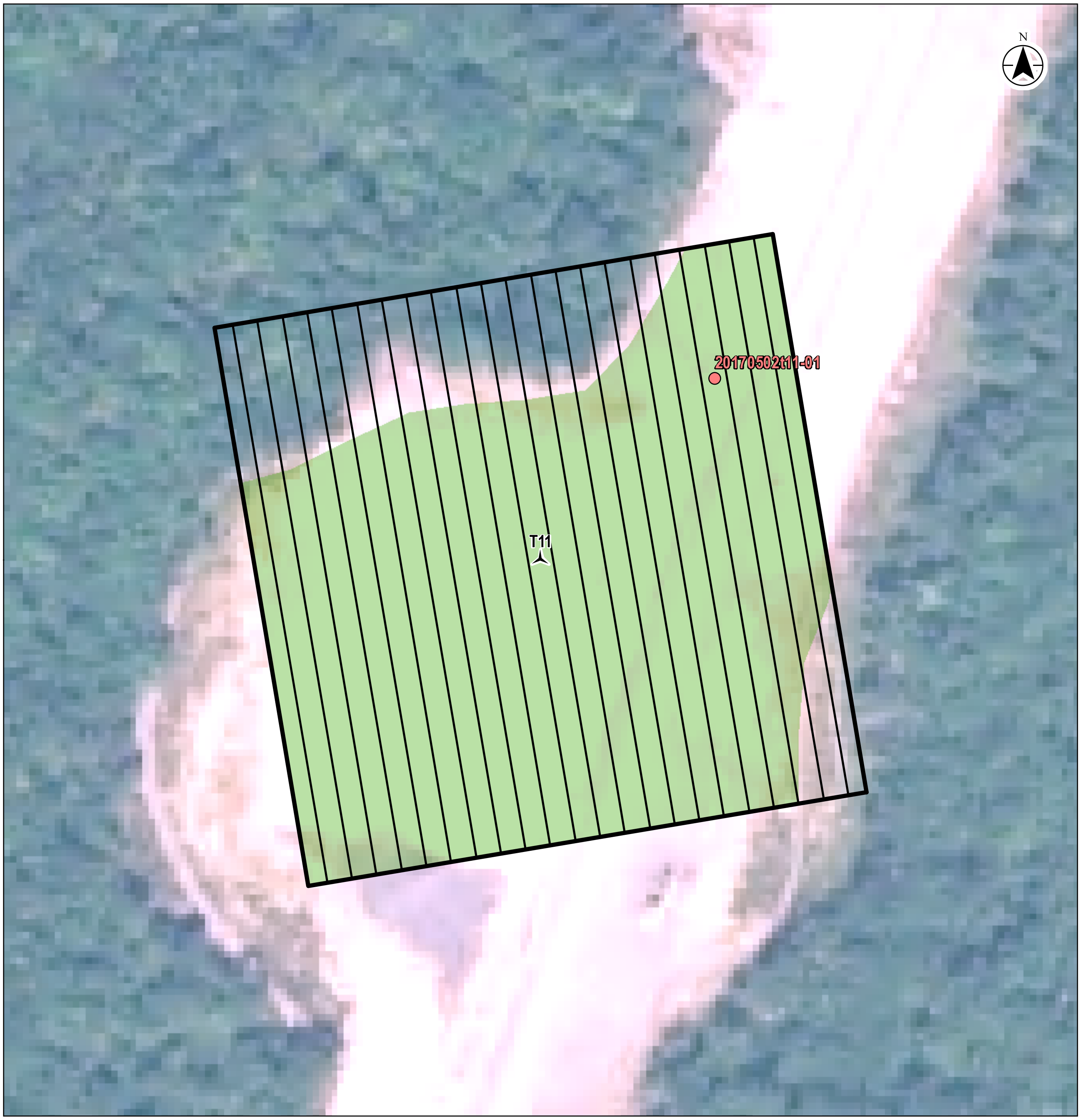
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

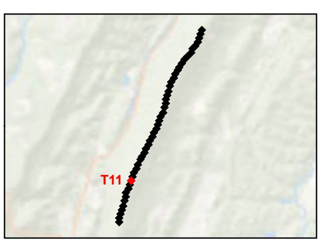
Figure No.
10

Title
Turbine 10 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpentier





Legend

- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

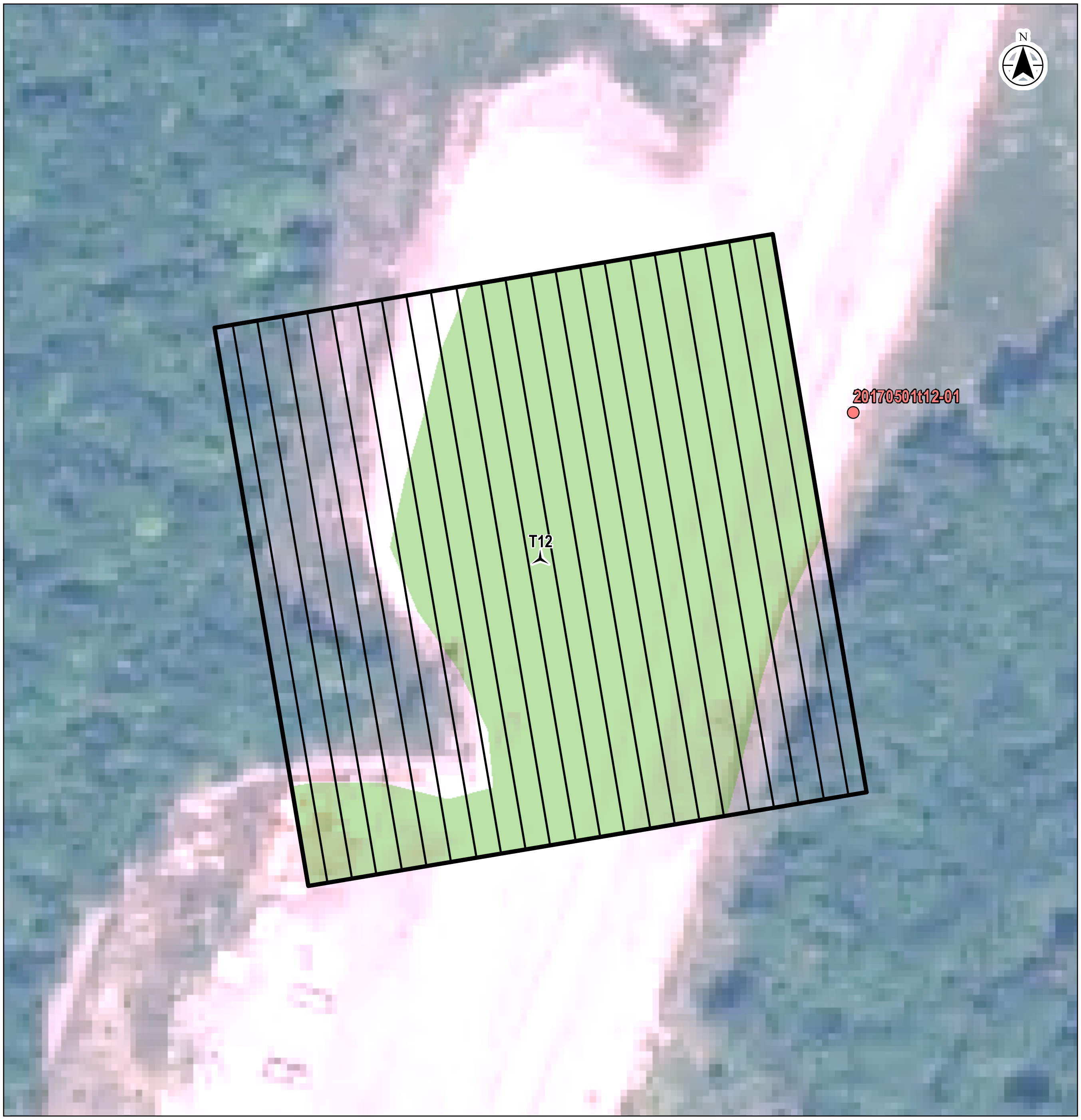
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

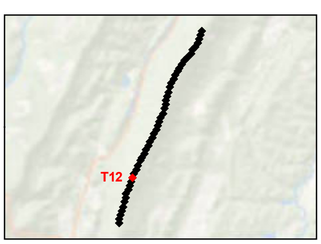
Figure No.
11

Title
Turbine 11 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd   Revised: 2018-01-31 By: gcarpenter





Legend

- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

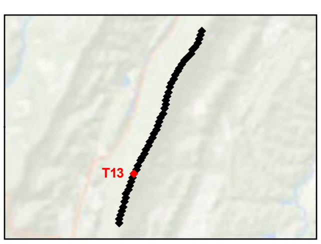
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
12

Title
Turbine 12 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter



Legend

- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

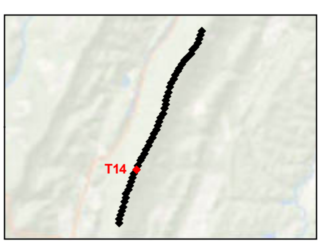
195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
13

Title
Turbine 13 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016



Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

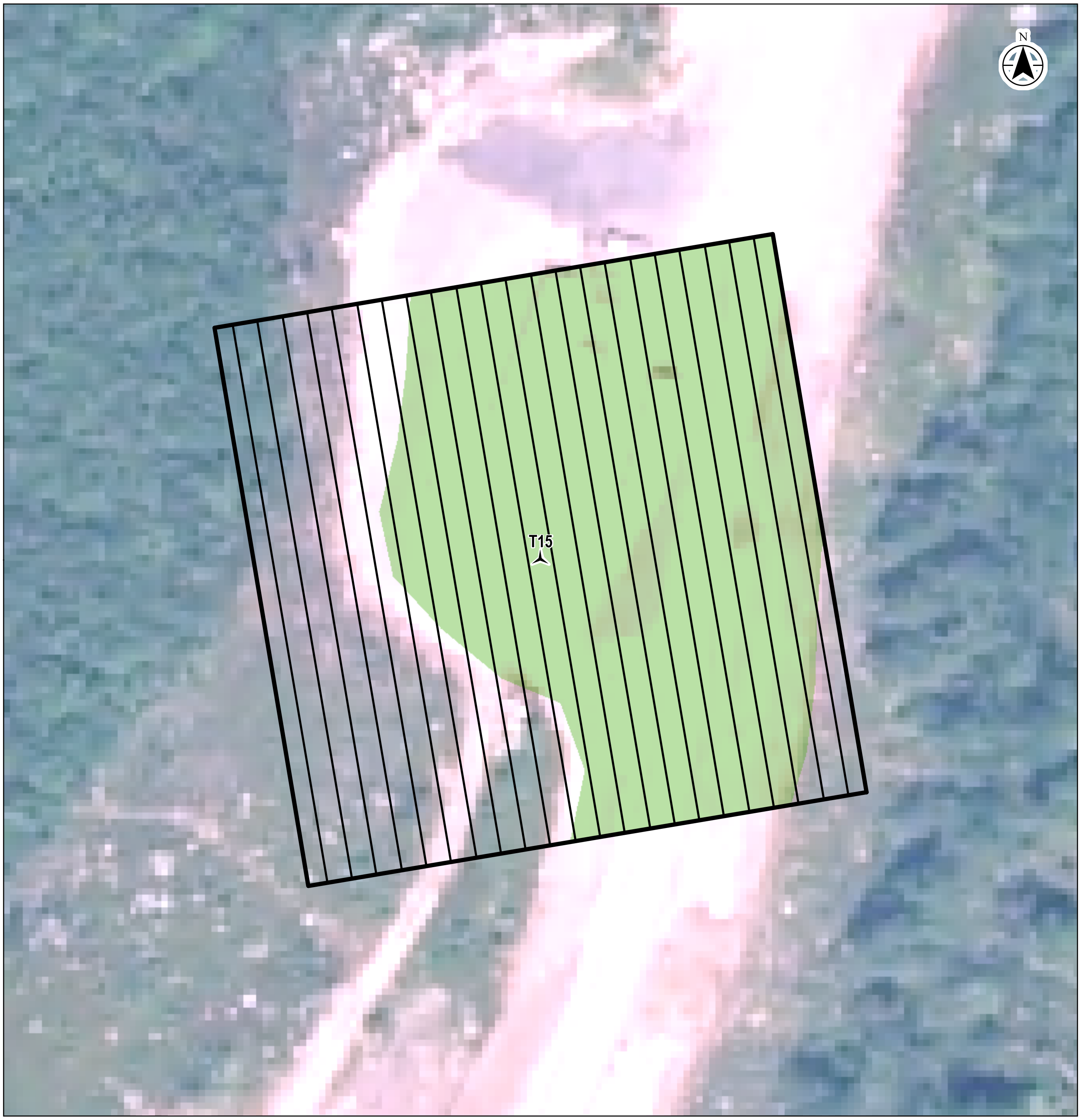
Figure No.
14

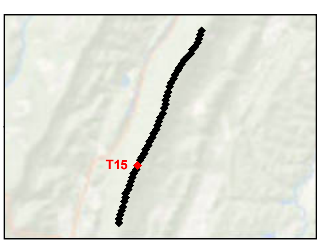
Title
Turbine 14 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpentier

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

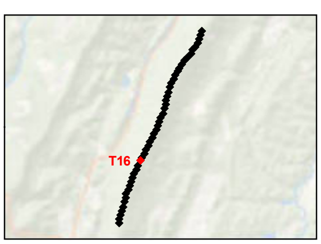
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
15

Title
Turbine 15 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd   Revised: 2018-01-31 By: gcarpenter



Legend

- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

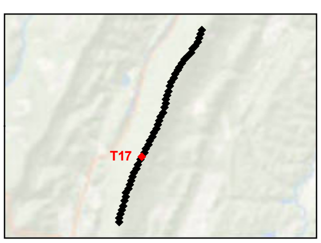
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
16

