Appendix C

Bird Report & Acadia Radar Study

Appendix C1

Bird Report

APPENDIX C1
BIRD REPORT
OSTRANDER POINT WIND ENERGY PARK

DRAFT

File No.160960369

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1.0 Introduction

1.1 PROJECT OVERVIEW

Gilead Power Corporation is proposing a 20MW wind power facility in southeastern Prince Edward County. The Ostrander Point Wind Energy Park will consist of twelve 1.65 MW turbines located on Crown land along the Lake Ontario shoreline (**Figure 1, Attachment A**).

As part of the Ontario Ministry of the Environment's ("MOE") Environmental Screening Process ("ESP") for electricity projects (i.e., Ontario Regulation 116/01), Stantec Consulting Ltd. ("Stantec") undertook avian studies in the April, May and June, 2008. Stantec's avian studies were completed in conjunction with a radar study completed by Acadia University which is discussed in **Appendix C2**.

1.2 BACKGROUND

1.2.1 Wind Facilities and Birds

Observed effects of wind plants on birds are either:

- direct, as in the case of mortality arising from collisions with wind turbines
- indirect, as in the case of habitat alteration and fragmentation for turbine pads and access roads, or disturbance of habitat through changes in existing activity levels or land-use.

The actual avian mortality depends on a number of site-specific factors, including bird densities and the types of species and habitats present, as well as design features that may either individually, or in combination with each other, influence avian mortality rates. These factors include:

- topography
- scale of the facility
- tower dimension and design
- turbine lighting
- blade speed
- transmission line design and location
- facility configuration.

A large number of studies have been undertaken to address concerns related to avian mortality. Although these studies used varied approaches to accounting for sources of bias, the findings indicate that overall, bird deaths due to wind turbines are low, especially when compared to other anthropogenic structures (Arnett et al., 2007; Kingsley and Whittam, 2007; National Academy of Sciences, 2007). In a review of avian fatality rates from 14 facilities across North

America with modern turbines, where recent standardized mortality monitoring was conducted using a systematic survey process for a minimum of one year and incorporating scavenging and searcher efficiency bias corrections, Arnett et al. (2007) indicated annual mortality rates ranged from 0.63 to 7.7 birds per turbine. The National Audubon Society also believes that bird mortality as a result of wind turbines is a very small fraction of all anthropogenically-induced mortality, and is much less than mortality as a result of other means of electricity generation that contribute to global warming (Levesque, 2006).

An Ontario study of the Canadian National Exhibition turbine in Toronto, proximal to the waterfront, determined that total annual mortality was unlikely to exceed three birds (corrected for predator removal) (James and Coady, 2003). This study concluded that local birds appeared to have adapted to the presence of the turbine and avoided it, and that the mortality rate at the turbine was “absolutely insignificant” when compared to mortality from other causes.

The magnitude of indirect effects varies according to the habitat type and bird species. Little quantitative information exists regarding bird disturbance or avoidance during the winter, during the breeding season or during migration due to wind turbines. In one Minnesota study designed to determine the relative influence of wind turbines on overall densities of upland nesting birds, Leddy et al. (1999) noted that grassland birds nested in lower densities within 80 m of wind turbines. However Kingsley and Whittam (2007) noted that some grassland bird species, including Horned Larks, continued to forage underneath turbines.

1.2.2 Birds in the Study Area

The Prince Edward County South Shore Important Bird Area (IBA) encompasses the southeastern peninsula of Prince Edward County, including the Study Area (**Figure 2**, **Attachment A**) (IBA Canada, undated; Wilson and Cheskey, 2001). The goal of the IBA program is to identify and conserve a worldwide network of site necessary to ensure the long-term viability of naturally occurring bird populations. BirdLife International, in cooperation with Bird Studies Canada and Nature Canada, identifies IBAs. The Prince Edward County South Shore IBA is also referred to as the Prince Edward Point IBA (IBA Canada, undated) and is reported variously to encompass approximately 91 km^2 (26 km^2 of land and 65 km^2 of nearshore waters; Wilson and Cheskey, 2001) or 371 km^2 (IBA Canada, undated). For the purposes of this report, it will be referred to as the Prince Edward County South Shore IBA. The Prince Edward Point Bird Observatory and National Wildlife Area are located within the IBA at the tip of the Prince Edward Point peninsula, and the Point Petre Provincial Wildlife Area is located at the western end of the IBA (**Figure 2, Attachment A**).

There were several factors contributing to the IBA designation (IBA Canada, undated, **Attachment C**). It has been designated as globally significant under the congregatory species category for wintering waterfowl, migratory raptors, and migratory landbirds (Wilson and Cheskey, 2001). The off-shore portions of the IBA support globally significant concentrations of waterfowl and nationally significant concentrations of waterbirds and seabirds. The IBA summary (**Attachment C**) notes that the most important waterfowl staging and wintering areas

for Greater Scaup, Long-tailed Ducks and White-winged Scoter are the shoals and deep waters off the tip of the Prince Edward Point peninsula. The IBA is a globally significant concentration area for landbirds during both the spring and fall migration periods. Species such as Tree Swallow, Blue Jay, Black-capped Chickadee, Golden-crowned Kinglet, Ruby-crowned Kinglet, Yellow-rumped Warbler, Dark-eyed Junco and White-throated Sparrow can be observed in large numbers within the IBA during migration.

During the fall migration, large numbers of raptors move up the point including Sharp-shinned Hawks, Red-shouldered Hawks and Red-tailed Hawks. Prince Edward Point has also been recognized as a major concentration area for fall migrating Northern Saw-whet Owls (Wilson and Cheskey, 2001). Weir et al. (1980) hypothesized that most of the Northern Saw-whet Owls arrive at Prince Edward Point via a land route from the mainland moving eastward down the peninsula. They also hypothesized that most owls do not cross Lake Ontario, but instead backtrack westward upon reaching the point. However, the exact route by which Northern Saw-whet Owls arrive and leave Prince Edward Point remains unconfirmed.

Wilson and Cheskey (2001) also indicate that the IBA has been designated for national significance in the threatened species category, however, the IBA summary (**Attachment C**) does not include mention of this designation. The Conservation Plan for the IBA indicates that monitoring is required to confirm breeding or establish numbers for Least Bittern, Black Tern, Loggerhead Shrike and Henslow's Sparrow to determine if the numbers meet IBA criteria; the reported presence of one King Rail apparently meets the criteria for nationally significant (Wilson and Cheskey, 2001). With the exception of Henslow's Sparrow, all of these species were recorded within the IBA during recent breeding bird atlas efforts (Cadman et al., 2007). During the atlas, Least Bittern, Black Tern and King Rail were recorded in the 10 x 10 km square that includes the Ostrander Point Study Area (Cadman et al., 2007).

Habitat within the Study Area consists of shrubland with open woodlands, providing breeding habitat for species indicative of thickets and open woodlands. Habitat for species that require large tracts of grassland or continuous forest is not present. There are no elevated topographical features such as ridges in the study area.

1.2.3 Site Sensitivity and Level of Concern

Environment Canada's "Wind Turbines and Birds: A Guidance Document for Environmental Assessment" (Environment Canada, 2007a) provides guidance for determining site sensitivity from the perspective of bird use.

The Ostrander Point site has a very high site sensitivity, due to its location within the Prince Edward County South Shore IBA, proximity to the Prince Edward Point Bird Observatory and National Wildlife Area, and proximity to the Lake Ontario shoreline (**Figure 2, Attachment A).** There is the potential to fragment a large shrubland.

All sites with very high site sensitivity area ranked as Category 4 projects, regardless of the size of the proposed facility. Projects in this category present a relatively high potential risk to birds, and consequently require the highest level of bird-related effort for the environmental assessment (Environment Canada, 2007a).

Specific bird issues of concern to Environment Canada, identified in March 4 and March 17, 2008 correspondence, include the following:

- Function of Prince Edward Point as an important landfall site for migratory landbirds;
- Potential presence of wintering raptors and grassland birds;
- Potential presence of Species at Risk and Bird Conservation Region (BCR) 13 priority species; and,
- Importance of the site for migratory Saw-whet Owls, fall raptor migration, migratory waterfowl movement.

2.0 Methods

2.1 BACKGROUND DATA REVIEW

The following data sources were reviewed to obtain information regarding birds in the Study Area:

- IBA Site Summary and Conservation Plan (IBA Canada, undated; Wilson and Cheskey, 2001);
- Ministry of Natural Resources and Natural Heritage Information Centre ("NHIC") database
- Atlas of the Breeding Birds of Ontario (Cadman, 2007)
- Breeding Waterfowl Survey Plots 2005-2008 (Canadian Wildlife Service, unpublished)

2.2 FIELD SURVEYS

Given background information, an analysis of bird risk factors and the Category 4 ranking of the Ostrander Point Wind Energy Park, a comprehensive pre-construction monitoring program was conducted. The proposed work program was circulated to Environment Canada and the Ministry of Natural Resources on May 8, 2008 and approved by Environment Canada on June 5, 2008. Bird studies were completed by Jacques Whitford Limited ("Jacques Whitford", unpublished), Acadia University ("Acadia") and Stantec, and included:

- Winter Raptor surveys (Jacques Whitford, February and March, 2008);
- Spring Waterfowl surveys (Stantec, April and May, 2008);
- Spring Passerine monitoring - Radar and area searches (Acadia, May and June, 2008);
- Breeding American Woodcock and Wilson's Snipe surveys (Stantec, April and May, 2008);
- Breeding Bird surveys (Stantec, June, 2008);
- Fall Passerine monitoring – Radar and area searches (Acadia, August - October, 2008)
- Fall Raptor surveys (Jacques Whitford, August - November, 2006)

Survey dates, times and weather conditions are summarized in **Table 2.1**. Methods, results and conclusions from Acadia's spring and fall migration area searches are presented in this report. Detailed methods and findings of the Acadia's radar study area provided in **Appendix C2**. Methods of all surveys were generally consistent with the recommendations of

Environment Canada (2007a, 2007b). Detailed descriptions of each survey are provided in the following sections.

2.2.1 Winter Raptors

Three winter raptor surveys were completed by Jacques Whitford (unpublished) on February 4, 20 and March 4, 2008. As there is no regular winter maintenance on most roads surrounding the study area, walking transects were established on existing roads. The transects provided vantage points of all major habitat types within the Study Area. The starting location for each transect alternated throughout the three surveys so that different areas of the site were covered at different times of the day. During the surveys, particular emphasis was placed on locating and recording raptor species, however all birds observed were recorded. The behavior (i.e. flying or at rest) and the height of observed birds were recorded. Height was recorded at three different regimes, 0-40 m, 40-100 m and over 100 m high (Jacques Whitford, unpublished).

2.2.2 Spring Waterfowl

Six weekly spring waterfowl surveys were completed by Stantec between April 1 and May 7, 2008. Survey dates, times and weather conditions are summarized in **Table 2.1**. The surveys consisted of early morning and dusk counts focused on movement over the Study Area between foraging areas and offshore roosting areas. Daytime surveys were also conducted to count numbers of waterfowl foraging inland, within the Study Area.

During each dawn and dusk survey, two observers were stationed at separate locations with good vantage points, one near the lakeshore at Ostrander Point and the other locally centrally within the Study Area. Movement of waterfowl was mapped and the altitude, direction and flight path were recorded along with the size of the flock. Observations of other flocks (e.g., groups of gulls, crows, or blackbirds), raptors and other species at each point count location were also noted.

During each dawn and dusk survey a spotting scope was used to scan the lake off Ostrander Point. Species and numbers of waterfowl were recorded. As with most waterfowl use data, the data is presented in the form of “waterfowl days”, calculated as in Dennis and Chandler (1974) as cited by Ross (1989). This analysis involves averaging results for each successive pair of surveys, multiplying the results by the number of days separating each pair, and summing over the migration period.

Daytime surveys for inland foraging or staging waterfowl consisted of two experienced surveyors driving internal roads and major roads surrounding the Study Area at slow speeds (i.e. 20-30 km/h). Fields were scanned using binoculars. Information on species, numbers, location and activity for all waterfowl observations was recorded and mapped. Observations of other bird and wildlife species were also recorded.

2.2.3 Spring Migration

Daily spring migrant area searches were completed by Acadia between May 2 and June2, 2008. Early morning area searches were conducted daily starting 0.5 hours after sunrise and continuing for approximately 2 hours. The same route was walked each day and is shown in **Figure 3, Attachment A**. Species and number of birds observed along the route was recorded.

2.2.4 Breeding Birds

2.2.4.1 Point Counts

Two rounds of surveys for breeding birds were conducted by Stantec, on June 11, 12, 25 and 26, 2008. Surveys were comprised of point counts and were augmented by area searches through the Study Area. Surveys began at, or within, half an hour of sunrise and were completed by 10:00 a.m. Weather conditions (i.e., precipitation and visibility) were within the parameters required by monitoring programs such as Environment Canada's Breeding Bird Survey or the Ontario Forest Bird Monitoring Program, and are provided in **Table 2.1** (**Attachment B**).

Environment Canada's recommended protocols (2007b) suggest that 20 point counts in each habitat type would normally be required for projects of more than 10 turbines. However, the guidelines also note that the number of sampling stations may be reduced if, as in the case with the Ostrander Point Study Area, there is insufficient space to place this number once minimum spacing requirements are taken into account (**Figure 3, Attachment A**). A total of 19 point counts were conducted, and were distributed throughout the Study Area to characterize the relative abundance of species breeding on site (**Figure 3, Attachment A**). Habitat within the Study Area was relatively uniform with the majority (14) of point counts conducted in shrublands. However, to ensure coverage of each type of habitat, three point counts were placed in the best examples of open woodland habitat and two point counts in the best examples of wetland habitat (one in swamp and one in marsh).

Point counts were conducted in compliance with Environment Canada's "Recommended Protocols for Monitoring Impacts on Wind Turbines on Birds" (Environment Canada, 2007b). Ten minute point counts were conducted at each station. Bird observations were recorded at four distance regimes, within a 50 m radius, 50 to 100 m, outside the 100 m radius, or flyovers. For each point count, a record was made of the start time and a hand held GPS unit was used to georeference its location. A brief description of the habitat was made for each point count.

The heights of birds within the 100 m radius were recorded. Four height regimes were used, on ground or below blade sweep (0 to 35 m), at blade sweep (35 to 125 m), above blade sweep (125 to 150 m), and well above blade sweep (over 150 m).

To standardize the data, densities per 10 ha were calculated for each point count.

2.2.4.2 American Woodcock and Wilson's Snipe

Four weekly singing-ground surveys for American Woodcock and Wilson's Snipe were conducted between mid-April to mid-May, and were conducted according to the North American Woodcock Singing Ground Survey guidelines (Kelley et al, 2007). Survey dates, times and weather conditions are summarized in **Table 2.1**. Surveys were comprised of two minute point counts at 16 monitoring stations. Monitoring stations were spaced at intervals of approximately 400 m. Birds that were visually observed or heard were recorded as either within 100 m or farther than 100 m from the observer. For birds that could be visually observed, their height was recorded. Surveys began at or just after sunset to ensure the peak activity period for calling woodcock was captured. The locations of stations are shown on **Figure 3, Attachment A**.

For each point count, a record was made of the start time and a hand held GPS unit was used to georeference its location. A brief description of the habitat was made for each point count.

To standardize the data with other breeding bird results, densities per 10 ha were calculated for each point count. The average density for each species also calculated.

2.2.4.3 Breeding Henslow's Sparrow Surveys

Historical records of breeding Henslow's Sparrow have been made in the vicinity of the study area, within the Prince Edward County South Shore IBA. Playback surveys, which target Henslow's Sparrow, were conducted on June 10 and 24, 2008 to determine its presence within the Study Area. Prior to conducting the Henslow's Sparrow breeding surveys, a field investigation was undertaken to identify areas within the study area that may provide suitable breeding habitat for Henslow's Sparrow.

The Henslow's Sparrow is a species of open habitats, consisting of weedy fields and meadows, preferably moist, with a mixture of grasses, forbs and scattered shrubs (Herkert et al., 2002). Factors that affect the quality of breeding habitat for Henslow's Sparrows include litter density and depth, standing dead residual vegetation, forb and woody-stem densities and size. In general, the species prefers large areas of tall, dense grass with a well-developed litter layer and standing dead forb vegetation for singing perches. Sparse to no woody vegetation is important. They have also been known to have a preference for flatter portions of fields. Henslow's Sparrows are area sensitive, generally requiring 50 ha or more of suitable nesting habitat (Herkert, 1991). With the decline of naturally-occurring habitat of Henslow's Sparrows, the species has been known to move into alternative habitats, in particular cultivated hayfields. However, frequently cut hay fields often do not provide the dense litter layer or dead standing forbs that are required by Henslow's Sparrow.

No patches of prime potential habitat were identified. Three relatively open areas of marginally suitable habitat were identified (**Figure 3, Attachment A**). Four playback stations were established, two in the larger patch and one in each of the smaller patches.

Henslow's Sparrow sings throughout the day, with higher activity levels before dawn and after dusk. Singing after dusk appears to be particularly active and occasionally individuals may sing all night long (Herkert et al., 2002). Therefore, surveys were conducted after dusk to take advantage of this period of increased activity. The Henslow's Sparrow breeding surveys employed tape playback recording to help detect the sparrows. A Henslow's Sparrow song was broadcast from a MP3 recording, followed by a period of silence to listen for a response. This was repeated several times at each station for a six-minute period. Two rounds of Henslow's Sparrow surveys were conducted in June.

2.2.5 Fall Migration

Daily fall migrant surveys were conducted by Acadia between August 12 and October 28, 2008. The study was conducted using the same methodology as the spring migrant study. Early morning area searches were conducted daily starting 0.5 hours after sunrise and continuing for approximately 1 hour. The same route was walked each day (**Figure 3, Attachment A**). Species and number of birds observed along the route were recorded. Acadia planned to collect diurnal radar data on days where significant raptor migration was observed in the field, however, only one day with significant raptor movement was identified.

A fall raptor study was completed by Jacques Whitford (unpublished) on 12 days between the end of August and the end of November, 2006. Survey dates, times and weather conditions are summarized in **Table 2.1**. The surveys consisted of a single point count (**Figure 3, Attachment A**) starting approximately 11:00 am and running for 1 to 3 hours. A skilled observer recorded observations of diurnal migrants with particular emphasis on raptor migration. The direction, height and behavior of all raptors were recorded. Height was recorded at three different regimes, 0-40 m, 40-100 m and over 100 m high (Jacques Whitford, unpublished).

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3.0 Results

3.1 HABITAT

A description of the designated features and vegetation types in the Study Area is provided in **Appendix A** of the ERR (Environmental Setting). The majority of the Study Area is comprised of shrubland habitat; generally scattered juniper (*Juniperus communis*) shrubs or occasionally denser stands of juniper over a ground cover of grasses. Scattered bur oak (*Quercus macrocarpa*), shagbark hickory (*Carya ovata* var. *ovata*) and red ash (*Fraxinus pennsylvanica*) occur throughout the study area. Bur oak and red ash become denser in some wetter areas creating open woodland habitat (approx. 30% tree cover). The open woodlands were typically associated with thickets of dogwoods (*Cornus* sp.), American prickly-ash (*Zanthoxylum americanum*) and ninebark (*Physocarpus opulifolius*).

In a few areas, where shrub cover was much reduced, open grassland habitat occurs. Grassland habitat was comprised of shorter grasses such as Canada bluegrass (*Poa compressa*), poverty oat grass (*Danthonia spicata*) and tufted hairgrass (*Deschampsia cespitosa* ssp. *cespitosa*).

Two permanent wetlands, where surface water persists year round, occurred within the Study Area (**Appendix A** of the ERR [Environmental Setting]). A red ash swamp occurred along the eastern boundary of the Study Area. The canopy was relatively open with patches of dense thicket understorey. The second permanent wetland consists of an open marsh located along the shoreline. The open marsh was comprised mostly of broad-leaved sedges, with patches of open water.

3.2 WINTER RAPTORS

No raptors were observed during the three winter raptor surveys. However, 16 other bird species were observed (**Table 3.1, Attachment B**). Six species of waterfowl and 2 gull species were observed in/over Lake Ontario. Long-tailed Ducks were the most common waterfowl species with a maximum number of 350 observed on February 4, 2008. Other waterfowl and gulls observed, with maximum number in parentheses, include Redhead (53), Greater Scaup (55), Bufflehead (31), Common Goldeneye (135), Tundra Swan (2), Ring-billed Gull (1), Herring Gull (1) and unknown gull species (2).

The most common species observed on land, within the study area, was the Bohemian Waxwing, with a one day maximum of 395 observed on March 4, 2008. Other species observed in relatively high numbers included, with maximum numbers observed in parentheses, European Starling (20), Black-capped Chickadee (14) and Pine Grosbeak (4).

With one exception, all birds were observed below the height of turbine blade sweep. One large flock of 125 Bohemian Waxwings (31% of total Bohemian Waxwing observations) was observed at a height of 40-100 m, within the turbine blade sweep area.

3.3 SPRING WATERFOWL

Results of the six daytime driving surveys indicated the presence of very few, if any, foraging waterfowl within and adjacent to the Study Area. Survey totals ranged from no waterfowl to a single pair of either Canada Geese or Mallards. The pair of Canada Geese, observed May 6, 2008 in the deciduous swamp along Ostrander Point Road, and the pair of Mallards, observed from April 16 to May 6, 2008 on flooded roadways, were likely breeders. Overall it appears that the thickets and grasslands of the Study Area did not provide attractive foraging habitat for staging waterfowl.

Similarly, few waterfowl were observed during the dawn and dusk movement surveys.,The results of these survyes are summarized in **Tables 3.2 and 3.3, Attachment B**. A total of 48 waterfowl was observed during the 6 dawn surveys, and a total of 17 waterfowl during the 6 dusk surveys. All waterfowl observed flying over the Study Area were either Canada Geese or large dabblers. Common Loon, Double-crested Cormorant and Sandhill Crane were also observed. No distinct routes or flight paths of waterfowl movement were identified, possible due to the very small number of waterfowl observed. Approximately 58% of the waterfowl observed flying over the Study Area were observed at turbine blade sweep height; the remainder were observed below turbine blade sweep height (**Tables 3.2 and 3.3, Attachment B)**.

The waterfowl observed off Ostrander Point were grouped into seven guilds, which included a total of eleven species. The “Geese” guild consisted of Canada Goose, the “Large Dabbler” guild of American Black Ducks, and the “Bay Duck” guild of Greater Scaup. Long-tailed Duck and White-winged Scooter made up the “Sea Duck” guild. The “Goldeneye” guild was comprised of mostly Common Goldeneye with few Bufflehead. Three merganser species were observed; Red-breasted Mergansers were by far the most common with fewer Common Merganser and Hooded Merganser. A single Common Loon was also observed.

The results were then summarized in “waterfowl day’ values, which represent the number of ducks in each guild multiplied by the number of days they were seen during the survey period. **Table 3.4, Attachment B** summarized the “waterfowl day” values. Common Goldeneye was by far the most abundant species observed off Ostrander Point, with almost 7 times the waterfowl days as the next most common guild, Mergansers. Geese, Bay Ducks and Sea Ducks were relatively common, with few Dabblers observed.

3.4 SPRING MIGRANTS

Attachment D provides a detailed list of species recorded by date during each of Acadia survey. A total of 103 species were observed during the spring migration of 2008. The following sections discuss the most significant species or numbers of individuals that were observed over the 32 survey days.

One species at risk was recorded, the Golden-winged Warbler, which is federally a threatened species and provincially a species of Special Concern. It is discussed further in **Section 3.8.**

Waterbirds

Double-crested Cormorants were abundant with a total of 347 individuals observed, many of which were seen flying over the site. Twenty-two Great Blue Herons were observed during the spring migration field surveys, with up to four observed in one morning. American Bittern, Sandhill Crane and Black-crowned Night Heron were also observed but in much lower numbers: six, four and one individual respectively.

Waterfowl

Waterfowl species observed during Acadia's early morning surveys include Canada Goose, Wood Duck, Mallard, Bufflehead, Common Merganser and Red-breasted Merganser. Results of surveys targeted to spring staging and migrating waterfowl are presented in **Section 3.3**.

Shorebirds

Shorebirds observed during the spring migration field surveys include the Wilson's Snipe and Killdeer. As both these species are early breeders, it is likely that many of the individuals observed were breeding on site. Breeding Wilson's Snipe is discussed further in **Section 3.5.2**.

Raptors and Vultures

Northern Harriers were the most common raptor observed during the spring migration field surveys. In total, 23 Northern Harrier observations were made, typically one to two a day but occasionally as many as 4. A breeding pair of Northern Harriers was observed in the Study Area in 2008 (discussed further in **Section 3.5**). It is likely that many of the individual observations were of the breeding pair. Other raptors and vultures observed on site included Sharp-shinned Hawk, Cooper's Hawk, Red-tailed Hawk, American Kestrel and Turkey Vulture. These species were observed in lower numbers with overall totals of one to seven individuals and no more than two individuals from any species observed in a single day.

Neotropical Migrants

Relatively small numbers of vireos (4 species totaling 25 individuals) and thrushes (3 species totaling 14 individuals) were observed through the spring migration study period. Some species of flycatcher were more abundant, including Alder Flycatcher (81), Willow Flycatcher (24) and Eastern Kingbird (167). In total, sixteen species of warblers were observed in the Study Area. Of these, Yellow Warbler was by far the most abundant, with an overall total of 1413 and as many as 84 in one day. Other relatively common warblers included the Common Yellowthroat (404), Ovenbird (40) and Yellow-rumped Warbler (38). Another common spring migrant was the Rose-breasted Grosbeak (49).

Other birds

Other species that occurred in larger numbers during the spring migration period include Brown-headed Cowbird (688), Cedar Waxwing (556), Blue Jay (382), American Robin (288), American Goldfinch (198), Brown Thrasher (194) and Mourning Dove (111).

Some sparrow species were common as well. The Song Sparrow was particularly abundant with an overall total of 1156 and up to 65 individuals observed in one day. Other sparrow and junco species included (with overall totals in parentheses) Chipping Sparrow (524), Field Sparrow (516), Eastern Towhee (165), Clay-colored Sparrow (157), Savannah Sparrow (125), White-throated Sparrow (81), White-crowned Sparrow (61) and Dark-eyed Junco (1).

3.5 BREEDING BIRDS

Attachment E provides a complete list of breeding bird species observed during Stantec's 2008 field surveys. A total of 56 species were observed during the breeding bird surveys, 48 of which were likely to be breeding within the Study Area.

All of the species identified are ranked S5 (i.e., secure - common and widespread and abundant in Ontario), S4 (i.e., apparently secure – uncommon but not rare), or SE (i.e., exotic and not a native component of Ontario's fauna), except for the Caspian Tern, which is ranked S3 (vulnerable in Ontario). The Caspian Tern was observed flying over the Study Area, along the lakeshore, but was not breeding on site.

No federally or provincially endangered, threatened or species of special concern were observed during the breeding season.

Priority species identified by Ontario Partners in Flight ("PIF", 2006) that were recorded breeding in the Study Area include grassland/agricultural species (Northern Harrier, Eastern Kingbird, Field Sparrow, Savannah Sparrow, Grasshopper Sparrow, and Eastern Meadowlark), shrub/successional species (Black-billed Cuckoo, Whip-poor-will, Willow Flycatcher, Brown Thrasher and Eastern Towhee), forest species (Northern Flicker, Wood Thrush and Baltimore Oriole).

Woodland area-sensitive species present included Ruffed Grouse, Whip-poor-will and Scarlet Tanager. The Ruffed Grouse and Scarlet Tanager prefer to nest in woodland patches over 20 ha in size. The Whip-poor-will prefers open woodland habitat over 100 ha in size.

One open habitat area-sensitive species was observed, the Northern Harrier, which prefers open habitats over 55 ha in size.

3.5.1 Point Counts

3.5.1.1 Species Densities

Thirty-seven species were observed on point counts within the Study Area. As the habitat within the Study Area was relatively homogeneous, all 19 point counts were pooled. **Table 3.5, Attachment B** summarizes the densities of all species observed on point counts. Eight species had densities of more than 2 pairs/10 ha in the Study Area, all of which are species typically associated with thicket or open woodland habitat. Song Sparrow had the highest density with 7.7 pairs/10 ha, while Yellow Warblers averaged 5.3 pairs/10 ha. Other species over 2 pairs/10 ha include Clay-colored Sparrow (2.7 pairs/10 ha), Brown Thrasher (2.5 pairs/10 ha), American Robin (2.5 pairs/10 ha), Alder Flycatcher (2.3 pairs/10 ha) and Eastern Towhee (2.2 pairs/10 ha).

Three species typically associated with woodland habitat were observed. Wood Thrush was observed at Point Count 4 at the northern boundary of the site, adjacent to an off-site mixed forest (**Figure 3, Attachment A**). A Black-and-white Warbler was observed in a narrow treed area that occurs along the shoreline. A Scarlet Tanager was observed in the deciduous treed / thicket swamp community in the southeastern portion of the Study Area.

Two species that are typically restricted to wetlands were also observed breeding on site. The Marsh Wren was recorded at Point Count 10, situated at an open marsh community (**Figure 3, Attachment A**). The Swamp Sparrow was observed at Point Count 10 as well as Point Count 3, the deciduous treed / thicket swamp in the southeastern portion of the Study Area.

3.5.1.2 Height Observations

Attachment F provides a summary of the height observation from point counts (i.e., on ground or below blade sweep [0 to 35 m], at blade sweep [35 to 125 m], above blade sweep [125 to 150 m], and well above blade sweep [over 150 m]).

All individuals of the majority of species were observed below the blade sweep of wind turbines. The exceptions were 25% of Ring-billed Gulls and 100% of Canada Geese and Killdeer that were observed at blade sweep height.

