BIPOLE III TRANSMISSION PROJECT

MAMMAL MONITORING PROGRAM
TECHNICAL REPORT YEAR 2 (2015/16)

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SUMMARY OF KEY FINDINGS AND MONITORING AND MITIGATION RECOMMENDATIONS

This monitoring report presents an analysis and summary of existing baseline data for mammal VECs potentially affected by the Bipole III Transmission Project ('the Project'). It provides an information base and reporting framework for annual reporting of mammal monitoring studies undertaken at two scales (local and landscape) to assess long-term effects of the Project (through each Project phase) on mammals with respect to:

1. Habitat alteration, population ecology and community dynamics;

2. Effectiveness of mitigation measures and management activities; and

3. Progress toward achieving Project commitments and monitoring objectives.

This document reports on monitoring studies undertaken in Year 2 (2015/16) of the long-term mammals monitoring program. Ongoing evaluation of annual monitoring results are intended to inform an adaptive management process by:

1. Providing the necessary information to allow for the implementation of adaptive mitigation measures, when and where necessary, to minimize significant effects (e.g., mortality, disturbance) to local mammal populations;

2. Facilitating modification of the monitoring design to improve rigor, sampling efficiency and/or duration; and

3. Adjusting for unforeseen Project effects encountered.

Based on the commitments outlined by MB Hydro in the Project EIS, the overall objectives of the mammals monitoring program include:

1. Expanding baseline knowledge of select VEC species interacting with the Project including estimates of population distribution, population abundance, habitat use and movement patterns, identification and fidelity of critical habitat sites;

2. Ensuring compliance with regulatory requirements and EIS commitments;

3. Monitoring and measuring VEC responses to the Project Right-of Way (ROW) creation and operation including disturbance/avoidance from sensory disturbance, direct and functional habitat loss, changes in population vital rates or demographics, and/or changes in predator-prey community dynamics;

4. Ensuring that mitigation measures, management activities, and restoration/enhancement measures are implemented;

5. Monitoring the level of success or effectiveness of mitigation measures with respect to reducing ROW effects on VECs; and

6. Identifying, measuring, and then mitigating and monitoring any unforeseen effects.

The report quantifies the pre-construction baseline condition from 2010 to 2014 and where feasible, data from the construction phase that was initiated in 2014 has also been evaluated. The following is a summary of key findings:

Woodland Caribou

A summary of results of woodland caribou monitoring activities conducted in Year 2 (2015/16) from population abundance and distribution studies, telemetry studies, and mortality monitoring are as follows:

1) Abandonment of traditionally used areas can indicate responses to disturbance. Telemetry data from collared female boreal woodland caribou are used to assess movement behavior, habitat selection and distribution on the landscape relative to the Project. Fidelity is the tendency of animals to remain in, or return to, a particular location at different times of the year and is believed to increase an individual's knowledge of the local environment by increasing their ability to find resources while reducing predation risk. Therefore the monitoring tasks for this Project are focused on assessing whether there are any shifts in annual or seasonal range use or levels of site fidelity to these areas through Project phases. Responses are measured through resource selection analysis, assessing the zone of influence (ZOI) around the Project, as well as the extent to which the Project ROW acts as a barrier to movement. Responses by caribou to mitigation measures is also assessed to determine the effectiveness of implemented strategies.

2) The average size of home range and seasonal range use for boreal woodland caribou varied among the monitored populations in the pre-construction and construction phases. The average size of home range, over-wintering range and calving ranges for Charron Lake caribou are significantly larger than the other monitored populations in both the pre-construction and construction Project phases.

3) Levels of site fidelity of boreal woodland caribou during the pre-construction phase were quantified in the Year 1 (2014/15) Monitoring Report (Amec Foster Wheeler 2016) and will be assessed for the construction phase in the Year 3 (2016/17) Monitoring Report.

4) For the boreal woodland caribou resource selection model, significant predictors of habitat selection included treed, shrub and herb wetland communities, as well as dense and open coniferous stands and open water. The probability of caribou occurrence increased with availability of any of the wetland communities and decreased in association with dense coniferous stands and open water. The base habitat model displayed a good fit to the data as determined by validation assessment.

5) The distance at which boreal woodland caribou change their behavior, habitat selection and distribution relative to disturbance has been labelled the ZOI; which is an area of reduced caribou occurrence. In the Wabowden range, the Project widened an already pre-existing linear corridor created by the railroad line. Therefore avoidance of this existing linear feature could have been present prior to the construction of the Project. An analysis of the ZOI before and after the Project was constructed examined whether caribou responded to the widening of this linear corridor. Results suggest that female boreal caribou avoided the pre-existing linear corridor by approximately 1 to 2 km prior to the Project being constructed. This avoidance has not changed of Project construction, caribou continue to have reduce occurrences within 2 km of the Project. As the analysis controlled for habitat preferences, this avoidance was not due to changes in habitat suitability. This response will continue to be monitored for changes over time.

6) In the P-Bog range, the Project created new linear corridor on the landscape and the analysis assesses the response to this new corridor created by the Project during the construction phase. Results suggest that there has been a short ZOI approximately 1 km in size during the construction phase. There is evidence suggesting that avoidance may have increased to 3 km during the spring and summer as the log-likelihood plots which describe the fit of the model illustrated larger ZOI for these seasons (i.e., higher log-likelihood equates to better fit). This indicates that boreal woodland caribou may have been more sensitive to the Project during the calving period. Although Manitoba Hydro avoids construction during the calving period, caribou may have been responding to the change in vegetation cover as the Project created a new disturbance on the landscape from vegetation clearing activities in the winter. This pattern will continue to be assessed as more data accumulates through 2017.

7) After the completion of the ZOI analysis, caribou behavior was further assessed on a more local scale by evaluating the extent to which the Project acted as a barrier to local movements. This crossing analysis differs from the ZOI analysis in that it evaluates the local movement responses of individual caribou to Project construction whereas the ZOI analysis quantifies the overall avoidance response by all collared caribou in a given range. The crossing analysis specifically assesses the extent to which the Project acts as a barrier to individual local movements by caribou whereas the ZOI analysis examines overall distribution of caribou on the landscape relative to the installation of the Project.

8) The crossing analysis revealed that in the Wabowden range, there was no significant increase in the level of avoidance from the pre-construction to construction phase ($df = 1, 76$; $P = 0.22$) by individual caribou. This indicates that widening of the ROW through the installation of the Project did not significantly increase barriers to local movement for caribou. This result is comparable to the ZOI analysis which revealed that the ZOI did not increase in this particular range as a result of Project construction. This is likely due to the fact that a linear corridor was already present on the landscape prior to the initiation of the Project and may have resulted in a level of habituation by local caribou.

9) However, the crossing analysis did reveal that collared caribou crossed the Project in the Wabowden range less frequently than expected (based on randomly generated crossings), suggesting that although caribou have not displayed an increase in avoidance of the Project during construction they are still significantly avoiding crossing the linear corridor (df = 77, P <0.0001). This result also supports the ZOI analysis which revealed that there is a ZOI of 1 to 2 km around the Project during both the pre-construction and construction periods indicating overall avoidance.

10) Therefore, in the Wabowden range, boreal female woodland caribou do avoid the Project by a buffer of 1 to 2 km throughout the year, irrespective of Project phase. The Project is a semi-permeable barrier to movement, it does not completely prevent local movement on the landscape, however, it does reduce the frequency. Caribou do not cross the Project as frequently as would be expected by random, however, they still do cross and this behavior has not been altered by construction. The 2017 report will assess the extent to which vegetation mitigation applications in this range have been effective in mitigating impacts to local caribou movements.

11) In the P-Bog range, the crossing analysis revealed that there was no significant change in local movement behavior by collared caribou during the construction phase of the Project (df = 1, 81; P = 0.31). During construction, individual collared caribou continued to move across the Project in similar locations to those used in pre-construction. The crossing analysis also revealed that in the P-Bog range, individual collared caribou were not significantly avoiding crossing the ROW; crossings occurred as frequently as those generated by simulated random trajectories (df = 82, P = 0.50) indicating that the Project did not act as a barrier to movement to these individuals. This may be the result of the mitigation provided by installation of vegetation mitigation areas (discussed below) and will continue to be assessed as more data accumulates.

12) The crossing analysis results for the P-Bog range do not contradict the ZOI results which indicated an overall avoidance buffer of approximately 1 to 3 km by caribou across seasons. Overall collared caribou did not occur as frequently within 1 km of the Project during construction as areas farther away. However, individual caribou who decided to cross Project, were doing so as frequently as what would be expected randomly. This indicates that the Project has not been a complete barrier to local movements and may be the result of effective installation of vegetation mitigation areas.

13) The effectiveness of the vegetation mitigation areas was assessed for the P-Bog range where detailed data currently exists on the location of where vegetation mitigation was applied. Overall, in both the pre-construction (df = 31, P<0.0001) and construction (df = 24, P<0.0001) phases, collared female boreal woodland caribou were crossing at mitigated areas more frequently than non-mitigated areas. These results suggest that collared caribou have not altered their local movement patterns in this region in response to construction and also that mitigated areas were put in place where caribou would naturally cross the ROW likely facilitating the permeability of the Project to local movement.

14) Winter boreal woodland caribou calf recruitment estimates (% Calves and Calves/ 100 Cows) and Kaplan-Meier adult female survival rate estimates are consistent with stable populations in the P-Bog, Wabowden and Charron Lake ranges, and a decreasing population in the N-Reed range. Recent widespread fire in the N-Reed core winter range during the study period may be a contributing factor for the suspected declining population trend (Arlt et al. 2015) and subsequent lower adult female survival relative to other monitored ranges.

15) No Cape Churchill, Pen Islands, or Qamanirjuaq caribou were present in the Project area during winter construction in 2014/15 (MB Government, V. Trim, Pers. Comm., February 22, 2016). Forest-tundra (coastal) caribou believed to be from the Cape Churchill population were harvested along Highway 280 between Gillam and Bird (Fox Lake Cree Nation) in January 2016 (MB Hydro, T. Barker, Pers. Comm., October 11, 2016).

Moose

The moose component of the Bipole III Biophysical Monitoring Plan (BMP) has not yet been approved by MB Government. Despite that, moose monitoring work was initiated by MB Hydro to address some of the objectives for moose identified in the BMP, as well as Bipole III Project EA License conditions (MB Government 2013).

A summary of results of moose monitoring activities to date include:

1) **Year 1 (2014/15)** – Population modelling of sensitive moose ranges and adjacent moose populations using historical survey data, a Gasaway population survey of the Split Lake (Keeyask GS Area 5) conducted as a component of the Terrestrial Effects Monitoring Plan for the Keeyask Generation Project in January 2015 involving an eastern portion of GHA 9 that is intersected by construction segment N1 of the Project, and four ungulate-wolf distribution surveys (one survey in each monitored boreal woodland caribou range) to assess changes in predator prey-dynamics and predation-risk from Project disturbances.

2) **Year 2 (2015/16)** - Gasaway population surveys in the Project area (Tom Lamb sensitive moose area [GHA 8], Red Deer Bog [GHA 11]), ungulate-wolf distribution surveys (in four monitored boreal woodland caribou ranges and both *P tenuis* monitoring blocks) to assess predator-prey dynamics and altered predation-risk from Project disturbances, and a multi-species aerial survey was conducted by Alaskan Trackers along transects paralleling construction segments N1, N2, N3, N4, and north half of C1.

Tom Lamb/GHA8 Sensitive Moose Area - Regional moose populations proximate to Tom Lamb WMA/GHA 8 all indicate declines in abundance in recent years, prior to Bipole III disturbance. Historical survey data indicate the Tom Lamb/GHA 8 sensitive moose area has a history of fluctuation. The January 2016 population survey of GHA 8 yielded a population of 339 ±18.5% (95% CI; 0.107 moose/km²), which is not significantly different from the January 2012 survey estimate of 317 ±32% (0.101 moose/km²). Both estimates are significantly lower than the long term winter population mean (1970 to present) of 648 moose (0.206 moose/km²), as well as the next most previous survey (January 2005) of 719 ±17.1% (0.228 moose/km²). Population discrete-time demographic trend modeling indicates the population declined after 2005 to a lower stable equilibrium and that the decline occurred several years prior to any Bipole III Project related disturbance to the local landscape. The population is currently 48% below its long term (1971 to 2015) mean size. The declining trend in population size and density is similar magnitude and timing to that observed in adjacent populations residing in GHA 6/6A and GHA11/12. The winter population structure indicates an increased adult sex ratio from a 10 yr (mean 2006 to 2015) of 80.4 bulls/100 cows relative to the long term mean of 61 bulls/100 cows because of a disproportionate reduction of adult cows in the population. This is also reflected in a corresponding reduced calf recruitment rate of 51.2 calves/100 cows (10 yr mean) compared to 58.9 calves/100 cows (long term mean), and lower twinning rate resulting in a diminished population growth potential. Consequently, the population growth rate (λ) in recent years is <1.0 indicating a declining trend.

Moose Meadows Sensitive Moose Area (portion of GHA 14) – Moose Meadows is also locally referred to as Bellsite Swamp (Shared Values Solutions 2015). It is a low lying area considered to be a sensitive winter foraging refuge (Manitoba Hydro 2014) for moose seasonally moving off of the east slopes of the Porcupine Hills, and is thought to serve as a spring moose calving area (Shared Values Solutions 2015). Regional moose population trends surrounding Moose Meadows are variable. The Porcupine Hills moose population is a shared population with Saskatchewan and situated adjacent to the west of Moose Meadows. The Porcupine Hills population (Saskatchewan portion + GHA 13 and 13A) was relatively stable prior to 2005, but since then has been in gradual decline. It is currently estimated to be 27.9% below the long term (1971 to 2015) mean winter population size of 6,071 moose (0.658 moose/km²). The Swan-Pelican (GHA 14/14A) moose population includes Moose Meadows sensitive moose area; it experienced a significant population decline (from 3,295 ±25.6% moose in January 1991 to 494 ±31.2% moose in January 2001) prior to 2000. Population discrete time demographic trend modelling (including recent aerial survey results) indicates the Swan-Pelican moose population remains significantly below (144 ±12.8% in January 2011 and 150 ±18.9% in January 2014); its long term (1971 to 2015) winter population mean of 1,515 moose (0.280 moose/km²).

Pine River (GHA 14A/19A) sensitive moose area – GHA 14A/19A represents a sensitive local moose population that potentially interacts with the Project ROW. Moose population demographic data are limited for this population. Based on modelling of available survey data, it appears the population significantly declined from a high of 1,047 moose (0.336 moose/km^2) in January 1992 to 213 (0.068 moose/km^2) in January 2002, and has since remained at a low level. The most recent survey (January 2013) estimated the population at 91 ±12.8% moose (0.033 moose/km²). Regional moose population trends in Porcupine Hills (Saskatchewan + GHA 13/13A), Swan-Pelican (GHA 14/14A), Duck Mountains (Saskatchewan + GHA 18/18A/18B/18C) indicate declining populations in recent years to levels significantly below their long term (1971 to 2016) mean winter population size.

The state of moose populations (depressed density of occurrence; population decline) in the Project area in recent years is not related to the Bipole III Project. A comprehensive review of long-term population data (1970 to present) for the sensitive moose ranges and adjacent reference populations demonstrates varying rates of population decline that began years ahead of any Project-related physical alteration to moose habitat, or Project-related changes in access (for hunters or predators).

Deer and Elk

A summary of results of deer and elk monitoring activities undertaken in 2015/16 included:

1) Monitoring for *Parelaphostrongylus tenuis* (*P. tenuis*) did not occur in Year 1 (2014/15) because that portion of the Biophysical Monitoring Plan (MB Hydro 2015) had not been fully approved, however, a sample collection design was developed. An aerial based sampling effort was attempted in Year 2 (2015/16) but was unsuccessful at obtaining deer pellet samples because of limited deer sign and access restrictions to private land where sign was detected.