Title
Turbine 16 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter



Legend
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

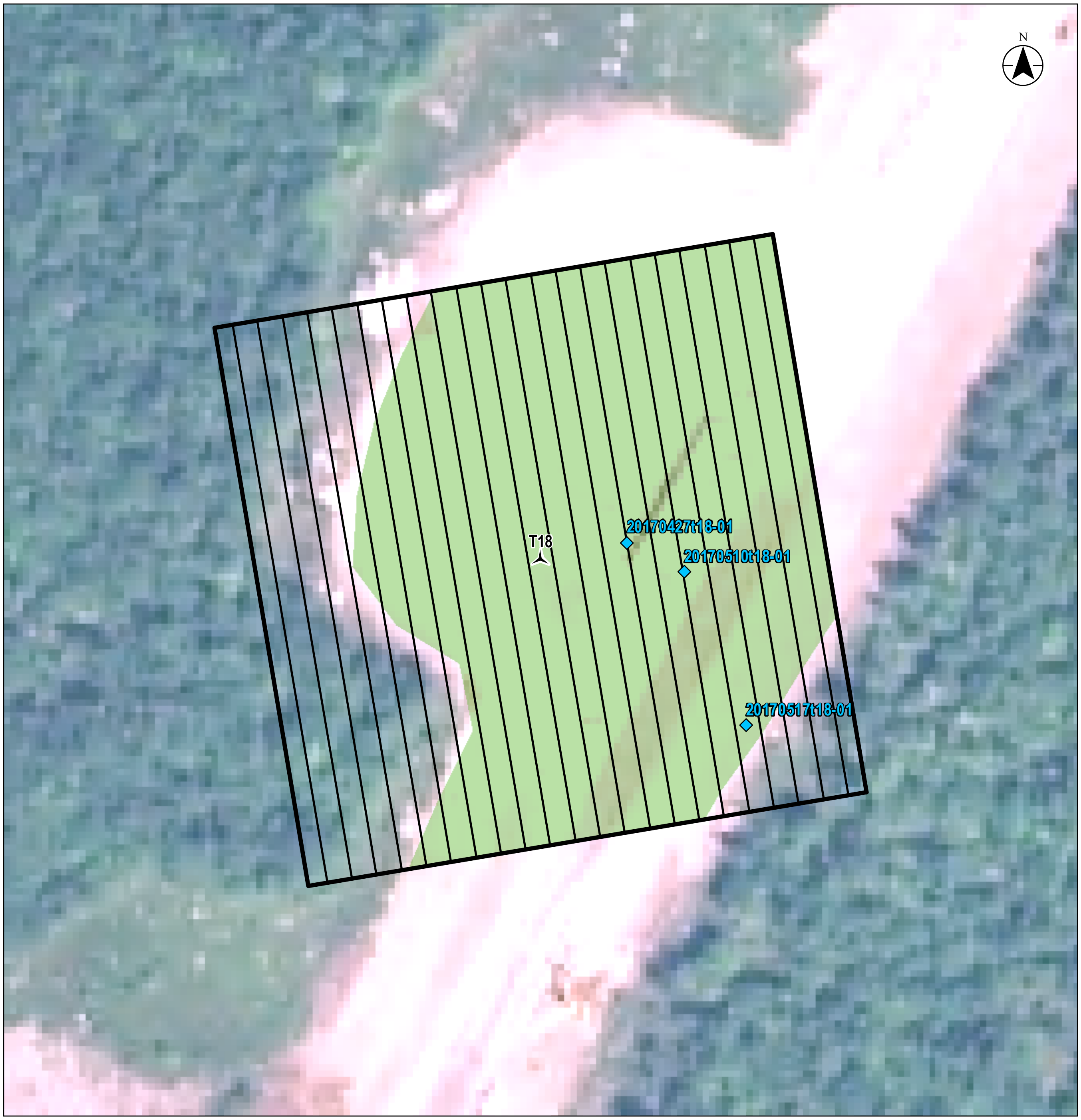
195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

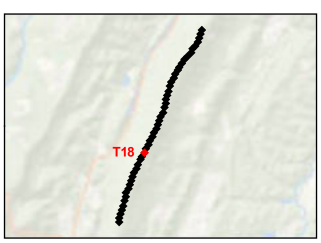
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
17

Title
Turbine 17 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016





Legend
- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location 195601197
Grant County, West Virginia
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

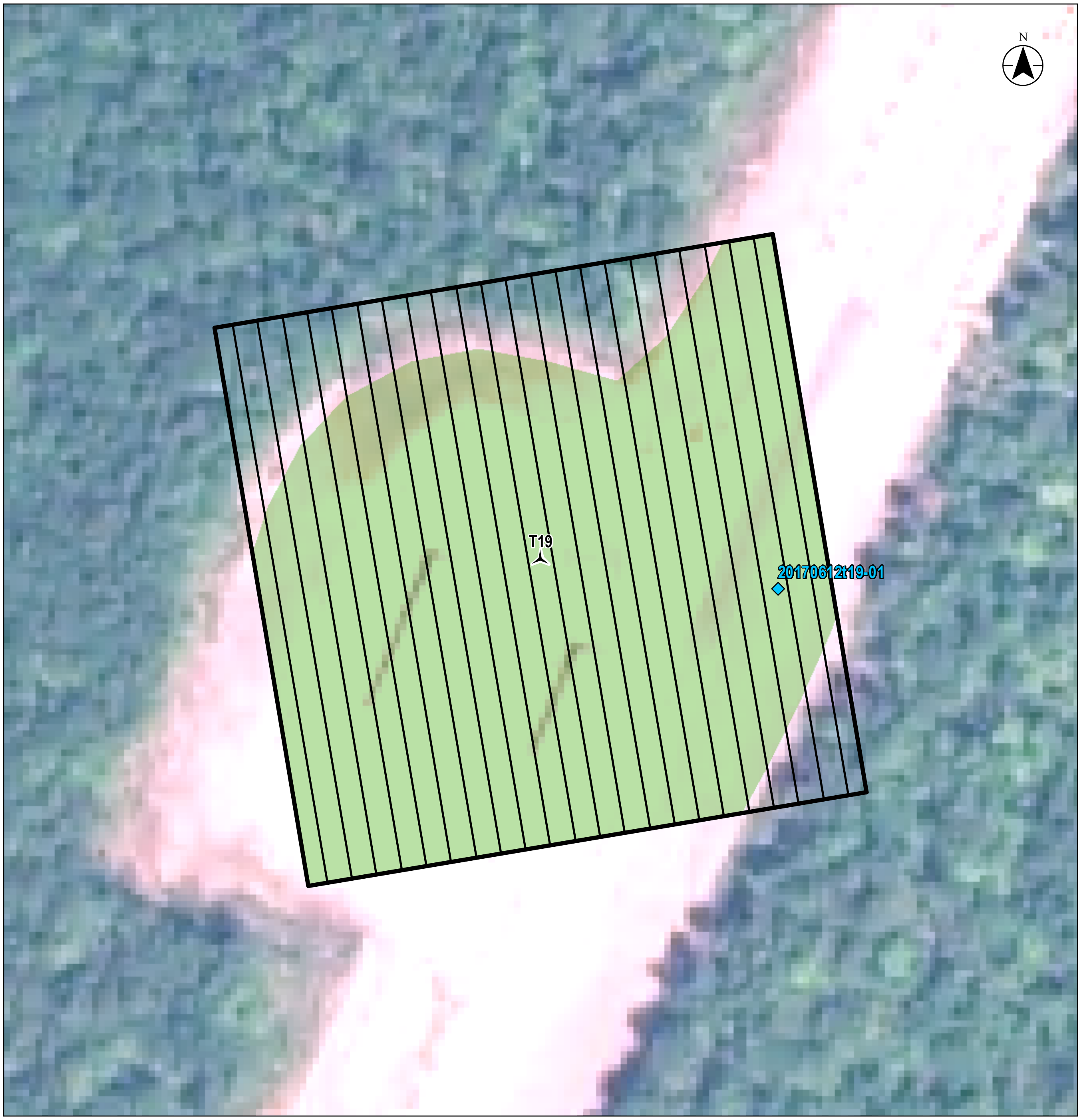
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

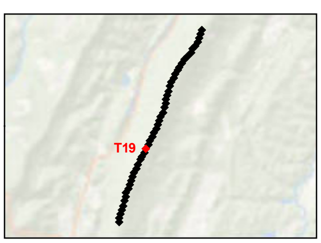
Figure No.
18

Title
Turbine 18 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

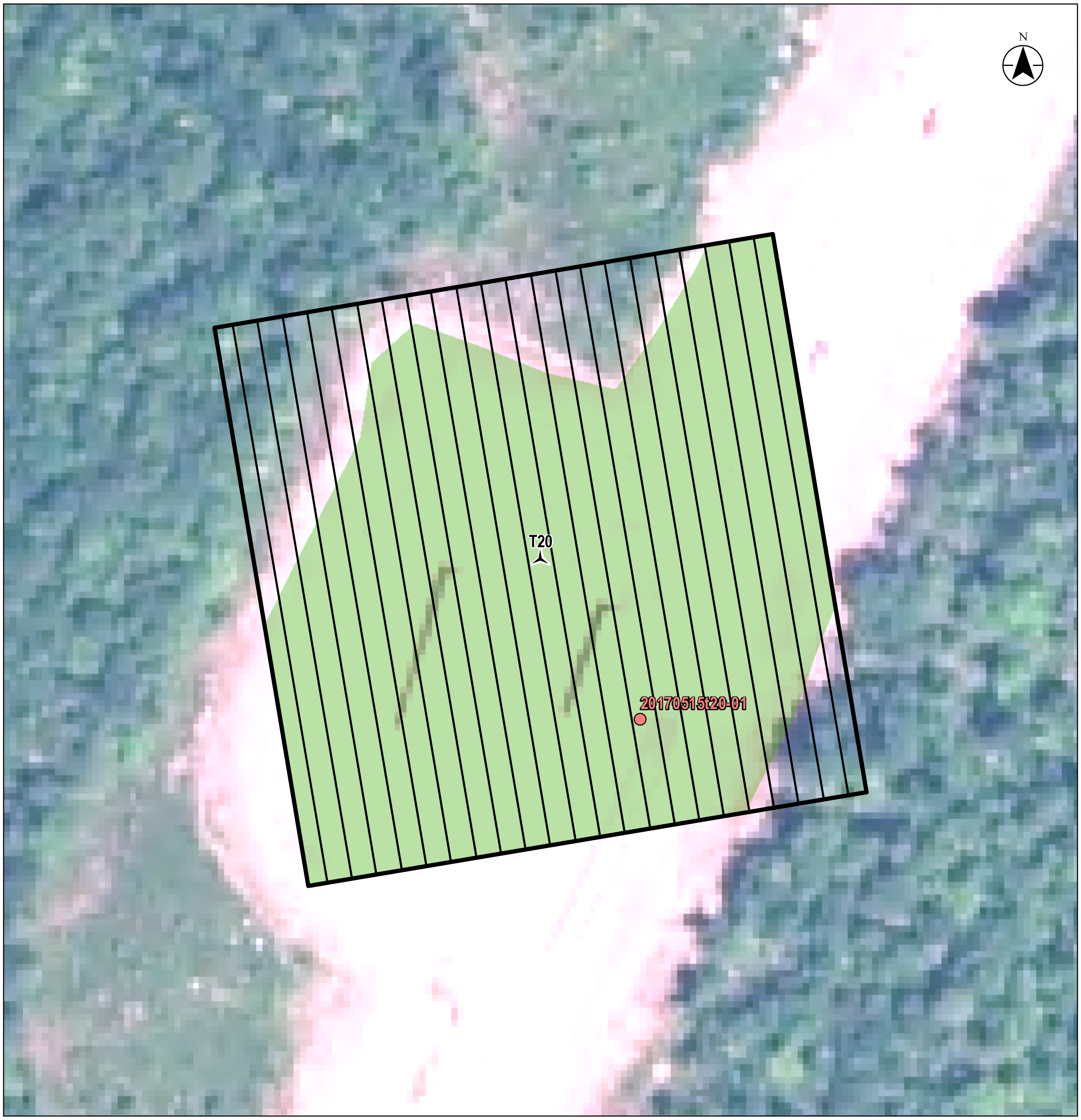
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

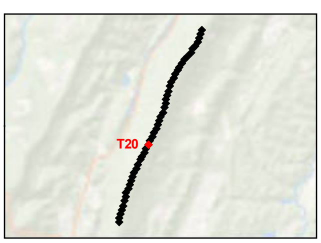
Figure No.
19

Title
Turbine 19 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

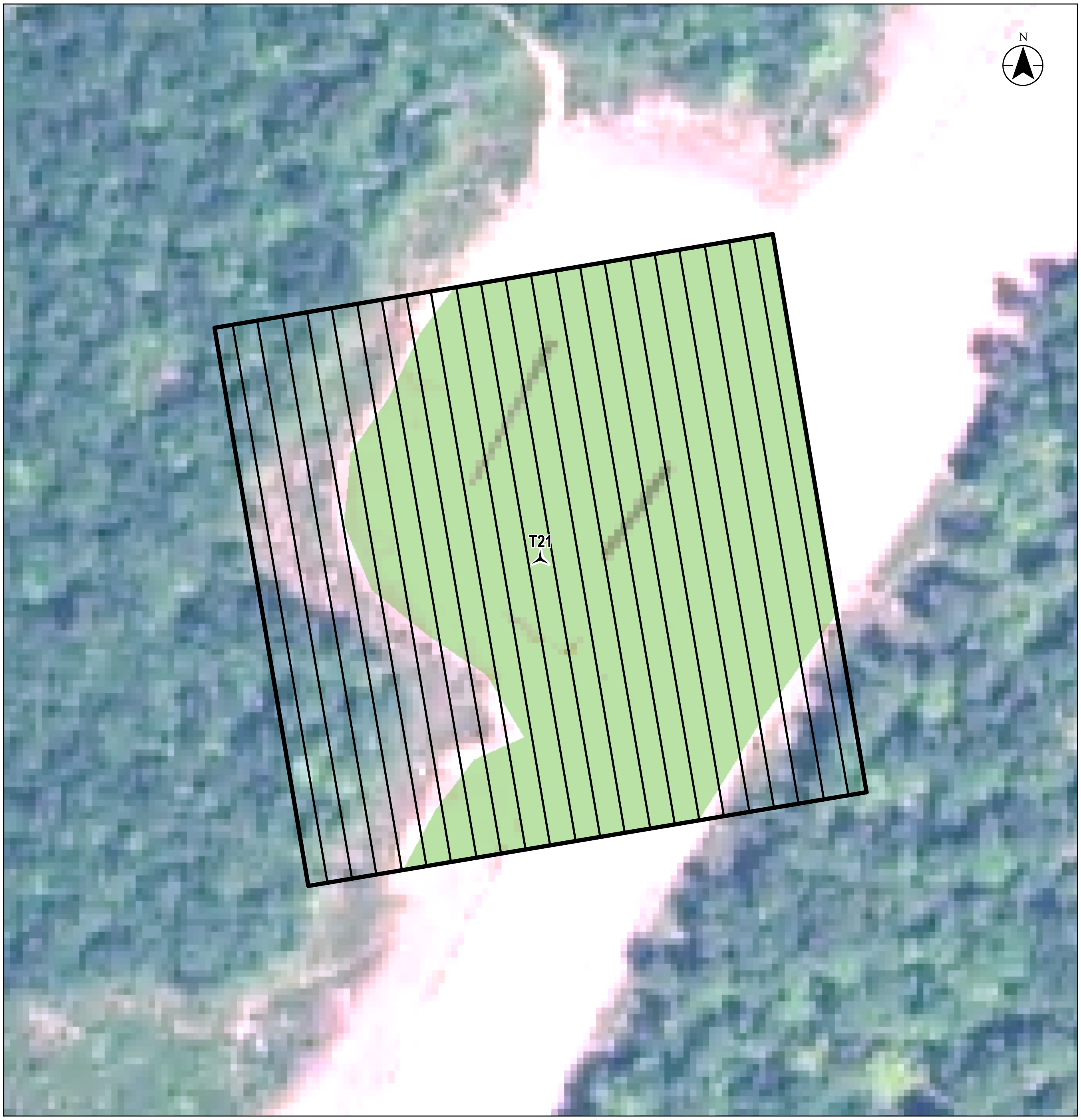
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

