

**Bat Surveys Report  
Port Alma Wind Project**

File No. 160960114



**Stantec**

Prepared for:

**Kruger Energy Port Alma Limited  
Partnership  
3285 Chemin Bedford  
Montreal, Quebec H3S 1G5**

Prepared by:

**Stantec Consulting Ltd.  
361 Southgate Drive  
Guelph ON N1G 3M5**

December 2006



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## **1.0 Introduction**

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### **1.1 STUDY AREA**

The Project is located in the Municipality of Chatham-Kent, formed in 1998 through amalgamation of 23 municipalities (Municipality of Chatham-Kent 2006). The study area, located in the former townships of Romney, East Tilbury, and Raleigh, is comprised of approximately 34,200 hectares of land.

A total of 44 2.3 MW turbines are proposed, distributed across the townships listed above. The study area is located in an area with one of the highest average wind speeds in Ontario. Along the shore of Lake Erie, wind speed is rated Very Good to Excellent for wind power production by the MNR (2005). Average wind speed is about 7.5 to 9 m/s.

In order for a wind plant to effectively generate electricity it is critical that the wind turbine generators are located in windy locations. The strong winds that blow across the Port Alma area provide excellent potential for wind power generation and makes this area particularly suitable for the installation of the proposed 101.2 MW wind plant.

As required under federal and provincial environmental assessment (“EA”) legislation, Stantec Consulting Ltd. (“Stantec”) undertook a background review and autumn bat surveys to assess the presence and abundance of bats within the study area. These surveys were carried out to help establish the environmental baseline conditions that exist prior to Project implementation.

### **1.2 BACKGROUND**

Four recent studies of direct mortality as a result of wind turbine facilities in the eastern United States’ Appalachian Mountains have found large numbers of bats killed by turbines. Mortality rates in 2005 were 23 bats/turbine in Pennsylvania and 38 bats/turbine in West Virginia, during the six week peak activity period for bats [United States Government Accountability Office (“GAO”), 2005]. However, a review of 14 additional studies, conducted outside Appalachia, resulted in annual mortality rates ranging from 0 to 4.3 bats/turbines. Experts agreed that this research has not shown “alarming” numbers of bat kills (GAO, 2005). Habitat, and specifically forested ridges such as those present at the Appalachian facilities, appear to be an important factor in mortality risk (Arnett et al., 2005).

Where studies have been conducted, most of the fatalities have taken place during the bat migratory season (GAO, 2005). Bat activity tends to be greatest in the two hours following sunset (Arnett et al., 2005), and activity level is highly variable from night to night (Horn et al., 2004).

However, given the limited nature of existing nighttime avian and bat data, Natural Resources Canada, along with four independent wind companies, supported a research initiative with EchoTrack Inc. (2005) to study nighttime bird and bat activity during the autumn of 2004 at six wind plants in Alberta. The study also included evaluations at six control sites that were similar in topography and land-use to the plant sites, but without turbines. Using radar and sound recording technology the study identified and tracked the movement of birds and bats at these sites, identifying some individuals to species.

Three nights of monitoring were undertaken at each of the twelve sites, yielding more than one million identified flight tracks. The recorded high was nearly 375,000 at the most active site, and just under 15,000 tracks at the least active site. The most frequent flight times were between one and two hours after dusk, gradually tapering off through the remainder of the night. A second peak of activity was observed at dawn at some, but not all, of the sites. Bats were noted during the radar and sound monitoring mainly near ridges, especially near treed areas or buildings that would provide roosting and foraging habitat for the animals.

The research showed that most of the activity noted during the middle of the night (i.e., four and six hours after dusk) were bats and most of the activity at or just after dusk and again at dawn were birds. The number of birds or bats observed at sites did not differ between those with turbines and those without, but birds were heard to call more frequently at turbine sites compared to sites without turbines.

The nightly pattern indicates that birds and bats may be at greatest risk of colliding with turbines at dusk for two hours, in the middle of the night (four to six hours after dusk), and for the two hours just before dawn. However, for there to be a risk, birds and bats must fly at turbine height (i.e., within the sweep area) and many do not. The research also concluded that reduced visibility had no effect on the altitude of avian flight.

