2014 Bat Survey Report

Wilton IV Wind Energy Center

Burleigh County, North Dakota

Confidential Business Information

Prepared for:

NextEra Energy Resources, LLC

700 Universe Blvd.

Juno Beach, Florida 33408

January 2015

TETRA TECH

This page intentionally left blank

Table of Contents

1.0 Introduction 1
2.0 Background 5
2.1 Wind Energy and Bats 5
2.2 Regulatory Framework 6
2.2.1 Federal Protection 6
2.2.2 State Protection 7
2.2.3 Voluntary Guidelines for Wind Power Projects 7
3.0 Habitat Assessment 8
3.1 Species Potentially Present 8
3.2 General Bat Biology 8
3.2.1 Roosting Habitat 9
3.2.2 Foraging Ecology 9
3.2.3 Bat Migration and Movement Characteristics 9
3.3 Bat Habitat Characteristics within the Project 10
3.3.1 Roosting Habitat 10
3.3.2 Foraging Habitat 13
3.3.3 Migration and Movement Corridors 13
3.3.4 Northern Long-eared Bat 13
3.4 Likelihood of Occurrence 13
3.5 Discussion 16
4.0 Acoustic Monitoring 16
4.1 Methods 16
4.1.1 Acoustic Detectors 16
4.1.2 Data Quality Assurance and Control 17
4.1.3 Data Analysis 17
4.2 Results 18
4.2.1 Species Presence and Activity Rates 19
4.2.2 Timing of Activity 20
4.3 Discussion 23
5.0 Summary 24
6.0 Literature Cited 25

List of Tables

Table 1. Land Cover Present in the Project Area, Burleigh County, North Dakota 10
Table 2. Bat Species List and Likelihood of Occurrence in the Project Area 14
Table 3. Summary of Acoustic Monitoring Surveys at the Project 19
Table 4. Activity Rates Recorded per Species at Each Detector 20
Table 5. Comparison of Pre-Construction Bat Activity, as Measured by Acoustic Monitoring, Among Wind Projects in the United States 24

List of Figures

Figure 1. Vicinity Map 3
Figure 2. Project Area Land Cover 11
Figure 3. Activity Rates of Bat Species Recorded at All Detectors 20
Figure 4. Total Number of Calls Recorded by Date at all Detectors 21
Figure 5. Total Number of Calls Recorded by Date and Species at all Detectors 22

List of Attachments

Appendix A. Detailed Figures Showing Bat Activity throughout the Survey Period at each Detector Location.

1.0 Introduction

Wilton Wind IV, LLC (Wilton IV, a subsidiary of NextEra Energy Resources, LLC) is proposing to develop the Wilton IV Wind Energy Center (Project) in Burleigh County, North Dakota (Figure 1). The Project is located in south-central North Dakota, approximately 20 miles northeast of Bismarck. The Project is anticipated to consist of 53 GE 1.715 megawatt (MW) and 5 GE 1.79 MW xle wind turbine generators, with a total nameplate capacity of 99.8 MW. Additional facilities would include up to six temporary meteorological towers (met towers) and up to two permanent met towers (which will replace temporary met towers in the same locations), a substation, two 10-acre construction laydown areas, access roads, and electrical collection systems with underground cabling. An 11.6-mile, 230 kilovolt overhead transmission line would be constructed to connect the Project collection substation with an existing substation.

Wilton IV contracted Tetra Tech, Inc. (Tetra Tech) to conduct a habitat assessment and passive acoustic bat surveys. The objective of the habitat assessment was to assess the suitability of habitat within the Project area for bats. The objective of the passive acoustic surveys was to assess the occurrence and use of the Project area by local and migratory bat species, and the surveys were designed to fulfill the recommendations outlined within Tier 3 of the U.S. Fish and Wildlife Service (USFWS) voluntary Land Based Wind Energy Guidelines (WEG; USFWS 2012) and the Northern Long-eared Bat (NLEB) Interim Conference and Planning Guidance for Phase 2 presence/absence surveys (USFWS 2014a).The Project area is within the range of the proposed endangered NLEB, and surveys were focused on identifying any potential NLEB calls documented throughout the survey period.

This page intentionally left blank

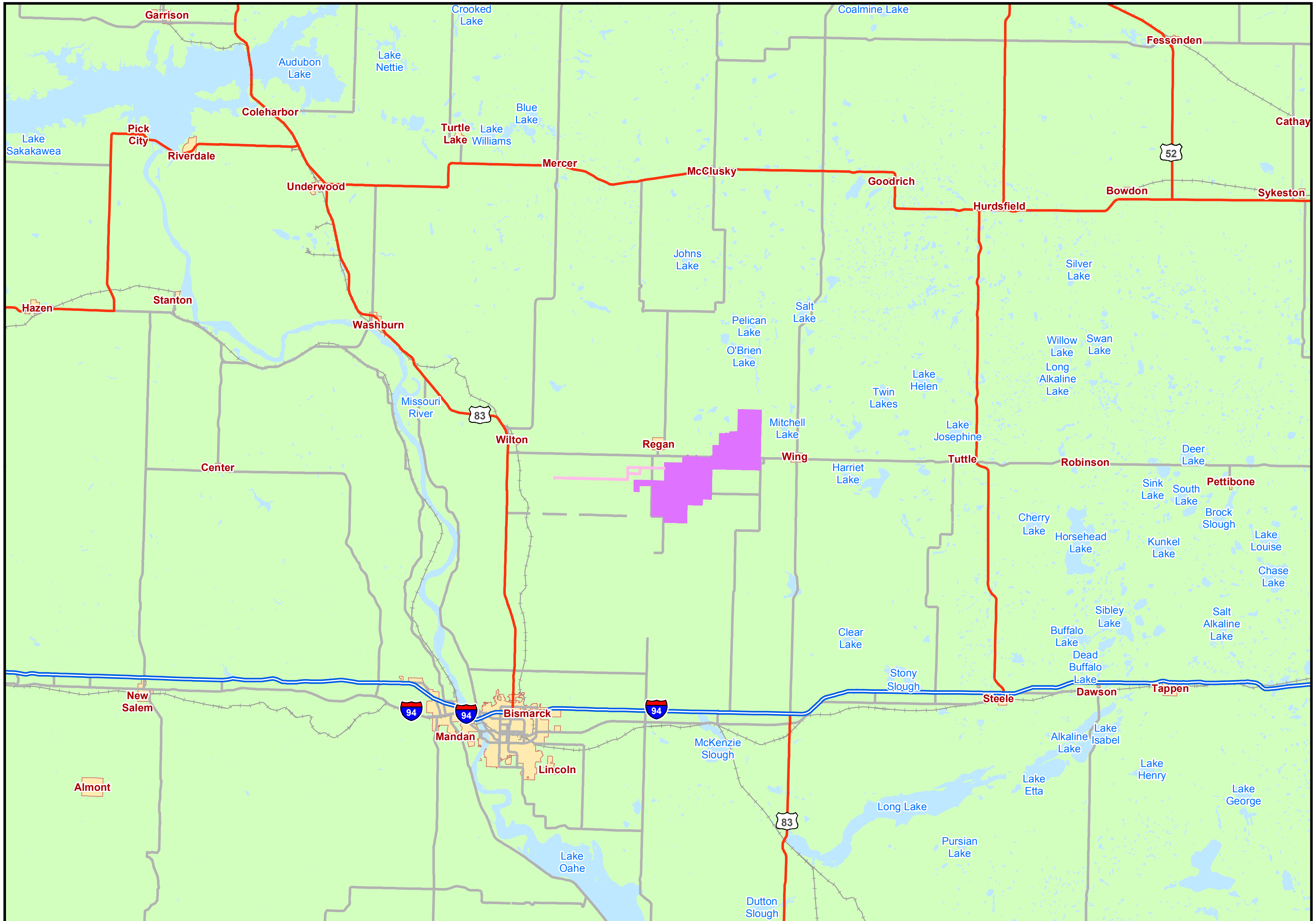


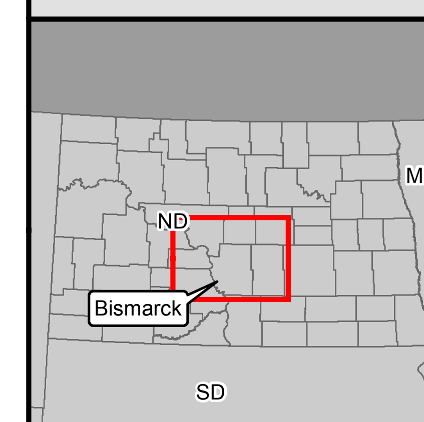
Figure 1

Vicinity Map

Wilton IV
Wind Energy Center
Burleigh County, ND
December 2014

Legend

- Project Boundary (8/12/2014)
- Transmission Line Corridor (8/12/2014)
- Limited Access Highway
- Highway
- Major Road
- Railroad
- Waterbody
- Populated Place



1:500,000 WGS 1984 UTM 14

0 5 10 20 30 40 50 Miles

P:\GIS\NextEra_WiltonIV\GIS\Spatial\MXD\20141205_WiltonIV_BatReport\WiltonIV_BatAssessment_Figure1_Vicinity.mxd - Last Saved 12/5/2014

This page intentionally left blank

2.0 Background

This section includes a summary of current information regarding bat interactions with wind energy facilities, and a discussion of the legal and regulatory framework applicable to bats and wind energy.

2.1 Wind Energy and Bats

Bat mortality associated with wind turbine operations has been reported at locations around the world, including wind energy facilities in the United States (Kunz et al. 2007, Arnett et al. 2008, Rydell et al. 2010a, Hayes 2013). Rates of overall bat mortality from wind turbines vary by region (Arnett et al. 2008, Baerwald and Barclay 2009, Cryan 2011, Hein et al. 2013). The highest numbers of fatalities reported in the United States are from wind energy facilities in the eastern U.S., particularly those located along forested ridges in the Appalachian region where annual mortality estimates have ranged from 20.8 to 69.6 bats per turbine per year, or 14.9 to 53.3 bats per MW per year (Arnett et al. 2008, Strickland et al. 2011). However, relatively high fatality estimates for bats also have been reported at wind energy facilities in agricultural settings in the central and Midwestern U.S. (Jain 2005, Gruver et al. 2009, Poulton 2010).

The cause of bat mortality at wind energy facilities includes direct collision with moving turbine blades (Horn et al. 2008). There is little information about the indirect causal factors that influence bat mortality at wind energy facilities, although several hypotheses have been proposed (Kunz et al. 2007, Arnett et al. 2008, Cryan and Barclay 2009, Rydell et al. 2010b). The current leading hypotheses are that bats are attracted to turbines for several reasons including as potential roosting locations (Kunz et al. 2007), potential pairing or mating sites (Cryan and Barclay 2009), or the potential accumulation of migratory insects around turbine rotors (Rydell et al. 2010b). Thus, variables that may contribute to bat fatalities from wind turbines include, but are not limited to: the biology of the bat species, season, region, and turbine design (Kunz et al. 2007). Regardless of the specific causes of bat fatalities, two general patterns of fatalities are consistent across nearly all wind energy facilities:

1. Migratory tree-roosting bats represent the majority of fatalities; and
2. The majority of bat fatalities occur during late summer and early fall, coinciding with the fall migratory movements of bats (Arnett et al. 2008, Cryan 2011).

Some migratory bats travel long distances at altitudes that may overlap with the height of wind turbine blades, making them more susceptible to collisions. The probability of mortality events may also increase during periods of poor weather, such as just before or after the passing of a storm front (Arnett et al. 2008).

Tree bats, such as eastern red bats (*Lasiurus borealis*), silver-haired bats (*Lasionycteris noctivagans*), and hoary bats (*Lasiurus cinereus*), make long latitudinal migrations to warmer climates, and peaks in fatality rates appear to coincide with increasing bat activity levels associated with the southward migration of these species (Cryan 2003, Arnett et al. 2008). *Myotis* species are not considered particularly susceptible to direct mortality from wind turbines, but individuals, mostly little brown bat (*Myotis lucifugus*), have been found during mortality searches (Arnett et al. 2008, BHE Environmental 2011, Grodsky and Drake 2011).