2) Remote cameras and winter ground track transects are two survey methods intended to acquire data to monitor change in occurrence of deer and elk over time. Winter ground track transect surveys were conducted during Year 2 (February 2016) in construction segment N1 (including remote camera deployment), as well as resampling of N2 and N3 transects that have remote cameras deployed (including memory card retrieval and camera refurbishment). No winter ground track transect surveys or remote camera deployments occurred on N4 because of access restrictions in 2015/16. Sampling of all four construction segments is planned for 2016/17. Deer and elk were not detected during the N2 and N3 winter ground track transect surveys in Year 1; deer tracks were detected at one location (transect N2-10) in Year 2 (February 2016). White tailed deer were detected on remote trail cameras deployed at N3-05 (ROW), N3-06 (1.5 km from ROW), N3-06 (ROW) and BPIII_ACCESS_003 in Year 1 (2014/15). No elk were detected during winter ground track transect surveys or associated trail cameras during Year 1 (2015/16) of monitoring. Year 2 camera data for N1, N2 and N3 will be acquired when remote cameras are refurbished in Year 3 (February 2017) during winter ground track transect surveys.

3) The Multi-species Aerial Survey is used to acquire distribution data for large and medium sized mammals including deer and elk proximate to the Project. The survey was not conducted during Year 1 (2014/15) of the mammals monitoring program, but was conducted in Year 2 (2015/16) by Alaskan Trackers, and included an expanded survey area relative to the pre-monitoring survey conducted in February 2014 by Alaskan Trackers. Deer and elk were detected in the pre-monitoring (February 2014) and Year 2 surveys, with all locations occurring in the anticipated local ranges for those species and no indication of range expansion as a result of the ROW.

4) There is no evidence to date of white-tailed deer ingress into areas outside of historical occurrence as a result of the ROW and associated project disturbance.

Predation - Gray (Timber) Wolf and Black Bear

Results of wolf and black bear monitoring activities undertaken in Year 2 (2015/16) are summarized below:

1) Mortality investigations conducted by MB Hydro to date suggest that predation constituted 81.6% of known mortality sources (n = 38) of collared adult female boreal woodland caribou, primarily by wolves. All documented adult female caribou predation events occurred prior to initiation of Project construction (i.e., vegetation clearing activities), except for three in the Wabowden range (all occurring in July 2014) and four in the P-Bog range (February 2014 July 2014, July 2015, and August 2015), all were from wolf predation.

2) The closest boreal woodland caribou predation mortality was 3.96 km from the cleared Project ROW in the Wabowden Range and 3.31 km from the ROW in the P-Bog range; the remaining predation mortalities were >15 km from the cleared Project ROW. There was also one known caribou-vehicle collision in the P-Bog range but it was unrelated to project-related activities (MB Hydro, T. Barker, Pers Comm. October 6, 2015).

3) Ungulate predation-risk was assessed within each study area for caribou using ungulate/wolf distribution aerial survey data. The distances of observed moose and woodland caribou from recent wolf sign and observed wolves were compared. Survey data collected during Year 2 surveys (January 2016) suggests that wolf predation-risk to boreal woodland caribou was greater than that for moose within the N-Reed and Charron Lake caribou survey blocks as a consequence of closer mean caribou distances to wolves, compared to moose. In the Wabowden range, moose were at greater wolf predation-risk than woodland caribou. In the P-Bog range there was no statistically detectable difference in wolf predation-risk between moose and woodland caribou. Overall, ungulate predation-risk from wolves at the landscape scale was greater in Year 2 than in Year 1 of the mammals monitoring program.

4) Ungulate predation-risk assessment using relative density surfaces for each boreal woodland caribou survey area consistently indicated the overlap of highest wolf density corresponded to areas of greater relative ungulate prey density. Areas of highest wolf predation-risk to woodland caribou or moose did not appear to be related to the ROW at the landscape scale.

5) No bear hibernation dens were detected during Year 2 (2015/16) of monitoring.

6) Winter ground track transect surveys and associated remote trail cameras were deployed along N2 and N3 construction segments in Year 1 (2014/15) to collect local occurrence

data for multiple species including bears and wolves. The study was expanded to N1 construction segment in Year 2 (2015/16) and is anticipated to be extended to N4 in Year 3 (2016/17) if field crew access is permitted.

Fur-bearers

A summary of results of furbearer monitoring activities initiated in 2015/16 are below:

1) Winter ground track transects surveyed during Year 2 (2015/2016) in construction segments N1, N2 and N3, detected most of the expected furbearing species including marten/fisher, wolf, fox, otter and mink, as well as ungulate species including moose (transect N2-12), white-tailed deer (transect N2-10) and boreal woodland caribou (transect N3-10); elk were not detected. One wolverine was recorded on N3-06 during Year 1, but none were detected during Year 2.

2) Analysis revealed a positive correlation between track density and distance to the Project for some species. Winter track density significantly increased as a function of distance from the Project for marten/fisher, wolf and hare; tracks of these species were observed more frequently at distances farther away from the Project during the winter construction period. For other species such as moose, lynx and ermine/weasel there was no relationship between distance to the Project and winter track density.

3) Power analysis reveals the number of transects required to achieve a power of 80% varies across species. For target species such as marten/fisher there are currently an adequate number of transects being sampled. For other target species such wolf, 85 transects would have to be completed in order to achieve a power of 80%.

4) Remote IR trail camera data associated with the winter ground track transects is limited to Year 1 (2014/15) in construction segments N2 and N3, and additional years of data collection are needed to assess Project effects. Early indications suggest some avoidance of the ROW by bears, moose and lynx, and some greater use of the ROW by wolf, fox and white-tailed deer. However, sample sizes are small and preliminary results should be interpreted with caution. Statistical analysis cannot be undertaken on temporal trends in species relative abundance or local occurrence until more data is acquired.

5) A pre-construction baseline of harvest and harvest rates was established using existing MB Government furbearer harvest records (2005/06 through 2013/14 inclusive), so that comparisons can be made in subsequent years during each project phase as fur harvest statistics become available. Annual harvest and harvest rate of many of the other furbearer species from the monitored traplines appears to be limited and highly variable, therefore, monitoring of project effects will occur at the construction segment scale.

Human Access

Results of human access monitoring activities undertaken to date are summarized below:

1) Remote cameras were deployed at three all-weather access points to the project ROW in Year 1 (2014/15) to collect data to monitor human access amount and type.

2) Remote cameras deployed in Year 1 along construction segments N2 and N3 were serviced and data cards retrieved in Year 2, along with additional camera deployments in N1.

3) Remote IR Camera Traps deployed at all season access points (n = 3 cameras) and along construction segments N2 (n = 8 cameras) and N3 (n = 9 cameras) all indicate that there is a very limited public use of the ROW for resource access or recreational purposes.

Monitoring and Mitigation Recommendations

Based on the results of the 2015/16 (Year 2) report, the following mitigation and monitoring recommendations have been made:

1) Repeat CMR sampling in all monitored boreal woodland caribou ranges in Year 3 (2016/17) and Year 5 (2018/19) to monitor population performance (abundance trend, lambda) though each project phase (construction, operation).

2) Continue with annual winter boreal woodland caribou calf recruitment surveys (aided by telemetry relocations) and concurrently conduct caribou-moose-wolf winter distribution surveys;

3) Continue to acquire boreal woodland caribou telemetry locations to evaluate behavioural responses to the Project, the effectiveness of the vegetation leave areas and monitor adult female boreal woodland caribou mortality.

4) Work with MB Government to confirm appropriate population survey methods to apply to low density moose populations (including the sensitive moose ranges).

5) The current number of transects is adequate for some target species such as marten/fisher. Other species such as moose and wolf require additional transects to achieve 80% power for the analysis. However, moose are not the focus of the winter ground track transect surveys as their distribution is measured through multiple aerial surveys at landscape scale. Wolf are target species for the ground surveys as they are hypothesized to use linear corridors for increased hunting efficiency and require an increase to 85 transects to achieve statistical power of 80%. However, wolves are also monitored using remote cameras and during winter aerial surveys, therefore an increased

winter ground transect sampling effort to increase statistical power for wolf is not planned for Year 3, but may be considered for future years.

6) MB Hydro will attempt a community involvement ground-based *P tenuis* sample collection (white-tailed deer fecal pellets) in winter 2016/17 in the pre-determined surveillance areas to assess current level of spiney-tailed larvae being shed by deer proximate to the Project. Supplemental samples can be collected by the MB Hydro environmental monitors during Project winter clearing and construction, along with documentation of all deer sign/observations encountered in N1 through N4 construction segments.

7) MB Hydro environmental monitors conducted a beaver presence/absence survey at all Project ROW intersections with creek/river crossings ±200 buffer of the crossing. There were no records of beaver within 200 m of crossings in Year 2 (MB Hydro, T. Barker Pers. Comm., October 11, 2016). Therefore there are no mitigation needs for local effects of sensory disturbance or evaluation of effectiveness of riparian buffers required at ROW crossings during clearing and construction activities.

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LIST OF ACRONYMS

BACI	Before-After-Control-Impact (Design)
CMR	Capture-Mark-Recapture
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
EIS	Environmental Impact Statement
ELC	Ecological Land Classification
EOSD	Earth Observatory for Sustainable Development
ESS	Environmentally Sensitive Sites
GHA	Game Hunting Area
kV	kilovolt
MB Hydro	Manitoba Hydro
MB Gov	Government of Manitoba
MMU	Moose Population Monitoring Unit
NGS	Non-invasive Genetic Sampling
N-Reed	The Reed portion of the Naosap-Reed boreal woodland caribou population
P-Bog	The Bog portion of the Pasquia-Bog boreal woodland caribou population
RCM	Retrospective Comparative Monitoring (Design)
RMNP	Riding Mountain National Park
RSF	Resource Selection Function
ROW	Project Right-of-Way
VEC	Valued Ecosystem Component
WMA	Wildlife Management Area
ZOI	(Project) Zone of Influence

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1.0 INTRODUCTION

On August 14, 2013, the Government of Manitoba (MB Government) granted an *Environment Act* License (EA License; MB Government 2013) to Manitoba Hydro (MB Hydro) for the construction, operation, and maintenance of the Bipole III Transmission Project (the 'Project'). Clearing for the Project began during the winter of 2013/14, Construction is scheduled for completion in the summer 2017. Clearing delays were encountered in the N1 and N4 construction segments during the winter of 2014/15 (Monitoring Year 1), and in N4 in 2015/16 (Monitoring Year 2). These delays have affected full implementation of ground-based mammal monitoring field programs as originally planned.

Project-related concerns about wildlife are focused largely on caribou, moose and migratory birds (CEC 2013). Construction and operation of the Project potentially affects several disturbance sensitive mammalian species including caribou, moose, wolves, bears, wolverine, and marten. Potential significant residual effects (i.e., after mitigations are applied) include direct habitat loss, functional habitat loss, sensory disturbance, altered mortality risk and/or altered predator-prey dynamics. MB Hydro has committed to implementing mitigation strategies intended to offset potential and predicted project effects, as well as monitoring to assess the effectiveness of mitigations and predicted effects. Types of ecological monitoring implemented to gather and analyze data include baseline, implementation, effectiveness and compliance monitoring. Once construction begins, monitoring emphasis will switch to effectiveness and compliance monitoring; baseline monitoring will continue in areas adjacent to the impact areas and reference areas outside the zone of influence (ZOI) of the project. The monitoring program will identify and measure potential effects on these species, inform the strategy for mitigation, and then monitor the effectiveness of the strategy. A passive adaptive management framework is implemented to deal with uncertainties as they arise; poorly performing mitigation strategies or monitoring techniques will be modified or replaced where warranted.

Mammal valued ecosystem components (VECs) selected for effects monitoring were specified in the Bipole III Environmental Impact Statement (EIS) and related documents. These include boreal woodland caribou, forest-tundra woodland caribou, barren-ground caribou, moose, elk, white-tailed deer, grey wolf, black bear and furbearers (beaver, wolf, wolverine and marten in particular). These VEC's were selected because of their ecological, cultural, and economic importance, and their sensitivity to Project-related stressors. The focus of effects monitoring varies by VEC and Project construction segment.

The EIS, technical report addendums, and regulatory review documents identify several predicted effects on mammal VECs. These effects vary by scale and Project phase. The study design assesses population effects on select VECs, disturbance thresholds (i.e., disturbance/ displacement/avoidance) relative to VEC responses within the Project ZOI, as well as altered mortality risk (i.e., increased disease risk, altered harvest and/or predation mortality).

2.0 MONITORING OBJECTIVES AND FRAMEWORK

The Bipole III mammal monitoring program was designed with multiple objectives per VEC in mind, and with the intent to examine spatio-temporal behavioral responses, as well as population level responses of each VEC at multiple scales as warranted. Monitoring programs should consider disturbance factors at coarse (landscape) and fine (local) scales with respect to effects on species occurrence, persistence and viability, and to inform mitigations and management interventions (Haufler et al. 2002, Christiansen et al. 2015). Long-term effects of human disturbance on population status requires long-term monitoring and a means of demonstrating a causal relationship between exposure to disturbance and effects on population demography (Christiansen et al. 2015). This is because human development may influence population abundance but not resource selection for some species (Keim et al. 2011). Short-term direct effects are relatively easy to measure and can be directly linked to the disturbance source, but are often not placed into context to understand demographic relevance (Christiansen et al. 2015). Indirect effects and lag effects are more difficult to relate to the disturbance source.

The Bipole III mammal monitoring program uses multiple indicators per VEC to assess potential effects. Counts, indices, population estimates and habitat selection lie at the core of monitoring programs because they provide guidance for species management, measuring effect of management activities or disturbance, documenting compliance with regulatory requirements and detecting incipient change (Gibbs et al. 1998). Estimates of animal abundance and composition are needed to monitor small or at-risk populations (Antao et al. 2011, Hansen et al. 2015, Joseph et al. 2006), to manage harvested species (Lounsberry et al. 2015, McCullough 1999), and to quantify population responses to inform defensible management decisions. Robust estimates of mammal abundance can be obtained using capture-mark-recapture (CMR) methods (Armstrup et al. 2005, Otis et al. 1978). Current population abundance is a function of past abundance and the demographic processes of survival, productivity, immigration and emigration (Skalski et al. 2005). The amount of resource use by a species is a function of both their resource selection and population abundance (Keim et al. 2011).

Mammals also commonly exhibit sex and age-specific differences in life history strategies, home range sizes, habitat use patterns and cause-specific mortality rates (Caughley 1966, Cederlund & Sand 1994), which can be affected differently by disturbance (Laurian et al. 2008, Polfus et al. 2011) and season. Any disturbance is likely to vary spatially and temporally, with effects on mammals also being inherently variable with respect to species, their susceptibility to disturbance, exposure to disturbance, seasonal distribution and their behavioral response (Christiansen et al. 2015, Clutton-Brock et al. 1987). Therefore, where such information exists or is being collected, the Bipole III monitoring program takes into account factors such as seasonality, age and sex to control to understand the variation in measured Project responses.

2.1 Objectives

Based on the commitments outlined by MB Hydro in the Project EIS, the overall objectives of the mammals monitoring program include:

1) Expanding baseline knowledge of select VEC species interacting with the Project including estimates of population distribution, population abundance, habitat use and movement patterns, identification and fidelity of critical habitat sites.

2) Ensuring compliance with regulatory requirements and EIS commitments.

3) Monitoring and measuring VEC responses to ROW creation and operation including disturbance/avoidance from sensory disturbance, direct and functional habitat loss, changes in population vital rates or demographics, and/or changes in predator-prey community dynamics.

4) Ensuring that mitigation measures, management activities, and restoration / enhancement measures are implemented.