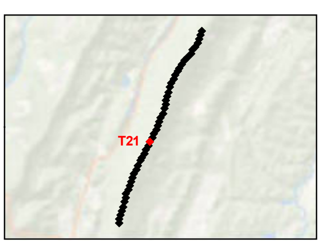
Figure No.
20

Title
Turbine 20 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

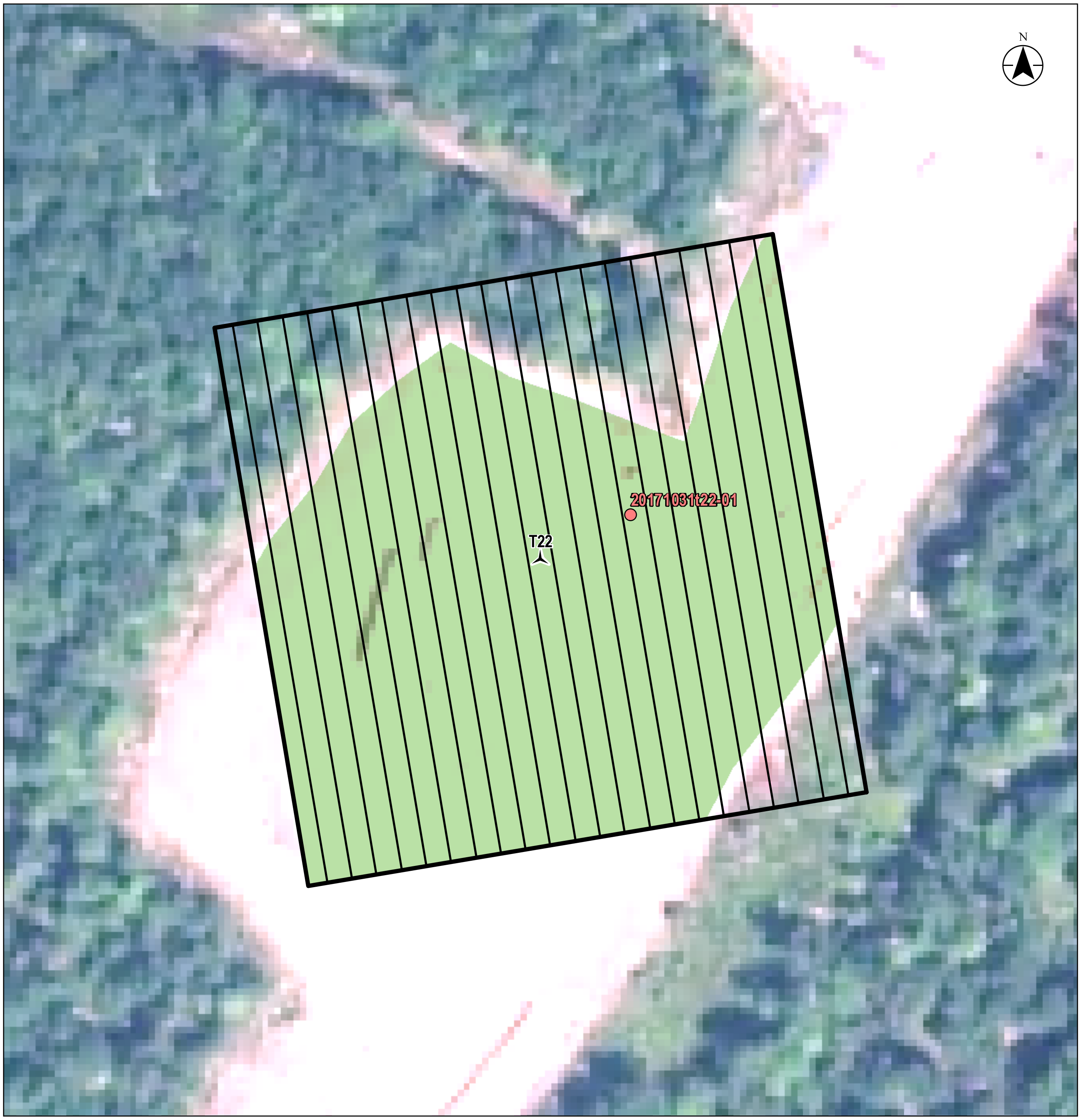
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

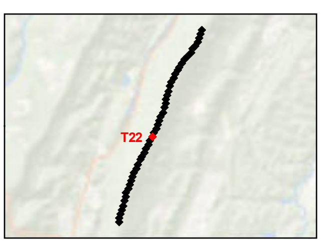
Figure No.
21

Title
Turbine 21 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Bird Carcass
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location 195601197
Grant County, West Virginia
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

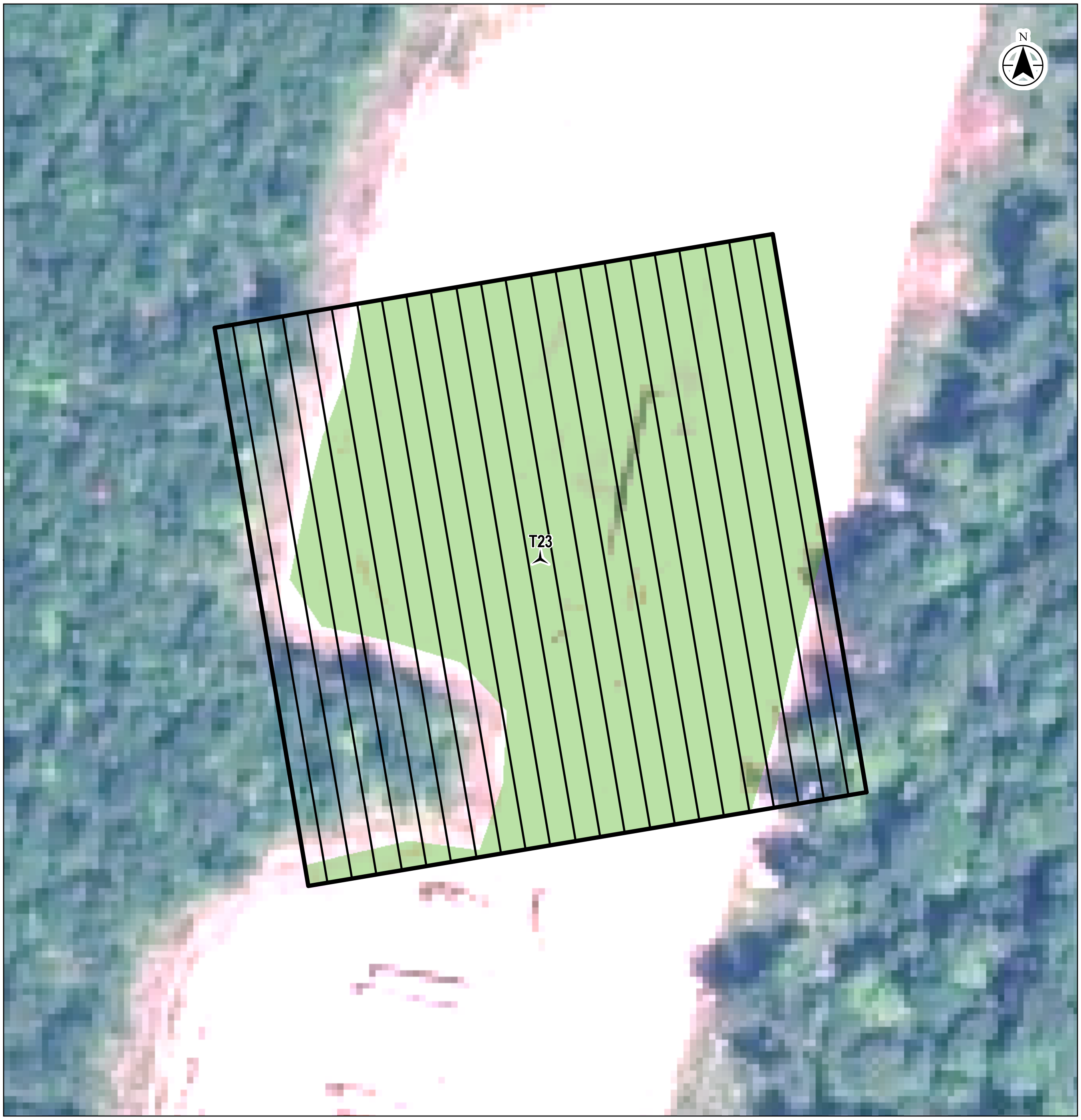
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

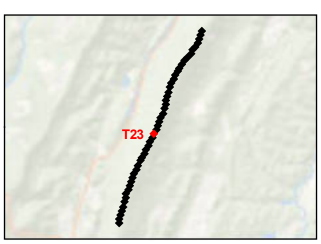
Figure No.
22

Title
Turbine 22 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

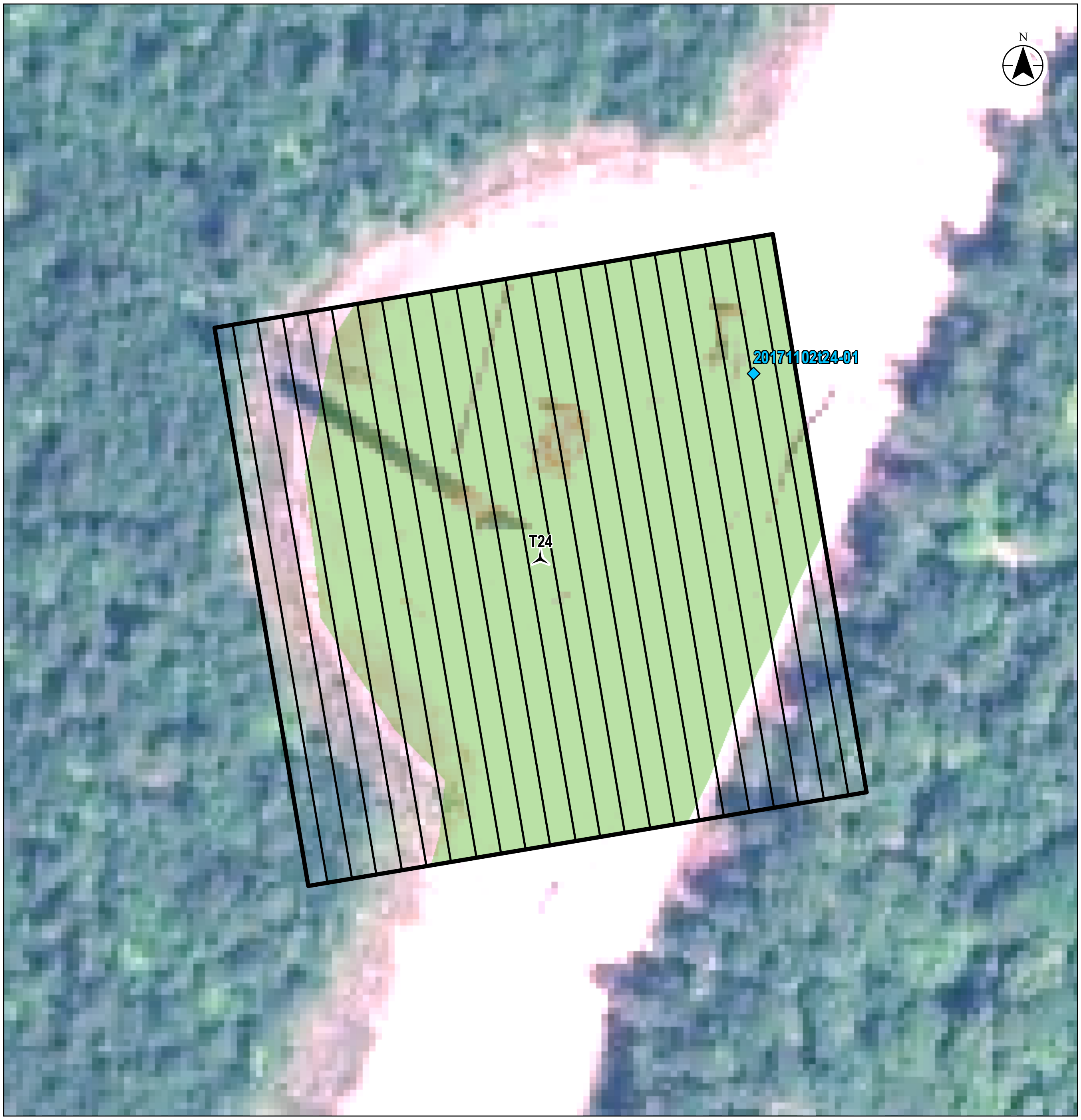
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

