Wind Turbines and Birds

A Guidance Document for Environmental Assessment

INTERIM DRAFT
July 2005

Environment Canada
Canadian Wildlife Service

Wind Turbines and Birds

A Guidance Document for Environmental Assessment

Environment Canada / Environnement Canada
Canadian Wildlife Service/Service canadien de la faune
351 St. Joseph Boulevard • Gatineau, Quebec
Telephone 819-997-1095 • Fax 819-997-2756
Email cws-scf@ec.gc.ca

These draft environmental assessment guidelines are intended to be used on an interim basis pending their finalisation. Environment Canada is continuing to work with the wind energy industry and following these discussions will undertake final revision and approval of the document. Once finalised, the guidelines will be provided on the CWS website; they will then be reviewed and updated when required as new information on the interactions between wind turbines and birds becomes available.

This document will be reviewed and updated periodically. The most up-to-date version is available on our web site at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm

The companion document, "Wind Turbines and Birds: A Review" is available for consultation at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm

For questions or information, please contact the Environment Canada / Canadian Wildlife Service

Acknowledgements

This guidance document was developed through a joint initiative of the Canadian Wildlife Service, the Ontario Region and the Environmental Assessment Branch of Environment Canada.

The guide is based on work undertaken by Bird Studies Canada (Andrea Kingsley and Becky Whittam) under contract to Environment Canada. It builds on the review of available information on bird-wind turbine interactions from around the world (Kingsley and Whittam 2005, available at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm), as well as work by the same authors on a matrix approach to environmental assessment guidance.

Input and advice was provided throughout the work by scientists from the Canadian Wildlife Service (CWS), and environmental assessment (EA) practitioners at Environment Canada. In particular the Wind Power Working Group from the CWS provided extensive input and reviewed this document.

In the course of developing this work, comments were provided by industry (including the Canadian Wind Energy Association), other levels of government and environmental associations. Dr. Steve Percival provided guidance in the development of the matrix approach.

These guidelines are based on current science and best available information. They will be reviewed and updated as required. Comments can be sent to:

Environment Canada / Environnement Canada
Canadian Wildlife Service/Service canadien de la faune
351 St. Joseph Boulevard • Gatineau, Quebec
Telephone 819-997-1095 • Fax 819-997-2756
Email cws-scf@ec.gc.ca

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Wind energy projects have the potential to adversely affect birds through direct fatalities and disturbance, including habitat loss. The purpose of this document is to outline the nature of information needed in an environmental assessment to identify, assess, mitigate and monitor the potential adverse effects of wind energy projects on birds, including migratory birds and species at risk. This guide recognises the uncertainty in predicting and understanding effects of turbines on birds, including inherent difficulties in assessing and monitoring bird-turbine collisions. It indicates the appropriate level of effort required to assess and monitor potential effects, given the sensitivity of relevant species and their habitats. This guide is intended to be used in consultation with regional Canadian Wildlife Service biologists and environmental assessment experts to consider site-specific concerns.

The guide can be used as a pre-assessment tool to identify site and design features that should be considered to minimise impacts on birds. The guide is also intended to be used as an environmental assessment (EA) guide, in conjunction with expert advice provided through Environment Canada, on how to undertake that part of the EA that relates to migratory birds. Guidance is provided on preliminary information necessary to determine site sensitivity. The guide uses a matrix approach based on site sensitivity and facility size to rank the level of concern associated with the proposed project. Baseline information and follow-up requirements are identified for the four "level of concern" categories. The guide also provides information on assessing cumulative effects.

1.0 INTRODUCTION

The Government of Canada ratified the Kyoto Protocol in 2002, and is committed to reducing greenhouse gas emissions and encouraging the establishment of alternative energy sources such as wind power. In 2001, Canada's Wind Power Production Incentive (WPPI[1]) was announced to encourage the growth of this green energy. Budget 2005 announced an expansion of WPPI to a level that would produce enough energy to power 1 million Canadian homes. Thus, wind energy is a fast-growing sector in Canada, as it is in the world.

Wind power projects have the potential to adversely affect wildlife, particularly aerial wildlife such as birds and bats. Two main types of adverse effects on birds have been identified: direct fatalities, and disturbance, including habitat loss (Kingsley and Whittam 2005). With the growth of the industry, the potential to adversely affect wildlife on a cumulative basis also increases.

This guidance document has been developed for proponents of wind energy projects in Canada. It identifies the types of information and assessments that Environment Canada (EC) would expect in a project-level environmental impact assessment to address the potential effects on birds. It also provides recommendations on site selection and design of wind energy installations so that factors that present the greatest risk to birds can be avoided upfront, early in the planning process.

The guidance document was developed following the completion of a companion background review of information available on bird-wind turbine interactions from around the world (Kingsley and Whittam 2005, available http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm). Input was also provided by Canadian Wildlife Service (CWS) scientists, Environment Canada environmental assessment (EA) practitioners, and members of the Canadian Wind Energy Association (CanWEA).

The approach adopted in this guide recognises the uncertainty in predicting and understanding effects of turbines on birds, including inherent difficulties in assessing and monitoring bird-turbine collisions. It builds on best available information to indicate the appropriate level of effort required to assess and monitor potential effects, given the sensitivity of relevant species and their habitats. Meanwhile, the Canadian Wildlife Service is fostering a collaborative research model with industry, universities and government to address priority issues and to establish greater certainty (CWS National Action Plan, in preparation). As the knowledge gaps are filled, and as Canadian experience grows and the science and technology of assessment improves, this guide will be updated to reflect the improved understanding. As well as addressing broader national-level questions, the collaborative model provides an additional opportunity for wind power companies to form partnerships to address environmental issues and engage in adaptive management.

The approach recognises that site-specific concerns, such as local patterns of bird use or differences in habitat, must be taken into account, and depending on these circumstances, a greater sampling effort may be needed. Therefore, these guidelines are intended to be used in consultation with regional CWS biologists and EA experts. The guide should not be regarded as exhaustive or restrictive, and should serve as the starting point for discussions with Environment Canada staff on each project.

This guide provides information needed to complete one aspect of the environmental assessment of a wind energy project, that is, the potential effects on birds. Environment Canada Regional Environmental Assessment Coordinators may also request information or provide advice on other issues such as potential adverse effects on sensitive habitats, non-avian wildlife species at risk, sensitive species such as bats, or other issues such as water quality. The responsible authority for the federal environmental assessment may provide additional guidance. For example, please consult the: "Environmental Impact Statement Guidelines for Screenings of Inland Wind Farms Under the *Canadian Environmental Assessment Act"* located at **http://www.canren.gc.ca/programs/index.asp?CaId=190&PgId=1155.**

Note that appropriate provincial environmental assessment guidelines may also need to be considered. In addition, impacts resulting from related facilities, such as access roads and transmission lines, may also need to be addressed.

1.1 Purpose

The purpose of this document is to outline the nature of information needed in an environmental assessment to identify, assess, mitigate and monitor the potential adverse effects of wind energy projects on birds, including migratory birds and species at risk, in order to:

- Ensure that the wind industry is aware of, and considers, the factors that present the greatest risk to birds in order to promote the development of best practices;
- Avoid or minimise the adverse effects on birds; and,
- Specify the types and amount of baseline information that is required for the environmental assessment; and describe the likely extent of follow-up that would be necessary after construction.

1.2 Wind farm project and federal environmental laws

Many bird populations in Canada and North America have been declining, especially over the past thirty years. Several species have lost half their numbers in only one human generation, and this rate of decline is of concern to scientists, naturalists and increasingly, to the general public. . These declines are due to a number of factors, including loss and degradation of breeding and wintering habitats, impacts of chemicals such as pesticides, as well as collisions with tall structures of all sorts (buildings, towers, power lines, etc.) on migration or while staging, wintering or breeding.

Most birds that occur in Canada migrate between breeding and wintering areas. As the conservation of migratory birds is the joint responsibility of all countries they visit during the year, the Canadian government is a party to international efforts to protect migratory birds and their habitats.

The Migratory Birds Convention of 1916 between the USA and Canada is an international treaty implemented in Canada by the federal *Migratory Birds Convention Act* (MBCA) and accompanying regulations. The MBCA (paragraph 5) prohibits any person to possess a migratory bird or nest, or buy, sell, exchange or give a migratory bird or nest or make it the subject of a commercial transaction.

[1] A list of acronyms is presented in Appendix B

Therefore, permits are required for the handling of migratory birds or bird carcasses. The *Migratory Birds Regulation* (MBR), in Section 6, prohibits the disturbance, destruction, taking of a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird; or the possession of a live migratory bird, or its carcass, skin, nest or egg, except under authority of a permit. It is important to note that under the MBR, no permits can be issued for economic activities or development projects, and therefore permits cannot be provided for economic development activities that incidentally affect migratory birds. Section 35 of the MBR also prohibits in general the deposit of harmful substances in any waters or any area frequented by migratory birds anywhere in Canada.

The *Species at Risk Act* (SARA) protects plants and animals listed in Schedule 1 of the Act (the List of Wildlife Species at Risk). SARA also requires that every person required by law to conduct a federal EA must (1) notify the competent minister(s) in the likelihood that a project will affect a listed wildlife species or its critical habitat; (2) identify the adverse effects of the project on the listed wildlife species; and, if the project is carried out, (3) ensure that measures are taken to avoid or lessen the effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategies and action plans.

