Appendix J
Draft Avian Monitoring Plan

Draft Avian and Bat Post-Construction Monitoring Plan: Raleigh Wind Farm, Invenergy Canada

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Submitted to:

Invenergy Canada

Submitted by

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1.0 INTRODUCTION

Raleigh Wind Power Partnership and Invenergy Wind Canada ULC ("Invenergy") is proposing to construct and operate a 55 turbine (82.5 megawatt (MW)) wind farm on private land located in the Municipality of Chatham-Kent. The project area covers approximately 12,982 hectares and is located in the southern portion of Raleigh Township in Chatham-Kent located south-west of Chatham on the north shore of Lake Erie. The project area/proposed wind farm layout is illustrated in **Figure 1**. The project location is largely rural in nature with the majority of land under agricultural use.

The project components include:

- 55 General Electric 1.5 sle/xle turbines;
- Pad mounted transformers (located at or near the base of each tower);
- Turbine access roads;
- Electrical collection system (including underground and above ground 34.5 kV electrical lines);
- Above and below ground 34.5 kV electrical lines along road rights of way;
- Electrical substation; and
- Staging areas for assembly of wind turbines.

With a total of 55 - 1.5 MW General Electric turbines, the wind farm will have an installed capacity of 82.5 MW.

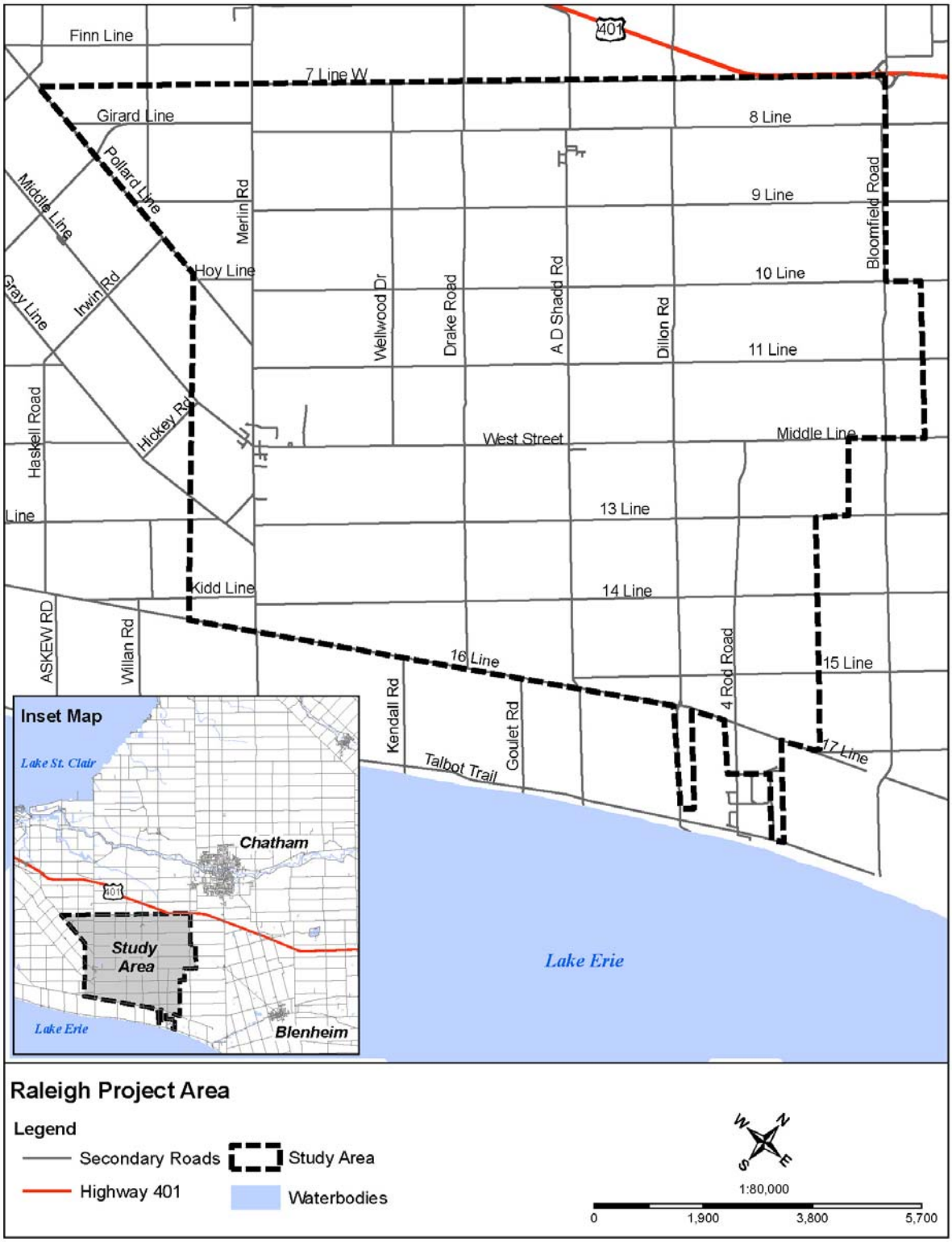
In developing this post-construction monitoring plan, protocols outlined in several guidance documents provided by Environment Canada (EC) and the Ministry of Natural Resources (MNR) were consulted including:

