BIPOLE III TRANSMISSION PROJECT

MAMMAL MONITORING PROGRAM
TECHNICAL REPORT YEAR 3 (2016/17)

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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 3 (2016/17 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

The following is a summary of results of woodland caribou monitoring activities conducted in Year 3 (2016/17) from population abundance and distribution studies, telemetry studies, and mortality monitoring.

1. **Population Abundance** – Genetic capture-mark-recapture (CMR) methods were applied to estimate size of Pasquia-Bog (P-Bog; The Bog portion of the range), Naosap-Reed (N-Reed; the Reed portion of the range), Wabowden and Charron Lake woodland caribou ranges. Abundance estimates generated during the construction phase using closed-population estimators indicate P-Bog local population has significantly increased (currently at 230 individuals; 0.0419 caribou/km²), Wabowden remained stable (currently at 201 individuals; 0.0513 caribou/km²), N-Reed remained stable (358 individuals; 0.0565 caribou/km²), and Charron Lake has remained stable (currently at 1,231 individuals, 0.0781 caribou/km²). These are preliminary estimates using closed-population estimators; future analyses will assess abundance and trend using open-population estimators. All populations are occurring at natural levels of abundance for this species.

2. **Population Trend** - Winter calf recruitment estimates (% calves and calves/100 cows), Kaplan-Meier adult female survival rate estimates for Year 3 (2016/17) and λ estimates from preliminary abundance trend population models (2009 to 2017 period) were consistent with stable populations in the P-Bog (λ=1.00), Wabowden (λ=0.99) and Charron Lake (λ=1.00) ranges, and a stable to slightly increasing population trend in the N-Reed (λ=1.03) range. Monitoring over the past 3 years indicates slightly lower adult female survival rates for Wabowden and N-Reed populations compared to PBog and Charron Lk (reference population).

3. **Telemetry Studies** - Abandonment of traditionally used areas can indicate responses to disturbance. Telemetry data from collared female boreal woodland caribou were 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 site fidelity and resource selection analysis, assessing the zone of influence (ZOI) around the Project, and the extent to which the Project ROW acts as a barrier to movement. Responses by caribou to mitigation measures are also assessed to determine the effectiveness of implemented strategies.

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

b) **Site Fidelity -** Overall results suggest that winter range use is scale dependent for some caribou, where females are philopatric to general wintering areas within a larger population range but not necessarily to precise locations within these areas. Conversely, patterns observed after May persist across scales indicating consistent site fidelity from calving to breeding periods irrespective of the extent of observations, suggesting that female caribou are attracted to specific locations for the calving and post-calving period from year to year. There were no differences in behaviour observed in the pre-construction phase in the Charron Lake population compared to P-Bog and Wabowden range during any portion of the year, however, N-Reed demonstrated a lack of fidelity at the population and seasonal scales to wintering areas. Currently in the construction phase, fidelity to calving areas in all ranges continues to be strong, however a lack of fidelity to wintering areas in some months has been observed for P-Bog, N-Reed and Charron Lake. As only two comparisons from 2015/2016 to the 2016/2017 winter are currently available for the construction phase additional data needs to accumulate before the long term pattern for levels of fidelity during the construction phase can be ascertained and will continue to be assessed in future months.

c) **Zone of Influence (ZOI) -** The distance at which boreal woodland caribou change their behavior, habitat selection and distribution relative to disturbance has been labeled 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. In 2016, 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 continued to have reduce occurrences within 2 km of the Project in 2017.

- In the **P-Bog range**, the Project created new linear corridor on the landscape. The analysis assesses the behavioural response by caribou to this new corridor during the construction phase. Results suggest that there has been a short ZOI of approximately 1 to 2 km during the construction phase. There is evidence suggesting that avoidance of the Project may have increased during the summer and fall as the log-likelihood plots illustrate the potential for larger ZOI during these seasons. However as per Boulanger et al. (2012), at this time model fit during these seasons is poor. This pattern will continue to be assessed through 2018 as more data accumulates. At this time, results indicate a potential for an increase in ZOI during this period that will continue to be assessed.

- **Barrier Effects and Crossing Analysis -** 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 each range.