The *Canadian Environmental Assessment Act* (CEAA) and its regulations are the legislative basis for federal involvement in environmental assessment. A federal authority responsible for decisions with respect to a project that triggers the Act is legally required to ensure that the environmental effects of the proposed project are considered, that the significance of those effects is understood and that mitigation measures that are technically and economically feasible are identified and applied where required. As a Federal Authority under the *Canadian Environmental Assessment Act*, Environment Canada provides advice to other federal departments on migratory birds, species at risk and their habitats, among other issues, for projects on private and public land. The EC regional EA offices are usually the first point of contact for EA information within the department; contact information is provided at http://www.ec.gc.ca/ea-ee/home/regions_e.asp.

2.0 HOW TO USE THIS GUIDANCE DOCUMENT

This guide should be used in two contexts:

1. As a pre-assessment tool. Early in the project planning process, the guide should be used in conjunction with the companion document to alert developers to important siting considerations, lighting options and basic turbine characteristics that can reduce risks to birds. Avoidance of features that lead to high potential risk at this stage will reduce the subsequent level of effort required in the environmental assessment. Proponents are strongly encouraged to consult the regional Canadian Wildlife Service or Environmental Assessment office for further information and guidance in identifying, assessing and mitigating these risks.

2. As an EA tool. The guide is intended to be used in conjunction with expert advice provided through Environment Canada.

    - Under CEAA, the federal authority responsible for the EA (the Responsible Authority, or RA) makes a decision on the adequacy of the federal EA, determines the likely

significance of potential adverse effects, and specifies the amount and type of follow-up required. Federal expert authorities provide advice and expertise throughout the process. The RA issues direction on how to carry out the screening which is then undertaken by the proponent.

- In the context of a federal EA, this document provides generic guidance on how to undertake that part of the EA that relates to migratory birds. It provides information on how to determine the sensitivity of the site to migratory birds, the baseline information required for the analysis of potential adverse effects, the identification of mitigation for these effects, and follow-up requirements. While the guide provides a picture of the "typical" situation, it is intended to be used with input from EC experts to identify regional/local case-specific considerations.

- The guide provides information on assessing cumulative effects, as required under the *Canadian Environmental Assessment Act*. Assessing cumulative effects may involve considering cumulative impacts at a site (increase in numbers of turbines) or at a region level (many sites). Broader-scale regional assessments may require a different approach that is beyond the scope of this guide. This is also the case for impacts related to access roads and transmission lines.

- In situations where follow-up is required, the EA should include the use of a protocol for determining the actual effects of a project following implementation. This guide provides generic direction on what may be required in such a follow-up protocol. Again, consultation of regional CWS experts is recommended.

2.1 Organisation of the guide

This guide is organised into sections that reflect each step in the recommended approach.

- **Step 1: Pre-assessment considerations** (Section 3). Before committing to a specific site or design, a quick check should be undertaken to see if the proposed site or design contains any features that are identified in this section as potentially important to birds and sensitive to disturbance.

- **Step 2: Preliminary information required** (Section 4) Collect preliminary data through appropriate reconnaissance field surveys or literature or other secondary studies to determine the bird populations and habitats that may be affected by the development.

- **Step 3: Determination of site sensitivity** (Section 5). Preliminary information is then used to determine a site sensitivity rank as outlined in Table 1.

- **Step 4: Size of the facility** (Section 6). The proposed size of the facility and the cumulative number of turbines in the area are used to determine the project's size category from Table 2.

- **Step 5: Determining the Level of Concern** (Section 7). A matrix based on site sensitivity and facility size is used to rank the level of concern associated with the project. The predominant issue for determining the level of concern is the site sensitivity and this is reflected in the approach; however, size of the proposed wind farm is also factored into the analysis.

- **Step 6: Determining the level of baseline information needed** (Section 8). The level of concern ranking then guides the extent of baseline information required, by identifying questions that must be addressed for each rank.

- **Step 7: General considerations relating to facility or site design** (Section 9). The answers to the baseline questions can assist in determining the potential environmental effects of the proposed project, and can be applied directly to modify the design and layout of the wind farm to reduce impacts on birds.

- **Step 8: Verifying predictions and mitigation effectiveness** (Section 10). The level of concern rank also guides the extent of follow-up that is needed to determine actual environmental effects of the project.

3.0 SITE SELECTION AND DESIGN CONSIDERATIONS

The risk of negative consequences to birds from turbines can be reduced through careful site selection and facility design. The following recommendations have been prepared based on best available information to assist the proponent in making such choices early in the planning process. In addition to reducing the potential for adverse environmental effects, this approach can reduce the amount of work required for the environmental assessment.

3.1 Site selection recommendations

The proponent should consult Table 1 and examine the factors that determine whether a site has a higher level of concern or whether it may entail special considerations. If the site has these factors, the proponent may wish to choose another site that presents less risk to birds, prior to initiating the environmental assessment.

Proponents may also wish to consider the relative suitability of different locations for a given facility, early in the planning process. By comparing different sites, based on the presence or absence of features identified in Table 1, the site presenting the least risk to birds may be selected and the ensuing environmental assessment may then be simplified.

3.2 Facility design recommendation

The following considerations provide some "rules of thumb" that can help in designing facilities that present less risk to birds:

- A smaller number of larger turbines may pose less of a risk to birds than a larger number of smaller turbines. Large modern turbines can have a rotor-swept area three times greater than older, smaller models, but despite their much larger size, it seems that they result in similar numbers of casualties. This means that if one larger turbine replaces three smaller ones, avian mortality per wattage may be reduced by two-thirds, although this is not yet fully understood or accepted. Studies to date also suggest that larger wind farms (*i.e.*, more turbines) kill more birds, but not disproportionately more birds (on a per turbine basis). Larger wind farms will also lead to a greater impact on habitat.

- Generally, objects over 150m in height appear to pose a greater threat to nocturnal migrants (especially when guyed and lit); such taller objects can cause mass bird kills, as found at communication towers and tall buildings. Any turbines taller than 150m in height should be subject to closer scrutiny to ensure their environmental impact is minimised, especially for sites close to arrival and departure sites of nocturnal migrants, on mountain tops or in foggy areas. However, even shorter turbines may pose a risk depending on their location (such as hill tops, ridgelines, or proximity to arrival or departure sites of nocturnal migrants).

- Until further information is available, the use of tubular towers without guy wires is recommended in commercial wind energy projects in Canada.

- On associated meteorological towers, avoid guy wires whenever possible, and equip these towers with minimum allowed lighting if they are required to be lighted under Transport Canada regulations.

- The number, location and types of lights can have an important effect on the probability of nocturnal migrants being killed at wind turbines. Lighting should only be used where required by Transport Canada regulations. Use strobe lights only, with the minimum number of flashes per minute (*i.e.*, longest pause between flashes) and the briefest flash duration allowable. Avoid steady-burning or other bright lights such as sodium vapour or spotlights on turbines and other structures.

- Where possible, measures should be taken to minimise motion smear. For example, where possible, blade revolutions per minute may be minimised in new developments to help increase visibility.

- Bury all lines where possible; reducing the amount of aboveground wires at wind energy projects will reduce the potential risk of collision to birds in the area. However, placing cables underground may be impractical where bedrock is at or near the surface, in the arctic where permafrost is present, and in other areas where there is insufficient soil depth to permit burial. In areas where the risk of bird collision is low, and where sensitive habitat exists, the placement of wires underground may cause more damage to local bird populations through habitat destruction than overhead wires would cause through collisions. Each site should be examined individually to assess the best solution. In some areas where burying the wires is impractical (*e.g.*, areas of shallow bedrock), the following mitigation techniques should be considered (from Avian Power Line Intervention Committee 1994, 1996):

    - Line visibility should be increased by bird flappers or other bird flight diverters, and increasing the size of the wire (to larger than 230kV).
    - Lines should not be built over water or other areas of high bird concentrations.
    - Small lightning shield wires should be eliminated where lines cross wetlands and migration routes.
    - Lines should be made parallel to prevailing wind directions.
    - Lines crossing rivers should be placed at oblique rather than right angles.
    - Lines should be placed as close to trees as is practical and below the level of tree tops wherever possible.

- To prevent the electrocution of large raptors, lines should be designed with adequate space between conductors to prevent a bird from simultaneously touching two phases.

- Configuration should avoid creating barriers to bird movement to the extent possible. Alternatively, spacing between turbines should be greater than 200m in order to avoid inhibiting movement. This recommended distance is often the amount of spacing required by industry to reduce wake effects of large turbines on neighbouring turbines but, when appropriate, the 200m minimum distance between turbines should also be used for smaller turbines.

- Keep the number of access roads constructed to a minimum.

- Prior to construction, constraint mapping should be undertaken to assess where roads should or should not be located. Habitat destruction, habitat fragmentation and disturbance of breeding, staging and wintering birds should be minimised as much as possible. In particular, intense construction should be focused outside the core breeding season to reduce disturbance to resident birds. However, it should be noted that each site is unique and construction outside of the breeding season actually may be more detrimental to local birds if, for example, the area is more important as a migration staging ground. Also, construction during the breeding season in areas that have been greatly modified by human activities (*e.g.*, intensively cropped fields) may have little impact on breeding birds.

- Access roads that are not used after construction should be allowed to re-vegetate. In natural settings, the habitat around the site should be maintained as close as possible to what occurred there before construction.

- Food waste may attract birds to a site. Therefore, all wastes should be collected and disposed of at a licenced facility during the operational phase.

