Bird Protection Plan

for the

Fort Providence / Kakisa Transmission Line Project

Government of Northwest Territories
Department of Infrastructure

Government of
Northwest Territories

Document Maintenance and Control

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Bird Protection Plan Document History

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Table of Contents

LIST OF TABLES

LIST OF APPENDICES

1 INTRODUCTION

1.1 Bird Protection Plan Objectives

The purpose of this Bird Protection Plan is to provide the framework for a program to reduce bird mortality risk at the Fort Providence / Kakisa Transmission Line Project (Project) from potential collision with power lines and electrocution. The Bird Protection Plan includes the following primary objectives:

- Present a literature review summary of contributing factors to bird collision and electrocution risk to provide context for mitigation.
- Conduct a collision risk assessment for whooping crane *(Grus americana)* due to their designation as Endangered under Schedule 1 of the federal *Species at Risk Act* (SARA), potential occurrence near the Project, and vulnerability to collisions with power lines (COSEWIC 2010; Stehn and Wassenich 2008).
- Conduct an electrocution risk assessment for raptors because of their vulnerability to electrocution (APLIC 2006) and occurrence near the Project (Golder 2021).
- Describe potential mitigation measures to be implemented at the Project to reduce the risk of bird collisions with power lines and electrocutions.

This Bird Protection Plan complements the Project Wildlife Management and Monitoring Plan, which covers other potential wildlife and avian interactions with the Project such as habitat loss and accidental destruction of bird nests during vegetation clearing for construction.

1.2 Project Details

The Project will consist of a new sub-transmission line extending from a new switching station located at the junction of Highway 2 and 5 south of Hay River. It will extend along Highway 2 south to Enterprise, then follow Highway 1 to the Kakisa highway junction. A new substation will be built at Kakisa junction and a new distribution line will extend along Highway 1 and 3 to Dory Point. The distribution line will then cross the Mackenzie River via a cable tray on the underside of the Deh Cho Bridge. The distribution line will terminate at a new substation in Fort Providence.

The transmission line will be built within the existing 60-metre highway right-of-way, which consists of a 30-metre buffer on either side of the highway centreline. This existing road allowance is considered sufficient width for construction, although minimal clearing and brushing may be required at certain locations. Single pole structures will typically be used. Typical pole foundation will involve augured hole, crib, or culvert arrangement with rock fill. Pole anchoring will be used as necessary (e.g., deflection points) by guy wire and helix screw, log, or grouted rock anchors. Project construction is anticipated to begin in spring, likely in 2024, with commissioning in the following spring. The transmission line is anticipated to remain in service indefinitely, with ongoing maintenance and repairs as required.

A three-phase single wood pole structure will be used for the Project. Pole heights are expected to be approximately 45 ft (13.7 m) depending on site-specific topography. The typical span between the poles will be about 100 m but can be adjusted (i.e., 80 to 120 m) as needed to ensure satisfactory pole placement to avoid features on ground or potential interactions with other property or infrastructure. Total transmission line length will be approximately 170 km.

1.3 Legislation and Guidelines

The federal *Migratory Birds Convention Act* (MBCA) protects migratory birds, including their eggs and nests, from harm. To maintain compliance with this legislation, proponents have a responsibility to minimize the risk of accidental bird mortality (or incidental take) related to project operations.

Migratory birds covered under the MBCA include (GoC 2017):

- waterfowl (e.g., ducks, geese, and swans)
- waterbirds (e.g., cranes, herons, rails, grebes, loons, gulls, and terns)
- shorebirds (e.g., plovers and sandpipers)
- doves and wild pigeons
- most songbirds (e.g., flycatchers, warblers, and sparrows)

Birds not included under the MBCA include upland game birds (e.g., grouse, quail, pheasants), raptors (e.g., hawks, owl, eagles, falcons), cormorants, pelicans, kingfishers, crows, jays, starlings, and some blackbird species.

The Northwest Territories (NWT) *Wildlife Act* provides additional protection to nests and eggs of bird species that are covered under the MBCA as well as species that are not.

The federal SARA provides protection to birds listed under its authority. Section 32(1) of the SARA prohibits killing, harming, or harassing of a listed threatened, endangered, or extirpated species. The whooping crane is listed as Endangered under Schedule 1 of the SARA (GoC 2021). The species range overlaps with the spatial extent of the Project.

The *Species at Risk (NWT) Act* helps fulfill the NWT commitment under the national Accord to provide effective protection of species at risk that are managed by the territory. The NWT contains provisions that protect species listed on the NWT List of Species at Risk. However, the Government of Canada has the ultimate responsibility for the management of migratory birds, as described in the MBCA. There are no “At Risk” bird species currently listed under the NWT SARA (GNWT 2023). The Wildlife Management and Monitoring Plan presents the status of all species at risk in the Project area.