Over the study a total of 49 collisions with the turbines were considered to have occurred, representing 0.02% of the total flights recorded. Of the 49 collisions, 45 were deduced to be bats and the most common casualty was the little brown bat, while others included the northern long-eared bat, hoary bat, and silver-haired bat. The collisions occurred an hour after dusk, six hours after dusk, and at dawn.

A significant finding of this research was the observation that birds and bats appear to detect wind farms at night and take action to avoid the wind turbines, resulting in a low (0.02%) collision rate relative to the number of flight tracks. The radar studies showed many birds and bats increased their flight height and slowed their flight speed when they approached the wind turbines. Since no such behaviour was observed at the control sites, the research suggests that it was the presence of the turbines that led to this behaviour. By increasing altitude and flying well above the turbine blades, birds and bats avoided the wind turbines and effectively reduced the risk of collision.

## 2.0 Methods

### 2.1 BACKGROUND DATA REVIEW

Very little is known regarding the pathways and behaviour of migratory bats (GAO, 2005; B. Fenton, York University, pers. comm. to C. Grooms, 2002), although the EchoTrack study (2005) has certainly provided invaluable information in this regard. Table 2.1 lists the eight species of bats likely to occur in southern Ontario, along with their population status, call information, and migratory behaviour and timing (van Zyll de Jong, 1985).

**Table 2.1 Bat Species of Southern Ontario**

COMMON NAME	SCIENTIFIC NAME	ONTARIO STATUS	GLOBAL STATUS	HIGHEST FREQ (kHz)	LOWEST FREQ (kHz)	MAXIMUM SEARCH CALL DURATION (ms)	WINTERING TIMING
Small-footed Bat	<i>Myotis leibii</i>	S2S3	G3	55	41	5	hibernates late Nov
Little Brown Bat	<i>Myotis lucifugus</i>	S5	G5	78	38	5	hibernates late Sep
Northern Long-eared Bat	<i>Myotis septentrionalis</i>	S3?	G4	110	38	3	hibernates
Silver-haired Bat	<i>Lasionycteris noctivagans</i>	S4	G5	50	25		migrates mid-Aug - early Oct
Eastern Pipistrelle	<i>Pipistrellus subflavus</i>	S3?	G5	73	45	2,3	hibernates late Aug - Oct
Red Bat	<i>Lasiurus borealis</i>	S4	G5	97	40	3	migrates Oct
Big Brown Bat	<i>Eptesicus fuscus</i>	S5	G5	48	27	10	hibernates
Hoary Bat	<i>Lasiurus cinereus</i>	S4	G5	39	26	15	migrates mid-Aug - Oct

None of the species are designated by the Committee on the Status of Wildlife in Canada (“COSEWIC”) or the Committee on the Status of Species at Risk in Ontario (“COSSARO”). One species, the small-footed bat, is considered very rare to uncommon in Ontario (S2S3), and two species, northern long-eared bat and eastern pipistrelle, are uncommon, although there is some uncertainty as to their ranks (S3?). Three species, the silver-haired, red, and hoary bats are migratory, moving south during the winter. Other species, specifically the small-footed bat, northern long-eared bat and eastern pipistrelle, make shorter migrations to hibernacula (caves or mines) where they hibernate. The big brown bat and small brown bat will use caves or mines, but will also hibernate in local buildings without making a migration.

Autumn migration periods for these species in Canada are generally from mid- to late August through October (van Zyll de Jong, 1985). Additional information on these bats is provided in Attachment 1.

## 2.2 BAT SURVEY

Bat surveys were conducted throughout the study area in 2006 on September 6, 11, 18 and 25; October 2 and 23; and November 6. The purpose of the surveys was to assess the presence, species, and abundance of bats within the study area, and in particular, the study area. Surveys conducted at this time of year were intended to capture both resident and migrant bats.