- Adopt a decommissioning plan that would require removal of the turbines and infrastructure when the facility is no longer operational, including restoration of the site to approximate pre-project conditions. The turbine platforms should be removed (when appropriate) to a reasonable depth and soil replaced over any remaining concrete. If the site was formerly a natural area, all roads and any other disturbed area should be re-vegetated using native vegetation or standard seed mixes (the use of invasive species should be avoided) to help the site return to its original state as quickly as possible.

4.0 GATHERING PRELIMINARY INFORMATION

Preliminary information must be gathered by the proponent or its consultants for all sites, regardless of size, prior to construction in order to determine site sensitivity. Environment Canada can provide guidance, but will not undertake this task. Section 4.1 outlines a list of basic questions that should be answered by gathering this preliminary information. Sections 4.1.1 and 4.1.2 outline methods of answering these questions.

4.1 Preliminary questions to consider

Part of determining a site's suitability for wind turbines includes gathering existing information on what birds are present (or likely present) and whether there are any potential features or species that would increase the site's sensitivity.

Information may be gathered through literature review (Section 4.1.1) or on-site surveys (Section 4.1.2), and should be sufficient to answer the following basic questions:

Birds

- Identify the species which:
  - breed and winter at the site and in the surrounding area, and indicate their relative abundance. Make special mention of:
    - any species at risk, including species listed under the *Species at Risk Act* (SARA), provincially or territorially designated species, species designated by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), or species designated as priority species by the Conservation Data Centres (CDC), Partners in Flight (PIF) or the CWS;
    - bird colonies (note species, size, location);
    - raptors, shorebird concentrations; and
    - species that give aerial flight displays.
  - congregate at significant migration staging areas at or near the site;
  - frequently migrate through or near the area; and
  - commute (*i.e.*, between breeding and foraging habitats) through or near the area, as compared to other locations within the region.

Habitat

- What habitat types occur on the site and in the surrounding area?
- Do these habitats typically support habitat-sensitive or habitat specialist species, *e.g.,* forest-interior species, grassland species, or shrubland species?
- What is the relative density of breeding birds in these habitats?
- What breeding or migrating birds do these habitats typically support?
- How much of each habitat type or function will be lost or altered as a result of this development?
- What topographical features, such as islands, peninsulas, and ridges, are located on or near the site that may influence bird activity and movement?

Human use

- What is the expected amount and type of human presence (vehicles, pedestrians, tourism, etc.) at the site at different times of the year, during and following construction?

Meteorological data

- What is the relevant meteorological data, such as wind speed, wind direction and visibility (*e.g.*, number of days during migration period with visibility <200m or cloud bases <200m) for the site?

***NOTE** - Proponents should not undertake surveys of known bird colonies or breeding areas for certain bird species at risk, such as Piping Plover, as they are particularly susceptible to human disturbance. When uncertain, proponents should contact the CWS for advice. For those sections of the study area where surveys are not advisable, information should be obtained from organisations and individuals listed previously and should be included with EA documentation. Should new colonies or breeding areas of species at risk be discovered while conducting field work, the Canadian Wildlife Service should be contacted immediately and this information should be sent to appropriate federal and provincial natural resource agencies and to the regional or provincial local CDC or National Heritage Information Centres (NHIC). See Section 8.5 for special considerations for species at risk.*

4.1.1 Literature Searches and Expert Consultation

Many of the above questions can be answered through literature searches and consultation with appropriate natural resource agencies, environmental non-government organisations, or through local ecological knowledge such as the observations and knowledge of local bird experts, ornithological clubs, naturalists and conservation organisations, and local landowners.

Information may be obtained from the following sources (see Appendix A for web-site information):

- Appropriate government agencies: Consult the local office of the Canadian Wildlife Service of Environment Canada, and provincial or territorial natural resource and wildlife departments, to identify key species that may be of concern in the area, and for other relevant sources of information on these birds.

- Conservation Data Centres (CDC): Also sometimes known as Natural Heritage Information Centres (NHICs), CDCs are an important source of information on locations where provincial and federal species at risk, and other species of regional conservation concern, have been identified.

- Species at risk (SAR) websites: Check the federal, provincial and territorial species at risk web sites to determine whether there may be any listed species, residences of individuals of those species, or critical habitat that occur within the general area. The federal SARA Public Registry will also provide information on critical habitat, residences and other available information (including the updated SARA List)[2]. The COSEWIC site identifies species that have been assessed by that committee that may or may not have been listed under SARA. Most web sites do not provide exact location information. When in doubt, contact appropriate federal or provincial/territorial agencies.

- Pre-existing survey information: This may include surveys conducted annually by local naturalists or naturalist groups, and various volunteer-based bird monitoring surveys such as provincial breeding bird atlases, Audubon/Bird Studies Canada Christmas Bird Counts, the Breeding Bird Surveys, and regional owl, raptor, woodpecker and other avian surveys.

- Migratory Bird Sanctuaries/National Wildlife Areas: Check to determine whether the site is in close proximity to a Migratory Bird Sanctuary (MBS) or National Wildlife Area (NWA). If so, the relevant websites will contain information on the significant species or features found there.

- Bird Conservation Region (BCR) plans: These are being developed across Canada as part of the North American Bird Conservation Initiative (NABCI). BCR plans identify species, or suites of species, along with their habitats that are conservation priorities for each region. Consult the Canadian Wildlife Service to obtain information on a specific region's BCR plan.

- Existing environmental assessments: Consult other environmental assessments or any similar documents that may be on the public record for the site in question, or for adjacent sites. Also, consult EA's for similar-sized projects in the same or nearby jurisdictions.

- General Status of Species in Canada website: Consult this website to determine if any of the species known to be at the site from the above surveys are ranked 1 (At Risk), 2 (May Be at Risk) or 3 (Sensitive), either nationally or provincially.

- Important Bird Areas website: Check this website to see whether the project site is near or within an Important Bird Area. If so, this website will contain information on the significant species found there.

- Scientific and natural history publications: These include refereed journals (*e.g.*, Canadian Field Naturalist), non-refereed publications (*e.g.*, Nova Scotia Birds), and provincial natural history databases (which may include the archives of natural history e-mail list serves).

4.1.2 Site reconnaissance

Questions that cannot be answered through literature searches and expert consultation should be addressed through site reconnaissance trips in appropriate seasons. An expert bird biologist should be hired to answer the questions and assess site sensitivity. The level of effort required in these reconnaissance surveys will depend on how much information has already been obtained. It should usually take several site visits to answer the basic questions listed above. In some cases, information available for similar or nearby sites, such as information on habitat or bird distribution, may be pertinent.

5.0 DETERMINING SITE SENSITIVITY

Information gathered in Sections 3 and 4 should now be compared with Table 1 to determine the sensitivity of this site from the perspective of bird use. Table 1 identifies factors that could increase the risk of adverse effects on birds. The presence of any one factor identified in each category will result in a sensitivity rating within that category. In the case of uncertainty over a particular feature, a precautionary approach is recommended. Please note that where there is insufficient information to determine the appropriate category, the site should be placed in the "high" sensitivity category. The determination of site sensitivity should be undertaken with the assistance of a CWS specialist.

Where a listed species at risk, a residence of individuals of that species, or critical habitat is identified at the site, special considerations apply, including provisions of the *Species at Risk Act*. Consult the

[2] Please note that provisions of SARA may apply where listed species, the residences of individuals of those species, or critical habitat, may be affected by the project. For more information, or for definitions of SARA terms, please consult Appendix C.

regional CWS office prior to continuing with any aspect of the project in such cases. For more information see section 8.6.

Any proposal for offshore developments also requires special consideration, because of the limited information available on possible interactions between birds and wind turbines offshore. Again, consult the regional EC experts for more information.

Table 1. Site sensitivity

Sensitivity	Determining factor
Very high	• Presence of a SARA listed species, the residence (s) of individuals of that species, or critical habitat, of a nature or proximity that could lead to potential adverse environmental effects (determined through baseline research and consultation with Environment Canada)[3]. • Site contains other species at risk (COSEWIC species or species designated by provincial or territorial governments) • Site contains, or is adjacent to, a large or important bird colony, such as herons, gulls, terns and seabirds (determined through baseline research and consultation with Environment Canada). • Site contains significant staging or wintering area for waterfowl or shorebirds, or significant areas of bird concentrations. • Site is, or is adjacent to, an area recognised as nationally important for birds (*e.g.*, by being located in or adjacent to a National Wildlife Area, Migratory Bird Sanctuary, Important Bird Area, National Park, WHSRN site, or similar area specifically designated to protect birds). • Site contains large concentrations of raptors (determined through baseline research and consultation with Environment Canada and provincial or territorial agencies). • Site is on a known migration corridor.
High	• Site contains one or more landform factors that concentrate birds (*e.g.*, islands, shoreline, ridge, peninsula or other landform that may funnel bird movement) or significantly increase the relative height of the turbines. • Site is located between habitats where large local bird movements occur, or is close to significant migration staging or wintering area for waterfowl or shorebirds. • Site contains, or is adjacent to, a small bird colony, such as heron, gull, tern or seabirds (determined through baseline research and consultation with Environment Canada). • Site subject to increased bird activity from the presence of a large heron, gull, tern or seabird colony located in the vicinity of the site (determined through baseline research and consultation with Environment Canada). • Site is subject to increased bird activity from the presence of an area

	recognised as nationally important for birds (*e.g.*, a National Wildlife Area, Migratory Bird Sanctuary, National Park, Important Bird Area or similar provincially or territorially protected area). • Site contains species of high conservation concern (*e.g.*, birds known to have aerial flight displays, PIF/CWS priority species, etc.).
Medium	• Site is recognised as regionally or locally important to birds, or contains regionally significant habitat types (*e.g.*, large contiguous tracts of forest or wetland).
Low	• Site does not contain any of the elements listed above and has no significant species or recognised conservation features.
Special considerations required	• Site contains a SARA listed species, the residence(s) of individuals of that species or critical habitat.[4] • Proposed project is located offshore.[5]

6.0 SIZE OF THE FACILITY

The proposed facility should then be assigned a size category based on the total number of turbines proposed, using Table 2. The assessment should include any existing turbines (*i.e.*, if the project is the expansion of an existing facility) as well as other turbines (*i.e.*, from other wind farms) within 1 km of the site.