- *Wind Turbines and Birds – A Guidance Document for Environmental Assessment* (EC 2007a),
- *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (EC 2007b)
- *Wind Turbines and Birds – A Background Review for Environmental Assessment* (EC 2007c)
- *Guidelines to Assist in the Review of Wind Power Proposals – Potential Impacts to Birds and Bird Habitats* (MNR 2006a)
- *Wind Turbines and Bats: Bat Ecology Background Information and Literature Review of Impacts* (MNR 2006b)
- *Guidelines to Assist MNR Staff in the Review of Wind Power Proposals – Potential Impacts to Bats and Bat Habitats* (MNR 2007).

This draft plan has been designed by Invenergy to evaluate the accuracy of the predicted environmental impacts on birds and bats and to meet requirements set out in both the *Canadian Environmental Assessment Act*, and the *Ontario Environmental Assessment Act* as per the requirements of Regulation 116/01. EC and MNR are being consulted with to confirm this monitoring strategy. Once their input is received, this plan will be finalized.

Kerns et al (2005), Erickson *et al* (2003) and Stantec (2008a) were also consulted in developing statistical analysis methods for searcher efficiency, carcass removal testing and calculation of corrected fatality counts.

Figure 1: Raleigh Wind Energy Centre Layout/Project Area Location



1.1 Project Area Features Relating to Birds and Bats

The project area is located close to the north shore of Lake Erie (closest turbine is about 2.4 km away from the shore), which is well known as a migration corridor, particularly for raptors during the fall. There are also known spring shorebird staging areas in fields found to the east (north of Rondeau Bay and approximately 10km from the project area) and to the immediate southwest of the project area, extending from Merlin Road west to Coatsworth Road (Dave Martin, *pers. comm.*). No important bird areas are found within the project area. Due to the proposed size of the wind farm and the proximity to the Lake Erie shoreline, the Project area has been determined to have a Very High Sensitivity with regards to birds and has been assigned a Category 4 Level of Concern based on criteria provided by EC (EC 2007a).

The project area has been assigned a Sensitivity Rating of 2 (Medium) in relation to bats, based on criteria provided by the MNR (MNR 2007). The major concern for the project area is the proximity to the Lake Erie shoreline and the potential for this feature to concentrate migrating bats. The closest turbine to the Lake Erie shoreline is greater than 2 km away.

Details of bird and bat pre-construction surveys are provided in sections 7.6 and 7.7, and Appendices D and C, of the ERR respectively. As stated in these sections, the expected level of impact to all guilds of birds and bats, after protection and mitigation measures have been implemented, is considered to be low.

Concerns that have been identified and will require specific monitoring include:

- Potential mortality effects to birds and bats in the project area. The main potential risk relating to elevated numbers of fall migrants (raptors and other land birds) and occasional high numbers of staging spring migrant shorebirds using project area fields.
- A pair of bald eagles (listed as Endangered, *Endangered Species Act, 2007* [ESA]) is known to nest in a woodlot adjacent to the southeast corner of the project area, more than 700m from the nearest turbine locations.