5) Monitoring the level of success or effectiveness of mitigation measures with respect to reducing ROW effects on VECs.

6) Identifying, measuring, and then mitigating and monitoring any unforeseen effects.

There are species specific monitoring objectives and parameters that are summarized in Tables 2-1-1 to 2-1-6.

2.1.1 Caribou

Caribou monitoring plan objectives (Table 2-1-1) are to:

1) Expand baseline knowledge of distribution, abundance and population characteristics of boreal woodland caribou interacting with the Project;

2) Investigate Project influence on woodland caribou at local and range (P-Bog, Wabowden, N-Reed and Charron Lake) scales; and

3) Assess effectiveness of mitigation measures.

4) Investigate the influence of Project effects on mortality (predation and/or hunting) to boreal woodland caribou, forest-tundra caribou (Penn Islands and Cape Churchill populations) and barren-ground (Qamanirjuaq) caribou populations interacting with the Project.

2.1.2 Moose

Moose monitoring plan objectives (Table 2-1-2) are to:

1) Expand baseline knowledge of distribution, abundance and population characteristics of moose interacting with the Project, with focus on three sensitive moose ranges (Tom lamb WMU/GHA8, Moose Meadows (Bellsite Swamp in GHA14) and Pine River GHA 14A/19A);

2) Investigate project influence on moose populations at local and landscape scales; and

3) Assess effectiveness of mitigation measures.

2.1.3 Deer and Elk

Deer and Elk monitoring plan objectives (Table 2-1-3) are to:

1) Monitor presence of *P. tenuis* and thereby change in risk to ungulates in relation to Project-related change in white-tailed deer distribution (i.e., potential deer ingress into woodland caribou local population ranges); and

2) Assess project-related change in mortality risk (harvest, predation, vehicle collisions) to elk as a consequence of altered Project access, sensory disturbance and/or habitat alteration.

2.1.4 Wolf and Black Bear

Wolf and Black Bear monitoring plan objectives (Table 2-1-4) are to:

1) Assess changes in predation-risk to woodland caribou and moose due to project effects on predator occurrence and distribution.

2.1.5 Furbearers

Furbearer monitoring plan objectives (Table 2-1-5) are to:

1) Assess Project-related changes in furbearer harvest statistics, furbearer occurrence and distribution relative to changes in Project access and associated habitat disturbance, with particular attention to beaver, marten, wolf and wolverine.

2.1.6 Human Access

Human access monitoring plan objectives (Table 2-1-6) are to:

1) Assess changes in access to the project area by humans.

2.1.7 Adaptive Management Framework

Monitoring is a key component of adaptive management. A passive adaptive management framework was adopted for the overall mammals monitoring program to allow for an ongoing evaluation of monitoring results as they relate to the effectiveness of the mitigation strategies and monitoring methods. This information will also be used to inform the associated adjustments required to improve effectiveness, and involves:

1) Providing the necessary information to plan, modify and/or implement adaptive mitigation measures, when and where necessary, to minimize mortality and/or disturbance to local mammal populations;

2) Modification of the mammals monitoring design to improve rigor, efficiency and/or duration; and

3) Adjust for unforeseen project effects encountered.

In addition, active adaptive management is applied with respect to evaluating habitat mitigations applied to boreal woodland caribou corridors by using different clearing prescriptions in each range.

Project activities will cause direct and indirect changes to VEC habitats through direct and/or functional habitat loss or gain. These changes can then alter wildlife population or community dynamics through altered population vital rates, state, range occupancy, predator-prey dynamics, disease and parasite transmission risk and human–wildlife encounters. Population and community level effects are strongly linked through recruitment and mortality rates via predator-prey, hunter/trapper and disease transmission dynamics. Consequently, key monitoring activities and the assessment of Project related effects have been categorized into: 1) habitat effects; 2) population effects; and 3) community effects.

Monitoring objectives are simultaneously met for multiple components (habitat, population and community) through integrated field and analytical approaches. Types of ecological monitoring implemented to gather and analyze data on mammalian VECs largely include:

1) **Baseline monitoring** is intended to identify temporal and spatial variability within an ecosystem, biological community, or population in order to understand the historical range of variability prior to disturbance by Bipole III. Baseline monitoring will continue in areas prior to construction and clearing the ROW. After construction, baseline monitoring will be focused in reference areas outside of the Project ZOI.

2) **Effects monitoring** investigates the influence (extent and magnitude) of disturbance-related Project effects on the habitat, population and/or community level components for each VEC. Reference or control sites will be used where feasible to allow for effects of the

Project to be disseminated from natural variation. Assessment of pre-disturbance condition to post-disturbance is used to assess project effects and mitigation effectiveness.

3) **Effectiveness monitoring** is conducted by measuring or estimating the effectiveness of mitigation measures, management activities, habitat restoration and enhancement measures. Where mitigation measures are not providing adequate protection for VEC species or their habitat, monitoring results will be used through a passive adaptive management framework to modify or identify new strategies to employ.

4) **Implementation monitoring** will be undertaken to ensure that mitigation measures were implemented as specified in the EIS, technical reports and EA License and that activities are compliant with applicable provincial and federal environmental legislation. Implementation monitoring is used to track the implementation of mitigation measures, management activities, and ecological restoration and enhancement measures identified in the EIS commitments. This inspection is largely completed by environmental inspectors overseeing the construction of the ROW.

Based on the commitments outlined by MB Hydro in the Bipole III EIS, associated technical reports, and the EA License, there are species specific monitoring commitments unique to each VEC that are incorporated into the study design. In particular moose and boreal woodland caribou have comprehensive and detailed monitoring objectives which are provided in the methods sections for each VEC (Section 4.0).

2.2 Study Design

To achieve the principal purpose of the follow-up monitoring program for Bipole III Monitoring Project, key monitoring activities and the assessment of Project related effects were grouped under three main components (Figure 2-3-1):

1) Habitat Effects;

2) Population Effects; and

3) Community Effects.

All monitoring objectives and parameters for each VEC fall under one or more of these three components. Biological systems are highly complex and interrelated and all three components share common indicators, as well as field and analytical methods. Consequently, monitoring objectives can be simultaneously met for multiple components through integrated field and analytical approaches.

Project activities will cause direct and indirect changes to VEC habitats through functional habitat loss or gain (Figure 2-3-1). These changes can then alter wildlife population or community dynamics through altered population vital rates, state, annual/seasonal range distributions, predator- prey dynamics, disease and parasite transmission risk and human-wildlife encounters. Population and community level effects are strongly linked through recruitment and mortality rates via predator-prey, hunter harvest, and disease transmission dynamics (Figure 2-3-1).

Central to the conservation of mammal populations and community ecology is an understanding of factors contributing to spatial and temporal variation in the state (distribution and abundance) and demographics (population structure and vital rates) of mammals, as well as understanding of the disturbance threshold responses of species sensitive to project effects. This understanding is achieved through monitoring to measure disturbance effects and detect incipient change (Gibbs et al. 1998). Population monitoring has two explicit roles; it provides information on population state and it contributes to knowledge of effects of management actions (e.g., project mitigations) on populations. Habitat monitoring is concerned with monitoring key habitat attributes (structure, composition) over time and contributes to understanding the ecological response of habitat to disturbance and management actions (restoration efforts, mitigations). Population and habitat monitoring are both required to understand project disturbance and mitigation effects on wildlife-habitat relationships and ultimately on community dynamics and ecosystem integrity.

Study designs were developed for each VEC based on monitoring commitments and available data from the EIS and addendum technical reports. Additional details pertaining to these designs are provided in an addendum (Arsenault & Hazell 2014) to the Bipole III Transmission Project Biophysical Monitoring Plan (Manitoba Hydro 2015), and are also provided in detail in the methods section of this report for each VEC (Section 4.0).

Scale of assessment has a strong influence on the probability of detecting effects (Polfus et al. 2011, Vistnes & Nellemann 2008). At local, seasonal and/or population scales, monitoring will examine Project-related effects on the abundance and distribution of mammal VECs. The exact scale(s) of assessment are specific for each unique VEC. In collaboration with MB Government, boreal woodland caribou and moose are monitored at the population range (landscape) scale, as well as the local scale. Wolves and wolverine are primarily assessed at a larger landscape scale because of their wide-ranging nature. The remaining VECs which are small fur bearing mammals are assessed solely at the local scale. Telemetry studies and non-invasive genetic sampling methods are implemented to monitor boreal woodland caribou populations interacting with the project, as well as a reference range. A moose monitoring plan is evolving for the Project and currently includes winter population surveys of the sensitive moose ranges, moose distribution surveys concurrent with boreal woodland caribou recruitment surveys, and local occurrence along the Project ROW using a combination of methods including remote IR cameras at access points and along the ROW, winter ground transects, and as a component of the multi-species aerial survey of N1 through C1 construction segments. A study design for a moose telemetry study was proposed and developed in consultation with MB Government during Year 1 (2014/15) for implementation in Year 2 (2015/16) of the mammals monitoring program, but was not implemented in response to local public consultation conducted by MB Government in 2015. A non-invasive genetic sampling design was then proposed as an alternative to the moose telemetry study, but was not supported for implementation by MB Government.

To test VEC specific hypothesis, a Before-After Control-Impact (BACI) study design (McComb et al. 2010) was applied where pre-existing and/or reference data permitted. Where feasible, the ZOI around the Project will be determined for each VEC, and used as the minimum boundary between impacted and non-impacted areas. For VECs where reference/ control site and/or comprehensive pre-construction data are not available, effects monitoring will be documented through temporal analysis focused on characterizing long-term trends, involving comparison of pre-disturbance versus post-disturbance within a Retrospective Comparative Monitoring (RCM) design (McComb et al. 2010) or analogous alternative. The Project intersects the Prairie, Boreal Plain, Boreal Shield and Hudson Plain ecozones (Figure 2-3-2). As mammalian communities may have different characteristics across different ecozones, survey locations have been selected to collect data across a diversity of habitat types within the ecozones where significant project effects for particular mammal VECs are anticipated. Locations, methods, and study area extent employed during pre-construction surveys have been incorporated where feasible to facilitate comparisons of before and after impact.

It should be noted that true replication in natural systems is often impossible. Designs involving treatment and control at large scales is impractical because of natural variation; ecosystems are dynamic. It is not possible to design monitoring programs to measure the dynamics of every species and every ecosystem process (Christensen et al. 1996). Also, gathering data in relation to patterns of ownership, access to areas and sampling technique limitations and biases are additional issues that complicate large scale study design and analysis, and should be reflected in any interpretations or conclusions (Christensen et al. 1996). The design, development and maintenance of monitoring programs requires commitment and long-term vision (Christensen et al. 1996).

Table 2-1-1: Monitoring Activities for Caribou

Phase	Task	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Construction Post-construction	Population monitoring	Change in population state (viability, structure, abundance)	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	$\leq$25 yrs or until suitable knowledge acquired	3 year intervals	Winter	Significant range (landscape) scale change in population abundance, structure, growth rate and/or viability
Post-construction	Distribution monitoring	Change in distribution (core use areas) or movements (barrier effects)	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	4 years via telemetry study (maintain 20 collars/range)	Annual, continuous via telemetry study	Year round via telemetry study	Range and local scale project-related range contraction, barrier effects altered site fidelity levels, altered Project ROW use and zone of influence (ZOI).
Construction Post-construction	Mortality investigation, calf recruitment survey	Change in collared adult female mortality, vehicle collisions, calf recruitment	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	Up to 4 yrs	Annual via telemetry study and aerial surveys	Year round via telemetry study	Range and local scale changes in mortality or recruitment rate relative to historical trend
Construction Post-construction	Functional habitat availability monitoring via telemetry studies and systematic surveys	Change in occurrence, prevalence, distribution, movements and/or habitat use	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	3 years via telemetry studies in combination with aerial, surveys	Annual, continuous via telemetry study	Year round via telemetry study	Detection of a zone of influence affecting occurrence or prevalence
Construction Post-construction	Aerial distribution surveys, IR camera studies, winter ground transects,	Altered predator-prey dynamics	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	Minimum 2 yrs post construction	Annual	Winter (aerial surveys, ground transects), year-round (IR cameras)	Change in mortality or mortality risk relative to Project disturbance
Construction	Sensory disturbance monitoring	Presence/ absence in N1 LSA	N1, Pen Islands, Cape Churchill populations	2 years	Annual	Winter	Proximity relative to construction

Table 2-1-2: Monitoring Activities for Moose

Phase	Task	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Construction Post-construction	Population monitoring	Change in population state (viability, structure, abundance)	Sensitive moose ranges (GHA 8, Moose Meadows, GHA14A/19A)	12-15 yrs or until suitable knowledge acquired	3 year intervals (integrate with MB Government survey schedule)	Winter	Significant range scale change in population abundance composition and/or viability
Post-construction	Distribution Monitoring	Change in distribution (core use areas) or movements (barrier effects)	Sensitive moose ranges (GHA 8, Moose Meadows, GHA14A/19A	3 years via telemetry study	Annual, continuous via telemetry study	Year round via telemetry study	Range and local scale project-related range contraction, barrier effects altered RSFs, altered Project ROW use
Construction Post-construction	Population vital rates monitoring	Change in mortality (hunter harvest, predation, vehicle collisions)	Sensitive moose ranges (GHA 8, Moose Meadows, GHA14A/19A	Up to 5 yrs	Annual	Fall/ Winter	Range and local scale changes in mortality relative to historical trend
Post-construction	Population vital rates monitoring	Calf Recruitment Adult female survival	Sensitive moose ranges (GHA 8, Moose Meadows, GHA14A/19A	3 years via telemetry studies in combination with aerial, surveys	Annual, continuous via telemetry study	Year round via telemetry study	Significant project-related change in calf recruitment or adult female survival
Post-construction	Functional habitat availability monitoring	Change in occurrence or prevalence	Sensitive moose ranges (GHA 8, Moose Meadows, GHA14A/19A	3 years via telemetry studies in combination with aerial, surveys	Annual, continuous via telemetry study	Year round via telemetry study	Detection of a zone of influence affecting occurrence or prevalence
Pre-construction	Mineral lick survey	Vulnerability of mineral lick to project construction	Known Mineral licks (TEK and detected via project activities)	One time	Once	Year-round	Presence and vulnerability, or functional disturbance/ destruction

Table 2-1-3: Monitoring Activities for Deer and Elk

Phase	Task	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Construction Post-construction	P. tenuis sampling via deer feces collection	Presence/absence	N3, N4	2-5 years	Annual or as necessary	Winter	*P. tenuis* presence in deer faeces along Project ROW
Post-construction	Distribution monitoring	Change in white-tailed deer and/or elk distribution	N3, N4, C2	3-10 years	2-3 years	Winter (aerial and ground transects) Year-round (IR cameras)	Presence/ absence at local scale (Project ROW use)
Construction Post-construction	Monitor elk mortality	Local change in elk mortality	N4, C1, C2	3 years	Annual	Annual	Increased mortality detection from harvest statistics, local reports, vehicle collisions, hunter use of Project ROW
Construction Post-construction	Distribution monitoring	Change in seasonal distribution and local occurrence	N3, C2	3 years	Annual,	Annual	Local scale, project-related change in presence/ absence

Table 2-1-4: Monitoring Activities for Wolf and Black Bear

Phase	Task	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Construction Post-construction	Predator-prey distribution surveys and IR camera traps	Presence/absence/ distribution	Caribou ranges and sensitive moose ranges intersected by N2, N3, N4	3 years post-construction	Annual	Winter (aerial) and annual (cameras)	Relative proximity and abundance of ungulate and predators and regional and local scales
Pre-construction Construction Post-construction	Telemetry assisted caribou mortality investigations	Mortality signal	P-Bog, N-Reed, Wabowden, Charron Lake (reference) woodland caribou ranges	3 years	Continuous/annual	Year-round	Change in seasonal mortality rate or type
Construction	Detect, mitigate dens encountered during clearing and construction	Sensitive sites (dens)	Project ROW	Clearing and construction period	Annual	Winter	Den detected