Table 2. Facility Size.

Size	Definition
very large	Proposed wind farm size has more than 100 turbines
large	Proposed wind farm size has 41- 100 turbines
medium	Proposed wind farm has 11-40 turbines
small	Proposed wind farm has 1-10 turbines

Note that the above table only considers the size of the facility in terms of number of turbines and does not incorporate other design features, such as the type of lighting used, tower structure, placement of turbines, and so on. While such design considerations are certainly relevant to the overall risk to birds, it is very difficult to assign a generic value to each. However, such features should be taken into consideration when incorporating site-specific considerations into the approach for gathering baseline information and follow-up requirements.

7.0 DETERMINING THE LEVEL OF CONCERN

[3] See section 8.5 for special considerations relating to species at risk.
[4] See section 8.5 for special considerations relating to species at risk.
[5] See sections 8.6 and 11.0 for special considerations relating to offshore projects.

Use the level of concern matrix (Table 3), which considers both the sensitivity and facility size, to determine the overall level of concern associated with bird risk for the proposed development.

Note that Table 3 does not apply to offshore projects, or if listed species at risk, residences of individuals of those species or their critical habitat are identified on site. Consult regional CWS office for details on special considerations for such projects.

Table 3. Level of Concern Matrix

FACILITY SIZE	SENSITIVITY			
	very high	**high**	**medium**	**low**
very large	very high	very high	High	Medium
Large	very high	very high	High	Medium
medium	very high	high	medium	Low
Small	very high	high	medium	Low

Very high concern (red) projects: This "level of concern" category represents the highest risks to birds, and consequently will require the highest level of effort for the environmental assessment. Proponents are strongly encouraged to seek alternative locations for their projects that would present a lower level of risk to birds. Proponents wanting to proceed with proposed projects in this category will need to collect thorough baseline information,usually over two years or more (see Section 8.1). If the project does proceed[6], the proponent will need to commit to very detailed follow-up for three years or more.

High concern (orange) projects: This "level of concern" category indicates that features are present that could represent a high risk to birds, and will usually require comprehensive surveys to gather baseline information (Section 8.1). Post-construction follow-up will likely also be required for at least two years.

Medium concern (yellow) projects: This "level of concern" category indicates that some features present may result in a moderate risk to birds, such projects would usually require basic baseline information surveys (Section 8.1). Basic follow-up will likely also be recommended.

Low concern (green) projects: This "level of concern" category represents the lowest risk to birds. These projects will require a minimum amount of baseline information surveys as suggested in Section 8.1, and possible follow-up after construction depending on specific circumstances.

19
19
19
19

[6] The environmental assessment will need to determine the likely significance of adverse effects, including effects on birds. Projects in this level of concern are more likely to lead to significant effects on birds, which is why proponents are

8.0 DETERMINING THE LEVEL OF BASELINE INFORMATION REQUIRED

The purpose of this step is to identify the baseline information needed to assess the potential adverse effects on birds, as required in the EA. The extent of baseline information required is based on the level of concern identified, and builds upon the preliminary information collected to determine site sensitivity. Basic questions that must be addressed for projects that fall within the low level of concern category are identified first. Additional questions are then identified for projects representing a medium level of concern; supplementary questions are added to the list for high levels of concern; and finally more in-depth questions are needed for projects that represent very high level of concern

Given the importance of site-specific considerations, the proponent should work closely with regional CWS experts to develop an appropriate approach to gather this baseline information. Additional site-specific details may need to be considered. For example, if a breeding colony is located near or on the site, the size of the colony and the species present would strongly influence the types of surveys required.

In some cases, geophysical conditions at the site (*e.g.*, ridges, valleys, peninsulas, or other topographical features) may require special considerations that could warrant, for example, more frequent site visits, or specialised surveys such as radar work. In other cases, there may already be sufficient background information for a particular site so less study is required in this step.

If the baseline surveys reveal that certain features are present at the site that were not initially identified in the preliminary information stage, the site sensitivity may need to be re-considered and the level of concern may require adjusting.

Finally, specific considerations may arise from the design of the facility itself (see section 3.2).

8.1 Baseline information questions for low level of concern projects

Low level of concern (Green):

Any gaps in the preliminary data collected (section 4.1) should be addressed. Beyond these, few additional questions need to be addressed for this level of concern. Most can normally be answered through relatively small field survey programs. Questions are as follows:

- If a bird colony is located within 5 km of the project area, or if a nationally recognised site occurs within 1 km, do individual birds pass through the proposed turbine locations as part of their daily movements? What proportion of the colony does this represent?

encouraged to consider other locations. At a screening level, the RA must determine whether the project, taking mitigation into account, is likely to lead to significant adverse effects, in which case it can either be abandoned or must be referred to a panel or mediation. The RA can exercise a duty or perform a function that will allow the project to proceed only if the screening determines that the project is unlikely to cause significant adverse environmental effects.

- Do raptors breed at the site or within 1 km of the site? If so, what species are present and how close do they nest to the proposed facility?

- If the site is recognised by local experts as having bird habitat that is locally important, how much of this habitat would be lost or altered by the proposed project?

8.2 Baseline information questions for medium level of concern projects

Medium level of concern (Yellow):

In addition to the questions listed in 8.1 above, the following questions should be addressed:

- If the site contains land features (islands, ridges, shorelines, peninsulas, areas of open water in winter, etc) that may concentrate birds on migration, while staging, or in winter:

    - Do birds concentrate at this site during any of the seasons mentioned above? If yes:

      For Migrants
      - What is the passage rate of migrants? How do migrants use the site in comparison to other local, regional, provincial or national sites of interest?
      - At what period of the day or night do migrants pass through the area?
      - Are there any lighted structures nearby that could attract birds to the area of the wind energy facility?
      - How often are weather incidents such as fog, rain or low cloud, noted at the site ?

      For Staging or Wintering Birds:
      - Are there prey or other food cycles (or other factors) on the site which periodically attract or concentrate birds (known as irruptions)?
      - Is there evidence to suggest that these particular sites are used regularly year-after-year, or perhaps only during irruption years?

- If the site is recognised by CWS or local experts as regionally or locally important to birds, how does the number and diversity of birds that use the site in the season of interest compare to other locations in the region or province? How much habitat would be lost or altered by the proposed project?

- If large numbers of birds may commute through or near the area during the day, what is the height and direction of this movement, and how does this relate to the proposed project design and turbine locations?

- If large numbers of birds stage in or near (within 1 km of) the area, are there any activities taking place nearby that could potentially disturb birds (for example by causing large numbers of bird to take off and fly directly overhead), thereby resulting in collisions with wind facility structures?

- What is the frequency of dense fog (visibility <200m) and low cloud bases (<200m) at the site during the spring and fall bird migration periods?

8.3 Baseline information questions for high level of concern projects

High level of concern (Orange)**:**

In addition to the questions listed in sections 8.1 and 8.2 above, the following questions should be addressed:

- If aerial flight display species occur at the site:
    - How many individuals might be affected by the proposed wind farm?
    - How significant is the site for these species (*i.e.*, is it one of the few sites in the region or province with this species)?
    - What proportion of these species' local habitat would be close to the facility, and what is the likelihood that birds will be displaying in close proximity to turbine blades?

- What is the "bird use rate" (see Section 10) (total number and by species group of interest) within the project area during one breeding, migration and wintering season? This information must be collected in a standard way for comparison with post-construction follow-up, which is often recommended for sites of this level of concern.

8.4 Baseline information questions for very high level of concern projects

Very high level of concern (Red)**:**

Again, this level of concern presents the highest risk to birds and extensive baseline information is required. This will usually take two or more years to complete. The following questions will need to be addressed, in addition to the questions listed in sections 8.1 to 8.3:

- If bird colonies occur in the project area:
    - How many of each species are present?
    - What proportion of the regional and national population does this colony represent?
    - What foraging behaviours might be affected by the development?
    - What is the predicted amount of disturbance to the colony?

- If large concentrations of raptors, shorebirds, waterfowl or other species congregate in the site during any time of the year:

- How many of each species are present?
- Is the site regionally, provincially or nationally important for these species?
- What movements or behaviour(s) of these species might lead to increased collision risks (*e.g.*, flight heights, foraging techniques) and how might these risks be minimised?

If the above questions have been answered or are not pertinent and the project is still to be considered for approval, the following may need to be answered:

- What is the "bird use rate" (see Section 10) (total number and by species group) within the project area, over at least two breeding, migration and wintering seasons? This information must be collected in a standard way for comparison with post-construction follow-up, which is almost always required for sites with a very high level of concern.