3.5.2 American Woodcock and Wilson's Snipe

Numbers of American Woodcock were relatively uniform throughout the Study Area, with observations of this species at every station. Wilson's Snipe were absent from two of the drier point count stations (Stations 11 and 12 in the northwestern corner of the Study Area, **Figure 3, Attachment A**) but were uniformly abundant across the other stations. Both species were estimated to be breeding in relatively high densities within the Study Area, specifically 7.0 breeding pairs of American Woodcock per 10 ha, and 4.8 breeding pairs of Wilson's Snipe per

10 ha. The maximum number of breeding pairs of each species over the 4 surveys at each monitoring station is presented in **Table 3.6, Attachment B**.

When visual observation of the woodcocks or snipes were possible, their height was estimated. Ten (100%) of 10 American Woodcocks displayed at blade sweep height, with estimated heights ranging from 30-50 m. Seven (78%) of 9 Wilson's Snipes were observed at blade sweep height, with estimated heights ranging from 25-60 m.

Whip-poor-wills were detected during these surveys. This species was likely breeding on site, with single males calling at 2 stations. Given the distance the call of this species carries and the proximity of the monitoring stations (approximately 400m), it is likely that every Whip-poor-will calling on site would have been detected during the singing-ground surveys. It is therefore concluded that no more than two pairs were breeding in the Study Area during the 2008 season. Unlike woodcock and snipe, Whip-poor-wills do not conduct aerial displays and were likely calling from a perch on the ground or low branch.

3.5.3 Henslow's Sparrow Surveys

An assessment of the Study Area for potential Henslow's Sparrow breeding habitat was completed. In general, Henslow's Sparrow prefers large areas of tall, dense grass with a well-developed litter layer and standing dead forb vegetation for singing perches. Sparse to no woody vegetation is important. They have also been known to have a preference for flatter portions of fields. Henslow's Sparrows are area sensitive, generally requiring 50 ha or more of suitable nesting habitat (Herkert, 1991).

Due to the prevalence of shrub and thickety vegetation, most of the Study Area would not be suitable for Henslow's Sparrow. However, three more open areas were identified across the northern portion of the study area (**Figure 3, Attachment A**). These areas were flat with comparatively few trees or shrubs (200-500 stems/ha), occasional residual dead standing vegetation and moderate litter layer. Considering the relatively small size of these patches, they were considered marginal habitat for the Henslow's Sparrow.

Playback survey within the marginal habitat did not detect Henslow's Sparrows. The species has experienced significant decline in Ontario. It should be considered absent from the Study Area.

3.6 FALL MIGRATION

Attachment G provides a detailed list of species recorded by date during each of fall migration surveys by Acadia. A total of 120 species were observed during the fall migration of 2008. The following sections discuss the most significant species or numbers of individuals that were observed over the 68 survey days.

Two species at risk were recorded: the Short-eared Owl, which is federally and provincially a species of special concern, and the Rusty Blackbird which is federally a species of special concern but not listed provincially. Both species are discussed further in **Section 3.8.**

Waterbirds

Double-crested Cormorants were abundant with a total of 1301 individuals observed with as many as 131 observed in a single day. Great Blue Heron and Sandhill Crane were much less common with respectively 4 and 1 individuals observed over the survey period.

Waterfowl

Eleven species of waterfowl were observed by Acadia's early morning fall surveys including Canada Goose, Greater White-fronted Goose, an unidentified swan, Wood Duck, Mallard, Bufflehead, Common Goldeneye, unidentified scaup, Long-tailed Duck, Common Merganser and Red-breastered Merganser. Of these, the unidentified scaup was the most common with 2604 observations, followed by Canada Goose with 423 observations and Mallard with 391 observations. Common Mergansers and Red-breasted Mergansers were relatively common with 267 and 180 observations, respectively. Other species were observed in much lower numbers, with 1 to 12 individuals of each observed over the survey period.

Shorebirds

Shorebirds observed during the fall migration surveys include the Spotted Sandpiper, Solitary Sandpiper, Semipalmated Sandpiper and an unknown plover. All species were observed in relatively low numbers, with 1 to 6 individuals of each observed over the survey period.

Raptors and Vulture

Merlins were the most common raptor observed during the fall migration survey. In total, 42 Merlins were observed with as many as 6 in one day. Other relatively common raptor species included Sharp-shinned Hawk (19 observations), American Kestrel (18 observations), and Cooper's Hawk (9 observations). Other raptor species were observed in lower numbers, with 1 or 2 observations overall, and include Turkey Vulture, Osprey, Bald Eagle, Northern Harrier, Northern Goshawk and Red-tailed Hawk.

Jacques Whitford conducted a more focused survey on fall migrating raptors in 2006. The findings of this survey are presented in **Section 3.7**.

Neotropical Migrants

Relatively small numbers of vireos (3 species totaling 23 individuals) and flycatchers (6 species totaling 71 individuals) were observed through the fall migration study period. Thrushes were also observed in small numbers with 3 species totaling 22 individuals, 20 of which were Hermit

Thrushes. In total, fifteen species of warblers were observed in the Study Area. Of these, Yellow-rumped warbler (182), Palm Warbler (121) and Common Yellowthroat (72) were the most common. Other species were observed in small numbers, with numbers of each totaling 1 to 24 observations.

Other birds

Other species that occurred in larger numbers during the fall migration period include European Starling (1489), Blue Jay (1365), American Goldfinch (1117), Cedar Waxwing (887) and American Robin (598). Blackbird species were abundant, represented by 2026 Common Grackles, 316 Red-winged Blackbirds and 2405 unidentified blackbirds.

In total, thirteen sparrow and junco species were observed. Song Sparrow was the most common species with 681 observations, followed by Dark-eyed Junco (263), White-throated Sparrow (233) and Field Sparrow (94).

3.7 FALL RAPTORS

A summary of Jacques Whitford's 2006 fall raptor data is provided in **Table 3.7, Attachment B.** A peak was observed on October 5 with 212 observations over the course of the 3 hour survey (70.7 observations/hr). Passage rates during other surveys varied from between 0 and 52.3 raptors per hour. Passage rates appeared to peak between September 12 and October 5 with very few observations after November 2.

In total, 13 species of raptors were observed. Across all survey dates, majority of the observations (369) were of Turkey Vulture, followed by Sharp-shinned Hawk (97) and Red-tailed Hawk (39).

Most raptors were observed flying to the east (23% of observations) or the southeast (38% of observations). A less important route was to the west (23% of observations).

Table 3.8, Attachment B summarized the flying height of the observed raptors. Fifty-two percent of the observations were over 100m high. Thirty-three percent were between 0 and 40m and sixteen percent between 40 and 100m.

In 2008, only one day of significant migrant raptor movement was noted. An Acadia observer at Prince Edward Point observed over 1100 raptors during the peak movement period between 09:00 and 14:00 on October 29, 2008. The majority of these (approximately 1000) were Red-tailed Hawks. Approximately 60 Golden Eagles and 25 Bald Eagles were estimated as well as 10 Rough-legged Hawks and several Merlins, American Kestrels, and Broad-winged Hawks (P. Taylor, pers. comm.).

Three species at risk were observed. The Peregrine Falcon is listed federally as a species of special concern and is provincially threatened. The Bald Eagle is designated Not at Risk federally; at the provincially level the southern population is considered Endangered and the

northern population is of special concern. The Golden Eagle is provincially endangered and federally Not at Risk. Species at risk are discussed in more detail in **Section 3.8**.

3.8 SPECIES AT RISK

A Golden-winged Warbler was observed on May 20, 2008 during Acadia's spring migratory area searches. The Golden-winged Warbler is a federally threatened species and a provincial species of special concern. The observation was made along the north-south road through the middle of the Study Area. This individual was not observed again through the remainder of the spring migration season or breeding season, and it was considered to be a migrating individual.

A Short-eared Owl (a federal and provincial species of special concern) was observed on October 15, 2008 by Acadia. This was an incidental observation, made outside of the regular early morning area searches. Wintering Short-eared Owls are regularly encountered in some areas of southeastern Ontario. According to the Canadian IBA database, Amherst Island, located 27 km northeast of the Study Area, is known to support the one of the highest concentrations of overwintering Short-eared Owls in Ontario. However, this species was not observed during the winter raptor surveys in the Study Area, and the Study Area does not provide suitable open country habitat for wintering raptors such as Short-eared Owl (**Section 4.1**). The individual Short-eared Owl was likely a migrant, moving on to more suitable overwintering habitat.

Rusty Blackbirds (a federal species of special concern) were observed during Acadia's fall migration area searches, with most observations in later October. A total of 179 Rusty Blackbirds were observed. It is considered a relatively common migrant in southern Ontario.

A single Bald Eagle was observed during Acadia's 2008 fall migration surveys and 4 were observed during the 2006 fall raptor migration study (with 3 observations on a single day). The southern Ontario population of Bald Eagles is provincially endangered, whereas the northern population (north of French and Mattawa Rivers) is special concern. Bald Eagles are known to overwinter on islands in eastern Lake Ontario and Prince Edward County, where they feed primarily on waterfowl. However, no observations of Bald Eagles were made in the Study Area during the winter raptor surveys.

A single Peregrine Falcon (provincially threatened and a federal species of special concern) was observed during the 2006 fall raptor migration study. This species experienced DDT-related population crashes in the 1970's but has experienced dramatic recovery since its return to the province in the late 1980's (Cadman et al., 2007).

Approximately 60 Golden Eagles (provincially endangered and federally Not at Risk) were observed at Prince Edward Point, located approximately 10 km east of the Study Area, on October 29, 2008. It is possible that some crossed over the Study Area during fall migration. No observations of Golden Eagles were made in the Study Area during the winter raptor surveys.

According to the NHIC database, Black Terns (a provincial species of special concern) are known to nest in two locations within the Prince Edward County South Shores IBA (MNR, 2008); in the Big Sand Bay wetland (approx. 3.5 km east of the Study Area) and the Gull Bar area of Point Petre Provincial Wildlife Area (approx. 7.5 km west of the Study Area). Although not observed during 2008 breeding bird surveys, the species was recorded in the Study Area by Jacques Whitford during surveys conducted in June, 2006. The Black Tern is area-sensitive, typically breeding in suitable marsh habitat with emergent vegetation measuring at least 20 ha in size. One marsh community occurs in the southeastern corner of the Study Area, however, it is only approximately 4 ha in size, and no Black Terns were observed during the 2008 breeding bird surveys that included this marsh. It is likely that the Black Tern observed in 2006 was a foraging visitor from a nearby breeding colony.

Of the species at risk listed in the Prince Edward County South Shore IBA by Wilson and Cheskey (2001), Least Bittern (federally and provincially threatened) and King Rail (federally and provincially endangered) were recorded in the 10 x 10 km breeding bird atlas square that includes the Study Area during recent atlas efforts (Cadman et al., 2007). These species are also thought to be area-sensitive marsh species that require approximately 100 ha of suitable habitat for breeding (although recent Ontario surveys have detected the presence of Least Bittern in smaller marshes). No marsh habitat of a suitable size for these species occurs on or adjacent to the Study Area. Neither species was observed during the 2008 breeding bird surveys that included the 4 ha marsh.

4.0 Discussion

4.1 WINTER BIRDS

4.1.1 Summary of Results

Raptors are generally attracted to winter habitats that offer several key features: open areas that support a range of small mammals for prey, scattered fence posts or snags for perches, and relatively mature woodlots nearby for roosting (Ontario Ministry of Natural Resources, 2000). Although a few open areas occur, the majority of the Study Area is comprised of shrubland that would be less suitable for hunting raptors. The site does not contain hayfields, pastures or croplands that typically would support small rodent populations upon which wintering raptors rely (Ontario Ministry of Natural Resources, 2000). Voles and mice are not well-suited to the shallow or absent soils and seasonal inundation. As well, there are no relatively mature mixed or dense coniferous woodlands on site that are preferred for roosting (Ontario Ministry of Natural Resources, 2000). Overall, the lack of ideal habitat and the results of the winter raptor survey would suggest that the Ostrander Point Study Area does not support significant numbers of wintering raptors.

Waterfowl were regularly observed in Lake Ontario adjacent to the study area. Observations occurred more than 50 m offshore in deeper water and beyond the frozen lakeshore. The highest number of waterfowl observed was 504 during the March 4, 2008 survey. Long-tailed Ducks were the most abundant species, with up to 350 observed in a single survey. However, this represents a very small percent of waterfowl that typically overwinter within the Prince Edward County South Shore IBA. In January 1996 and 1997, one-day peaks of Long-Tailed Ducks were approximately 37,700. A count on April 17, 2000 resulted in an estimate of 150,000 Long-tailed Ducks in the waters of the IBA (Wilson and Cheskey, 2001). White-winged Scoters and Greater Scaup regularly overwinter in numbers of 5,000 and 10,000 respectively (Wilson and Cheskey, 2001). The IBA Site Summary (IBA Canada, undated; **Attachment C**) indicated that the most significant portion of the IBA for staging and wintering waterfowl occurs along the shoals and deep water off the tip of the peninsula, further east of the Study Area.

Aside from waterfowl, few species were observed during the winter surveys. Two of the species observed in relatively high numbers in 2006, Bohemian Waxwing and Pine Grosbeak, are considered nomadic during winter months.

4.1.2 Potential Effects

Impacts to wintering birds are anticipated to be minimal. As few raptors are likely to utilize the site during winter months, there is very little risk of direct collision or indirect avoidance impacts.

Waterfowl wintering offshore may potentially experience displacement by avoidance. However, the waters offshore of the proposed Ostrander Point Wind Energy Park support a very small proportion of the total waterfowl wintering in the Prince Edward County South Shore IBA.

4.2 MIGRATORY WATERFOWL

4.2.1 Summary of Results

At the proposed Ostrander Point Wind Park, waterfowl were regularly observed offshore during both spring and fall migratory periods. Waterfowl in the Goldeneye guild (mostly Common Goldeneye), mergansers (mostly Common Mergansers and Red-breasted Mergansers) and bay ducks (mostly scaup) were commonly encountered. Canada Geese were also common in spring and fall and Mallards common in fall only.

Almost all waterfowl observations were made offshore. Results of comprehensive spring waterfowl surveys found that geese and dabblers rarely foraged in or flew over the Study Area and adjacent lands. During the spring surveys, bay ducks, mergansers and goldeneye were only observed offshore, with no observations over the Study Area.

4.2.2 Potential Effects

A summary of studies conducted by Kingsley and Whittam (2007) indicated that few waterfowl fatalities occur as a result of contact with wind turbines, relative to the numbers of waterfowl present, due to avoidance behaviors. Direct mortality of migratory waterfowl is not expected to be a significant issue at the Ostrander Point Wind Energy Park.

Disturbance or behavioural effects related to turbine activity are more likely (Kingsley and Whittam, 2007). Operational turbines may result in displacement of waterfowl staging offshore. However, as with wintering waterfowl, the most important areas for staging migrants appear to occur along the shoals and deep water off the tip of the peninsula, further east of the Study Area (IBA Canada, undated). The waters offshore of the proposed Ostrander Point Wind Energy Park support a very small proportion of the total waterfowl staging in the Prince Edward County South Shore IBA.

4.3 FALL MIGRATORY RAPTORS AND OWLS

4.3.1 Summary of Results

Although many Northern Saw-whet Owls in Ontario stay on territory year-round, many migrate south in the fall (Cadman et al., 2007). Variation in migrant numbers between years seems to be related to breeding success, with significantly higher than average proportions of hatchling-year individuals recorded during peak years (Whalen and Watts, 2002).

Northern Saw-whet Owls have been consistently captured in large numbers at the Prince Edward Point Bird Observatory, located at the tip of Prince Edward Point. A fall migratory banding program at the bird observatory from 1975 to 1988 resulted in the capture of between 83 and 779 Northern Saw-whets annually for a total of 4,875 owls over the 13-year period (Prince Edward Point Bird Observatory, 2008).

Timing of Northern Saw-whet migration through Prince Edward Point occurs from September to November. At the bird observatory most owls are captured in October with a peak mid-month (Weir et al., 1980; Prince Edward Point Bird Observatory, 2008). Some banding data suggest that adults migrate earlier than immatures (Contreras, 2000), however Weir et al. (1980) and Jobes (2002) did not find significant relationships in Ontario between migration timing and age or sex. Northern Saw-whet Owls migrate during the night with most captures at banding stations in the 4-hour period before sunrise (Weir et al. 1980, Duffy and Kerlinger 1992). However, it is unclear if this period of higher capture rate is related to migration activity or other behavior (i.e. hunting).

Weir et al. (1980) hypothesized that most of the Northern Saw-whet Owls arrive at Prince Edward Point via a land route from the mainland moving eastward down the peninsula. They also hypothesized that most owls do not cross Lake Ontario, but instead backtrack westward upon reaching the point. However, the exact route by which Northern Saw-whet Owls arrive and leave Prince Edward Point remains unconfirmed.

Northern Saw-whet Owls typically fly low over the ground with rapid wingbeats (Rasmussen et al., 2008). However, the manner and height at which they fly during migration is poorly understood.

Fall migration raptor surveys, conducted by Jacques Whitford, found relatively high raptor movement at the Ostrander Point site, peaking on October 5, 2006 with 212 raptor observations over a 3 hour survey. Across all surveys, Turkey Vultures were the most commonly observed species, with relatively high numbers of Sharp-shinned Hawks and Red-tailed Hawks. Most raptors appeared to be moving eastward, towards the tip of the Prince Edward Point peninsula. The majority of raptors observed were flying above turbine blade sweep height; however, many were also observed flying at blade height.

During fall migration, large numbers of raptors migrate along the north shoreline of Lake Ontario, down into Prince Edward County (Sprague and Weir, 1984). Prevailing winds tend to push these raptors eastward, along the south shore of the county to Prince Edward Point (Sprague, 1987). The IBA Site Summary (IBA Canada, undated; **Attachment C**) indicates that up to 2000 raptors a day can be observed moving up the point. The results of field surveys reflected this function.

To put the numbers of Ostrander Point fall migrating raptors observations in context, **Table 4.1, Attachment B** provides a comparison with three other Ontario hawk watch stations located on the north shore of Lake Ontario or Lake Erie (Hawk Count, 2008). The Cranberry Marsh hawk watch is located near Oshawa on Lake Ontario, Hawk Cliff is located near Port Stanley on Lake Erie and Holiday Beach is located at the western tip of Lake Erie. As migration counts on individual days can be highly variable, only days with available data from Ostrander Point were used in the comparison. It was assumed that weather conditions would be relatively similar across all hawk watch station on each of the days compared.

Daily numbers at the hawk watch stations were highly variable. Numbers at the Ostrander Point Study Area were generally similar to or slightly higher than at the other count locations early in the season (August and early September), but through October and November numbers at hawk watch stations were typically higher than those observed within the Study Area. Overall, the number of migrating raptors appeared to be increasingly larger at more westerly hawk watch stations.

4.3.2 Potential Effects

There is little to no information available regarding the collision and disturbance effects to owls (Kingsley and Whittam, 2007). No collisions of Northern Saw-whet Owls with wind turbines have been documented in the studies examined by Kingsley and Whittam (2007). The hunting behaviour of Northern Saw-whet Owls from low perches of 3 m or less in forest openings or edges (Rasmussen et al., 2008) is expected to minimize opportunities for colliding with turbine blades. However, flight altitude during migration is less certain.

Due to the concentration of raptors during the fall migration period, there is some risk of potential negative effects, including direct mortality. Raptors appear to be more vulnerable to collision than other species groups (National Academy of Sciences, 2007). Many of the raptors observed during fall surveys were flying at turbine blade sweep height making them potentially susceptible to collision. In addition, because raptors have relatively low reproductive rates, population recovery from mortality effects can be slow (Kingsley and Whittam, 2007).

Results of post-construction monitoring from another wind farm in Ontario may provide insight into potential impacts to fall migrating raptors and vultures. The Erie Shores Wind Farm is located near Port Burwell on the north shore of Lake Erie. This site is approximately 30 km east of the Hawk Cliff hawk watch station, an area that typically has higher fall raptor and vulture activity than Ostrander Point (**Table 4.1, Attachment B**). Peak numbers at the Hawk Cliff have been known to reach tens of thousands of raptors. Post construction monitoring of the Erie Shore Wind Farm was completed in 2006 (James, 2007), and included mortality searches and behaviour monitoring of fall migrating raptors and vultures. The behavioural monitoring found several raptor species including Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Red-tailed Hawk and American Kestrel moving through the wind farm in large numbers with no particular avoidance or hesitation in flying past the wind turbines. Results of the mortality searches found a single raptor fatality (Sharp-shinned Hawk) and a single Turkey Vulture fatality during the fall migration season in 2006.

4.4 MIGRATORY PASSERINES

4.4.1 Summary of Results

The majority of migratory birds observed in the Study Area were neotropical migrants or other passerines. The Prince Edward County South Shore IBA is a known concentration area for migrating passerines, with particular concentrations at the tip of the peninsula where the Prince Edward Point Bird Observatory is located (Wilson and Cheskey, 2001).

4.4.2 Potential Effects

Various studies have been conducted throughout North America to document bird collisions at wind facilities and to determine why collisions may be occurring. From a review of the available literature, it appears that most collisions are of nocturnal migratory songbirds (Kingsley and Whittam, 2007), at least partly because they are the most abundant species at wind energy facilities (National Academy of Sciences, 2007). Most of these studies have shown that direct mortality attributable to wind facilities is low, especially when compared to other anthropogenic structures (Arnett et al., 2007; Kingsley and Whittam, 2007; National Academy of Sciences, 2007), and are not expected to be significant at a population level (Arnett et al., 2007).

No information exists regarding the effects on migrating passerines of disturbance and habitat fragmentation due to wind turbines. However, because these species in general are able to use a much wider range of habitat types during migration compared to the breeding season, it is expected that the effects of disturbance would be less significant during migration than during the breeding season.

4.5 BREEDING BIRDS

4.5.1 Summary of Results

Most species of breeding birds observed within the Study Area are typically associated with shrubland or open woodland, which corresponds to the habitat found on site. The site did not provide significant habitat for grassland breeding birds, although small numbers of grassland birds such as Eastern Meadowlark and Grasshopper Sparrow were observed. Targeted surveys for American Woodcock and Wilson's Snipe indicated they were abundant breeders within the Study Area.

A few forest habitat species including Wood Thrush and Scarlet Tanager were observed around the periphery of the Study Area, in proximity to forest patches. However, substantive forest cover does not occur within the Study Area itself.

Fourteen priority species identified by PIF (2006) were recorded breeding in the Study Area including Northern Harrier, Whip-poor-will, Black-billed Cuckoo, Northern Flicker, Willow

Flycatcher, Eastern Kingbird, Wood Thrush, Brown Thrasher, Field Sparrow, Savannah Sparrow, Grasshopper Sparrow, Eastern Towhee, Eastern Meadowlark and Baltimore Oriole.

4.5.2 Potential Impacts

Species that conduct aerial mating displays, such as American Woodcock and Wilson's Snipe, may be at higher risk to collisions with turbines. Most observations of the aerial displays of these species in the Study Area indicated they attained the height of turbine blade sweep, making them potentially susceptible to collision.

For most other species of breeding birds, indirect effects have the potential to be greater threats than direct mortality. Destruction, fragmentation, and disturbance of habitat as a result of wind energy projects were identified as larger threats to breeding birds than direct mortality (Kingsley and Whittam, 2007). In Minnesota, the density of breeding grassland birds including Bobolink, Red-winged Blackbird, and Savannah Sparrow was reduced by 50% within 80 m of turbines; (Leddy et al., 1999). No disturbance information exists for shrubland birds, some of which have been identified as priority species by PIF (2006).

4.6 POTENTIAL EFFECTS – SUMMARY

The Ostrander Point Wind Energy Park Study Area was found to be used by a variety of bird species during each season. The results of the comprehensive bird studies within the Study Area suggest that potential effects to the following groups of birds require further analysis:

- Fall migratory raptors and Northern Saw-whet Owls;
- Spring and fall migratory passerines;
- Breeding American Woodcock and Wilson's Snipe; and,
- More sensitive breeding bird species including priority species identified by Partners in Flight.

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5.0 References

Arnett, E. B., D. B. Inkley, D. H. Johnson, R. P. Larkin, S. Manes, A. M. Manville, J. R. Mason, M. L. Morrison, M. D. Strickland, and R. Thresher. 2007. Impacts of wind energy facilities on wildlife and wildlife habitat. Wildlife Society Technical Review 07-2. The Wildlife Society, Bethesda, Maryland, USA.

Cadman, M. D., D. A. Sutherland, G. G. Beck, D. Lepage and A. R. Couturier. 2007. Atlas of the Breeding Birds of Ontario, 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto. 706 pp.

Canadian Wildlife Service. Unpublished. Breeding Waterfowl Plots: Prince Edward County and Wolfe Island Half-Mile Plots, 2005-2008. K. Ross, pers. comm. September 8, 2008.

Contreras, A. 2000. Changing seasons – fall migration: August-November 1999. North American Birds 54:16-17.

Dennis, D. G. and R. E. Chandler. 1974. Waterfowl use of the Ontario shoreline of the southern Great Lakes during migration. Pp. 58-65 *in* H. Boyd (ed.), Canadian Wildlife Service Waterfowl Studies in eastern Canada. Canadian Wildlife Service Report Series No. 29, Ottawa, Canada.

Duffy, K. and P. Kerlinger. 1992. Autumn owl migration at Cape May Point, New Jersey. Wilson Bulletin 104(2):312-320.

EchoTrack Inc. 2005. An Investigation of a New Monitoring Technology for Birds and Bats. Prepared for Suncor Energy Products Inc., Vision Quest Windelectric-TransAltas's Wind Business, Canadian Hydro Developers, Inc., and Enbridge Inc. August 2005.

Environment Canada. 2007a. Wind Turbines and Birds: A Guidance Document for Environmental Assessment. Prepared by the Canadian Wildlife Service. Final Report, April 2007.

Environment Canada. 2007b. Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds. Prepared by the Canadian Wildlife Service. Final Report, February 2007.

Hawk Count. 2008. Hawk Count database; www.hawkcount.org. Accessed November 2008.

Herkert, J.R. 1991. An ecological study of the breeding birds of grassland habitats within Illinois. Ph.D. dissertation. University of Illinois, Urbana, IL. 112 pp.

Herkert, J. R., P. D. Vickery, and D. E. Kroodsma. 2002. Henslow's Sparrow (*Ammodramus henslowii*). In The Birds of North America, No. 672 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

IBA Canada. Undated. Important Bird Areas of Canada database; http://www.bsc-eoc.org/iba/site.jsp?siteID=ON003. Accessed May 2008.

Jacques Whitford. 2008. 2006-08 Bird Monitoring Ostrander Point Wind Energy Park; Prince Edward County, Ontario. Draft Report.

James, R.D. 2007. Erie Shores Wind Farm; Port Burwell, Ontario; Fieldwork Report for 2006; Birds. February 2007.

James, R. D and G. Coady. 2003. Exhibition Place Wind Turbine: Bird Monitoring Program in 2003. Report to Toronto Hydro Energy Services Inc. and Windshare. December 2003.

Jobes, A. P. 2002. Influence of age, sex, and weather on timing of fall migration in Northern Saw-whet Owls in central Ontario. Ontario Bird Banding 33:38-50.

Kelley, J.R., Jr., R. D. Rau, and K. Parker. 2007. American woodcock population status, 2007. U.S. Fish and Wildlife Service, Laurel, Maryland. 17pp.

Kingsley, A. and B. Whittam. 2007. Wind Turbines and Birds: A Background Review for Environmental Assessment. Prepared for the Canadian Wildlife Service. Draft April 2, 2007.

Leddy, K. L., K. F. Higgins and D. E. Naugle. 1999. Effects of wind turbines on upland nesting birds in Conservation Reserve Program grasslands. Wilson Bulletin 111(1): 100-104.

Levesque, C. 2006. For the Birds: Audubon Society Steps Up in Support of Wind Energy. Renewable Energy Access, December 16, 2006. American Wind Energy Association.

National Academy of Sciences. 2007. Environmental Impacts of Wind-Energy Projects. Committee on Environmental Impacts of Wind-Energy Projects, Board on Environmental Studies and Toxicology, Division on Earth and Life Studies, National Research Council of the National Academies. The National Academies Press, Washington, D.C., USA.

Ontario Ministry of Natural Resources. 2000. Significant Wildlife Habitat Technical Guide. Fish and Wildlife Branch, Wildlife Section, Science Development and Transfer Branch, Southcentral Sciences Section. 151 pp.

Ontario Ministry of Natural Resources. 2008. Natural Heritage Information Centre internet database. Accessed April, 2008. http://www.mnr.gov.on.ca/MNR/nhic/nhic.html.

Ontario Partners in Flight. 2006. Ontario Landbird Conservation Plan: Lower Great Lakes/St. Lawrence Plain (North American Bird Conservation Region 13), Priorities, Objectives and Recommended Actions. Environment Canada (Ontario Region) and Ontario Ministry of Natural Resources. Final Draft, February 15, 2006.

Prince Edward Point Bird Observatory. 2008. The Northern Saw-whet Owl Migration Monitoring Program. Prince Edward Point Bird Observatory webpage, **http://www.peptbo.ca.** Last updated November 2008.

Rasmussen, J. L., S. G. Sealy and R. J. Cannings. 2008. Northern Saw-whet Owl (Aegolius acadicus), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/042 doi:10.2173/bna.42

Ross, R. K. 1989. A re-survey of migrant waterfowl use of the Ontario St. Lawrence River and northeastern Lake Ontario. Technical Report Series No. 52. Canadian Wildlife Service, Ontario Region.