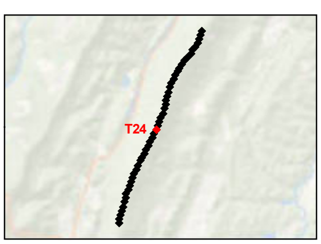
Figure No.
23

Title
Turbine 23 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpentier





Legend

- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

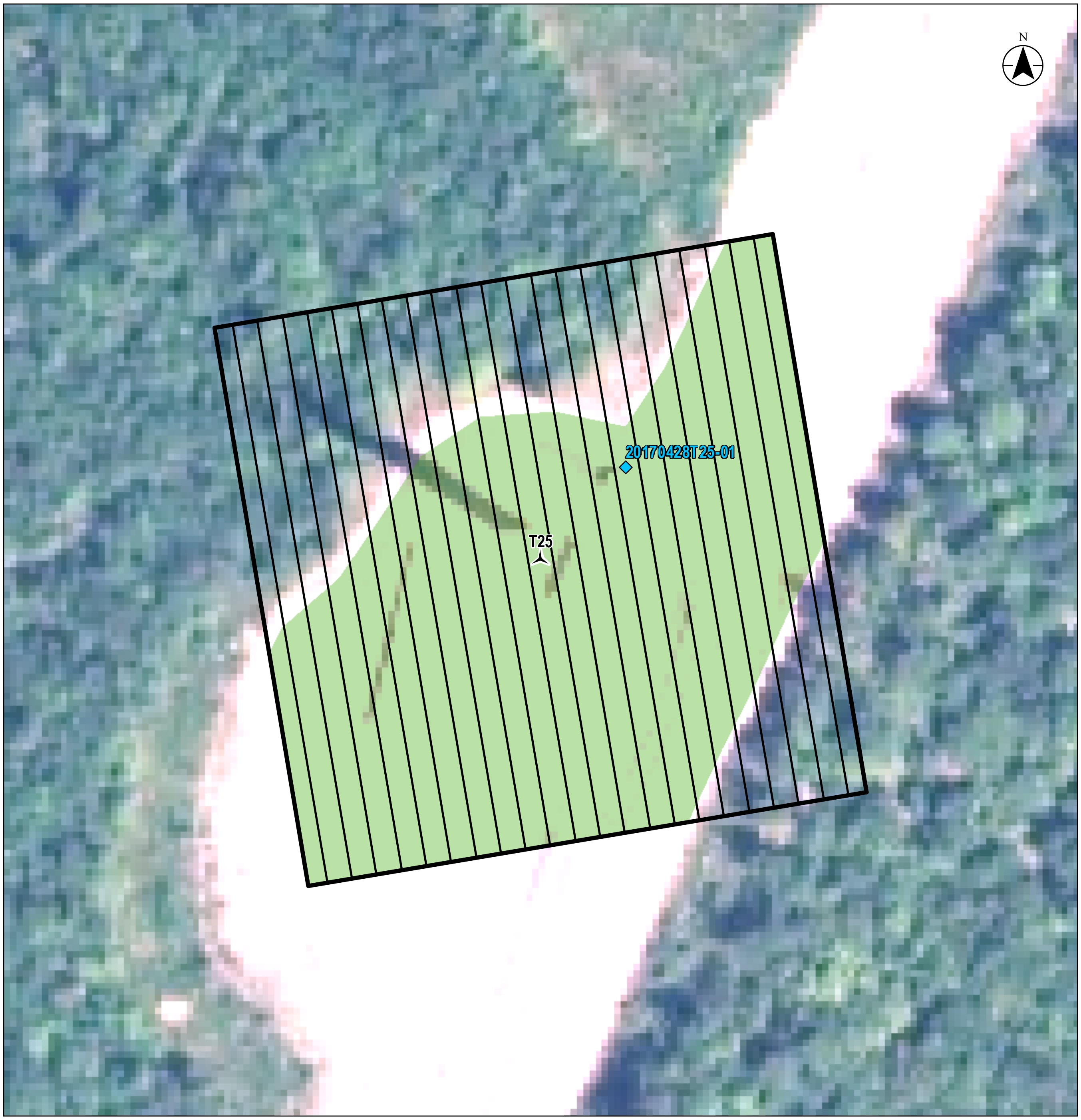
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

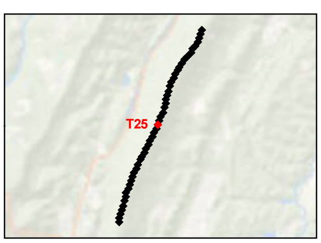
Figure No.
24

Title
Turbine 24 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

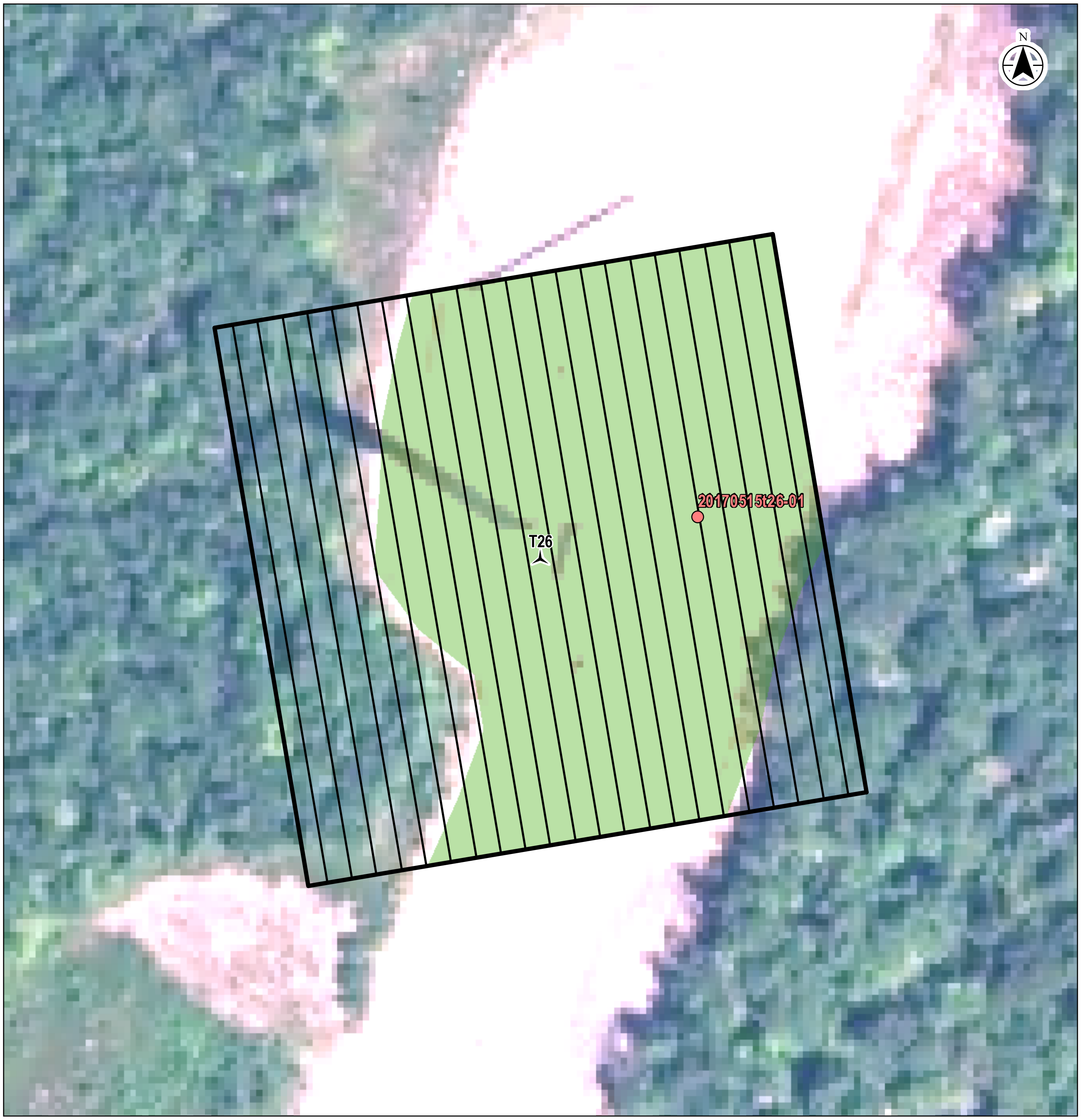
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

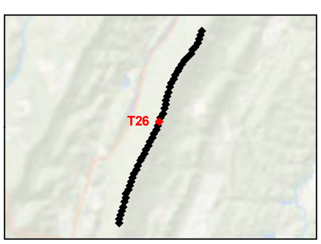
Figure No.
25

Title
Turbine 25 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd   Revised: 2018-01-31 By: gcarpenter





Legend
- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0   80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

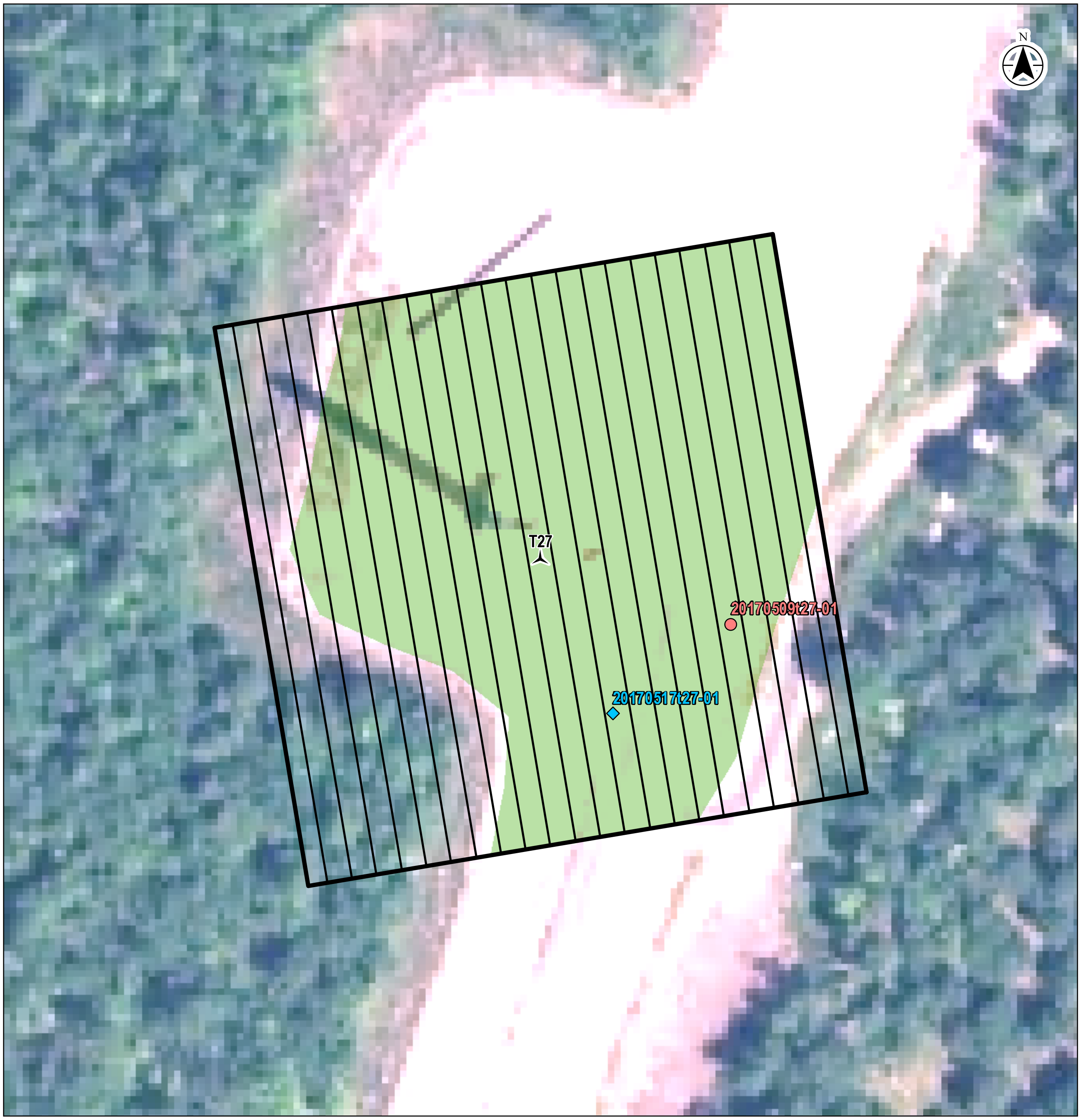
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

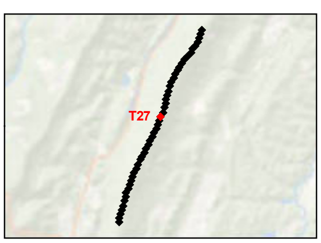
Figure No.
26

Title
Turbine 26 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Bat Carcass Location
- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