NLEB may be most susceptible to impacts during the summer residency period if roosting habitat is cleared during wind project construction, as well as during the spring and fall periods when migrating bats, more likely to be flying within the rotor swept area (RSA), could collide with operational turbines. Although there are less than 30 confirmed records of NLEB fatalities at wind energy facilities (USFWS 2013), the USFWS considers wind projects to be a threat to the species. The USFWS believes that the large decline in NLEB populations as a result of WNS may be compounded by the loss of even small numbers of the NLEB as a result of collision with wind turbines. USFWS has indicated that there "is no evidence suggesting effects from wind energy development in itself have led to population declines…" (USFWS 2013).

All known NLEB fatalities are from wind energy facilities located east of the Mississippi River. The greatest numbers of NLEB have been found at wind energy facilities on forested ridge tops in West Virginia, where a total of seven fatalities have been documented (Kerns and Kerlinger 2004, Young et al. 2009). NLEB mortality has also been documented in New York, Pennsylvania, and Ontario Canada (Arnett et al. 2005, Jacques Whitford 2009, Stantec 2011). In all cases, NLEB documented mortality rates at wind energy facilities are substantially lower than mortality rates of long-distance migratory species, and other *Myotis* species. Recently, white-nose syndrome (WNS) has caused large declines in populations of cave-hibernating species throughout eastern North America. WNS has been especially devastating to populations of species in the *Myotis* genus, including NLEB (*Myotis septentrionalis*), prompting proposed protected status for this species by USFWS (USFWS 2013).

2.2 Regulatory Framework

2.2.1 Federal Protection

At the federal level, there are no laws or regulations protecting bats in general as there are for birds; existing environmental laws primarily address the protection of habitat favored by bats, such as caves, and prohibit wanton destruction of wildlife. Bat species determined to be at risk are listed under the federal Endangered Species Act (ESA). Beyond that, federal land management agencies such as the U.S. Forest Service, USFWS, and the Bureau of Land Management have developed habitat management guidelines and other provisions to enhance or minimize disturbance to natural habitats, including bat habitats.

Of the 45 species of bats known to occur in the continental U.S., seven species are currently federally listed as endangered and protected under the ESA (USFWS 2014b): gray myotis (*Myotis grisescens*), Indiana myotis (*M. sodalis*), Ozark big-eared bat (*Corynorhinus townsendii ingens*), Virginia big-eared bat (*C. t. virginianus*), lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*), Mexican long-nosed bat (*L. nivalis*), and Florida bonneted bat (*Eumops floridanus*). None of the currently ESA listed bat species are known to occur in North Dakota. However, one additional species, NLEB, is proposed for listing as endangered. North Dakota is within the range of NLEB, although the state represents the western boundary of the known range and many areas of the state do not support suitable habitat for the species.

In July 2011, the USFWS was petitioned to list the NLEB as endangered or threatened and to designate critical habitat under the ESA (USFWS 2011). On October 2, 2013, USFWS released the results of their 12-Month Finding on the 2011 petition (USFWS 2013). USFWS concluded that listing for the NLEB was warranted, and the species is now “proposed for listing as endangered.” The USFWS also concluded that critical habitat could not be determined for NLEB at this time. The public comment period on the proposed federal listing was originally scheduled to close on January 2, 2014, but on June 30, 2014, USFWS published a 6-month extension (79 FR 125 33698-33699). On January 16, 2015, the USFWS proposed a rule under Section 4(d) of the Endangered Species Act for the NLEB if it is listed as threatened (USFWS 2015). This 4(d) rule would limit the prohibition of take to areas affected by white nose syndrome and an additional 150-mile buffer around this area, and would only apply if the species is listed as threatened as opposed to endangered. All other take incidental to other lawful activities would be allowed in those areas of the NLEB range not in proximity to documented occurrence of WNS as identified by the USFWS. This proposal is currently in a 60-day public comment period. If this rule is implemented, North Dakota, and the Project area specifically, would fall outside of the area where take is prohibited as it is currently mapped by the USFWS.

2.2.2 State Protection

The protection and regulation of bat species not listed under the federal ESA is typically at the discretion of state wildlife agencies. North Dakota does not have a state endangered or threatened species list, but the North Dakota Game and Fish has identified 100 species of conservation priority, or those in greatest need of conservation in the State (NDGF 2012). Species are categorized into three levels according to conservation need:

- Level I – species in greatest need of conservation;
- Level II – species in need of conservation, but have had support from other wildlife programs; and
- Level III – species in moderate need of conservation, but are believed to be on the edge of their range in North Dakota.

There are three bat species on the conservation priority list categorized as Level III, including western small-footed myotis (*Myotis ciliolabrum)*, long-eared myotis (*Myotis evotis)*, and long-legged myotis (*Myotis volans*).

2.2.3 Voluntary Guidelines for Wind Power Projects

The USFWS has developed voluntary Land-Based Wind Energy Guidelines (USFWS 2012), a non-regulatory tiered framework for assessing risk and collecting data on wildlife for wind projects.

3.0 Habitat Assessment

Because of the high level of concern regarding bats expressed by regulatory agencies, the ability to evaluate the risk to bats at an individual wind energy facility is an important component of understanding the environmental impacts of a proposed wind energy development. There is no clear relationship between levels of pre-construction bat activity and post-construction bat mortality; however, research to date indicates that certain features of the landscape may make an area more attractive to bats.

Tetra Tech assessed the likelihood of bat occurrence in the Project area through consideration of habitat characteristics in a desktop assessment (Duchamp et al. 2004). Habitat characteristics addressed in the assessment included the amount of suitable foraging and roosting habitat, as well as migration and movement corridors in and near the Project area.

It is important to note that although this report assesses the habitats within the Project area, these assessments are specific to the breeding and summer seasons (i.e., residency period) unless otherwise noted. There is little known about bat migration patterns across North America, although there is speculation that bats may migrate in a similar manner to some birds (northward migration during spring and southward migration during fall; Cryan 2003). Migratory bats moving through the area during migration may still be at risk of colliding with wind turbines, regardless of habitat conditions.

3.1 Species Potentially Present

There are eleven bat species that are known to occur in North Dakota: the little brown bat, silver-haired bat, big brown bat (*Eptesicus fuscus*), eastern red bat, western red bat (*L. blossevillii*), hoary bat, western long-eared myotis (*Myotis evotis*), western small-footed myotis (*M. ciliolabrum*), NLEB, Townsend's big-eared bat (*Corynorhinus townsendii*) and long-legged myotis (*M. volans*) (BCI 2014). Of these eleven species, six potentially occur within the Project area based on current known distribution ranges: little brown bat, big brown bat, silver-haired bat, eastern red bat, hoary bat, and NLEB (BCI 2014, Table 5). None of the species that potentially occur within the Project Area are currently federally listed as threatened or endangered, although the NLEB is proposed for listing.

3.2 General Bat Biology

Depending on the species, bats utilize many different structures for roosting, such as rock formations, caves, human-made structures, and dead and dying trees with cavities and loose bark (Schmidly 2004). Many bat species use riparian corridors and wetlands as feeding habitats due to the higher nocturnal insect densities within these areas (Hill and Smith 1984). Linkages between roosting and foraging habitats represent pathways of continual or regular bat activity throughout much of the year. Identification of suitable habitats that are present within a project area, and the bat species that use these habitats, can be used to help limit interactions between wind turbines/project construction, and bats. However, it is important to note that bats are still at risk of colliding with turbines even if they are only moving through an area during migration, not necessarily just when they are roosting or foraging.

3.2.1 Roosting Habitat

Roosts are critical to bats because they provide shelter from the environment and predators. Further, roosts can be used for hibernation, rearing of young, and social interaction. Bat species can be divided into three broad roosting categories: tree-roosting species, cavity-roosting species, and generalist species. Tree-roosting species prefer larger trees in early stages of decay, which are often found in older forest stands (Barclay and Bringham 1996, Crampton and Barclay 1998). Cavity-roosting species use cavities at some point during their life cycle and may be found in large aggregations within spacious structures (i.e., caves, mines, and buildings [Bogan et al. 2003]). Generalist species are those species adapted for use of many types of roosting habitats. Due to their dependence on roost structures during all stages of their life cycle, the preservation of summer roosting habitat and winter hibernacula have been identified as critical for the conservation of bats in North America (Kunz 1982, Kunz and Fenton 2003).

3.2.2 Foraging Ecology

Foraging habitats are not necessarily exclusive of roosting or migrating habitat; however, there are notable preferences among species for different foraging habitats, which are in fact often different from preferred roosting locations (Harvey et al. 2011). Insectivorous bats (including the majority of the bat species found in North America) feed on a variety of prey, including moths, beetles, flies, and mosquitoes (Kunz and Fenton 2003). Resources, such as type and size of foraging habitat and the selection of prey, are species-specific and are further dependent upon the individuals' energetic needs, sex, and reproductive status. Bats typically choose areas high in prey concentrations in a number of diverse habitats, such as riparian areas (Waldien and Hayes 2001), water bodies (Henry et al. 2002), or forest edges (Hayes and Gruver 2000). Additionally, some bat species, such as the big brown bat, use agricultural fields as foraging habitat (Rogers et al. 2006). The commonality in most studies of foraging habitat; however, is the proximity to water (Lacki et al. 2007).

3.2.3 Bat Migration and Movement Characteristics

Migration is defined as a seasonal, usually two-way, movement from one place or habitat to another to avoid unfavorable climatic conditions and to seek more favorable energetic conditions (Fleming and Eby 2003). This annual shift in distribution is generalized by individuals occupying northern latitudes during the summer and southern latitudes during the winter (Cryan 2003). Migratory tree-roosting species, such as the eastern red bat, silver-haired bat, and hoary bat, appear to make long-distance migrations (Barclay and Brigham 1996, Cryan 2003). Other species, such as the little brown bat and NLEB, migrate short distances from summer to winter roosts in a partial migration or are present as year-round residents (Fleming and Eby 2003).

Beyond generalities, current understanding of bat migration is limited, largely due to the difficult nature of studying bats (Baerwald and Barclay 2009).

In nightly movements among multiple roosts, and between roosts and foraging habitat, most species are thought to move along linear landscape features that connect habitats, such as horizontal forest features, (e.g., forest edges), vertical forest features, (i.e., between forest canopy structures), or riparian corridors (Hayes and Gruver 2000, Downs and Racey 2006, Furmankiewicz and Kucharska 2009).

3.3 Bat Habitat Characteristics within the Project

3.3.1 Roosting Habitat

Trees available as roosts for tree-roosting species are limited within the Project area, given the predominance of grassland/pasture lands and agricultural lands. Less than 1 percent of the Project area consists of deciduous forest (Table 1, Figure 2). Most of the deciduous forests within the Project area consist of stands of cottonwoods occurring as windbreaks surrounding homesteads. Bats may also roost at manmade structures such as buildings, bridges, and culverts. Potentially suitable manmade roosting structures within the Project area include grain bins, barns, sheds, and other buildings associated with farmsteads. Manmade structures are most suitable for generalist species such as little brown bat and big brown bat. No cavity or cave-roosting habitat such as caves, mines, or other natural rock or crevice formations are known to occur in the Project area. In addition, there are no known geological formations that have the potential for karst or pseudokarst development (which could potentially support hibernacula) within the Project area (Weary and Doctor 2014).