Sprague, R.T. 1987. "A Birding Site Guide to Prince Edward County" in Ontario Birds

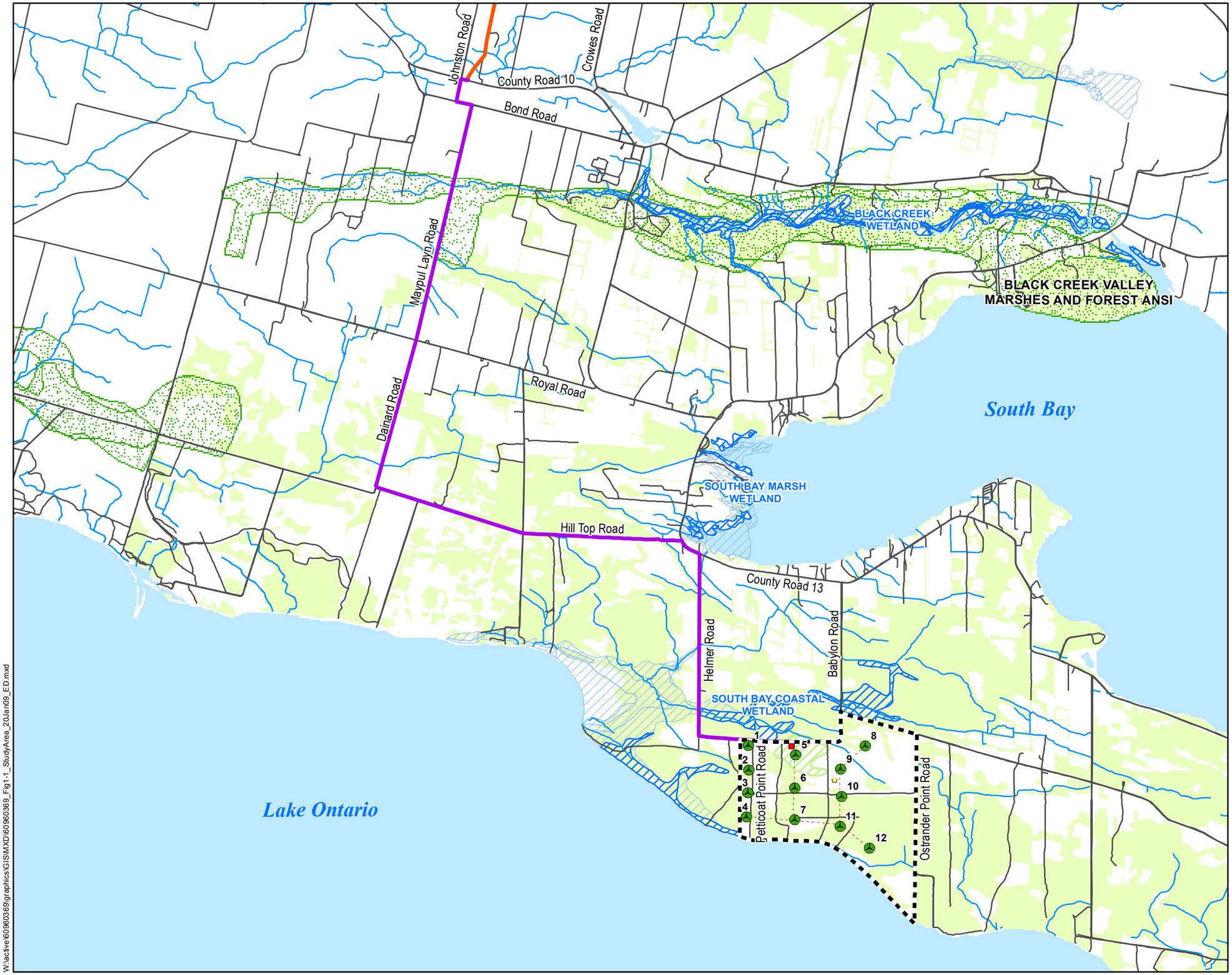
Sprague, R.T., and R.D.Weir. 1984. The Birds of Prince Edward County, 2nd ed. Kingston Field Naturalists, Kingston, Ont.

Weir, R. D., F. Cooke, M. H. Edwards, and R. B. Stewart. 1980. Fall migration of Saw-whet Owls at Prince Edward Point, Ontario. Wilson Bulletin 92(4):475-488.

Wilson, W.G. and E.D. Cheskey. 2001. Prince Edward County South Shore Important Bird Area Conservation Plan. Prince Edward County South Shore Important Bird Area Steering Committee and Stakeholders

Attachment A

Figures



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0 500 1,000 1,500 2,000 Meters

1:45,000

- Study Area
- Existing Roads
- Existing Transmission Line
- Proposed Transmission Line
- Proposed Access Roads
- Watercourses
- Wetland - Mapped but not present (pending MNR confirmation)
- Wetlands - Provincial
- Wetlands - Unevaluated
- Waterbody
- ANSI
- Wooded Area
- MET Tower
- Turbine
- Transformer Station

PREPARED FOR:

GILEAD POWER
OSTRANDER POINT WIND ENERGY PARK

FIGURE NO. 1.1

OSTRANDER POINT WIND ENERGY PARK STUDY AREA

Initiated: April, 2008
Revised: January 20, 2009

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Stantec

0 1 2 3 4

Kilometers

1:125,000

- Study Area
- Existing Roads
- Watercourses
- Wetland - Mapped but not present (pending MNR confirmation)
- Wetlands - Provincial
- Wetlands - Unevaluated
- Waterbody
- ANSI
- Wooded Area
- Candidate ANSI
- Important Bird Area (Approximate)
- Wildlife Area
- Built Up Areas
- Prince Edward Point Bird Obvservatory

Highway 33

Picton

Cherry Valley

Highway 33

Waupoos Island

Milford

County Road 10

South Bay

Royal Road

County Road 13

Army Reserve Road

Point Petre
Provincial Wildlife Area

Prince Edward Point
National Wildlife Area

Lake Ontario

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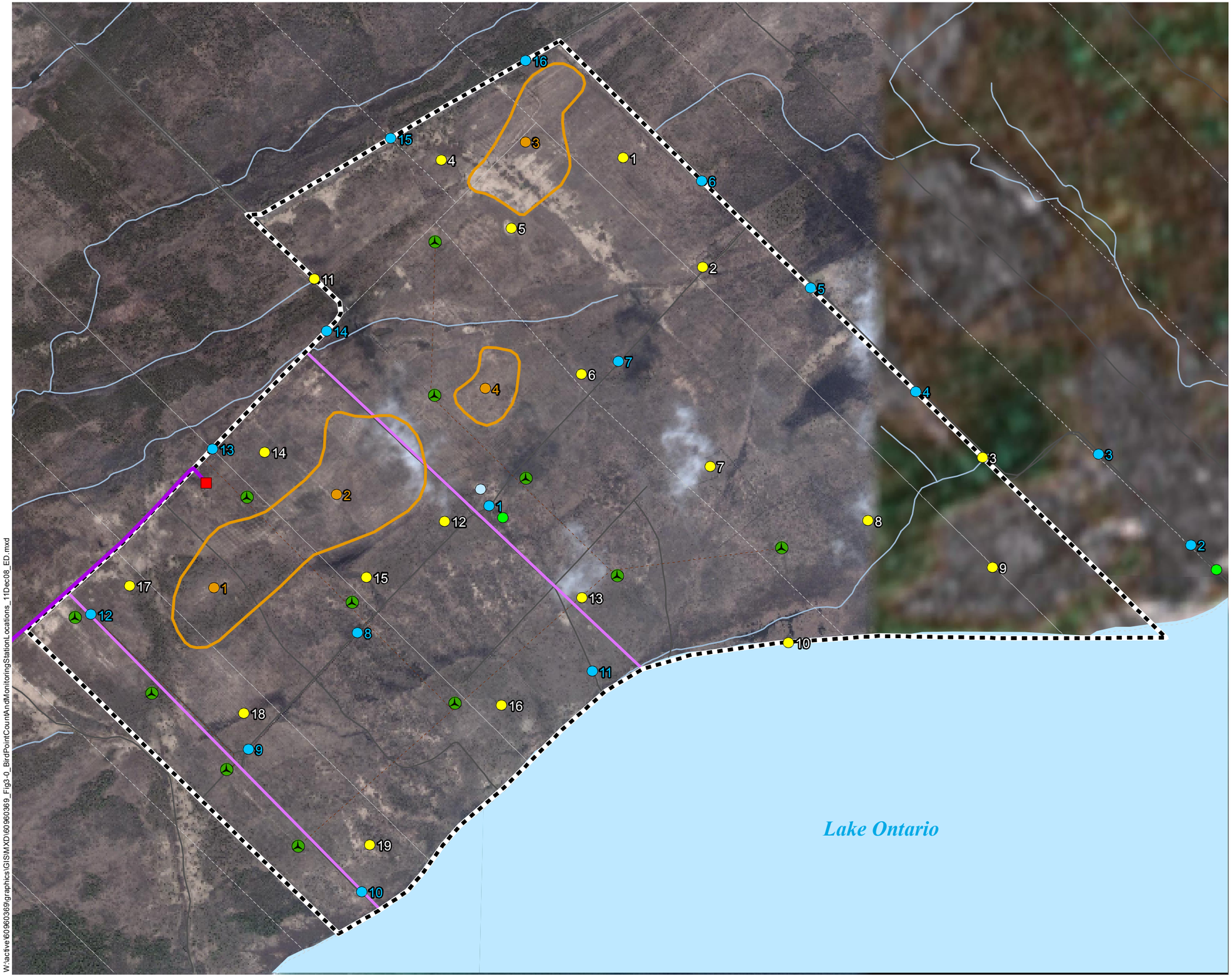
PREPARED FOR:

GILEAD POWER
OSTRANDER POINT WIND ENERGY PARK

FIGURE NO. 2.0

REGIONAL CONTEXT

Initiated: April, 2008
Revised: December 10, 2008



Stantec

N
W
E
S

0 100 200 300 400

Meters

1:10,000

- Study Area
- Property Lines
- Proposed Transmission Line
- Proposed Access Roads
- Watercourse
- Turbine
- Transformer Station
- AMWO/WISN Point Counts
- Breeding Bird Point Counts
- Fall Rapter Monitoring Station
- HESP Playback Station
- Waterfowl Monitoring Station
- Spring and Fall Migration Monitoring Transect
- Marginal HESP Habitat

PREPARED FOR:

GILEAD POWER
OSTRANDER POINT WIND PROJECT
PRINCE EDWARD COUNTY, ONTARIO

FIGURE NO. 3.0

BIRD POINT COUNT AND MONITORING STATION LOCATIONS

Initiated: November 21, 2008
Revised: December 11, 2008

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Attachment B

Tables

Table 2.1 Survey Conditions

Survey Date	Survey Type	Completed By	Time	Weather Conditions*
February 4, 2008	Winter Raptor Survey	Jacques Whitford	08:00-13:30	-3°C; wind of 0-3; 65-100% cloud cover; no precipitation; good visibility
February 20, 2008	Winter Raptor Survey	Jacques Whitford	11:00-17:30	-13°C; wind of 0-2; 5-75% cloud cover; no precipitation; good visibility
March 4, 2008	Winter Raptor Survey	Jacques Whitford	10:30-16:30	-1 to 1°C; wind of 0-3; 90-100% cloud cover; no precipitation; good visibility
April 1, 2008	Spring Waterfowl Daytime	Stantec	16:35 - 17:30	9°C with a wind of 5. 80% cloud cover with no precipitation.
April 1, 2008	Spring Waterfowl Dusk	Stantec	19:20 - 20:10	5°C with a wind of 5-6. 80-100% cloud cover with no precipitation.
April 2, 2008	Spring Waterfowl Dawn	Stantec	07:00 - 08:00	-5°C with a wind of 2-3. 0% cloud cover and no precipitation.
April 9, 2008	Spring Waterfowl Daytime	Stantec	15:40 - 16:30	5°C with a wind of 2-3. 100% cloud cover with no precipitation
April 9, 2008	Spring Waterfowl Dusk	Stantec	19:00 - 20:15	5°C with a wind of 4. 10% cloud cover with no precipitation.
April 10, 2008	Spring Waterfowl Dawn	Stantec	06:30 - 07:35	2°C with a wind of 3. 0% cloud cover with no precipitation.
April 16, 2008	Spring Waterfowl Daytime	Stantec	18:45 - 19:10	13°C with a wind of 1. 15% cloud cover with no precipitation
April 16, 2008	Spring Waterfowl Dusk	Stantec	19:10 - 20:15	13°C with a wind of 0-1. 15% cloud cover with no precipitation.
April 16, 2008	Wilson's Snipe and American Woodcock	Stantec	20:32 - 22:18	10-5°C with a wind of 0-1. 5% cloud cover with no precipitation.
April 17, 2008	Spring Waterfowl Dawn	Stantec	06:30 - 07:30	1°C with a wind of 1. 5% cloud cover with no precipitation.
April 22, 2008	Spring Waterfowl Daytime	Stantec	18:45 - 19:15	15°C with a wind of 0. 60% cloud cover with no precipitation
April 22, 2008	Spring Waterfowl Dusk	Stantec	19:20 - 20:25	12°C with a wind of 0-1. 50% cloud cover with no precipitation.
April 22, 2008	Wilson's Snipe and American Woodcock	Stantec	20:21 - 21:51	18°C with a wind of 0-1. 10% cloud cover with no precipitation.
April 23, 2008	Spring Waterfowl Dawn	Stantec	06:30 - 07:40	9°C with a wind of 0-1. 5% cloud cover with no precipitation.
April 29, 2008	Spring Waterfowl Daytime	Stantec	18:45 - 19:10	8°C with a wind of 4. 5% cloud cover with no precipitation.
April 29, 2008	Spring Waterfowl Dusk	Stantec	19:10 - 20:25	8°C with a wind of 4. 5% cloud cover with no precipitation.
April 29, 2008	Wilson's Snipe and American Woodcock	Stantec	20:25 - 22:00	7-5°C with a wind of 2-4. 5% cloud cover with no precipitation
April 30, 2008	Spring Waterfowl Dawn	Stantec	06:00 - 07:00	1°C with a wind of 1-2. 5% cloud cover with no precipitation.
May 6, 2008	Spring Waterfowl Daytime	Stantec	18:35 - 19:15	11°C with a wind of 2. 60% cloud cover with no precipitation
May 6, 2008	Spring Waterfowl Dusk	Stantec	19:10 - 20:15	10°C with a wind of 2. 70% cloud cover with no precipitation.
May 6, 2008	Wilson's Snipe and	Stantec	20:20 - 21:44	8°C with a wind of 1-2. 60% cloud

Table 2.1 Survey Conditions

Survey Date	Survey Type	Completed By	Time	Weather Conditions*
	American Woodcock			cover with no precipitation.
May 7, 2008	Spring Waterfowl Dawn	Stantec	05:55 - 06:45	8°C with a wind of 1. 20% cloud cover with no precipitation.
Daily; May 2 to June 2, 2008	Spring Migration	Acadia	0.5 - 2.5 hours after sunrise	N/A
June 11, 2008	Breeding Birds Point Counts	Stantec	04:45 - 10:00	15-23°C, with a wind of 1 increasing to 3. Cloud cover of 5 increasing to 20% and no precipitation
June 12, 2008	Breeding Birds Point Counts	Stantec	04:45 - 10:00	14-17°C, with a wind of 1 increasing to 3. Cloud cover of 50% and no precipitation
June 25, 2008	Breeding Birds Point Counts	Stantec	05:00 - 10:00	12-17°C, with a wind of 1-2. Cloud cover of 5% and no precipitation.
June 26, 2008	Breeding Birds Point Counts	Stantec	05:00 - 10:00	14-17°C, with a wind of 2. 100% Cloud cover. Short periods of light rain.
June 10, 2008	Breeding Henslow's Sparrow	Stantec	20:45 - 21:40	22°C, with a wind of 1. Cloud cover of 10% and no precipitation.
June 24, 2008	Breeding Henslow's Sparrow	Stantec	21:45 - 23:00	16°C, with a wind of 2. Cloud cover of 10% and no precipitation.
August 12-16, 25-31 2008; September 1-19, 21-30, 2008; and October 1-16, 18-28, 2008.	Fall Migration	Acadia	0.5 - 1.5 hours after sunrise	N/A
August 21, 2006	Fall Raptor Migration	Jacques Whitford	11:15-14:15	N/A
September 5, 2006	Fall Raptor Migration	Jacques Whitford	11:15-14:15	N/A
September 12, 2006	Fall Raptor Migration	Jacques Whitford	11:15-14:15	N/A
September 19, 2006	Fall Raptor Migration	Jacques Whitford	11:15-14:15	N/A
October 5, 2006	Fall Raptor Migration	Jacques Whitford	11:15-14:15	10°C, with a wind of 3-4 from the E. Cloud cover 10-60% with no precipitation.
October 12, 2006	Fall Raptor Migration	Jacques Whitford	11:15-13:15	8°C, with a wind of 5-6 from the W. Cloud cover 70-90% with no precipitation.
October 19, 2006	Fall Raptor Migration	Jacques Whitford	11:15-13:15	12°C with a wind of 3 from the W. Cloud cover 100% with no precipitation.
October 26, 2006	Fall Raptor Migration	Jacques Whitford	11:15-13:15	5°C with a wind of 2-3 from the N to NE. Cloud cover 20-40% with no precipitation.
November 2, 2006	Fall Raptor Migration	Jacques Whitford	11:15-13:15	6°C with a wind of 4 from the W. Cloud cover 60-80% with no precipitation.
November 9, 2006	Fall Raptor Migration	Jacques Whitford	11:00-13:00	13°C with a wind of 3 from the W. Cloud cover 90% with no precipitation.

Table 2.1 Survey Conditions

Survey Date	Survey Type	Completed By	Time	Weather Conditions*
November 17, 2008	Fall Raptor Migration	Jacques Whitford	11:00-13:00	6°C with a wind of 5 from the W. Cloud cover 100% with drizzle during the count.
November 24, 2006	Fall Raptor Migration	Jacques Whitford	11:00-13:00	5°C with a wind of 3 from the E. No cloud cover or precipitation during the count.

* Wind conditions expressed using Beaufort Scale:

0 – calm, <2km/hr
1 – light, 2-6 km/hr
2 – light, 7-12 km/hr
3 – moderate, 13-19 km/hr
4 – moderate, 20-30 km/hr
5 – fresh, 31-40 km/hr
6 – strong, 41-51 km/hr

Table 3.1 Summary of Winter Raptor Results

Species	Feb 4, 08	Feb 20, 08	Mar 4, 08	Height
Tundra Swan		2		0-40m (over lake)
Redhead			53	In Lake
Greater Scaup			55	In Lake
Long-tailed Duck	350		230	In Lake
Bufflehead			31	In Lake
Common Goldeneye	1		135	In Lake
Ruffed Grouse			4	On ground
Ring-billed Gull	1			0-40m (over lake)
Herring Gull			1	0-40m (over lake)
Gull Species		2		0-40m (over lake)
Hairy Woodpecker	1	1	1	0-40m
Blue Jay	3		1	0-40m
American Crow			1	0-40m
Black-capped Chickadee	5	14	7	0-40m
American Robin			1	0-40m
European Starling		20		0-40m
Bohemian Waxwing		6	395	69% @ 0-40m; 31% @ 40-100m
Pine Grosbeak		4	1	0-40m
Total	**361**	**47**	**916**	

Table 3.2 Spring Waterfowl Dawn Movement 2008

Date	South over land towards lake	North or northwest over land	East over land	West overland	Grand Total
April 2, 08	17 (100%)		6 (33%)		23 (83%)
April 10, 08					0 (0%)
April 17, 08	1 (0%)	2 (100%)		2 (100%)	5 (80%)
April 23, 08	1 (0%)		2 (0%)	6 (66%)	9 (45%)
April 30, 08	4 (25%)		1 (0%)		5 (20%)
May 7, 08			5 (0%)	1 (100%)	6 (17%)
Grand Total	**23 (78%)**	**2 (100%)**	**14 (14%)**	**9 (78%)**	**48 (60%)**

Notes:

Cells represent number of individuals observed. Number in brackets denotes percentage of birds flying at blade height (35- 125m).
63% of observations were of Canada Goose, 15% were Mallards, 13% were Common Loons, 8% were Double Crested Cormorant and 2% Sandhill Crane

Table 3.3 Spring Waterfowl Dusk Movement 2008

Date	Flying South towards lake	Flying North	Flying East	Flying West	Grand Total
April 1, 08	10 (100%)		1 (0%)		11 (91%)
April 9, 08		2 (0%)		3 (0%)	5 (0%)
April 16, 08	1 (0%)				1 (0%)
April 22, 08			2 (0%)		2 (0%)
April 29, 08					0 (0%)
May 6, 08					0 (0%)
Grand Total	**11 (91%)**	**2 (0%)**	**3 (0%)**	**3 (0%)**	**17 (53%)**

Notes:

Cells represent number of individuals observed. Number in brackets denotes percentage of birds flying at blade height (35- 125m).

21 % of observations were of Canada Goose, 26% were Mallards and 53% were identifed to dabbling ducks

Table 3.4 Summary of Waterfowl Days by Guild, Spring 2008

Guild	Total Waterfowl Observed	Total Waterfowl Days
Geese	253	880
Large Dabblers	5	18
Bay Ducks	90	348
Sea Ducks	59	212
Goldeneye	3803	13802
Merganser	747	1956
Loon	1	4

Table 3.5 Summary of Breeding Bird Densities

Species	Total birds	avg/pc	pairs/10ha
Wild Turkey	1	0.05	0.17
Northern Harrier	1	0.05	0.17
Killdeer	1	0.05	0.17
Mourning Dove	2	0.11	0.34
Alder Flycatcher	14	0.74	2.35
Willow Flycatcher	1	0.05	0.17
Least Flycatcher	1	0.05	0.17
Eastern Kingbird	4	0.21	0.67
Blue Jay	1	0.05	0.17
Tree Swallow	2	0.11	0.34
Black-capped Chickadee	4	0.21	0.67
House Wren	6	0.32	1.01
Marsh Wren	1	0.05	0.17
Wood Thrush	1	0.05	0.17
American Robin	15	0.79	2.51
Gray Catbird	6	0.32	1.01
Brown Thrasher	15	0.79	2.51
Cedar Waxwing	5	0.26	0.84
Yellow Warbler	32	1.68	5.36
Chestnut-sided Warbler	1	0.05	0.17
Black-and-white Warbler	1	0.05	0.17
Common Yellowthroat	11	0.58	1.84
Scarlet Tanager	1	0.05	0.17
Eastern Towhee	13	0.68	2.18
Chipping Sparrow	9	0.47	1.51
Clay-colored Sparrow	16	0.84	2.68
Field Sparrow	21	1.11	3.52
Savannah Sparrow	5	0.26	0.84
Song Sparrow	46	2.42	7.71
Swamp Sparrow	4	0.21	0.67
White-throated Sparrow	1	0.05	0.17
Northern Cardinal	2	0.11	0.34
Red-winged Blackbird	11	0.58	1.84
Common Grackle	3	0.16	0.50
American Goldfinch	10	0.53	1.68
Brown-headed Cowbird	11	0.58	1.84
Baltimore Oriole	2	0.11	0.34

Table 3.6 American Woodcock and Wilson's Snipe survey results. Cells represent maximum number of individuals observed over four surveys.

Monitoring Station	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Density (pair/10ha)
Wilson's Snipe	3	1	1	2	2	3	2	2	1	1	0	0	1	2	2	1	**4.8**
American Woodcock	3	3	2	2	1	2	2	1	3	2	3	3	2	2	2	2	**7.0**

Table 3.7 Summary of Fall Raptor Survey Results, 2006

	21-Aug-06	5-Sep-06	12-Sep-06	19-Sep-06	5-Oct-06	12-Oct-06	19-Oct-06	26-Oct-06	2-Nov-06	9-Nov-06	17-Nov-06	24-Nov-06	Total
Turkey Vulture	6	10	87	103	151	2		3	7				**369**
Bald Eagle					3						1		**4**
Osprey			2	6									**8**
Northern Harrier			5		2	3	1	2	3	1			**17**
Sharp-shinned Hawk	1	6	40	8	34	3		4	1				**97**
Cooper's Hawk		1	2		3			1					**7**
Broad-winged Hawk				10									**10**
Red-shouldered Hawk					3			1					**4**
Red-tailed Hawk	1	1	8	2	13	3		6	2		3		**39**
Rough-legged Hawk									2				**2**
Buteo Sp.								6	2				**8**
American Kestrel	1	4	13	3	1								**22**
Merlin		1			2					1			**4**
Peregrine Falcon				1									**1**
Total Observations	9	23	157	132	212	11	1	23	17	2	4	0	591
Duration of Survey (hr)	3	3	3	3	3	2	1	2	2	1	1	2	14
Passage Rate (observations/hr)	**3.0**	**7.7**	**52.3**	**44.0**	**70.7**	**5.5**	**1.0**	**11.5**	**8.5**	**2.0**	**4.0**	**0.0**	**42.2**

Source: Jacques Whitford (unpublished)

Table 3.8 Summary of Fall Migratory Raptor Height Results				
	At or Above Tree Level (0-40m)	**Well Above Tree Level (40-100m)**	**High (>100m)**	**Total**
Turkey Vulture	103	53	213	369
Bald Eagle			4	4
Osprey	4		4	8
Northern Harrier	10	3	4	17
Sharp-shinned Hawk	47	11	38	96
Cooper's Hawk	2	2	3	7
Red-shouldered Hawk			4	4
Red-tailed Hawk	10	8	21	39
Rough-legged Hawk		1	1	2
Buteo Sp.	1		7	8
Broad-winged Hawk		10		10
American Kestrel	15	2	5	22
Merlin	1	1	2	4
Peregrine Falcon		1		1
Total	193	92	306	591
Percent	32.7%	15.6%	51.8%	

Table 4.1 Comparison of Ostrander Point and Ontario Hawk Watch Stations

Hawk Watch Station		Aug 21, 2006	Sept 5, 2006	Sept 12, 2006	Sept 19, 2006	Oct 5, 2006	Oct 12, 2006	Oct 19, 2006	Oct 26, 2006	Nov 2, 2006	Nov 9, 2006	Nov 17, 2006	Nov 24, 2006	Total
Ostrander Point	Total Observations	9	23	157	132	212	11	1	23	17	2	4	0	591
Study Area	Duration of Survey (hr)	3	3	3	3	3	2	1	2	2	1	1	2	26
	Passage Rate (observations/ hr)	**3.0**	**7.7**	**52.3**	**44.0**	**70.7**	**5.5**	**1.0**	**11.5**	**8.5**	**2.0**	**4.0**	**0.0**	**22.7**
Cranberry Marsh	Total Observations	14	7	7	132	1240	25	1	270	26	0	7	3	1732
Lake Ontario Shoreline	Duration of Survey (hr)	5	2	2	7	6	3	3	6	5	2	3	2	46
	Passage Rate (observations/ hr)	**2.8**	**3.5**	**3.5**	**18.9**	**206.7**	**8.3**	**0.3**	**45.0**	**5.2**	**0.0**	**2.3**	**1.5**	**37.7**
Hawk Cliff	Total Observations	N/A	10	0	393	2883	62	41	1953	191	22	N/A	22	5577
Lake Erie Shoreline	Duration of Survey (hr)	N/A	5	2	8.5	10	1	7	9	6	9	N/A	3	60.5
(near Erie Shores Wind Farm)	**Passage Rate (observations/ hr)**	**N/A**	**2.0**	**0.0**	**46.2**	**288.3**	**62.0**	**5.9**	**217.0**	**31.8**	**2.4**	**N/A**	**7.3**	**92.2**
Holiday Beach	Total Observations	N/A	41	56	210	6396	191	107	976	1728	429	10	72	10216
West end of Lake Erie	Duration of Survey (hr)	N/A	3	6	5	11	5.5	6	7	6.5	9	5	7	71
	Passage Rate (observations/ hr)	**N/A**	**13.7**	**9.3**	**42.0**	**581.5**	**34.7**	**17.8**	**139.4**	**265.8**	**47.7**	**2.0**	**10.3**	**143.9**

Attachment C

Summary of Spring Migratory Area Searches (Acadia University)

