Wind Energy Development - Haeckel Hill
Environmental and Socio-economic Impact Assessment

Prepared for:

Yukon Environmental and Socio-economic Assessment Board
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1 Executive Summary

Haeckel Hill north of Whitehorse Yukon provides an exciting opportunity for wind energy production in the territory. During periods of peak demand, Yukon faces a production shortfall from its current hydroelectric facilities. The addition of wind energy would substantially reduce, if not eliminate, the need for fossil fuel electrical production to meet typical energy shortfalls in the territory.

Northern Energy Capital is proposing the development of 2.7 MW of additional wind energy on Haeckel Hill north of Whitehorse. Three 900 kW wind turbines will be installed essentially within the existing Yukon Energy lease site. This document details the potential impacts of this proposal to values around the project site as per the requirements of the *Yukon Environmental and Socio-economic Assessment Act* (*YESAA*).

Based on the proposed activities, birds and bats were identified as the valued environmental components and are the basis of the effects assessment detailed in this report. Little to no interaction between the proposed wind energy towers and these values are predicted. As a result, significant adverse effects to these values are considered unlikely. Overall, this project is predicted to have a significant positive environmental and socio-economic effect in Yukon.

2 Introduction

Haeckel Hill was first identified by Yukon Energy as a site to develop wind energy in the early 1990's. The site was close to Whitehorse, demonstrated a reasonable wind regime and was accessible with moderate road construction and power line upgrades. Third party wind monitoring, with support from Yukon Energy, began in 1990. In the years that followed a Bonus 150 kW wind turbine was installed (1993) and a Vestas 660 kW turbine followed (2000).

As anticipated, due to the lack of blade-heating technology available at the time, both turbines struggled with rime icing in the winter months. However, the team at Yukon Energy devised many after-market heating solutions achieving varying success at energy production during the winter months. Today, without maintenance, the Bonus stands inoperable and the Vestas falls victim to rime icing every winter rendering it inoperable during the highest energy-yielding months.

While there are alternative sites ranging of viability for wind energy production, none present an opportunity greater than Haeckel Hill to demonstrate the resilience of the Yukon spirit in our unparalleled ability to overcome the harsh challenges of our winter climates. Today, there is a new generation of wind turbine available, one that is engineered for winter conditions. Blade heating technology provides a response to rime icing, enabling winter-power production. This revitalization project of Haeckel Hill creates an unprecedented opportunity to bring together First Nations, the Community and the Private Sector in the development of a collaborative project so grand it will become the landmark for what is possible with renewable energy development across Canada's Northern Communities.

Northern Energy Capital (NEC) has proposed the development of an additional 2.7MW of wind power – enough to supply over 525 homes annually. The project is scheduled to be operational fall of 2018, subject to the Independent Power Producer (IPP) Policy, Power Purchase Agreement (PPA).

This project is a perfect match for Yukon's electrical needs. Peak wind production is in the winter season during periods of peak fossil fuel combustion currently required to meet production shortfalls. Additional energy from this site would substantially reduce Yukon's dependence on fossil fuels in the winter and supplement hydro-electric production on the Yukon electrical grid year round. Wind energy production in combination with hydroelectric power production in Yukon would allow for reservoirs to stay full longer, further off-setting dependence on fossil fuels for electrical energy production.

The following document details NEC's proposed 2.7 MW wind energy expansion project on Haeckel Hill north of Whitehorse Yukon. This report outlines the project details, values in the project area and potential environmental and socio-economic effects of this proposal to values in the area. This report was prepared for the Whitehorse Designated Office of YESAB as per the requirements of the *Yukon Environmental and Socio-economic Assessment Act* (*YESAA*).

3 Project Details

3.1 Overview

We are proposing the construction and operation of up to three modern ~900 kW wind turbines within the boundaries of an existing (~9 ha) Yukon Energy lease site located on Haeckel Hill. One tower may be located immediately north of the north-west corner of the existing lease site. The Project is comprised of two phases: the first being construction and the second being operation and maintenance. Installation of the wind turbines is considered a permanent development. The following sections detail the components of this project.