Table 1. Land Cover Present in the Project Area, Burleigh County, North Dakota

Land Cover Type	Acres	Percent of Project Area
Developed, Low Intensity	2.67	0.01
Woody Wetlands	2.89	0.01
Deciduous Forest	22.91	0.09
Open Water	86.07	0.35
Emergent Herbaceous Wetlands	275.47	1.13
Pasture/Hay	743.66	3.05
Developed, Open Space	874.34	3.59
Cultivated Crops	5,623.95	23.07
Grassland/Herbaceous	16,742.40	68.69
Total	24,374.35	100

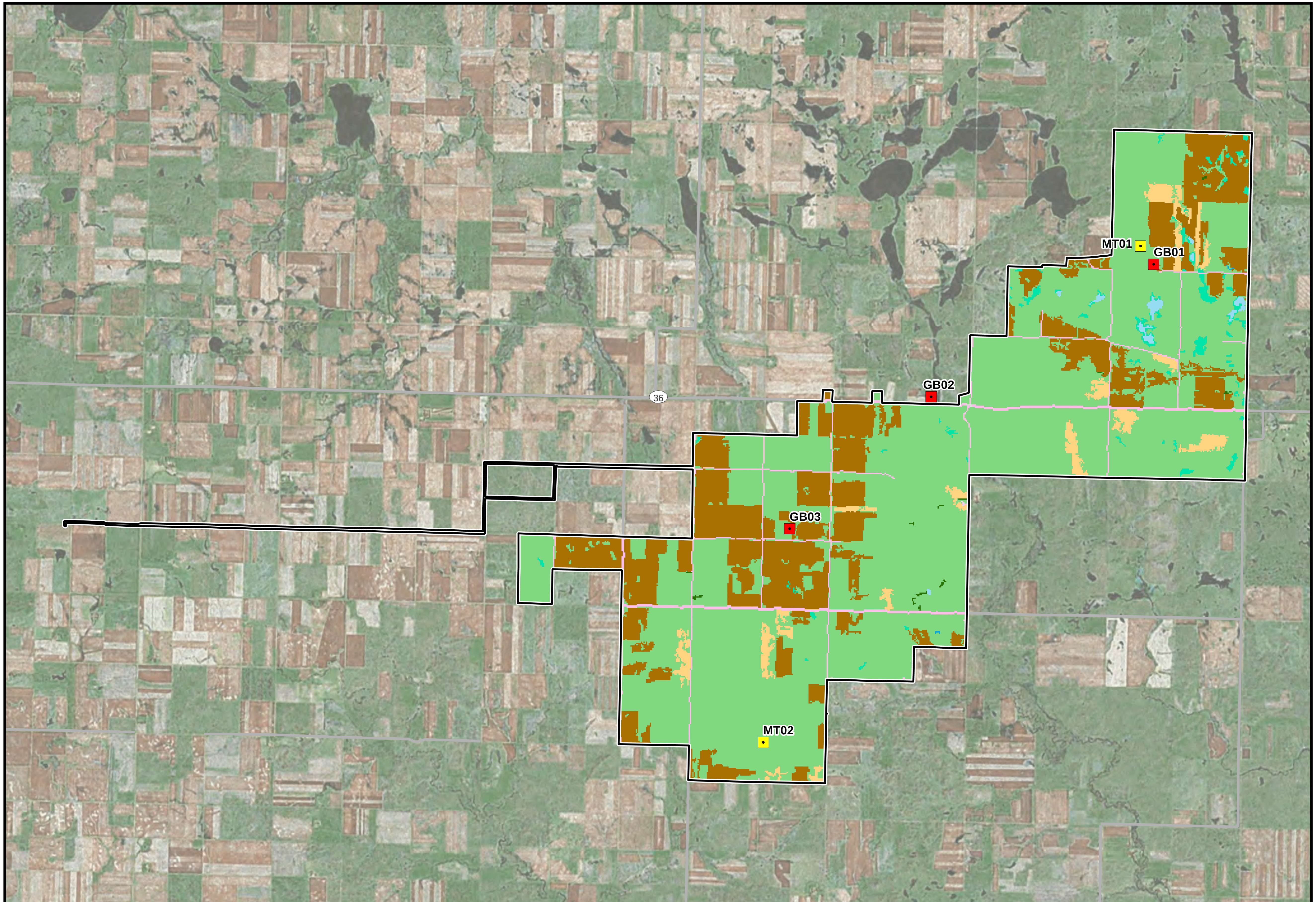


Figure 2

Project Area
Land Cover

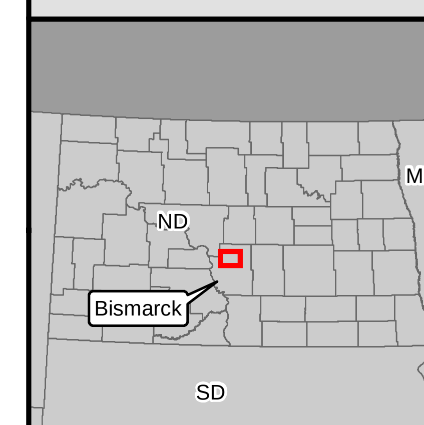
Wilton IV
Wind Energy Center
Burleigh County, ND
December 2014

Legend

- Met Tower Bat Detector
- Ground Based Bat Detector
- Project Boundary (8/12/2014)

NLCD Land Cover (2011)

- Open Water
- Developed (Open Space)
- Developed (Low Intensity)
- Developed (Medium Intensity)
- Barren Land
- Deciduous Forest
- Grassland/Herbaceous
- Pasture/Hay
- Cultivated Crops
- Woody Wetlands
- Emergent Herbaceous Wetlands
- Limited Access Highway
- Highway
- Major Road



1:87,357 **WGS 1984 UTM 14**

0 1 2 4 6 8 10 Miles

Data Sources Nextera: project facilities / ESRI: roads, background imagery / USDOI: NLCD 2011

P:\GIS\NextEra_Wilton\GIS\Spatial\MXD\20141205_WiltonIV_BatReport\WiltonIV_BatAssessment_Figure2_LandCover.mxd - Last Saved 12/17/2014

This page intentionally let blank

3.3.2 Foraging Habitat

Foraging habitat within the Project area is primarily limited to grasslands and agricultural lands, although there is a small amount of deciduous forest consisting of stands of cottonwoods occurring as windbreaks surrounding homesteads that could also be used for foraging. Grasslands and cultivated crops compose approximately 69 and 23 percent of the Project area, respectively (Table 1, Figure 2). Grasslands provide marginal foraging habitat for insectivorous bats, as they often prefer to forage in clutter or along forested edges (Coleman and Barclay 2013). Agricultural lands have little to no value as bat habitat if standing water is not present, except to those species that have a preference for foraging over agricultural lands, such as the regionally-occurring big brown bat. Habitats associated with water, including open water, woody wetlands, and emergent herbaceous wetlands cover less than 2 percent of the Project area (Table 2, Figure 2). Wetlands within the Project area include lakes, ponds, stock ponds, and several unnamed creeks. The largest bodies of water are primary located in the northern portion of the Project area (Figure 2).

3.3.3 Migration and Movement Corridors

Migration and movement corridors for bats are mostly absent from the Project area. There are no large forested riparian corridors for bat species to follow or utilize as stopover day roosting sites. Forested areas within the Project area consist of a few small wooded parcels that are disconnected from each other. Given the lack of large, forested riparian corridors and limited roosting habitat within the Project area, use of the Project area by migrating bats is likely low.

3.3.4 Northern Long-eared Bat

The NLEB requires trees for roosting outside of the hibernation period and its presence is generally correlated with closed canopy forests (Bales 2007, Broders and Forbes 2007). Given the lack of forested areas within the Project, it is anticipated that the species is unlikely to occur within the Project during the breeding period, generally May through August. Although the species may use forested wind breaks within fragmented forest-agricultural landscapes for commuting between roosts and foraging areas, there is little forested habitat present in the Project area that would be desirable for roosting and breeding by NLEB. There are no known hibernacula records of this species in North Dakota (USFWS 2013) and the nearest known hibernaculum of this species is in the Black Hills of South Dakota, more than 200 miles from the Project; therefore, there is a low likelihood that NLEB migrating between summer and winter roosts will pass through the Project.

3.4 Likelihood of Occurrence

Table 2 describes habitat associations and likelihood of occurrence for each species potentially occurring in the Project area. Likelihood of occurrence is based upon species' range and potentially suitable habitats present within the Project area.

Table 2. Bat Species List and Likelihood of Occurrence in the Project Area

Likelihood of Occurrence[1]	Reason for Likelihood	Common Name	Scientific Name	Habitat Association[2]	Species Identified during Passive Acoustic Monitoring[3]
Present	Detected during acoustic survey. Suitable roosting and foraging habitat present and species range overlaps within Project area.	big brown bat	*Eptesicus fuscus*	Habitat generalist found in a variety of habitats, including agricultural croplands; associated with human habitation structures.	Yes
Present	Detected during acoustic survey. Suitable foraging habitat in Project area and species range overlaps with Project area.	silver-haired bat	*Lasionycteris noctivagans*	Closely associated with conifer and mixed hardwood forests; generally found in association with riparian areas. Feed predominantly in disturbed areas.	Yes
Present	Detected during acoustic survey. Suitable roosting and foraging habitat within Project area and species range overlaps with Project area.	little brown bat	*Myotis lucifugus*	Found in close proximity to a water source for foraging and in close proximity to manmade structures.	Yes
Present	Detected during acoustic survey. Marginal suitable roosting and foraging habitat present and species range overlaps with Project area.	hoary bat	*Lasiurus cinereus*	Deciduous and coniferous forests and woodlands, including areas altered by humans.	Yes
Present	Detected during acoustic survey. Marginal suitable foraging habitat present and species range overlaps with Project area.	eastern red bat	*Lasiurus borealis*	Found in hardwood deciduous forests; generally found in close association with riparian areas.	Yes

Likelihood of Occurrence[1]	Reason for Likelihood	Common Name	Scientific Name	Habitat Association[2]	Species Identified during Passive Acoustic Monitoring[3]
Low	Edge of species range overlaps with Project area and very little marginally suitable foraging habitat present.	northern long-eared bat	*Myotis septentrionalis*	Found in dense forest areas and forages in a variety of habitats. Closely associated with cave structures.	No
Unlikely	Species range does not overlap with Project area	western red bat	*Lasiurus blossevillii*	Closely associated with cottonwoods in riparian areas.	No
Unlikely	Species range does not overlap with Project area	Townsend's big-eared bat	*Corynorhinus townsendii*	Semi-arid desert and montane shrub lands; also associated with areas of active agriculture.	No
Unlikely	Species range does not overlap with Project area	long-legged myotis	*Myotis volans*	Found in mountainous, rugged terrain with suitable coniferous forests for roosting.	No
Unlikely	Species range does not overlap with Project area	Western small-footed myotis	*Myotis ciliolabrum*	Found in arid and semi-arid habitats, such as shortgrass and mixed grass habitats.	No
Unlikely	Species range does not overlap with Project area	long-eared myotis	*Myotis evotis*	Found in higher coniferous forests.	No

[1] Present = Detected during acoustic survey, suitable habitat present and species range overlaps with Project area.
Low = Edge of species range and minimal suitable habitat present.
Unlikely = No suitable habitat present or species' range does not overlap with Project area.
[2] Bat Conservation International 2014
[3] See Section 4.2 for details.

3.5 Discussion

Of the eleven bat species that are known to occur in North Dakota, five were detected during acoustic surveys and are considered present on site (Section 4.0). The remaining six species are unlikely to occur based on the lack of suitable habitat and ranges that do not overlap with the Project area (Table 2).

Highly suitable habitats for bats are largely absent from the Project area. Roosting and foraging habitat is limited to less than one percent of the Project area and consists of deciduous forest that is primarily composed of windbreaks surrounding homesteads. Lower quality foraging habitat occurs in the form of grasslands and agricultural lands, which compose the majority of Project area lands. Clear migration and movement corridors for bats are absent from the Project area, although some migration through the Project could occur.

Suitable habitat for the federally-proposed threatened NLEB is lacking in the Project area as the species is generally associated with closed canopy forest. Based on the lack of suitable summer habitat and the distance at which the nearest known hibernaculum occurs (greater than 200 miles away), there is a low likelihood that NLEB migrating between summer and winter roosts would pass through the Project area.

4.0 Acoustic Monitoring

4.1 Methods

To supplement and refine the desktop assessment of bat likelihood of occurrence, Tetra Tech conducted acoustic bat monitoring in the Project area in spring, summer, and fall 2014. The objective of acoustic monitoring was to assess bat use and occurrence of the Project area by local and migratory bat species. Standardized protocols have been established for pre-construction passive acoustic surveys undertaken to evaluate bat species' risk from wind projects. Tetra Tech designed the acoustic monitoring surveys at the Project area to fulfill the recommendations outlined within Tier 3 of the USFWS voluntary Land Based Wind Energy Guidelines and the NLEB Interim Conference and Planning Guidance for Phase 2 presence/absence surveys (USFWS 2014a). Detector locations were coordinated with USFWS and were placed accordingly within the limits of property access.