Issues that were determined to be of limited concern, and therefore not requiring specific monitoring, include:

- Species at Risk – Besides bald eagles, Species at Risk that have been historically recorded in or near the project area (including northern bobwhite, Henslow's sparrow, barn owl, red-headed woodpecker) were not observed during breeding bird surveys and are not considered likely breeders due to lack of suitable habitat. Small numbers of Species at Risk were observed during migration seasons.

Because large wind farm facilities are a relatively new addition to Ontario's infrastructure, large datasets with multiple years of study relating to environmental impacts do not exist to inform the accurate prediction of impacts. To address this uncertainty an Adaptive Monitoring and Management Plan has been developed. In the event that unexpected negative impacts occur, employment of this Plan will allow for flexibility in the operation of the wind farm in an attempt to reduce these negative impacts and the likelihood of their future occurrence.

2.0 PROJECT TEAM

Table 1: Post Construction Environmental Monitoring Team

Staff	Role
Don McKinnon	Dillon Consulting Limited – Project Manager
Michael Enright	Dillon Consulting Limited – Natural Environment Coordinator
Dave Restivo	Dillon Consulting Limited – Field Ornithologist
Richard Baxter	Dillon Consulting Limited – Field Ornithologist
Dave Martin	Dave Martin Inc. – Field Ornithologist

Don P. McKinnon MES, MCIP –is an Associate and Senior Environmental Planner at Dillon with over 19 years of experience. Don has worked in many parts of Canada and internationally, and has extensive experience with Environmental Assessments. Don has direct experience in the preparation of EIAs for wind power project facilities having been involved in more than ten wind farm projects.

Michael Enright, BSc. (Hons) - is a Terrestrial Biologist with fourteen years of education and professional employment in the biological sciences. During this time, Michael has acquired an in-depth knowledge of natural systems and their protection under the various levels of the legislative framework. He has been involved in numerous Environmental Assessments and developed environmental solutions for multi-disciplinary projects. Michael has been the Project Manager or environmental coordinator for nine wind energy projects.

David Restivo, BSc. (Hons), CEPIT - is a Biologist with over five years of professional experience conducting biological assessments including avian surveys. Prior to working with Dillon, David worked with Bird Studies Canada conducting migration monitoring studies on the shores of Lake Erie. David has been involved in avian surveys for three wind power projects.

Richard Baxter, BSc. - is a Biologist with over three years of professional experience conducting biological assessments including avian surveys. Prior to working with Dillon, Richard worked with Ducks Unlimited Canada as a Biological Technician, the University of Alberta as a Research Assistant on a cavity nester study and with Bird Studies Canada conducting migration monitoring studies on the shores of Lake Erie. Richard has been involved in avian surveys for four wind power projects.

Dave Martin Inc. and Team - Dave Martin's bird survey team for this project all have been birding for 20 to 40 years. Members of the team have extensive involvement in the Ontario Breeding Bird Atlases, Christmas Bird Counts, Breeding Bird Surveys, Forest Bird Monitoring programs. Dave Martin and Ross Snider have coordinated the Ingersoll and London CBCs, respectively, for over 20 years. They each have been involved in small and large-scale projects that have involved the completion of both federal and provincial Environmental Assessments Environmental Impact Assessments. Project experience ranges from highway corridors, water and waste water facilities, wind power, municipal Environmental Impact Studies and municipal/provincial/federal agency sponsored Natural Area Studies. Natural Areas studies include surveys for Bird Studies Canada, Nature Conservancy Canada and various Conservation Authorities, Stewardship Councils, OMNR and CWS. Dave Martin's team has also been involved in various surveys for endangered species including Loggerhead Shrike, Acadian Flycatcher, Hooded Warbler and Prothonotary Warbler. Dave Martin's team has worked on six wind turbine projects along the Lake Erie and Lake Huron shorelines.