3.2 Construction

The construction phase of this development will occur during the spring, summer and fall seasons. Construction may occur over multiple sequential years within the same seasonal window; however, the current schedule is to complete the works in their entirety the spring, summer and fall of 2018. Subject to the IPP PPA this may be pushed to 2019. It is likely that access road upgrades and site preparations on Haeckel Hill, including foundation construction for the towers, will occur in the spring and summer, with tower erection to occur early fall.

3.2.1 Access to be Upgrade

Access to the site is by way of a ~5 km long existing all-weather road beginning near KM 4 of Fish Lake Rd. Existing road widths vary and are estimated at ~4 – 5 m. Road widths will be increased to ~7 m to accommodate the necessary construction equipment including a 500 tonne crane and transport trucks with tower components. Existing corners will be increased to a radius of approximately 24 m. No watercourse crossings exist along the portion of the access road where upgrading is proposed.

Road widening will be accomplished by hauling in gravel from existing licenced quarries in the project area. Final gravel sources and volumes will be determined during the final engineering design for the road upgrades. Regular highway gravel trucks and heavy machinery will be used to complete necessary upgrades (e.g. 30-40 tonne excavators, bulldozer – D7 or equivalent, grader, etc.).

Access upgrading will not require complete road closure. Other road users will be notified in advance of proposed road work and work will be coordinated with these other users to maintain access to their interests on Haeckel Hill.

3.2.2 Site Preparations on Haeckel Hill

The Yukon Energy lease site plus a very small (~0.5 ha) area adjoining the north-west corner of the existing lease site is the area for the proposed wind turbines. The site is an alpine area with little vegetation and shallow soils with exposed rock throughout (Figure 1). The lease area is gently sloping to level. Existing infrastructure includes:

- two wind turbines
- access roads and trails
- transmission lines
- transformers
- exclusion fencing around each tower
- miscellaneous small buildings (storage shed and portable toilet)

Figure 1: Photo of one of two existing towers and related infrastructure on Haeckel Hill.

Site preparations at the lease site will include three main parts:

1. Decommissioning of existing tower(s);
2. Foundation construction; and
3. Access improvements/development between future tower sites.

The following sections detail these three components of site prep on Haeckel Hill.

3.2.2.1 Decommissioning of Existing Tower(s)
Two towers currently exist at the site:

- An early generation 150 kW wind turbine installed in 1993; and
- A Vestas 660 kW turbine installed in 2000.

As anticipated, due to the lack of blade-heating technology available at the time, both turbines struggled with rime icing in the winter months. Despite considerable effort on the part Yukon Energy Corporation (YEC) to devise many after-market heating solutions to eliminate rime icing, the 150 kW turbine stands inoperable altogether and the 660 kW Vestas falls victim to rime icing every winter during what would be the highest energy-yielding months.

As part of this proposal, NEC (and/or Yukon Energy) will remove the inoperable and outdated 150 kW turbine. NEC may also decommission the 660 kW Vestas turbine and replace it with a new ~900 kW tower (subject to negotiations with Yukon Energy). Removal and replacement of the 660 kW Vestas turbine has not yet been confirmed, nor is it currently anticipated, but is included in the project scope as it is considered a possibility.

Decommissioning of the two towers is essentially the same. First, the tower will be broken down into its component parts and disassembled. All parts will be removed from the site. Existing fencing will be taken down and all small buildings and transforming stations associated with the towers will be removed. Steel anchors in the foundations will be cut flush and the concrete foundations will be buried using spoil material produced during the construction of the new towers. Infrastructure not required for the operation of the new towers will be removed from the site.