4.1.1 Acoustic Detectors

Tetra Tech used Wildlife Acoustic Song Meter SM2Bat+ Monitoring Systems (bat detectors) for the duration of the acoustic monitoring survey. Each detector set-up consisted of the acoustic detector, powered by a 25-50 watt solar panel and a 12-volt DC battery encased in a waterproof housing. The microphone was attached to the recording unit by a high quality, low loss microphone cable. Each detector was equipped with a satellite data link (Song Stream, Wildlife Acoustics, Inc.) to minimize data loss. Each detector was also manually checked by trained technicians approximately monthly during the survey period.

Sampling locations within the Project area were based on locations of met towers available for use, representative habitats within the Project area, areas with potential for high bat activity, and areas available for access under existing lease agreements. The Project area was continuously sampled from March 28 through November 4 of 2014 to sample the period that included spring migration, summer breeding, and fall migration for the majority of North American bat species.

Tetra Tech installed two bat detectors on each of two met towers within the Project area (Figure 2). The met towers are located on knolls in remnant native grasslands in the northeastern and southern portions of the Project area. For each of the bat detectors installed on a met tower, one microphone was placed approximately 45 meters above ground (hereafter, the “high” microphone) and another detector was place approximately 1.5 meters above ground (hereafter, the “low” microphone) during met tower installation in March 2014. The paired microphone approach allowed for a more complete sampling of the airspace adjacent to the met tower. Placing microphones at approximately 45 meters allowed for acoustic monitoring at a height within the lower portion of the RSA of the turbines, whereas detectors near ground height captured additional bats using the area closer to the ground. In addition, Tetra Tech deployed three ground-based bat detectors within the Project area in April 2014. The microphone height of each of the ground-based detectors was approximately 1.5 meters. To ensure that the greatest period of bat activity was surveyed, each detector was programmed to begin recording approximately 45 minutes prior to sunset and stop recording approximately 45 minutes after sunrise each day. All detectors remained in their designated locations throughout the study period.

4.1.2 Data Quality Assurance and Control

Tetra Tech implemented quality assurance and quality control measures during all stages of data collection, analysis, and report preparation. Detector data were downloaded once every month. Equipment malfunctions occurred during May to August, so the field technician was sent to the Project area on a more frequent basis to maintain equipment and adjust settings. The incoming echolocation calls were recorded onto high-capacity SD data storage cards. The data from the SD data storage cards were then backed up to an external hard drive and sent to a Tetra Tech biologist for analysis. Field biologists submitted data within 7 business days, and data were immediately reviewed to confirm the operational status of the bat detectors.

4.1.3 Data Analysis

All recorded data files were filtered using the appropriate software (see details below) to identify which data files contained potential bat calls and which files did not. Tetra Tech conservatively defined a call as suitable quality and duration to be included in data analysis if the individual call pulses exhibited the full spectrum of frequency modulation produced by a bat (i.e. sonogram consisting of sharp, distinct lines) with a minimum of five pulses.

The original raw recordings were first processed using Kaleidoscope 1.1.22 software to parse .wav recordings into the maximum 10 second segments and convert to zero-crossing (Anabat type files) format. Full spectrum .wav files were then processed with Sonobat Batch Scrubber

5.2 (Sonobat, Inc., Humboldt, CA) at a “medium” level, which accepts all but poor quality calls, to remove noise signals. A similar “scrubbing” process was followed for the zero-crossing files using Kaleidoscope.

Tetra Tech used both Sonobat 3.2.0 NNE (Sonobat, Inc.) and BCID 2.6a (Ryan Allen, Bat Call Identification, Inc.) to analyze all recordings. Sonobat was set to a “discriminate probability threshold” of 0.9, an “acceptable quality” of 0.7, an “acceptable quality for tally” of 0.1, and to consider a maximum of five call pulses per sequence. BCID was set to add predicted species results to the species section of call files, to use a minimum of five call pulses within 15 seconds of recording, set to “North Dakota,” and all other settings were set to the default.

All calls classified as *Myotis* species were manually reviewed in full spectrum format to confirm the automated classifications. Zero-crossing files that were classified as *Myotis* species in BCID were linked to their parent .wav file and viewed in full spectrum within Sonobat as well. Classifications that reached a “consensus” level by Sonobat (most putative) were used for the quantitative results. Due to the low number of classifications and to ensure that all potential *Myotis* species were included in manual review, Tetra Tech used a “by vote” classification, which is a more liberal classification, to select additional potential *Myotis* calls for manual review.

4.2 Results

During the 2014 survey, a total of 1,024 detector-nights were sampled over the course of 222 calendar nights between March 28 and November 4, 2014 (Table 3). A total of 338 bat calls were detected, resulting in an overall activity rate of 0.33 bat calls/detector night. Table 3 summarizes the sampling period for each detector, calls detected, and activity rates. The met tower detectors were deployed March 28, 2014, and the ground-based detectors were deployed April 30, 2014. A number of survey nights were missed due to equipment malfunctions, especially at met tower 1 (operational 38% of survey period), and some bats may have been missed during periods when detectors were not functioning. However, ground-based detector 1 was positioned less than half a mile from met tower 1 (Figure 2), providing further coverage of this area. The detectors placed on the two met towers and the three ground-based detectors placed throughout the site adequately sampled overall occurrence and use of the area by bats.

Table 3. Summary of Acoustic Monitoring Surveys at the Project

Detector	Level of Effort				Call Sequence Summary	
	Operational Period (2014)	Detector Nights	Survey Nights Available	Percentage of Survey Period Detectors Were Functional	Total # of Bat Calls	Activity Rate (bat calls/detector night)
Met tower 1 low	March 28-April 6, April 30-May 3, May 29-July 19, August 4-August 21, October 2-October 6	85	222	38	0	0.00
Met tower 1 high	March 28-April 6, April 30-May 3, May 29-July 19, August 4-August 21, October 2-October 6	85	222	38	127	1.49
Met tower 2 low	May 1-May 7, May 29-July 15, August 4-November 4	146	222	66	60	0.41
Met tower 2 high	May 1-May 7, May 29-July 15, August 4-November 4	146	222	66	42	0.29
Ground-based 1	April 30-July 1, July 3-November 4	187	189	99	3	0.02
Ground-based 2	April 30-November 4	189	189	100	87	0.46
Ground-based 3	April 30-June 30, July 3-November 4	186	189	98	19	0.10
Total		**1,024**			**338**	**0.33***

*Represents overall activity rate for all detectors (338 bat calls/1,024 detector nights)

4.2.1 Species Presence and Activity Rates

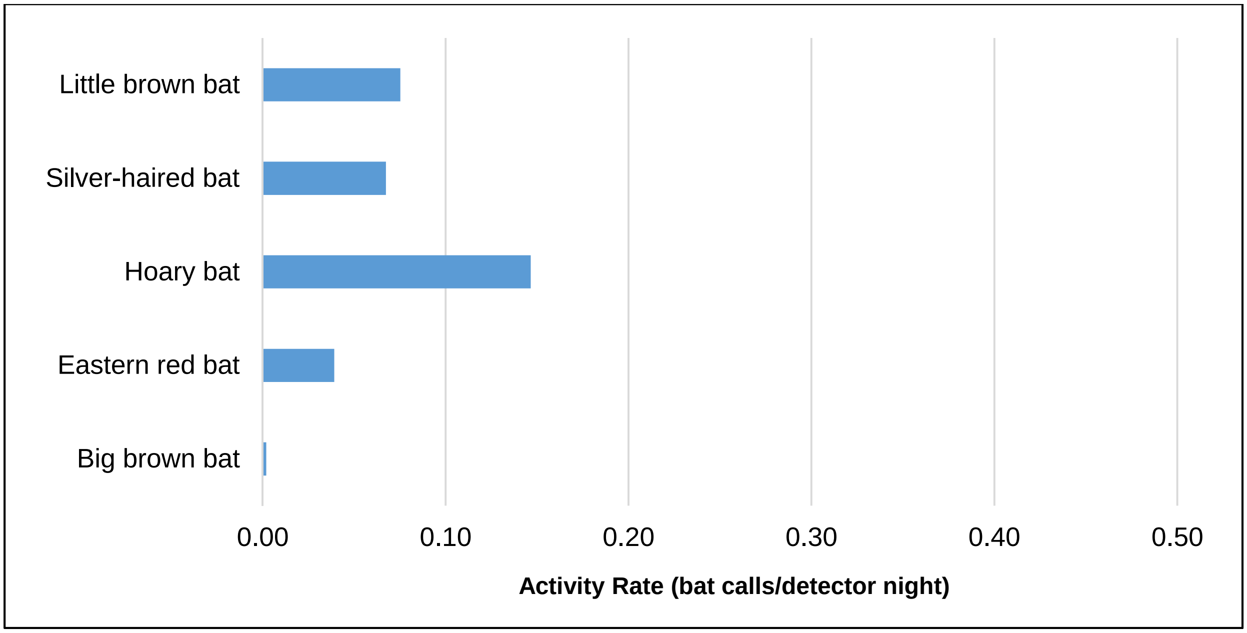
A total of 338 bat calls were recorded during the survey, representing five species (Table 4). Hoary bats were the most commonly recorded (150 calls), followed by little brown bat (77 calls), silver-haired bat (69 calls), eastern red bat (40 calls), and big brown bat (two calls). The high detector on met tower 1 recorded the highest number of bat calls, and had the highest activity rate (i.e., bat calls per detector night; Table 4). The low detector at met tower 1 did not record any bat calls during the survey period, despite being operational for 85 detector-nights. Activity rates were calculated for each detector and for each species by detector (Table 4). Activity rates across all detectors ranged from 0 bat calls/detector night to 1.49 bat calls/detector night, with no strong patterns of bat use across the Project area occurring. No calls of federally protected bat species, including NLEB, were identified from calls recorded during the 2014 survey.

Table 4. Activity Rates Recorded per Species at Each Detector

Detector	Big brown bat	Eastern red bat	Hoary bat	Silver-haired bat	Little brown bat	Activity Rate by detector (bat calls/detector night)
Met tower 1 low	0	0	0	0	0	0.00
Met tower 1 high	0	0.05	1.40	0.01	0.04	1.49
Met tower 2 low	0.01	0.01	0.06	0.32	0.01	0.41
Met tower 2 high	0.01	0.08	0.12	0.08	0.01	0.29
Ground-based 1	0	0	0	0	0.02	0.02
Ground-based 2	0	0.12	0.01	0.03	0.31	0.46
Ground-based 3	0	0.01	0.02	0.03	0.05	0.10
Activity rate by species (bat calls/detector night)	**0.002**	**0.04**	**0.15**	**0.07**	**0.08**	**0.33***

*Represents overall activity rate for all species and all detectors (338 bat calls/1,024 detector nights)

Figure 3. Activity Rates of Bat Species Recorded at All Detectors



4.2.2 Timing of Activity

Bat activity was first detected on May 2 and last detected on October 6, 2014. Bat activity was relatively low throughout the summer months, and had a single night peak on August 30 (40 of 45 calls being silver-haired bat), and another peak in early October (all hoary bat calls; Figures 4 and 5). As expected, the higher pulses of fall activity were migratory species (silver-haired and hoary bats), with lower rates throughout the summer of all species, but primarily the likely resident little brown bat. The met tower 1 high detector and met tower 2 low detector primarily recorded the fall pulses of migratory species (Appendix A). All other detectors had relatively low activity rates throughout the summer (Appendix A).