8.5 Special considerations relating to species at risk

The presence of listed species at risk, the residences of individuals of those species or their critical habitat is an indication that special considerations are required. Proponents must comply with the requirements of the *Species at Risk Act*. In addition, it is a matter of best practice in environmental assessment to address potential adverse effects on species at risk.

The SARA protects plants and animals listed in Schedule 1 of the Act (the List of Wildlife Species at Risk). SARA prohibitions apply to aquatic species and migratory birds protected under the *Migratory Birds Convention Act, 1994* wherever they are found and to all listed wildlife species on federal lands. For other listed species located outside of federal lands, the provinces and territories are given the first opportunity to protect them through their laws. If those measures are not in place or are insufficient, the *Species at Risk Act* has a "safety net" whereby certain prohibitions may apply by order of the Governor in Council. SARA prohibitions make it an offence to kill, harm, harass, capture or take an individual of a listed endangered, threatened or extirpated species; and to possess, collect, buy, sell or trade an individual of a listed endangered, threatened or extirpated species, or its parts or derivatives. As well, SARA prohibitions make it an offence to damage or destroy the residence of one or more individuals of a listed endangered or threatened species, or a listed extirpated species if a recovery strategy has recommended its reintroduction into the wild in Canada. SARA also provides a way for the government to take immediate action to protect a wildlife species in an emergency. In addition, SARA provides for the protection of critical habitat of listed species through various means.
SARA also requires that every person required by law to conduct a federal EA must (1) notify the competent minister(s) in the likelihood that a project will affect a listed wildlife species or its critical habitat; (2) identify the adverse effects of the project on the listed wildlife species; and, if the project is carried out, (3) ensure that measures are taken to avoid or lessen the effects and to monitor them. The measures must be taken in a way that is consistent with any applicable recovery strategies and action plans.

For more information on listed species and environmental assessment requirements, please consult the SARA Public Registry at http://www.sararegistry.gc.ca. Guidance material on species at risk and environmental assessment is also available on the CWS website at http://www.cws-scf.ec.gc.ca/publications/eval/index_e.cfm.

8.6 Special considerations relating to offshore projects

Offshore wind farms are only beginning to be developed in North America, and there are still fewer than ten offshore facilities currently in operation in Europe, although a total of about 13,000 turbines are proposed for erection along the European coast (Desholm *et al.*, 2004; Percival 2001). Offshore wind farms provide a unique challenge for the prediction and assessment of environmental effects, because it is much more difficult to gather the data outlined above for offshore sites than it is for terrestrial sites. Currently, no standard protocol is available for evaluating the risks to birds of offshore wind turbines, nor is there any previous body of knowledge on which to build. Therefore, baseline information and follow-up requirements for offshore and near-shore wind energy installations must proceed in close collaboration with the Canadian Wildlife Service regional office.

Among other requirements, it is generally recommended that numbers of migrating waterbirds (including waterfowl and shorebirds) be estimated for proposed offshore sites, as well as their direction of movement and the height at which they fly.

It is also important that the existing conditions of the fish and shellfish communities should be noted at offshore sites, and used to assess the potential impact of the offshore facility on the abundance, availability and access to prey species. For example, are turbines located on the path of seabirds commuting between their principal foraging area and their breeding site? If so, are the birds likely to be at risk of collision with the turbines? Is there the potential for the birds to avoid this area, and use less suitable or productive foraging sites? Locations of important feeding areas for seabirds near the proposed wind farm should be identified during baseline studies and in consultation with Environment Canada and other agencies.

9.0 ASSESSING THE POTENTIAL ENVIRONMENTAL EFFECTS ON BIRDS

Once the baseline information has been gathered, answers provided to the baseline questions will assist in determining what potential environmental effects may result from the project and how important those effects are likely to be. Mitigation measures should be identified to avoid or minimise the potential adverse effects. Cumulative effects must also be considered.

9.1 Mitigating potential adverse effects

Mitigation measures can occur in three general stages (Australian Wind Energy Association 2002). First is the design stage, where mitigation focuses on reducing the potential impact of a site before it is constructed (which can include rejecting a location because of likely negative and significant consequences to birds). Second is the construction stage, where careful planning avoids destroying important habitat and reduces disturbance by focussing the construction at appropriate times of the year and/or away from sensitive areas. Third is the operation stage, where unforeseen problems (higher-than-expected bird collisions, barrier or exclusion effects, etc.) may occur and need to be addressed.

In keeping with the purposes of the *Canadian Environmental Assessment Act*, mitigation to avoid or reduce potential adverse effects should be considered early in the planning process. Depending on the nature of the environmental effects identified, mitigation measures can include avoidance of certain areas (especially sites which present higher sensitivity as outlined in Table 1); and changes to the facility design (see section 3.0).

9.2 Considering cumulative environmental effects

The CEAA requires that an environmental assessment examine the expected cumulative effects that the project will have on the environment. These are effects "that are likely to result from the project in combination with other projects or activities that have been or will be carried out" (CEAA ss.16 (1) (a)) (see Hegmann *et al.*, 1999 for more information, available at: http://www.ceaa-acee.gc.ca/0011/0001/0004/index_e.htm). For wind farms, habitat disturbance should be the primary focus when determining cumulative effects. When undertaking a cumulative effects assessment, a proponent should not only consider other wind farms in the area (both disturbance and mortality factors), but any other structure or project that may affect birds. It is important to identify any residual direct effects from wind turbines, for instance habitat disturbance from turbine placement, as these residual effects are carried forward in the cumulative effects assessment. When identifying other projects that will be carried out, proposed projects that are either in some stage of a planning process or have been approved should be included.

Birds, like all other organisms, are affected by changes to their environment in many different ways, and these effects are often difficult to predict without looking at the entire system. One change to their environment may have little impact in and of itself, but combined with other developments, the total or synergistic impact could be significant. The impact of a wind energy facility may be negligible, but if placed in another location where there are many disturbances, birds may be significantly affected. If the area is already subject to a large degree of human-induced bird mortality, any additional source of mortality has the potential to produce a significant adverse effect. Also, any project that could increase the likelihood of birds concentrating in an area, such as the presence of a landfill or artificial ponds, could increase the adverse environmental effects caused by wind turbines. Proponents must consider what surrounds the proposed site and what reasonably foreseeable future projects can be expected in the area. Factors that should be assessed include:

1. the cumulative amount of disturbed habitat relative to the amount of intact undisturbed habitat in the region;
2. the estimated amount of current and additional mortality (due to the presence of tall towers, large numbers of wires or busy roads);
3. habitat rehabilitation or creation that may attract birds;
4. other activities or development projects that may result in birds being displaced; and; other development projects that may attract birds (*e.g.*, flooding for hydroelectric projects, landfills, oil and gas platforms for offshore projects); and,
5. the presence of any lit structures nearby which could attract birds to the area of the wind power facility.

One aspect that should be mentioned regarding cumulative effects is that there is still a certain degree of scientific uncertainty related to mortality effects of turbines on birds, including whether siting

multiple turbines in certain geographic area such as along a shoreline that concentrates bird migration will lead to an increase in bird mortality or loss of habitat function. In such cases, intensive baseline data collection and follow-up programs may be recommended.

10.0 DEVELOPING A FOLLOW-UP PROGRAM

Once baseline information has been collected and incorporated into the environmental assessment, a follow-up program appropriate to the project's level of concern should be designed in consultation with the regional Canadian Wildlife Service office. Such follow-up will be necessary after construction of the project has occurred to ensure that the predictions made when ranking the project during its assessment were accurate, that mitigation (where necessary) is effective, and that the actual environmental consequences of the project are recorded and understood.

At the most basic level, the follow-up program should be designed to confirm the answers to the questions identified for the collection of baseline information (Section 8) as well as to collect additional data identified in Table 4. The follow-up work should always be conducted or managed by a qualified bird biologist, who will need to consider habitat disturbance and displacement effects of the wind energy installation, as well as the rate of bird mortality.

Proponents can expect that projects with very high or high levels of concern will require extensive follow-up programs. Those with medium or low levels of concern would require work to identify and address unanticipated or underestimated problems, but a detailed program will not be required in most cases. Table 4 summarises the basic follow-up requirements for projects, categorised by their anticipated level of concern. Because of the need to incorporate site-specific considerations into the follow-up study design, regional Canadian Wildlife Service officials should always be consulted, and project-specific requirements may be greater or less than outlined here. No matter what the level of complexity, follow-up must be scientifically and statistically sound and able to provide answers to the questions asked.

Table 4. Recommended follow-up

Level of Concern	Recommended follow-up.
Low (green)	Minimal follow-up (one year): Bird mortality rate should be estimated through sufficient carcass surveys during the migratory seasons to derive a reliable estimate, with corrections for carcass removal rate and searcher efficiency.
Medium (yellow)	Basic follow-up (two years): Bird mortality rate should be estimated through sufficient carcass surveys to derive a reliable estimate for each time period (breeding and non-breeding), with corrections for carcass removal rate and searcher efficiency.
High (orange)	Detailed follow-up (over two years): Bird use and other variables of interest should be estimated at a sample of turbine locations for comparison with the baseline information (as outlined in section 8). Bird

	mortality rate should be calculated through several carcass surveys during the breeding and non-breeding periods, with corrections for carcass removal rate and searcher efficiency.
Very High (red)	Extensive follow-up program (three years or more): Bird use rate and other variables of interest should be calculated at a sample of turbine locations for at least three years after construction for comparison with the baseline information (as outlined in section 8). The bird mortality rate should be calculated through carcass surveys, with corrections for carcass removal rate and searcher efficiency.