3.2.2.2 Foundation Construction
Circular re-enforced concrete pads will form the foundation for the new towers. Precise pad sizes will be determined during final engineering design and will vary depending upon the competency of bedrock at each site. Foundations will be smaller at sites with highly competent bedrock as they will be directly bolted to the bedrock for added strength. In the event that bedrock is less competent, the pad size will increase.

For each tower the foundation area will be excavated to bedrock. Bedrock will be drilled and blasted to prepare the surface for foundation placement. Spoil material will be spread along the on-site access road facilitating level access to each tower base for later stages of construction.

Blasting will be completed by a licenced blaster. Explosives will **NOT** be manufactured or stored on site. Precise volumes of explosives will depend primarily on the nature of the bedrock at each site.

The circular steel re-enforced concrete pads will be poured on site with concrete hauled in by trucks from existing batch plants in Whitehorse. Pads will be poured in stages with engineering oversite to ensure quality control for each pad. Once the pads have sufficiently cured, the tower components will be mobilized to the site for the next stage of development.

3.2.2.3 Access Improvements Within Lease Site

Each tower will require access for the crane, trucks and for future maintenance. Given the very shallow soils of the site, access development will consist of placement of spoil material from foundation construction. Each turbine will have an access road that connects to the existing access to the lease site. Once the access and foundations are in place, the tower components will be brought to the site by special highway transport trucks.

3.2.3 Tower Installation

The new towers will be transported to the site in pieces and erected using a 500 tonne crane and other equipment on site. The proposed towers are free-standing towers with constant revolution turbine blades. These towers will not require any lattice or guy wire supports.

Tower erection will occur in stages with installation of the blades and turbine following tower installation. Figure (2) shows a schematic of the tower components.