2 POTENTIAL IMPACTS

Bird collisions with power lines and electrocution are the primary risks to birds associated with operational electrical transmission and distribution systems. Understanding the nature of bird collisions and bird electrocutions is essential for minimizing occurrences and mitigation. This section provides a summary of contributing factors to bird collision (Section 2.1) and electrocution risk (Section 2.2) to provide context for mitigation.

2.1 Bird Collisions with Power Lines

Bird collision risk with power lines depends on biological factors (e.g., species vulnerability), environmental factors (e.g., surrounding habitat), and engineering factors (e.g., physical characteristics of the power line) (Bernardino et al. 2018). These factors are discussed in the following sections.

2.1.1 Biological Factors

Some bird species have a greater risk of collision with power lines than others. Species-specific vulnerability is related to morphology, vision, and behaviour. In general, birds with high wing loading (i.e., the ratio of body weight to wing area) and low wing aspect ratio (i.e., ratio of the square of the wingspan to the wing area) are more susceptible to collisions with power lines because they lack the manoeuvrability to quickly avoid obstacles (APLIC 2012; Smith and Dwyer 2016; Bernardino et al. 2018). Heavy-bodied fast fliers, such as waterfowl, tend to also be more susceptible to collisions with power lines (APLIC 2012; Smith and Dwyer 2016; Bernardino et al. 2018).

Visual acuity in some bird groups may also contribute to collision risk (Bernardino et al. 2018). Species such as cranes have poor forward-vision during flight (Martin and Shaw 2010), meanwhile waterfowl and some other waterbirds are adapted for underwater vision, which causes near-sightedness above water (Jones et al. 2007; APLIC 2012).

Flocking behaviour may increase collision risk because density of large flocks leaves little room for individuals to manoeuvre around obstacles and may obstruct the view for trailing birds (Drewitt and Langston 2008; Smith and Dwyer 2016). Species that undertake routine flights during dusk and dawn may be more vulnerable to collision with power lines because of their inability to see wires due to low light conditions (APLIC 2012; Bernardino et al. 2018). Some studies have found that most collisions typically occur at dusk and dawn (Pandey et al. 2008), although other studies have found little diurnal pattern (Martin and Shaw 2010). Examples of species that undertake routine flights during low light conditions include gulls and waterfowl, which tend to fly between foraging and roosting sites before sunrise and after sunset.

Bird groups that are most vulnerable to collision with power lines and occur in the NWT are waterfowl (Anseriformes), grebes (Podicipediformes), shorebirds (Charadriiformes), and cranes (Gruiformes) (Rioux et al. 2013). The whooping crane *(Grus americana)*, in particular, is considered a priority species for mitigation collision risk from the Project because it is listed as Endangered under Schedule 1 of the federal SARA and is vulnerable to collisions with power lines (COSEWIC 2010).

2.1.2 Environmental Factors

Surrounding habitat and landscape features can affect bird exposure to power lines. Power lines that are perpendicular to topographic features that concentrate flight paths (such as coastlines, rivers, mountains passes, and ridges) may pose greater collision risk than parallel power lines (APLIC 2012). Power lines located in or near areas of high avian use (e.g., foraging, nesting, or roosting sites) may increase exposure and collision risk. This appears to be especially true when only a short distance separates high use areas because birds will typically fly between them at low altitudes, potentially within the range of heights of power lines. Conversely, power lines that are in forested habitat and are at or below the height of the surrounding trees generally present low-risk collision because birds will be flying at higher altitudes than the canopy and consequently avoid the power line (Thompson 1978; APLIC 2012; Bernardino et al. 2018).

Although proximity to areas of high avian use is an important factor in collision risk, no specific thresholds have been identified in scientific literature. Faanes (1987) found that collision rates were higher at power lines within 400 m from the edge of water than those beyond this distance. Quinn et al. (2011) found mortality rates dramatically decreased beyond 60 m from the edge of water and did not find any bird carcasses under power lines that were more than 500 m from the edge of water. Another study from the western US reported that the average distance of collision mortalities from the nearest waterbody ranged from 82.3 to 213.4 m for six waterbird species (APLIC 2012). Mojica et al. (2009) reported that bald eagle *(Haliaeetus luecocephalus)* power line related mortalities (i.e., electrocutions and collisions combined) were significantly higher within 300 m, and between 300 to 1,000 m, than beyond 1,000 m compared to what would be expected based on relative line lengths.

2.1.3 Engineering Factors

Engineering factors that can influence bird collision risk are summarized in Table 1. The engineering design for high voltage transmission lines generally presents greater collision risk than low voltage distribution lines (APLIC 2012).