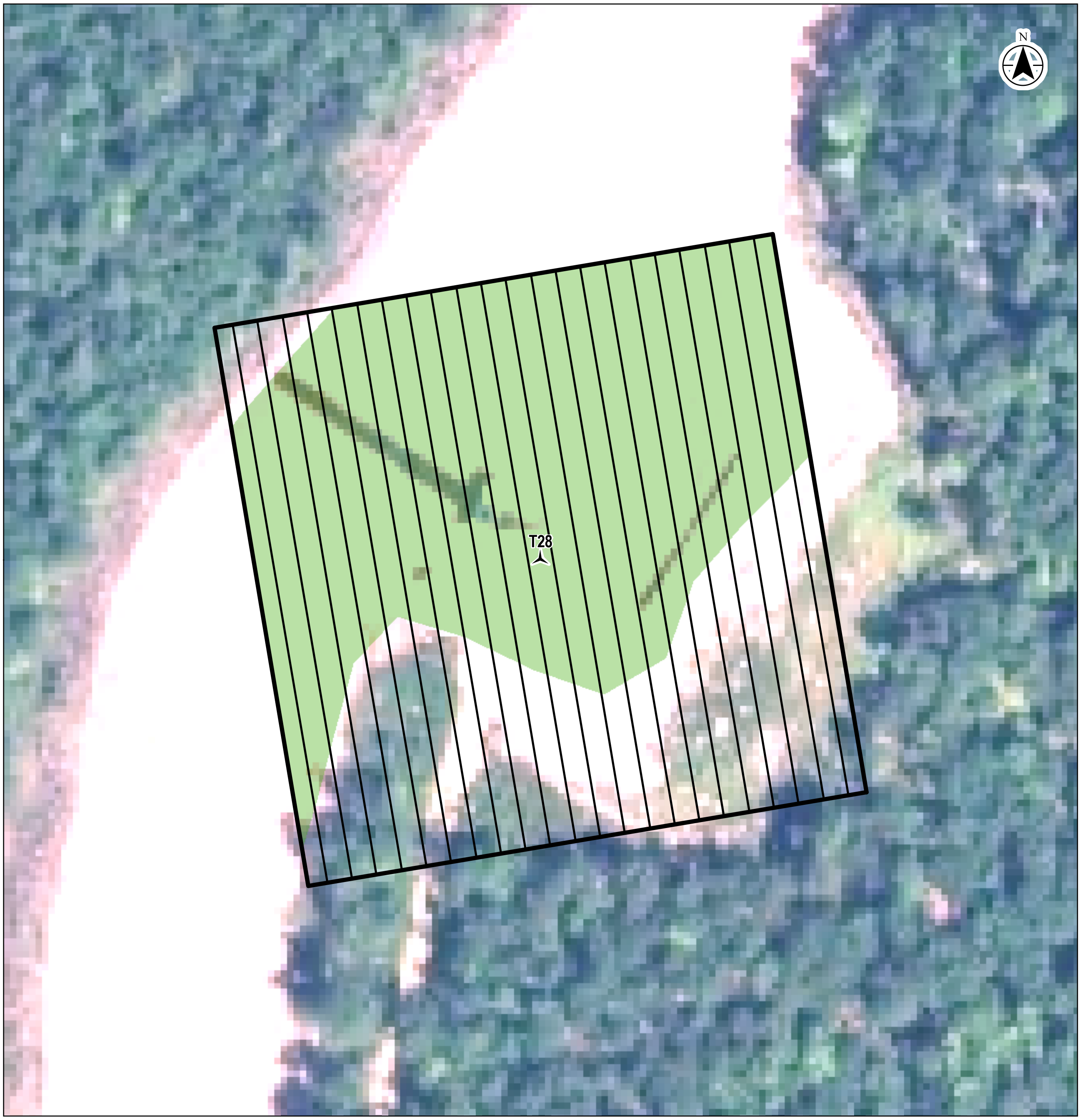
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

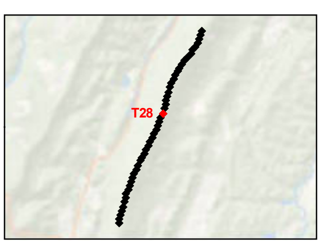
Figure No.
27

Title
Turbine 27 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

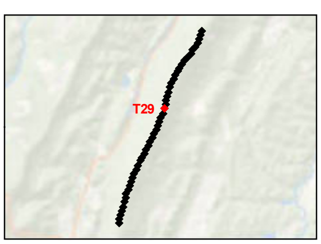
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
28

Title
Turbine 28 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpentier



Legend
- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

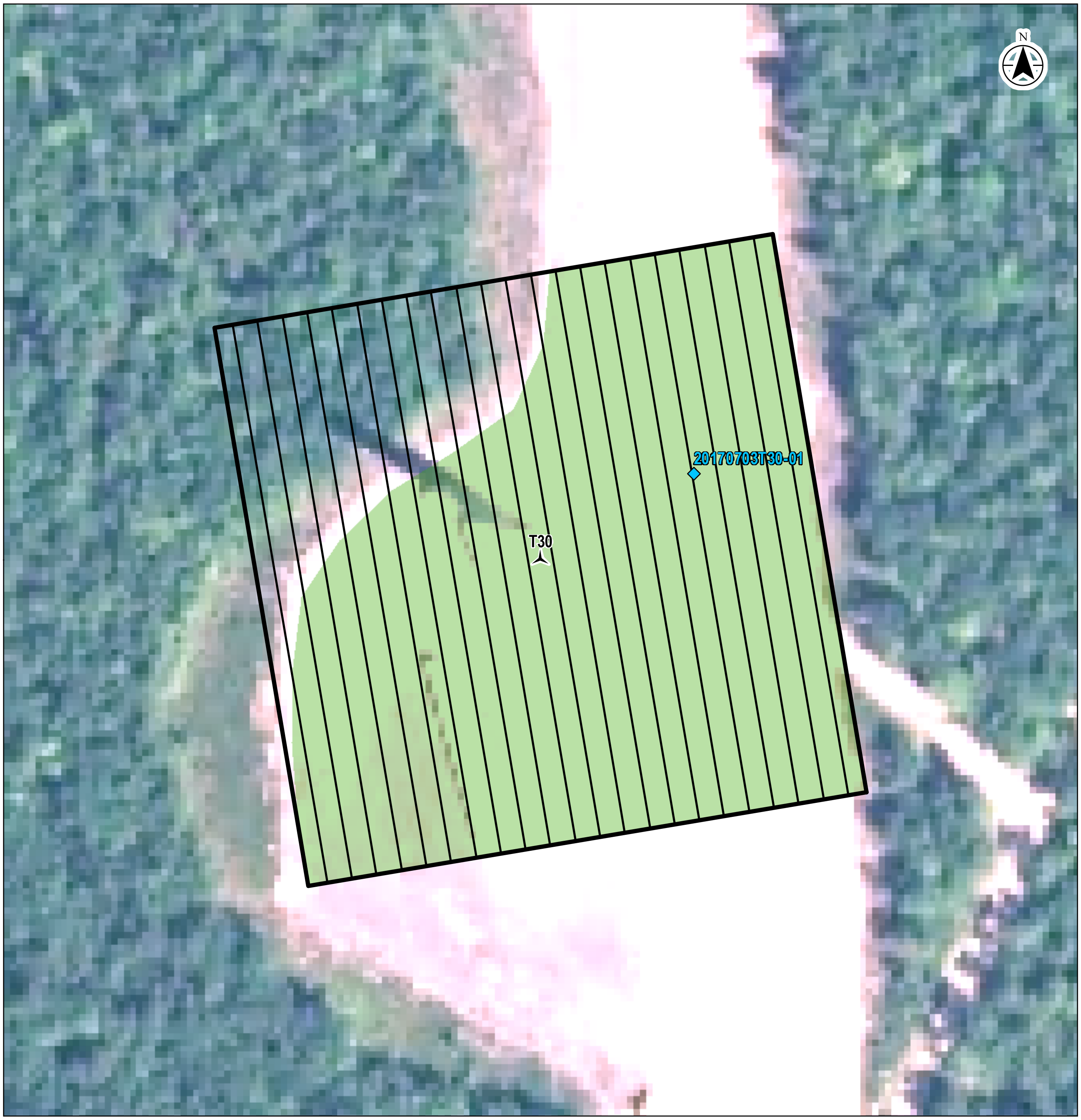
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

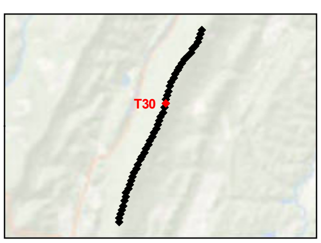
Figure No.
29

Title
Turbine 29 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

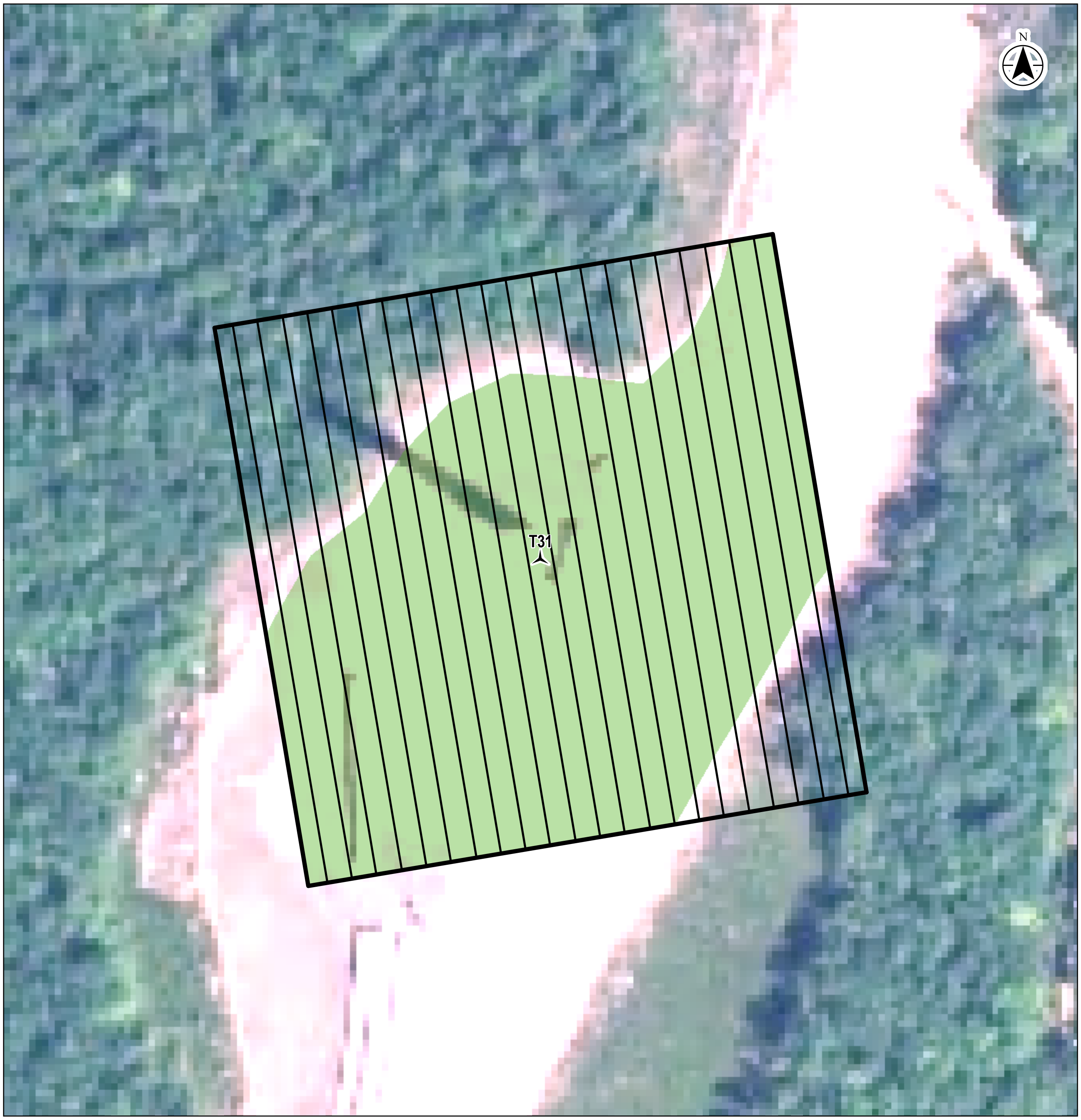
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

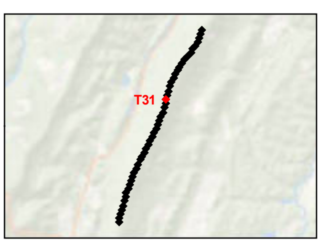
Figure No.
30

Title
Turbine 30 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

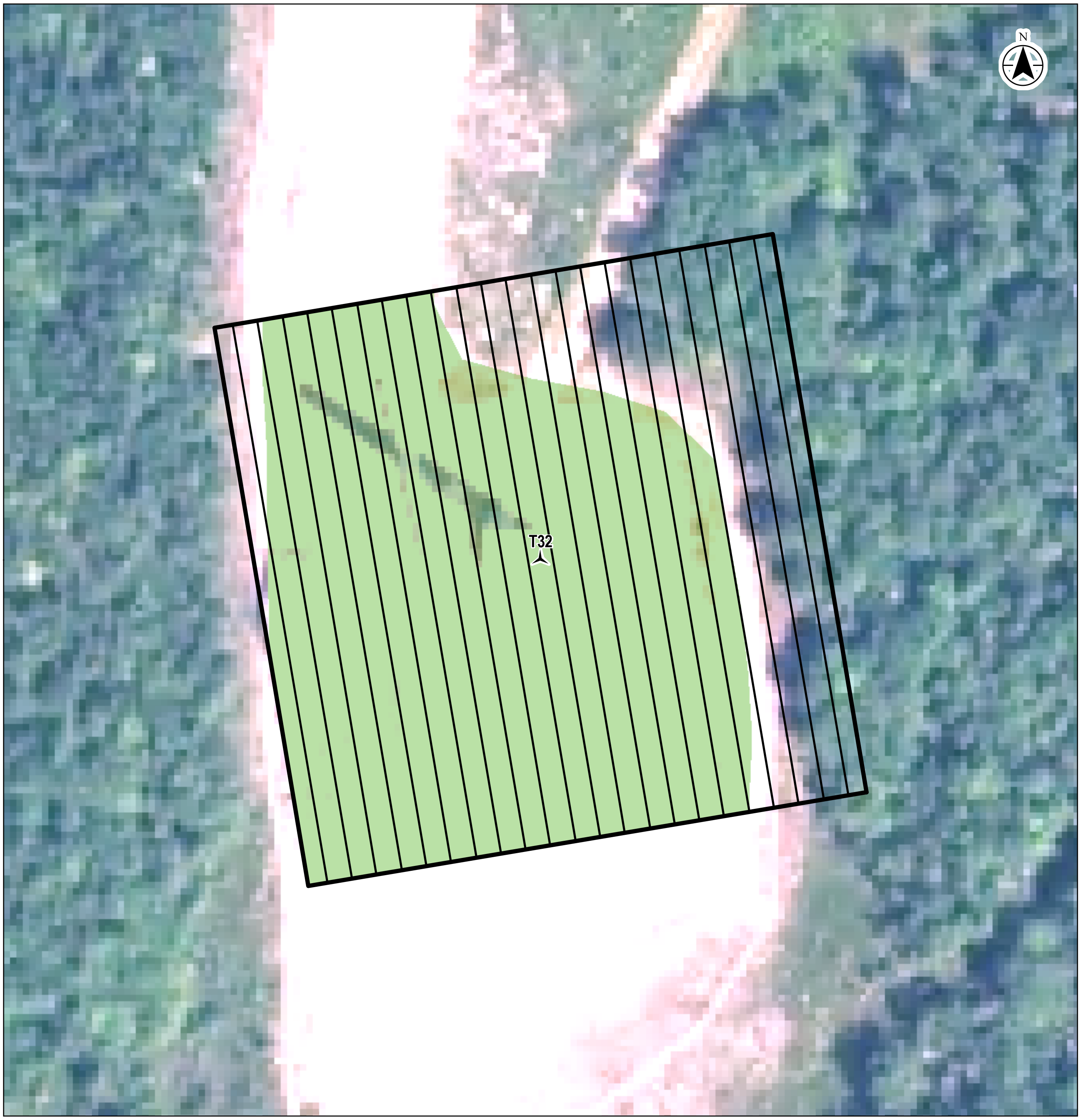
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