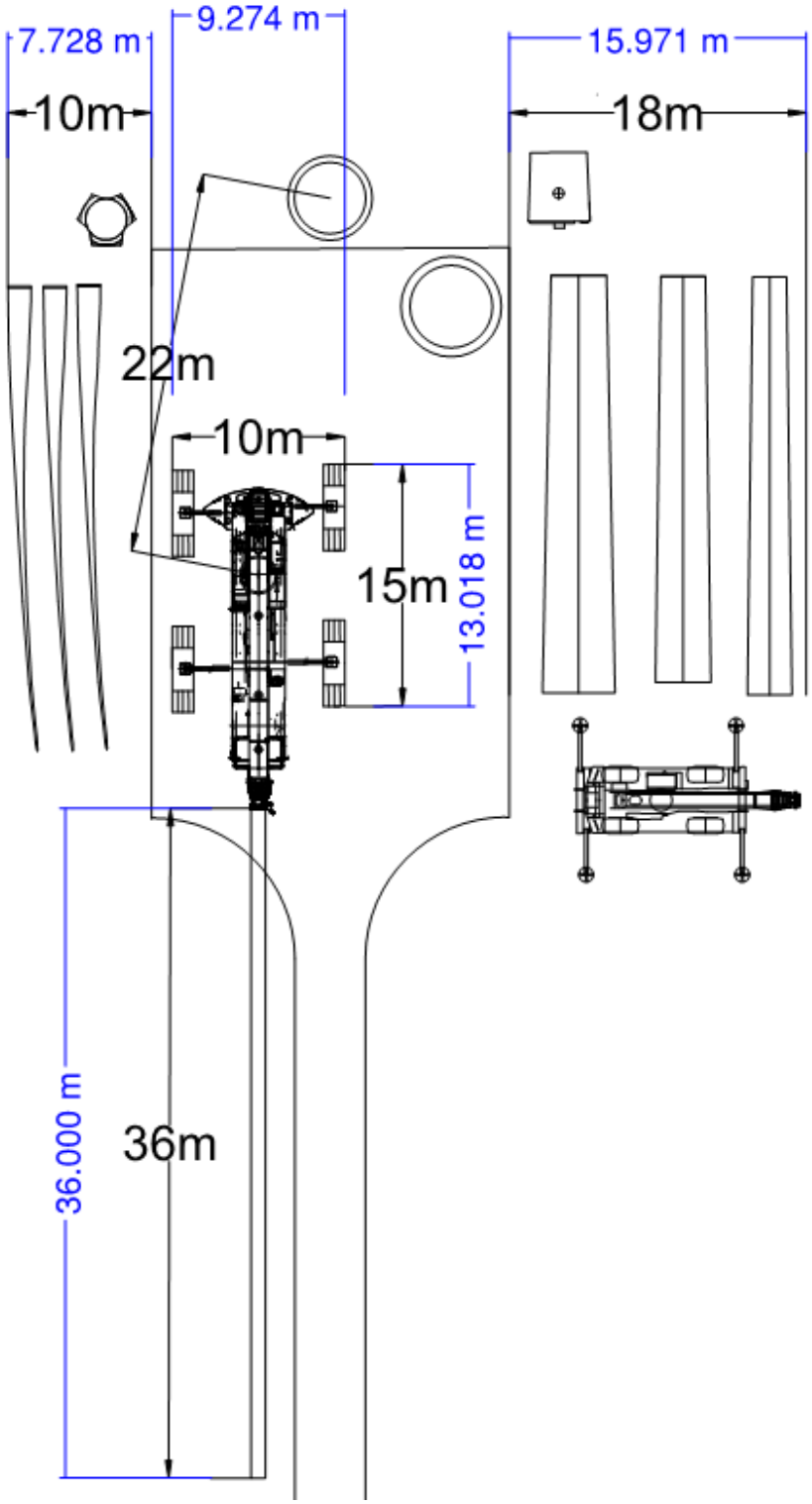

Figure 2: Schematic showing proposed wind turbines to be installed on Haeckel Hill with sizes of component parts.

Figure (3) is a photo of Haeckel Hill with three of the proposed ~900 kW wind turbines superimposed on to the photo. In the event that a fourth turbine is installed it would replace the turbine seen between turbine 2 and 3 in the image below.

Figure 3: Photo of Haeckel Hill with proposed wind turbines superimposed.

3.2.4 Powerline Upgrades and Accessory Structures

I think 4.5 km long and 8m wide is good.

Structures are standard power poles
Timing would be between Spring 2017 and Fall 2018

Each tower will have its own transforming unit. All three turbines will be connected via underground high voltage cables to a new substation to be built within the existing lease site. The new substation will be connected to the existing electrical grid that terminates to the east of the lease site. The connection to the grid will be detailed in the final engineering stages.

Two options are proposed to connect the wind turbines to the existing Yukon electrical grid. Ideally, the existing powerline running roughly south from the lease site to the Fish Lake sub-

station would be used. However, a final decision regarding tie in will need to be made at a later stage necessitating the proposal of an alternative new powerline option.

In the event that the existing power line is used, the only work will be upgrading the wire to accommodate the new higher output turbines. The existing power line from the lease site will be re-wired to a 25 kv line from the existing 12 kv line. Existing power poles and corridors will be utilized to connect the new towers to the existing substation at Fish Lake – tying the towers into the Yukon electrical grid.

In the event that tie-in at the current location is not feasible, a new powerline will be built running north-east from the site. Figure (4) shows both the existing corridor (the red line running roughly north-south) and the optional new line (the red line running roughly east-west to the Kulan Industrial Park).

Figure 4: Map showing approximate location of existing power line (running roughly north-south) and the proposed 8 m x 4.5 km power line running roughly east west.

The new power line running roughly north-east from the site would be approximately 8 m wide and run a total of approximately 4.5 km. Vegetation would be cleared to allow for installation of the power poles and line. A 25 kv line will be strung along wooden power poles to the point of tie-in located at an existing sub-station near Kulan Industrial Park. Heavy equipment access will be developed up the corridor to permit installation and maintenance of the line. Power line development would occur between spring 2017 and fall 2018.