Figure 4. Total Number of Calls Recorded by Date at all Detectors

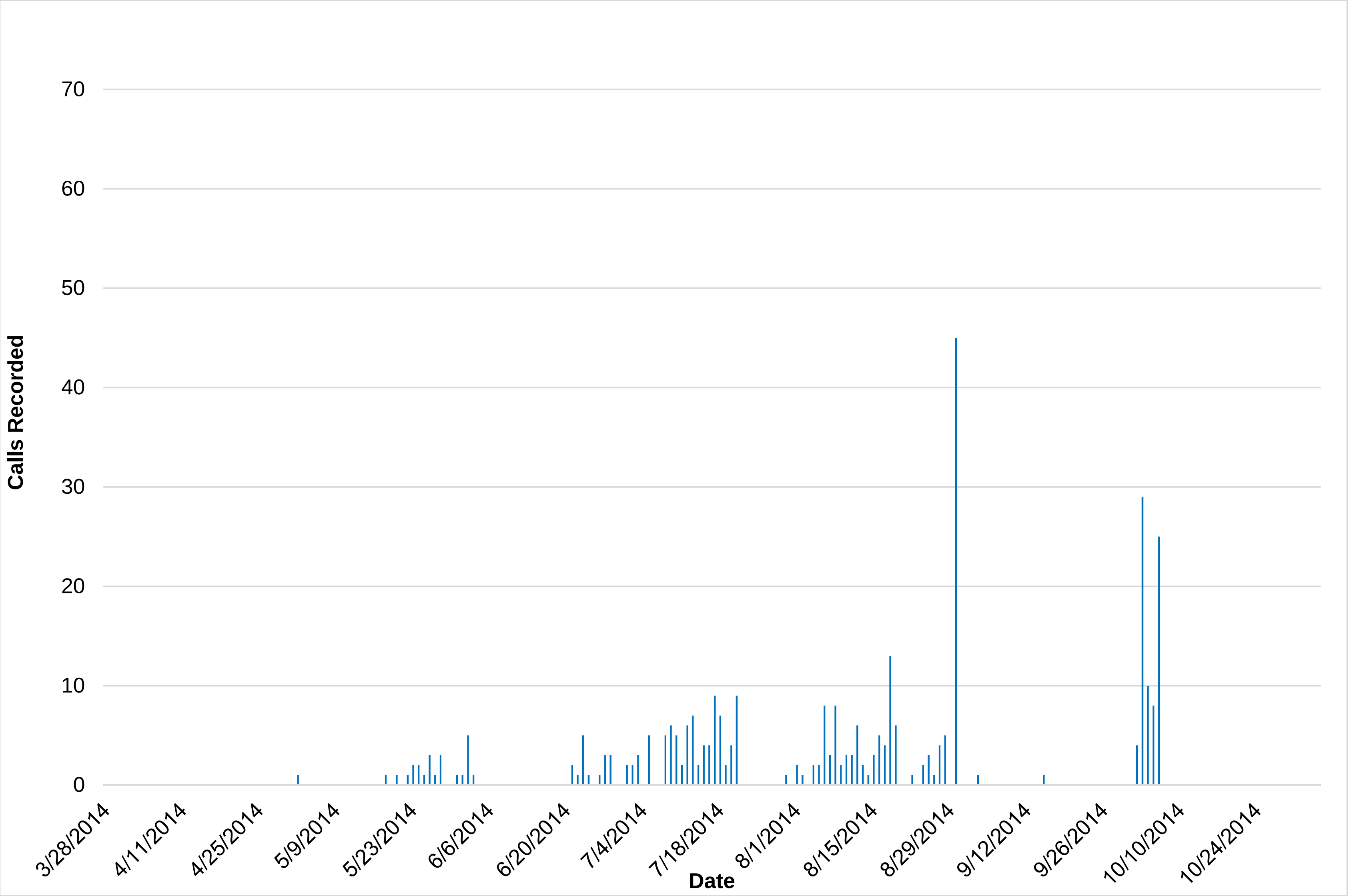
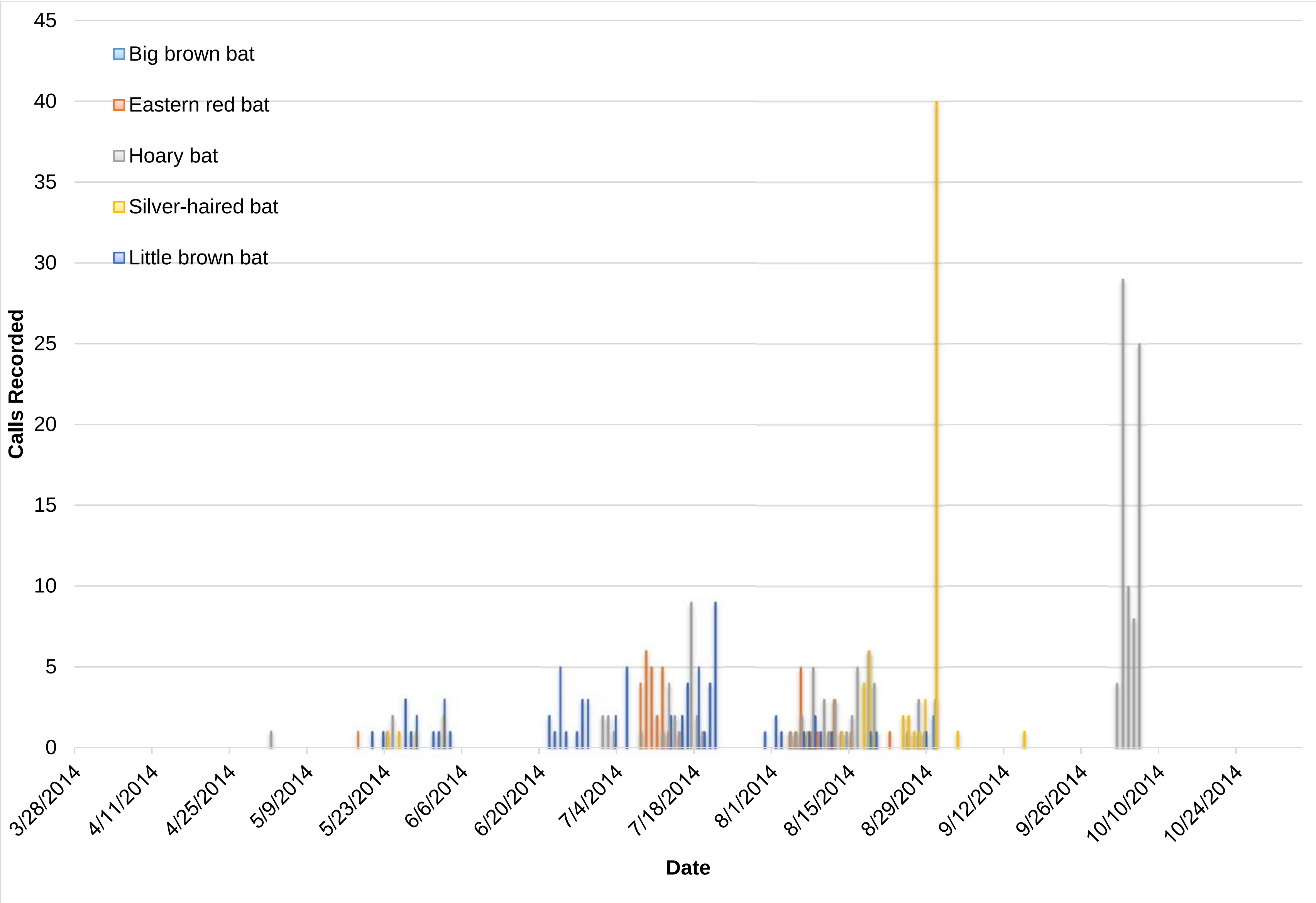


Figure 5. Total Number of Calls Recorded by Date and Species at all Detectors



4.3 Discussion

Hoary bat, silver-haired bat, and eastern red bats, all migratory tree-roosting bats, were detected during 2014 surveys during both the summer and fall seasons, indicating that these species are both potentially breeding in the vicinity of the project and migrating through the Project in brief, episodic periods. The occurrence of migratory bat species during the summer season demonstrates that there were likely some long-distance migratory tree-roosting bats spending the summer breeding period at the Project area. There also appeared to be long-distance migrants moving through the Project area during the fall, as evidenced by the increased number of migratory species calls recorded during those periods as compared to the summer period.   Specifically, a peak of hoary bat calls was detected at the met tower 1 high detector in late September, indicating these were likely migratory bats flying near the RSA and moving through the area (Appendix A). In contrast, a peak of silver-haired bats was recorded at the met tower 2 low detector in late August, with the met tower 2 high detector only picking up a few silver-haired bat calls that night (Appendix A). This indicates that these bats were likely not traveling within the RSA and were unlikely to be migrating through the area; and were thus potentially resident bats foraging in the area.

The migratory hoary bat, silver-haired bat, and eastern red bat have been regularly documented as fatalities at wind projects across North America, most frequently in later summer and early fall during migratory periods (Arnett et al. 2008, Strickland et al. 2011). Patterns of activity in the Project area (i.e., the low fall activity rates) do not suggest the presence of a large bat migration corridor in the vicinity of the met towers; however, some bats are likely migrating through the project and may occur as fatalities during Project operations.

The resident little brown bat and big brown bat were documented throughout the summer breeding period. Fatalities of summer resident species, including little brown bat and big brown bat, have usually been low at wind projects, with the exception of two sites in Canada and Iowa where little brown bats accounted for approximately 25 percent of fatalities (Arnett et al. 2008). There is no indication that the Wilton IV wind farm would have higher than typical risk for either of these species, so it is expected that fatality trends would be low as is typical at most wind projects.

In comparison to other pre-construction passive acoustic monitoring surveys at wind projects in North America, the Project area is on the low end of the range of mean activity rates (Table 5). It is important to note that, to date, no empirical evidence suggests a correlation between pre-construction bat activity, as measured by acoustic monitoring, and post-construction bat mortality. However, acoustic monitoring provides a relative index of bat activity within the Project area. The following table is summarized from Hein et al. 2013, and shows activity rates across a number of wind projects summarized by region.

Table 5. Comparison of Pre-Construction Bat Activity, as Measured by Acoustic Monitoring, Among Wind Projects in the United States

Region	Number of sites included	Bat Activity (passes/detector night)	
		Mean	Minimum-Maximum
Great Basin/Southwest Open Range-Desert	22	10.69	0.02-77.14
Great Plains (includes North Dakota)	24	4.19	0.15-17.45
THIS PROJECT North Dakota	**1**	**0.33**	**NA**
Northeastern Deciduous Forest	15	25.2	1.24-141.70
Midwestern Deciduous Forest-Agricultural	31	7.29	0.73-33.88
Data summarized from Hein et al. 2013			

5.0 Summary

Based on the desktop assessment and the monitoring results, it is likely that migratory, tree-roosting bat species use the Project area in low numbers during the summer and during migration in brief, episodic periods. Additionally, resident species little brown bat and big brown bat may be present year-round in lower numbers of individuals. While bat species were documented using the Project area, there is no highly suitable bat habitat present.

Although the Project area falls within the range of the NLEB, there does not appear to be suitable habitat present that would adequately support resident NLEB, and acoustic results did not document any NLEB during the survey period. There is a low likelihood that NLEB would be impacted by this Project.

Among the five species identified during the acoustic monitoring, all five have been found during mortality studies at North American wind energy facilities. Three of these species (the hoary, silver-haired, and eastern red bats) are the most commonly documented bat fatalities at North American wind energy facilities (Arnett et al. 2008). Further, the eastern red bat and the little brown bat have been frequently identified as fatalities in the Midwest; however, it is important to note that the relationship between pre-construction bat activity, as measured by acoustic monitoring, and post-construction mortality is currently unclear (Hein et al. 2013). While that relationship is lacking, the acoustic data do give us some indication of levels of bat use in the area, and these appear to be relatively low for the Project area.

6.0 Literature Cited

Arnett, E.B., W.P. Erickson, J. Kerns, and J. Horn. 2005. Relationships between Bats and Wind Turbines in Pennsylvania and West Virginia: An Assessment of Fatality Search Protocols, Patterns of Fatality and Behavioral Interactions with Turbines. Prepared for Bats and Wind Cooperative. 187 pgs.

Arnett, E.B., W.K. Brown, W.P. Erickson, K.K. Fiedler, B.L. Hamilton, T.H. Henry, A. Jain, G.D. Johnson, J.Kerns, R.R. Koford, C.P. Nicholson, T.J. O'Connel, M.D. Piorkowski, and R.D. Tankersley, Jr. 2008. Patterns of bat fatalities at wind energy facilities in North America. Journal of Wildlife Management 72:61–78.