Attachment C Summary of Spring Migration Area Searches (Acadia University

COMMON NAME	*SCIENTIFIC NAME*	DATE: 5/2/2008	DATE: 5/3/2008	DATE: 5/4/2008	DATE: 5/5/2008	DATE: 5/6/2008	DATE: 5/7/2008	DATE: 5/8/2008	DATE: 5/9/2008	DATE: 5/10/2008	DATE: 5/11/2008	DATE: 5/12/2008	DATE: 5/13/2008	DATE: 5/14/2008	DATE: 5/15/2008	DATE: 5/16/2008	DATE: 5/17/2008	DATE: 5/18/2008	DATE: 5/19/2008	DATE: 5/20/2008	DATE: 5/21/2008	DATE: 5/22/2008	DATE: 5/23/2008	DATE: 5/24/2008	DATE: 5/25/2008	DATE: 5/26/2008	DATE: 5/27/2008	DATE: 5/28/2008	DATE: 5/29/2008	DATE: 5/30/2008	DATE: 5/31/2008	DATE: 6/1/2008	DATE: 6/2/2008	
BIRDS																																	**Total**
Canada Goose	*Branta canadensis*	2	2	24	3	2	43	2	2	7		6		6	1		2	6		3		3	2		3	35			23				50	227
Wood Duck	*Aix sponsa*																1																1
Mallard	*Anas platyrhynchos*				2	5	2		1						1	3									1		2		2			2		21
Bufflehead	*Bucephala albeola*					8			3			1																						12
Common Merganser	*Mergus merganser*					4				4	12	7				4	4	1		10	8	25	12					17	2				14	124
Red-breasted Merganser	*Mergus serrator*	6																																6
Duck Species																				2		1												3
Ruffed Grouse	*Bonasa umbellus*				1			1		1	2			1	2	1	1	3		1	1	2	2	2	4		1	2	1	2	1	1	2	35
Wild Turkey	*Meleagris gallopava*	1			2	1	5			2			3		2	2		2				1	1		2	2	3	2		3				34
Common Loon	*Gavia immer*					1		1					3	1	1	1		1		1	2	2	2			4		1		3		2		26
Double-crested Cormorant	*Phalacrocorax auritus*		6			5					41	35		45					10	34		3	5	11	15	20	17	53		35		11	1	347
American Bittern	*Botaurus lentiginosus*					1	1		1	1		1	1																					6
Great Blue Heron	*Ardea herodias*		1				1					1		2	1						1	2	4			1		2	2	2	1	1		22
Black-crowned Night-Heron	*Nycticorax nycticorax*																													1				1
Turkey Vulture	*Cathartes aura*		1									1										2		1				1				1	7
Northern Harrier	*Circus cyaneus*	1	1	2			1			1			1		1					1	4		1	1	1	3	1	1	2					23
Sharp-shinned Hawk	*Accipiter striatus*				1					1																								2
Cooper's Hawk	*Accipiter cooperii*			1																														1
Red-tailed Hawk	*Buteo jamaicensis*													1																				1
American Kestrel	*Falco sparverius*	1	1			1						1																		1				5
Sandhill Crane	*Grus canadensis*													1			1	2																4
Killdeer	*Charadrius vociferus*			2						1			1		1				2				1		1	2		1						12
Wilson's Snipe	*Gallinago delicata*	1	2	2	3	2			1	2	1		2	1		1		1																19
Ring-billed Gull	*Larus delawarensis*								4		9	16		17		9	22	10	25	15	44	30	27		15	3	9	17	1	1		5		279
Herring Gull	*Larus argentatus*															3		4						3	1					1				12
Great Black-backed Gull	*Larus marinus*													1																				1
Mourning Dove	*Zenaida macroura*			3	2	5	3	2	2	3	3		6		4	6	6	13	2	3	4	3	2	7	11	3	6	1	2	3		5	1	111
Ruby-throated Hummingbird	*Archilochus colubris*																	1											1					2
Belted Kingfisher	*Ceryle alcyon*			1		1																												2
Downy Woodpecker	*Picoides pubescens*							2																										2
Hairy Woodpecker	*Picoides villosus*																												1					1
Northern Flicker	*Colaptes auratus*		2	1					1	2		1	1					1				1					1	1		1				13
Pileated Woodpecker	*Dryocopus pileatus*								1																									1
Woodpecker Species															1																			1
Eastern Wood-Pewee	*Contopus virens*																								2	1				1			1	5
Alder Flycatcher	*Empidonax alnorum*																								1	2	7	12	8	17	10	10	14	
Least Flycatcher	*Empidonax minimus*							1	1	1				3	2	1		2	1	3		1		3	4	1								24
Empidonax Species																							1	2	1	1				2			2	9
Eastern Phoebe	*Sayornis phoebe*													1		1																	1	3
Great Crested Flycatcher	*Myiarchus crinitus*							1						1	1	1	1				2				1			1				1	2	12
Eastern Kingbird	*Tyrannus tyrannus*			2				4	4	3	2	3	2	5	9	5	5	7	5	7	8	5	14	4	8	13	7	10	4	6	6	10	9	167
Blue-headed Vireo	*Vireo solitarius*		1	1																														2
Warbling Vireo	*Vireo gilvus*							1	1											1				2	1	1					1			8
Philadelphia Vireo	*Vireo philadelphicus*																													1				1
Red-eyed Vireo	*Vireo olivaceus*																	1		1			1	1	1	5	1			2			1	14
Blue Jay	*Cyanocitta cristata*		1	1	1	9	8	5	4	29	9	3	18	8	15	8	7	43	3	13	15	4	37	24	9	3	8	40	3	31		8	15	382
American Crow	*Corvus brachyrhynchos*	5	2	2	2	2	1	5	1	2	4	5	3	2	4	3	3	8	5	6	1	6	5	5	5	6	5	7	4	4	1	3	3	120
Common Raven	*Corvus corax*							1					1	1					1															4
Purple Martin	*Progne subis*	1															1	2								1								5
Tree Swallow	*Tachycineta bicolor*								4							3	3	1				2	2		4	6	8			2		2	4	41
Cliff Swallow	*Petrochelidon pyrrhonota*	1		1				1	1																									4
Barn Swallow	*Hirundo rustica*								1									2						1			1			1				6
Swallow Species											1					2																		3
Black-capped Chickadee	*Poecile atricapillus*						1			1	4			1	2	2	1		1		1	3	2	1	2			3		1	1	4	2	33
Red-breasted Nuthatch	*Sitta canadensis*									1										1														2
House Wren	*Troglodytes aedon*									1	1	2	1	1	1	1	4	2	3	2	1	2	3	4	3	1	2	1	1	1	1	1		40
Golden-crowned Kinglet	*Regulus satrapa*			4																														4
Ruby-crowned Kinglet	*Regulus calendula*				1		2	2		1								1																7
Blue-gray Gnatcatcher	*Polioptila caerulea*																						1											1
Swainson's Thrush	*Catharus ustulatus*																														1			1
Hermit Thrush	*Catharus guttatus*	1	1																															2
Wood Thrush	*Hylocichla mustelina*					1	1							2	2	2							1	1					1					11
American Robin	*Turdus migratorius*	17	13	8	10	17	10	10	13	11	10	4	12	9	10	7	7	8	8	13	6	3	7	8	14	7	7	9	5	7	7	2	9	288
Gray Catbird	*Dumetella carolinensis*																																	0
Thrush Species			1																															1
Brown Thrasher	*Toxostoma rufum*	3	5	4	7	7	6	6	5	12	8	4	5	6	4	5	5	4	3	8	3	9	7	6	10	4	6	6	7	10	6	5	8	194
European Starling	*Sturnus vulgaris*								3			12	11	1			1	8	1						6	2				2	1				48
Cedar Waxwing	*Bombycilla cedrorum*				69	78	1	14	14	3		40	55	2	37	15	8	8	14	9	14	3	3	2		59	44	37		7	14		6	556
Golden-winged Warbler	*Vermivora chrysoptera*																			1														1
Nashville Warbler	*Vermivora ruficapilla*			1	2			1			1		2	1	1										1				1			2	13
Northern Parula	*Parula americana*																	1																1
Yellow Warbler	*Dendroica petechia*	3	3	9	11	17	31	27	32	19	27	22	27	30	46	38	42	65	65	69	65	75	84	74	75	63	60	70	55	65	36	52	56	1413
Chestnut-sided Warbler	*Dendroica pensylvanica*		1		1	1	2	1						1		1		1		3	1		1											14
Magnolia Warbler	*Dendroica magnolia*														3	1		3		1			3		1		1					1		14
Black-throated Blue Warbler	*Dendroica caerulescens*						2	3	4	1										2															12
Yellow-rumped Warbler	*Dendroica coronata*	1	1	2	4	2	6	5	4	4								1	2			1		5										38
Black-throated Green Warbler	*Dendroica virens*						1		1				1		3			2		2			1	1		1								13
Blackburnian Warbler	*Dendroica fusca*																						1											1
Palm Warbler	*Dendroica palmarum*			1	1	1		8																										11
Blackpoll Warbler	*Dendroica striata*																										1							1
Black-and-white Warbler	*Mniotilta varia*		2					3			1		1					1		2		1					1		1				2	15
American Redstart	*Setophaga ruticilla*			1											1								1		1	1								5
Ovenbird	*Seiurus aurocapilla*				1			3		2	1	1	2	1	3	2	1	2	1	2		1	2	2	1	1	2	1	2	2	1	2	1	40
Mourning Warbler	*Oporornis philadelphia*																				1													1
Common Yellowthroat	*Geothlypis trichas*	1	2	1	4	7	10	9	14	11	12	12	10	10	18	18	19	13	13	24	15	22	14	12	17	16	15	16	11	18	9	15	16	404
Warbler Species						1																												1

Attachment C Summary of Spring Migration Area Searches (Acadia University																																		
COMMON NAME	***SCIENTIFIC NAME***																																	
		DATE:	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	
		5/2/2008	5/3/2008	5/4/2008	5/5/2008	5/6/2008	5/7/2008	5/8/2008	5/9/2008	5/10/2008	5/11/2008	5/12/2008	5/13/2008	5/14/2008	5/15/2008	5/16/2008	5/17/2008	5/18/2008	5/19/2008	5/20/2008	5/21/2008	5/22/2008	5/23/2008	5/24/2008	5/25/2008	5/26/2008	5/27/2008	5/28/2008	5/29/2008	5/30/2008	5/31/2008	6/1/2008	6/2/2008	
BIRDS																																		**Total**
Scarlet Tanager	*Piranga olivacea*																	1		2	1				1									5
Eastern Towhee	*Pipilo erythrophthalmus*	8	5	3	3	7	7	4	6	6	6	4	5	4	5	6	3	3	4	4	4	7	6	4	7	6	8	3	5	5	4	6	7	165
Chipping Sparrow	*Spizella passerina*	24	24	14	12	12	20	15	12	11	10	13	25	20	18	14	11	12	13	18	18	19	27	25	20	10	10	14	18	16	15	12	22	524
Clay-colored Sparrow	*Spizella pallida*					1	2	2	3	4	4	5	6	5	8	4	8	8	6	9	4	5	7	9	6	7	5	9	5	7	4	6	8	157
Field Sparrow	*Spizella pusilla*	31	24	20	18	19	24	17	21	14	18	12	14	14	13	17	18	14	6	26	23	20	22	18	16	9	12	11	10	13	2	12	8	516
Savannah Sparrow	*Passerculus sandwichensis*	3	5	2	8	4	6	3	3	3	4	2	5	2	3	3	2	2	1	4	3	5	4	2	9	3	3	2	6	10	3	4	6	125
Fox Sparrow	*Passerella iliaca*																											2						2
Song Sparrow	*Melospiza melodia*	40	23	15	23	27	26	21	30	25	26	24	24	26	28	29	33	39	29	47	44	39	48	44	48	40	39	49	65	54	55	44	52	1156
Swamp Sparrow	*Melospiza georgiana*								1	1	1	1																						4
White-throated Sparrow	*Zonotrichia albicollis*	4	7	2	7	6	17	4	6	7	1	1	3	2	2	3	1	1		4			1				1						1	81
White-crowned Sparrow	*Zonotrichia leucophrys*						9	12	6	14	4				1	1		6	1	3	2				2									61
Sparrow Species						1																												1
Dark-eyed Junco	*Junco hyemalis*				1																													1
Northern Cardinal	*Cardinalis cardinalis*																								1	1								2
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	1	6			9	1		2		3			2	13	2	1	2			1					2	3			1				49
Indigo Bunting	*Passerina cyanea*															1									1		1							3
Bobolink	*Dolichonyx oryzivorus*				1	1					3			2																				7
Red-winged Blackbird	*Agelaius phoeniceus*	3	8	5	4	3	3		13	2	4	2	1	2		1	3	4	1	1	1		2	3	1	2		2			1	2	2	76
Eastern Meadowlark	*Sturnella magna*	1	4	2	2	3	3		3	3	3	1	3	2	1	1	2	2	3	4	1	1	2	2		3	2	2	1	2		2		61
Common Grackle	*Quiscalus quiscula*	10	20	2	22	1	13	9	6	1	19	1	2	2	1	2	5	12	2	12	3	4	14	6	2	8	6	2	1		4	1	4	197
Brown-headed Cowbird	*Molothrus ater*	36	40	25	20	33	20	15	4	15	9	7	19	18	19	16	29	21	13	23	24	23	23	19	24	28	26	29	25	23	14	22	26	688
Baltimore Oriole	*Icterus galbula*					1			1	2	1		3	3	4	1	2	3	1	2	1		4	1	1			1					2	34
Purple Finch	*Carpodacus purpureus*																						1											1
American Goldfinch	*Carduelis tristis*	2	2		7	3		4	3	2	2	5	7	2	5	10	9	4	9	5	4	2	15	10	13	5	7	29	10	9	5	3	5	198
Total Activity		208	217	164	256	309	289	226	243	237	267	256	288	263	299	257	274	365	254	404	331	338	426	332	370	390	339	466	289	371	203	258	366	

Attachment D

Breeding Bird Species List

COMMON NAME	*SCIENTIFIC NAME*	ONTARIO STATUS	GLOBAL STATUS	COSSARO	COSEWIC	AREA (ha)	Local Status PIF Priority Species	COMMENTS	Area Sensitive Reference		
BIRDS											
Ruffed Grouse	*Bonasa umbellus*	S5	G5			20			Sandilands 2005		
Wild Turkey	*Meleagris gallopava*	S4	G5								
Common Loon	*Gavia immer*	S4	G5	NAR	NAR	70		Not likely breeding in the Study Area			
Double-crested Cormorant	*Phalacrocorax auritus*	S4	G5	NAR	NAR	20		Not likely breeding in the Study Area	Sandilands 2005		
Great Blue Heron	*Ardea herodias*	S5	G5					Not likely breeding in the Study Area			
Turkey Vulture	*Cathartes aura*	S4	G5					Not likely breeding in the Study Area			
Osprey	*Pandion haliaetus*	S4	G5					Not likely breeding in the Study Area			
Northern Harrier	*Circus cyaneus*	S4	G5	NAR	NAR	55	X		Sandilands 2005		
Killdeer	*Charadrius vociferus*	S5	G5								
Wilson's Snipe	*Gallinago delicata*	S5	G5								
Ring-billed Gull	*Larus delawarensis*	S5	G5					Not likely breeding in the Study Area			
Herring Gull	*Larus argentatus*	S5	G5					Not likely breeding in the Study Area			
Caspian Tern	*Hydroprogne caspia*	S3	G5	NAR	NAR			Not likely breeding in the Study Area			
Mourning Dove	*Zenaida macroura*	S5	G5								
Black-billed Cuckoo	*Coccyzus erythropthalmus*	S4	G5				X				
Whip-poor-will	*Caprimulgus vociferus*	S4	G5			100	X				
Downy Woodpecker	*Picoides pubescens*	S5	G5								
Northern Flicker	*Colaptes auratus*	S5	G5				X				
Alder Flycatcher	*Empidonax alnorum*	S5	G5								
Willow Flycatcher	*Empidonax traillii*	S5	G5				X				
Least Flycatcher	*Empidonax minimus*	S5	G5								
Great Crested Flycatcher	*Myiarchus crinitus*	S5	G5								
Eastern Kingbird	*Tyrannus tyrannus*	S5	G5				X				
Blue Jay	*Cyanocitta cristata*	S5	G5								
American Crow	*Corvus brachyrhynchos*	S5	G5								
Tree Swallow	*Tachycineta bicolor*	S5	G5								
Barn Swallow	*Hirundo rustica*	S5	G5								
Black-capped Chickadee	*Poecile atricapillus*	S5	G5								
House Wren	*Troglodytes aedon*	S5	G5								
Marsh Wren	*Cistothorus palustris*	S5	G5								
Wood Thrush	*Hylocichla mustelina*	S5	G5				X				
American Robin	*Turdus migratorius*	S5	G5								
Gray Catbird	*Dumetella carolinensis*	S5	G5								
Brown Thrasher	*Toxostoma rufum*	S5	G5				X				
European Starling	*Sturnus vulgaris*	SE	G5								
Cedar Waxwing	*Bombycilla cedrorum*	S5	G5								
Yellow Warbler	*Dendroica petechia*	S5	G5								
Chestnut-sided Warbler	*Dendroica pensylvanica*	S5	G5								
Common Yellowthroat	*Geothlypis trichas*	S5	G5								
Scarlet Tanager	*Piranga olivacea*	S5	G5			20					
Eastern Towhee	*Pipilo erythrophthalmus*	S4	G5				X				

COMMON NAME	*SCIENTIFIC NAME*	ONTARIO STATUS	GLOBAL STATUS	COSSARO	COSEWIC	AREA (ha)	Local Status PIF Priority Species	COMMENTS	Area Sensitive Reference		
BIRDS											
Chipping Sparrow	*Spizella passerina*	S5	G5								
Clay-colored Sparrow	*Spizella pallida*	S4	G5								
Field Sparrow	*Spizella pusilla*	S5	G5				X				
Savannah Sparrow	*Passerculus sandwichensis*	S5	G5				X				
Grasshopper Sparrow	*Ammodramus savannarum*	S4	G5				X				
Song Sparrow	*Melospiza melodia*	S5	G5								
Swamp Sparrow	*Melospiza georgiana*	S5	G5								
White-throated Sparrow	*Zonotrichia albicollis*	S5	G5								
Northern Cardinal	*Cardinalis cardinalis*	S5	G5								
Red-winged Blackbird	*Agelaius phoeniceus*	S5	G5								
Eastern Meadowlark	*Sturnella magna*	S5	G5				X				
Common Grackle	*Quiscalus quiscula*	S5	G5								
Brown-headed Cowbird	*Molothrus ater*	S5	G5								
Baltimore Oriole	*Icterus galbula*	S5	G5				X				
American Goldfinch	*Carduelis tristis*	S5	G5								
SUMMARY											
Total Butterflies:											
Total Amphibians:											
Total Reptiles:											
Total Birds:											
Total Breeding Birds:											
Total Mammals:											
SIGNIFICANT SPECIES											
Global:											
National:											
Provincial:											
Regional:											
Local:											
Explanation of Status and Acronymns											
COSSARO: Committee on the Status of Species at Risk in Ontario											
COSEWIC: Committee on the Status of Endangered Wildlife in Canada											
REGION: Rare in a Site Region											
S1: Critically Imperiled—Critically imperiled in the province (often 5 or fewer occurrences)											
S1S2: Extremely rare to very rare in Ontario											

COMMON NAME	*SCIENTIFIC NAME*	ONTARIO STATUS	GLOBAL STATUS	COSSARO	COSEWIC	AREA (ha)	Local Status PIF Priority Species	COMMENTS	Area Sensitive Reference		
BIRDS											
S2: Imperiled—Imperiled in the province, very few populations (often 20 or fewer),											
S2S3: Very rare to uncommon in Ontario											
S3: Vulnerable—Vulnerable in the province, relatively few populations (often 80 or fewer)											
S3S4: Rare to common in Ontario											
S4: Apparently Secure—Uncommon but not rare											
S4S5: Common to very common in Ontario											
S5: Secure—Common, widespread, and abundant in the province											
SE: Exotic; not believed to be a native component of Ontario's fauna											
SH: Possibly Extirpated (Historical)											
SZ: Not of practical conservation concern as there are no clearly definable occurrences											
SZB: Breeding migrants/vagrants											
SZN: Non-breeding migrants/vagrants											
?: Not yet ranked; or, following a ranking, rank inexact or uncertain											
G1: Extremely rare globally; usually fewer than 5 occurrences in the overall range											
G1G2: Extremely rare to very rare globally											
G2: Very rare globally; usually between 5-10 occurrences in the overall range											
G2G3: Very rare to uncommon globally											
G3: Rare to uncommon globally; usually between 20-100 occurrences											
G3G4: Rare to common globally											
G4: Common globally; usually more than 100 occurrences in the overall range											
G4G5: Common to very common globally											
G5: Very common globally; demonstrably secure											
T: Denotes that the rank applies to a subspecies or variety											
END: Endangered											
THR: Threatened											
VUL: Vulnerable											
SC: Special Concern											
NAR: Not At Risk											
IND: Indeterminant, insufficient information to assign status											
DD: Data Deficient											
6: Rare in Site Region 6											
7: Rare in Site Region 7											
Area: Minimum patch size for area-sensitive species (ha)											
H- highly significant in Hamilton Region (i.e. rare)											
m- moderately significant in Hamilton Region (i.e. uncommon)											
L1- extremely rare locally (Toronto Region)											
L2- very rare locally (Toronto Region)											
L3- rare to uncommon locally (Toronto Region)											
HR- rare in Halton Region, highly significant											
HU- uncommon in Halton Region, moderately significant											
COSEWIC status - *-Carolinean population designation, **- Great Lakes/St.Lawrence population designation											

COMMON NAME	*SCIENTIFIC NAME*	ONTARIO STATUS	GLOBAL STATUS	COSSARO	COSEWIC	AREA (ha)	Local Status PIF Priority Species	COMMENTS	Area Sensitive Reference		
BIRDS											
COSSARO status- END-R[1]- south of the French and Mattawa Rivers											
* The Pileated Woodpecker will incorporate smaller woodlots into its homerange, therefore it may not be a true area-sensitive species											
LATEST STATUS UPDATE											
Butterflies: June, 2008											
Amphibans: June, 2008											
Reptiles: June, 2008											
Birds: June, 2008											
Mammals: June, 2008											
S and G rank explanations: August 30, 2007											
NOTE											
All rankings for birds refer to breeding birds unless the ranking is followed by N											
REFERENCES											
COSSARO Status											
Endangered Species Act, 2007 (Bill 184). Schedules 1- 5. June 30 2008.											
COSEWIC Status											
COSEWIC. 2007. Canadian Species at Risk. Committee on the Status of Endangered Wildlife in Canada. September 11, 2007 with updates from COSEWIC Assessments November 2007, April 2008											
Local Status											
Dwyer, Jill K. 2003. Nature Counts Project Hamilton Natural Areas Inventory 2003. Species Checklists. Hamilton Naturalists Club.											
Halton Natural Areas Inventory 2006: Volume 2 Species Checklists (ISBN 0-9732488-7-4)											
Ontario Partners in Flight. 2006. Ontario Landbird Conservation Plan: Lower Great Lakes/St. Lawrence Plain (North American Bird Conservation Region 13), Priorities, Objectives and Recommended Actions. Environment Ca											
Region of Waterloo. 1996. Regionally Significant Breeding Birds.											
TRCA. 2003. Revised Fauna Scores and Ranks, February 2003. Toronto Region Conservation Authority.											
Area-sensitive information											
Austen, M.J.W., M.D. Cadman, and R.D. James. 1994. Ontario birds at risk: status and conservation needs. Toronto and Port Rowan, ON: Federation of Ontario Naturalists and Long Point Bird Observatory. 165 pp.											
Dunn, Erica H. and David J. Agro. 1995. Black Tern (Chlidonias niger), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.c											
Hejl, S.J., J.A. Holmes, and D.E. Kroodsma. 2002. Winter Wren (Troglodtyes troglodytes). In Poole, A., and F. Gill, eds. The birds of North America, No. 623. Philadelphia, PA: The Birds of North America, Inc. 31 pp.											
Page, A.M., and M.D. Cadman. 1994. Status report on the Acadian Flycatcher Empidonax virescens in Canada. Prepared for the Committee on the Status of Endangered Wildlife in Canada. 27 pp											
Robbins, C.S. 1979. Effect of forest fragmentation on bird populations. Pp. 198-212 in DeGraaf, R.M., and K.E. Evans, eds. Management of northcentral and northeastern forests for nongame birds. United States Department o											
Sandilands. A. 2005. Birds of Ontario. Habitat Requirements, Limiting Factors and Status. UBC Press.											

Attachment E

Point Count Height Summary

		TOTAL BIRDS IN ALL	On Ground or Below	At Blade	Above Blade	Well Above Blade
		POINT COUNTS	Blade Sweep Height	Sweep Height	Sweep Height	Sweep Height
COMMON NAME	***SCIENTIFIC NAME***					
Alder Flycatcher	*Empidonax alnorum*	21	21			
American Crow	*Corvus brachyrhynchos*	10	10			
American Goldfinch	*Carduelis tristis*	13	13			
American Robin	*Turdus migratorius*	22	22			
Baltimore Oriole	*Icterus galbula*	3	3			
Barn Swallow	*Hirundo rustica*	2	2			
Black-and-white Warbler	*Mniotilta varia*	1	1			
Black-capped Chickadee	*Poecile atricapilla*	4	4			
Blue Jay	*Cyanocitta cristata*	2	2			
Brown Thrasher	*Toxostoma rufum*	28	28			
Brown-headed Cowbird	*Molothrus ater*	12	12			
Canada Goose	*Branta canadensis*	20	0	20		
Cedar Waxwing	*Bombycilla cedrorum*	10	10			
Chestnut-sided Warbler	*Dendroica pensylvanica*	1	1			
Chipping Sparrow	*Spizella passerina*	12	12			
Clay-colored Sparrow	*Spizella pallida*	23	23			
Common Grackle	*Quiscalus quiscula*	3	3			
Common Loon	*Gavia immer*	2	2			
Common Yellowthroat	*Geothlypis trichas*	15	15			
Eastern Kingbird	*Tyrannus tyrannus*	5	5			
Eastern Towhee	*Pipilo erythrophthalmus*	15	15			
European Starling	*Sturnus vulgaris*	2	2			
Field Sparrow	*Spizella pusilla*	29	29			
Gray Catbird	*Dumetella carolinensis*	11	11			
House Wren	*Troglodytes aedon*	8	8			
Killdeer	*Charadrius vociferus*	1	0	1		
Least Flycatcher	*Empidonax minimus*	1	1			
Marsh Wren	*Cistothorus palustris*	1	1			
Mourning Dove	*Zenaida macroura*	5	5			
Northern Cardinal	*Cardinalis cardinalis*	4	4			
Northern Flicker	*Colaptes auratus*	1	1			
Northern Harrier	*Circus cyaneus*	1	1			
Osprey	*Pandion haliaetus*	1	1			
Red-winged Blackbird	*Agelaius phoeniceus*	18	18			
Ring-billed Gull	*Larus delawarensis*	8	6	2		
Savannah Sparrow	*Passerculus sandwichensis*	5	5			
Scarlet Tanager	*Piranga olivacea*	1	1			
Song Sparrow	*Melospiza melodia*	73	73			
Swamp Sparrow	*Melospiza georgiana*	7	7			
Tree Swallow	*Tachycineta bicolor*	6	6			
White-throated Sparrow	*Zonotrichia albicollis*	2	2			
Wild Turkey	*Meleagris gallopava*	1	1			
Willow Flycatcher	*Empidonax traillii*	1	1			
Wood Thrush	*Hylocichla mustelina*	2	2			
Yellow Warbler	*Dendroica petechia*	52	52			

Attachment F

Summary of Fall Migratory Area Searches (Acadia University)