3.2.5 Access Control

For public safety, access to each turbine site and the new transforming station at the lease site will be restricted using chain link fencing and barbed wire. This is a necessary precaution against un-authorized access and potential injury to public.

3.3 Operation & Maintenance

Once commissioned, the towers will require periodic (bi-annual) maintenance. This routine maintenance may include:

- Access grading and repair;
- Power line maintenance including pole replacement;
- Turbine inspection and maintenance of components.

Regular inspection and maintenance of the towers will occur year-round. Access to the site will either by way of the access road.

3.4 Decommissioning

This is considered a permanent installation and decommissioning of the site is not anticipated in the foreseeable future. However, for completeness of this proposal, potential decommissioning after 20 years is included.

Tower decommissioning would occur as described in Section 3.2.2.1 for the existing towers at the site. All equipment waste etc. would be removed from the site. The site would be left clean and stable.

3.5 Project Scope

Table 1 lists the primary activities that comprise the project scope along with the approximate timing and duration of each.

Table 1: Primary activities comprising the project scope.

Activity	Approximate Timing and Duration
Road upgrading (~7 m x 5 000 m)	Will occur early in the snow free season of 2018 – will take ~3 weeks to complete
Use of various heavy equipment including 500 tonne crane	Will occur during construction phase of late summer/fall 2018
Decommissioning of existing tower(s)	Will occur during summer/fall of 2017 or early 2018
Foundation construction for new towers	Will occur early during the snow free season of 2018 – will take up to one month to complete
Blasting	Used as required for foundation construction prior to foundation construction 2018 (*does NOT include manufacture or storage at site*)
Erection of new towers	During snow-free period of late 2018
Installation of new transforming station within existing lease site	During snow-free period of 2018
Upgrading of existing transmission line to 25 kv or construction of new line	Between spring 2017 and fall 2018

Ongoing operation and maintenance of wind towers and turbines	Indefinitely

4 Assessment Triggers

Numerous permits and authorizations will be required to complete the proposed development. Table (2) lists the primary authorizations required along with the corresponding trigger in the *Assessable Activities, Exceptions and Executive Committee Projects Regulations.* Though the most appropriate trigger appears to be the Development Permit required by the City of Whitehorse for the installation of the towers, the Land Use Permit required by Government of Yukon for the road upgrading is also included.

Table 2: Triggering authorization(s) and corresponding activities in YESAA regulations.

Authorization	Responsible Agency	Assessable Activity Trigger
Development Permit – required to construct wind towers on Haeckel Hill	City of Whitehorse Municipal Government	Part 4; Item 2(c): *"Construction, operation, modification, decommissioning or abandonment of, or other activity in relation to, (c) a wind-powered electrical generating station"*
Land Use Permit – required to upgrade access road to Haeckel Hill lease site and for possible new powerline development	Government of Yukon – Energy Mines and Resources Branch	Part 13; Item 13: *"On Crown land or settlement land, levelling, grading, clearing cutting or snow ploughing of (b) the right of way of a powerline, pipeline, railway line or road…"*

5 Environmental and Socio-economic Setting

Haeckel Hill, though visible from great distances in and around Whitehorse, is remote and more than 4 km from the nearest residence. The Project site is currently home to two wind energy towers and a communications tower. The site abuts a forestry reserve for the purposes of a fire look-out tower.

The following sections detail the bio-physical and socio-economic settings of the area to provide the background for the environmental and socio-economic impact assessment that follows. The majority of the information provided is for the lease itself as proposed activities are primarily focused there.

5.1 Bio-physical Environment

Haeckel Hill is a flat-topped 1 430 m high ridge with steep slopes on all sides. This leased site for the proposed towers is located on this relatively level ridge. Gently sloping alpine habitat with shallow to absent soils and exposed bedrock characterize the physical nature of the lease area.