Areas of potential bat feeding habitat were identified during a daylight survey on September 6. Features such as woodlots and wetlands were marked on the map and given a station number. A total of 10 stations were identified in areas close to the lakeshore, since this is where the turbine locations are proposed (**Appendix C, Figure C-12**). A description of the habitat components at each survey station were recorded. The evening surveys began at dusk and concluded before midnight.

The survey consisted of driving to the station and standing at the roadside, near the identified habitat, with a Pettersson Elektronik AB D200 ultra-sonic detector. For a period of ten minutes, all frequencies were scanned by slowly rolling up and then down the scale on the device (between ~10 and 115 kHz). If a bat was detected, the range of frequencies they emitted was recorded in order to help determine species. With this equipment, if a bat flew overhead quickly it was not possible to determine the upper and lower limits of the frequencies emitted by that bat. Therefore, only a single frequency, or small range could be recorded. When this occurred, the frequency recorded for that event was written as, for example, -20-40+ kHz to indicate that the entire range was not captured. Further, this device may have up to a +/- 10 kHz margin of error.

During the final survey (November 6) an AnaBat SD1 CF bat detector was used for a period of 10 minutes at each station. This device automatically records the full range of frequencies emitted by a bat as it forages nearby or passes overhead, which can be downloaded to a computer and visually interpreted.

For bats that were visually observed in the field, size and flight pattern were also used to distinguish species.

## 3.0 Results

### 3.1 HABITAT

A summary of the vegetation can be found in **Appendix C, Figure C-4**. The vegetation communities of the study area have been significantly altered by anthropogenic activities, predominantly clearing and draining of land for agricultural purposes. Many of the fields were in crops such as hay or winter wheat, with some areas of pasture and abandoned farmland. Scattered woodlots contained mature trees or large snags that may provide limited roosting or hibernating habitat, however, more habitat potential for resident bats is likely present in old barns, abandoned houses, and attics of older farmhouses. Cliff habitat is present along the Lake Erie shoreline, but the exposed nature of that habitat limits its utility for hibernating bats. No cave habitat is known to occur in the study area. The habitat components at each survey station are summarized in Table 3.1.

**Table 3.1 Summary of Station Habitat Descriptions**

Station	Habitat Description
1	In a residential area along Highway 3 within 100 metres of the lakeshore. The area contains mowed lawns and mature white ash.
2	In a residential area along Highway 3 within 100 metres of the lakeshore. The area contains mowed lawns and a mix of mature trees.
3	Both residential and agriculture land use were within the vicinity of this station. The agricultural field consisted of soybean bordered by a thicket hedgerow. The residence had mowed lawns and Manitoba maple trees. This station was within 50 metres of the shoreline.
4	Agriculture and residential land use were within the vicinity of this station. The agriculture consisted of harvested wheat. Mature poplars were present. Sampling at this station went right up to the shoreline bluffs.
5	This station was located in a marsh community. Canary reed grass, cattails and common reeds dominated the community. The marsh was sparsely treed.
6	This station was located along a roadside wet drainage ditch in agricultural habitat. A hedgerow was located within the vicinity of the survey station.
7	In a residential area with a fruit orchard. The orchard contained mowed lawns and low pear trees. Mature white ash were located around the residence. Beyond the orchard were soybean fields.
8	This station was located along a cluster of woodlands. The woodlands consisted of mature sugar maple, white ash and basswood. Roadside ditches were wet, containing standing water. Agricultural field of soybean and wheat were located between the woodlots. The sampling station ran the length of the woodland cluster.
9	At the edge of woodland community dominated by mature sugar maple and white ash. The roadside ditches were wet.

**Table 3.1 Summary of Station Habitat Descriptions**

Station	Habitat Description
10	This station was located at a fire pond just outside the village of Merlin. The pond was still and stagnant. It was surrounded by mature black willow and white ash.

## 3.2 BATS

### 3.2.1 September 6

Weather on the evening of September 6 was cool (15°C), with a very light breeze (1-2 Beaufort scale), 0% cloud cover, no precipitation. This survey was conducted between 20:00 and 23:00. Bats were observed at stations 1 and 9, with negative results at all other stations. The results of this survey are provided in Table 3.2.