10.1 Follow-up program considerations for land-based installations

This section gives a definition of important terms, a simple outline of what questions a proponent should answer through a follow-up program, and sketches of the methods used to answers those questions. Even though many wind farms and individual turbines have been erected around the world, methods for the evaluation of their effects on habitat and wildlife are not equivalent everywhere, and Environment Canada cannot at this point recommend a specific method that is equally applicable in all areas of the country. Site specific recommendations must still be made. The proponent must contact the local Canadian Wildlife Service office for support in developing and carrying out the follow-up studies.

10.1.1 Definitions of terms specific to wind energy project EA follow-up programs

Collision rate: the average number of birds expected to be killed by one wind turbine in the project each year, expressed as birds/turbine/year. It must be corrected for the amount and distribution of ground searched, for carcass removal rate and searcher efficiency.

Searcher efficiency trials: repeated tests of the individuals conducting searches for dead and injured birds to test their ability to find these birds. These trials are to be conducted without the searchers knowing they are being tested.

Carcass removal rate: the rate at which carcasses are removed from the study area by vertebrate scavengers, burying beetles or other insects or farm equipment. The calculation of this rate requires that fresh carcasses of birds be laid out in the study area, and monitored at regular intervals to determine whether they have been removed by predators, and their state of decomposition.

10.1.2 Considerations to be borne when planning post-construction follow-up

Staff

- Ideally, one observer or one set of observers should conduct the bird observations and mortality counts for the entire duration of the follow-up studies, to reduce inter-observer differences. If this is not possible then searcher efficiency (see below) will have to be tested for each new observer or change in set of observers.

- Best results can be expected of experienced persons with good bird knowledge. Study coordinators must be experienced in bird study design and follow-up
- Qualified biological contractors may be able to plan, lead and evaluate a study independently, but the intended methodology must be approved by the Canadian Wildlife Service before commencing studies.

Data collection and analysis

- Data must be collected under approved study designs.
- Measurements and counts must be consistently made throughout the area and for the duration of the studies.
- Data analysis must be done according to methods approved by the Canadian Wildlife Service that are specific to the project area and design. Methods described in the literature are of variable quality, and are not necessarily applicable to the study area or design.

Permits

- Under the *Migratory Birds Regulations*, a permit is required for the collection of a migratory bird (dead or alive), feathers, or parts of a migratory bird.
- For salvage of migratory bird species listed as endangered or threatened under the *Species at Risk Act*, an additional permit will be required.
- Proponents should also contact the appropriate provincial or territorial wildlife agency for information related to requirements to collect species under provincial jurisdiction (bats, raptors, grouse, and members of the crow and blackbird families for example).
- It is the responsibility of the proponent to ensure that all permits are in hand before studies commence. The Canadian Wildlife Service may also require that the carcasses of species listed as threatened or endangered be sent to the nearest office of the CWS.

10.1.3 Determining the disturbance effect of the installation

Quantifying bird use allows an estimation of the potential risk posed to birds by the installed turbines, and, when compared with the studies done before construction or at reference sites, can be used to determine the disturbance effects of the project.

Bird use during the breeding season is most often estimated by standard 5-minute point count protocols. In some situations, the Canadian Wildlife Service recommends the point count intervals be increased to ten minutes, to better estimate densities of breeding birds. The regional Canadian Wildlife Service office should be contacted regarding these specific recommendations, but in general, data should be collected such that species are recorded, not just numbers of birds, and results should be expressed as "bird density per unit area". Note that point count protocols are ineffective for sampling numbers of birds outside the breeding period: migrating and overwintering birds do not always sing.

All bird counts should be conducted at the standard times of day common to all such studies (*e.g.*, beginning before sunrise for passerines, mid-day for raptors, etc.) and should not occur during adverse weather conditions (*e.g.*, strong wind, heavy rain). The number of counts required to effectively sample an area will vary depending on the level of concern established for the site in the pre-construction evaluation, as well as the size of the area of concern and the number of species expected to occur. As

mentioned earlier, different protocols will be required for bird counts during different seasons (breeding, summering, migration and overwintering seasons) and depending on the level of concern evaluated for the site studies in more than one season may be required. A Canadian Wildlife Service biologist can suggest appropriate methods for specific sites and times.

Radar studies may be the only effective means to count night migrating birds, or taped recordings of flight calls can be analysed and an estimate of species and numbers made. Specialists may need to be consulted for this kind of work.

Observations of bird behaviour may be necessary to determine not only bird use but risk to birds in the area. Data such as height of bird flight relative to the turbines is valuable when estimating the risk of collision. Example categories of bird flight height are: A) Below blade height; B) Within the blade-swept area; or C) Well above blade height.

10.1.4 Determining the bird collision rate at the installation

Bird mortality is an estimate of how many birds are killed by the installed wind turbines. The estimation process begins by searching for carcasses. Carcass searches should occur within a defined area around turbines and reference sites, usually in a radius equal to the height of the turbine with one blade standing vertically. Some sites, such as those on steep ridges where carcasses would fall farther from the turbine base, may require a larger search radius. Survey methodologies should ensure that all turbines are searched over the course of the follow-up program.

Search methodology must be consistent across the site and across sampling periods, and must be sufficient to reliably find recently killed carcasses on the site. Walking transects across the search area is effective, but then the actual area searched will have to be factored into the final estimate of mortality. Trained dogs have been used, and many more biological contractors specialising in birds routinely use dogs to find carcasses. Carcasses, including single or groups of feathers, should be picked up with gloved hands and placed in individual plastic bags labelled with the date, location, observer, and identification number; everything must be recorded on a data sheet. The data sheet should also include information on species, sex and age (if known), condition and freshness of the carcass, cause of death if it can be determined, and distance and compass direction from the turbine. Carcasses should be frozen and/or immediately sent for necropsy to determine cause of death or, once fully identified and processed, discarded as per conditions of the applicable permit. They can also be kept frozen for searcher efficiency trials, but this should be noted on all relevant permits.

In order to correct the number of carcasses found to determine an estimate for how many were actually killed, two factors must be estimated: the number of carcasses presumed to have been removed and not found because they were removed, and the number of carcasses not found because they were missed by the searcher(s).

To determine how many carcasses are being missed by searchers due to removal by scavengers, farm equipment, etc., carcass removal experiments must be conducted. These involve placing carcasses of recently killed birds of different sizes in known locations and monitoring them regularly to determine their state of decomposition, and how long they remain. The rate of decay of the carcasses is important, because scavengers will not be interested in a carcass when it becomes severely decayed or desiccated. Once a degraded carcass is ignored by scavengers, it will begin to bias the average time a carcass

remains in the location of placement - it should therefore be removed from the study. Carcasses for use in the experiments can be road-killed birds and/or carcasses from veterinary colleges, wildlife rehabilitation centres, or wildlife control programs at nearby landfills or airports. A regional office of the Canadian Wildlife Service can be contacted for information on possible sources of carcasses, and for advice on whether permits are required to handle them. If such carcasses are unavailable, chickens, pigeons, quail, or other more readily obtainable non-native birds of the appropriate size and colour for the study may be used.

To determine how many carcasses are not found due to searcher ability or method, searcher efficiency experiments must be conducted. Fresh carcasses that are coloured similar to wild birds found in the area are placed in random locations within a trial site by someone other than the regular searcher before the area is searched as normal. The searcher must not know, if at all possible, that an efficiency experiment is underway as it may affect his or her searching strategy. All searchers must be tested for efficiency and rates must be calculated separately for each searcher. The use of dogs for carcass searches is increasing, and dogs must also be tested for searcher efficiency. . The use of unnaturally coloured species (*e.g.*, certain domestic species) should be discouraged where possible because of the potential introduction of bias in the results. Carcasses that are placed for experimental purposes can be distinguished from turbine mortality by geo-referencing, or by dusting them with an 'invisible' coloured fluorescent pigment before placing them on the site. These pigments are visible under ultraviolet "blacklight'. Caution must be taken to ensure that the searcher, when finding a carcass unnatural to the environment (be it a mock bird, painted Starling, or quail), does not adjust his or her searching strategy upon realisation that a trial is underway. Doing so adds bias to the estimate of searcher efficiency. Best results are clearly obtained with carcasses of birds of species expected to be found at the site.

Note that if sites are stratified based on habitat or other factors that might affect carcass removal rates or searcher efficiency, then carcass removal and searcher efficiency experiments should be conducted separately in each stratum.

The bird mortality estimation process ends with correcting the number of dead birds found for the searcher efficiency, the carcass removal rate, and possibly the proportion of the total area searched. The Canadian Wildlife Service is currently evaluating the available methods for applying the corrections, and proponents are requested to contact the local Canadian Wildlife Service office for the method best suited to the conditions of their project site.

Corrected mortality rates can be compared across time periods to determine if collision risk to birds is higher during the migratory, breeding, or wintering seasons, and/or across various weather conditions to determine if collision rates are higher during periods of low visibility. This information can be very useful if mitigation has been recommended to reduce the negative consequences of the installation to birds.

10.2 Study Design Examples to Evaluate the Bird Risk of the Installation

There are several different study designs available. The design chosen in each particular case will depend upon several factors, including the level of concern for the site and the species and area of interest. The proponent can refer to Anderson *et al.*, (1999) for full details on survey design.