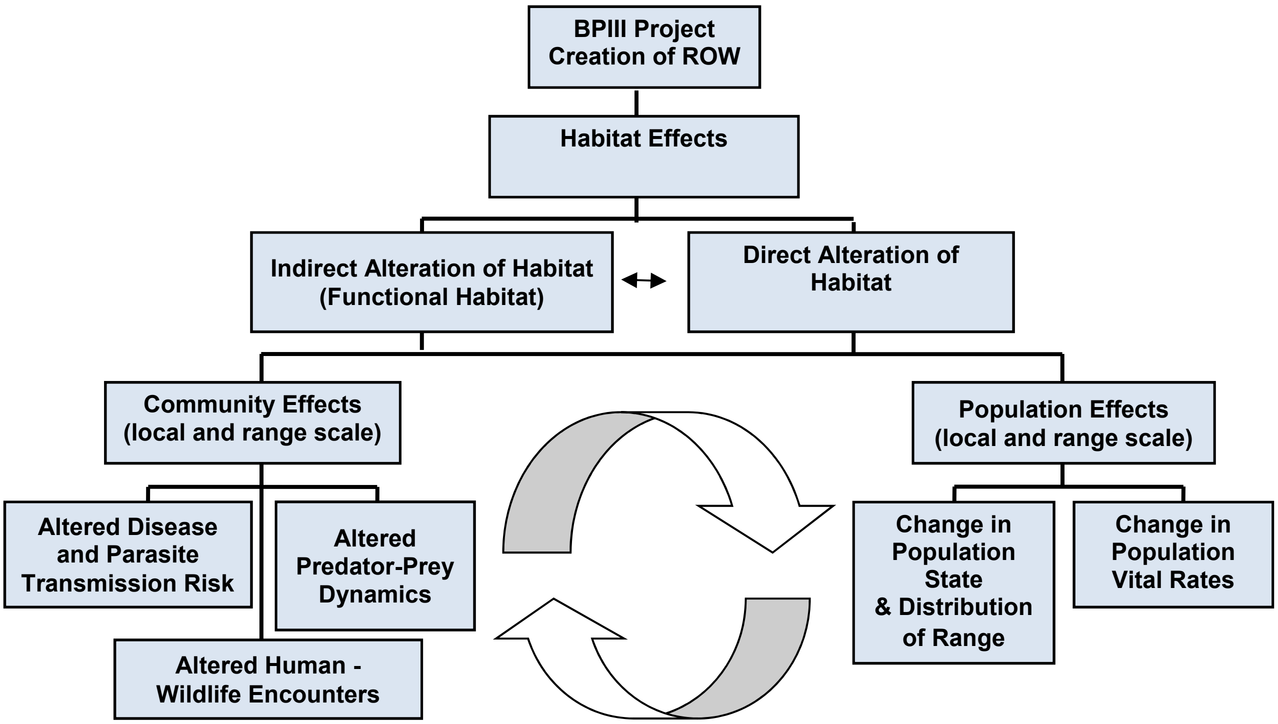
Table 2-1-5: Monitoring Activities for Furbearers

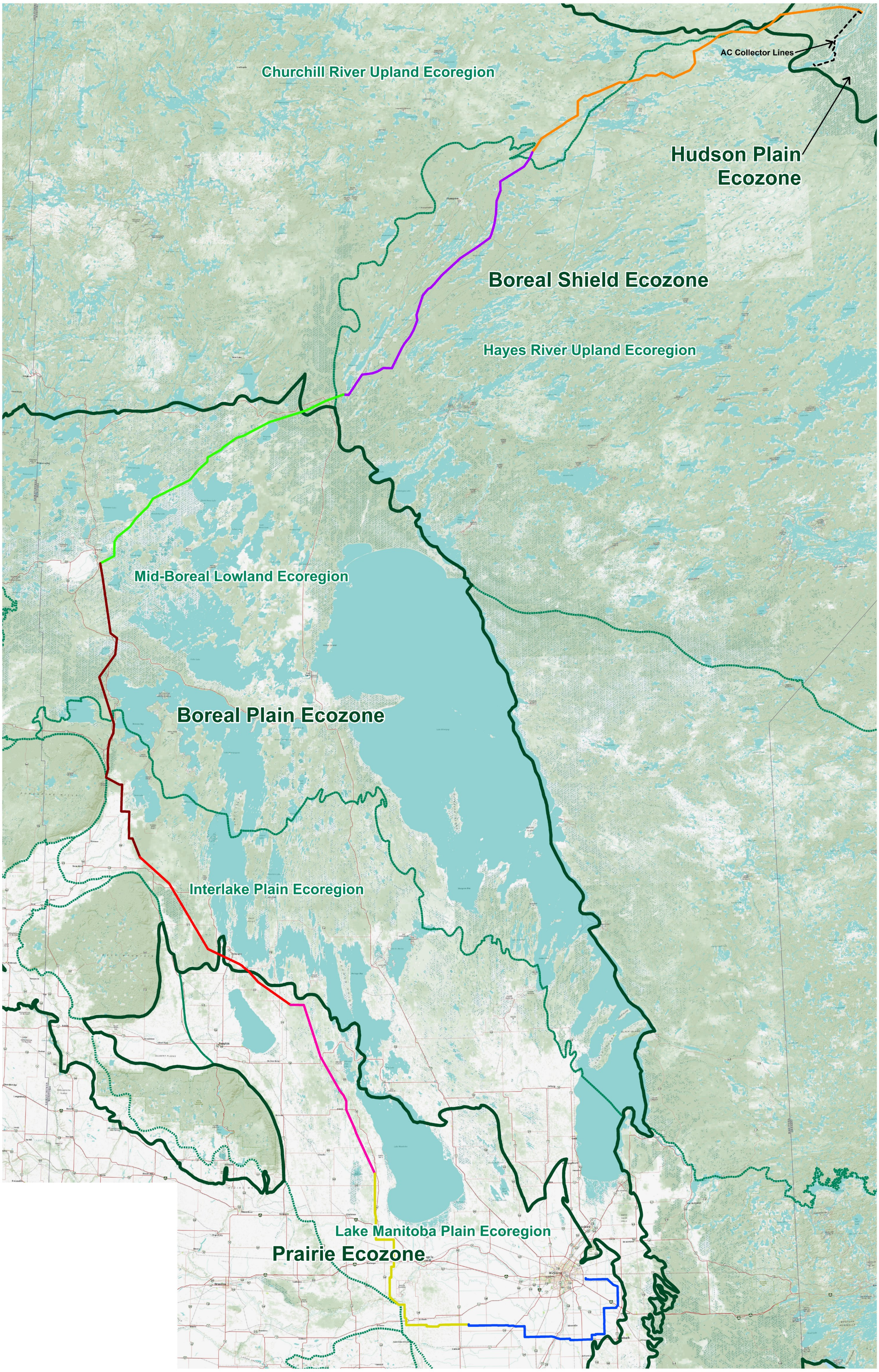
Phase	Task	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Construction Post-construction	Furbearer distribution and occurrence surveys	Presence/absence/ distribution	N1, N2, N3, N4	3 years post-construction	Annual ground transect surveys Continuous IR cameras survey	Winter transects Year-round cameras	Presence/absence
Pre-construction Construction Post-construction	Fur harvest monitoring	Harvest by species and trapline	N1-N4 traplines intersected by project	3 years	Annual	Annual	Change in harvest success
Post-construction	Community trapping program	Sensitive sites (dens)	Community traplines proximate to project	3 years	Annual	Annual	Presence/ absence Harvest success

Table 2-1-6: Monitoring Activities for Human Access

Phase	Task	Environmental Indicator	Site Location	Duration	Frequency	Timing	Measurable Parameter
Construction Post-construction	IR Cameras to monitor human use of ROW at major access points	Human presence/ absence	N1, N2, N3, N4	During construction and 5 years post-construction	Continuous	Year-round	Presence and magnitude of human use of ROW

Figure 2-3-1: Monitoring Design Conceptual Overview





G:\WX17393_Man_Hydro_Bipoleiii\Mammal\Annual_Report_Nov2016\MXD_Maps\BPIII_Overview_3.mxd
G:\WX17393_Man_Hydro_Bipoleiii\Mammal\Annual_Report_Nov2015\MXD_Maps\BPIII_Overview_BASE_2.mxd

LEGEND

- Ecozones
- Ecoregions

BPIII Transmission Line Route
By Section

- N1
- N2
- N3
- N4
- C1
- C2
- S1
- S2
- AC Collector Lines

0 70 140 210 280 350 Kilometres

NOTES:
- Background topographic map extracted from ESRI online basemap services
-

Datum: NAD83
Projection: UTM Zone 14N

N W E S

Manitoba Hydro

amec foster wheeler

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bipole III Transmission Project Overview

PROJECT N°: WX17393

FIGURE: 2-3-2

SCALE: 1:2,300,000

DATE: November 2016

3.0 MONITORING ACTIVITIES

Pre-monitoring (2013/14) – Pre-monitoring activities conducted by MB Hydro in 2013/14 are presented in AMEC (2014). These activities included acquisition and review of existing information and baseline data for the Bipole III project, including the project EIS, regulatory review documents and associated technical reports and included compilation of project commitments. This informed the planning and development of a comprehensive and rigorous mammals monitoring plan scope, which is a component of the Bipole III Transmission Project Biophysical Monitoring Plan (Manitoba Hydro 2015).

Year 1 (2014/15) Monitoring - The mammals monitoring plan is presented in AMEC's Year 1 (2014/15) monitoring workplan, and was presented at a meeting (September 17, 2014) with Manitoba Conservation and Water Stewardship (Arsenault & Hazell 2014). Mammals monitoring results for Year 1 (2014/15) were presented in Amec Foster Wheeler 2016.

Year 2 (2015/16) Monitoring - Results for Year 2 (2015/16) are provided in the following sections of this report.

3.1 Field Activities – Year 2 (2015/16)

Field survey programs conducted during the winter of 2015/16 (Year 2 of monitoring) included the following primary data collection methods:

1) Deployment of 20 supplemental GPS satellite collars in three boreal woodland caribou ranges (7 collars in P-Bog, 7 collars in Wabowden, and 6 collars in Charron Lake) during February 11 to 18, 2016, to maintain a sample of ±20 active collars/range/year, allowing for continuance of the long-term existing biotelemetry studies currently underway in each of the boreal woodland caribou ranges.

2) Aerial surveys to obtain winter calf recruitment estimates and population structure in four boreal woodland caribou ranges (P-Bog, N-Reed, Wabowden and Charron Lake).

3) Winter distribution surveys of ungulates, wolf and wolverine were conducted in each boreal woodland caribou study area (P-Bog, Wabowden, N-Reed and Charron Lake) and in two *P. tenuis* surveillance areas to collect information on relative landscape distribution to assess predator-prey dynamics (i.e., changes in predation-risk to moose and woodland caribou) and potential *P. tenuis* risk to woodland caribou in relation to changes in deer and elk distribution, resulting from project landscape disturbance.

4) Multi-species aerial survey conducted by Alaskan Trackers via transect sampled parallel to the N1, N2, N3, N4 and north half of C1 construction segments to record occurrence of large and medium sized mammal species (observations, and sign) at various distances from the ROW (0.25 km, 1.25 km, 3.25 km, 5.25 km, and 10.25 km (in proximity to the

sensitive moose ranges and N1)). The 10.25 km transects were added to the survey design for the Year 2 survey.

5) Moose population surveys were conducted in GHA 8 (led by MB Government with field assistance from MB Hydro) and GHA 11 (led by MB Government).

6) Winter mammal ground track surveys were initiated in N1 (n = 15 transects) and repeated in N2 (n = 10 transects with IR cameras) and N3 (n = 10 transects with IR cameras) construction segments to document mammal VEC occurrence on the ROW and habitat use at various distance bands away from the ROW. N4 was not sampled because of access restrictions.

7) Remote IR cameras were deployed on N1 (n = 20) and existing cameras were serviced on N2 (n = 19) and N3 (n = 19) to collect data on seasonal mammal use proximate to the ROW and up to 1.5 km from the ROW. No cameras were deployed on N4 because of access restrictions.

8) Boreal woodland caribou telemetry collar mortality investigations (conducted by MB Hydro).

9) Servicing of remote IR cameras at all-weather ROW access points (n = 3 locations) and along N2 and N3 construction segments (n = 18 locations) to monitor human access.

Some planned monitoring field activities were not initiated in the Year 2 (2015/16) work cycle. These included:

1) Winter mammal track surveys (n = 20 transects) and remote IR camera deployment in N4 construction segment was not undertaken because of access restrictions.

2) White-tailed deer fecal pellet collection (*P. tenuis* sampling) via systematic transect sampling using aerial access was not successful during February 2016 because of access restrictions on private land, limited deer observations and sign, and inaccessible landing spots in proximity to forested areas where deer occurrences were noted.

3) Moose monitoring – a monitoring plan was not finalized between MB Government and MB Hydro prior to undertaking Year 2 mammal monitoring activities, although a telemetry study was planned (cancelled because of public opposition), and non-invasive genetic study was suggested as an alternative to the invasive collaring study (no interest by MB Government).

3.1.1 Data Acquisition

Boreal woodland caribou GPS satellite telemetry data collected by MB Hydro from 2010 to 2016 were acquired for each monitored boreal woodland caribou population (P-Bog, N-Reed, Wabowden) for analysis of baseline movement behaviors in ranges directly intersected and adjacent to the Project, as well as for a reference population (Charron Lake).

Provincial moose population survey data collected in the regional project area during winter of 2015/16 (monitoring Year 2) were acquired from MB Government to facilitate updating of discrete time moose population demographic trend models and monitoring of population performance relative to Project activities. Annual moose harvest statistics for individual moose populations were not readily available for this report.

Pre-disturbance annual furbearer harvest statistics (2001/02 to 2013/14) were acquired from MB Government for all 42 registered traplines intersected by the Bipole III ROW. Harvest results during Year 1 (2014/15) of project disturbance were also acquired; harvest statistics Year 2 (2015/16) were not available, therefore these data are not included in calculations presented in this report. Future annual fur harvest data sets will be integrated into subsequent annual monitoring reports as it becomes available to allow comparison of pre- versus post-disturbance furbearer harvest statistics.

Large and medium sized mammal winter occurrence data collected via the multispecies aerial survey (by Alaskan Trackers during Year 2 (2015/16) on behalf of MB Hydro), and woodland caribou telemetry collar mortality investigation results, were obtained from MB Hydro.

3.2 Planned Monitoring Activities - Year 3 (2016/17)

Monitoring field activities planned for Year 3 (2016/17) include:

1) Moose population surveys (led by MB Government in collaboration with MB Hydro) of Moose Meadows (GHA 14) and Pine River (GHA 14A/19A) sensitive moose ranges are recommended as a component of the mammals monitoring program for Year 3. MB Government has advised that neither area is on the survey schedule (MB Government, V. Harriman, Pers. Comm. 4 Nov 2016). However, adjacent reference populations (Duck Mountains / GHA18/18A/18B/18C, and Porcupine Hills / GHA13/13A) are scheduled to be surveyed in Jan/February 2017.

2) Boreal woodland caribou winter calf recruitment and population structure surveys in four monitored caribou ranges (P-Bog, N-Reed, Wabowden and Charron Lake), assisted by GPS telemetry relocations.

3) Genetic Capture-Mark-Recapture (CMR) winter pellet collection in four monitored boreal woodland caribou ranges (P-Bog, N-Reed, Wabowden and Charron Lake).

4) Moose, wolf and wolverine occurrence and distribution surveys within each monitored boreal woodland caribou range (concurrent with the CMR collections and caribou recruitment/population structure surveys).