Table 1: Engineering Factors Related to Bird Collision Risk with Power Lines

Engineering Factor	**Collision Risk Summary**
Wire diameter	Collision risk is higher with shield wires than phase conductors (Bevanger and Brøseth 2001; APLIC 2012; Bevanger et al. 2018). Shield wires are typically installed on the top of transmission structures to protect the phase conductors from lighting strikes. The smaller diameter of shield wires makes them less visible and their position above the phase conductors places them in the flight path of birds that gain altitude to avoid the more obvious phase conductors (APLIC 2012; Bernardino et al. 2018). Brown et al. (1987) found an 80% reduction in collision mortality of sandhill cranes and whooping cranes following removal of the shield wire from a span of 116-kV line. However, placement of the shield wire above phase conductors may confound the effect of wire diameter.
Line placement	Proximity to bird habitats (e.g., wetlands, roosting, nesting, and foraging sites) is an important consideration. Power lines that parallel primary bird flight paths pose less risk than those with perpendicular orientation (Scott et al. 1972; McNeil et al. 1985; APLIC 2012). For example, perpendicular orientation of a line relative to a topographical feature poses greater collision risk to local and migrating birds.
Line configuration	Horizontal arrangement of lines (i.e., phase conductors), reducing the number of vertical levels, and minimizing the spread of vertical lines was suggested to reduce collision risk (Bevanger 1998; Haas et al. 2005; APLIC 2012). There is little scientific evidence to support this due to practical difficulties of testing such effects (Bernardino et al. 2018).
Line height	There is general agreement that taller power lines pose higher collision risk (Bernardino et al. 2018). However, while transmission lines may be a greater threat to birds while flying at higher altitudes (e.g., migratory flights), distribution lines may become dangerous during lower altitude local flights (APLIC 2012). Collision risk is also related to power line height relative to the surrounding tree canopy. Power lines that are at or below the height of nearby trees rarely presents a problem to small tree-dwelling birds because of their maneuverability, meanwhile large birds will gain altitude to fly over the tree line; thus avoiding the power line (APLIC 2012).

Table 1: Engineering Factors Related to Bird Collision Risk with Power Lines

Engineering Factor	Collision Risk Summary
Span length	Collision risk appears to be greatest along the middle span of power lines between pole structures (Pandey et al. 2008; APLIC 2012; Bernardino et al. 2018). A study from the western US found that most waterfowl collisions on power line span lengths of 91 to 122 m occurred at distances of 12 to 18 m from the nearest poles (APLIC 2012).

2.2 Bird Electrocutions

Bird electrocutions can occur when a bird simultaneously contacts electrical equipment either phase-to-phase or phase-to-ground. There are three interacting elements that contribute to electrocution risk: biology, environment, and engineering. These factors are discussed in the following sections.

2.2.1 Biological Factors

Body size is one of the most important characteristics for determining species susceptibility to electrocution. Large birds are more vulnerable because their wingspans may bridge the distance between conductors on horizontal crossarms, while tall birds may simultaneously contact different conductors on poles with vertical construction (APLIC 2006). For electrocution to occur, birds must typically contact electrical equipment with conductive fleshy parts such as feet, bill, and wrists (i.e., the bend of the wing) because dry feathers provide insulation (APLIC 2006).

Raptors (e.g., eagles, hawks, owl) are particularly vulnerable to electrocution because of their size and frequent use of power lines and poles for perching, roosting, and nesting (APLIC 2006). Power poles can offer raptors ideal hunting perches with expansive views of the surroundings to watch for prey, allowing them to conserve energy compared to foraging in flight. Eagles constitute the greatest proportion of raptor electrocution mortalities in North America, followed by hawks in the genus *Buteo* (APLIC 2006). Although Buteos comprise a large proportion of electrocuted birds, their mortality rate due to electrocution is low (3% to 13%) compared to other causes of death (APLIC 2006). Owl mortalities are considerably lower compared to diurnal raptor species. The great horned owl *(Bubo virginianus)* is the most commonly electrocuted owl in North America (APLIC 2006), but as many as 5.6% of snowy owl *(Bubo scandiacus)* mortalities in Alberta were attributed to electrocution (Kerlinger and Lein 1988).

Electrocutions have also been reported in over 30 non-raptor species in North America (APLIC 2006). Corvids (e.g., ravens, crows, and magpies) are the next most vulnerable bird group occurring in the region. Common ravens *(Corvus corax)* have been reported as the most frequently electrocuted bird species in some parts of North America (APLIC 2006). Although small birds are less vulnerable, they can be electrocuted on closely spaced energized equipment such as transformers (APLIC 2006).