A comprehensive and statistically rigorous means to evaluate the effects of the wind energy installation on the wildlife in the area is the "Before-after, reference-impact, matched pairs" (Anderson *et al.*, 1999, Australian Wind Energy Association 2002). "Before-after" refers to the estimation of bird use and mortality before and after turbines are constructed and in operation. "Reference-impact" refers to the estimation of these factors (bird use and mortality) both on the wind energy sites (= "impact site") and on nearby reference or control sites. This is important in determining if any changes in bird use at the wind facility can be attributed to the project or are related to landscape or population changes. "Matched pairs" means that each impact site has an equivalent, off-site reference, matched by landscape setting and habitat characteristics.

When statistically comparable pre-construction data do not exist, an "Impact-Reference" design can be used. Variables measured at the project site are compared with those from one or more reference areas. However, if this method is to be applied it is important to reduce the number of differences between the reference and impact sites, otherwise, it is difficult to determine what amount of the differences is bird use between the Impact and Reference are unrelated to the presence of the turbines.

Another example survey design is" Impact Gradient Methodology" (Anderson *et al.*, 1999). In this method, neither reference sites nor comparable pre-construction surveys are required. (Note however that baseline studies may still be required to answer questions outlined in Section 8.1). In this form of study, the proponent examines the potential consequences to birds at different distances from the turbines, assuming that collisions and other consequences such as habitat exclusion will decrease as the distance from the turbines increases. This type of survey design works best in a homogeneous environment where other factors such as changes in habitat type are less likely to confound the results. Otherwise, covariates such as vegetation type need to be measured in association with the impact variables to prevent confounding the results.

10.3 The Use of Radar

Radar is separately mentioned here, as well as throughout the text in other portions of these guidelines, because the Canadian Wildlife Service recognises that Radar studies can be very valuable adjuncts to other studies, especially when estimating bird use and migrating numbers and flight altitudes of both day and night-flying birds.

At sites where there is medium to very high risk of nocturnal migrants colliding with turbines, the use of radar to count migrants, and to identify the height and location of their flight paths may be necessary. Gauthreaux and Belser (2003) review the conservation applications of the use of radar, including its value to monitor collision risks, nocturnal flight paths, timing and altitude and number of migrating birds near power lines, wind turbines and other man-made structures. Desholm *et al.*, 2004, review the many methods of remote bird study, particularly for offshore turbines but these methods are also valuable for onshore installations. Marine surveillance radar can be used to determine nocturnal flight paths, timing and altitude and number of migrating birds. It is therefore valuable for determining whether a wind farm is situated within an important flight path (*i.e.*, of sea ducks; see Spaans 1998) and for examining impacts of weather events such as fog and low cloud on flight behaviour (Larkin and Fraser 1988).

Radar is most valuable when used in combination with visual observation using binoculars, video cameras or night vision optics (Gauthreaux and Belser 2003). Auditory surveys of call notes, together with information on flight behaviour and speed, can be used to determine the species composition of migrants (Cooper *et al.*, 2004). In addition, NEXRAD (NEXt generation RADar) or WSR-88D (Weather Surveillance Radar, 1988 Doppler) can be used to examine large-scale patterns of bird migration (Gauthreaux and Belser 2003). Harmata *et al.*, (2003) discussed a cost-effective and practical method for using radar to monitor bird movements near turbines.

11.0 SPECIAL CONSIDERATIONS AT OFFSHORE WIND FARMS

The proponent of off-shore and near-shore wind energy installations can expect to expend significantly more effort to collect the same type of data as a proponent for a similar-sized project onshore. Knowledge of local inshore and near-shore bird movements is necessary when turbines are to be sited in these areas. Proponents siting wind farms in near-shore areas (*i.e.*, within 5 km of the coast) should be aware that such sites are more likely to intercept flight paths of birds moving between feeding areas (*e.g.*, ducks), feeding and roosting areas (*e.g.*, shorebirds), or breeding and feeding areas (*e.g.*, seabird colonies). Wind farms in these areas may affect larger-scale movements along the coast during migration. The magnitude and significance of this interception effect will have to be measured after construction.

Bird use of offshore and near-shore areas can be estimated using observers on ships, in small boats, in helicopters or fixed-wing aircraft, using radar-tracking techniques (Desholm *et al.*, 2004; Tulp *et al.*, 1999, van der Winden *et al.*, 1996, Dirksen *et al.*, 1998) or by using pre-existing data from pelagic bird surveys (which may be sparse in most cases, but see Lock 1994).

Aerial or ship transect surveys should be used to assess bird use, potentially together with land-based surveys, depending on the distance offshore and the size of the study area. Aerial surveys are best for covering large areas, whereas ship-based surveys enable more accurate species identification and behavioural observations (Langston and Pullan 2002). Where possible, observations should document flight height, both before and after construction. Radar can be used to measure flight patterns and height, and is particularly useful at night or during times of low visibility (Desholm *et al.*, 2004; Langston and Pullan 2002).

Counts of birds using offshore sites should be conducted throughout the year and over greater areas than at terrestrial wind facilities. This is because most species of interest will be seabirds and sea ducks which congregate in large numbers at particular times of year, and which may move long distances each day or night between feeding and roosting areas. Again, these studies need to be very thorough, because published and accurate knowledge of bird use of most sites is as yet unknown.

Bird use studies will include sampling the availability of food for ducks and seabirds, as large concentrations of birds offshore may be related to tidal upwellings of plankton, schools of fish or shallow sandbars. Food availability should be measured before and after construction, because turbines could affect local food sources (Langston and Pullan 2002).

Measuring bird mortality at offshore wind farms is extremely difficult and may require innovative methods of data collection (*e.g.*, nets under turbines to catch fatalities, or cameras or special sensors to

monitor strikes – see Desholm *et al.*, 2004). Infra-red video technology is being developed and tested in Europe (described in Kahlert *et al.*, 2000). Another bird collision detecting system (described by Verhoef *et al.*, 2003) records video images of birds just before and after hitting the turbine, and records the sound of the collision. Yet a different system (Thermal Animal Detection System or TADS), uses a thermal camera to detect objects flying within a certain distance under various conditions, including darkness and fog (see Desholm 2003).

A major consequence to birds at offshore windfarms may be displacement from preferred habitat, habitat that may not be widely available for a number of biological and geological reasons. If an offshore wind farm is built, proponents should expect that a detailed study of the exclusion effect of the windfarm be done, and it must be compared with pre-construction site evaluation studies already completed.

As for terrestrial sites, the appropriate sampling design and duration of the follow-up studies will depend on the characteristics of the installation. For offshore and near-shore sites these may be the location of the turbines, their distance from shore, the species of birds present, the sensitivity and level of concern for these species, and the size both in surface area and turbine number of the wind farm. Pre-construction baseline data should already have been collected to compare with the follow-up study results. Both the baseline information surveys and follow-up up programs must be done over a period of at least 2 years, with a minimum of three years in ecologically sensitive sites, because a one-year study may not provide results representative of the average annual conditions: there is more variability at offshore sites than at onshore. Follow-up studies should consider diurnal, tidal-cycle, species-related, weather-related and seasonal variations in site use by birds.

12.0 ADAPTIVE MANAGEMENT

Most wind farms will cause some bird mortality. Follow-up (described in section 10) is required to determine the actual direct impacts on birds. Prior to construction and as part of the follow-up protocol, in consultation with the regional CWS specialist, the level of "acceptable" bird mortality should be determined, likely through comparison with other similar wind farms across North America. Should unanticipated impacts become apparent through monitoring data, additional monitoring to determine the source of impacts may be needed.

For example, the proponent will need to determine if all turbines at the site are causing the collisions or if there are particular turbines consistently involved. An examination of the placement of the problem turbine(s) should then be undertaken. Questions to consider include: Where is the problem turbine(s) located in relation to topographic features and in relation to the other turbines? What site-specific conditions, or other local conditions (such as the cropping practice in an agricultural setting), set it apart from the other turbines? If it is found that 'problem' turbines have characteristics that set them apart from others, several things can be tried, depending on the bird species affected (see below), to reduce mortality before the turbines should be decommissioned or moved to a new location (both of which would be considered "last resort" methods). Adopting an adaptive approach and reporting on

the successes and the failures of certain methods will help to guide future research and development in wind energy.

If mortality is due to attraction to lights, other lighting options may need to be considered. For example, if night-flying migrant landbirds are affected primarily during periods of inclement weather conditions (*i.e.*, when a large number of fog days, occur during the spring and fall migration periods), an evaluation of other options for lighting at the site may need to be conducted in co-operation with Transport Canada and the Canadian Wildlife Service. It may be possible to reduce the amount of lighting, or even to turn lights off during periods of high risk (*e.g.*, foggy nights during the peak of the passerine migration period). A search for other sources of lighting at or near the site (*e.g.*, at neighbouring communication or meteorological towers, or at power substations or maintenance sheds) which may be attracting birds is also recommended. Should mortality be attributed or partially attributed to these additional lighting sources, it may be possible in some cases to reduce or remove them.

Several mitigation options have been suggested for reducing raptor collisions at wind facilities. If there are high densities of raptors using the area, it may be appropriate to attempt to reduce the number of raptors present through a prey control program and/or removal of other raptor food sources (carrion) at the site. Perching opportunities such as lattice towers, guy wires, hydro poles or other structures should be reduced or removed whenever possible.