Baerwald, E.F., and R.M.R. Barclay. 2009. Geographic variation in activity and fatality of migratory bats at wind energy facilities. Journal of Mammalogy 90:1341–1349.

Bales, B. T. 2007. Regional distribution and monitoring of bats, especially species of conservation concern, along the lower Missouri River in South Dakota. Master's Thesis. South Dakota State University. Available online at: http://bathead.com/batpdf/balesMS.pdf

Barclay, R.M.R., and M.R. Brigham (editors). 1996. Bats and Forests Symposium, October 19–21, 1995, Victoria, British Columbia, Canada. Ministry of Forests Research Program, Victoria, B.C. Work Paper 23.1996.

Bat Conservation International (BCI). 2014. Species Profiles. Accessed December 2014 at: http://www.batcon.org/resources/media-education/species-profiles

BHE Environmental, Inc. (BHE). 2011. Post-Construction Bird and Bat Mortality Study: Cedar Ridge Wind Farm, Fond Du Lac County, Wisconsin. Final Report. Prepared for Wisconsin Power and Light, Madison, Wisconsin. Prepared by BHE Environmental, Inc. Cincinnati, Ohio. February 2011.

Bogan, M.A., P.M. Cryan, T.J. O'Shea, L.E. Ellison, and E.W. Valdez. 2003. Western crevice and cavity roosting bats. In: T.J. O'Shea and M.A. Bogan (eds.). Monitoring Trends in Bat Populations of the U. S. and Territories: Problems and Prospects. Information and Technology Report 2003-0003:U. S. Geological Survey. 69-77 pg.

Broders, H. G. and G. J. Forbes. 2004. Interspecific and intersexual variation in roost-site selection of Northern long-eared and little brown bats in the greater Fundy National Park Ecosystem. Journal of Wildlife Management, 68(3):602-610.

Coleman, J. L., & Barclay, R. M. 2013. Prey availability and foraging activity of grassland bats in relation to urbanization. Journal of Mammalogy, 94(5), 1111-1122.

Crampton, L.H., and R.M.R. Barclay. 1998. Selection of roosting and foraging habitat by bats in different-aged aspen mixedwood stands. Conservation Biology12:1347–1358.

Cryan, P.M. 2003. Seasonal distribution of migratory tree bats (Lasiurus and Lasionycteris) in North America. Journal of Mammalogy 84:579–593.

Cryan, P.M. 2011. Wind Turbines as Landscape Impediments to the Migratory Connectivity of Bats. Environmental Law 41: 355-370.

Cryan, P.M., M.A. Bogan, and G.M. Yanega. 2001. Roosting habitats of four bats in the Black Hills of South Dakota. Acta Chiropterologica 3: 43-52

Cryan, P.M., and R.M.R. Barclay. 2009. Causes of bat fatalities at wind turbines: hypotheses and predictions. Journal of Mammalogy 90:1330–1340.

Downs, N.C., and P.A. Racey. 2006. The use by bats of habitat features in mixed farmland in Scotland. Acta Chiropterologica, 8(1): 169–185.

Duchamp, J.E., D.W. Sparks, and J.O. Whitaker Jr. 2004. Foraging-habitat selection by bats at an urban-rural interface: comparisons between a successful and a less successful species. Canadian Journal of Zoology 82:1157–1164.

Fleming, T.H., and P. Eby. 2003. Ecology of bat migration. In: T.H. Kunz and M.B. Fenton (eds.). Bat Ecology. University of Chicago Press, Chicago, Illinois.

Furmankiewicz, J. and M. Kucharska. 2009. Migration of bats along a large river valley in southwestern Poland. Journal of Mammalogy 90:1310–1317.

Grodsky, S.M. and D. Drake. 2011. Assessing Bird and Bat Mortality at the Forward Energy Center. Final Report. Public Service Commission (PSC) of Wisconsin. PSC REF#:152052. Prepared for Forward Energy LLC. Prepared by Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, Madison, Wisconsin. August 2011.

Gruver, J., M. Sonnenburg, K. Bay, and W. Erickson. 2009. Post-Construction Bat and Bird Fatality Study at the Blue Sky Green Field Wind Energy Center, Fond Du Lac County, Wisconsin July 21 - October 31, 2008 and March 15 - June 4, 2009. Unpublished report prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming. December 17, 2009.

Harvey, M. J., J. S. Altenbach, and T. L. Best. 2011. Bats of the United States and Canada. The Johns Hopkins University Press, Baltimore, MD. USA.

Hayes, M.A. 2013. Bats Killed in Large Numbers at United States Wind Energy Facilities. BioScience 63:975-979.

Hayes, J.P., and J.C. Gruver. 2000. Vertical stratification of activity of bats in an old-growth forest in western Washington. Northwest Science 74:102–108.

Hein, C.D., J. Gruver, and E.B. Arnett. 2013. Relating Pre-Construction Bat Activity and Post-Construction Bat Fatality to Predict Risk at Wind Energy Facilities: A Synthesis. A report submitted to the National Renewable Energy Laboratory. Bat Conservation International. Austin, TX, USA.

Henry, M., D. W. Thomas, R. Vaudry, and M. Carrier. 2002. Foraging distances and home range of pregnant and lactating little brown bats (Myotis lucifugus). Journal of Mammalogy 83:767–774.

Hill, J., and J. Smith. 1984. Bats: A Natural History. University of Texas Press, Austin, Texas.

Horn, J.W., E.B. Arnett, and T.H. Kunz. 2008. Behavioral responses of bats to operating wind turbines. Journal of Wildlife Management 72:123-132.

Jacques Whitford Stantec Limited (Jacques Whitford). 2009. Ripley Wind Power Project Post-construction Monitoring Report. Project No. 1037529.01. Report to Suncor Energy Products Inc., Calgary, Alberta, and Acciona Energy Products Inc., Calgary, Alberta. Prepared for the Ripley Wind Power Project Post-Construction Monitoring Program. Prepared by Jacques Whitford, Markham, Ontario. April 30, 2009. www.jacqueswhitford.com

Jain, A.A. 2005. Bird and Bat Behavior and Mortality at a Northern Iowa Windfarm. M.S. Thesis. Iowa State University, Ames, Iowa.

Kerns, J. and P. Kerlinger. 2004. A Study of Bird and Bat Collisions at the Mountaineer Wind Energy Facility, Tucker County, West Virginia: Annual Report for 2003. Prepared for FPL Energy and the Mountaineer Wind Energy Center Technical Review Committee. February 14, 2004. Technical report prepared by Curry and Kerlinger, LLC., for FPL Energy and Mountaineer Wind Energy Center Technical Review Committee. Curry and Kerlinger, LLC. 39 pp. http://www.wvhighlands.org/Birds/MountaineerFinalAvianRpt-%203-15-04PKJK.pdf

Kunz, T.H. 1982. Roosting Ecology of Bats. in Ecology of Bats. T.H. Kunz (ed.) Plenum Publishing Corporation, New York, New York.

Kunz, T.H. and M.B. Fenton (eds.). 2003. Bat Ecology. The University of Chicago Press. Chicago, Illinois.

Kunz, T.H., E.B. Arnett, W.P. Erickson, A.R. Hoar, G.D. Johnson, R. P. Larkin, M.D. Strickland, R.W. Thresher, and M.D. Tuttle. 2007. Ecological impacts of wind energy development on bats: questions, research needs, and hypotheses. Frontiers in Ecological Environments 5:315-324.

Lacki, M.J., Hayes, J.P., and A. Kurta. 2007. Bats in Forests: Conservation and Management. The Johns Hopkins University Press. Baltimore, Maryland.

North Dakota Game and Fish Department (NDGF). 2012. Species of Conservation Priority. Available online at: http://gf.nd.gov/wildlife/programs-and-grants/species-conservation-priority, accessed on July 16, 2014.

Poulton, V. 2010. Summary of Post-Construction Monitoring at Wind Projects Relevant to Minnesota, Identification of Data Gaps, and Recommendations for Further Research Regarding Wind-Energy Development in Minnesota. Prepared for State of Minnesota Department of Commerce. 52 Pgs.

Rogers, D.S., M.C. Belk, M.W. Gonzalez, and B.L. Coleman. 2006. Patterns of habitat use by bats along a riparian corridor in northeastern Utah. The Southwestern Naturalist 51: 52–58.

Rydell, J., L. Bach, M. Dubourg-Savage, M. Green, L. Rodrigues, A. Hedenstrom. 2010a. Bat Mortality at Wind Turbines in Northwestern Europe. Acta Chiropterologica 12(2):261-274.

Rydell, J., L. Bach, M. Dubourg-Savage, M. Green, L. Rodrigues, A. Hedenstrom. 2010b. Mortality of bats at wind turbines links to nocturnal insect migration? European Journal of Wildlife Research 56:823-827.

Schmidly, D.J. 2004. The Mammals of Texas. University of Texas Press, Austin, Texas.

Stantec Consulting, Inc. (Stantec). 2011. Cohocton and Dutch Hill Wind Farms Year 2 Post-Construction Monitoring Report, 2010, for the Cohocton and Dutch Hill Wind Farms in Cohocton, New York. Prepared for Canandaigua Power Partners, LLC, Portland Maine. Prepared by Stantec, Topsham, Maine. January 2011.

Strickland, M.D., E.B. Arnett, W.P. Erickson, D.H. Johnson, G.D. Johnson, M.L. 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, D.C.

USFWS (United States Fish and Wildlife Service). 2011. Federal Register Notice of a 90-day finding for the Eastern Small-footed Bat and the NLEB. Available online at http://www.fws.gov/midwest/es/soc/mammals/FR90DayFndngNLEB_ESFB29June2011.html. Accessed August 2014.

USFWS. 2012. Land-Based Wind Energy Guidelines. Available online at http://www.fws.gov/windenergy.

USFWS. 2013. 12-month Finding on a Petition to List the Eastern Small-footed Bat and the NLEB as Endangered or Threatened; Listing the NLEB as an Endangered Species – Proposed Rule. Federal Register 78(191): 61046-61080. Available online at http://www.gpo.gov/fdsys/pkg/FR-2013-10-02/pdf/2013-23753.pdf Accessed December 2013.

USFWS. 2014a. Northern Long-eared Bat Interim Conference and Planning Guidance. USFWS Region 2, 3, 4, 5, & 6. January 6, 2014.

USFWS. 2014b. Endangered species program. Available online at http://www.fws.gov/endangered/. Accessed December 2014.

Waldien, D.L., and J.P. Hayes. 2001. Activity areas of female long-eared myotis in coniferous forests in western Oregon. Northwest Science 75: 307-314.