3.0 POST-CONSTRUCTION MONITORING PLAN

3.1 The Need for Monitoring - Bird and Bat Mortality at Wind Farms in North America

Data available from studies of wind farms in North America indicate that the number of passerine birds killed due to blade strikes is not numerically significant in terms of population effects. Estimates of total passerine fatalities from a review of 14 studies of North American wind farms vary considerably, however on a per turbine and per MW basis, fatality rates are similar (Arnett et al 2007). Annual fatality rates ranged from 0 at a Searsburg, Vermont wind farm (Kerlinger 1997 *in* Arnett et al 2007) to 11.7 birds/MW/year at Buffalo Mountain, Tennessee (Nicholson 2003 *in* Arnett et al 2007). Most studies indicate that passerine fatalities occur throughout the wind farm facility, with no relationship to specific features within the facility. In general, fatalities occur throughout the year but are most common from April to October (Arnett et al 2007). It appears that certain seasons pose a higher risk to birds at specific facilities; for example spring migration at Buffalo Ridge, Minnesota (Johnson et al 2002 *in* Arnett et al 2007) and fall migration at Stateline, Washington (Erickson et al 2004 *in* Arnett et al 2007).

The highest recorded raptor fatality rates relating to wind power facilities have occurred in California at a few specific sites that were designed and constructed with little thought given to impacts on avian resources. Outside of California, studies of 14 newer generation wind farm facilities in North America indicate that the mean fatality rate for raptors was 0.03 raptors per turbine and 0.04 raptors per MW. These studies occurred over at least a one-year period and included correction for scavenging and searcher efficiency (Arnett et al 2007).

Several studies on wind farms in Ontario have been performed which can provide more area specific context for the Raleigh Wind Energy Centre project. James (2003) reported finding 3 bird carcasses in association with the single turbine present near the Lake Ontario shore at Pickering, with monitoring conducted throughout 2002. James and Coady (2004) reported finding 2 bird carcasses in association with the single turbine present at Exhibition Place in Toronto, over 11 weeks of monitoring during the spring and fall of 2003. James (2008) estimated a range of 0.41-2.6 native birds/turbine/year at the 66 turbine Erie Shores Wind Farm near Port Burwell, with all but 4 individual turbines having estimates of below 1 bird/turbine/year. For raptors as a group, an estimate of 0.04 raptors/turbine/year was given at Erie Shores. The Erie Shores Project is similar to the Raleigh project in terms of the number of turbines and geographic setting. Natural Resource Solutions Inc. (2008a) estimated an annual mortality rate for birds of 0.39 birds/turbine (0.26 birds/MW) at the 126 turbine Prince Wind Power Project (as in Stantec 2008a). Stantec Consulting Ltd (2008b) estimated an annual mortality rate for birds of 1.4 birds/turbine (0.9 birds/MW) at the Melancthon 1 Wind Plant, based on 12 weeks of post construction monitoring during the spring and fall of 2007 (as in Stantec 2008a).

Large numbers of bat fatalities have been reported at some wind energy facilities in North America. In general, bat fatalities at wind farms are higher than at other man made structures. Estimates of bat fatalities from 21 studies located at 19 wind farms in North America range from 0.9-53.3 bats/MW/year. The highest bat fatality rates have been found to occur near forested ridges. Bat fatalities appear to be higher in late summer and early fall, with migratory species like hoary bat, eastern red bat and silver haired bat being most susceptible. Bat activity and associated wind farm mortality appear to be higher on nights with low wind speeds (Arnett et al 2007).

3.2 Methods

Post-construction monitoring for birds and bats will be done concurrently to improve efficiency of fieldwork. Therefore, the methods outlined below are designed to address both faunal groups. The work being proposed will be refined through consultation with Environment Canada and the MNR. The current program as present herein is designed to monitor the most sensitive seasonal periods for each species or group of concern as identified in the ERR, including:

- Bird and bat mortality monitoring through all seasons, due to the possibility of mortality resulting from wind farm operation.
- Bald eagle monitoring, due to the presence of a known breeding pair adjacent to the southeast corner of the project area. This nest location is more than 700m from the nearest turbine.

Personnel conducting fieldwork will be skilled at identifying all species birds, both by sight and sound, and all species of bats by sight, that are likely to occur in the project area. Detailed monitoring methods, including duration and frequency, are outlined below.