If a moving blade appears to be causing high bird mortality along a particular flight path, the turbine can be shut down which may reduce the number of direct hits.

If birds are killed at an agricultural site where they appear to be feeding on crop residues, perhaps the area under the turbine(s) can be planted in a crop that is less attractive. If grassland birds such as Bobolinks are being killed during aerial displays at particular turbines, it may be possible to offset losses in productivity if hay cutting can be delayed at adjacent sites.

When wind farms are found to cause an unacceptable number of bird kills, and various mitigation strategies prove unsuccessful, other options such as encouraging the proponent to purchase and then protect (with conservation easement or other method) a parcel of land of similar size and habitat type, and within the same general region, to that impacted by the wind farm should be considered. While this will not reduce the number of collisions at the wind farm in question, it will contribute to long-term protection of bird and other wildlife habitat (*e.g.*, Washington Department of Fish and Wildlife 2003).

APPENDIX A: SOURCES OF INFORMATION

Information on bird mapping and surveys

- NABCI

  For information on the North American Bird Conservation Initiative (NABCI), including maps and descriptions of Canadian Bird Conservation Regions (BCRs), visit:

  http://www.bsc-eoc.org/nabci.html

  or

  http://www.cws-scf.ec.gc.ca/birds/nabci_e.cfm

- Regional Bird Conservation Plans

To obtain a copy of the BCR plan for your region, contact:

Canadian Coordinator, North American Bird Conservation Initiative
Tel: (819) 994-0512
Fax: (819) 994-4445
E-mail: Silke.Neve@ec.gc.ca

- For information on provincial or regional bird sightings, lists, nature list-servs, etc, visit: Birding in Canada website: http://www.web-nat.com/bic/

- For information on regional hawk, owl, woodpecker and other bird surveys, visit: Bird Studies Canada: www.bsc-eoc.org

- Important Bird Areas of Canada: http://www.ibacanada.ca/

Environment Canada /Canadian Wildlife Service contacts:

- Canadian Wildlife Service: http://www.cws-scf.ec.gc.ca/index_e.cfm
- The Migratory Birds Convention Act and Regulations: http://www.pnr-rpn.ec.gc.ca/nature/migratorybirds/dc00s06.en.html

- Environment Canada EA program and list of regional contacts is provided at http://www.ec.gc.ca/ea-ee/home/regions_e.asp

Information on existing environmental assessments

- Canadian Environmental Assessment Registry at

  http://www.ceaa-acee.gc.ca/050/index_e.cfm

Information on species at risk:

- The General Status of Species in Canada: http://www.wildspecies.ca/
- To determine if a species is listed by COSEWIC or has legal standing under SARA, visit Environment Canada's Species at Risk website: www.speciesatrisk.gc.ca
    - SARA Public Registry: http://www.sararegistry.gc.ca/default_e.cfm
    - Regional Conservation Data Centre websites are available through NatureServe Canada: http://www.natureserve-canada.ca/english/map.htm

Local naturalists groups

- To contact a local naturalists' club, visit the website of the appropriate provincial naturalists' society:

  Federation of British Columbia Naturalists: http://www.naturalists.bc.ca/

  Federation of Alberta Naturalists: www.fanweb.ca

  Nature Saskatchewan: www.naturesask.com

  Manitoba Naturalists' Society: www.manitobanature.ca

  Ontario Nature: www.ontarionature.org

  L'Union québécoise pour la conservation de la nature: www.uqcn.qc.ca

  New Brunswick Federation of Naturalists/Fédération des naturalistes du Nouveau-Brunswick: www.naturenb.ca

  Federation of Nova Scotia Naturalists: http://www.chebucto.ns.ca/Environment/FNSN/menu.html

  Natural History Society of Prince Edward Island: http://www.isn.net/%7Enhspei/nhsAbout.htm

  Natural History Society of Newfoundland and Labrador: www.nhs.nf.ca

APPENDIX B: LIST OF ACRONYMS

CDC: Conservation Data Centre
CEEA: *Canadian Environmental Assessment Act*
COSEWIC: Committee on the Status of Endangered Wildlife in Canada
CWS: Canadian Wildlife Service
EA: environmental assessment
EC: Environment Canada
FA: Federal Authority
IBA: Important Bird Area
MBS: Migratory Bird Sanctuary
NABCI: North American Bird Conservation Initiative
NIHC: National Heritage Information Centre
NWA: National Wildlife Area
PIF: Partners in Flight
RA: Responsible authority
SAR: Species at risk
SARA: *Species at Risk Act*
WHSRN: Western Hemisphere Shorebird Reserve Network
WPPI: Wind Power Production Incentive

REFERENCES

Anderson, W.L., M. Morrison, K. Sinclair and D.Strickland. 1999. Studying wind energy/bird interactions: a guidance document. National Wind Coordinating Committee. 88 pp.

Australian Wind Energy Association. 2002. Best practice guidelines for implementation of wind energy projects in Australia. Prepared for Australian Greenhouse Office. Available online: http://www.auswea.com.au.

Cooper, B.A., A.A. Stickney and T.J. Mabee. A visual and radar study of 2003 spring bird migration at the proposed Chautauqua wind energy facility, NY. A report by ABR, Inc. Environmental Research & Services for Chautauqua Windpower LLC, 27 April 2004. http://www.abrinc.com/Brochures/Visual%20and%20Radar%20Study%20of%20Bird%20Migration,%20Chautauqua%20%20Wind%20Energy%20Facility,%20NY,%20Spring%202003.pdf

Desholm, M. 2003. Thermal Animal Detection System (TADS). Development of a method for estimating collision frequency of migrating birds at offshore wind turbines. *NERI* National Environmental Research Institute Technical Report, No. 440, Denmark. http://www.dmu.dk/1_viden/2_Publikationer/3_fagrapporter/rapporter/FR440.pdf

Desholm, M., T. Fox and P. Beasley, 2005. Best practice guidance for the use of remote techniques for observing bird behaviour in relation to offshore windfarms. First Draft for comments, version 21-03-2005. Collaborative Offshore Wind Energy Research into the Environment (COWRIE).

Dirksen, S., A.L. Spaans and J. Winden 1998. Nocturnal collision risks with wind turbines in tidal and semi-offshore areas. Pp. 99-108. In Wind Energy and Landscape. Proceedings of the 2nd European and African Conference on Wind Engineering, 1997.

Gauthreaux, S.A. Jr. and C.G. Belser. 2003. Radar ornithology and biological conservation. Auk 120:266-277.

Harmata, A.R., G. Leighty and E.L. O'Neil 2003. A vehicle-mounted radar for dual-purpose monitoring of birds. Wildlife Society Bulletin. 31(3): 882-886.

Jacques Whitford Environment Limited. 2003. Protocol for bird migration monitoring at the proposed Royal Road Wind Farm. Prepared for Vision Quest Windelectric Inc., March 2003.

James, R.D. 2002. CNE wind turbine bird mortality monitoring program. Unpublished report prepared for Environment Canada, Downsview, ON.

Johnson, G. D., W.P. Erickson, M.D. Strickland, M.F. Shepherd, D.A. Shepherd, and S.A. Sarappo. 2002. Collision mortality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. Wildlife Society Bulletin 30: 879-887.

Kahlert, J., M. Desholm, I. Clausager and I.K. Petersen. 2000. VVM-redegørelse for havvind-møllepark ved Rødsand. Teknisk rapport vedrørende fugle. DMU report to SEAS. As cited in Langston and Pullan 2002.

Langston, R.H.W., and J.D. Pullan. 2002. Windfarms and birds: An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues. Birdlife International on behalf of the Bern Convention. Convention standing committee, 22nd meeting.

Larkin, R.P. and B.A. Fraser. 1988. Circular paths of birds flying near a broadcasting tower in cloud. Journal of Comparative Psychology 102: 90-93.

Lock, A.R. 1994. Gazetteer of marine birds in Atlantic Canada: an atlas of seabird vulnerability to oil pollution. Canadian Wildlife Service, Atlantic Region, 1994.

Morrison, M.L. 1998. Avian risk and fatality protocol. National Renewable Energy Laboratory, Golden, Colorado.

Percival, S.M. 2001. Assessment of the effects of offshore wind farms on birds. Report ETSU W/13/00565/REP, DTI/Pub URN 01/1434.

Spaans, A., L. van den Bergh, S. Dirksen and J. van den Winden. 1998. Windturbines en vogels: Hoe hiermee om te gaan? De Levende-Natuur 99: 115-121.

SunBridge. 2002. Unpublished draft monitoring guidelines for the SunBridge Wind Power Project at Gull Lake, Saskatchewan - a joint venture between Suncor Energy Inc. and Enbridge Inc.

Tulp, I., H. Schekkerman, J. K. Larsen, J. van der Winden, R.J.W van de Haterd, P. van Horssen, S. Dirksen and A.L. Spaans. 1999. Nocturnal flight activity of sea ducks near the windfarm Tunø Knob in the Kattegat. IBN-DLO Report No. 99.30. (As cited in Percival 2001.)

Verhoef, J.P., C.A. Westra, P.J. Eecen, R.J. Nijdam, and H. Korterink. 2003. Development and first results of a bird impact detection system for wind turbines. Paper presented EWEC, 16-19 June 2003, Madrid Spain. http://www.ecn.nl/docs/library/report/2003/rx03035.pdf