Attachment F - Summary of Fall Area Searches

COMMON NAME	SCIENTIFIC NAME	DATE: 12-Aug-08	DATE: 13-Aug-08	DATE: 14-Aug-08	DATE: 15-Aug-08	DATE: 16-Aug-08	DATE: 25/08/08	DATE: 26/08/08	DATE: 27/08/08	DATE: 28/08/08	DATE: 29/08/08	DATE: 30/08/08	DATE: 31/08/08	DATE: 1/9/2008	DATE: 2/9/2008	DATE: 3/9/2008	DATE: 4/9/2008	DATE: 5/9/2008	DATE: 6/9/2008	DATE: 7/9/2008	DATE: 8/9/2008	DATE: 9/9/2008	DATE: 10/9/2008	DATE: 11/9/2008	DATE: 12/9/2008	DATE: 13/9/2008	DATE: 14/09/2008	DATE: 15/9/2008	DATE: 16/9/2008	DATE: 17/09/2008	DATE: 18/09/2008	DATE: 19/09/2008	DATE: 21-Sep-08	DATE: 22-Sep-08	DATE: 23-Sep-08	DATE: 24-Sep-08	DATE: 25-Sep-08	DATE: 26-Sep-08
BIRDS																																						
Canada Goose	*Branta canadensis*																2			32			18			5		2	76	37	9	1	30		30			
Greater White-fronted Goose	*Anser albifrons*																																					
UNID Swan																																						
Wood Duck	*Aix sponsa*																																					
Mallard	*Anas platyrhynchos*	1					1										32						200		40		56	50										
Bufflehead	*Bucephala albeola*																																					
Common Goldeneye	*Bucephala clangula*																																					
UNID Scaup																																						
Long-tailed Duck	*Clangula hyemalis*																																					
UNID Duck																	15					200			7				25			20						
Common Merganser	*Mergus merganser*				15	55											16	3	30		2	5			2								18					
Red-breasted Merganser	*Mergus serrator*																																					
UNID Merganser																																						
Wild Turkey	*Meleagris gallopava*																					2			2													
Common Loon	*Gavia immer*				1				2										1			1																
Double-crested Cormorant	*Phalacrocorax auritus*		50	22	10		10	38	9	4	131	15	32	3	91	1	28	2	23	96	2	29	17	33	12	39	20	20	69	14	12	118	3	28	3		3	3
Great Blue Heron	*Ardea herodias*																				2								1									
Turkey Vulture	*Cathartes aura*	1																																				
Osprey	*Pandion haliaetus*																													1								
Bald Eagle	*Haliaeetus leucocephalus*																														1							
Northern Harrier	*Circus cyaneus*		1																																			1
Sharp-shinned Hawk	*Accipiter striatus*		1																		1				1		1		3									
Cooper's Hawk	*Accipiter cooperii*																							1				1	1	3	2							
Northern Goshawk	*Accipiter gentilis*																																					
UNID Accipiter																														1								
Red-tailed Hawk	*Buteo jamaicensis*	1																																				
American Kestrel	*Falco sparverius*					1			1	1	1					4																							1
Merlin	*Falco columbarius*			1	1											6	6	4				2	1		4	1	2	3			5	4						
Virginia Rail	*Rallus limicola*																																1					
Sandhill Crane	*Grus canadensis*																													1								
Spotted Sandpiper	*Actitis macularia*	1																																				
Solitary Sandpiper	*Tringa solitaria*																											1										
Semipalmated Sandpiper	*Calidris pusilla*																					3																
UNID Shorebird		5		1				3																										1				
UNID Plover												6																										
Ring-billed Gull	*Larus delawarensis*	3	12			1	3		2	8	18	11	3			8	16	15	20	6	12	2	4	6	5	7	5	6		10	3	14	6	2		1	4	3
Herring Gull	*Larus argentatus*	20	2		3				1		17		2	1	1			7	4		2								1									
Great Black-backed Gull	*Larus marinus*			2									1	1	1					1	1											1						
UNID Gull							10	4	8	20	10		7	3	3		4	17			7		7	4	7	2	20	7	5	13	5	3						
Caspian Tern	*Hydroprogne caspia*		1		1				1																													
Common Tern	*Sterna hirundo*							1																														
Mourning Dove	*Zenaida macroura*			2	6	2	1		1				2	1	4	2				5	3		1				1			1								2	
Black-billed Cuckoo	*Coccyzus erythropthalmus*	2				1							1			1																						
UNID Cuckoo																							1			1												
Short-eared Owl	*Asio flammeus*																																					
Ruby-throated Hummingbird	*Archilochus colubris*																				1																	
Belted Kingfisher	*Ceryle alcyon*						1		1																													
Yellow-bellied Sapsucker	*Sphyrapicus varius*																																	1		1		1
Downy Woodpecker	*Picoides pubescens*						1					1											1															
Hairy Woodpecker	*Picoides villosus*																												1									
Northern Flicker	*Colaptes auratus*	1			1	1						1	2							1		4		4		3	9	1		4			3		3			
Yellow-bellied Flycatcher	*Empidonax flaviventris*			1																																		
Alder Flycatcher	*Empidonax alnorum*	2	4	1	1								1																									
Least Flycatcher	*Empidonax minimus*		3	1	1	2								3							3		1						1									
UNID Empidonax								1					1	1	1								1				1				1							
Eastern Phoebe	*Sayornis phoebe*																												1		1			1	2		1	
Great Crested Flycatcher	*Myiarchus crinitus*													1																								
Eastern Kingbird	*Tyrannus tyrannus*		5	3									1																									
Northern Shrike	*Lanius excubitor*																																					
Blue-headed Vireo	*Vireo solitarius*																																					
Warbling Vireo	*Vireo gilvus*												1	1	1		2							1					1									
Red-eyed Vireo	*Vireo olivaceus*													1	2	2	1										1				1						1	
Blue Jay	*Cyanocitta cristata*		4		3	4	4	1		2		3	3	9	13	7	9		6	5	10	2	5	16	1	19	3	3	10	28	6	19	2	36	3	11	6	3
American Crow	*Corvus brachyrhynchos*	6	1	2		1	1	1	1			1	1	1		1	4		4	8	3		8	1	1	9	2	1	9	2	2							
Common Raven	*Corvus corax*																																					
Purple Martin	*Progne subis*	17	25		6	19																																
Tree Swallow	*Tachycineta bicolor*	13																																				
Bank Swallow	*Riparia riparia*	3				1																																
Cliff Swallow	*Petrochelidon pyrrhonota*	20	18	1																																		
Barn Swallow	*Hirundo rustica*	7	7		2	12																																
UNID Swallow		50	22		3																			1														
Black-capped Chickadee	*Poecile atricapillus*		2	1		1		1					3		6	3	1		2	1	2	1	3	2					7	2	1	1	1					
Red-breasted Nuthatch	*Sitta canadensis*																												4		1							
White-breasted Nuthatch	*Sitta carolinensis*																																	3	1	1			
Brown Creeper	*Certhia americana*																															5						
House Wren	*Troglodytes aedon*				1	1		1				2		2							1		2			5	1			1	2							
Winter Wren	*Troglodytes troglodytes*																																					
Golden-crowned Kinglet	*Regulus satrapa*																																	3	1	2			
Ruby-crowned Kinglet	*Regulus calendula*																													1		2			8	4	3	1
UNID Kinglet																																						
Blue-gray Gnatcatcher	*Polioptila caerulea*																1														1							
Eastern Bluebird	*Sialia sialis*																																					
Veery	*Catharus fuscescens*																																					
Gray-cheeked Thrush	*Catharus minimus*																																					1
Swainson's Thrush	*Catharus ustulatus*																																					
Hermit Thrush	*Catharus guttatus*																																					
American Robin	*Turdus migratorius*		5	1	4	1		1				1				1	2			1	7		1			3				1					1			2
Gray Catbird	*Dumetella carolinensis*	3	3	6	2	2	1	1		1		3	4	3	3	4	4		3	5	4	2	1	3		7	3	1	5		2	3	1	4	1	3	1		
Brown Thrasher	*Toxostoma rufum*																1												3	1		1						
European Starling	*Sturnus vulgaris*	20				1																10						44			2	104						
American Pipit	*Anthus rubescens*																																4	1					
Cedar Waxwing	*Bombycilla cedrorum*	12	30	10	21	9	17	28	35	15	14	12	16	52	59	29	14	27	31	32	34	1	28	25	13	44	10	19	55	15	16	32	26	13	10	5	3	3
Orange-crowned Warbler	*Vermivora celata*																																	1				
Nashville Warbler	*Vermivora ruficapilla*							1						2																				2				
Yellow Warbler	*Dendroica petechia*	5	14	2	3	1	3							2		2																						
Chestnut-sided Warbler	*Dendroica pensylvanica*																												1									

Attachment F - Summary of Fall Area Searches

COMMON NAME	SCIENTIFIC NAME	DATE: 27-Sep-08	DATE: 28-Sep-08	DATE: 29-Sep-08	DATE: 30-Sep-08	DATE: 1-Oct-08	DATE: 2-Oct-08	DATE: 3-Oct-08	DATE: 4-Oct-08	DATE: 5-Oct-08	DATE: 6-Oct-08	DATE: 7-Oct-08	DATE: 8-Oct-08	DATE: 9-Oct-08	DATE: 10-Oct-08	DATE: 11-Oct-08	DATE: 12-Oct-08	DATE: 13-Oct-08	DATE: 14/10/2008	DATE: 15/10/2008	DATE: 16/10/2008	DATE: 18/10/2008	DATE: 19/10/2008	DATE: 20/10/2008	DATE: 21/10/2008	DATE: 22/10/2008	DATE: 23/10/2008	DATE: 24/10/2008	DATE: 25/10/2008	DATE: 26/10/2008	DATE: 27/10/2008	DATE: 28/10/2008
BIRDS																																
Canada Goose	*Branta canadensis*	15	4	1			7			44	10					1				12	65	22										
Greater White-fronted Goose	*Anser albifrons*					10																										
UNID Swan																															1	
Wood Duck	*Aix sponsa*						1																									
Mallard	*Anas platyrhynchos*							4										1				4		2								
Bufflehead	*Bucephala albeola*																														2	8
Common Goldeneye	*Bucephala clangula*									5																						
UNID Scaup		40		210	290	150	200	100	225	220	100				150	200		150					14		100	250	80			25		100
Long-tailed Duck	*Clangula hyemalis*																								1		1					10
UNID Duck													50							14	52	45	150	14	28	28	74	55		28	136	37
Common Merganser	*Mergus merganser*						11		50	44				1		15																
Red-breasted Merganser	*Mergus serrator*																		23	50	8	35	25			5	1			2		31
UNID Merganser																		8														
Wild Turkey	*Meleagris gallopava*																															
Common Loon	*Gavia immer*						1	1	1																							
Double-crested Cormorant	*Phalacrocorax auritus*		2	11	3		2	41	12	40	61							16		47	5	30	30	1	1		7	1			1	
Great Blue Heron	*Ardea herodias*		1																													
Turkey Vulture	*Cathartes aura*																															
Osprey	*Pandion haliaetus*																															
Bald Eagle	*Haliaeetus leucocephalus*																															
Northern Harrier	*Circus cyaneus*				1		1																									
Sharp-shinned Hawk	*Accipiter striatus*		1	1			2	1	2	1	1					1			1		1										
Cooper's Hawk	*Accipiter cooperii*						1																									
Northern Goshawk	*Accipiter gentilis*																										1					
UNID Accipiter																																
Red-tailed Hawk	*Buteo jamaicensis*																															1
American Kestrel	*Falco sparverius*			1	1	1	4	1	1																							
Merlin	*Falco columbarius*	1					1																									
Virginia Rail	*Rallus limicola*																															
Sandhill Crane	*Grus canadensis*																															
Spotted Sandpiper	*Actitis macularia*																															
Solitary Sandpiper	*Tringa solitaria*																															
Semipalmated Sandpiper	*Calidris pusilla*																															
UNID Shorebird																																
UNID Plover																																
Ring-billed Gull	*Larus delawarensis*		2	4	3			3	15				3		4	1		2		7	4	2		3		1	1	3	2	9	4	24
Herring Gull	*Larus argentatus*						1					2																				
Great Black-backed Gull	*Larus marinus*																															
UNID Gull																			4		1		2		3		1					
Caspian Tern	*Hydroprogne caspia*																															
Common Tern	*Sterna hirundo*																															
Mourning Dove	*Zenaida macroura*				2			1							3					8												
Black-billed Cuckoo	*Coccyzus erythropthalmus*																															
UNID Cuckoo																				1												
Short-eared Owl	*Asio flammeus*																					1										
Ruby-throated Hummingbird	*Archilochus colubris*																															
Belted Kingfisher	*Ceryle alcyon*																			2												
Yellow-bellied Sapsucker	*Sphyrapicus varius*						1				1																					
Downy Woodpecker	*Picoides pubescens*																					2					1					
Hairy Woodpecker	*Picoides villosus*																										1	1				
Northern Flicker	*Colaptes auratus*					1			1	1	1	1									1											
Yellow-bellied Flycatcher	*Empidonax flaviventris*																															
Alder Flycatcher	*Empidonax alnorum*																															
Least Flycatcher	*Empidonax minimus*																															
UNID Empidonax																																
Eastern Phoebe	*Sayornis phoebe*						1	3	2	3		2	1			6				2	2	2										
Great Crested Flycatcher	*Myiarchus crinitus*																															
Eastern Kingbird	*Tyrannus tyrannus*																															
Northern Shrike	*Lanius excubitor*																					1										
Blue-headed Vireo	*Vireo solitarius*						1		4	1		5					3					1	1									
Warbling Vireo	*Vireo gilvus*																															
Red-eyed Vireo	*Vireo olivaceus*					1																										
Blue Jay	*Cyanocitta cristata*	2	53	7	257	8	6	502	46	9	1	2	1	8	35	6		2	19	25	36	22	30	8		4	3	10	2	2	2	1
American Crow	*Corvus brachyrhynchos*		1				3			2	2			2	1				43	8	5	5	2	4		43		1				
Common Raven	*Corvus corax*																						2							2	1	
Purple Martin	*Progne subis*																															
Tree Swallow	*Tachycineta bicolor*																															
Bank Swallow	*Riparia riparia*																															
Cliff Swallow	*Petrochelidon pyrrhonota*																															
Barn Swallow	*Hirundo rustica*																															
UNID Swallow																																
Black-capped Chickadee	*Poecile atricapillus*	2				2				1	1	2	1						3		3		2	4			2			2		
Red-breasted Nuthatch	*Sitta canadensis*															1					1	1										
White-breasted Nuthatch	*Sitta carolinensis*									1																						
Brown Creeper	*Certhia americana*																						1									
House Wren	*Troglodytes aedon*														1																	
Winter Wren	*Troglodytes troglodytes*			1										1				1									1					
Golden-crowned Kinglet	*Regulus satrapa*			16		11	16	19	13	7	16	8	3	1	4	25	15	2	3	6	5	6	3	1		1	5	1		1	1	
Ruby-crowned Kinglet	*Regulus calendula*	2	4	19	4	14	15	11	10	10	11	12	6	3	17	17	7	23	4	8	2	5		2				2		1	2	1
UNID Kinglet																																
Blue-gray Gnatcatcher	*Polioptila caerulea*																															
Eastern Bluebird	*Sialia sialis*														1		3															
Veery	*Catharus fuscescens*																															
Gray-cheeked Thrush	*Catharus minimus*																															
Swainson's Thrush	*Catharus ustulatus*			1																												
Hermit Thrush	*Catharus guttatus*															4	3	3		4		3		1		1	1					
American Robin	*Turdus migratorius*		2				1	31	12	6	12	20			7	3	4	54	6	3	124	29	24	2			116	40		66	1	3
Gray Catbird	*Dumetella carolinensis*	1	1	2	1	1	1	2	2	1	1				2			1		1												
Brown Thrasher	*Toxostoma rufum*																															
European Starling	*Sturnus vulgaris*		25	25			50	11	277	40		20	25			280	120	30	16	189	73	64	51	4				8				
American Pipit	*Anthus rubescens*			10					2				5		12		2															
Cedar Waxwing	*Bombycilla cedrorum*			34			6	7		4		7		1	13																	
Orange-crowned Warbler	*Vermivora celata*							1																								
Nashville Warbler	*Vermivora ruficapilla*								1																							
Yellow Warbler	*Dendroica petechia*																															
Chestnut-sided Warbler	*Dendroica pensylvanica*																															

Attachment F - Summary of Fall Area Searches

COMMON NAME	***SCIENTIFIC NAME***	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**
		12-Aug-08	13-Aug-08	14-Aug-08	15-Aug-08	16-Aug-08	25/08/08	26/08/08	27/08/08	28/08/08	29/08/08	30/08/08	31/08/08	1/9/2008	2/9/2008	3/9/2008	4/9/2008	5/9/2008	6/9/2008	7/9/2008	8/9/2008	9/9/2008	10/9/2008	11/9/2008	12/9/2008	13/9/2008	14/09/2008	15/9/2008	16/9/2008	17/09/2008	18/09/2008	19/09/2008	21-Sep-08	22-Sep-08	23-Sep-08	24-Sep-08	25-Sep-08	26-Sep-08
BIRDS																																				
Magnolia Warbler	*Dendroica magnolia*							2	3					2	1		5		5							2					1					
Black-throated Blue Warbler	*Dendroica caerulescens*															1																				
Yellow-rumped Warbler	*Dendroica coronata*																													1	2		38	12		1	6
Black-throated Green Warbler	*Dendroica virens*															1														1			2			
Blackburnian Warbler	*Dendroica fusca*															1																				
Pine Warbler	*Dendroica pinus*													6																						
Palm Warbler	*Dendroica palmarum*																			1			6	2		4	2	1	2	9		1		2	4	1	
Blackpoll Warbler	*Dendroica striata*																1			3						1								3			
Common Yellowthroat	*Geothlypis trichas*		2	1		1			1		1	2	4	8	5	3	3	1	8	3	1		4	1		3		1	4	3	3	2	2	1	1	1	1	1
Wilson's Warbler	*Wilsonia pusilla*																		2	1																	
Canada Warbler	*Wilsonia canadensis*																	1								1					1						
UNID Warbler					2		1			1	2	1									2		4		1	5		1	1	1		3			3	1	4	3
Eastern Towhee	*Pipilo erythrophthalmus*	2	1	2	1	2		1												1	1					1			1		1			2	4	2	
Chipping Sparrow	*Spizella passerina*	1			2																													2			
Clay-colored Sparrow	*Spizella pallida*		1			1																							10								
Field Sparrow	*Spizella pusilla*		5	1	1	9				1			1	14	6	4	4		5	8	2		2				6	1	4		2			1		1	
Vesper Sparrow	*Pooecetes gramineus*																																				
Savannah Sparrow	*Passerculus sandwichensis*																										8	4						18	2	3	
Fox Sparrow	*Passerella iliaca*																																				
Song Sparrow	*Melospiza melodia*	14	15	10	13	13	5	13	6	3	6	14	9	25	6	4	7	3	12	16	3	2	9	8	1	11	14	3	9	2	9	9		15	35	28	12	3
Lincoln's Sparrow	*Melospiza lincolnii*																																				
Swamp Sparrow	*Melospiza georgiana*																																			1	
White-throated Sparrow	*Zonotrichia albicollis*																						1						3						3	2	1
White-crowned Sparrow	*Zonotrichia leucophrys*																																				
UNID Sparrow																					2		5			3								8			
Dark-eyed Junco	*Junco hyemalis*																																				
Northern Cardinal	*Cardinalis cardinalis*				1	1							1																								
Rose-breasted Grosbeak	*Pheucticus ludovicianus*												1			2							1											1			
Bobolink	*Dolichonyx oryzivorus*															1																					
Red-winged Blackbird	*Agelaius phoeniceus*				3																												20				
Eastern Meadowlark	*Sturnella magna*					1																								2		1	4	6	9		
Rusty Blackbird	*Euphagus carolinus*																																		1		
Common Grackle	*Quiscalus quiscula*					3							1																				3				
Brown-headed Cowbird	*Molothrus ater*																																				
Baltimore Oriole	*Icterus galbula*				3												1																				
UNID Icterid																																					
Purple Finch	*Carpodacus purpureus*																																2				
UNID Finch																																					
Pine Siskin	*Carduelis pinus*																																1	1			
American Goldfinch	*Carduelis tristis*	3	14	9	10	15	8	23	16	6	3	11	14	19	23	16	15	2	8	30	5		29	22	5	41	5	54	42	10	176	32	61	85	78	3	11	13
UNID Passerine									12				95																								

Attachment F - Summary of Fall Area Searches

COMMON NAME	***SCIENTIFIC NAME***	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**	**DATE:**
		27-Sep-08	28-Sep-08	29-Sep-08	30-Sep-08	1-Oct-08	2-Oct-08	3-Oct-08	4-Oct-08	5-Oct-08	6-Oct-08	7-Oct-08	8-Oct-08	9-Oct-08	10-Oct-08	11-Oct-08	12-Oct-08	13-Oct-08	14/10/2008	15/10/2008	16/10/2008	18/10/2008	19/10/2008	20/10/2008	21/10/2008	22/10/2008	23/10/2008	24/10/2008	25/10/2008	26/10/2008	27/10/2008	28/10/2008
BIRDS																														
Magnolia Warbler	*Dendroica magnolia*																													
Black-throated Blue Warbler	*Dendroica caerulescens*					2																								
Yellow-rumped Warbler	*Dendroica coronata*	1	1	22	2	3	5	12	9	20	10	13	4	8	2		7	2		1							1				
Black-throated Green Warbler	*Dendroica virens*																													
Blackburnian Warbler	*Dendroica fusca*																													
Pine Warbler	*Dendroica pinus*																										18			
Palm Warbler	*Dendroica palmarum*	1			2	8		1	25	1	1			11	9	1	2	12		12										
Blackpoll Warbler	*Dendroica striata*					1																								
Common Yellowthroat	*Geothlypis trichas*																													
Wilson's Warbler	*Wilsonia pusilla*																													
Canada Warbler	*Wilsonia canadensis*																													
UNID Warbler			3	8	54	2	13	26	66	18	11	4	4		2		2													
Eastern Towhee	*Pipilo erythrophthalmus*		1	1		2	4	4	5	1		2			1		1	3		1										
Chipping Sparrow	*Spizella passerina*														3															
Clay-colored Sparrow	*Spizella pallida*																													
Field Sparrow	*Spizella pusilla*				3		2			3				2			2	4												
Vesper Sparrow	*Pooecetes gramineus*													1																
Savannah Sparrow	*Passerculus sandwichensis*					15		1	2	3	5			2																
Fox Sparrow	*Passerella iliaca*																1													
Song Sparrow	*Melospiza melodia*	11	8	8	7	19	14	22	20	29	8	13	3	7	20	20	24	14	18	15	4	4	8	3		1	1	1	1	3	6	2
Lincoln's Sparrow	*Melospiza lincolnii*			5									1			1		1												
Swamp Sparrow	*Melospiza georgiana*		1		1													2												
White-throated Sparrow	*Zonotrichia albicollis*	3		2	8	5	25	5	22	19	4	7	1	12	22	23	24	14	3	6	3	2					7			2	1	3
White-crowned Sparrow	*Zonotrichia leucophrys*	2	1	1		2	1			2	2	1		12		8			4	6	3	3								1		
UNID Sparrow			8		5										2			1	2												
Dark-eyed Junco	*Junco hyemalis*						3		2					3	4	3	3	1		26	124	22	13	19		11	14	6	2	1	2	4
Northern Cardinal	*Cardinalis cardinalis*																														
Rose-breasted Grosbeak	*Pheucticus ludovicianus*																														
Bobolink	*Dolichonyx oryzivorus*																														
Red-winged Blackbird	*Agelaius phoeniceus*		15	10			8			16	1	26	3		45	24	139	6													
Eastern Meadowlark	*Sturnella magna*			1	2														3	3		1	3				1	1			
Rusty Blackbird	*Euphagus carolinus*																8			14		108	18	30							
Common Grackle	*Quiscalus quiscula*							120	272			8			257					31	697	7	31			586		8			2
Brown-headed Cowbird	*Molothrus ater*			1				7			5	4			2			1													
Baltimore Oriole	*Icterus galbula*																														
UNID Icterid								22		5																2240		138			
Purple Finch	*Carpodacus purpureus*														3			2			7	1	73	1		3	34				
UNID Finch																											8				4
Pine Siskin	*Carduelis pinus*									1	2					12		2													
American Goldfinch	*Carduelis tristis*	3	10	21		1	4	34	18	4	20	6	4	1	11	12	7	3		12	3	13	4				7	1		1	
UNID Passerine																															

Appendix C2

Acadia Radar Study

APPENDIX C2 – ACADIA RADAR STUDY

SUMMARY OF RESULTS ACADIA UNIVERSITY RADAR STUDY OF BIRD MIGRATION, OSTRANDER POINT

February 2009

SUMMARY OF RESULTS
ACADIA UNIVERSITY RADAR STUDY OF BIRD MIGRATION, OSTRANDER POINT

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SUMMARY OF RESULTS
ACADIA UNIVERSITY RADAR STUDY OF BIRD MIGRATION, OSTRANDER POINT

1.0 Introduction

1.1 BACKGROUND

Gilead Power Corporation is proposing the development of the Ostrander Point Wind Energy Park, which will be comprised of wind turbines generating up to 24 MW of renewable electricity. This project is located on Crown land within Prince Edward County. It also falls within the Prince Edward County South Shores Important Bird Area (IBA), which has been designated for its concentrations of migratory landbirds during spring and fall migration, among other things (IBA Canada, undated; Wilson and Cheskey, 2001). A particular area of concentration is the tip of Prince Edward Point, located approximately 10 km east of the project site.

The results of a radar-acoustic study conducted at Prince Edward Point in the spring of 2005 (Prince Edward Point Bird Observatory and EchoTrack, undated) suggested that nocturnally-migrating songbirds cross directly over Lake Ontario, as well as along the shoreline from the west and east. In spring, Prince Edward Point provides the first landfall opportunity for these individuals. Radar results indicated that the flight activity, as measured by the number of flights per minute, increased sharply between 1.25 and 1.5 hours after dusk, with a second peak between 6 and 7 hours after dusk (2 to 3 hours before dawn) (Prince Edward Point Bird Observatory and EchoTrack, undated). Average minimum height of targets was lowest at these times, which led the author to conclude that these peaks represented departing and arriving migrants, respectively (Prince Edward Point Bird Observatory and EchoTrack, undated). Arriving migrants were observed to prefer forested and shrub areas on Prince Edward Point.

In North America, nocturnal migrants comprise the majority of bird fatalities attributable to wind energy facilities. However, the numbers affected are small relative to the overall populations of these species, and mortality of nocturnal migrant passerines from wind energy facilities is not considered to be significant (Arnett et al., 2007). Numbers of bat fatalities at North American facilities are comparatively higher, and the potential population effects are less certain. Additionally, the proximity of the site to the shoreline of Lake Ontario is thought to present a higher risk to migratory bats by the Ontario Ministry of Natural Resources (2007). As part of the project consultation process for the proposed Ostrander Point Wind Energy Park, and based on the potential significance of the area for migratory landbirds, Environment Canada recommended that radar studies be conducted during the spring and fall bird migration (Environment Canada, letter to M. Dawson, March 17, 2008). As a result, the proponent elected to participate in an integrated research study conducted by Acadia University, Bird Studies Canada and Environment Canada.

1.2 STUDY OVERVIEW

Radar studies were conducted nightly by Acadia University on the Ostrander Point Crown land block between May 4 and May 31, 2008 and between August 11 and October 30, 2008. The radar was run continuously from one half hour before sunset to between 1 and 3 hours after sunrise. Data acquired during periods of rain were removed from the analysis. The Acadia

SUMMARY OF RESULTS
ACADIA UNIVERSITY RADAR STUDY OF BIRD MIGRATION, OSTRANDER POINT
Introduction
February 2009

summary report (Taylor, 2008) is provided in **Attachment 1**. This document provides a detailed description of the equipment, methods, calibrations, corrections and calculations employed in the radar study. The location of the radar unit is shown in **Figure 3** of **Appendix C1**.

The radar unit detects biological targets, which can include birds, bats, and insects. Because insects are thought to fly more slowly than birds and bats, Taylor (2008, **Attachment 1**) screened the data to eliminate insects by using an airspeed cutoff of 10 m/s.

SUMMARY OF RESULTS
ACADIA UNIVERSITY RADAR STUDY OF BIRD MIGRATION, OSTRANDER POINT

2.0 Summary of Results

2.1 MIGRATION ACTIVITY

Taylor (2008) presents the estimated density of biological targets per km^3 (x.corr) and the mean traffic rate (MTR), expressed as the number of targets per km^2 per hour, and calculated as x.corr multiplied by the average groundspeed and by 1 km (the assumed height of sky being sampled). These measures of migratory activity are presented for each hour interval through the night, by 50 m height intervals between 0 m and 1000 m (Taylor, 2008; **Attachment 1**).

For this summary report, by dividing by 20, the MTR was adjusted to reflect the estimated number of targets passing through each 50 m height interval across a 1 km length perpendicular to the direction of travel. These data were summed across each season to indicate the total estimated number of targets passing through each height zone for each time interval (**Tables 1** and **2, Attachment 2**).

In spring, approximately 70,355 targets were detected. Of these, an estimated 41% were detected between 50 m and 150 m above ground (**Table 1**, **Attachment 2**). The proportion that fell within this height interval varied considerably across the season, and likely was related to weather conditions. The proportion that fell within this height interval ranged from 9% on May 12 (on which date the largest number of targets was recorded), to 73% on the night of May 22 (on which date the smallest number of targets was recorded) (**Table 3, Attachment 2**).

In fall, approximately 160,649 targets were detected. Of these, an estimated 50% were detected between 50 m and 150 m above ground (**Table 2**, **Attachment B**). The proportion that fell within this height interval ranged from 25% on September 18, to 86% on August 23 (**Table 4, Attachment 2**).

2.2 DISCUSSION

Taylor (2008**, Attachment 1**) indicated that patterns of movement and flight altitude varied widely during migration. Under certain weather conditions or during periods of ascent and descent, higher numbers of targets flew at lower altitudes, however, no general conclusions were drawn.

Taylor (2009, pers. comm.) argues strongly that the measures of flight activity and target density determined by different radar studies cannot be directly compared due to differences in equipment configuration, calibration, data processing and analysis, and interpretation. As a result, no formal comparison among studies was attempted.

The risk of collision is determined by two factors: the number of targets passing through the airspace at the height of turbine blades, and the probability of interaction (Plissner et al., 2008). The probability of interaction is dependent on the exposure rate, which varies from minimal to

maximal according to whether the turbines are oriented along the axis of primary flight direction or perpendicular to it, as well as the flight speed of the target, size of target, rotor speed, and blade dimensions (Plissner et al., 2008). Consequently, it should not be assumed that all targets flying between 50 and 150 m are at risk of collision with wind turbines, because if oriented perpendicular to the direction of migration travel, a single wind turbine occupies a maximum of 90 m of the 1 km length perpendicular to travel. Additionally, under many conditions, some birds and bats will detect and alter flight paths to avoid collision (EchoTrack Inc., 2005; Plissner et al., 2008).

3.0 References

Arnett, E. B., D. B. Inkley, D. H. Johnson, R. P. Larkin, S. Manes, A. M. Manville, J. R. Mason, M. L. Morrison, M. D. Strickland, and R. Thresher. 2007. Impacts of wind energy facilities on wildlife and wildlife habitat. Wildlife Society Technical Review 07-2. The Wildlife Society, Bethesda, Maryland, USA.MNR 2007 guidelines

EchoTrack Inc. 2005. An Investigation of a New Monitoring Technology for Birds and Bats. Prepared for Suncor Energy Products Inc., Vision Quest Windelectric-TransAltas's Wind Business, Canadian Hydro Developers, Inc., and Enbridge Inc. August 2005.

Plissner, J. H., B. A. Cooper, R. H. Day, P. M. Sanzenbacher and T. J. Mabee. 2008. Models for estimating bird fatalities at wind energy facilities. Presentation to Wind Wildlife Research Meeting VII, October 28-29, 2008. Milwaukee, WI.

Prince Edward Point Bird Observatory and EchoTrack Inc. undated. Avian Populations and Flight Behaviour at Prince Edward Point Bird Observatory. Preliminary Findings.

Taylor, P.D. 2008. Radar Studies of Bird Migration at Ostrander Point, ON. Spring and Fall, 2008. Summary Report prepared for Gilead Power, December 2008.

Attachment 1

Acadia Report

Radar studies of bird migration at Ostrander Point, ON.
Spring & Fall, 2008.

Summary report on data collected for Gilead Power.

Philip D. Taylor, Department of Biology, Acadia University.
5 December 2008.

The statements and summaries presented herein are intended to aid consultants at Stantec in the preparation of their Environment Impact Assessment for Gilead Power, not as a standalone EA document, in whole or in part.

Methods

Hardware: Radar

All radar data were acquired with a 25 kw Furuno 1964 BB with a modified parabolic antenna (Rosendale, 24 inch dish). The dish has a theoretical beam width of 4°. For the duration of the study, the radar was run at short pulse, with a maximum range of ~5 km. All internal Furuno software settings (e.g. sea/rain clutter) were disabled or set to zero, but these are also known, through out own tests, to be bypassed by the Sigma S6 card. Thus, the signal that was processed for biological target detection was the 'raw' signal from the radar scanner.