2.2.2 Environmental Factors

Habitat is a key factor influencing avian use of power poles. In open areas lacking natural perches, power poles provide sites for hunting, feeding, resting, roosting, or nesting. Habitats with abundant prey may also attract raptors. Power lines in forested habitats typically have fewer reported raptor electrocutions than those in open habitats because of the availability of natural perches (APLIC 2006). Poles that provide the greatest height above the surrounding terrain have a higher probability of raptor use and consequently electrocution. In homogenous habitats, raptors may be equally likely to use any pole; therefore, electrocution risk can be similar for poles of the same configuration across the entire power line span (APLIC 2006).

2.2.3 Engineering Factors

Power line configuration, specifically the separation between energized components or between energized and grounded components, influences bird electrocution risk. Electrocution can occur where horizontal separation is less than the wrist-to-wrist distance of a bird's wingspan or where vertical separation is less than a bird's length from head-to-foot. APLIC (2006) recommends that avian-safe construction standards to prevent bird electrocutions should provide a separation of 150 cm between energized conductors and grounded hardware.

High voltage transmission lines typically have large spacing between phase conductors (i.e., greater than 150 cm) and pose less electrocution risk to birds than lower voltage distribution lines (APLIC 2006). Distribution lines with wood pole structures are generally less hazardous than those using metal poles or components (APLIC 2006). On pole structures with grounded metal crossarms, bird electrocutions can occur from simultaneous contact with a phase conductor and the metal crossarm (APLIC 2006). Structures on pole-top assemblies with bonded and grounded hardware increase the potential for avian electrocutions because there is typically more energized and grounded parts with close separation (APLIC 2006).

Structures with transformers or other exposed, energized equipment account for a disproportionate number of avian electrocutions (APLIC 2006). Dead-end distribution structures that accommodate directional changes, line terminations, and lateral taps usually have energized jumper wires that can pose an additional electrocution risk to birds, especially if they are mounted over the crossarms (APLIC 2006).

On an armless pole configuration in which conductors are mounted on horizontal post insulators, a bird perched on the insulator can be electrocuted if it simultaneously contacts the energized conductor and either the grounded insulator base or a bonding conductor (APLIC 2006).

3 RISK ASSESSMENT

The purpose of a risk assessment is to identify areas of the Project alignment with the highest relative mortality risk to birds such that mitigation measures can be strategically implemented in areas where the greatest benefit to birds will be realized. This section describes the methods used to identify areas with higher relative risk of bird collisions with power lines and electrocutions, followed by the results of the risk assessment.

3.1 Bird Collisions with Power Lines

3.1.1 Methods

The collision risk assessment considered a whooping crane habitat model, additional data to generate bird collision risk maps, and the transmission line height relative to tree canopy. Each factor is described in the following sections.

3.1.1.1 Whooping Crane Habitat Model

The collision risk assessment focused on whooping crane due to its designation as Endangered under Schedule 1 of the federal SARA, and vulnerability to collisions with power lines (COSEWIC 2010; Stehn and Wassenich 2008). In Canada, whooping cranes are only known to nest in Wood Buffalo National Park, concentrated in an area of approximately 3,340 km^2 in the vicinity of the Nyarling, Sass, Klewi, and Little Buffalo Rivers (COSEWIC 2010). Although their core nesting area is more than 75 km east of the Project, whooping cranes have the potential to occur near the Project based on telemetry data from tracked individuals. Whooping cranes were not detected during avian use surveys conducted in the study region in August 2021 and June 2022; however, surveys were not specifically intended or designed to identify whooping crane presence (Golder 2021).

A whooping crane nesting habitat suitability model was developed using geographic information system (GIS) mapping methods for use as a proxy for collision risk because whooping cranes are most likely to make low-level flights, potentially at the height of the proposed power line, in areas with suitable nesting habitat.

The model was developed following methods described for the best fit model in the *Whooping Crane Potential Habitat Mapping Project* (Olson and Olson 2003) report prepared for Parks Canada and the Canadian Wildlife Service. The best fit model (i.e., Equation 4 from Olson and Olson 2003) is provided below and each variable used in the equation is described in Table 2.

$$p = \frac{1}{1 + e^{-(-3.265+(-0.002*Distance\ To\ Water)+(-0.016*LS7\ MidInfrared\ 5x5)+(0.506*MajorityVeg\ 5x5)+(0.023*Pond\ density\ 7.5\ km)}}$$

Table 2: Variable Definitions Used in the Whooping Crane Nesting Habitat Suitability Model

Variable	Description
p	Probability of occurrence of nesting habitat (0 to 1).
Distance to water	Euclidian distance in metres from water.
LS7 mid-infrared 5 × 5	Landsat-7 band 7 average spectral value over a 5 by 5 pixel (150 m by 150 m) window. This is an indicator of water content within the pixel window. Water features exhibit low values for band 7 as the incoming radiation is absorbed rather than reflected back to the satellite sensor. A satellite pixel containing a mixture of water and marsh vegetation would contain a lower band 7 value due to wavelength absorption. The probability of crane nesting habitat increases with decreasing band 7 values.
Majority vegetation 5 × 5	Land cover diversity (i.e., number of land cover classes) over a 5 by 5 pixel (150 m by 150 m) window.
Pond density 7.5 km	Number of ponds in 7.5 km by 7.5 km window.