**Table 3.2 Results from September 6 Survey**

Station	Frequency Range(s)	Other Observations	Probable Species
1	30-88 kHz	Small; circling flight	Little Brown
9	-50+ kHz	Not observed	Indeterminate

### 3.2.2 September 11

Weather on the evening of this survey was again cool (15°C) with a light wind (3 Beaufort scale), 70% cloud cover, and no precipitation. This survey was conducted between 20:00 and 23:00. Bats were encountered at stations 1, 2, 4, 8 and 10, the results of which are provided in Table 3.3.

**Table 3.3 Results from September 11 Survey**

Station	Frequency Range(s)	Other Observations	Probable Species
1	23-41 kHz	Large; circling flight; group of several individuals	Big Brown or Silver-haired
2	24-39 kHz	Large; direct flight; possibly more than one individual	Big Brown or Silver-haired
4	30-60+ kHz	Short burst of clicks as bat flew overhead	Little Brown
8	23-40 kHz	Not Observed	Big Brown, Hoary or Silver-haired
10	35-100 kHz	One individual	Red

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**3.2.3 September 18**

The evening of September 18 was cool (15°C) with no wind, 100% cloud cover, and a very light rain. This survey was conducted between 20:10 and 23:00. Bats were only observed at station 1 (see Table 3.4).

**Table 3.4 Results from September 18 Survey**

Station	Frequency Range(s)	Other Observations	Probable Species
1	-30+ kHz	Not observed	Indeterminate

**3.2.4 September 25**

This survey was performed under cool conditions (13°C) with a moderate wind (3-4 Beaufort Scale), 95% cloud cover and no precipitation. This survey was conducted between 19:50 and 22:45. Bats were observed at all stations, except 6 and 7. The results of the survey are presented below.

**Table 3.5 Results from September 25 Survey**

Station	Frequency Range(s)	Other Observations	Probable Species
1	25-35+ kHz	Mid-sized; circling flight	Big Brown or Silver-haired
2	25-35+ kHz	Circling flight	Big Brown, Hoary or Silver-haired
3	25-35+ kHz	Circling flight	Big Brown, Hoary or Silver-haired
4	25-45 kHz	Not observed	Big Brown
5	35-35+ kHz	Not observed	Big Brown, Hoary or Silver-haired
8	25-35+ kHz	More than one individual	Big Brown
9	25-35+ kHz	Not observed	Big Brown, Hoary or Silver-haired
10	30-110 kHz	Strong, direct flight	Red or Northern Long-eared

**3.2.5 October 2**

Weather conditions during this survey were cool (13°C) with a very light breeze (1 Beaufort Scale), 20% cloud cover and no precipitation. This survey was conducted between 19:40 and 22:45. Bats were observed at station 1, 2, 3, 8, 9 and 10, the results of which are presented below.

**Table 3.6 Results from October 2 Survey**

Station	Frequency Range(s)	Other Observations	Probable Species
1	25-35+ kHz	Mid-sized; circling flight	Big Brown or Silver-haired
2	25-40 kHz	Not observed	Big Brown
3	25-42 kHz	Not observed	Big Brown
8	25-40 kHz	Not observed	Big Brown
9	25-30+ kHz	Not observed	Big Brown, Hoary or Silver-haired
10	25-35+ kHz 40-95 kHz	Not observed	Big Brown, Hoary or Silver-haired Red

### 3.2.6 October 23

Air temperature during this survey was cold (3°C). There was a moderate breeze (3 Beaufort Scale), 100% cloud cover and no precipitation. This survey was performed between 19:30 and 22:30. No bats were recorded at any of the stations.

### 3.2.7 November 6

Weather during this survey was cool (10°C) with no to light wind (0-1 Beaufort Scale), 20-80% cloud cover, and no precipitation. The survey was conducted between 18:30 and 22:00. Stations 2, 3 and 8 had bat activity. The AnaBat SD1 CF bat detector was used during this survey. With this device, a vastly greater number of events were recorded when compared to the Pettersson Elektronik AB D200. Given the volume of events recorded (up to 35 at station 8), a general description of the findings will be presented for this survey date.