Hardware: Radar Scan converter

Radar data were digitized using a Sigma S6 radar scan converter (Ruttter Technologies. During the spring session, the signal was digitized with a sampling rate of 4096 pulses/scan (1 scan = ~ 2.4 s revolution of the antenna) and 1024 samples/pulse (e.g. a resolution of ~ 5 m per sample within a pulse). During the fall, the signal was digitized with a sampling rate of 1024 pulses/scan and 1024 samples/pulse.

Software:

The digital signal produced by the radar scan converter was captured and processed by the open source software, radR (radr.wik.is). radR uses a simple moving average/z-score method to extract putative biological signals from background; these 'blips' are stored in files (blipmovie archive format) for later viewing and processing (for details see radr.wik.is). Within radR, we used the tracker 'plugin' to combine multiple hits of putative targets into tracks.

All data were saved to text files for further processing (see below). All further processing was done using the R statistical language (R Statistical core team; v. 2.8.0).

Implementation
The radar was mounted ~2 m above ground at UTM 339429 (E) 4862816 (N) ~370 m SW of the Helimax meteorological tower, on Ostrander Point, Prince Edward County, ON. It was run continuously (except for technical failures) from 1 May through 31 May 2008 and from 11 Aug to 29 October 2008 (inclusive). The specific parameters set while running radR are presented in Appendix 1.

From 1-13 May 2008 , the antenna was run with the antenna at an angle of 30 degrees off the horizontal; For all other sampling, the antenna was at an angle of 20 degrees off the horizontal. Angles were chosen to best obtain information on patterns of target movement at lower elevations. This meant that information from higher targets was sacrificed. Although the unit was operated at a nominal range of ~ 5 km, the practical range is considerably less and varies with target size. This is true of all radars, and is due in party to the attenuation of both the transmitted and reflected signals with distance, as detailed in the 'radar equation' (Larkin 2005). The radar cross section of targets (the amount of reflected energy seen by the radar) decays by about a fourth power with distance (Gauthreaux & Livingston 2006; Schmaljohann et al. 2008) so, with a 25 kw radar, small songbirds beyond about 1.4 km range are usually not detected. When the antenna is at an angle of 20°, a 1.4 km range translates into an altitude of ~ 500 m.

The radar was run continuously from ~ ½ h before sunset to 1-3 h after sunrise. Days in each period were lost due to equipment failure: 1 night in spring (97% coverage) and 7 nights in fall (91% coverage). Data were acquired during periods of rain, but these were subsequently identified, and removed from the analysis. The advantage of running the unit through the rain is that behavior of target before and after these weather events can be observed.

Calibration and detection probabilities
It is difficult to distinguish between insects, birds and bats using scanning radar because all biological targets reflect radar energy, and the relationship between target size and reflected energy is non-linear. In particular, bats are problematic, since radar cross-sections completely overlap those of birds. Biologists must therefore infer the identity of biological targets from other sources of information.

For example, we can sometimes distinguish birds from bats by patterns of movement – foraging bats have more curved paths than migrating birds, which are straight, but we cannot distinguish migratory bats if they are moving in a straight line. Many biologists use an airspeed cutoff to make the distinction. This cutoff is usually set at 8 m/s; birds are thought to usually flying faster than that speed, and insects to fly slower (e.g. see Shmaljohann et al 2008). However, some empirical work suggests that there is still considerable overlap; for example, Odonates can fly at airspeeds of up to 11 m/s (Feng et al. 2006) and obviously birds in some situations (e.g. when soaring) fly more slowly than 8 m/s.

Insect "contamination"
Periods when insects were known to be migrating (from daily visual observations) and likely bird movement (later in the year) were selected from all blipmovies. For example, in late August and early Sept there was a massive movement of Odonates at the site, likely consisting mostly of Green Darners (*Anax junius)* a well-known migrant (Russell 1998). These were major accumulations that occurred just before sunset and just before and after sunrise, and so targets detected by the radar were likely almost 100% insects.

I examined air speeds for these targets and determined maximum ranges for insect targets (e.g. smaller radar cross sections). As Schmaljohann (2007) I plotted the maximum range of detection under different conditions to determine minimum ranges beyond which insects can be considered a problem. For Odonates in this study, these ranges were ~ 800 m range, which at 20 deg antenna is about 275 m in altitude; these are likely the largest insects, smaller ones are only detected below this altitude. Such a pattern was consistent with patterns observed on other days in early Sept (up to 15 Sept) and some later in the month. I used these patterns to infer possible nighttime movement of Odonates (or other larger insects that are known to migrate; e.g. Armyworms), but these cannot be separated unequivocally.

I also tallied counts of nocturnally migrating songbirds (from daily ground counts) and computed Spearman's rank correlations those with MTR and raw counts of tracks observed the night before. Correlations were positive in both cases, and significantly different from zero (0.47, $p < 0.001$; 0.58, $p < 0.001$). I did the same for numbers of bat detections (with data provided by Stantec) but found no correlation (cor = -0.12; $p = 0.39$) between total counts across all four detectors and counts of migratory birds from the radar. Nights with high bat activity are not necessarily associated with high migration traffic, although this obviously needs more in-depth exploration.

Data summary
Data captured by program radR were processed as follows. All putative targets (blips) were first filtered using a set of parameters that, through visualizations of known insect and bird movements, appeared to best capture the bulk of targets that were birds, while eliminating at least some insects, rain, and other clutter. All targets were then processed through a tracking algorithm in radr (Shafique and Shah 2005) using parameters that captured tracks of migrating birds well (i.e. straight tracks of targets with airspeeds > 10 m/s), while eliminating spurious tracks during periods of intense activity (e.g. curved tracks, or tracks that were clearly in a direction not consistent with the pattern of movement being observed). The approach is conservative in that it underestimates the numbers of targets; however, it gives better estimates of speed and direction of real targets moving through the area.

Because signal strengths of radar beams attenuate towards the edges data are biased against the detection of targets closer to the radar (and hence at lower altitudes). This bias is partly because the radar beam samples a smaller airspace closer to the source of the beam which means that fewer targets of interest (e.g. birds) intersect the beam, and a larger number of spurious targets are detected (e.g. insects) which can contaminate or

make track finding difficult. I estimated the extent of this bias by examining the relative number of targets at 100 m altitude bins in data sets containing only targets determined to be part of tracks) to the same data sets containing information on all targets detected by the radar. Empirically, this confirmed that estimates of target density at lower altitudes are likely lower than the true estimates, and target densities at higher altitudes are likely higher. Examining 5 nights with a strong pattern of migration, I determined that the point of no bias is approximately 230 m altitude (with our particular configuration of hardware, software, and track extraction parameters) and for the 100 – 200 m altitude bin estimates of target density (and hence migration traffic rates) are roughly a minimum of 75-95% of the true values.

Basic characteristics of all tracks detected by radR were computed: ground speed, altitude and bearing. Tracks were corrected for known air speed and direction obtained at 10 minute intervals from the nearby meteorological tower (at 60 m elevation) to obtain a target airspeed and heading, corrected for air movement. Plots of each migration night showing target elevation through time (at 3 different airspeeds) were produced for inspection and to aid in interpretation (Appendix 1 & 2). I then amalgamated data into bins of 1/3 h duration, and 100 m altitudinal ranges, to compute summary statistics for plotting and interpretation. Circular mean and rho were computed using the 'circular' package in R. Target density was calculated by first estimating the volume of sky sampled in each bin. This was done by first estimating an empirical 'beam width' from the 95^{th} quantile of the angular span of all targets detected by radR within each bin, and then dividing the observed number of targets by the volume of sky measured and the duration of time the sky was sampled.

Calculation of Migration Traffic Rate

The approach used is conservative, in that estimate of rate is at the low end of the 'true' rate. This is in part because of the parameters I associated with the tracking algorithm, and in part because I used a high cutoff (10 m/s) of airspeeds to eliminate most insect targets. A high airspeed also removes birds and bats but an inspection of the results suggests that the resulting patterns remain similar.

Although it has a somewhat straightforward interpretation (the number of targets passing perpendicular to an arbitrary 1 km line) the means for calculation of MTR is not always clear in the literature. Furthermore, there are several assumptions associated with the calculation that are violated on some nights. In particular, the calculation assumes a constant flow of migrants *in the same direction* during the period of measurement but we know there are some periods when migrants are moving in different directions at different (or even the same) altitude. Finally, an ambiguous part of the calculation is the altitude of the sampled airspace, which is assumed to be 1 km, but is often not stated (e.g. see Schmaljohann 2008). This assumed volume of space has an impact on the resulting MTR number because the probability of detection of targets changes with altitude. Nonetheless, I compute MTR as in Schmaljohann (2008) by multiplying the estimated target density (targets/km^3) by average groundspeed (km/h) and by 1 km (the assumed height of sky being sampled).

So for example, a density of 1000 targets/km^3 travelling an average of 50 km/h in 1 km of airspace is: 100 targets/km^3 * 60 km/h * 1 km = 6000 targets/km/h. I view this as most useful as an index *within a given study* to compare adjacent heights, or height bands within some known range of high probable detection. Even though it appears to be widely used in various reports and studies, I discourage users of these data from making direct comparisons of MTR among studies, until better means of calibrating results can be determined.

Analysis
I calculated MTR for all subsections of all nights (as described above). I also summarized these to produce an 'average' MTR for each night (e.g. the simple average across all times, and height bins), for each height bin (e.g. the simple average across all times, for each night, within each height bin) and for each hour since sunset (e.g. the simple average across all heights, for each hour, within each night). It should be stressed that the simple average of these numbers may not be comparable across studies, for reasons described above.

For additional insight, I present a visual picture of migration for a subset of nights. Each night shows different patterns of movement, which, while not quantitatively expressed, aid in assessing the potential risk of turbines to migratory birds. In particular, one would expect higher risks when large numbers of targets are moving at low altitudes, or when meteorological conditions are such that many targets are forced to fly at lower altitudes. These 'abnormal' conditions can be compared to 'normal' conditions, when migrants appear to travel with no changes through the night, and in the expected direction for the season (e.g. south in the fall, north in the spring). A visual comparison of the numbers and durations of times of 'abnormal' activity compared to 'normal' activity, thus gives a better sense of the relative risk of the site to migratory organisms. The visual method allows a focus on particular times during the night when targets might be more at risk – in particular during periods of ascent and descent.

Summary
Nights w/no data: Spring: 2 May; Fall: 20 August, 18 Sept, 12-15 Oct, 28 Oct.

Selection of nights with bird behavior pertinent to turbine-siting considerations.
Each plot is a summary of the migration traffic rate by time (GMT) and altitude (m). Only targets below 600 m altitude are shown. The black line on the left hand side of the plot shows the time of sunset. The orange line on the right hand side of the plot shows the time of sunrise. Pairs of blue lines show periods of rain, where no birds are detected.

The black arrows show, for combinations of altitude bins (50 m) and time bins (20 min) the circular mean of track bearings (geographic orientation), strength of direction (i.e. rho; the length of each arrow) and estimated migration traffic rate (log(MTR) ~ line thickness) of all targets moving > 10 m/s, throughout the night. The base of the arrow is situated at the mid-point of the height and time bin.

The plots are presented in separate pdf files (attached). Below are annotations for each night, giving my interpretation of what is going on.

3 May
Rain at beginning of night; strong migration between 0400 and 0800 after which there was more rain. The plot shows an increase in MTR with altitude through the night, with a decrease after the short period of rain (~0700). It also shows most targets (that in the spring are likely arriving from across the lake) are very high.

5 May
The plot shows migration beginning around 1.5 h after sunset, at lower altitudes, followed by strong migration between 0500 and 0700 at mid-high higher altitudes. Note the shift in wind from a southerly flow (until about 0600) to a NW flow around 0800. The shift in wind curtails the migration for the night, and is followed by higher densities at lower altitudes for a short period.

16 May
A night with a very high MTR (one of the highest) and no rain, or changes in weather. Good light flow of winds from the SW throughout the night. The pattern shows high densities of targets at lower altitudes than previous nights.

25 May
Another big night of migration, but with stronger, more southerly winds, and with a short period of rain. The birds kept migrating through the rain (there was only a short period with no targets detected). Note that before dawn, targets are ascending to higher altitudes; this is known as the ‘dawn ascent’, and is thought to be birds assessing the landscape for suitable placed to land. Note that there is no evidence of high densities of targets at lower altitudes during this period, which suggests that they did not choose to settle in the vicinity of the radar.

26 May
Another big night of migration, but with an extended period of rain. Note that before the rain the behaviour of targets is typical of a night such as 25 May (except that it begins much earlier) but that after the period of rain, targets are at generally lower altitudes, and stay there. A higher proportion of these targets is at lower altitudes than other nights.

29 May
This plot shows a) big migration of targets that are likely local (e.g. not from across the lake) at the beginning of the night (~ 0100) followed by another influx of targets after 0300 (likely representing targets that have arrived from across the lake). Targets show a different height profile from other nights. This may be due to a different atmospheric configuration in the altitude between 200 and 600 m, suggested by the low numbers of targets in that zone, and the pattern of bearings that suggest air at those altitudes was moving in a different direction from that at lower elevations.

Fall

11 Aug
Shows a extensive S movement throughout. Some re-orientation of targets is evident between 0300 and 0530 (smaller rho at lower altitudes indicates less overall directionality within that bin).

12 Aug
A shift in winds associated with strong N movement at 0300 shows a pattern of re-orientation of targets over a period of ~ 2 h. Many targets remained at high altitudes initially, but after 0500 targets were generally lower.

24 Aug
Wind switches at ~2 h after sunset; very strong S flow of birds through night; targets are up to relatively high altitudes. Insect activity at dawn. Some targets apparently moving N between 0100 and 0200, down low only; then additional targets low (fast moving, N, between 0600 and 1000).

25 Aug
Good movement throughout night, fast southerly targets (even with virtually no wind between 0100 and 0300). Some noticeable descent of targets by 0900

27 Aug
Nice wind shift to N after 0600. Targets were mostly at low altitudes even before the shift, but lower thereafter.

30 Aug
Huge number of targets, mostly heading S. Many at high altitudes.

03 Sept
Targets throughout the night at generally lower altitudes. Large emergence of insects at dawn, mostly moving S.

04 Sept
No insects; impressive movement on light NE winds until a shift in winds around 0700 to v. strong S. This shift was followed by a decrease in abundance and altitude of targets with many targets moving N. This likely represents re-orientation towards the shore after the wind shift.

09 Sept
Large movement, at low-high altitudes. Mostly moving S, but note that the directionality of targets lower down is quite mixed, in particular between 0200 and 0500. This does not appear to coincide with any shift in weather.

14 Sept
A major emergence of insects around dawn, after strong southerly winds changed to moderate NW – fast moving targets low-med height started around 0400 until dawn, mostly moving N). Between 0400 – 0700 the targets appear to be birds (fast moving,

lower densities) moving NE. Between 0700 – 0800 there is a huge influx of targets, moving with the wind, at about 16-17 m/s. The tail wind at that time is about 5-6 m/s – so these targets are fast, but on the edge of being insects. I'm inclined to think that they are either Odonates (which can fly at night) or some other insect (e.g. armyworms).

15 Sept
Massive continual movement throughout night on light S winds, many high up.

17 Sept – good movement, mostly high and S but some re-orientation and low directionality between 0700 and 1000.

20 Sept
Good example of wind shift, from strong S to strong N; targets pick up (mostly high up) during shift and then descend. Low rho values indicate some strong N movement low down between 0500 and 0600. Notice too that the wind shift appears sooner at higher altitudes – a good example of why corrections of target speed and direction for wind speed and direction is difficult without data at very high altitudes (which generally isn't available).

28 Sept
Good movement, mostly high, but low down N movement between 0600 and 0800
Interesting moving – many low targets, clearly flying N into the wind after 0600. Throughout the altitudinal bands after 0600 the target directions are highly variable. I suspect that there was fog, drizzle or something else happening in the morning.

01 Oct
Huge movement, mostly high, but lots of targets moving N lower. The movie is quite similar to 28 Sept … many targets low down, clearly flying in to the wind; many of these are non-directional, and are presumably birds descending or exploring for places to land

04 Oct
Large movement even through some small bands of rain.

06 Oct
Huge movement, mostly S, mostly higher up.

16 Oct
Good strong movement S, mostly high up. Targets show increased lack of directionality after 0500.

23 Oct
Good example of S movement in light S headwinds at beginning of night.

References

Feng et al. 2006. Ecological Entomology. Dragonflies migrating at night, between 5 and 11 m/s “Nocturnal migration of dragonflies over the Boihai Sea in northern China”

Gauthreaux, S.A. and J. W. Livingston. 2006. Monitoring bird migration with a fixed-beam radar and a thermal imaging camera. J. Field Ornithol. 77:319-328.

Larkin, R.P. 2005. Radar techniques for wildlife biology. Pages 448-464 in: C.E. Braun, editor. Techniques for wildlife investigations and management, 6th edition. The Wildlife Society, Bethesda, ML. USA.

Russell, R.W. et al. 1998. The American midland naturalist. 140: 325-342. Massive swarm migrations of dragonflies (Odonata) in Eastern North America.

Shafique, K. & M. Shah. 2005. A noniterative greedy algorithm for multiframe point correspondence. IEEE Trans. Pattern Anal. Mach. Intell. 27: 51-65.

Attachment 2

Tables

Table 1: Sum of targets in each height interval, all dates, spring 2008.

Sum of Targets/km/h	Hours Since Sunset													
Height	**-0.5**	**0.5**	**1.5**	**2.5**	**3.5**	**4.5**	**5.5**	**6.5**	**7.5**	**8.5**	**9.5**	**10.5**	**11.5**	**Total**
25	0.0	84.1	39.0	33.4	207.8	73.5	92.0	92.5	140.1	53.0	15.0	0.0	0.0	830.2
75	0.0	684.3	678.3	809.1	1,929.0	1,854.7	1,467.6	1,198.0	862.6	396.0	57.5	1.0	3.6	9,941.5
125	0.0	1,745.0	1,758.8	1,830.4	2,814.9	3,203.5	2,515.4	2,275.5	1,826.5	889.6	86.4	8.0	0.6	18,954.5
175	0.0	1,258.3	1,339.0	1,409.6	1,746.3	2,589.7	1,969.7	1,908.0	1,767.0	946.8	80.9	6.5	4.2	15,026.0
225	0.0	683.2	799.1	914.6	1,206.8	1,927.6	1,709.3	1,232.1	982.4	741.6	73.2	5.6	3.0	10,278.5
275	0.0	345.6	427.2	531.2	900.8	1,179.3	1,031.9	674.0	459.1	468.7	63.2	3.6	4.8	6,089.2
325	0.0	169.4	228.0	370.8	683.1	631.1	595.5	399.7	199.2	298.1	43.3	6.3	3.7	3,628.2
375	0.0	82.6	111.1	229.1	396.3	269.8	233.2	172.1	100.7	158.2	29.0	3.8	3.4	1,789.3
425	0.0	37.6	78.4	157.2	201.6	144.9	127.0	103.4	68.2	100.3	23.7	4.1	2.2	1,048.6
475	0.0	19.6	53.5	128.2	119.2	98.0	104.6	70.4	46.1	71.5	19.0	2.8	2.9	735.9
525	0.0	7.1	38.9	96.0	100.7	75.6	78.0	54.9	35.3	46.9	16.8	5.5	1.2	557.1
575	0.0	3.9	31.7	87.8	75.4	58.1	53.0	40.8	24.0	32.9	12.3	3.8	2.2	426.0
625	0.0	1.4	27.5	74.9	61.1	55.6	36.4	25.3	19.9	20.2	8.6	2.4	4.3	337.6
675	0.0	0.5	19.7	49.2	41.8	39.2	28.6	18.3	18.5	14.0	7.9	1.8	2.3	241.9
725	0.0	0.2	14.0	28.2	32.4	24.8	22.2	12.7	12.8	12.9	5.3	1.7	1.4	168.4
775	0.0	0.2	8.6	13.8	23.9	16.2	15.8	10.3	8.9	7.8	3.9	1.5	1.6	112.4
825	0.0	0.4	5.7	7.3	15.4	14.0	10.3	6.1	7.3	5.2	2.8	1.2	1.9	77.4
875	0.0	0.6	4.3	8.4	9.4	8.8	5.2	4.0	7.2	4.0	2.5	1.5	0.3	56.2
925	0.0	0.0	2.5	4.6	6.9	5.7	3.0	2.8	3.9	2.3	0.8	0.6	0.1	33.3
975	0.0	0.0	2.1	2.4	4.3	3.5	2.6	1.7	3.2	1.4	1.2	0.5	0.1	23.2
Total	**0.0**	**5,123.9**	**5,667.4**	**6,786.3**	**10,577.2**	**12,273.6**	**10,101.3**	**8,302.6**	**6,592.7**	**4,271.4**	**553.3**	**61.9**	**44.0**	**70,355.6**
Proportion in Potential Risk Zo	**0.0**	**0.5**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.4**	**0.3**	**0.3**	**0.1**	**0.1**	**0.4**

Table 2: Sum of targets in each height interval, all dates, fall 2008.

Sum of Targets/km/h	Hours Since Sunset																
Height (m)	**-0.5**	**0.5**	**1.5**	**2.5**	**3.5**	**4.5**	**5.5**	**6.5**	**7.5**	**8.5**	**9.5**	**10.5**	**11.5**	**12.5**	**13.5**	**14.5**	**15.5**	**Total**
25	-	205.3	313.4	218.1	560.3	507.5	642.1	727.9	604.1	321.8	315.1	586.1	197.8	110.0	124.0	144.8	-	5,578.3
75	-	1,933.2	2,995.9	2,787.5	3,657.1	3,788.7	4,177.9	4,413.5	3,561.9	2,677.3	1,925.2	2,112.6	1,121.4	526.8	556.4	395.0	9.6	36,639.9
125	-	2,593.5	4,182.7	4,216.3	4,752.3	4,770.6	4,997.2	4,686.0	3,504.1	3,068.7	2,045.1	2,462.6	1,448.9	384.0	356.1	135.8	6.0	43,609.8
175	-	1,171.4	2,585.2	3,416.2	3,567.7	3,813.3	3,528.8	3,246.4	2,602.8	2,089.8	1,276.3	1,540.0	924.0	311.0	190.6	77.2	1.5	30,342.1
225	-	553.7	1,577.9	2,243.9	2,388.0	2,482.1	2,164.1	1,995.2	1,704.6	1,294.4	773.0	788.0	483.6	183.2	127.4	51.5	1.8	18,812.4
275	-	304.4	950.6	1,415.6	1,518.1	1,528.0	1,300.5	1,156.8	1,057.6	781.6	456.4	342.6	238.9	80.3	74.2	28.1	0.8	11,234.4
325	-	177.0	586.1	919.3	902.5	910.9	799.9	751.5	605.8	401.6	256.4	173.5	106.4	40.5	41.0	20.1	0.3	6,692.8
375	-	94.8	372.2	565.5	520.2	529.7	499.6	447.1	350.6	226.7	141.2	85.4	42.4	16.4	22.9	11.2	0.1	3,926.1
425	-	47.9	219.8	305.3	291.7	280.7	260.8	235.7	187.5	113.0	73.6	39.1	15.6	8.9	12.8	7.1	0.5	2,100.1
475	-	24.1	119.3	147.2	135.4	123.5	114.1	107.9	81.2	51.7	33.2	17.0	7.3	4.9	6.4	4.2	0.1	977.5
525	-	10.5	50.1	58.5	49.8	50.4	44.2	46.6	36.5	22.7	14.3	8.9	3.8	2.6	3.3	2.3	-	404.6
575	-	5.3	25.5	30.3	21.0	25.0	20.1	18.0	16.5	12.8	8.3	3.5	2.1	1.3	1.8	1.6	0.0	193.1
625	-	3.3	12.5	12.8	11.0	10.4	7.2	6.0	5.3	5.0	3.8	2.1	0.8	0.7	1.6	0.9	-	83.5
675	-	1.7	4.9	3.8	3.8	3.2	2.9	2.4	2.0	1.3	1.4	1.3	0.5	0.2	0.8	0.7	-	30.8
725	-	0.6	1.5	1.2	1.6	1.0	1.0	1.0	0.9	0.8	0.4	0.6	0.2	0.1	0.4	0.3	-	11.5
775	-	0.6	0.5	0.6	0.5	0.2	0.6	0.5	0.6	0.3	0.0	0.3	0.1	0.1	0.2	0.2	-	5.1
825	-	0.4	0.2	0.3	0.4	0.1	0.4	0.3	0.2	0.1	0.1	0.3	0.0	0.1	0.0	0.0	-	3.0
875	-	0.2	0.2	0.2	0.3	0.1	0.1	0.2	0.1	0.0	0.1	0.2	-	0.1	0.0	0.0	-	1.8
925	-	0.2	0.1	0.1	0.2	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	-	1.1
975	-	0.1	0.1	0.1	0.1	-	0.1	0.1	0.1	0.1	0.0	0.1	0.0	0.0	0.0	0.0	-	1.0
Total	**-**	**7,128.3**	**13,998.6**	**16,342.8**	**18,382.0**	**18,825.5**	**18,561.4**	**17,843.3**	**14,322.5**	**11,069.7**	**7,324.1**	**8,164.0**	**4,593.8**	**1,671.4**	**1,520.0**	**881.0**	**20.6**	**160,649.0**
Proportion in Potential Risk Zor	**-**	**0.635**	**0.513**	**0.429**	**0.457**	**0.455**	**0.494**	**0.510**	**0.493**	**0.519**	**0.542**	**0.560**	**0.559**	**0.545**	**0.600**	**0.602**	**0.754**	**0.500**

Table 3: Proportion of total targets that are in the zone of potential risk (50-150 m), spring 2008.

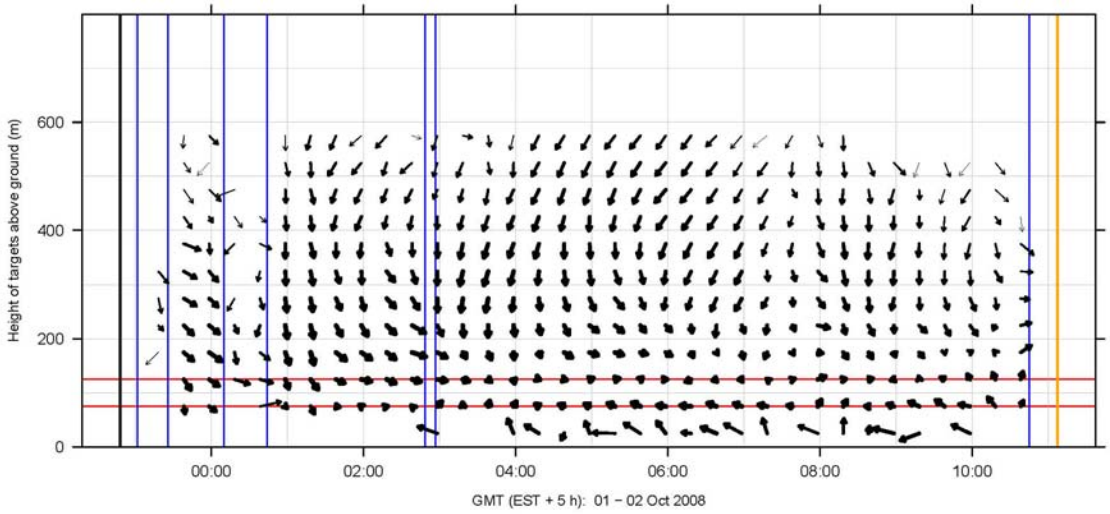
	Hours Since Sunset													
Date	**-0.5**	**0.5**	**1.5**	**2.5**	**3.5**	**4.5**	**5.5**	**6.5**	**7.5**	**8.5**	**9.5**	**10.5**	**11.5**	**Daily %**	**Total Targets**
5/4/2008				0.255	0.143	0.153	0.079	0.082	0.153					0.118	2,416.7
5/5/2008		0.196	0.121	0.279	0.332	0.457	0.606	0.384	0.379	0.390	0.335			0.316	1,655.9
5/6/2008		0.200	0.164	0.233	0.237	0.197	0.297	0.458	0.386	0.635	0.114			0.301	3,353.5
5/7/2008		0.674	0.607	0.439	0.629	0.472	0.556	0.446	0.495	0.434	0.097			0.504	1,841.7
5/8/2008				0.147		0.159	0.114	0.060	0.061	0.154				0.107	1,640.2
5/9/2008		0.174	0.305	0.281	0.236	0.302	0.271	0.230	0.207	0.461	0.759			0.261	1,172.2
5/10/2008		0.392	0.570	0.566	0.304	0.366	0.338	0.572	0.197	0.402	0.363			0.428	307.1
5/11/2008		0.344	0.309	0.285	0.433	0.438	0.515	0.466	0.426	0.311	0.200			0.411	2,028.1
5/12/2008		0.814	0.059	0.064	0.047	0.103	0.112	0.135	0.188	0.034	0.035			0.091	8,677.1
5/13/2008		0.347	0.184	0.185	0.182	0.156	0.059	0.045	0.099	0.183	0.267			0.120	1,813.9
5/14/2008		0.511	0.664	0.306	0.185	0.343	0.253	0.299	0.216	0.141	0.070	0.052	0.095	0.263	2,671.4
5/15/2008		0.413	0.367	0.379	0.377	0.517	0.503	0.346	0.406	0.528	0.853			0.407	2,935.8
5/16/2008		0.455	0.543	0.468	0.406	0.613	0.699	0.724	0.544	0.546	0.913			0.505	1,669.3
5/17/2008		0.750	0.635	0.463	0.352	0.457	0.455	0.451	0.471	0.288	0.220			0.440	5,334.4
5/18/2008		0.481	0.524	0.503	0.451	0.622	0.638	0.712	0.690	0.428	0.534	0.454		0.570	3,717.4
5/19/2008		0.644	0.543	0.733	0.579	0.540	0.536	0.244	0.522					0.538	329.1
5/20/2008		0.366	0.682	0.377	0.342	0.262	0.302	0.493	0.254	0.162	0.183			0.315	2,040.5
5/21/2008		0.436	0.445	0.622	0.772	0.747	0.607	0.668	0.547	0.323	0.491			0.635	3,666.9
5/22/2008			0.786	0.386			0.616		0.952	0.935	0.930			0.729	75.3
5/23/2008		0.777	0.544	0.531	0.478	0.847	0.887	0.750	0.673	0.788				0.680	801.9
5/24/2008		0.715	0.709	0.833	0.678	0.820	0.678	0.770	0.677	0.820	0.455			0.726	949.0
5/25/2008		0.671	0.713	0.685	0.736	0.790	0.772	0.711	0.611	0.500	0.693			0.702	2,222.3
5/26/2008		0.604	0.528	0.751	0.695	0.685	0.618	0.428	0.364	0.244	0.309			0.473	6,540.9
5/27/2008		0.486	0.403	0.423	0.697	0.807	0.842	0.759	0.675	0.750	0.553			0.593	6,691.8
5/28/2008		0.272	0.424	0.448	0.519	0.809	0.379	0.792	0.635	0.825	0.175			0.521	205.6
5/29/2008		0.729	0.730	0.494	0.582	0.559	0.397	0.370	0.469	0.452	0.238			0.535	1,678.3
5/30/2008		0.525	0.474	0.463	0.775	0.873	0.845	0.859	0.756	0.429				0.656	2,568.5
5/31/2008			0.397	0.415	0.598	0.500								0.544	1,350.6
															70,355.6

Table 4: Proportion of total targets that are in the zone of potential risk (50-150 m), fall 2008.