Source: Olson and Olson 2003.

The model equation was applied to the appropriate GIS layers (Table 3) to produce a whooping crane nesting habitat map where pixel values represent the probability of occurrence of nesting habitat, ranging from 0 (low probability) to 1 (high probability). These probability values were divided into ten equal interval classes representing habitat suitability. The spatial extent of the model was terrestrial areas within a 1-km wide corridor centred on the existing highways that the Project alignment will follow. This spatial extent is based on the relationship between collision risk and distance of power lines from areas of high avian use (Section 2.1.2).

Table 3: Data Sources for the Whooping Crane Nesting Habitat Suitability Model

Data	Sources Used
Water layers	● GNWT Atlas platform Waterbodies (No Marsh category included) ● GNWT Atlas platform Watercourses ● NTDB CanVec 50K Waterbodies (where NWT Atlas water was not available) ● NTDB CanVec 50K Watercourses (where NWT Atlas water was not available)
Ponds	● NWT Atlas platform Waterbodies (No River/Stream, No Marsh Included) ● NTDB CanVec 50K Waterbodies (where NWT Atlas water was not available. No River, No Liquid Waste included)
Landcover classification	2015 land cover of Canada
Landsat 8	two scenes (June 2021, September 2021)

GNWT = Government of Northwest Territories; NTDB = National Topographic Data Base; NWT = Northwest Territories; 50K = 1:50,000 scale.

3.1.1.2 Bird Collision Risk Maps

Areas of high-risk bird collisions were identified within a 1-km wide corridor centred on the existing highways that the Project alignment will follow using GIS mapping methods. The following areas were considered high-risk bird collision areas:

- Within 400 m of the highest whooping crane nesting habitat suitability classes (i.e., classes 8 to 10). These classes correspond to what COSEWIC (2010) suggests is suitable habitat (nesting probability of 0.70 or higher). The 400-metre distance corresponds to the distance from known crane roost or use areas that the United States Fish and Wildlife Service recommends marking power lines (Stehn and Wassenich 2008).
- Within 100 m from the edge of waterbodies.
- Within 1 km from the edge of large watercourses (i.e., MacKenzie, Kakisa, and Hay Rivers) based on the proportion of bald eagle power line related mortalities relative to distance from shoreline reported by Mojica et al. (2009).
- Within 10 m from the edge of all other watercourses.
- Within 1 km of the osprey *(Pandion haliaetus)* nest near Dory Point identified during field surveys (Golder 2021).

- Within 500 m of avian use survey locations with the highest observed abundance of birds belonging to the taxonomic families with a high-risk power line collision (Section 2.1.1). Abundance (i.e., number of individual birds) was divided into the following categories: 0, 1 to 3, 4 to 6, 7 to 10, more than 10. The following abundance categories were included in the high-risk areas: 4 to 6, 7 to 10, more than 10.

3.1.1.3 Categorizing Transmission Line Height Relative to Tree Canopy

The height of the transmission line relative to the tree canopy was characterized using field surveys and LiDAR. Field surveys were used where there is an existing transmission line between Hay River and Enterprise, and between Dory Point and Kakisa junction. This was done by noting the current height of the line (above, equal to, or below the canopy) then travelling the line and marking where the height changes relative to the forest and the new value (Golder 2021).

LiDAR was used for the remaining portion. Preliminary pole locations (dated June 2023) were connected using GIS mapping software to create a transmission line centreline that was compared to the tree canopy height at the centreline location. The transmission line height was characterized as follows based on a pole height of 45 ft:

- below canopy: where the tree canopy is greater than 46 ft in height
- equal to canopy: where the tree canopy is 44 to 46 ft in height
- above canopy: where the tree canopy is less than 44 ft in height

3.1.2 Results

Results of the whooping crane nesting habitat suitability model are shown in Table 4 and illustrated in Appendix A. Most (76.9%) of the modelled area was classified as having a low probability (less than 0.3) of occurrence of whooping crane nesting habitat (i.e., suitability classes 1 to 3) (Table 4). Only 9.4% of the modelled area was classified as having a high probability (greater than 0.7) of occurrence of whooping crane nesting habitat (i.e., suitability classes 8 to 10) (Table 4). A large proportion of this habitat occurs from approximately 7.2 km north of Enterprise (i.e., junction of Highways 2 and 1) to 15.8 km west of Enterprise, as measured along the existing highways (Appendix A). Sections of the Project alignment that are near the highest nesting habitat suitability classes are expected to present the greatest collision risk to whooping cranes because these areas are likely to receive the greatest use by cranes and have the highest frequency of low-level flights.