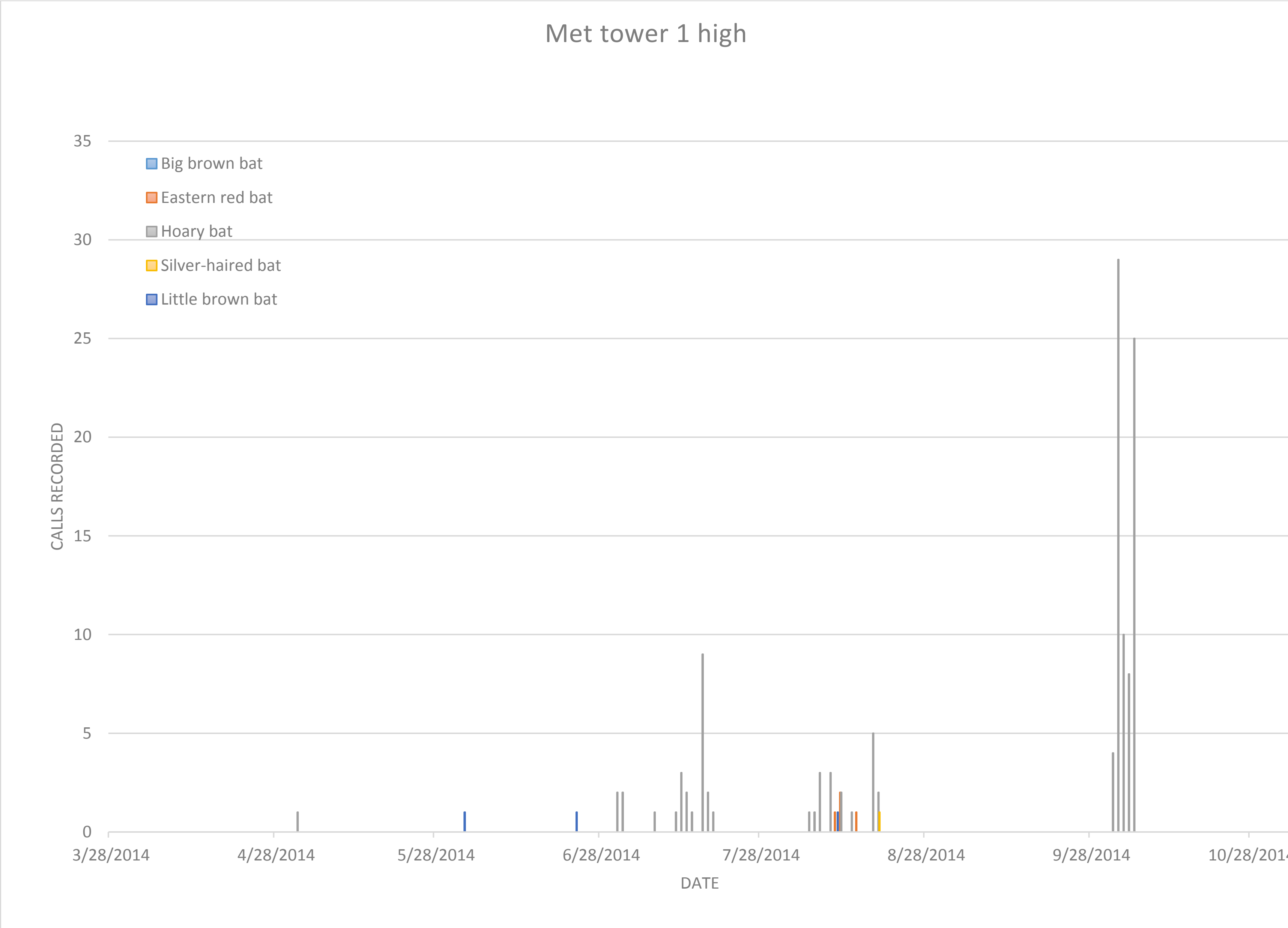
Weary, D.J., and Doctor, D.H., 2014, Karst in the United States: A digital map compilation and database: U.S. Geological Survey Open-File Report 2014–1156, 23 p., http://dx.doi.org/10.3133/ofr20141156.

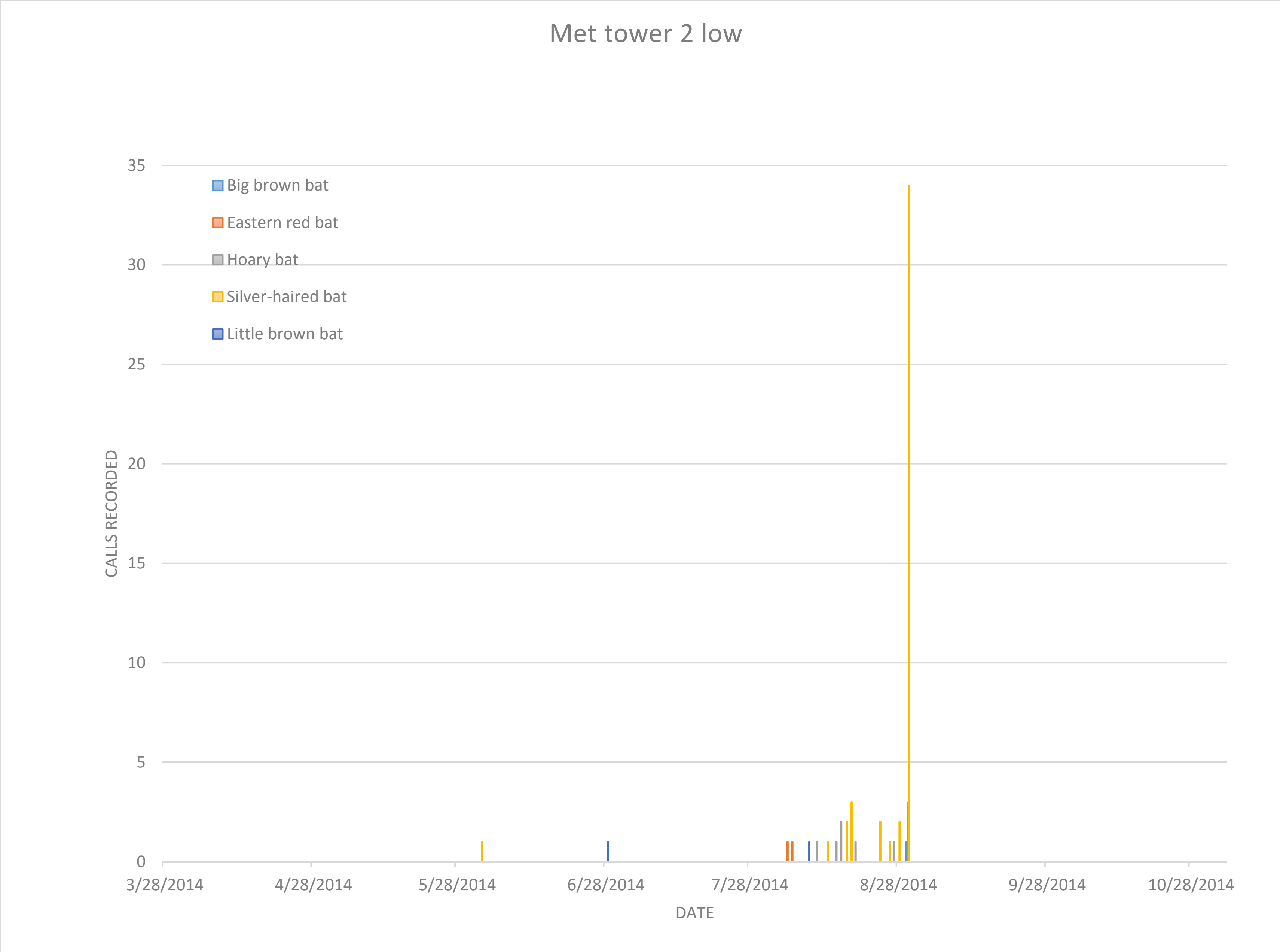
Young, D.P. Jr., W.P. Erickson, Bay, K., Nomani, S., and Tidhar, W. 2009. Mount Storm Wind Energy Facility, Phase 1 Post-Construction Avian and Bat Monitoring: July - October 2008. Prepared for NedPower Mount Storm, LLC, Houston, Texas. Prepared by Western EcoSystems Technology, Inc. (WEST), Cheyenne, Wyoming.