	Hours Since Sunset																	Daily %	Total Targets
Date	-0.5	0.5	1.5	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.5	11.5	12.5	13.5	14.5	15.5		
8/11/2008																			
8/12/2008		0.880	0.759	0.609	0.563	0.487	0.425	0.410	0.499	0.538	0.499	0.369	0.203					0.615	3,824.0
8/13/2008		0.776	0.716	0.683	0.627	0.527	0.665	0.615	0.675	0.512	0.465	0.447						0.636	2,542.8
8/14/2008		0.733	0.520	0.556	0.466	0.533	0.551	0.653	0.597	0.620	0.503	0.575						0.561	2,009.7
8/15/2008		0.552	0.544	0.660	0.651	0.621	0.747	0.643	0.545	0.632	0.554	0.487	0.306					0.587	2,950.9
8/16/2008			0.550	0.582	0.420	0.522	0.657	0.708	0.349	0.591	0.708	0.525						0.561	100.5
8/17/2008		0.450	0.257	0.494	0.396	0.396	0.578	0.709	0.426		0.570	0.639						0.466	71.2
8/18/2008		0.475	0.139	0.450	0.567	0.387	0.518	0.722	0.588	0.205	0.744	0.539						0.510	45.6
8/19/2008			0.808		0.718	0.832		0.507	0.223	0.634	0.412	0.410						0.575	34.0
8/20/2008		0.272	0.596	0.473	0.375	0.524	0.632	0.440	0.240	0.315	0.783	0.833						0.496	158.2
8/21/2008																			
8/22/2008		0.857	0.804	0.735	0.617	0.529	0.428	0.554	0.585	0.616	0.180	0.729						0.588	805.0
8/23/2008		0.950	0.944	0.894	0.893	0.721	0.748	0.642	0.651	0.801	0.814	0.620						0.857	677.1
8/24/2008		0.970	0.712	0.501	0.572	0.750	0.625	0.602	0.636	0.701	0.821	0.856						0.673	239.0
8/25/2008		0.680	0.693	0.527	0.427	0.402	0.374	0.465	0.601	0.670	0.648	0.349						0.526	2,329.2
8/26/2008		0.376	0.282	0.416	0.493	0.597	0.601	0.320	0.292	0.260	0.538	0.712	0.319					0.427	1,917.3
8/27/2008		0.545	0.560	0.507	0.510	0.389	0.371	0.552	0.537	0.681	0.689	0.466						0.495	900.5
8/28/2008		0.825	0.736	0.588	0.568	0.435	0.576	0.677	0.747	0.644	0.832	0.586	1.000					0.604	1,549.5
8/29/2008		0.635	0.783	0.725	0.820	0.477	0.727	0.853	0.604	0.863	0.648	0.623						0.730	210.2
8/30/2008			0.851	0.708	0.697	0.852	0.774		0.953	0.904	0.887	0.772						0.819	649.9
8/31/2008		0.545	0.514	0.369	0.380	0.543	0.718	0.640	0.500	0.476	0.548	0.479	0.086					0.509	4,989.0
9/1/2008		0.739	0.767	0.747	0.715	0.690	0.725	0.722	0.650	0.699	0.691	0.553	0.764					0.693	2,216.5
9/2/2008		0.702	0.798	0.708	0.625	0.646	0.747	0.699	0.767	0.677	0.700	0.450	0.625					0.681	1,425.9
9/3/2008		0.866	0.645	0.575	0.614	0.591	0.714	0.721	0.649	0.608	0.623	0.720	0.877					0.761	3,579.7
9/4/2008		0.832	0.720	0.700	0.592	0.671	0.695	0.632	0.615	0.563	0.680	0.509	0.200	0.443				0.595	1,968.4
9/5/2008		0.441	0.455	0.324	0.358	0.391	0.648	0.770	0.810	0.596	0.621	0.798	0.086	0.868				0.462	3,416.6
9/6/2008		0.848	0.754	0.655	0.622	0.728	0.707	0.850	0.785	0.736	0.785	0.703	0.483	0.596	0.763			0.732	695.5
9/7/2008		0.443	0.444	0.446	0.425	0.470	0.588	0.514	0.580	0.655	0.656	0.571	0.441	0.606	1.000			0.508	4,254.3
9/8/2008		0.641	0.508	0.560	0.641	0.647	0.638	0.668	0.585		0.659	0.395	0.680	0.624				0.606	966.0
9/9/2008		0.309	0.680	0.537	0.675	0.675	0.695	0.823	0.828	0.594	0.728	0.743						0.623	1,213.5
9/10/2008		0.344	0.166	0.201	0.377	0.381	0.425	0.328	0.294	0.399	0.495	0.460	0.433	0.394	0.555			0.339	6,189.1
9/11/2008		0.848	0.503	0.450	0.505	0.493	0.467	0.576	0.509	0.615	0.621	0.681	0.383	0.785	0.184			0.535	1,552.9
9/12/2008		0.829	0.511	0.602	0.509	0.449	0.730	0.654	0.729	0.871	0.666	0.812	0.807	0.995				0.725	527.0
9/13/2008		0.661	0.688	0.586	0.593	0.628	0.442	0.510	0.428	0.610	0.763	0.686	0.428	0.221	0.754			0.546	2,483.0
9/14/2008		0.653	0.768	0.601	0.686	0.817	0.599	0.674	0.664	0.895	0.712	0.680	0.566	0.637	0.296			0.664	3,388.7
9/15/2008		0.559	0.785	0.785	0.713	0.774	0.779	0.884	0.735	0.558	0.672	0.678	0.205	0.490	0.635			0.598	3,367.3
9/16/2008		0.792	0.439	0.284	0.274	0.300	0.313	0.278	0.284	0.314	0.367	0.413	0.631	0.678	0.840			0.324	12,116.9
9/17/2008		0.701	0.741	0.567	0.579	0.606	0.653	0.607	0.575	0.585	0.580	0.657	0.498	0.736	0.590			0.630	2,094.8
9/18/2008			0.569	0.315	0.209	0.135	0.213	0.205	0.280	0.297	0.324	0.294	0.373	0.347	0.499			0.253	2,103.1
9/19/2008																			0.5
9/20/2008		0.882	0.440	0.484	0.415	0.245	0.626	0.528	0.522	0.740	0.669	0.608	0.508	0.839				0.574	169.8
9/21/2008		0.493	0.530	0.596	0.662	0.503	0.551	0.532	0.430	0.433	0.489	0.593	0.692	0.765	0.345			0.507	2,838.8
9/22/2008		0.481	0.474	0.381	0.335	0.329	0.317	0.330	0.286	0.272	0.295	0.342	0.417	0.599	0.604			0.344	10,620.4
9/23/2008		0.750	0.426	0.427	0.396	0.545	0.460	0.607	0.571	0.624	0.473	0.476	0.575	0.650	0.857			0.507	1,894.9
9/24/2008		0.878	0.634	0.660	0.640	0.614	0.457	0.692	0.680	0.737	0.675	0.611	0.758	0.883	0.819			0.699	1,087.1
9/25/2008		0.865	0.774	0.711	0.826	0.764	0.801	0.770	0.846	0.707	0.690	0.783	0.831	0.774	0.878			0.795	802.2
9/26/2008		1.000	0.891	0.801	0.789	0.809	0.652	0.796	0.694	0.761	0.724	0.631	0.669	0.729	1.000			0.788	900.3
9/27/2008		0.757	0.893	0.985	0.648	0.580	0.686	0.735	0.741	0.799	0.847	0.890	0.724	0.812	0.779			0.731	1,252.7
9/28/2008		0.430	0.803	0.921	0.996	0.590	0.963	0.923	0.265	0.972	0.830	0.806	0.763	0.936	0.890			0.645	875.0
9/29/2008		0.586	0.362	0.357	0.431	0.520	0.485	0.526	0.650	0.690	0.667	0.644	0.501	0.561	0.841			0.513	7,416.4
9/30/2008		0.480	0.520	0.439	0.598	0.497	0.705	0.628	0.790	0.803	0.677	0.766	0.681	0.789	0.656			0.602	1,350.6
10/1/2008		0.397	0.478	0.414	0.449	0.459	0.493	0.566	0.528	0.696								0.512	2,006.0
10/2/2008		0.386	0.404	0.289	0.483	0.518	0.498	0.620	0.570	0.611	0.576	0.600	0.675					0.519	9,419.7
10/3/2008		0.296	0.374	0.523	0.604	0.548	0.463	0.517	0.518	0.479								0.505	5,043.7

Table 4: Proportion of total targets that are in the zone of potential risk (50-150 m), fall 2008.

	Hours Since Sunset																	Daily %	Total Targets
Date	**-0.5**	**0.5**	**1.5**	**2.5**	**3.5**	**4.5**	**5.5**	**6.5**	**7.5**	**8.5**	**9.5**	**10.5**	**11.5**	**12.5**	**13.5**	**14.5**	**15.5**		
10/4/2008		0.485	0.391	0.483	0.577	0.576	0.530	0.475	0.435	0.529	0.548	0.661	0.630	0.596	0.634	0.617		0.505	3,714.5
10/5/2008		0.563	0.362	0.376	0.328	0.434	0.456	0.508	0.600	0.577	0.597	0.636	0.526	0.524	0.427	0.533		0.480	5,456.8
10/6/2008		0.275	0.441	0.446	0.632	0.582	0.569	0.442	0.421	0.409	0.515	0.543	0.559	0.509	0.617	0.981		0.471	3,743.7
10/7/2008		0.652	0.331	0.300	0.241	0.311	0.416	0.437	0.455	0.343	0.387	0.524	0.364	0.578	0.685	0.785		0.366	5,502.5
10/8/2008			0.540	0.485	0.564	0.617	0.642	0.681	0.754	0.595	0.638	0.807	0.745					0.650	573.6
10/9/2008		0.643													0.356	0.266		0.528	128.5
10/10/2008		0.641	0.524	0.420	0.404	0.487	0.491	0.392	0.496	0.602	0.588	0.578	0.526	0.658	0.505	0.686		0.499	2,251.2
10/11/2008		0.498	0.436	0.318	0.396	0.326	0.378	0.238										0.333	1,518.2
10/12/2008			0.288	0.320	0.358	0.322	0.348	0.407	0.501	0.530	0.607	0.645	0.465	0.414	0.594			0.438	1,416.5
10/16/2008		0.230	0.311															0.301	291.1
10/17/2008		0.146	0.440	0.253	0.293	0.287	0.326	0.409	0.479	0.429	0.440	0.358	0.517	0.287	0.613	0.651		0.364	2,727.0
10/18/2008		0.255	0.233	0.350	0.296	0.313	0.321	0.285	0.260	0.380	0.317	0.261	0.310	0.466	0.673	0.655		0.348	1,489.3
10/19/2008		0.736	0.790	0.303	0.412	0.331	0.364	0.411	0.347	0.423	0.448	0.409	0.360	0.211	0.514	0.708		0.417	864.8
10/20/2008				0.442	0.862	0.515	0.594	0.488	0.570	0.482	0.560	0.551	0.673	0.558	0.578			0.574	124.4
10/21/2008			0.949													0.725		0.750	249.9
10/22/2008		0.305	0.104	0.899	0.487	0.506	0.474	0.377	0.404	0.405	0.400	0.414	0.401	0.482	0.585	0.547		0.454	540.6
10/23/2008		0.309	0.492	0.351	0.362	0.289	0.413	0.388	0.548	0.572	0.480	0.549	0.429	0.554	0.418	0.641		0.445	675.3
10/24/2008				0.458	0.522	0.551	0.655	0.653	0.711	0.574	0.405	0.528	0.472	0.318	0.943	0.245		0.552	620.8
10/25/2008		0.849	0.460															0.672	6.1
10/26/2008				0.720	0.617	0.665	0.581	0.535	0.635	0.727	0.519	0.692	0.569		0.970	0.700		0.624	251.4
10/27/2008			0.509		0.874	0.495	0.596	0.241	0.613	0.628	0.525	0.546	0.479	0.518	0.331	0.418	0.548	0.536	369.9
10/28/2008				0.363	0.450	0.525	0.419	0.453	0.453	0.565	0.539	0.483	0.484	0.718	0.966	0.793	0.851	0.498	1,386.7
10/29/2008		0.262	0.414															0.362	143.3
10/30/2008				0.508	0.434	0.543	0.477	0.448	0.476	0.356	0.454	0.614	0.593	0.499	0.447	0.431	0.811	0.481	1,361.8
Total																			**160,649.0**