Vegetation consists primarily of grasses, forbs and small shrubs scattered across areas where soils are present. Dwarf birch and willow are the predominate shrub species at the site.

Though numerous species of wildlife could pass through the site periodically, the lease site area is not considered critical habitat for any wildlife. The lease site does overlap with a Government of Yukon Wildlife Key Area (WKA) polygon for raptors (breeding and nesting) and a rare species polygon for Collared Pika. However, these polygons are general boundaries and no known occurrences of raptor nest sites or Collared Pika habitats are noted within the lease site.

As noted by Government of Yukon – Department of Environment during YESAB assessment YOR #2013-0010, the rare species polygon for Collared Pika was delineated around a reported siting from 1963. Subsequent observations of the lease site found no suitable Collared Pika habitat or sign.[1] Therefore, the project site does not appear to overlap with habitat of Collared Pika.

The Yukon and Takhini River valleys located east and north of the project site respectively, are of international significance for the migration of perhaps more than a million birds annually from wintering areas outside Yukon to breeding grounds principally in Alaska and Siberia. These valleys are a major migration corridor of the Pacific Flyway. In addition to many other species of birds, these adjacent migration routes are used by a significant proportion of the western population of Tundra swans (*Cygnus columbianus*) and at least 10% of the global population of Trumpeter swans (*Cygnus buccinator*) (Mossop 1997).

Despite the proximity to the significant Pacific Flyway migration route, observations over five years by Mossop (1997) concluded that the project site is not within the migration corridor. Nearly all waterfowl consistently followed the center of the adjacent valleys and remained at elevations well below the Haeckel site. No flock was observed within 200 m of the site and despite preliminary concern (prior to the Mossop [1997] study), no flocks attempted to “cut the corner” between the north-south Yukon River valley and the east-west Takhini River valley migration corridors that would have put them directly in the path of the Haeckel site.

During the Mossop (1997) study, flocks of passerine bird species also did not use the Haeckel site for through-flight and very few were observed anywhere near the Haeckel site.

Raptors were the only group of birds observed by Mossop (1997) to actually transit the Haeckel site. In general raptors utilized the upward wind currents of the eastern fronts of the Haeckel ridge for soaring in search of prey.

5.2 Socio-economic Setting

The project is located within Kwanlin Dun First Nation (KDFN) Traditional Territory. A KDFN Settlement Land parcel (KDFN R -75A) is located approximately 4 km south of the Haeckel Hill site. KDFN citizens likely use the surrounding area for traditional pursuits as they have done for time immemorial.

Despite high recreational and traditional values in the surrounding region, the lease area and location of the proposed towers is not known to provide any specific recreational or traditional values. Haeckel Hill provides considerable value for telecom infrastructure and emergency fire

[1] YESAB document #2013-0010-035-1.

monitoring. Directly east of the lease site are communication towers and a fire lookout tower. These adjacent sites share the same access as for the proposed project.

Haeckel Hill is more than four kilometers from the nearest residence located at the bottom of the access road and more than five kilometers from the nearest residential subdivision. Though Haeckel Hill is within the City of Whitehorse municipal boundaries it is separated by significant horizontal and vertical distance from areas of human occupation.

6 Scope of Assessment

The following section provides the analysis for the selection of Valued Environmental and Socio-economic Components (VESECs) upon which the impact assessment in Section 7.0 is focused. Potential valued components were identified in the following ways:

- Using GIS software to identify values;
- By reviewing past YESAB assessments in the project area – specifically YESAB assessment YOR 2013-0010;
- By discussing the project with partners and stakeholders including KDFN.

6.1 Valued Environmental and Socio-economic Components (VESECs)

Despite numerous VESECs in the area, only those for which there are real or perceived potential adverse effects were selected for further discussion and analysis. Based on the proposed activities and the values in the area, birds and bats were selected as the only VESEC potentially adversely affected by the proposed project.