5) Alaskan Trackers are not available to repeat the Multi-species Aerial Survey of the Bipole III ROW consistent with previous surveys on construction segments N1 through C1 during winter 2016/17 (monitoring Year 3). Therefore, MB Hydro plans to conduct the survey via helicopter using the same survey transect design.

6) Repeat annual winter ground track transects where camera traps were installed in N1, N2 and N3 (n = 30 transects) and service remote cameras (n = 58 camera traps) to acquire wildlife image data. Initiate winter ground transects (n = 20) where access is permissible in N4 construction segment, including remote IR camera deployments on every second transect (n = 10 transects with cameras).

7) Caribou telemetry collar mortality signal investigations (MB Hydro to lead).

8) Initiate disease (*P. tenuis*) monitoring as a ground-based sampling design using local volunteers (MB Hydro to lead the sample collection project).

4.0 METHODS

The current report focuses on quantifying and comparing results from the pre-construction phase (2010 to November 2014) to the construction phase (December 2014 to present). The following section provides summaries of field and analytical methods.

4.1 Boreal Woodland Caribou

Three woodland caribou ranges (P-Bog, N-Reed and Wabowden) may interact with the Bipole III Project (Figure 4-1-1). In addition, Charron Lake is used as a reference woodland caribou range for population demographic and telemetry analytical comparisons.

4.1.1 GPS Satellite Telemetry Program

Purpose: To use daily caribou locations from GPS satellite telemetry to quantify the ZOI around the Project, to monitor changes in habitat use and movement behavior relative to the Project, to assess the effectiveness of habitat driven mitigation strategies such vegetation leave areas, and to monitor changes in the state of caribou populations via altered population structure and abundance via dynamics in range use, site fidelity and movement. This is to be achieved through quantification of a variety of behaviours such as annual or seasonal range use, site fidelity, habitat selection/avoidance and the ZOI at multiple scales and involves comparison of these indicators from the pre-construction Project phases through construction and operations phase for multiple ranges.

GPS satellite collar telemetry studies were initiated for the Project in 2010 and are currently underway in four woodland caribou ranges. Three of the woodland caribou ranges (P-Bog, Wabowden, N-Reed) interact with the Project and have been included in the monitoring program to assess the extent (if any) that the Project alters movement dynamics of woodland caribou within each of these ranges. Charron Lake, is included in the monitoring program as a reference range that is isolated from the Project, as well as other forms of cumulative disturbance (e.g., mining and forestry). All of these ranges were delineated through long term monitoring data of GPS collared caribou and defined by MB Government (Government of Manitoba 2014). Telemetry was continued in Year 3 of this monitoring program, including deployment of 20 additional collars (7 in P-Bog, 7 in Wabowden and 6 in Charron Lake) in February 2016 to ensure a continued sample size of 20 collars/caribou range (MB Hydro 2016).

4.1.1.1 Data Analysis

A Before-After-Control-Impact (BACI) study design has been implemented to assess for potential shifts in behaviour relative to baseline conditions observed during the pre-construction period and/or the reference location, as well as across all phases of the Project including; 1) pre-construction; 2) during construction; and; 3) post-construction. This report focuses on quantifying behaviour from the pre-construction phase and the construction phase. Specifically, monitoring objectives for the woodland caribou telemetry program are to:

1) Quantify whether there are any shifts in annual or seasonal range use through Project phases. Shifts in range use can indicate responses to disturbance or suggest adaptation to variation in local abiotic or biotic factors.

2) Quantify whether there are any shifts in levels of site fidelity to annual and/or seasonal ranges areas through different phases of the Project. Abandonment of traditionally used areas can indicate responses to disturbance.

3) Quantify resource selection functions and use RSF models to control for habitat related variation in ZOI.

4) Determine whether there is a detectable ZOI around the Project demarcating the change in behaviour of caribou relative to the Project installation. Then using this spatial boundary to compare behaviours of animals while they are within the ZOI versus outside the ZOI.

5) Determine whether the Project has caused a barrier to movement on the landscape.

6) Quantify the extent to which caribou are using or benefiting from mitigation strategies such as the vegetation leave areas.

Annual and seasonal range use and site fidelity analyses were completed for all ranges in the Year 1 (2014/15) monitoring report for the pre-construction phase; additional data accumulation is required before these analyses can be conducted for the construction phase and will be undertaken for the Year 3 (2016/17) monitoring report. Analysis of the ZOI around the Project was completed for the Wabowden and the P-Bog ranges for both the pre-construction and construction phases. Too few animals in the N-Reed range have spent enough time in proximity to the Project to date, however, this will be assessed again for the Year 3 monitoring report. The ZOI analysis will not be undertaken for the Charron Lake range as it is not impacted by the Project and is a reference range.

In the Wabowden range, the Project widened an already pre-existing linear corridor providing the unique opportunity to examine the response of caribou to the widening of an existing linear disturbance. Therefore a ZOI around this linear feature could have been present prior to the Project widening it. Subsequently it was decided that the analysis would; 1) assess whether there was a ZOI associated with the pre-existing linear feature during the pre-construction phase and then 2) assess the extent to which the ZOI changed as a result of the Project installation.

In the P-Bog range, aside from some limited areas adjacent to Highway 10, the Project created a largely new corridor on the landscape allowing for the assessment of the response of caribou to the creation of a new corridor. Accordingly the analysis assessed whether there was a ZOI around the Project during the construction phase.

Range Use and Site Fidelity

Fidelity is the tendency of animals to remain in, or return to, a particular location at different times of the year (Switzer 1993) and is believed to increase an individual's knowledge of the local environment by increasing their ability to find resources while reducing predation risk (Schaefer et al. 2000). Disturbance within home range or local core use areas can cause species to abandon those areas or shift their distribution (Dyer et al. 2001, Antoniuk 2007). Therefore if caribou continue to use the same areas from year to year, then results suggest that the Project has not disturbed these individuals to the extent that they are avoiding or abandoning traditionally used areas. Or, they are not sensitive to this type of disturbance.

Baseline levels of site fidelity were quantified in the Year 1 (2014/15) monitoring report (Amec Foster Wheeler 2016) using Schaefer et al. (2000) methods. To allow for the appropriate accumulation of daily location points for a robust analysis, range use and site fidelity will not be assessed again until the Year 3 (2016/17) monitoring report. This will facilitate intra-year seasonal comparisons across two full years within the construction phase.

The distribution and size of each range area during the pre-construction phase calculated for the Year 1 (2014/15) monitoring report (Amec Foster Wheeler 2016) will be used to assess whether any changes in size or centroids of use occurred as a result of the initiation of construction.

Resource Selection Models and Zone of Influence

Resource selection function (RSF) models were used to quantify selection and disturbance responses through ZOI analysis of monitored caribou during each season using recent methods developed in detail for caribou effects assessments (Johnson et al. 2005, Boulanger et al. 2012 and Johnson & Russell 2014). This analysis included:

1) Developing a base habitat model using conditional logistic regression, Akaike Information Criterion (AIC), and K-fold cross validation; and

2) Using the RSF model to control for habitat when quantifying the ZOI around the Project within the woodland caribou local population range during pre-construction and construction phases.

To build the base habitat model, individual logistic analysis was applied to determine the statistical significance of individual predictor variables for the early winter, late winter, spring, summer and fall seasons. This approach allowed for the assessment of any obvious differences in habitat selection and/or ZOI across seasons. Daily woodland caribou locations and random points were compared using conditional (paired) logistic regression (Hosmer & Lemeshow 2000) generating coefficients for each candidate RSF ("ClogitL1" in R, Reid & Tibshirani 2014), representing more local behaviour and habitat selection with relocation intervals of 24 hours. For each woodland caribou location, five random locations were generated within the defined buffer to quantify habitat availability; used locations and the paired five random locations were then analysed as a cluster.

Random locations were selected within a buffer around the observed caribou location that represented the potential movement distance of that individual. That circle was centred on the preceding caribou location and had a radius equal to the 95th percentile daily movement distances displayed for observed caribou for the 24 hour relocation interval for that season (Johnson et al. 2005). The cluster centred each comparison on the habitat available to the caribou at the time the location was taken. This approach also ensures that the RSF model is premised on habitat availability of where the caribou could have gone based on observed movement potential which provides for an ecologically relevant definition of availability (Compton et al. 2002; Johnson et al. 2005; Boulanger et al. 2012; Johnson & Russell 2014).

As behaviour may shift throughout the year, data was broken into five seasons; early winter, late winter period/movement to calving areas, spring calving period, summer post–calving period and fall rutting period/movement to over-wintering areas (Ferguson & Elkie 2004) and analyzed separately. The 95th percentile daily movement distances displayed for caribou (24 hour relocation interval) was generated for each season to assess the level of variability throughout the year. In general, movement rates were higher in late winter and fall and more restricted in the spring and summer periods (Table 4-1).

As movement rates varied significantly throughout the year, RSF and ZOI analysis were undertaken within each season (Table 4-1). The average number of locations for an individual varied across season (Table 4-2). The maximum percent for any one individual was 3.33% in the P-Bog Range (Table 4-2) and 3.88% in the Wabowden Range (Table 4-3), therefore the effect of individuals was not controlled as each individual had a relatively small contribution to the pool of locations used (Johnson and Russell 2014).

Base Habitat Model

Vegetation classes from the Earth Observation for Sustainable Development (EOSD, available at: http//www.geobase.ca/geobase/en/data/landcover/index.html) and Digital Elevation Models (DEM) were obtained (Table 4-1-4) for inclusion in the model. The enhanced land classification created for the Project was assessed for potential suitability for use in this analysis, however, its coverage is not broad enough (i.e., it covers <50% of the caribou range areas). The enhanced classification would have to cover 100% of the caribou range areas for inclusion in the model.

Variation and error in vegetation distribution and boundaries was controlled statistically to the extent possible. A 1 km error buffer was applied to each real and random location within which, the proportions of each habitat type were calculated. Elevation (via DEM model surface) was eventually removed from consideration as an explanatory variable due to correlation with vegetation type and the lack of variation due to the flat topography present in the majority of the range.

Correlation between habitat variables was assessed to observe the extent to which, if any, habitat types needed to be pooled and/or removed from the analysis. When variables are highly correlated (~r >0.7), it is difficult to determine their independent effects on the response variable.

In the Wabdowden range, all of the vegetation types were r <0.5 and correlation was not an issue. In the P-Bog range, the majority of vegetation types were r <0.5, except for treed wetland and water (r = 0.66). As these communities are not correlated above >0.7, and because water comprised a very small amount of available habitats enclosed in the buffers, combining these communities was not likely to have any impact on the results and were not pooled. Further, because the overall goal was to develop the best predictive habitat model and not establish individual habitat effects, correlations among variables was not a significant concern.

We selected the most parsimonious habitat model for each season using Akaike information criterion (AIC). In a preliminary analysis, we found that the inclusion of rare landscape variables resulted in unstable model coefficients (i.e., coefficients switched between selection or avoidance depending on the model). Thus, for each season we removed any variables that were present at an average of <5% within use and available buffers, prior to the model selection analysis. Because we were mainly interested in a robust and predictive model for the ZOI analysis, all possible model combinations with the remaining landscape variables were compared. Any variables that remained unstable are likely uninformative and were removed (Arnold, 2010). The remaining top model for each season were used to spatially predict the probability of occurrence and used in the ZOI analysis for the corresponding range and season. We also log transformed the landscape variables for the P-Bog because it improved the stability of the model coefficients. Transformation was not needed for the Wabowden model coefficients.

The predictability of each model was assessed using K-fold cross validation as per methods outlined in the Year 1 (2014/15) Monitoring Report (Amec Foster Wheeler 2016). The models were applied to the EOSD classified satellite imagery to illustrate areas the model had predicted would have a high probability of occurrence. Probability of occurrence relative to mean landscape values within the study area was predicted on the landscape by applying the top conditional logistic model for each season. For display purposes, the resulting values were binned into 10% increments of the overall distribution.

The feasibility of other disturbance information such as recent and/or old forestry blocks, forest fires, as well as smaller linear disturbance such as snow mobile tracks and/or seismic cut lines could be considered for inclusion in future RSF analyses. Future winter RSF models may also include a predation-risk layer generated from observations of wolves collected during the annual winter calf recruitment surveys; inclusion would be contingent on sample size. Hunting or snowmobiling activity may also impact the reaction of woodland caribou to the Project (Wolfe et al. 2000), access to the ROW is being monitored and this information may be considered for inclusion in subsequent years.

Zone of Influence (ZOI)

The distance at which caribou change their behaviour, habitat selection and distribution relative to disturbance has been labelled the ZOI (Johnson et al. 2005, Johnson and St. Laurent 2011, Boulanger et al. 2012) and has implications for measuring cumulative effects on wildlife (Johnson & Russell 2014, Dyer et al. 2001, Vors et al. 2007, Quinonez-Pinon et al. 2007, Leblond et al. 2011, Polfus et al. 2011 and Dussault et al. 2012). It is a measurement of reduced occurrence of caribou around a given disturbance and controls for habitat quality at a given location.

For this report, the Project ZOI within each the Wabowden and P-Bog ranges was quantified. In both ranges, the vegetation clearing process is completed (Wabowden) or almost completed (P-Bog). Both ranges also have an accumulation of caribou telemetry locations within 5 to 10 km of the Project ROW for both the pre-construction and construction Project phases. The ZOI analysis in the Wabowden range quantifies the behavioral response of caribou to widening of an existing corridor. Whereas the ZOI analysis in the P-Bog range quantifies the behavioral response of woodland caribou to a newly created linear corridor. The N-Reed range will continue to be considered for inclusion in this assessment in following years, however, currently does not have a large enough sample size of caribou location points in close proximity to the Project.

Analysis for the 2016 report followed methods outlined in the Year 1 (2014/15) monitoring report (Amec Foster Wheeler 2016). The base habitat model was used to iteratively estimate the Project ZOI through a piecewise conditional regression approach with distance to the Project as an additional predictor variable (Boulanger et al. 2012). As a linear corridor was present in the Wabdowden prior to the initiation of the Project a ZOI in the pre-disturbance as well as the construction phase was quantified. In the P-Bog range the Project created a new linear corridor on the landscape, therefore ZOI was quantified for the construction phase.

The habitat model accounted for caribou distribution due to habitat selection with ZOI predictor variable and associated regression coefficient. A procedure analogous to a piece-wise regression was undertaken to determine an optimal cut-point (Hudson 1966). The influence of increased distance was assessed for each category by setting all distances greater than the current distance category to that categories cut value. For example, when a 1 km distance was tested all locations >1 km were set to 1 km regardless of how far out they were. By doing this, the odds ratio of selection relative to the Project was able to change linearly up to the hypothesized ZOI at which point it would asymptote and remain constant for distances >ZOI. Thus, the odds ratio was allowed to vary up to a maximum at the ZOI. The model fit (log-likelihood) should increase to a maximum at the ZOI, before decreasing. If there is no ZOI the log likelihood would remain constant across the range of distances. The distance at which the log likelihood is maximized is the estimate for the ZOI; the maximum distance where an influence of the Project can be detected.

Crossing Analysis

In the P-Bog range, the Project created a new linear corridor on the landscape in most areas. The current accumulation of monitoring data allows for the quantification of movements across the landscape prior to the Project being installed and then any changes in movement behavior in areas where the Project was built, as a result of construction. Whereas in the Wabowden range, the Project follows an existing linear corridor which was subsequently widened to accommodate the Project. Therefore the current accumulation of data allows for the quantification of any barrier effects from the original ROW during the pre-construction phase, as well as widening of the ROW through the construction phase.