Height of targets above ground (m)
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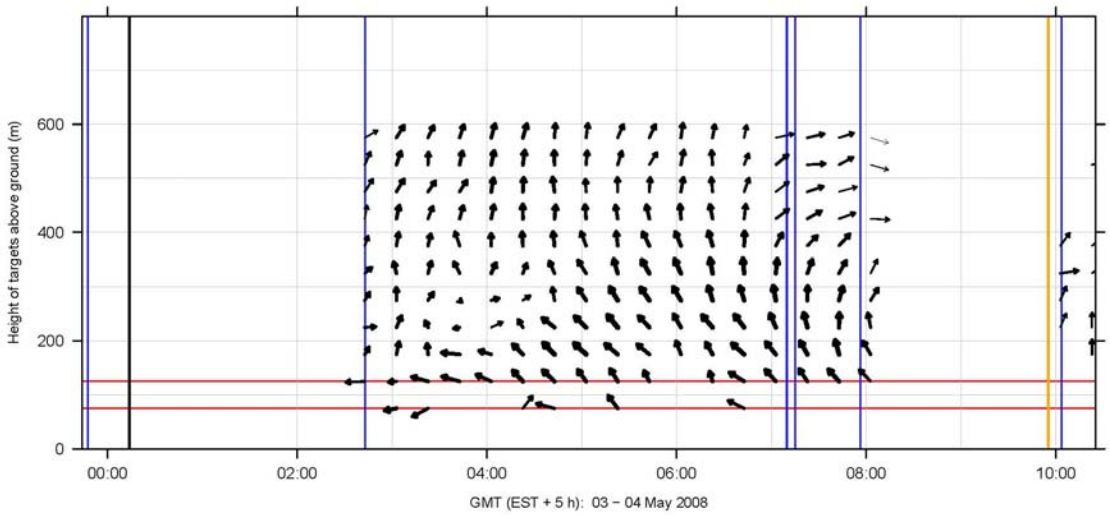
GMT (EST + 5 h): 01 – 02 Oct 2008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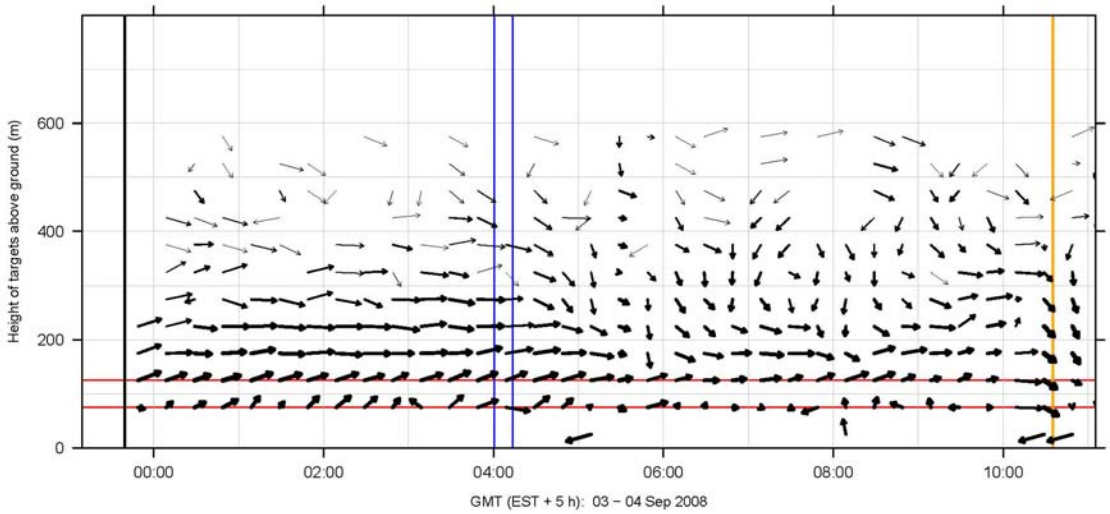
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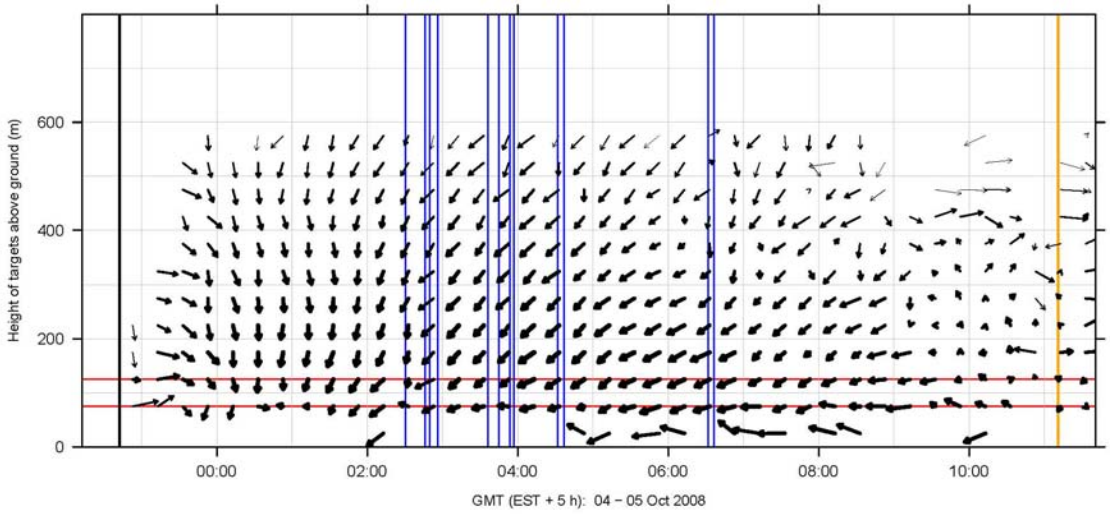
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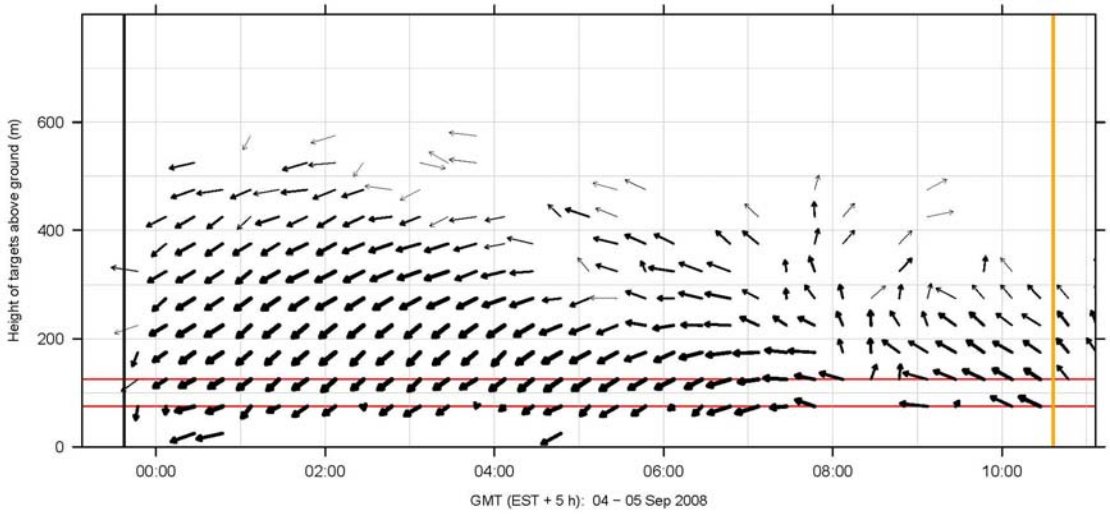
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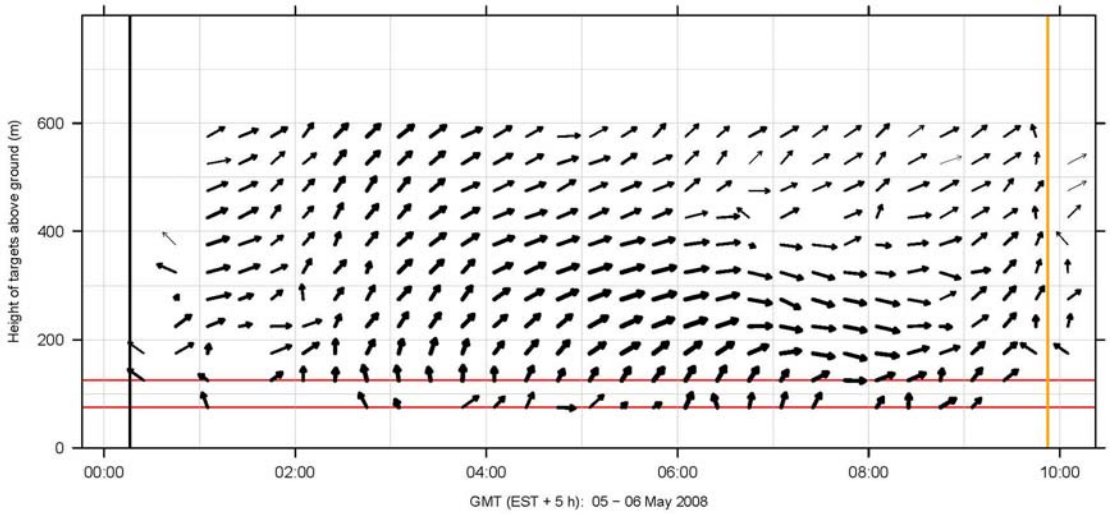
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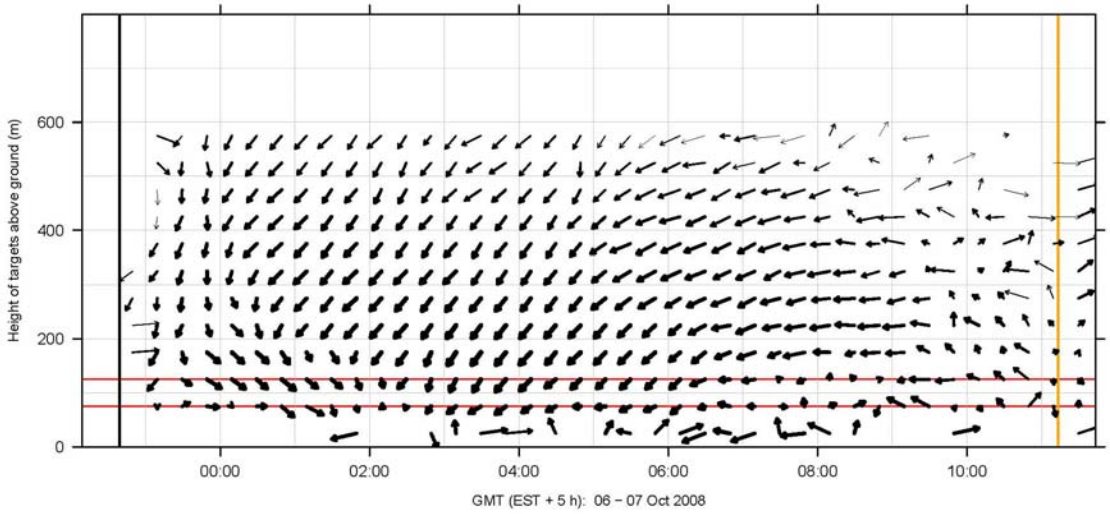
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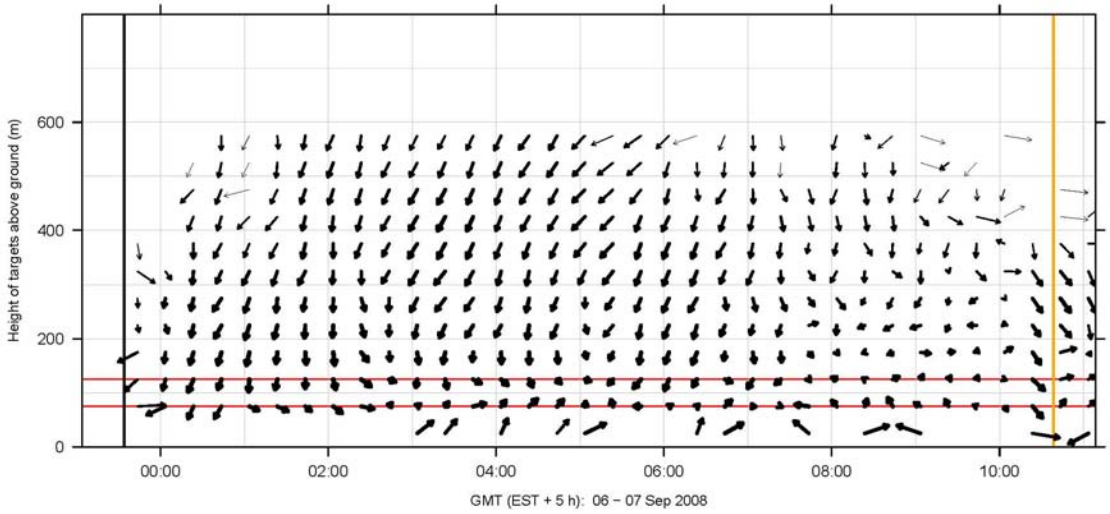
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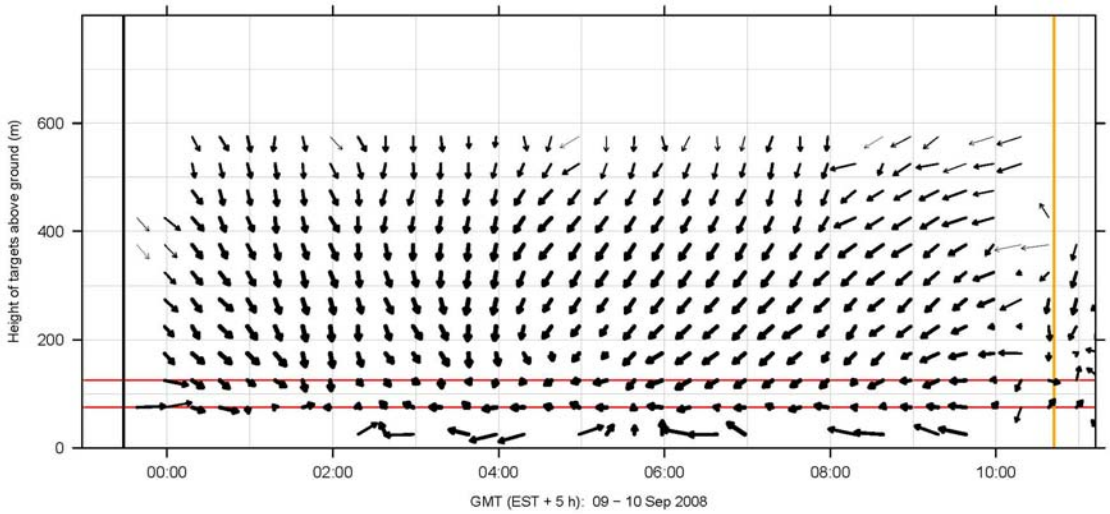
GMT (EST + 5 h): 06 – 07 Sep 2008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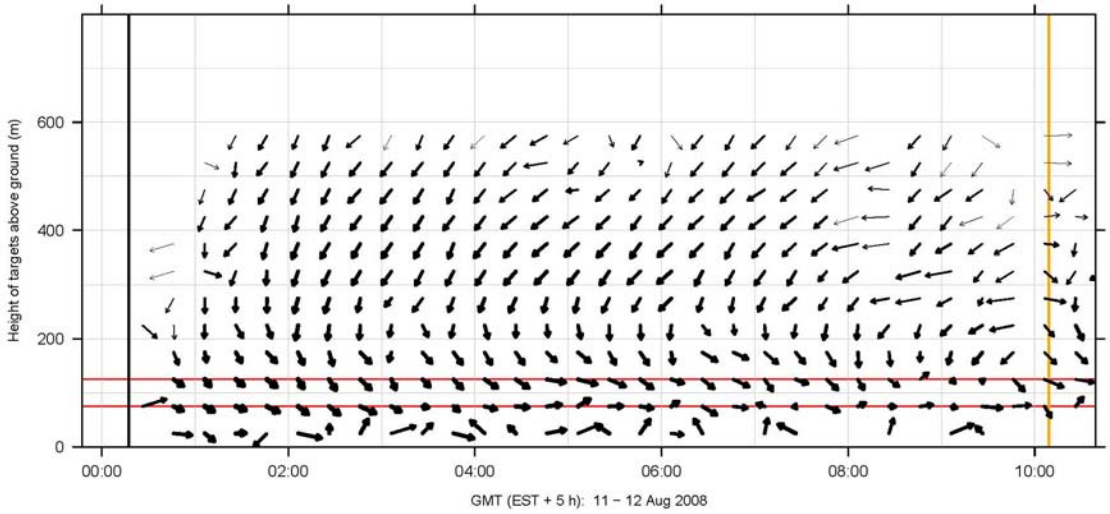
GMT (EST + 5 h): 09 – 10 Sep 2008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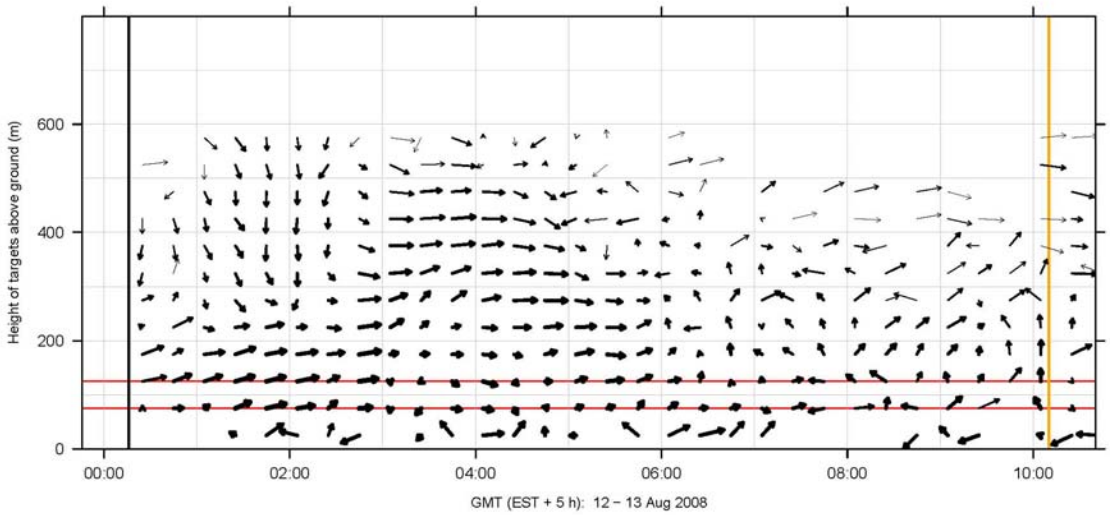
GMT (EST + 5 h): 11 – 12 Aug 2008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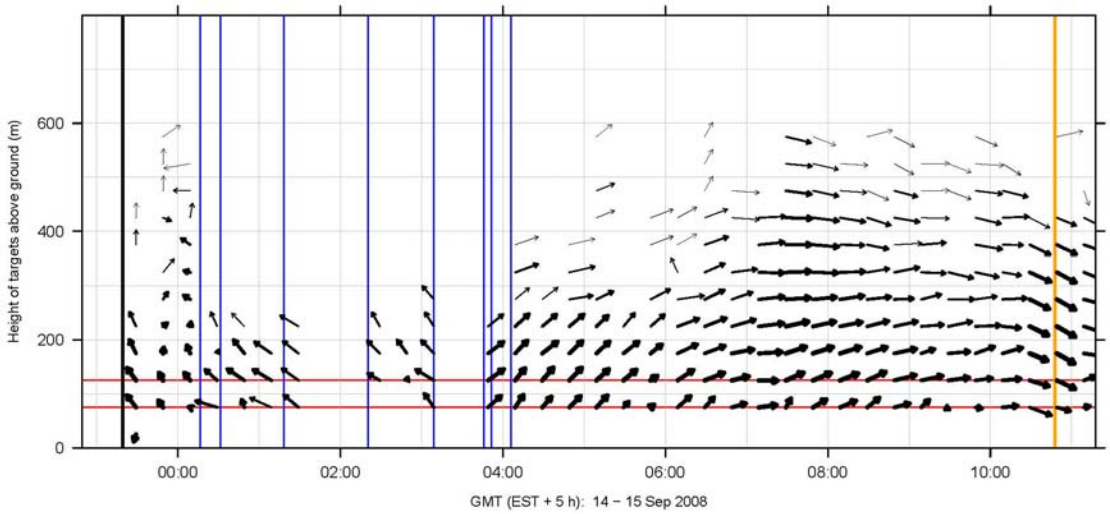
GMT (EST + 5 h): 12 – 13 Aug 2008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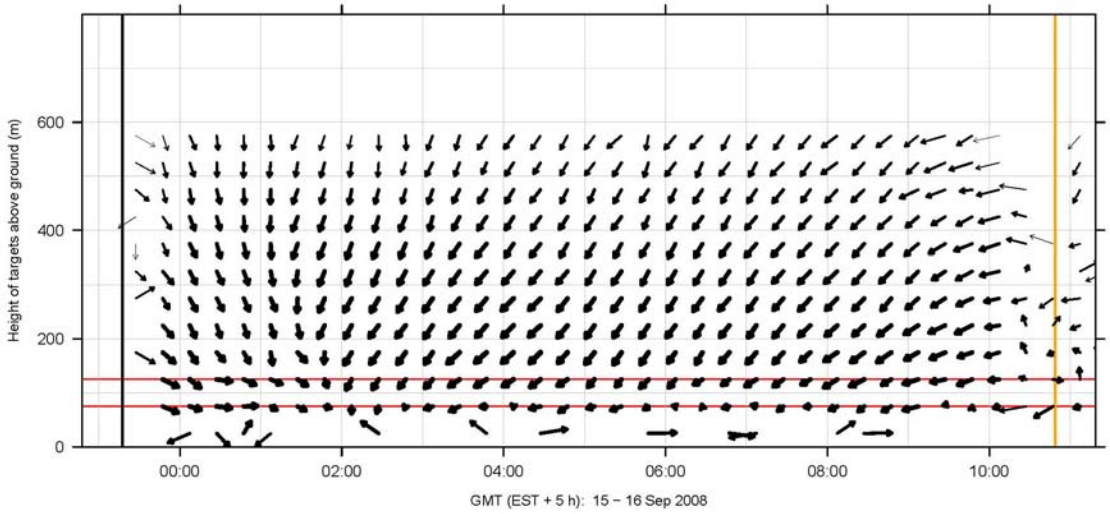
GMT (EST + 5 h): 14 – 15 Sep 2008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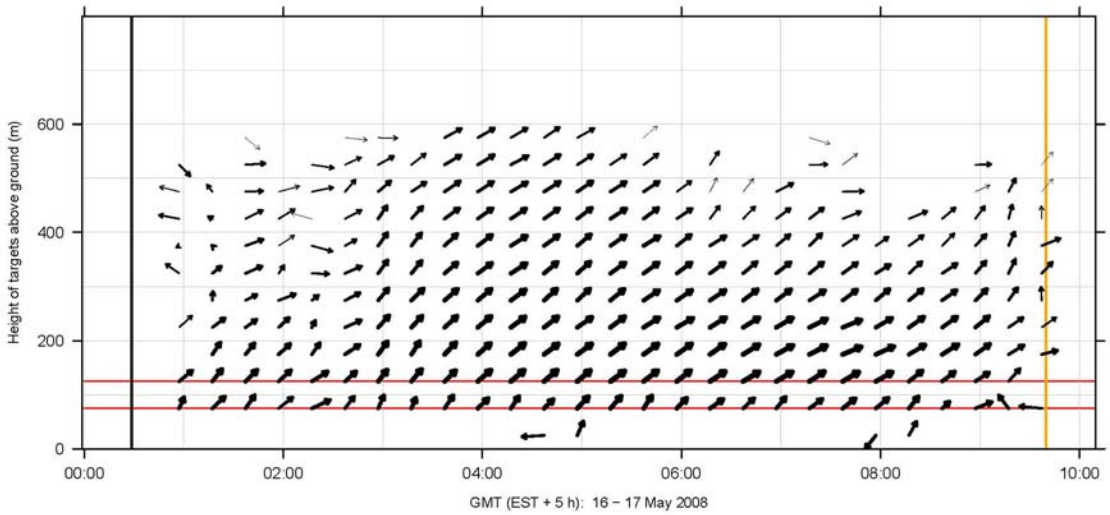
GMT (EST + 5 h): 15 – 16 Sep 2008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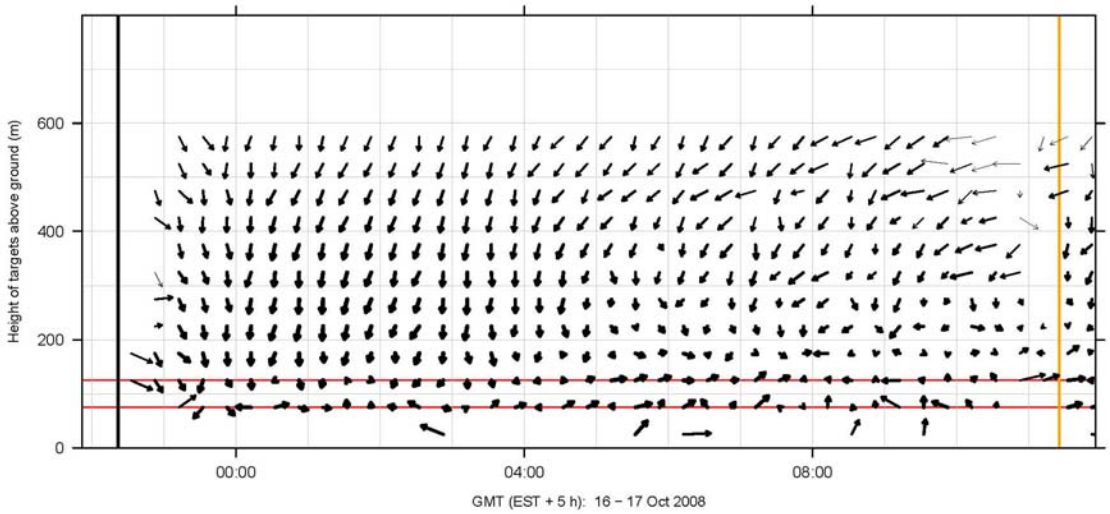
GMT (EST + 5 h): 16 – 17 May 2008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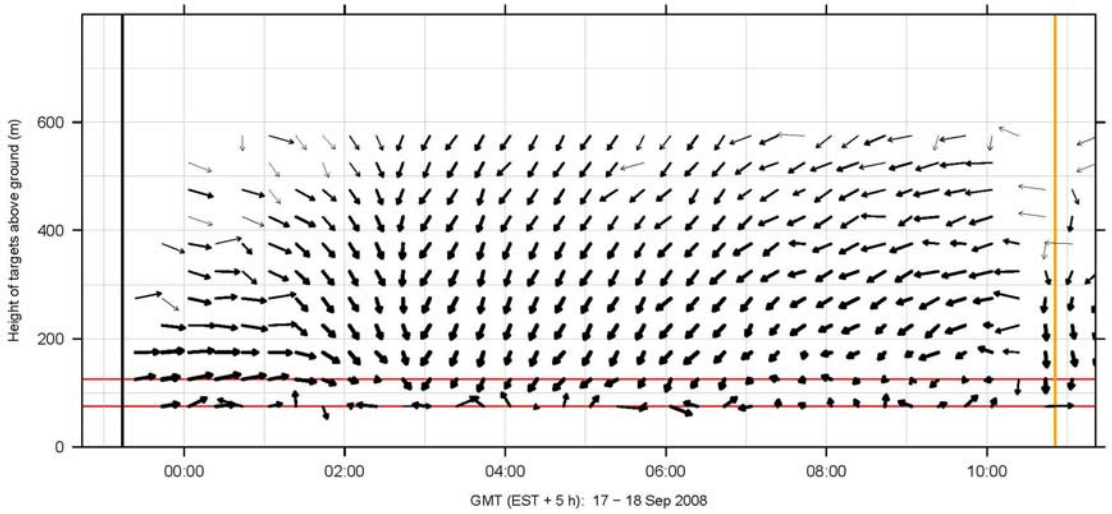
GMT (EST + 5 h): 16 – 17 Oct 2008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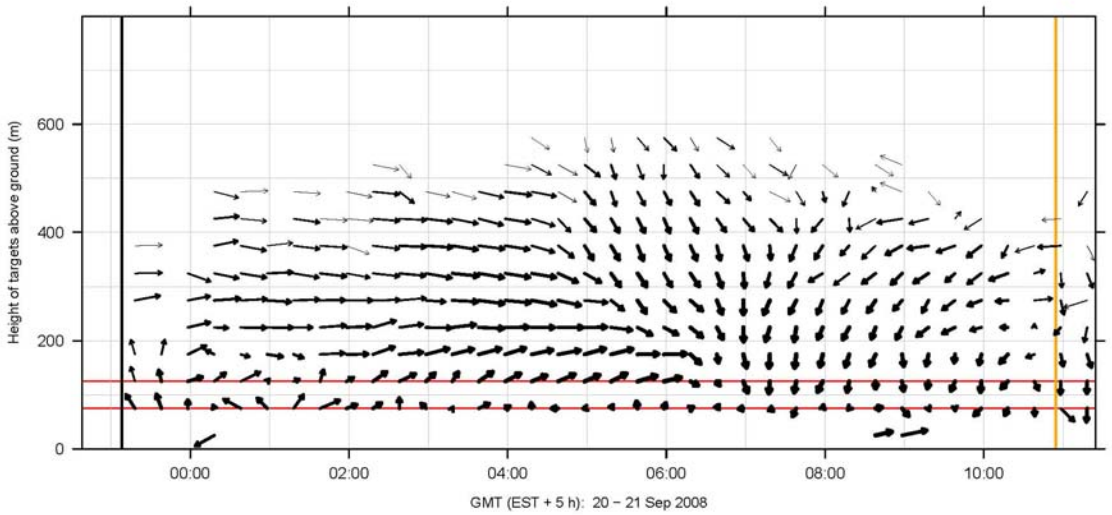
GMT (EST + 5 h): 17 – 18 Sep 2008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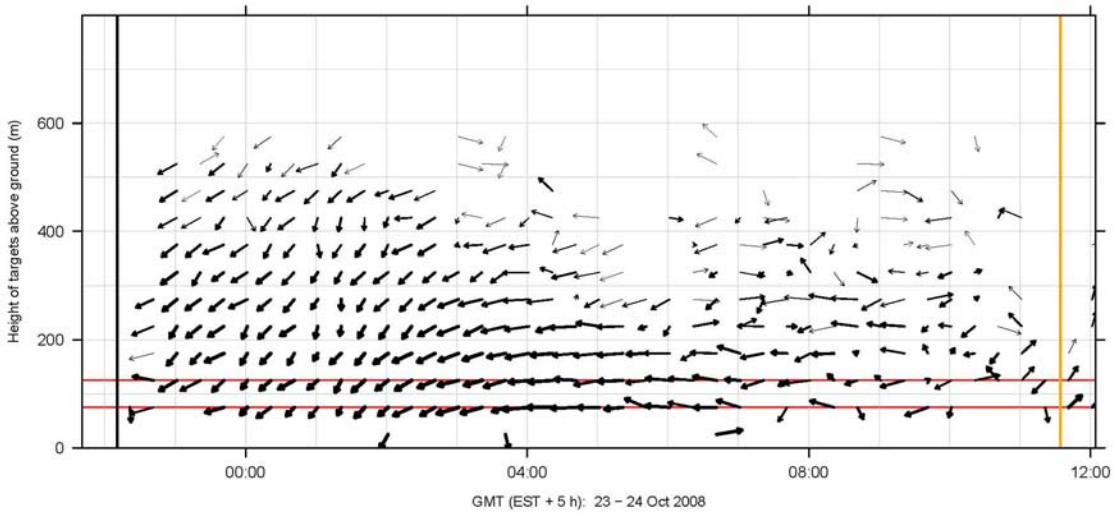
GMT (EST + 5 h): 20 – 21 Sep 2008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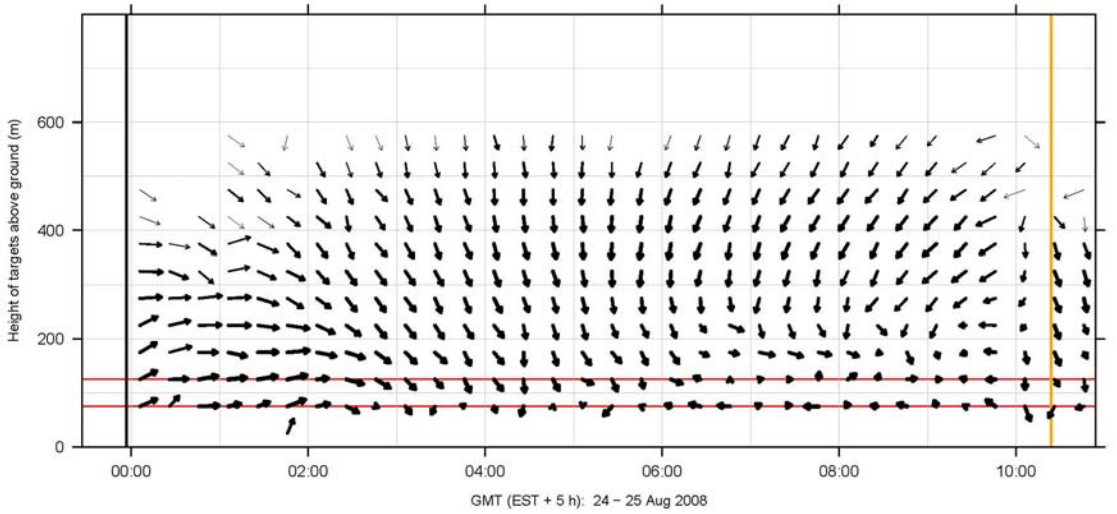
GMT (EST + 5 h): 23 – 24 Oct 2008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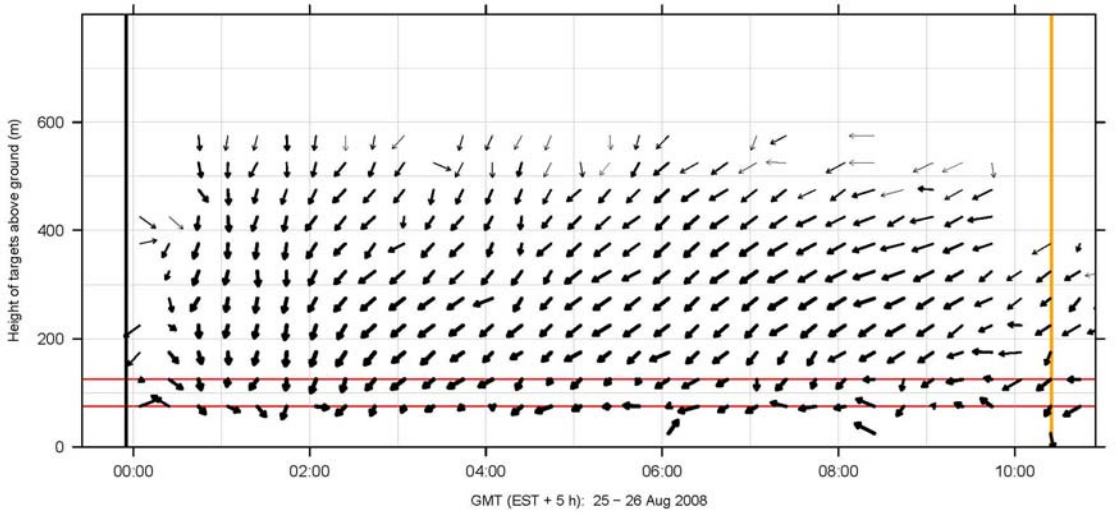
GMT (EST + 5 h): 24 – 25 Aug 2008


Height of targets above ground (m)
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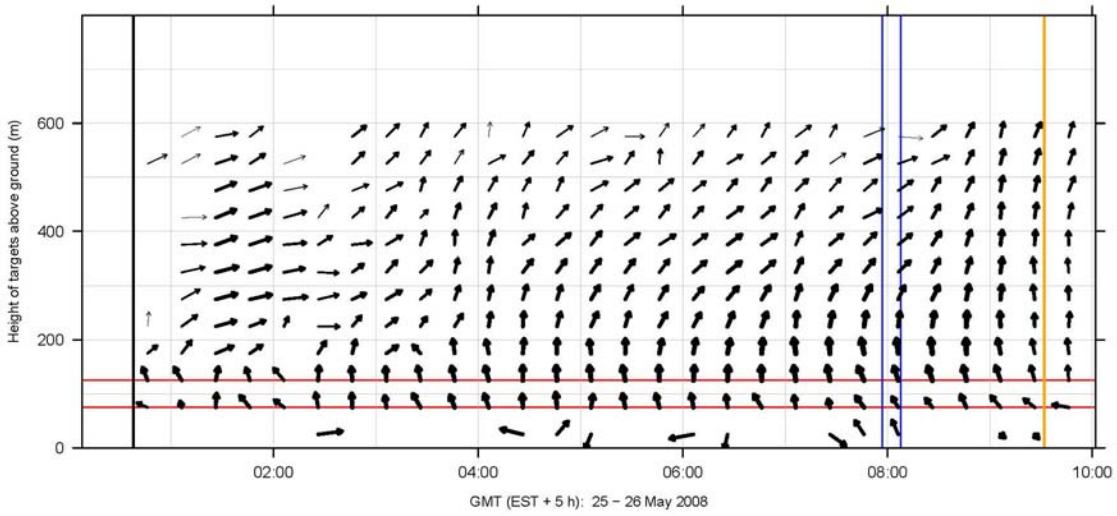
GMT (EST + 5 h): 25 – 26 Aug 2008


Height of targets above ground (m)
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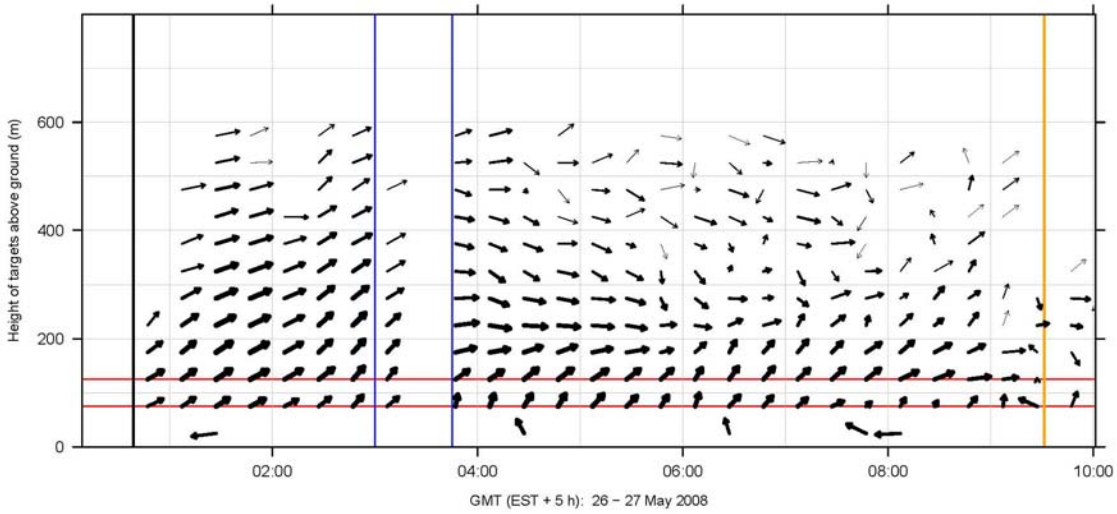
GMT (EST + 5 h): 25 – 26 May 2008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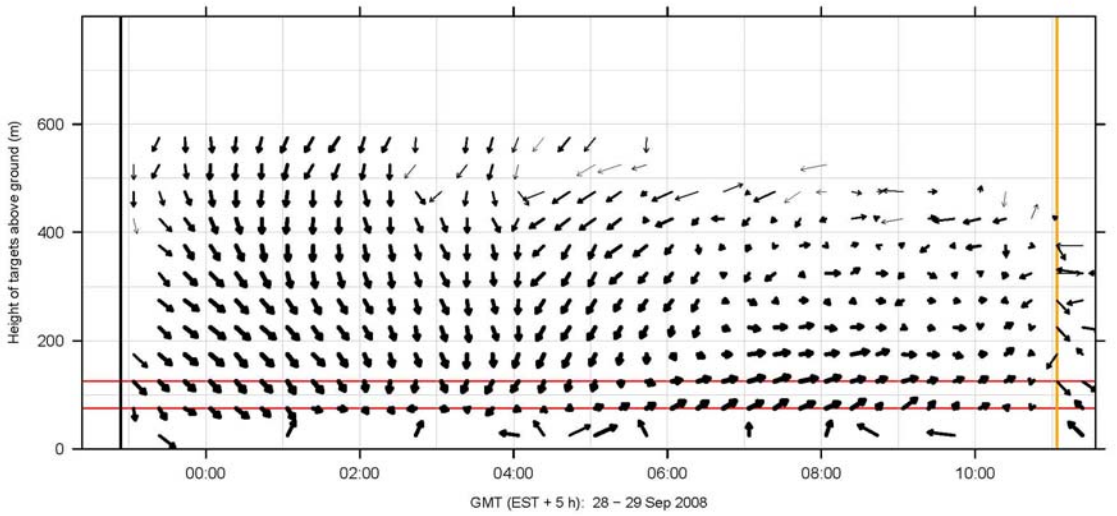
GMT (EST + 5 h): 26 – 27 May 2008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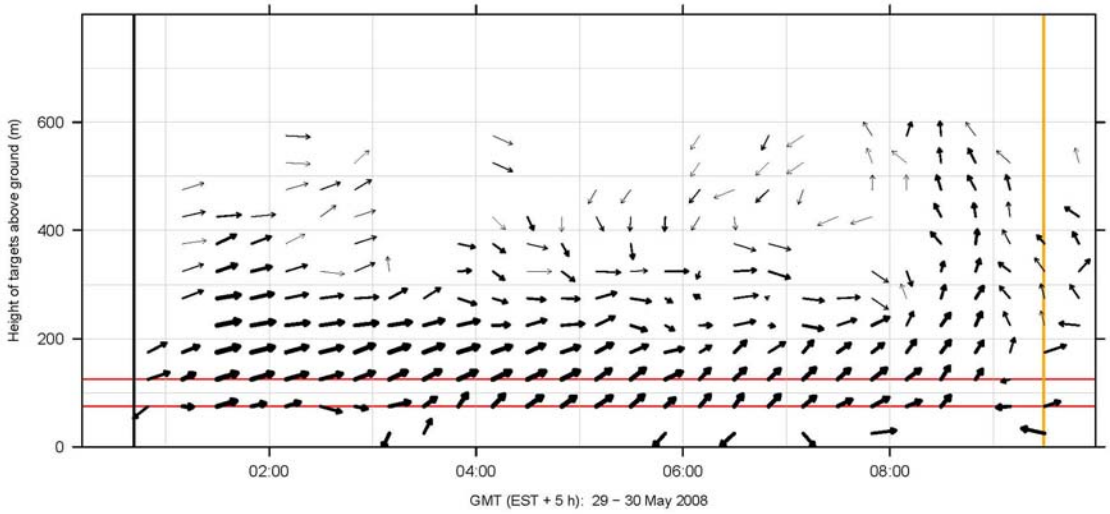
GMT (EST + 5 h): 28 – 29 Sep 2008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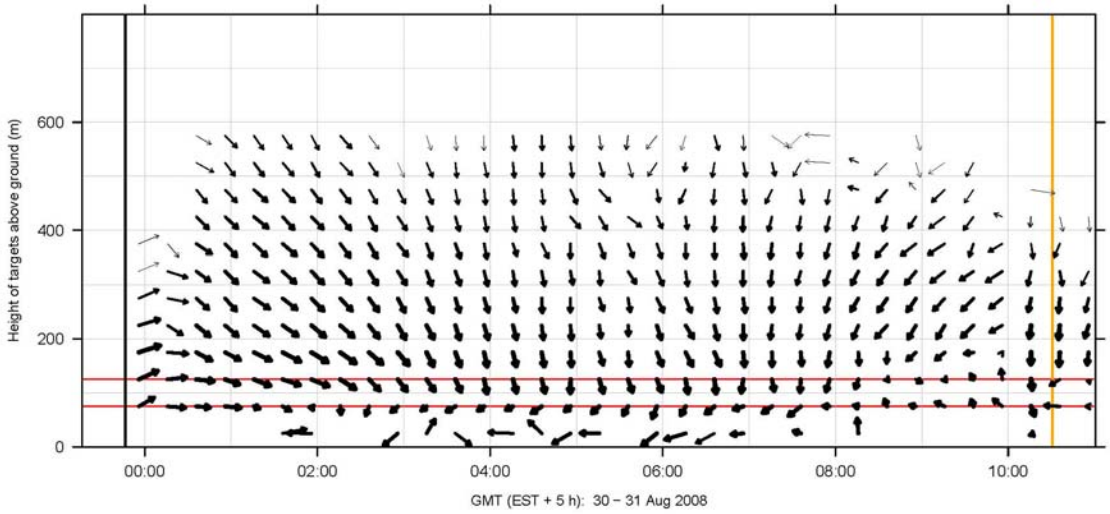
GMT (EST + 5 h): 29 – 30 May 2008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GMT (EST + 5 h): 30 – 31 Aug 2008