Table 4: Whooping Crane Nesting Habitat Suitability Classes within 1 km of the Project Alignment

Nesting Habitat Suitability Class	Nesting Habitat Probability	Nesting Habitat Quality	Area (ha)	Percentage of Modelled Area (%)
1	0 to ≤0.1	low	16,674.4	46.5
2	>0.1 to ≤0.2	low	7,469.4	20.8
3	>0.2 to ≤0.3	low	3,412.1	9.5
4	>0.3 to ≤0.4	moderate	1,923.5	5.4
5	>0.4 to ≤0.5	moderate	1,338.3	3.7
6	>0.5 to ≤0.6	moderate	919.4	2.6
7	>0.6 to ≤0.7	moderate	739.2	2.1
8	>0.7 to ≤0.8	high	954.2	2.7
9	>0.8 to ≤0.9	high	1,105.9	3.1
10	>0.9 to ≤1.0	high	1,299.6	3.6

> = greater than; < = less than; ≤ = less than or equal to.

Results of the whooping crane habitat model were combined with the other high-risk collision layers and overlaid with the estimated transmission line height relative to the tree canopy (Appendix B). Approximately 17.9 km of the transmission line is within a high-risk collision area and above tree canopy height. These sections are considered to present the highest collision risk to birds and should be mitigated. Bird collision risk is considered low in the remaining areas because the transmission line is either outside a high-risk collision area, equal to or below tree canopy, or both. Transmission line lengths are summarized in Table 5.

Table 5: Transmission Line Lengths relative to Tree Canopy Height and Bird Collision Risk Areas

Category	Length (km)
Above tree canopy and within high-risk collision area	17.9
Above tree canopy and outside high-risk collision area	10.4
Equal to tree canopy and within high-risk collision area	3.7
Equal to tree canopy and outside high-risk collision area	0.6
Below tree canopy and within high-risk collision area	70.1
Below tree canopy and outside high-risk collision area	76.6

Note: Shaded gray rows indicate categories with high-risk collision to birds that should be mitigated.

3.2 Bird Electrocutions

3.2.1 Methods

The electrocution risk assessment focused on raptors because of their vulnerability to electrocution (APLIC 2006) and occurrence near the Project (Golder 2021). The risk assessment considered two factors:

- A qualitative desktop review to identify areas where raptors are most likely to occur along the Project alignment based on the field summary report completed for the Project (Golder 2021) and prominent habitat features visible in satellite imagery (i.e., Google Earth).
- Transmission tower geometry (Appendix D of the Interconnection Study Report; Hatch 2023) compared to avian-safe standards recommended by APLIC (2006).

3.2.2 Results

3.2.2.1 Habitat Review

Characteristic vegetation surrounding the Project alignment consists of treed, shrubby and sedge-dominated fens, and upland areas with stands of jack pine, trembling aspen, black and white spruce, balsam poplar, and paper birch (Golder 2021). Because of the availability of natural perches and relative homogeneity of surrounding habitat, raptor use of power poles along most of the Project alignment is anticipated to be opportunistic and not spatially clustered.

Raptor use of power poles is anticipated to be highest in sections of the Project alignment along the Mackenzie, Kakisa, and Hay rivers that provide suitable foraging habitat for bald eagle and osprey. A bald eagle was observed along the Kakisa River during 2021 field surveys and an osprey nest was identified along the south shoreline of the Mackenzie River near Dory Point (Golder 2021). These sections of the Project alignment along the Mackenzie, Kakisa, and Hay rivers are anticipated to present the highest electrocution risk to raptors in the absence of avian-safe design standards.

3.2.2.2 Engineering Drawing Review

Avian-safe standards for pole structures recommended by APLIC (2006) include maintaining 150 cm horizontal and 100 cm vertical separation between phase conductors or a phase conductor and grounded hardware/conductor, or using insulation where minimum spacing is not possible. The Interconnection Study Report (Hatch 2023) identified three tower geometries for the Project:

- understrung scenario (page F-1 in Hatch 2023)
- 72 kV (page F-2 in Hatch 2023)
- 25 kV (page F-3 in Hatch 2023)

Bird electrocution hazards associated with each tower geometry are summarized in Table 6. Tower geometry for the 72 kV transmission line and the understrung scenario exceed the minimum separation between phase conductors for avian-safe design (APLIC 2006), but there is potential for birds to simultaneously contact the phase conductors and the grounded base of their horizontal post insulators. The horizontal separation (122 cm) between phase conductors on the 25 kV distribution line is less than what is recommended for avian-safe design standards (150 cm; APLIC 2006). Based on the current design, the 25 kV distribution line will be approximately 51 km long and will contain approximately 509 towers. The 72 kV transmission line will be approximately 116 km long and contain approximately 1,231 towers. The length and number of towers may be adjusted as the detailed design progresses.