7 Environmental and Socio-economic Impact Assessment

7.1 Overview

The following sections detail the environmental and socio-economic impact assessment and demonstrate NEC's considerations as per s.50 of the Yukon Environmental and Socio-economic Assessment Act (*YESAA*). Our effects characterization and significance determination are provided for potential adverse effects to the VESEC identified in Section 6.1 of this report.

7.2 Birds and Bats

7.2.1 Overview

Despite the enormous environmental benefits of wind energy, this technology has a reputation as a significant threat to both birds and bats. However, wind turbines remain far down the list of the primary culprits for incidental take with house cats retaining the top spot. In fact, Erickson et. al. (2014) quantified annual fatalities across all wind energy generating facilities in the US and Canada and estimated that they are responsible for annual fatalities by population of less than 0.05% of the highest impacted small-passerine species. This represents a very small fraction of the annual mortality of small-passerines.

Despite the findings of Erickson et. al. (2014) specific to mortality of small-passerines, for numerous sites around the world, wind turbines can cause socially unacceptable mortality of birds. Large migratory waterfowl and birds of prey (highly valued species) are routinely killed at some wind energy sites in the US and Canada.

Indeed, given the proximity of the Haeckel Hill site to the internationally significant Pacific Flyway migration route, mortality of migratory birds was initially a primary concern of the original development team and biologists. Investigating these concerns led to five years of monitoring at the site for potential bird mortalities along with approximately four years of observations (since 2013) at the site of the existing turbines. The results of the investigations have reported with high confidence that mortality of birds and bats is not a likely impact of wind energy generation at this site. Significant adverse effects to birds (all species groups) and bats are not predicted as a result this proposed development.

7.2.2 Birds and Bats Commonly Killed by Wind Turbines

As reported by AWWI (2016), bird and bat fatalities have been recorded at all wind energy facilities for which results are publicly available in North America and collisions with rotating turbine blades are assumed to represent the primary mechanism of mortality. Small-passerines comprise the bird species most often killed by wind energy developments (representing ~60% of the impacted group)

Bat fatalities at some wind turbine sites are higher than those for birds. Migratory tree-roosting species represent the group of bats most affected by collisions at wind turbine facilities and these collisions occur primarily during migration periods. Despite early hypothesis that the barotrauma (i.e. injury from rapidly altered air pressure) is a primary factor in the death of bats, recent forensic evidence suggests this mechanism is far less a factor and that direct impact with rotating blades appears to be the primary cause of mortality. (AWWI 2016)

Despite the common occurrence of bird and bat fatalities at wind energy facilities in North America, current fatality rates are not likely to lead to population declines in most bird species because mortality of species specifically related to wind energy facilities remains a very small component of mortality for all species (AWWI 2016).

7.2.3 Location of Wind Turbines is a Determining Factor Affecting Mortality of Birds and Bats

Avoiding areas of high bird or bat use is critical to reducing potential mortalities (AWWI 2016). Considerable work is being completed to develop prediction models to evaluate risk to birds and bats based on specific topographic features. NEC is very fortunate to have direct site study and monitoring to provide confidence in concluding that the Haeckel Hill site is ideal in terms of a low risk to birds and bats.

7.2.4 Five Year Study Concludes Haeckel Hill Ideal Site for Wind Turbines

Mossop (1997) details results of a comprehensive study conducted over five years (1993-97) evaluating bird strike potential at the location of this proposed project on Haeckel Hill. This study benefited from the continuous operation of the 150 kW turbine installed in 1993. This study was comprised of three main components:

1. a migration watch from the wind turbine site,
2. a standardised ground search below the turbine tower and structures,
3. a standardised ground search below nearby existing towers in the same migration corridor.