At station 2, the AnaBat device recorded 2 events. From the data collected, two species were clearly evident at this station and included the big brown and small-footed bat.

Six events were recorded at station 3, and included little brown and silver-haired bats. Three of the events recorded were inconclusive, and could have been related to background noise.

Station 4 had five events; four of which corresponded to the eastern pipistrelle and/or small-footed bat. The fifth event was inconclusive.

Station 8 contained 35 events, nearly all of which corresponded to the eastern pipistrelle and/or the small-footed bat. One event was clearly a little brown bat, and several events were inconclusive.

## 4.0 Analysis of Significance

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Although very little is known about bat populations and distribution, particularly through the migration period, studies at existing wind turbine facilities show that mortality is relatively low in the absence of forested ridges and outside of Appalachia. However, geographic features, such as the Lake Erie shoreline, may concentrate migratory species of bats during the fall.

A review of mortality studies conducted by Arnett (2005) determined a bias towards mortality of migratory, tree-roosting species such as the eastern red, hoary, and silver-haired bats (relative to the sedentary big brown bat and bats that migrate to local hibernacula including small-footed, little brown, and northern long-eared bats and eastern pipistrelle). An analysis of bat foraging and migratory behaviour in Ontario (Attachment 1) indicated that eastern red, hoary, silver-haired and big brown bats may be at higher risk of collision than other bat species.

An infrared study of flight patterns and avoidance behaviour indicated that bats often fly through the sweep zone of turbines and can avoid moving blades. The ratio of avoidance to contact is high (Horn et al., 2004), which means that collisions are rare compared to the number of bats present (EchoTrack Inc., 2005). However, bat longevity is relatively high and reproduction rates are relatively low compared to birds, and as a result bat populations may be more vulnerable to effects (GAO, 2005).

During the 2006 bat surveys, a similar number of observations were made both at stations along the lakeshore and more inland. This would indicate no clear correlation between bat movement and the vicinity of the lake. Although few of the bat observations were concluded to be migrants, it is possible that migrants were moving above the range of the bat detectors.

Bats in the group of big brown / hoary / silver-haired bat were most frequently observed throughout the study. It was generally not possible to determine to species based on the frequency range. However, occasionally visual observations and proximity to buildings suggested the big brown bat. Most of the observations were of circling bats, likely feeding individuals. Based on the presence of the non-migratory big brown bats and the constant feeding behavior of individuals within the group, most were likely resident bats.

A red bat was consistent observed at station 10. This individual was likely a resident at a favourite feeding location, holding on late before migrating south.

Little brown bats were not commonly observed throughout the study. The individual that were observed may have been passing through to hibernacula, but were likely resident bats.

Eastern pipistrelle and small-footed bats were observed on the last survey only. Small-footed bats in particular, are known to move towards hibernacula late in the fall. Although they appeared to be feeding, these bats were likely stopping over on their migration to hibernacula. Most of these observations could be attributed to the small-footed bat, based on the time of year.

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## **5.0 Conclusion**

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The study area offers some bat roosting habitat in the form of woodlots and buildings, and may provide foraging habitat for migratory species. Further, the shore of Lake Erie may be a route for migrating bats, as it is with some other migratory groups. A consistent number of bats were recorded during early surveys with the Pettersson device, while a larger number were recorded with the AnaBat device.

However, there is very little, if any, evidence of links between pre-construction bat assessments and post-construction mortality results (Arnett, 2005). Bats are thought to have a very low collision rate relative to the number of individuals present (EchoTrack, 2005). A rigorous post-construction monitoring program is recommended to allow assessment of risk using these Ontario data. Furthermore, opportunities for additional baseline monitoring in 2007 should be examined.

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# **Attachment 1**

## **Background Information on Bat Species**

## Attachment 1

### Background Information on Bat Species

#### *Small-Footed Bat*

Relatively little is known of the biology of the Small-footed Bat. It appears to be relatively uncommon, as it is very infrequently encountered compared with other Ontario bat species. Its distribution in Canada is restricted to Ontario, where it occurs from the southern boundary of the province, north to a line approximately from Sault Ste. Marie to the North Bay area. Its habitat requirements are poorly known, as there are only a few summer records.