3.2.1 Bird Mortality Monitoring

As this project has been assigned a Category 4 Level of Concern in relation to birds according to EC's guidance criteria, it will be subject to the highest level of effort to assess environmental effects. Surveys will include two years of carcass searching and post-construction mortality monitoring around turbines during the spring migration period (a 6 to 8 week search period from early April to late May), the summer breeding season (a 6 week search period during June and July), fall migration period (an 8 to 10 week search period from early August to late October) and the winter season (a 4 week period from mid January to mid February). Though mortality monitoring will occur throughout the year, the fall and spring seasons are of particular concern due to higher observed bird activity during these times.

Protocols used to perform carcass searches will follow those set out in EC's *Recommended Protocols for Monitoring Impacts of Wind Turbines on Birds* (EC 2007b). Carcass searches will be performed by trained technicians, under the guidance of an experienced biologist, within an 80m radius from the base of turbines as most birds will likely fall within this range. As this is a large project with 55 turbines, a subset of 18 turbines (approximately one third of all turbines) will be selected for carcass searching. A stratified random sample will be used to select turbines that are likely to represent the range of probable risk to birds and bats. Stratification will generally be based on grouping turbines based on their proximity to the study areas natural features (e.g. Lake Erie shoreline, forest, riparian vegetation, etc.).

Monitoring will initially be conducted twice weekly for each turbine, where mortality estimates are being conducted. Depending on the results of initial carcass searches and scavenger rate estimates, monitoring may be scaled back to once a week, where deemed appropriate through consultation with the MNR and EC. Over a three-day period all 18 turbines will be searched. Frequent searches will minimize loss to scavengers and enable a better understanding of weather conditions associated with mortality. If carcass removal trials indicate that carcasses persist for a week or more, less frequent searches may be employed. Searches will begin as soon after sunrise as possible to minimize the loss of carcasses to early morning scavengers. Carcass searches will be performed on days with weather conditions that are most suitable for successful searches, i.e. bright days, with light breeze and no recent rain. Carcass searching will also attempt to focus on substrates that are more likely to yield results such as the gravel pad at the base of the turbine, access roads and short vegetation.

For each carcass found, the following data will be recorded: date and time, state of decomposition, extent and type of injury, species if possible, distance and direction from the turbine, GPS location of carcass

and substrate on which the carcass was found. Information will also be gathered for wind speeds and direction on each night preceding searches, extending to the last search event.

Scavenging Rate Trials

Scavenging rate trials will be performed to estimate the proportion of carcasses that were scavenged before the search period. Trials will be conducted twice during each season in each monitoring year, and will use native species that are freshly dead or frozen (and were freshly dead prior to being frozen). Carcasses will be laid out in a search area with their location marked by GPS in advance of a search being conducted. Technicians will wear gloves to avoid getting human scent on the test specimens, which could bias results. Carcasses can be laid out in varying time intervals before a search, or can be resurveyed multiple times to test for carcass persistence. Carcasses should be laid out for trials at each turbine that will be searched, with a small number used (1 to 2 specimens) at each site. Carcasses should be distributed on substrates in proportion to the availability of these substrates. Scavenger trials will be repeated during each survey year, as efficiency of scavengers may change among years. Presence or absence of scavenging, and degree of scavenging if present, will be recorded for trial specimens.

The rate of carcass removal by scavenging will be calculated using the following equation:

$R_s = (n_{visit1} + n_{visit2} + n_{visit3})/ (n_{visit0} + n_{visit1} + n_{visit2})$

Where:

R_s = Rate of scavenging
n_{visit0} = Number of carcasses originally placed
n_{visit1} - n_{visit3} = Number of carcasses remaining on visit 1 through 3

Searcher Efficiency Trials

Because individual surveyors will have different search success rates, searcher efficiency trials will be conducted once per year as required by EC's guidelines. Each searcher will be tested and if survey personnel changes, searcher efficiency trials will be repeated as needed. Testing can occur continuously. Carcasses will be laid out in random locations at a search location on the night before a search period and will have their location marked by GPS. A small number will be used (1 to 2 specimens) for a test at each site; however overall at least twenty carcasses should be used. Testing will occur continuously over multiple nights. Native species will be used in searcher efficiency tests so that searchers are not aware that they are trial specimens. The date, time and location that test specimens were planted will be recorded, as will the date it was searched for and whether or not it was retrieved. The condition of the carcass when it was retrieved will also be recorded.