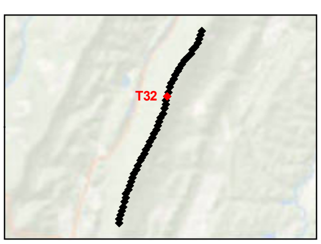
Figure No.
31

Title
Turbine 31 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

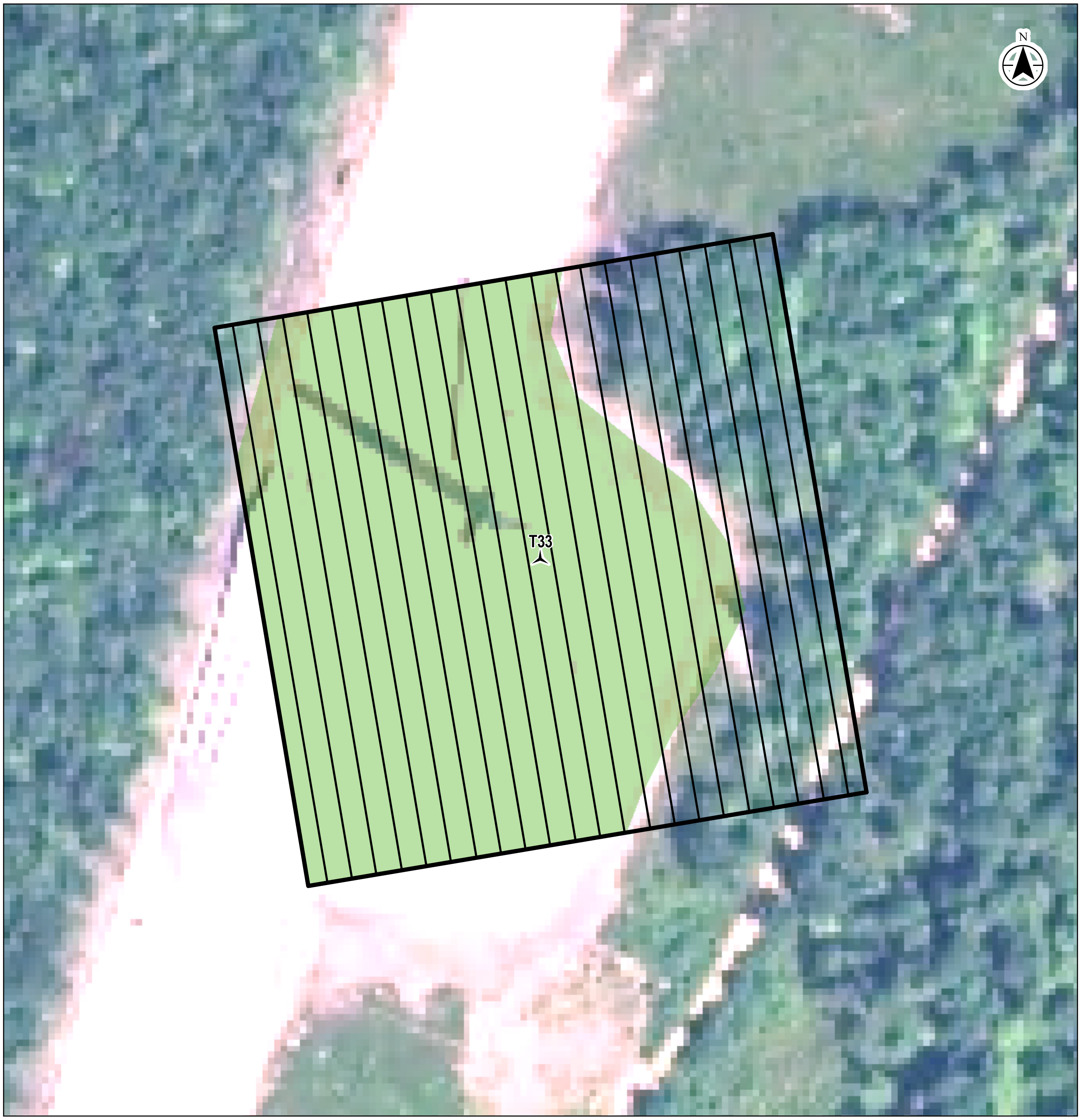
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

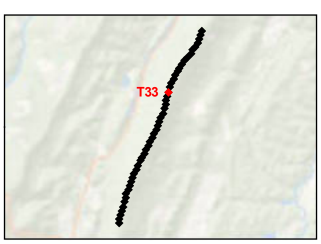
Figure No.
32

Title
Turbine 32 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

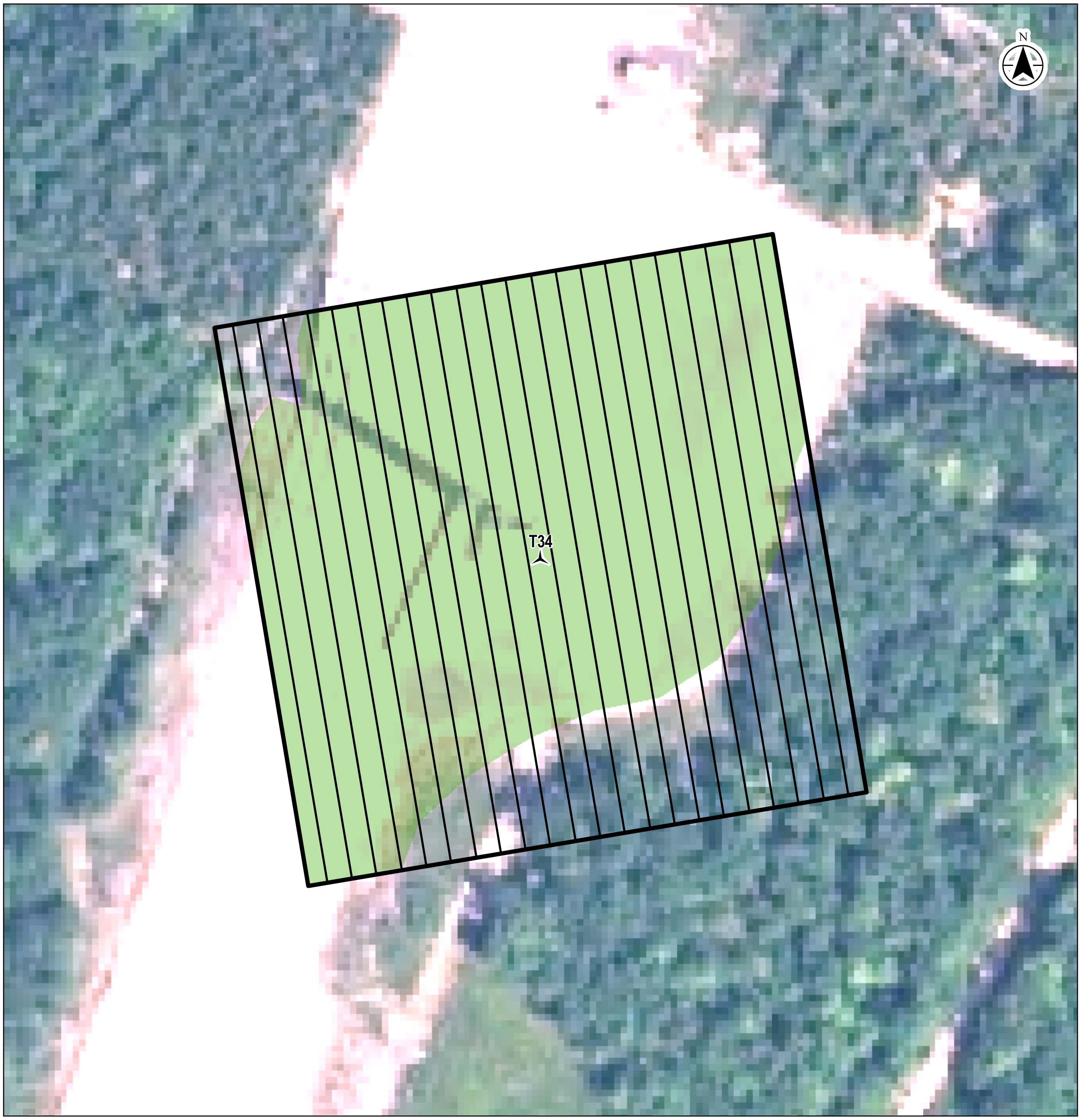
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

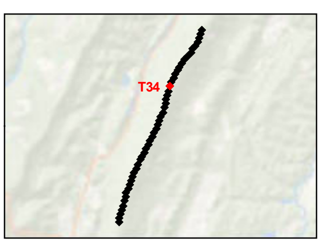
Figure No.
33

Title
Turbine 33 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd   Revised: 2018-01-31 By: gcarpenter





Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

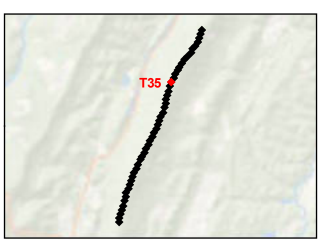
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
34

Title
Turbine 34 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpentier



Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

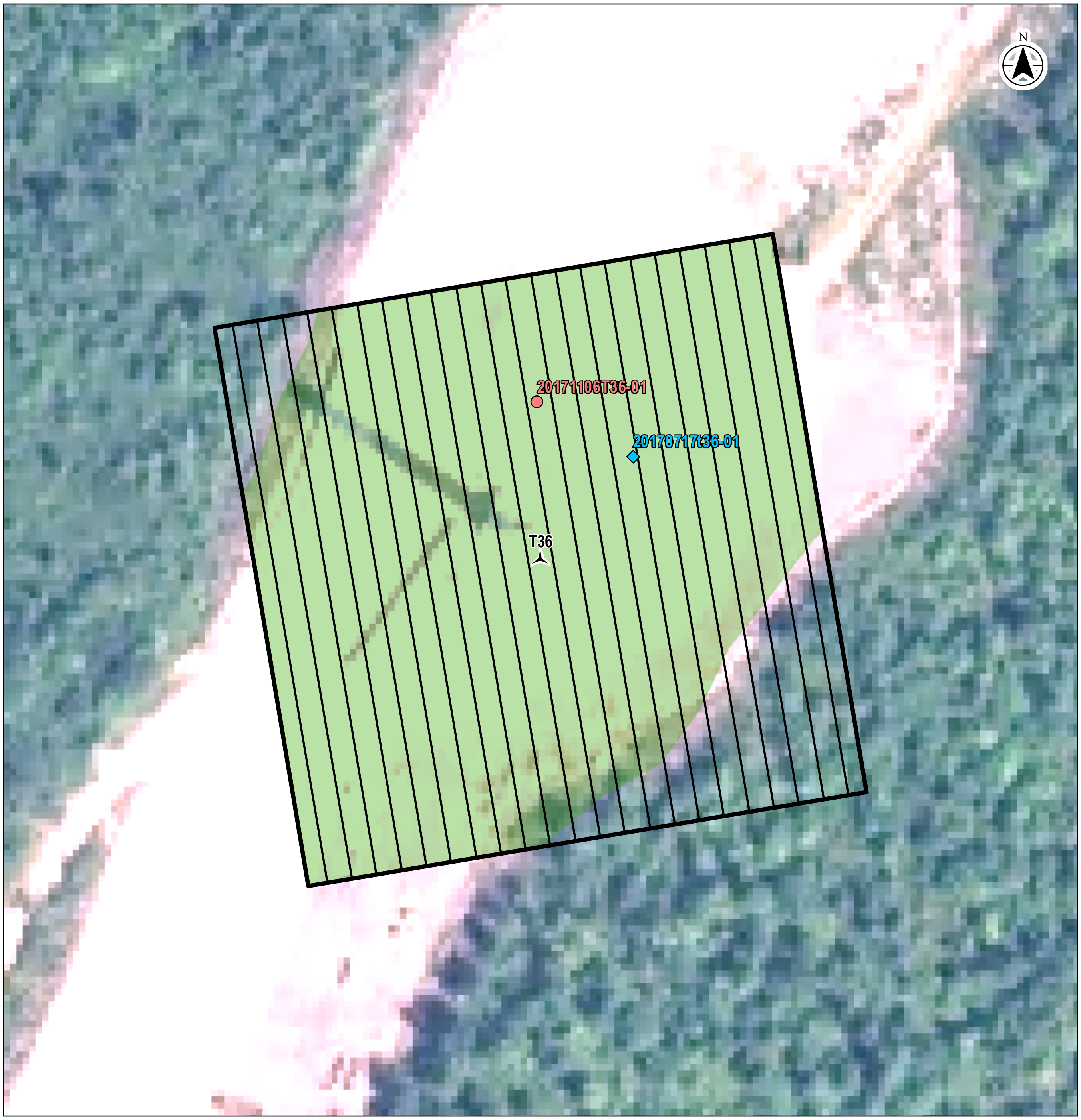
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

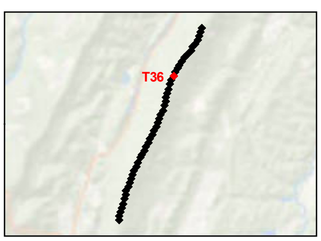
Figure No.
35

Title
Turbine 35 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Bat Carcass Location
- Bird Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location 195601197

Grant County, West Virginia

Prepared by GAC on 2018-01-02

Reviewed by TSP on 2018-01-03

Client/Project

New Creek Wind, LLC

New Creek Wind Energy Project

Figure No.