This small bat emerges shortly after dusk. It is a slow and erratic flier and typically flies at heights of 1 to 3 m. There is some evidence that it hibernates close to the summer roost and does not undertake extensive movements (van Zyll de Jong, 1985). Foraging has been observed over water, along lake shorelines, and in forest clearings (A. Sandilands, pers. obs.), but it is possibly that foraging occurs in other habitats as well. The Small-footed Bat may not even occur on Wolfe Island due to its relative rarity and apparent scattered distribution. The Natural Heritage Information Centre ("NHIC") distribution map for this species shows no records from the Island, but there are some records from the Kingston mainland. Even if it is present, it has a very low probability of mortality due to a wind farm since it has a low flight habit and very slow flight that would allow it to detect blades.

#### *Little Brown Bat*

The Little Brown Bat is a habitat generalist, living anywhere that trees and water are found. Its range includes all of southern Ontario north to the southern limit of the Hudson Bay Lowland. It is most common in open habitats such as agricultural landscapes, but also occurs in forested regions where it is most frequent in woodland clearings, over water, over beaver ponds, and other openings. The Little Brown Bat roosts in natural cavities, in trees, in crevices, under bark, in buildings in attics, and under shutters and other cover.

This bat emerges late at dusk and forages most actively in the first two or three hours after dark. After the initial foraging it typically returns to the night roost, but may emerge for a later, second foraging period. Little Brown Bats prefer to forage low over water, but they also hunt among trees at heights of 3 to 6 m. Hunting also occurs over streets and lawns in suburban and urban areas (van Zyll de Jong, 1985).

Due to its habit of hunting at very low altitudes the Little Brown Bat should be at relatively low risk of mortality from collisions with wind turbines. EchoTrack Inc. (2005), however, found the Little Brown Bat to be the most common bat killed by turbines, even though this study found that relatively few were killed (<0.02%). The highest numbers / concentrations of these bats are most likely to occur near old houses or farm buildings where large roosts may contain in the order of 200 to 300 bats.

#### *Northern Long-Eared Bat*

The Northern Long-eared Bat is closely associated with extensive forests, in particular the boreal forest. In Ontario, it ranges from the southern provincial boundary north to Moosonee and west to the Manitoba border. Little is known of its biology, other than its preference for treed habitat. Emergence occurs shortly after sunset and initial foraging occurs 1 or 2 hours after sunset and a secondary hunting period 7 to 8 hours after sunset. Hunting occurs over small woodland pools and streams, along roads and clearings within and under the forest canopy, often down to the shrub layer 1 to 3 m from the ground (van Zyll de Jong, 1985).

The Northern Long-eared Bat is considered to be at low risk of mortality from wind turbines on Wolfe Island. This species is likely absent from the Island due to its preference for extensively forested areas, and it is at low risk of mortality due to its habit of hunting primarily under the forest canopy. The NHIC map for this species shows no records from Wolfe Island, but several from the Kingston mainland.

#### *Silver-Haired Bat*

The Silver-haired Bat is found in forested areas or in small stands within open habitat, preferably near ponds or streams. It has a wide range in Ontario, from the southern boundary of the province north to Moosonee and northwest to the Manitoba border. It typically roosts in cavities, in trees, behind loose bark, or in woodpecker holes. It emerges at, or even slightly before, dusk and in Iowa and Montana exhibited a major feeding peak three hours after sunset and a minor peak seven to eight hours after sunset. In Manitoba this bat was active all night long.

Foraging occurs at a variety of heights, from just above the ground to above treetops, but usually over small bodies of water in forested habitat. During migration the Silver-haired Bat may be found in a wide variety of habitats. It is a solitary species typically occurring singly or in small groups of three or four. Autumn migration is from mid-August until early October and there may be major return flights in late May and June, with spring migration spanning from late April until summer (van Zyll de Jong, 1985). The migration pattern of the Silver-haired Bat has the potential to put it in contact with turbine blades.