We calculated the degree of avoidance for each individual by comparing the actual number of crossings made by individual caribou, to the number of crossings that would have made by a randomly moving caribou on the landscape (Row *et al*. 2007). The number of crossings made by a randomly moving caribou was generated from 100 random walk (Turchin 1998) movement paths for each individual in R (package “adehabitatLT”). Each random movement path started at the same location as its paired caribou movement path, and had the same chronological series of distances moved. A randomly determined bearing was used between each move.

We compared the difference between actual and random crossings during the pre-construction versus construction time periods to assess the extent to which caribou altered their crossing behavior across Project phases. We used a linear mixed model that controlled for non-independence due to repeated random walks for each individual. There are 66 total individuals in Wabowden of which 12 were tracked during both the pre-construction and construction phases. For the P-Bog range, there are 72 total individuals of which 11 were tracked during both the pre-construction and construction phases. In both ranges, individuals tracked across both phases were considered independent within each time period. We also confirmed the results by comparing the observed average random crossings within an individual using a linear model.

We subsequently tested for avoidance of crossing by comparing the overall difference between observed and random crossings against 0 using a mixed model. We confirmed the overall avoidance of crossing using a t-test of the mean difference against 0 for the average random crossings.

Effectiveness of Vegetation Mitigation Analysis

There are two types of vegetation clearing undertaken within caribou ranges;

1) **Full ROW Clearing** - is the entire ROW to a width of 50 m. Full ROW clearing was applied in areas that were not designated as sensitive for caribou.

2) **Centreline Clearing** - are areas where vegetation mitigation has been applied. In these areas, the centerline of the ROW has been cleared, as well as 40% danger trees outside of the centerline to the edge. As a result there are more trees and shrubs that are left standing as only the danger trees are removed.

The locations of these vegetation mitigation areas were selected based on the movement behavior and distribution of caribou during the pre-construction phase. Mitigation was applied in areas that had previously been used by caribou and was focused on providing as much cover as logistically possible and shortening the width of open area the caribou would have to cross to move across the ROW. Therefore, if the mitigation strategy was effective we would expect to see caribou continue to use these areas to cross the Project. In the P-Bog range, the location of the vegetation mitigation prescriptions is known and analysis could be undertaken to assess the extent to which they effectively facilitated movement across the ROW. The locations of these areas for the Wabowden range are still being assimilated and use by caribou could not be quantified for this current report.

In the P-Bog range, we assessed the extent to which caribou used the vegetation mitigation areas (Full Centerline) versus the unmitigated (Full ROW) areas to cross the ROW. We tested this by comparing the proportion of mitigated crossings to unmitigated crossings from observed caribou and 100 random caribou (same starting locations and distances, random directions). If caribou were preferentially crossing at mitigated areas we expected a higher proportion of mitigated crossings for observed caribou. Any sequential location that was greater than 6 hours was split into separate tracks (hereafter called bursts), because we had to assume that the crossing location on either side of the ROW corresponded to the straight-line path between the locations. Longer time period between locations increases the likelihood that this assumption is not valid. Although 3 hours could also be used, this resulted in very short bursts for many individuals. We also removed any bursts that did not cross the ROW at least twice, because the goal was to determine “where”, not “if” individuals were crossing and thus bursts with zero crossings did not assist with the analysis. We used a mixed model with a random effect for individuals and a t-test on individual means to determine if individuals had a significantly higher proportion of mitigated crossings than random. Because of the similar results for the different models only t-test results are shown.

4.1.2 Genetic CMR Fecal Pellet Collection

Non-invasive genetic sampling (NGS) of woodland caribou was not conducted in Year 2 (2015/16) of the mammals monitoring program, but is planned for Year 3 (2016/17) using the survey design implemented in Year 1 (2014/15).

4.1.3 Population Structure and Distribution Aerial Survey

Annual winter calf recruitment, population structure and distribution were assessed in Year 2 by aerial observations (aided by telemetry relocations of collared woodland caribou), using the methods and survey design implemented in Year 1 (2014/15) of the mammals monitoring program.

Classification of individuals to sex and age category was conducted by experienced caribou biologists. Effort was made to avoid overstressing caribou, to minimize risk of stress myopathy. Animals were identified to sex and age category based on physical characters including antler configuration, presence of vulva patch/penis sheath, shape of rump patch stature (physical size) and behavior (within group association). Number of calves, number of adult females, number of adult males, and number un-classified were recorded.

Moose, deer, elk and wolf sign and observations, were incidentally recorded because these species can provide insight into coarse (landscape) scale patterns of caribou distribution, and the information is also used for analysis of wolf predation risk and changes in community dynamics.

4.2 Forest-Tundra and Barren-Ground Caribou

4.2.1 Field Studies

There are no formal field studies of forest-tundra woodland caribou (Cape Churchill and Pen Islands populations) or barren-ground (Qamanirjuaq herd) caribou specific to the Bipole III mammals monitoring component of the Project. However, there is an 8-year collaborative satellite telemetry project initiated in 2010 involving MB Government, MB Hydro, and Fox Lake, Split Lake and York Factory Resource Management Boards to monitor Cape Churchill and Pen Islands populations. The telemetry study is intended to monitor changes in post-calving range use, describe current seasonal range use and identify changes in population abundance using a combination of telemetry and aerial survey methods (Trim 2015). Cape Churchill and Pen Islands caribou ranges overlap the northern extent of the N1 construction segment (Figure 4-2-1) and infrequently occur in the project area in some years. Qamanirjuaq caribou may also occasionally occur (during winter) in proximity to the Project (Figure 4-2-1).

4.2.2 Monitoring

Mitigation measures are limited to avoiding effects from Project construction activities if/when migration movements overlap construction segment N1. MB Hydro environmental monitors from local communities are on site to advise if caribou are in proximity of the Project during active construction.

4.3 Moose

4.3.1 Field Studies

4.3.1.1 Aerial Population Surveys

Gasaway moose surveys were conducted in Year 2 (2015/16) by MB Government (with participation by MB Hydro staff) in two GHAs (Tom Lamb/GHA 8 sensitive moose area, and in GHA 11) that overlap the Bipole III ROW (Figure 4-3-1).

Moose distribution (observed moose and fresh tracks) was incidentally recorded concurrent with the annual Caribou Winter Calf Recruitment Surveys conducted during Year 2 (2015/16) of the mammals monitoring program in the boreal woodland caribou winter ranges (P-Bog, N-Reed, Wabowden and Charron Lake), and in the two *P. tenuis* disease surveillance blocks (Section 5.6.5).

4.3.2 Population Modelling

Sensitive moose ranges (Figure 4-3-2) were identified in the Bipole III Transmission Project Biophysical Monitoring Plan (Manitoba Hydro 2015) for long-term monitoring. The sensitive ranges are Tom Lamb/GHA 8, Moose Meadows (portion of GHA 14) and Pine River (GHA 14A/19A). In order to understand population change, it is necessary to investigate causes and processes; reliable information on population dynamics is central to that effort (Taber & Raedeke 1979). By first developing a model of how a typical population acts, inferences can be drawn on population performance, including effects of disturbance (Taber & Raedeke 1979).

Discrete time series population demographic models for each monitored population and adjacent reference populations were updated to incorporate 2015/16 moose survey results; see Amec Foster Wheeler 2016 for a description of the models. Each population model establishes a reference condition (i.e., pre-disturbance baseline status and historical range of variability). Through ongoing monitoring, population modelling allows comparison of trends in population state (abundance, structure) and vital rates (λ, adult sex ratio, calf recruitment) using baseline population metrics collected prior to Bipole III disturbance, with post-disturbance conditions for each sensitive moose range to assess population performance. Modelling also provides insight and context for Project-related effects on any of these population metrics at a population scale, and facilitates comparisons of sensitive moose range population metrics with regional trends of adjacent reference moose populations that are not directly intersected by Bipole III.

4.4 Deer and Elk

4.4.1 *P. tenuis* Monitoring

Two surveillance areas were identified to locate areas of winter deer activity and to obtain winter fecal pellet samples for evaluation of presence of spiney-tailed larvae, which would indicate probable P. tenuis in the deer population. The surveillance areas were determined using coarse scale observation data from a Multi-species Aerial Survey conducted by Alaskan Trackers in January/February 2014 prior to significant project disturbance (clearing) of the ROW. No pellet sampling occurred during Year 1 (2014/15) because that portion of the Project Biophysical Monitoring Plan (MB Hydro 2015) had not yet been approved. During Year 2 (2015/16) an aerial transect survey design was implemented which encompassed the two *P. tenuis* surveillance areas (Figure 4-4-1). The purpose was to obtain ungulate distribution along the ROW on either side of the P-Bog caribou range, with specific intent to locate areas of white-tailed deer activity and obtain winter fecal pellet samples for P. tenuis analysis. Access restrictions to private land precluded pellet sample collection. For Year 3 (2016/17), a ground-based community assisted pellet collection project is anticipated to acquire samples.

4.4.2 White-tailed Deer Ingress

Deer ingress and elk occurrence along the ROW is assessed using several methods discussed elsewhere in this report:

- Winter Ground Track Transect Surveys of N1, N2, N3 and N4 construction segments;
- Remote IR Camera Traps associated with the Winter Ground Track Transect sampling design;
- Aerial Species Distribution Surveys concurrent with the annual Woodland Caribou Winter Calf Recruitment Survey;
- Gasaway Moose Population Surveys of sensitive moose ranges and GHAs intersected by the ROW;
- Multi-species Aerial Survey (conducted by Alaskan Trackers; Figure 4-4-2); and
- Incidental observations of deer and deer sign by the Project Environmental Monitors.

4.5 Furbearers

4.5.1 Furbearer Harvest Monitoring

The Bipole III Transmission Project directly intersects 42 registered traplines (Figure 4-5-1). Annual harvest statistics for each trapline were obtained from MB Government to calculate baseline harvest statistics by species for each construction segment intersecting the registered traplines, with the objective of comparing the pre-disturbance phase (baseline harvest statistics 2001/02 to 2013/14) to other Project phases (2014/15 ongoing).

4.5.2 Winter Ground Track Transects

Annual winter ground transect intercept sampling was undertaken as per methods outlined in the 2015 report (Amec Foster Wheeler 2016, Figure 4-5-2) to compare furbearer occurrence (by species) as a function of the distance to the Project during the pre-disturbance versus construction phases. The data is used to determine if there are significant changes in distribution of furbearer species with respect to local displacement from sensory disturbance and habitat fragmentation, as well as effects on mammal community structure. Transect sampling is integrated with remote camera traps to collect supplementary data on furbearers across seasons.

Winter ground transect intercept sampling in 2015/16 was initiated on N1 construction segment (n = 15 transects, including remote camera deployments), and was repeated on the N2 (n = 10 transects) and N3 (n = 10 transects) that had remote cameras deployed. Sampling of N1, N2 and N3 construction segments was conducted from February 18 to 25, 2016, and included memory card retrieval and servicing of remote cameras deployed in March 2015 in construction segments N2 and N3. To date, on the N4 construction segment, no transects have been sampled and no remote cameras have been deployed due to access restrictions.

4.5.2.1 Data Analysis

All data manipulation and statistical analyses with the ground transect data were conducted in R (The R Foundation for Statistical Computing). Some covariate categories were simplified, transformed and/or pooled to reduce autocorrelation among vegetation types and satisfy the assumptions of the statistical models used. Categories representing vegetation type were grouped into ten types: Coniferous, Mixedwood, Deciduous, Muskeg, Water, Shrub, Open Meadow, Recently Burned, Developed and Rock. Categories representing cover were grouped into three types: Open, Sparse and Dense. Many track observations had more than one dominant tree species so two covariate columns were created, one for the most dominant tree species, and the other for the second most dominant tree species. Covariates were made into multiple columns (one per group per covariate) of binary data. Data were then binned by intervals of 200 m from the Project ROW. Numbers of tracks were summed and covariates averaged with respect to each distance bin.

Separate analyses were conducted for each species. Track observations for all species were relatively sparse with respect to sampling effort resulting in the distribution of the data being strongly skewed towards zero and attempts to fit generalized linear mixed models with Poisson or negative binomial distribution families were not successful. Therefore only observed tracks (presence) were included in subsequent analyses. Track data were tested for normality and log- or natural log- transformed when non-normal. Linear mixed models (R package lme4) were used to test for a correlation between track density and distance to the Project ROW and for a difference between years. Two hundred and twelve models were tested with 'distance to ROW' and 'year' as fixed effects, 'transect' as a random factor with various combinations of covariates. The model with the lowest AIC was selected as the model that best fit the data. Power analyses were then conducted (R package simr) using 1000 Monte Carlo simulations based on the best fit model for each species and re-running simulations for different sample sizes until a power of 80% was reached.

4.5.3 Remote IR Camera Traps

The purpose of camera trapping was to monitor Project disturbance effects on furbearer species and relative predator distribution at fine scale by comparing occurrence and distribution near the ROW vs away from the ROW across seasons and Project phases and initial operation phases (see Amec Foster Wheeler 2016 for a description of the sampling design). In addition the camera traps will collect annual data on large predator (wolf, black bear and wolverine) occurrence and potential white-tailed deer ingress proximate to the Project ROW.

In Year 2 (2015/16) of monitoring, all remote cameras deployed on N2 (n = 18) and N3 (n = 19) winter ground transects were relocated, serviced and had memory cards replaced. On N2 construction segment, two cameras failed and were replaced, one camera was stolen and not replaced, and two additional cameras were installed, resulting in a revised/new sample size of 19 remote cameras for 2016/17. On N3 construction segment, one camera along the Project ROW was missing because the trees at its location were knocked over, and a second camera failed and was fixed. N1 construction segment had 20 cameras deployed in Year 2. No cameras to date have been deployed in N4 construction segment because of access restrictions.

A total of 58 remote cameras are currently deployed in association with the winter ground transects for Year 3 (2016/17) data collection along construction segments N1, N2 and N3. Figure 4-5-2 provides an overview of the Remote IR Camera Trap sampling design.

4.5.4 Winter Distribution Surveys

Ungulate and predator (wolf and wolverine) winter distribution were incidentally recorded concurrent with the annual woodland caribou winter calf recruitment surveys and in the *P. tenuis* monitoring block surveys in Year 2. Data collected systematically via aerial transect sampling methods included observation date and location (UTM coordinates) of observations of sign (number of track sets, ungulate kill sites) and sightings (group size). The purpose was to collect additional baseline data on predator distribution relative to the Project ROW, and distribution relative to potential ungulate prey species to evaluate predation risk to ungulate species from wolves.

The Multi-species Aerial Survey was conducted along the ROW during winter of 2015/16 (Year 2) by Alaskan Tracker survey crews on behalf of by MB Hydro. This survey provides coarse scale winter distribution data on wolves and wolverines within proximity of the ROW (Figure 4-4-2), as well as incidental winter distribution of other medium and large furbearer species (e.g., otter) and ungulate species. This survey samples 500 m wide transect strips parallel to the ROW centered on distances of 0.25 km, 1.25 km, 3.25 km, 5.25 km along construction segments N1, N2, N3, N4 and north half of C1 construction segments. Additional strip transects were flow at 10.25 km from the ROW in the sensitive moose areas (Pine River/GHA 14A/19A, Moose Meadows and Tom Lamb/GHA 8) and along the ROW from Thompson (northern portion of N2 construction segment) to the Keewatinoow Converter Station (N1 construction segment) (Figure 4-4-2).