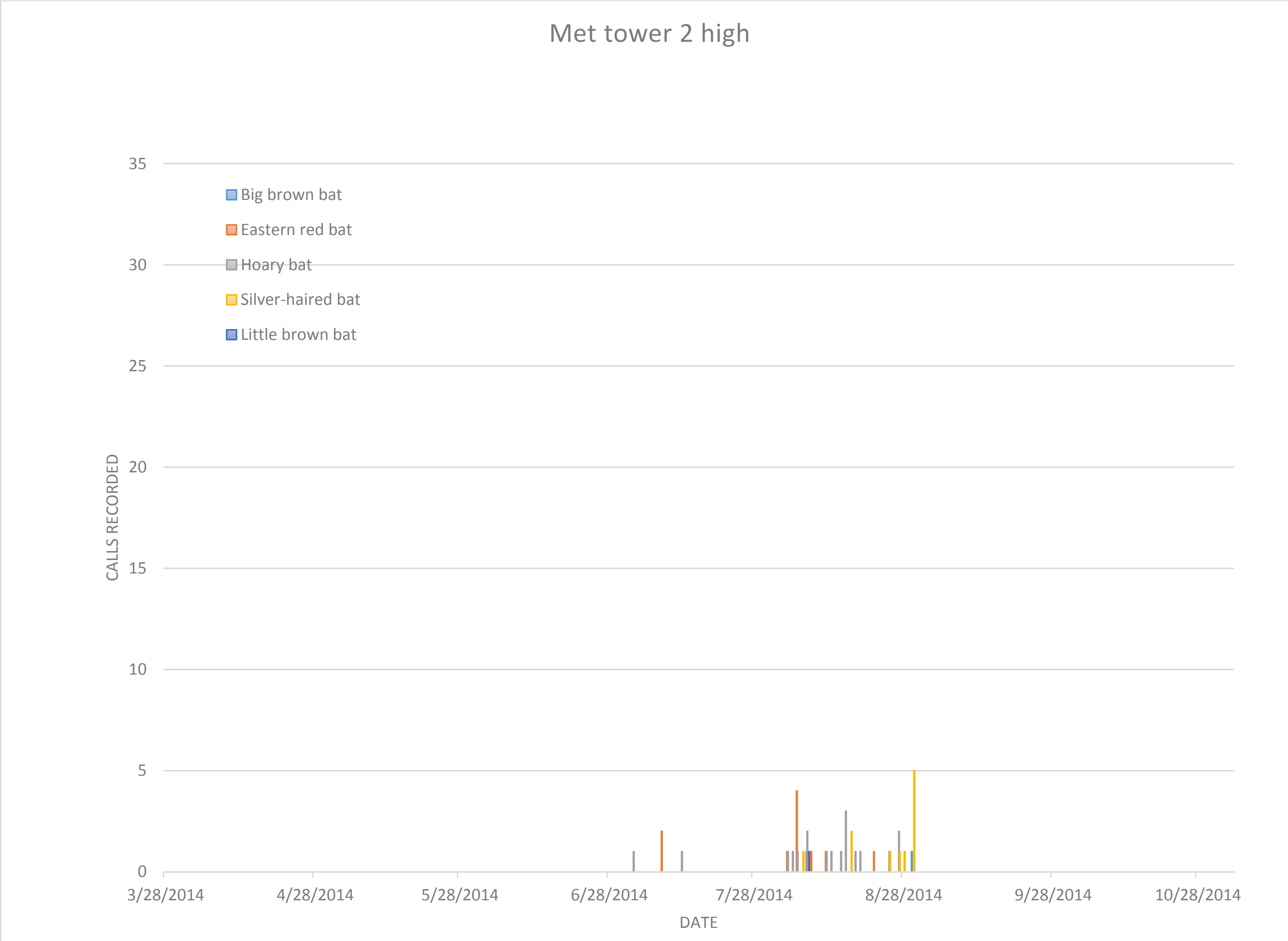
This page intentionally left blank

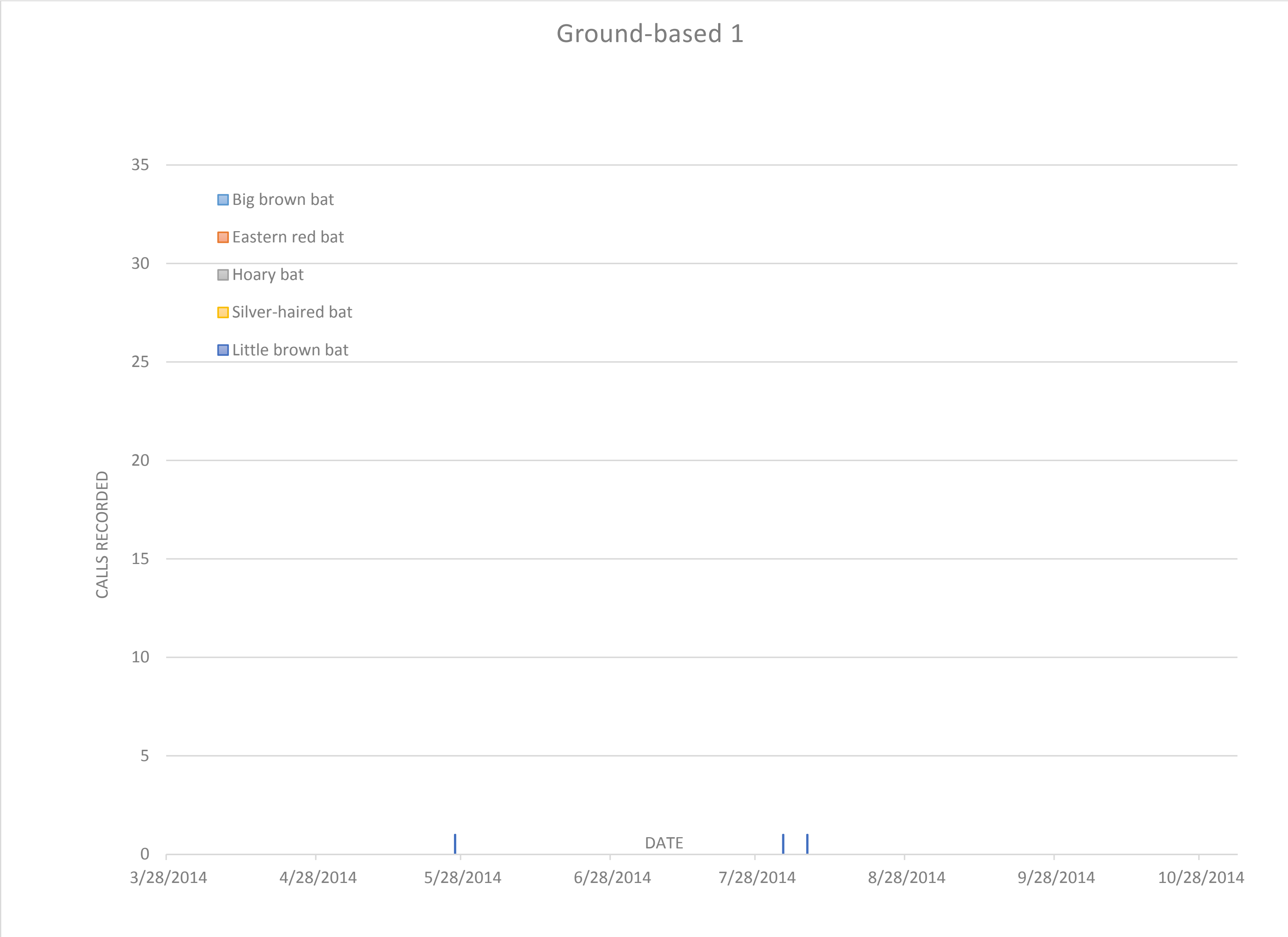
APPENDIX A: DETAILED FIGURES SHOWING BAT ACTIVITY THROUGHOUT THE SURVEY PERIOD AT EACH DETECTOR LOCATION

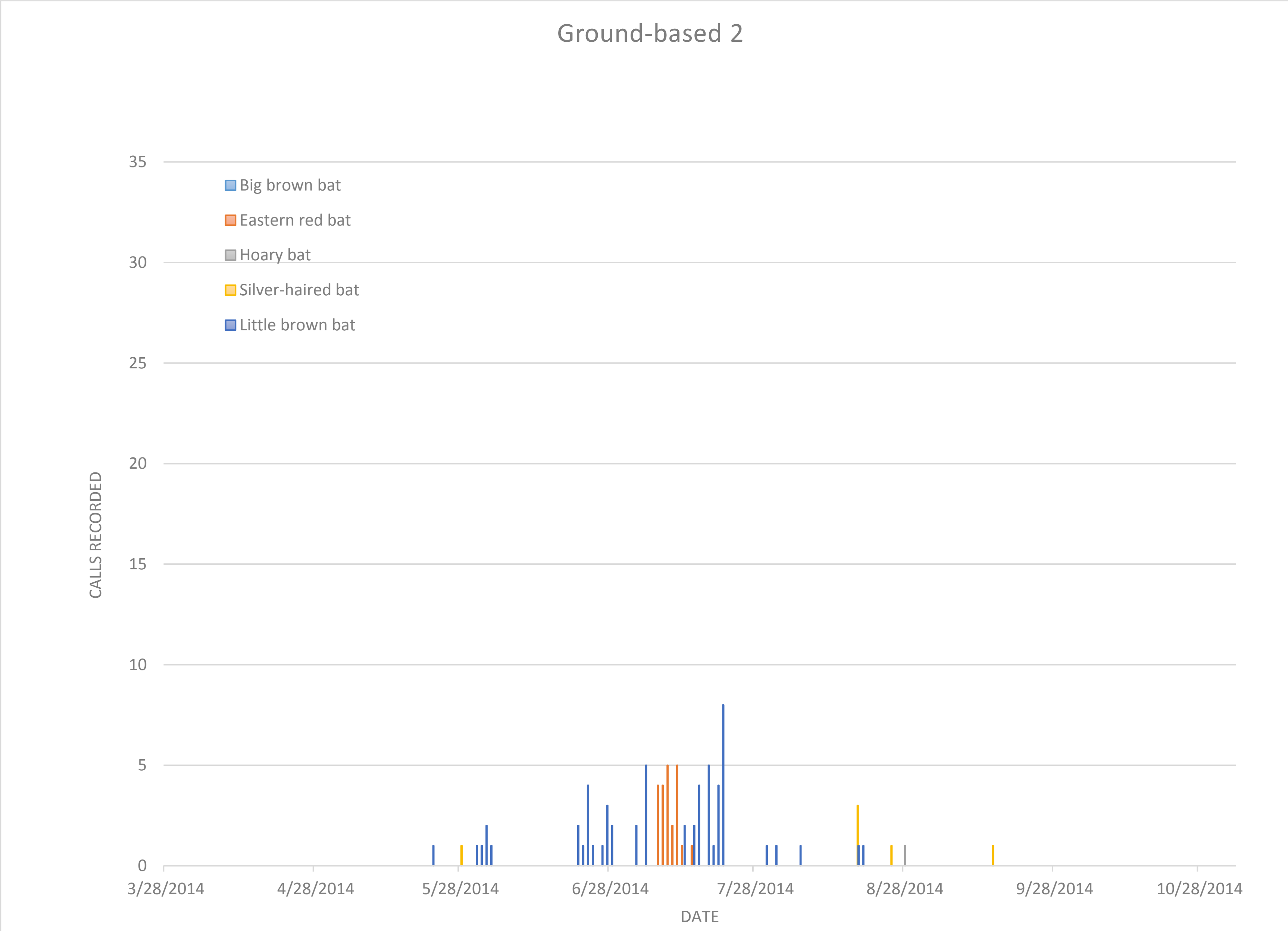
This page intentionally left blank

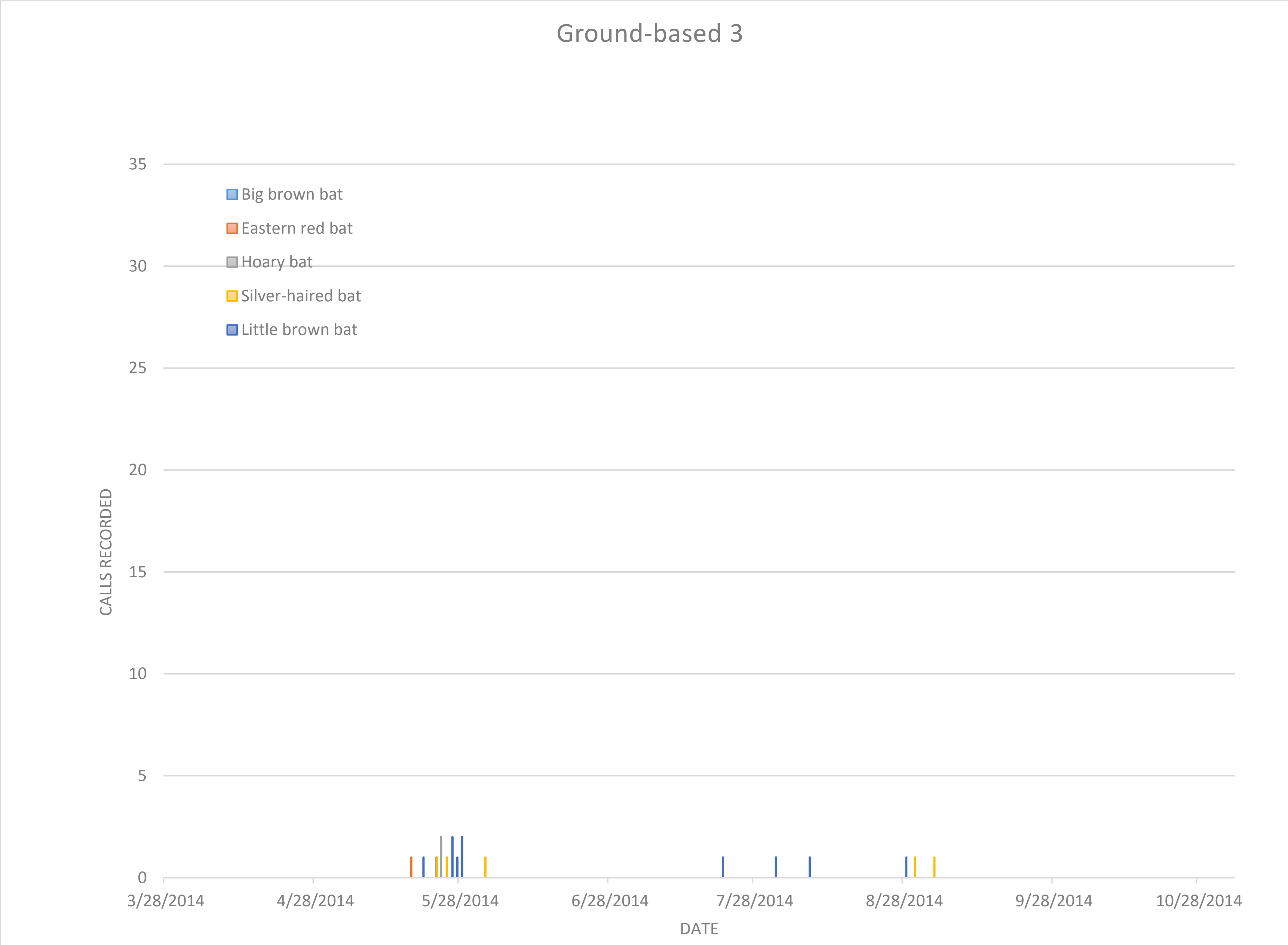

Met tower 1 high
35
30
25
20
15
10
5
0
CALLS RECORDED
Big brown bat
Eastern red bat
Hoary bat
Silver-haired bat
Little brown bat
3/28/2014
4/28/2014
5/28/2014
6/28/2014
7/28/2014
8/28/2014
9/28/2014
10/28/2014
DATE


Met tower 2 low
Big brown bat
Eastern red bat
Hoary bat
Silver-haired bat
Little brown bat
CALLS RECORDED
35
30
25
20
15
10
5
0
3/28/2014
4/28/2014
5/28/2014
6/28/2014
7/28/2014
8/28/2014
9/28/2014
10/28/2014
DATE


Met tower 2 high
35
30
25
20
15
10
5
0
CALLS RECORDED
Big brown bat
Eastern red bat
Hoary bat
Silver-haired bat
Little brown bat
3/28/2014
4/28/2014
5/28/2014
6/28/2014
7/28/2014
8/28/2014
9/28/2014
10/28/2014
DATE


Ground-based 1
Big brown bat
Eastern red bat
Hoary bat
Silver-haired bat
Little brown bat
CALLS RECORDED
35
30
25
20
15
10
5
0
DATE
3/28/2014
4/28/2014
5/28/2014
6/28/2014
7/28/2014
8/28/2014
9/28/2014
10/28/2014


Ground-based 2
Big brown bat
Eastern red bat
Hoary bat
Silver-haired bat
Little brown bat
35
30
25
20
15
10
5
0
CALLS RECORDED
3/28/2014
4/28/2014
5/28/2014
6/28/2014
7/28/2014
8/28/2014
9/28/2014
10/28/2014
DATE


Ground-based 3
Big brown bat
Eastern red bat
Hoary bat
Silver-haired bat
Little brown bat
CALLS RECORDED
35
30
25
20
15
10
5
0
3/28/2014
4/28/2014
5/28/2014
6/28/2014
7/28/2014
8/28/2014
9/28/2014
10/28/2014
DATE