#### *Eastern Pipistrelle Bat*

The Eastern Pipistrelle inhabits open areas with scattered trees and edges of woodlands. In Canada, it is restricted to Ontario, where it occurs south of a line from approximately Sarnia to Ottawa. The NHIC map for this species shows that most records are in eastern Ontario from the Peterborough and Kingston areas east to the Ottawa area. It appears to roost predominantly in the foliage of trees.

The pipistrelle emerges at sunset. It forages intermittently until about midnight and has another foraging period around dawn. It forages slowly and erratically back and forth over small areas near trees or water. The pipistrelle usually forages alone, although small groups of four or five have been reported (van Zyll de Jong, 1985).

The potential vulnerability of this species to mortality at a wind farm on Wolfe Island is uncertain, as no information is available about its typical foraging height or movement patterns. Although it has not specifically been recorded on the Island, the habitat is generally suitable and the Island is within its range.

#### *Red Bat*

The Red Bat is another habitat generalist that occurs widely in forested areas, but also in agricultural landscapes and even where there are only scattered shade trees. This species is common in Ontario and ranges from the extreme south, north to Moosonee, and northwest to the Manitoba border. It roosts almost exclusively in the foliage of trees, typically 1 to 6 m from ground. Although it typically emerges about half an hour after sunset, individuals may occasionally fly during late afternoon or even broad daylight, especially in spring.

Summer foraging activity peaks two or three hours after sunset with a lesser peak five or six hours after sunset. This species flies fast and often patrols the same area over and over. Flight may be high during the early foraging bout, when it often forages over treetop level, hunting over forests and streams. Later at night this bat descends and forage between the ground and treetop. Groups of 20 to 30 individuals may forage together.

Autumn migration begins in late August and continues through September into October, with 27 October usually being the latest Ontario date. Most spring migrants arrive in May, although there are records as early as 11 March (van Zyll de Jong, 1985). The Red Bat may be vulnerable to mortality at wind farms throughout its range due to a number of factors: it is a common species during summer and migration, it hunts at levels that could potentially bring it in contact with turbine blades, and it often occurs in groups.

### *Big Brown Bat*

The Big Brown Bat is a very common habitat generalist in Ontario, however, it is generally restricted to the Deciduous Forest and Great Lakes-St. Lawrence Forest Regions. It occurs in forested habitats, agricultural areas, and may be common in urban areas. In agricultural and urban landscapes, it is strongly associated with buildings. Roosts are in buildings, tree cavities, and crevices in rocks.

The Big Brown Bat emerges at twilight and forages briefly within five hours of dusk, after which it retires to the night roost. Most fill their stomachs within a few minutes and then retire. There may also be a short feeding period just before dawn (A. Sandilands, pers. obs.). The flight is fast and direct and usually at heights of 7 to 10 m, but often higher. It frequently forages above woodland canopy.

Most Big Brown Bats hibernate near the summer roosting areas, but some have been known to travel as far as 200 km to hibernate (van Zyll de Jong, 1985). This species may also be vulnerable to mortality at wind farms as it may be locally abundant around buildings and it forages at heights that could potentially bring it into contact with wind turbine blades.

### *Hoary Bat*

The Hoary Bat is usually associated with forest habitat, but also occurs in agricultural areas with scattered trees and has been found roosting in orchards. It has a wide distribution in Ontario, from the south, north to Moosonee, and west to Manitoba. Most roosts are in tree foliage 3 to 12 m from the ground, and near the end of branches. Occasionally, it roosts in woodpecker holes.

It emerges late, usually after it is very dark, and may be active all night. The flight of this large bat is rapid, direct, and high, usually 7 to 15 m from the ground, but often higher. During the summer, this species is usually found alone or in small family groups, but individuals may congregate during migration. Autumn migration spans from mid-August until October, with the peak probably in the first half of September. Little information is available on the timing of spring migration, but it is probably in May and June (van Zyll de Jong, 1985). Due to its flight habits and the fact that it may be relatively common during migration, the Hoary Bat may also be vulnerable to mortality at wind farms.