The following equation will be used to calculate searcher efficiency:

$E_s = C_f/C_p$

Where:

E_s = Searcher efficiency
C_f = Carcasses found
C_p = Carcasses placed

Calculating corrected number of bird and bat fatalities will then be done using the following formula:

$C = c/[(E_s)(R_s)(P_s)]$

Where:

C = Corrected number of carcasses
c = Number of carcasses found
E_s = Searcher efficiency
R_s = Rate of scavenging
P_s = Percentage of area searched

3.2.2 Bat Mortality Monitoring

As the project area has been assigned a Sensitivity Rating of 2 (Medium) according to the MNR's *Guidelines to Assist in the Review of Wind Power Proposals – Potential Impacts to Bats and Bat Habitats* (MNR 2007), at least two years of post-construction monitoring will be required from May to September to assess impacts to bats. The major associated risk for the project area is the proximity to the Lake Erie shoreline, which may concentrate migrating bats.

Bat mortality monitoring will be conducted, as is recommended in the MNR's *Guidelines to Assist in the Review of Wind Power Proposals – Potential Impacts to Bats and Bat Habitats* (MNR 2007) and using the same protocol as listed above for bird mortality monitoring. Bat mortality data will be collected along with bird mortality data using the same methods, to improve efficiency.

Any bats encountered outside of the sensitive seasons of late summer and early fall (i.e. spring, early summer) will also be collected and recorded. Monitoring will occur approximately twice per week but the frequency of searches can be increased if it is believed to be necessary, based on results of scavenger trials. Searcher efficiency trials will be conducted once per month during the season of highest bat sensitivity (late summer and early fall) (MNR 2007).

During carcass searches, technicians will use protective gear (gloves, tools etc.) and ensure that they have updated rabies pre-exposure vaccination. Biological waste will be disposed of in a way that will not pose a risk to public or environmental health, and that will comply with appropriate legislation. Mortality monitoring can be focused on turbines that are in close proximity to landscape features that are likely to concentrate bats (e.g. riparian areas, lakeshores, larger woodlots and buildings). For example, pre-construction monitoring found the highest number of bat passes near the monitoring station BAT-001 near the southeast corner of the project area, which was located close to a woodlot and was also the closest to Lake Erie (NRSI 2008b).

3.2.3 Species at Risk Monitoring - Bald Eagle

A pair of bald eagles is known to have an active nest located in a large woodlot directly adjacent to the southeast corner of the project area. The exact location of the nest was not determined as it was outside the project area and the nest is believed to be more than 700m from the nearest turbine.

Surveys will consist of behavioural watches primarily concerned with monitoring bald eagle activity and behaviour in or directly adjacent to the southeast corner of the project area during the breeding season. As bald eagles may nest from February 15-July 15 in Ontario (BSC 2005), surveys should occur during this time period to fully cover the possibility of early or late breeding by the pair. Surveys will be conducted twice weekly throughout the breeding season for approximately 6 hours each visit. Surveys

will consist of watches conducted from a vantage point having a clear view of both the woodlot with the active nest, and the southeast corner of the wind farm. Flight paths in relation to turbines, flight heights in relation to turbine blade sweep, habitats used and number of times eagles enter the wind farm will be recorded. If access allows, determination of breeding will be documented. Besides bald eagles, no other specific monitoring is planned for breeding Species at Risk in the project area; however surveyors will be made aware of the potential Species at Risk present, and any occurrence during surveys will be noted and investigated.

4.0 REPORTING

Reporting of fieldwork results will be submitted annually, and results will be expressed both in terms of fatalities/turbine/year and fatalities/MW/year, to enable comparison between studies. Reports will include comparisons between projected annual avian mortality rates for the Raleigh Project and rates reported at other projects throughout North America (e.g. as summarized in Arnett et al 2007). If these projected annual mortality rates fall within the low or middle ranges of reported rates, no immediate mitigation is needed. However, if mortality rates approach the higher end of the reported scale, Invenergy will consult with the relevant agencies as needed to adjust monitoring and reporting described below to determine the reasons for the high mortality rates and to develop possible mitigation measures.