Table 6: Bird Electrocution Risk Assessment for Project Tower Geometries

Tower Geometry Description	Page Number (Hatch 2023)	Bird Safe Design Components	Bird Electrocution Hazards
Understrung scenario	F-1	• >100 cm vertical separation between all phase conductors • >150 cm horizontal separation between all phase conductors	potential for simultaneous contact of the energized conductor B and C and the grounded base of their horizontal post insulator
72 kV	F-2	• >100 cm vertical separation between all phase conductors • >150 cm horizontal separation between all phase conductors	potential for simultaneous contact of the energized conductor B and C and the grounded base of their horizontal post insulator
25 kV	F-3	none identified	<150 cm horizontal separation between all three phase conductors

> = greater than.

4 MITIGATION

This section describes mitigation measures considered for implementation at the Project to reduce the risk of bird collisions with power lines (Section 4.1) and electrocutions (Section 4.2). The Government of Northwest Territories Department of Infrastructure (GNWT-INF) has committed to further exploring these mitigation measures in collaboration with its utility partners and key stakeholders throughout the remainder of detailed design of the Project.

4.1 Bird Collisions with Power Lines

4.1.1 Engineering Design

The Project engineering design includes the following elements that are anticipated to reduce bird collision risk:

- The Project will not have a shield wire, which generally presents higher collision risk than phase conductors.
- Crossing of the Mackenzie River will be via a cable tray on the underside of the Deh Cho Bridge, which will avoid overhead power lines perpendicular to the river and associated collision risk to birds flying along the river.
- Phase conductors will generally have a horizontal configuration, which reduces the vertical spread of the collision risk area.
- Based on a tower height of 45 ft (13.7 m), approximately 84% of the transmission line will be equal to or below the forest canopy. This presents low-risk collision because migratory birds will be flying at higher altitudes than the canopy and consequently avoid the transmission line.
- Typical span between poles will be about 100 m, which reduces the length of the mid-span corresponding with high-risk collisions.

4.1.2 Line Marking Devices

Line marking devices are used to reduce collision risk by increasing the visibility of power lines. There are three general categories of line marking devices: aerial marker spheres, spirals, and suspended devices (swinging, flapping, and fixed) (APLIC 2012). Most studies report a reduction in collision risk at marked power lines compared to unmarked power lines, but the reported magnitude is variable (e.g., 9.6% to 80% [Rioux et al. 2013]; 78% [Barrientos et al. 2011]; 50.4% [Bernardino et al. 2019]). Reduction rates in collision risk may vary with location, type of line marking device, differences in bird species, habitats, and power line configurations and may not be replicable from one power line or study to another (APLIC 2012; Bernardino et al. 2018). Some studies suggest that suspended devices with mobile parts are more effective at reducing collision risk than static devices (e.g., spirals) (Bernardino et al. 2019a; Ferrer et al. 2020). However, there are relatively few systematic studies of the comparative effectiveness of different line marking devices, thus no single device is considered to be the best performing (APLIC 2012). Information on optimal marker spacing from experimental studies is also limited (Bernardino et al. 2018). In general, any line marking device that thickens the appearance of a power line for at least 20 cm in length and spaced 5 to 10 m apart is likely to lower collision rates by 50% to 80% (Jenkins et al. 2010). Utility industry practices for line marker device spacing ranges from 3 to 100 m depending on the line marker type (APLIC 2012).

GNWT-INF will work with partners and stakeholders to determine to what extent the following line markings will be used at the Project:

- Line marking devices will be installed where the two following conditions are met:
  - power line is higher than the tree canopy
  - power line overlaps a high-risk collision area

  These areas equal 17.9 km in length (Appendix B).
- Line marking devices will be added to the central portion (60%) of each span within high-risk collision areas because this is where most collisions occur (Eskom Transmission 2009).
- Line marking devices will be installed according to the manufacturer's recommended spacing (typically 5 to 10 m), provided it does not exceed ice or wind loading specifications.
- Line marking devices will be staggered on parallel lines to increase their visual density while reducing ice and wind loading on each line.
- Line marking devices with components that glow in the dark (Murphy et al. 2016) and reflect visible and UV light will be preferred. The colours of individual line marking devices will be alternated to improve power line visibility under a variety of light conditions (APLIC 2012).