Table 4-1-1: Seasonal Daily Movement Rates

Season	Dates	Number of Caribou	Pooled 95th Percentile Daily Movement Distances (m)
Wabowden Range			
Early Winter	December 1 to February 28	62	8554
Late Winter	March 1 to April 30	47	8636
Spring	May 1 to June 30	63	5160
Summer	July 1 to September 15	60	5405
Fall	September 16 to November 30	52	8685
P-Bog Range			
Early Winter	December to February	67	6451
Late Winter	March to April	52	7904
Spring	May to June	67	6031
Summer	July to September 15	67	6168
Fall	September 16 to November	58	9057

Table 4-1-2: Seasonal Sample Size Information for the P-Bog Range

Season	Number of Individuals	Number of Locations	Average Number of Locations/ Individual	Average Percent Contribution per Individual	Maximum Percent Contribution for an Individual
Early Winter	67	8643	129.00	1.49	3.12
Fall	52	6847	131.67	1.92	3.33
Late Winter	67	8186	122.18	1.49	2.59
Spring	67	8010	119.55	1.49	2.36
Summer	58	7609	131.19	1.72	3.22

Table 4-1-3: Seasonal Sample Size Information for the Wabowden Range

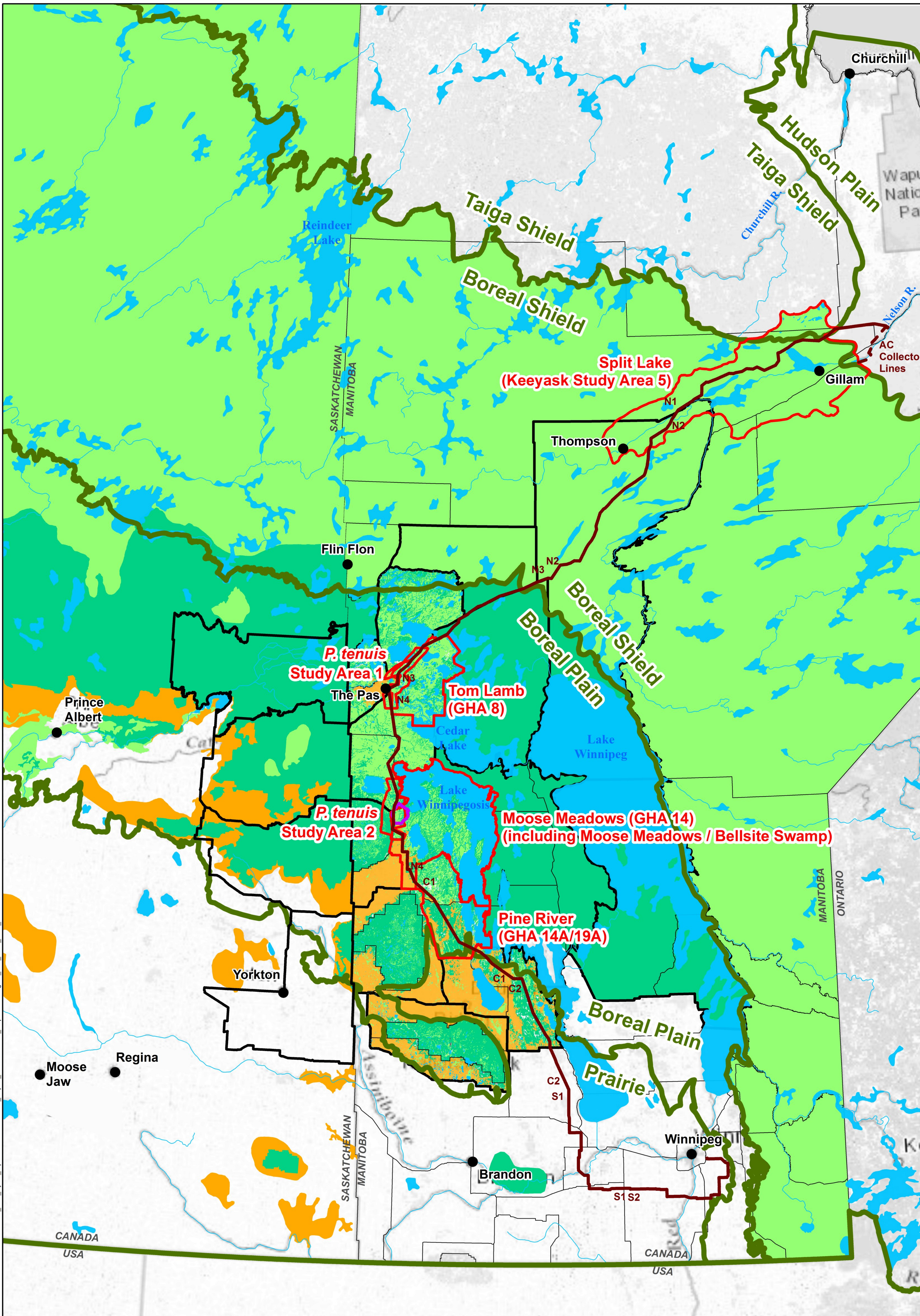
Season	Number of Individuals	Number of Locations	Average Number of Locations/ Individual	Average Percent Contribution per Individual	Maximum Percent Contribution for an Individual
Early Winter	62	7434	119.90	1.61	3.59
Fall	47	5880	125.11	2.13	3.88
Late Winter	63	7164	113.71	1.59	3.39
Spring	60	6910	115.17	1.67	3.50
Summer	52	6343	121.98	1.92	3.64

Table 4-1-4: Descriptions of Vegetation Classifications for the Earth Observatory for Sustainable Development (EOSD) Landsat within the Wabowden and P-Bog Ranges

EOSD Cover Type	Description
Wetlands	Land with a water table near/at/above soil surface for enough time to promote wetland or aquatic processes (semi-permanent or permanent wetland vegetation, including fens, bogs, swamps, sloughs, marshes)
Treed Wetland	Land with a water table near/at/above soil surface for enough time to promote wetland or aquatic processes; the majority of vegetation is coniferous, broadleaf, or mixed wood
Shrub Wetland	Land with a water table near/at/above soil surface for enough time to promote wetland or aquatic processes; the majority of vegetation is tall, low, or a mixture of tall and low shrub
Herb Wetland	Land with a water table near/at/above soil surface for enough time to promote wetland or aquatic processes; the majority of vegetation is herb
Forest Stands	Predominantly forested or treed areas; comments: this class is mapped only if the distinction of sub-forest covers is not possible
Dense Coniferous Forest	Greater than 60% crown closure; coniferous trees are 75% or more of total basal area
Open Coniferous Forest	26-60% crown closure; coniferous trees are 75% or more of total basal area
Sparse Coniferous Forest	10-25% crown closure; coniferous trees are 75% or more of total basal area
Dense Broadleaf Forest	Greater than 60% crown closure; broadleaf trees are 75% or more of total basal area
Open Broadleaf Forest	26-60% crown closure; broadleaf trees are 75% or more of total basal area
Sparse Broadleaf Forest	10-25% crown closure; broadleaf trees are 75% or more of total basal area
Dense Mixedwood Forest	Greater than 60% crown closure; neither coniferous nor broadleaf tree account for 75% or more of total basal area
Open Mixedwood Forest	26-60% crown closure; neither coniferous nor broadleaf tree account for 75% or more of total basal area
Sparse Mixedwood Forest	10-25% crown closure; neither coniferous nor broadleaf tree account for 75% or more of total basal area
Shrub	Predominantly woody vegetation of relatively low height (generally ±2 m); comments: may include grass or grassland wetlands with woody vegetation, regenerating forest

REDACTED

REDACTED



LEGEND

- BPIII Transmission Line Route (labelled at segment divides)
- Ecozone Boundaries
- Game Hunting Areas
- Moose Monitoring Unit (MMU)
- Sensitive Moose Ranges and the 2016 *P. tenuis* Survey Areas (labelled with names)
- Moose Meadows Area (Bellsite Swamp)
- Waterbody

Moose Range

- Primary Range
- Secondary Range (Forest)
- Secondary Range (Agriculture)

0 90 180 270 360 450 Kilometres

NOTES:
- Background topographic map extracted from ESRI online basemap services
- Land cover data aggregated from NRCan Land Cover database Geobase.ca

Datum: NAD83
Projection: UTM Zone 14N

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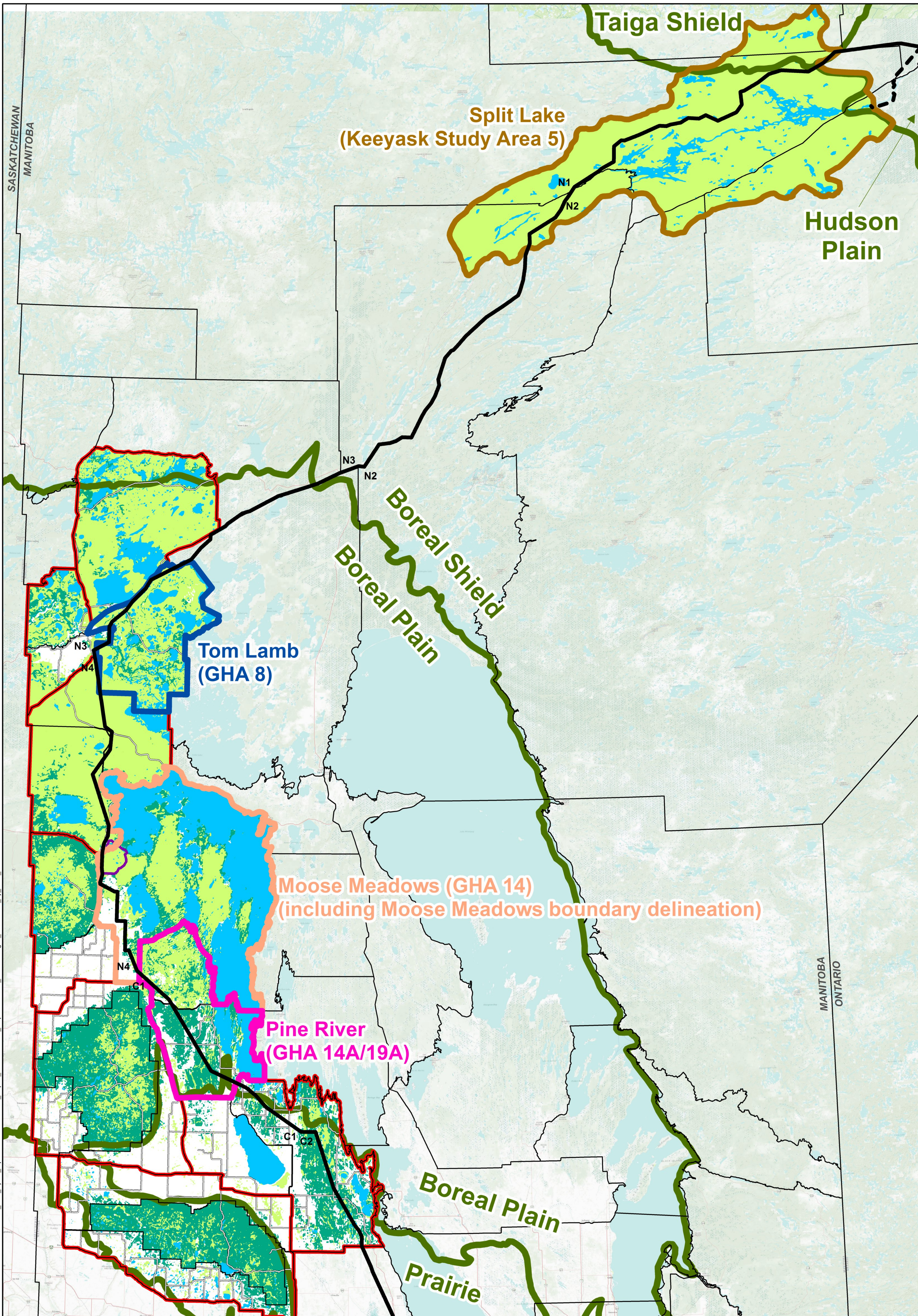
MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Summary of Active Moose Monitoring via Population and Distribution Surveys during Winter 2015-2016

PROJECT N°: WX17393	**FIGURE: 4-3-1**
SCALE: 1:3,331,000	DATE: November 2016



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LEGEND

- Moose Meadows Boundary
- Game Hunting Areas (GHA)
- Moose Monitoring Unit (MMU)
- Ecozone Boundaries

Moose Range

- Primary Range
- Secondary Range (Forest)
- Waterbody within MMU's and Sensitive Ranges

- BPIII Transmission Line Route (labelled at segment divides)
- AC Collector Lines
- Main Roads within MMU's

Sensitive Moose Range Areas (labelled with name)

- Moose Meadows (GHA 14)
- Pine River (GHA 14A/19A)
- Tom Lamb (GHA 8)
- Split Lake (Keeyask Study Area 5)

0 60 120 180 240 300 Kilometres

NOTES:
- Background topographic map extracted from ESRI online basemap services
- Land cover data aggregated from NRCan Land Cover database Geobase.ca

Datum: NAD83
Projection: UTM Zone 14N

N W E S

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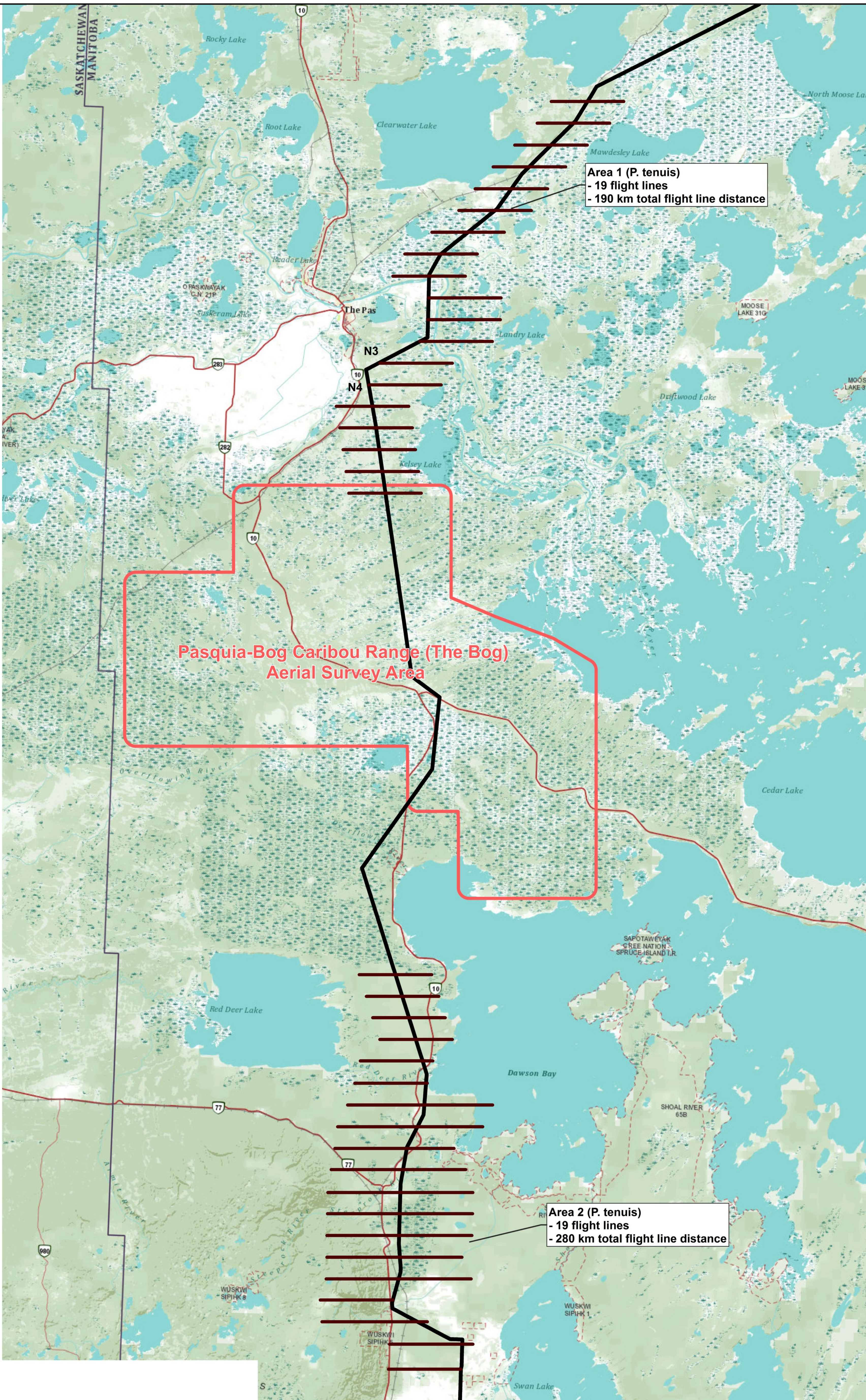
MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Sensitive Moose Ranges intersected by the Bipole III Transmission Project