If a potentially serious negative effect is observed during monitoring, Invenergy will notify the relevant agencies during the survey period. If needed, Invenergy may take action prior to contacting the relevant agencies. Specific thresholds that will trigger the need for notification are outline in **Table 2** below.

Table 2:Observed Mortality Thresholds Triggering Notification of Relevant Authorities

Species group	Single Mortality Event	Observed Mortality Rate	Number of Mortalities Observed During Surveys (sampling 18 turbines)
General Birds	33 or more observed[a]	11.7 fatalities/MW/year[b]	18 fatalities observed over 3 weeks
Raptors	1 or more observed	0.09 fatalities/MW/year[c]	1 fatality observed over 3 weeks
Bats		20 fatalities/turbine/year[d]	20 fatalities observed over 3 weeks
Species at Risk	Any mortality	Any mortality	Any mortality

[a] - the largest single mortality event observed at a wind farm in North America, at the Mountaineer site (Kerlinger and Kerlinger 2004).

[b] - the highest recorded rate in North America observed at the Buffalo Mountain Facility in Tennessee (Arnett et al 2007).

[c] - the highest recorded in North America, outside of California, from the Stateline Facility in Oregon (Arnett et al 2007).

[d] - the highest documented bat mortality in Ontario (Stantec 2008a).

5.0 ADAPTIVE MONITORING AND MANAGEMENT

In general, if observed mortality impacts for any group of birds, bats and/or Species at Risk are found to exceed thresholds noted in **Table 2** above, EC and the MNR will be consulted to establish the appropriate mitigative response, which could include: conducting research with the goal of identifying the factors leading to the observed mortality rate; conducting more frequent surveys; increasing reporting frequency; and operational modifications.

If bats are experiencing disproportionate mortality, and rates are near the higher reported levels, Invenergy may consider installation of ultrasonic deterrent devices. However, as yet this technology has limited ability to effectively deter bats from areas as large as a turbines blade-sweep radius (Szewczak and Arnett 2008). Increasing the wind speed required to start a turbine on specific turbines having a high associated mortality could occur, as bats tend to be active at lower wind speeds (Arnett et al 2007).

If a review of environmental conditions unrelated to the wind farms operation is unable to shed light on increased mortality rates, then further action will be required. This could include blade feathering, and if necessary, shutting down specific problem turbines.

Blade feathering involves adjusting the pitch of the turbine blade such that reduced aerodynamics precludes efficient turbine operation. Blade rotation would be slowed and energy output reduced. This approach would be used to manage the turbine operation during specific time periods or weather conditions considered a high risk for bats or birds.

Turbine shut down would include the temporary removal of a turbine from service, stopping production of power. This action would be taken during a set period, such as a core seasonal migration window, and turbine operation would resume after the period of high risk has passed (EC 2007a).

These actions will be considered on a turbine by turbine basis, based on areas of concern identified through the monitoring program and as deemed economically feasible. Actions taken in response to mortality events will depend on species involved, behaviour implicated (migration, foraging etc.) and geographical extent of the observed mortality, as agreed upon by the relevant agencies.

6.0 SUMMARY

The project area for Invenergy's Raleigh Wind Energy Centre has been designated as having a Very High Sensitivity, Category 4 Level of Concern with respect to birds, and a Sensitivity Rating of 2 (Medium) with respect to bats. These sensitivity ratings trigger the need for this post construction monitoring plans as stipulated in EC and MNR guideline documents. The potential for bird and bat mortality, particularly during the spring and fall migration seasons, and the presence of breeding bald eagles directly adjacent to the project area boundary are the main concerns that will require post-construction monitoring. Post-construction monitoring is planned for two years after the wind farm is in operation. EC and the MNR will be kept up to date on monitoring results through annual reporting and will be notified of unexpected negative environmental effects. Mitigation measures have also been outlined in the case that unexpected negative environmental effects occur that cannot be explained by factors unrelated to the wind farms operation.

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