36

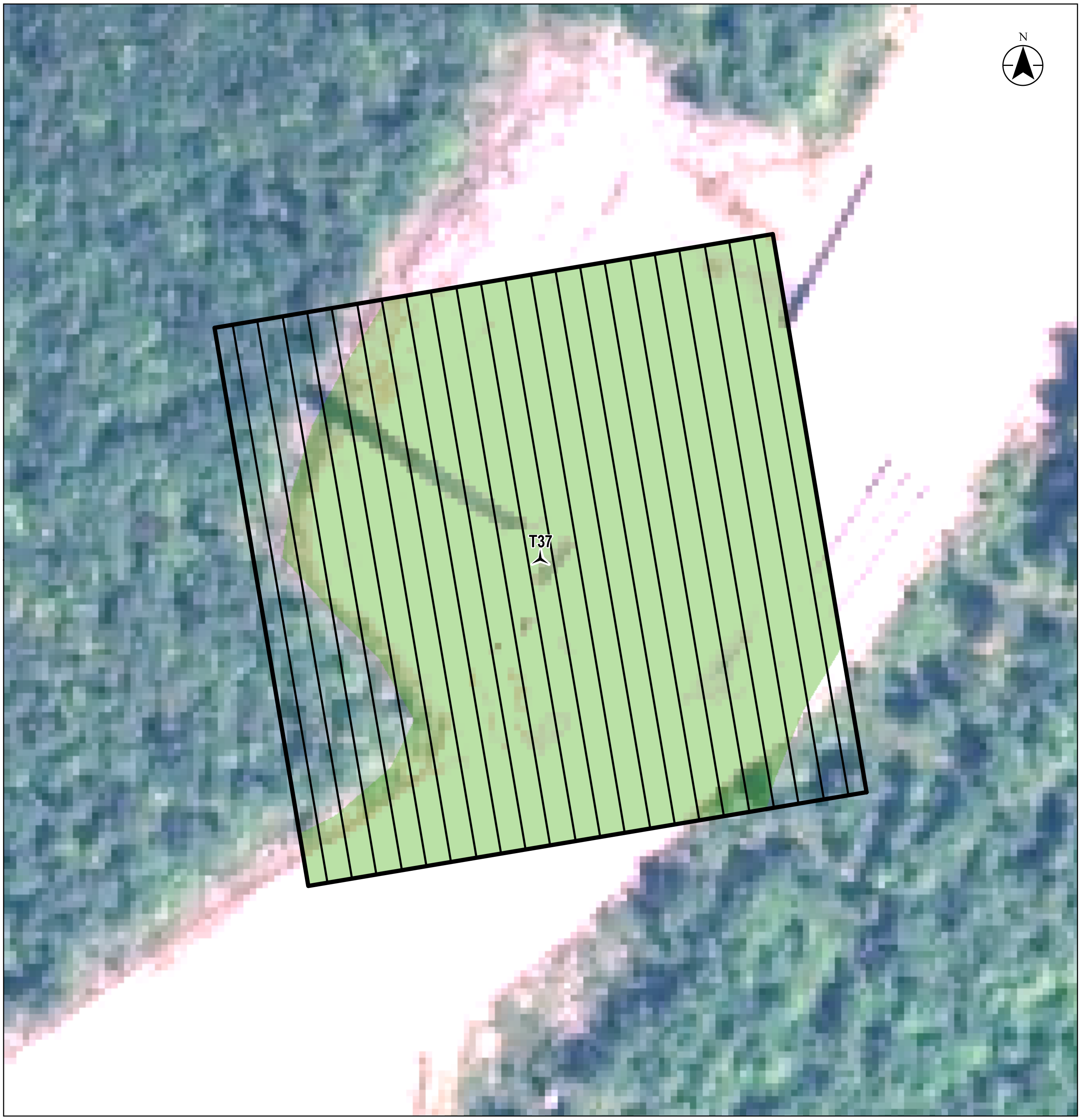
Title

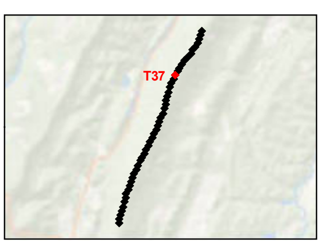
Turbine 36 Search Area

Notes

1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

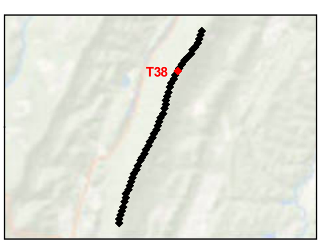
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
37

Title
Turbine 37 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter



Legend

- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

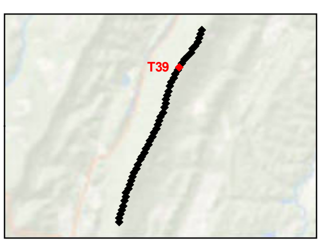
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
38

Title
Turbine 38 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpentier



Legend
- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

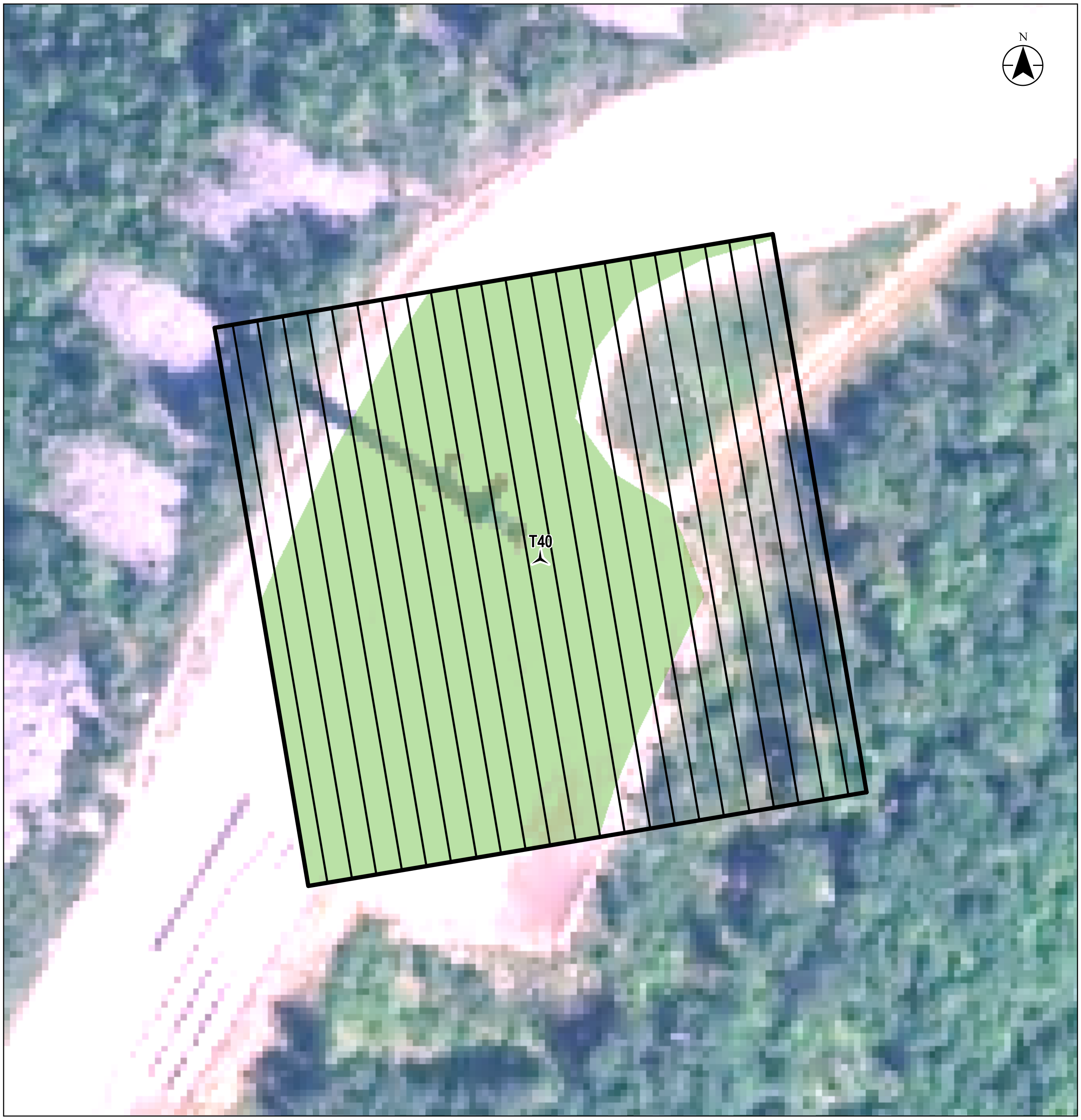
195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

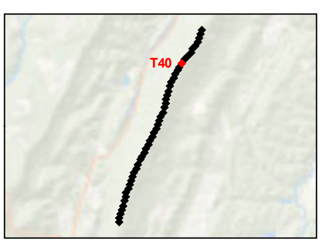
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
39

Title
Turbine 39 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016





Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location 195601197
Grant County, West Virginia
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

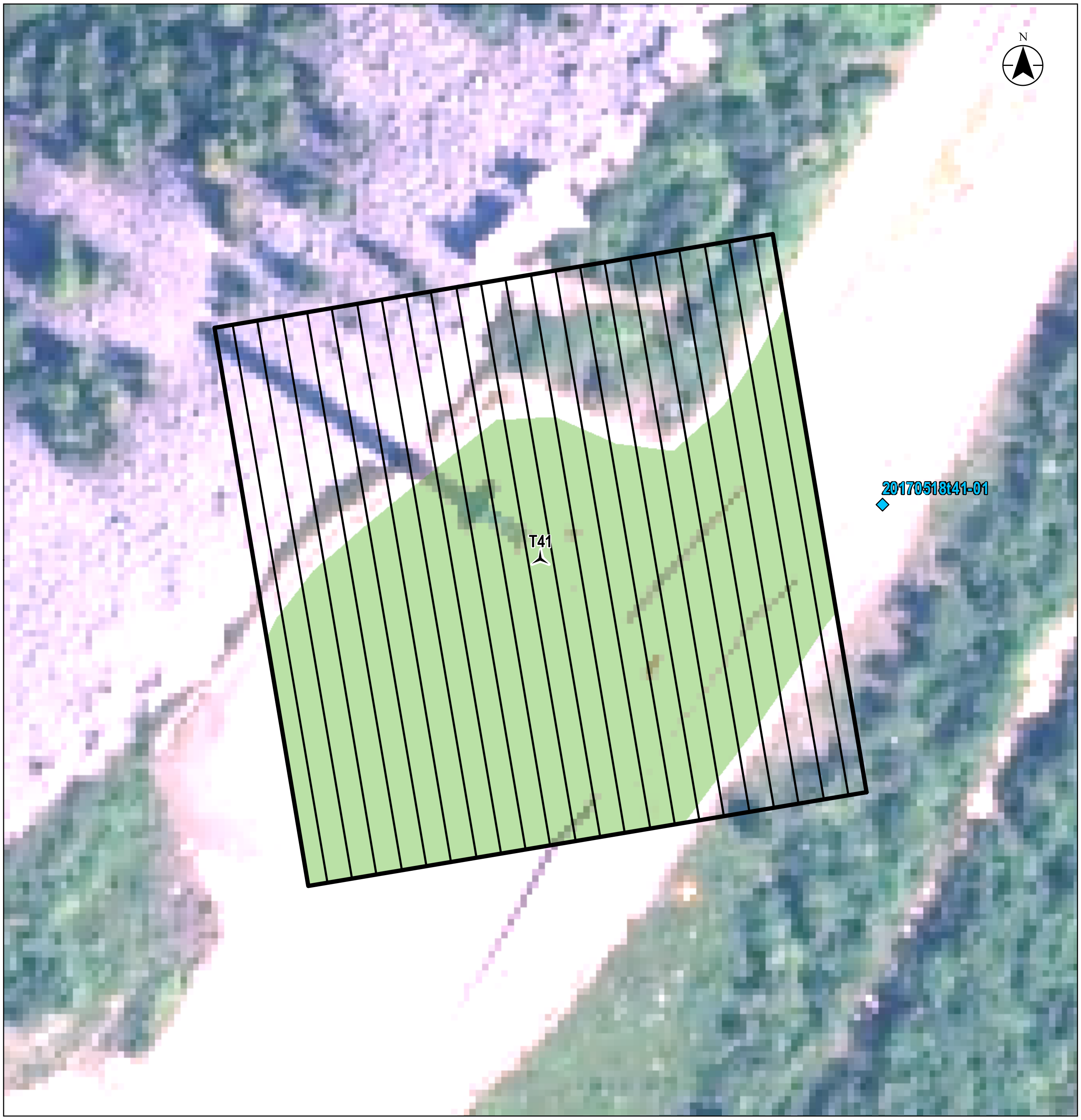
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

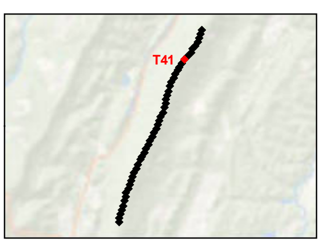
Figure No.
40

Title
Turbine 40 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend
- Bat Carcass
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

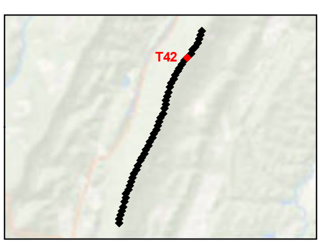
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
41

Title
Turbine 41 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd   Revised: 2018-01-31 By: gcarpenter



Legend
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location 195601197
Grant County, West Virginia
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

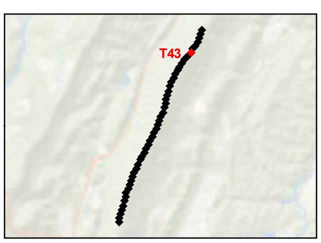
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
42

Title
Turbine 42 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd   Revised: 2018-01-31 By: gcarpenter



Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

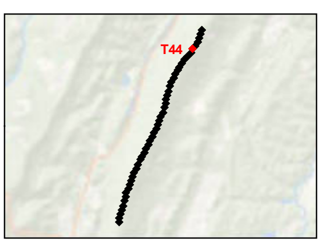
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
43