4.2 Bird Electrocutions

4.2.1 Engineering Design

Mitigation of bird electrocutions is based on the principles of isolation and insulation. Isolation refers to providing adequate separation between phase conductors or a phase conductor and grounded hardware/conductor to accommodate avian use of structures. Insulations refers to covering exposed energized or grounded parts to prevent avian contacts. Where isolation or insulation is not possible, perch discouragers may be used to deter birds from landing on hazardous pole locations but should be installed with alternate perches (e.g., raiser perch) if used for long consecutive spans. Depending on structure configuration, a combination of these techniques may be required to achieve avian safety (APLIC 2006).

GNWT-INF will work with partners and stakeholders to determine to what extent the following mitigations will be applied to the engineering design:

- Where possible, a minimum horizontal separation of 150 cm will be maintained between energized conductors and grounded hardware.

- Where possible, a minimum vertical separation of 100 cm will be maintained between energized conductors and grounded hardware.
- Where horizontal separation of 150 cm or vertical separation of 100 cm is not possible, energized parts and grounded hardware will be covered using materials designed for insulation.

Specific mitigations recommended for each tower geometry is described in Table 7.

Table 7: Mitigation for Bird Electrocution Risk at Project Tower Geometries

Tower Geometry Description	Page Number (Hatch 2023)	Bird Electrocution Hazards in the Preliminary Design	Mitigation
Understrung scenario	F-1	potential for simultaneous contact of the energized conductor B and C and the grounded base of their horizontal post insulator	• increase spacing between energized conductor and the grounded base of the horizontal post insulator to meet minimum horizontal separation (150 cm) • install phase covers on phase conductors B and C if hardware is bonded or grounding conductor is uncovered
72 kV	F-2	potential for simultaneous contact of the energized conductor B and C and the grounded base of their horizontal post insulator	install phase covers on phase conductors B and C if hardware is bonded or grounding conductor is uncovered
25 kV	F-3	<150 cm horizontal separation between all three phase conductors	• install covers over the insulator and conductor on the centre phase if no bonding present • if hardware is bonded, install phase cover over all three insulators and phase conductors • lower crossarm to achieve 150 cm separation between phase conductors

< = less than.

5 BIRD MORTALITY REPORTING

GNWT-INF will engage Environment and Climate Change Canada and GNWT-Environment and Climate Change in discussion about the requirement, suitability, and design of a post-construction bird mortality monitoring program for the Project. At minimum, incidental observations of bird mortalities by NTPC operations staff or where birds are determined to be the cause of an outage will be entered into an internal database. Collected information will include the species, location, date, cause of mortality if known (i.e., electrocution or collision), and photographs. This information can assist with adaptive management such as identifying problem structures or spans for retrofitting for mitigation (e.g., line marking devices).

6 TRAINING

Project staff will be informed about the Bird Protection Plan and the requirement and procedures for reporting any avian mortalities observed during routine work.

7 QUALITY CONTROL

The purpose of quality control is to confirm implementation of the Bird Protection Plan. Site inspections will be conducted during construction and post-construction to confirm that mitigation is implemented according to the final Project design. During site inspections, recommended mitigation areas with avian protection measures will be documented and recommended mitigation areas without measures will also be documented as non-conformances for resolution.

8 ROLES AND RESPONSIBILITIES

GNWT-INF is responsible for the distribution, maintenance and updating of the Bird Protection Plan. As the operator of the Project, NTPC is responsible for the implementation of this plan including compliance and internal reporting. Table 8 identifies the key responsibilities integral to the success of the Plan. The identified responsibilities are not exhaustive, and the responsible departments will work collaboratively to implement commitments in the Plan.

Table 8: Key Responsibilities related to Implementation of the Bird Protection Plan

Agency/Department	Responsibilities
GNWT-INF	conduct routine reviews of the Plan and make revisions, as required
GNWT-INF	ensure that mitigation measures described in this Plan are applied during Project construction
NTPC	inspect condition of line marker devices during Project operation and perform maintenance as required
NTPC	report and track incidental observations of bird mortalities observed at the Project
NTPC	identify whether adaptive management actions are required based on documented bird mortalities
NTPC	implement remedial actions (e.g., retrofitting mitigation) identified as part of adaptive management

GNWT-INF = Government of Northwest Territories-Department of Infrastructure; NTPC = Northwest Territories Power Corporation.

8.1 Project Contacts

Primary GNWT-INF contacts for information regarding this Plan are:

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Incidents involving migratory birds should be reported to Environment and Climate Change Canada-Canadian Wildlife Service North email (cwsnorth-scfnord@ec.gc.ca) or Wildlife Enforcement Directorate email (dalfnord-wednorth@ec.gc.ca). In the case of wildlife injury and/or mortality, contact GNWT-Environment and Climate Change Wildlife Emergency at 867-873-7181.

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Appendices

Appendix A: Whooping Crane Nesting Habitat Suitability Maps

Appendix B: Bird Collision Risk Areas and Transmission Line Height Relative to Tree Canopy

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