The author of this study concluded that bird collision with the structures at the Haeckel Hill site would be an extremely rare event. Only one mortality was documented over the five year period and it was a Ptarmigan that collided with a fence. The primary conclusions of the study are:

1. Waterfowl and other waterbirds are using the migration corridor near Whitehorse in large numbers, but are not at risk from collision with towers above 1 200 m altitude.
2. Birds of Prey and to a minor extent, small perching birds, can be expected to traverse high altitude turbine sites in the area.
3. If lattice and guy wire construction towers are used, even at altitude, bird collisions can be expected to occur in relatively small numbers, especially during winter.
4. Solid free-standing towers and slower, constant revolution turbine blades apparently pose no threat to bird movements in the high altitude areas near Whitehorse.

Overall the author concludes that the Haeckel Hill site poses no real threat to any of the bird species found in the region. Despite the fairly regular occurrence of raptor species in the area, they were able to see the wind tower and had no trouble avoiding it. Further, their behaviour around the site was such that they were moving at low speeds and so impacts with the wind tower (though none were observed in five years) were considered highly unlikely.

7.2.5 Risk to Bats Considered Low Given Altitude and Proximity to Water

The primary bat species in the region is the Little Brown Bat. Despite the presence in the region this bat inhabits areas near water and at much lower elevations than the project site. Indeed, comments from a senior Government of Yukon biologist during the 2013 YESAB assessment of the site, noted that not only are bats unlikely to transit the site, but Little Brown Bats are not typically a species involved with fatal hits with wind turbines.[2]

7.2.6 Monitoring Indicates no Fatalities of Avian Wildlife at Site

A recommendation from the YESAB assessment completed in 2013 was for continued monitoring of bird and bat fatalities at the site.[3] Nearly four years have passed since this monitoring was instituted and no fatalities of birds or bats have been observed at the existing site.

7.2.7 Data Suggest Newer Larger (>500 Kw) Reduce Raptor Collisions Compared to Older Models

As noted in Mossop (1997), if future bird mortality was to occur at the site the author believed it could be with a raptor species simply because they are the only species regularly transiting the site. Though this seems highly unlikely as noted in Mossop (1997), recent research suggests that newer larger turbines like the ones proposed here reduce raptor collisions compared to older smaller models like the original turbine involved in the five year study by Mossop (1997).

The number of raptor fatalities at a large wind energy facility in the US are declining substantially (67-97% depending on species) as a result of replacing older low capacity turbines with larger higher capacity turbines (AWWI 2016). Because the original Mossop (1997) study evaluated potential strikes based on an old low capacity turbine, removal of this turbine (as

[2] YESAB document YOR #2013-0010-035-1.
[3] Recommendation in the Decision Document from assessment YOR #2013-0010.

proposed) along with the installation of new high capacity turbines at the site, suggests that the risk to raptors from this project may be lower than what exists currently at that site.

7.2.8 Significance Determination

Placement of up to four additional wind turbines at the Haeckel Hill site will not result in significant adverse effects to either birds or bats. In fact, bird or bat mortality for individuals of any species appears highly unlikely. In the unlikely event that a raptor or member of another species where to be killed by these wind towers, mortality levels would be so low that they would be indiscernible at the population level. This project will most likely produce only net benefits to these species as it will reduce Yukon's contribution of green house gas emissions and the significant ecological effects of global warming and climate change.

8 References

American Wind Wildlife Institute (AWWI). 2016. Wind turbine interactions with wildlife and their habitats: a summary of research results and priority questions. (updated June 2016). Washington, DC. Available at www.awwi.org.

Erickson W.P., M. M. Wolfe, K. J. Bay, D.H. Johnson, J. L. Gehring. 2014. A comprehensive analysis of small-passerine fatalities from collision with turbines at wind energy facilities. PloS ONE 9(9): e107491. doi: 10.1371/journal.pone.0107491

Mossop, D.H. 1997. Five years of monitoring bird strike potential at a mountain-top wind turbine, Yukon Territory. Northern Research Institute – Yukon College. 17p.