PROJECT N°: WX17393	**FIGURE: 4-3-2**
SCALE: 1:2,000,000	DATE: November 2016



LEGEND

- Flight Line Transects (labelled with ID)
- BPIII Transmission Line Route
- Pasquia-Bog Caribou Range (The Bog) Aerial Survey Area

0 10 20 30 40 50 Kilometres

NOTES:
- Background topographic map extracted from ESRI online basemap services
-

Datum: NAD83
Projection: UTM Zone 14N

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MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

P. tenuis Sampling Survey Design
2016 Flight Line Transects

PROJECT N°: WX17393	FIGURE: **4-4-1**
SCALE: 1:530,000	DATE: November 2016

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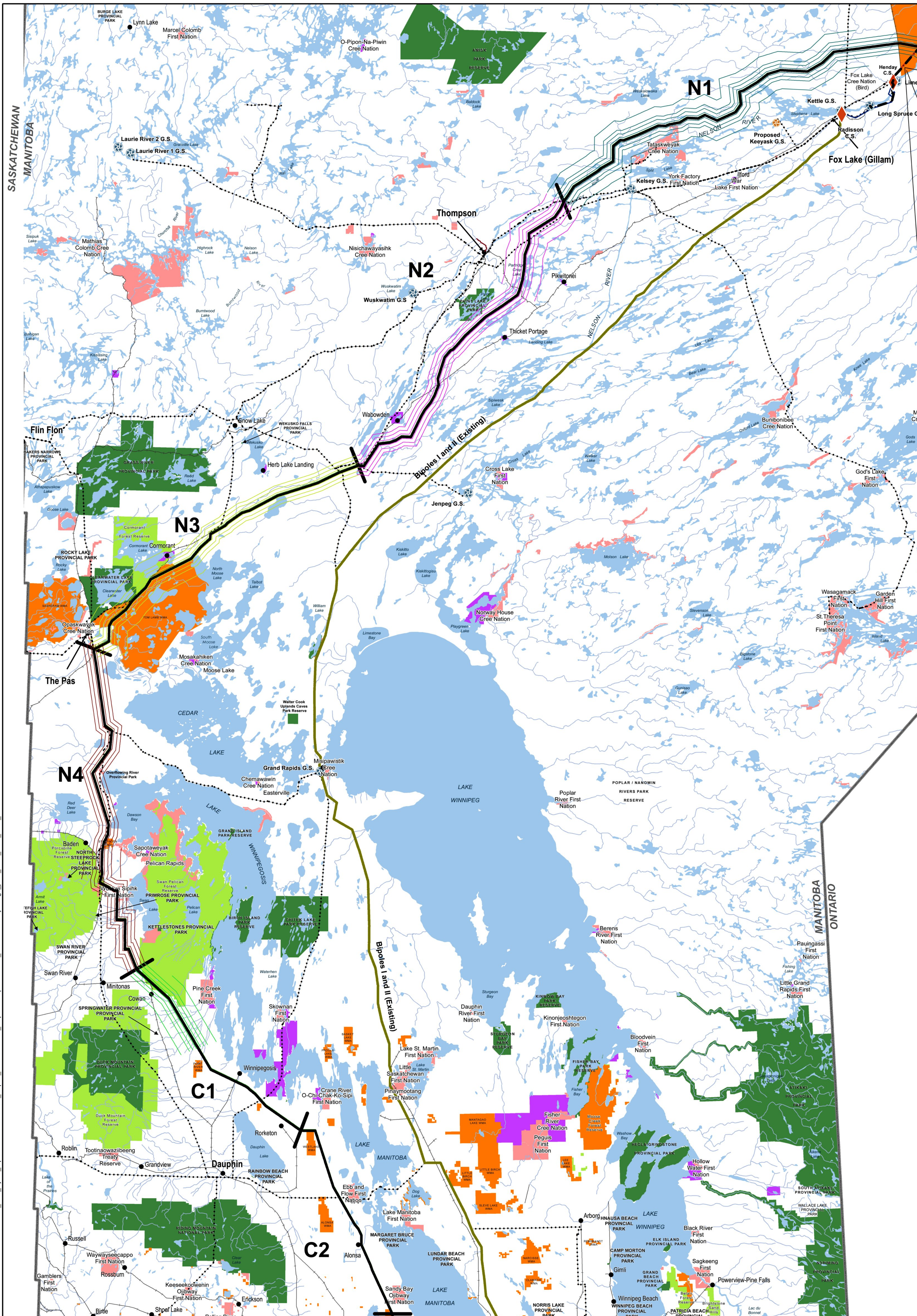

LEGEND

- BPIII Transmission Line Route (labelled at segment divides)
- AC Collector Lines

Multi-species Aerial Survey Flight lines

- C1 - North portion flown in 2016
- N1 - Western 3/4 flown in 2016 (10km line not flown)
- N2 - Not flown in 2014 or 2016
- N3 - Southern 1/2 flown in 2016 and 2014 (10km line and parts of 5km line not flown, expanded areas > 2.5km only flown in 2016)
- N4 - Flown in 2014 and 2016 (10km line not flown in 2014, parts of 5km not flown in 2016 or 2014)
- ACCollector - North portion flown in 2016

- Existing Converter Station
- Proposed Converter Station
- Existing Generating Station
- Proposed Generating Station
- First Nation
- Wildlife Management Area
- Northern Affairs Community
- National/Provincial Park
- Provincial Forest

0 40 80 120 160 200 Kilometres

NOTES:
- Background topographic map extracted from ESRI online basemap services
- Land cover data aggregated from NRCan Land Cover database Geobase.ca
- Map extracted from Manitoba Hydro "BPIII Transmission Project" map.

Datum: NAD83
Projection: UTM Zone 14N

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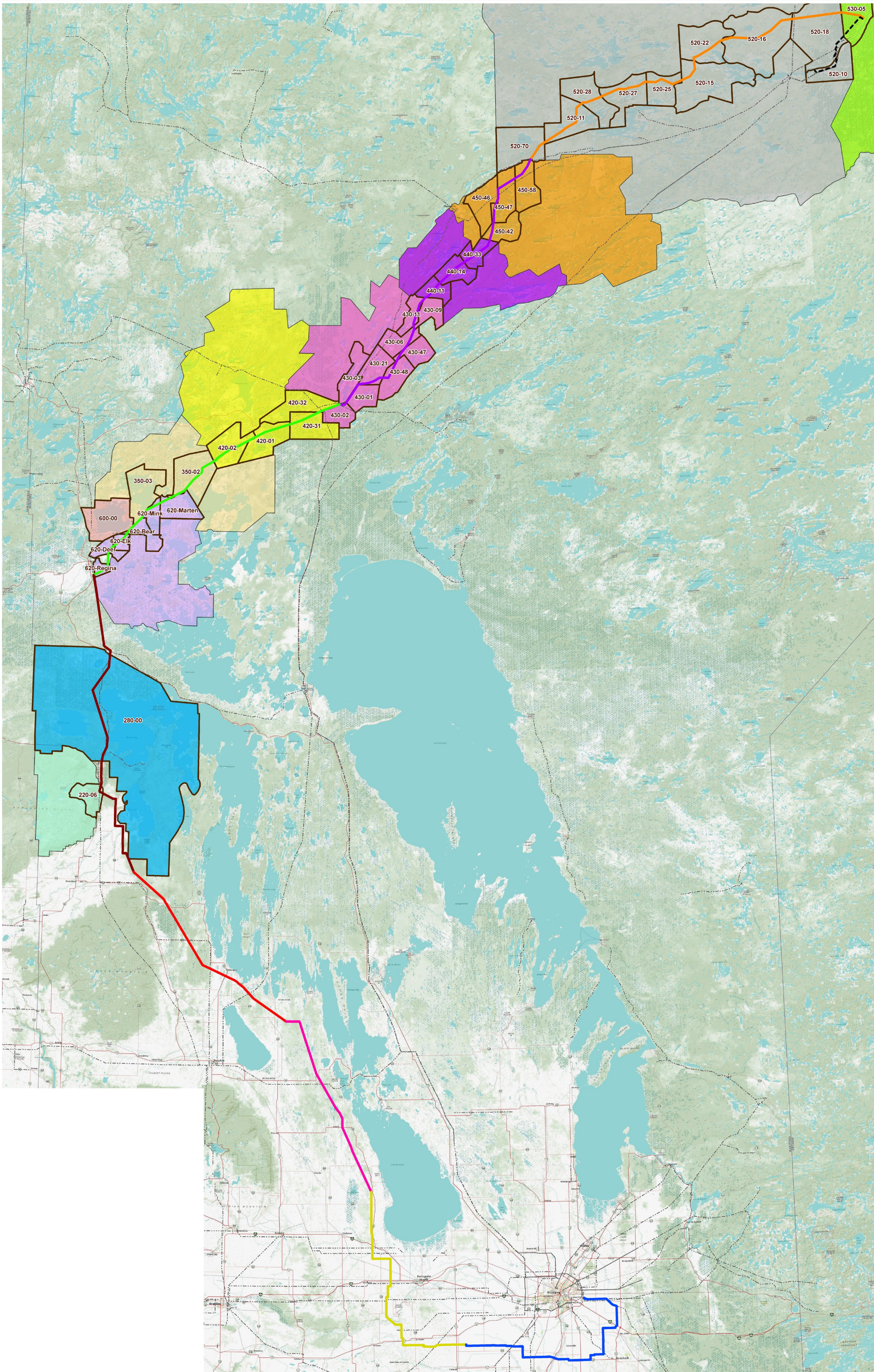
MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Multi-species Aerial Transect Survey Design for BPIII for 2014 - 2016

PROJECT N°: WX17393	FIGURE: 4-4-2
SCALE: 1:2,000,000	DATE: November 2016



LEGEND

Registered Trapline Area (Lablelled with ID)

Registered Trapline Area Section by Name

- CLEARWATER
- CORMORANT
- HERB LAKE
- LIMESTONE
- PIKWITONEI
- PORCUPINE
- RED DEER - SHOAL RIVER
- SPLIT LAKE
- SUMMERBERRY
- THICKET PORTAGE
- WABOWDEN

BPIII Transmission Line Route By Section

- N1
- N2
- N3
- N4
- C1
- C2
- S1
- S2
- AC Collector Lines

Transmission Line

NOTES:
- Background topographic map extracted from ESRI online basemap services
- Transmission lines extracted from CanVec10 (geogratis.ca)

Datum: NAD83
Projection: UTM Zone 14N

0 60 120 180 240 300 Kilometres

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MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Registered Traplines intersected by the Bipole III Transmission Project

PROJECT N°: WX17393

FIGURE: **4-5-1**

SCALE: 1:2,300,000

DATE: November 2016

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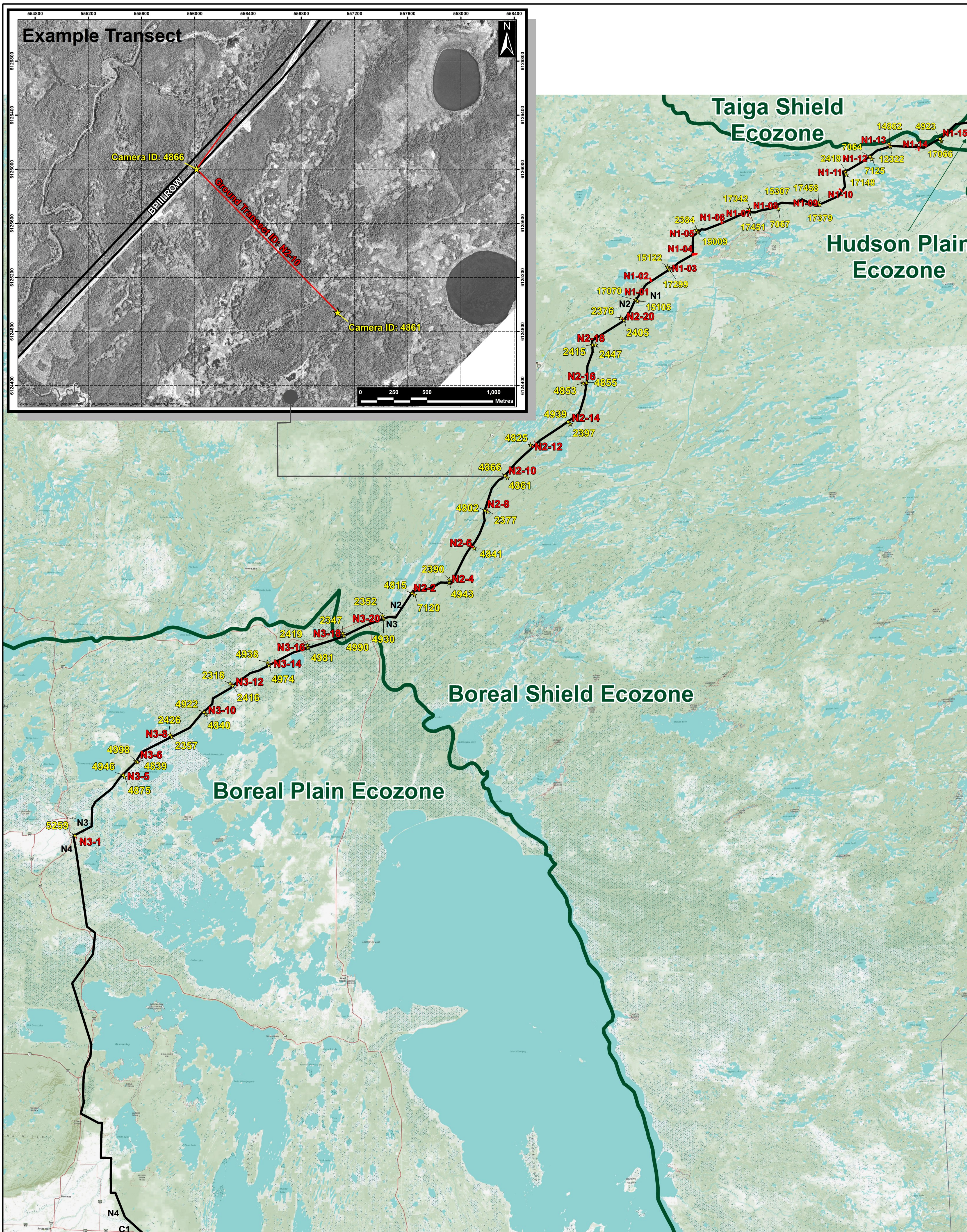

LEGEND

- 4841 — Remote IR Cameras Visited or Deployed in 2016 (labelled with camera label ID)
- N2-9 — Winter Ground Transects Completed in 2016 (labelled with transect ID)
- BPIII Transmission Line Route
- Ecozones

NOTES:
- Background topographic map extracted from ESRI online basemap services
-

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MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Winter Ground Transects Completed and Remote IR Cameras Visited or Deployed in 2016

Datum: NAD83
Projection: UTM Zone 14N

0 50 100 150 200 250 Kilometres

PROJECT N°: WX17393	FIGURE: 4-5-2
SCALE: 1:1,770,000	DATE: November 2016

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Available in accessible formats upon request