Title
Turbine 43 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter



Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

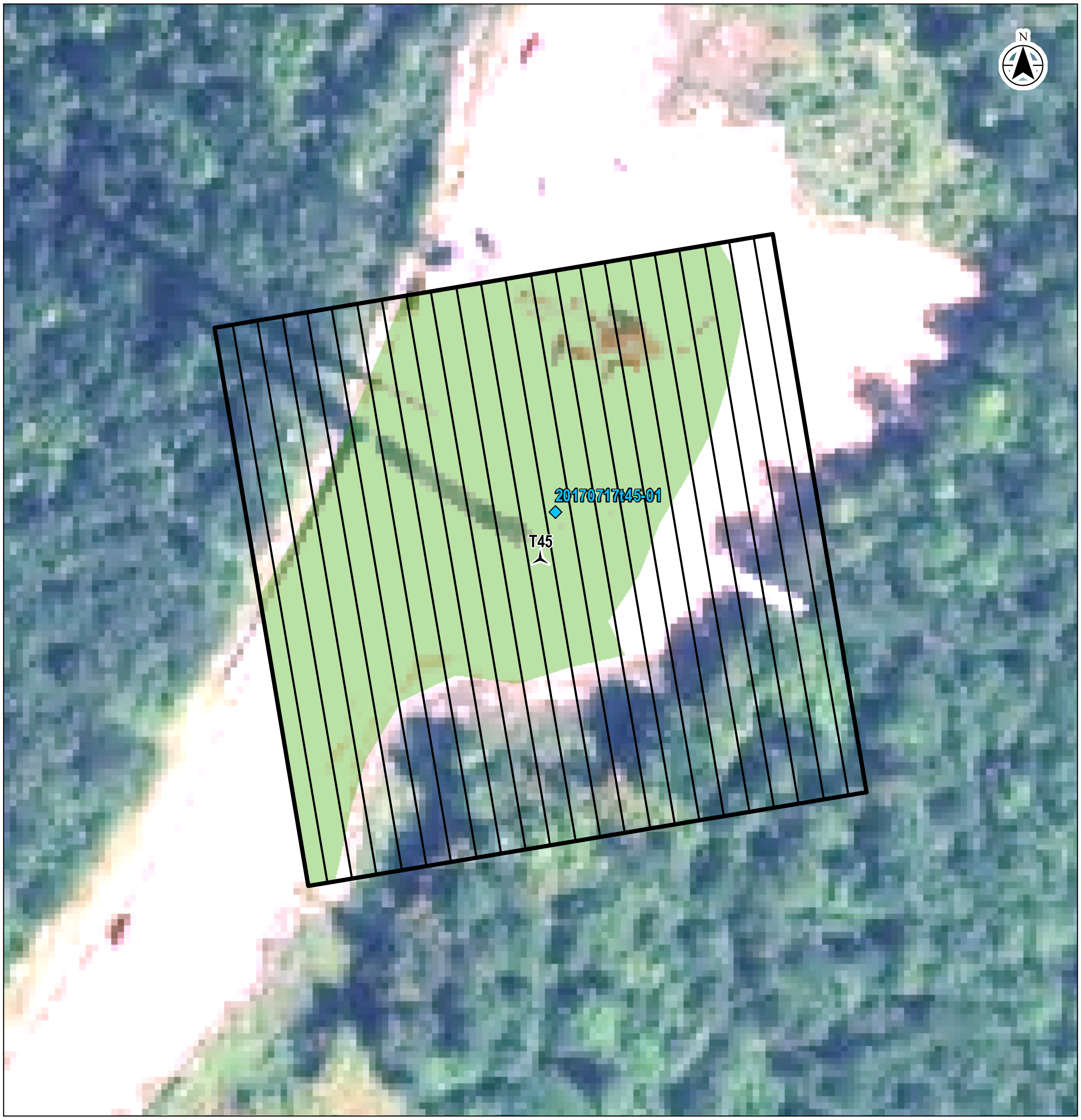
195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

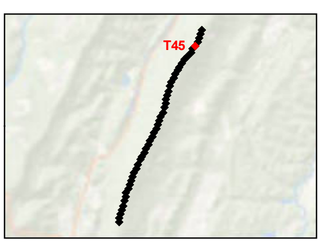
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
44

Title
Turbine 44 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016





Legend
- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

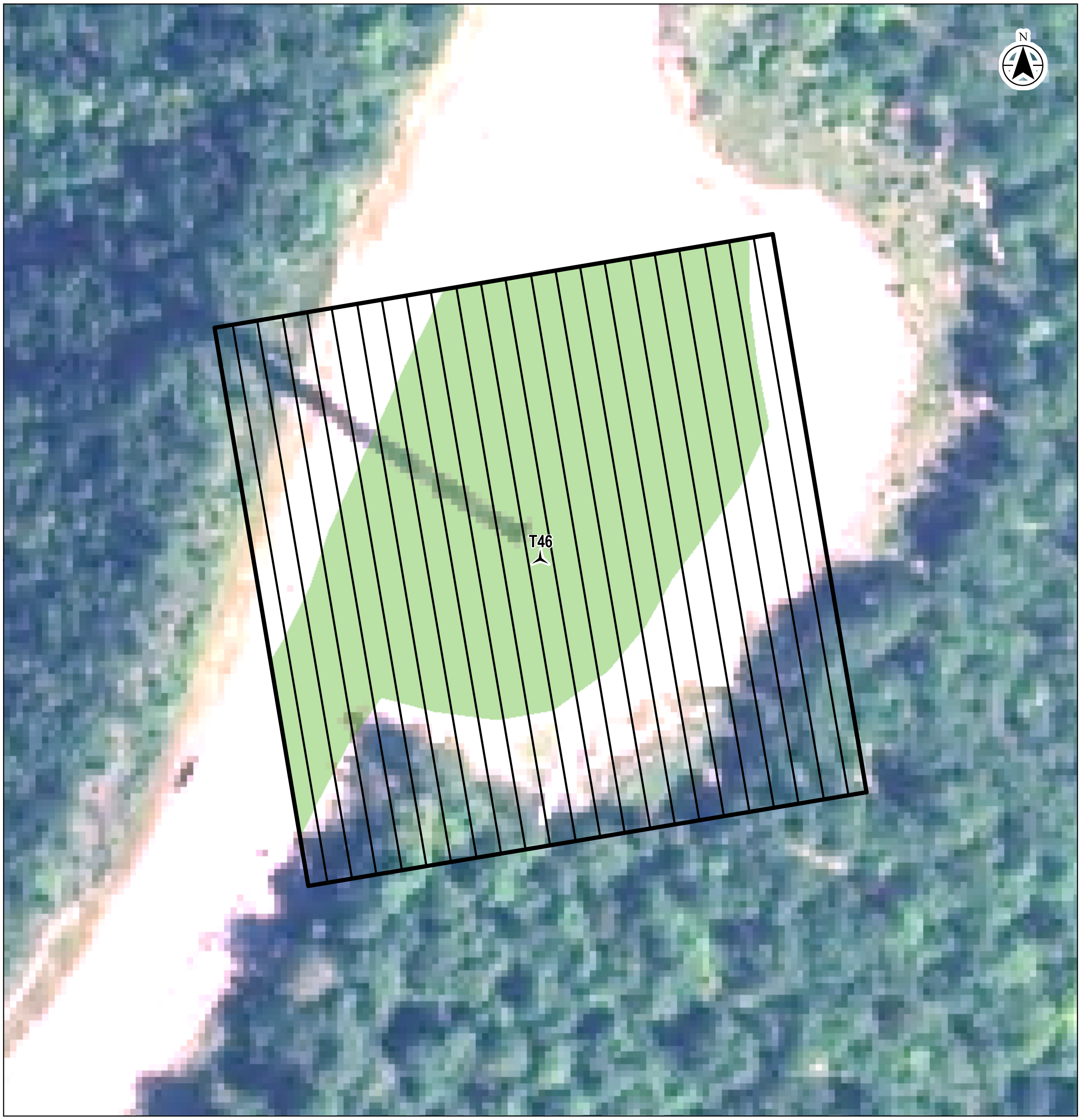
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

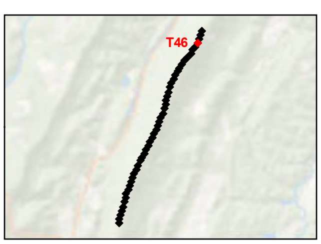
Figure No.
45

Title
Turbine 45 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd Revised: 2018-01-31 By: gcarpenter





Legend

- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

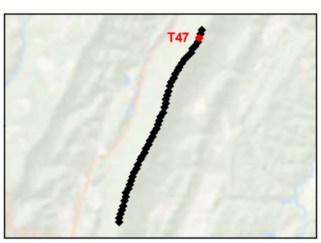
195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
46

Title
Turbine 46 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016



Legend
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80
Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

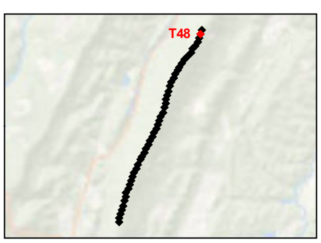
Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
47

Title
Turbine 47 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

V:\1956\active\195601197\03_data\gis_cad\GIS\mxd\AvianBat\PCM\01197_01_CarcassLocs.mxd   Revised: 2018-01-31 By: gcarpenter



Legend

- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet

1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location
Grant County, West Virginia

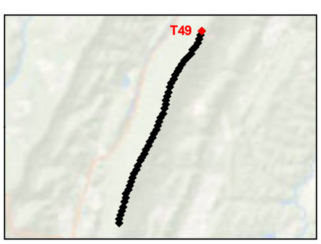
195601197
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
48

Title
Turbine 48 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016



Legend
- Bat Carcass Location
- Turbine Location
- Survey Transect
- Survey Grid Area
- Search Area

0 80 Feet
1 inch = 80 feet (At original document size of 8.5x11)

Stantec

Project Location 195601197
Grant County, West Virginia
Prepared by GAC on 2018-01-02
Reviewed by TSP on 2018-01-03

Client/Project
New Creek Wind, LLC
New Creek Wind Energy Project

Figure No.
49

Title
Turbine 49 Search Area

Notes
1. Coordinate System: NAD 1983 UTM Zone 17N
2. Orthoimagery: NAIP 2016

Appendix E PUBLICLY AVAILABLE FATALITY ESTIMATES FOR WEST VIRGINIA WIND PROJECTS

Site	Year	Dataset	Survey Period	Estimated Bat Fatality (per turbine)	Estimated Bird Fatality (per turbine)	Search Interval	Estimator	Curtailment	Reference
Mount Storm	2008	2008 (daily)	July 18 - October 17	24.21	3.81	daily	Erickson	None	Young, D.P., W.P. Erickson, K. Bay, S. Normani, W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1: Post-construction Avian and Bat Monitoring. Prepared for: NedPower Mount Storm, LLC.
Mount Storm	2008	2008 (weekly)	July 18 - October 17	7.76	2.41	weekly	Erickson	None	Young, D.P., W.P. Erickson, K. Bay, S. Normani, W. Tidhar. 2009. Mount Storm Wind Energy Facility, Phase 1: Post-construction Avian and Bat Monitoring. Prepared for: NedPower Mount Storm, LLC.
Mount Storm	2009	2009 (daily)	March - June; July - October	28.6	8.7	daily	Erickson	None	cited in Young, D., C. Nations, M. Lout, and K. Bay. 2013. 2012 Post-construction Monitoring Study Criterion Wind Project Garrett County, Maryland
Mount Storm	2010	2010 (daily)	April - July; July - October	32.4	6.7	daily	Erickson	None	cited in Young, D., C. Nations, M. Lout, and K. Bay. 2013. 2012 Post-construction Monitoring Study Criterion Wind Project Garrett County, Maryland
Mount Storm	2011	2011 (daily)	July 16 - October 15	14.9	8	daily	Erickson	Seasonally Variable	cited in Young, D., C. Nations, M. Lout, and K. Bay. 2013. 2012 Post-construction Monitoring Study Criterion Wind Project Garrett County, Maryland
Mountaineer	2003	2003 (2x week)	April 4 - November 11	47.53	4.04	2x per week	Shoenfeld	None	Kerns, J., and P. Kerlinger. 2004. A study of bird and bat collision fatalities at the Mountaineer Wind Energy Center, Tucker County, West Virginia, USA: annual report for 2003.
Pinnacle	2012	2012 (weekly)	March 1 - November 30	96.47	9.58	weekly	unknown	None	Hein, C.D., A. Prichard, T. Mabee, M.R. Shirmacher. 2013. Avian and Bat Post-construction Monitoring at the Pinnacle Wind Farm, Mineral County, West Virginia, 2012. Prepared for Edison Mission Energy.
Laurel Mountain	2012	2012 curtailed (3-day)	August 15 - October 31, 2011; April 1 - July 31, 2012	6.6	5.3	3-day	Shoenfeld	4.5 m/s	Stantec. 2013. Fall 2011 and Spring/Summer 2012 Post-construction Monitoring Data Report for the Laurel Mountain Wind Energy Project in Randolph and Barbour Counties, West Virginia. Prepared for AES Laurel Mountain Wind, LLC.
Laurel Mountain	2012	2012 control (3-day)	August 15 - October 31, 2011; April 1 - July 31, 2012	23.4	9	3-day	Shoenfeld	None	Stantec. 2013. Fall 2011 and Spring/Summer 2012 Post-construction Monitoring Data Report for the Laurel Mountain Wind Energy Project in Randolph and Barbour Counties, West Virginia. Prepared for AES Laurel Mountain Wind, LLC.
Laurel Mountain	2013	2013 (3-day)	April 1 - November 15	1.4	3.4	3-day	Shoenfeld	Seasonally Variable	Stantec. 2015. 2014 Bird and Bat Post-construction Monitoring Report - Laurel Mountain Wind Energy Project
Laurel Mountain	2014	2014 (3-day)	April 1 - November 15	1.9	4.9	3-day	Shoenfeld	Seasonally Variable	Stantec. 2015. 2014 Bird and Bat Post-construction Monitoring Report - Laurel Mountain Wind Energy Project
Laurel Mountain	2015	2015 (3-day)	April 1 - November 15	2.1	2.5	3-day	Shoenfeld	Seasonally Variable	Stantec. 2016. 2015 Bird and Bat Post-construction Monitoring Report - Laurel Mountain Wind Energy Project
New Creek	2017	2017 (weekly)	April 17 - November 15	2.63	1.02	weekly	Huso	Seasonally Variable	This report