- **Wabowden range** - The 2016 crossing analysis revealed that there was no significant increase in the level of avoidance from the pre-construction to construction phase 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 similar 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. In 2017, the crossing analysis revealed that collared caribou crossed the Project in the Wabowden range less frequently than expected, suggesting that although caribou have not displayed an increase in avoidance of the Project during construction they are still significantly avoiding crossing the ROW. 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. 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.

- **P-Bog range -** The 2016 crossing analysis revealed that there was no significant change in local movement behavior by collared caribou during the construction phase of the Project. During the initiation of construction, individual collared caribou continued to move across the Project in similar locations to those used in pre-construction. However, in 2017, the updated analysis revealed that caribou are now significantly avoiding crossing the ROW suggesting there has been a potential lag effect in response to construction. Caribou in the P-Bog range continue to use vegetation mitigation areas to cross the Project ROW. The crossing analysis results do not contradict the ZOI results which indicated an overall avoidance buffer of approximately 1 to 2 km by caribou across seasons. Overall, collared caribou do not occur frequently within 1 to 2 km of the Project. However, caribou who decided to cross Project, are doing so less frequently than would be expected randomly. Results indicate that the Project has not been a complete barrier to local movements and may be the result of effective installation of vegetation mitigation areas.

d) **Vegetation Mitigation** - 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 collared female boreal woodland caribou continue to cross at mitigated areas more frequently than non-mitigated areas.

4. **Caribou-Vehicle Collisions** - There are 2 known caribou-vehicle collisions with collared caribou. The occurrence in P-Bog range (animal BOG1408 on December 25, 2014) was 18.1 km from the ROW and was unrelated to Project-related activities (MB Hydro, T. Barker, personal communication, October 6, 2015). The collision with a Wabowden caribou (WAB1304 on April 23, 2017) was 17.9 km from the ROW and was unrelated to Project construction.

Forest-Tundra and Barren-ground Caribou

1. Forest-Tundra Caribou - No Pen Islands or Cape Churchill caribou were present along the Bipole III ROW during Year 3 (2016/17) winter construction; GPS collared Pen Islands caribou all remained south of the Nelson River and Cape Churchill caribou remained north of the ROW into at least late February 2017 (MB Gov, V. Trim, personal communication, August 14, 2017). There were no calf recruitment surveys conducted for either population during Year 3. The telemetry study is winding down; no additional telemetry collars will be deployed and no calf recruitment surveys are planned for this or future years in relation to the current telemetry study (MB Gov, V. Trim, personal communication, August 14, 2017).

2. **Barren-ground Caribou** - The last known occurrence in the Project area (proximate to the N1 construction segment) was in 2004 (about 10,000 caribou).

Moose

Moose monitoring 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 Gov, 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 Winter 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)** – MB Gov undertook Gasaway Population Surveys in the Project area (Tom Lamb sensitive moose area [GHA 8], Red Deer Bog [GHA 11]). MB Hydro undertook Ungulate-Wolf Winter 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.

3. **Year 3 (2016/17)** – MB Gov undertook Gasaway Population Surveys in the Project Area (Duck Mountains, Porcupine Mountains). MB Hydro undertook Ungulate-Wolf Winter Distribution Surveys (in four monitored boreal woodland caribou ranges), a Multi-Species Aerial Survey was conducted by MB Hydro along transects paralleling construction segments N1, N2, N3, N4, and north half of C1 based on the transect survey design used in Year 2.

4. No Gasaway population surveys of the sensitive moose areas were conducted in Year 3. MB Hydro repeated Ungulate-Wolf Winter Distribution Surveys (in four monitored boreal woodland caribou ranges), a Multi-Species Aerial Survey was repeated by MB Hydro along transects paralleling construction segments N1, N2, N3, N4, and north half of C1 based on the transect survey design used in Year 2. The following summarizes the known state of each Sensitive Moose Area:

   a) **Tom Lamb/GHA8 -** 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 642 moose (0.204 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 estimated to be 48% below its long term (1971 to 2015) mean size. Regional moose populations proximate to this area all indicate declines in abundance in recent years, prior to Bipole III disturbance.

b) **Moose Meadows (portion of GHA 14)** – Moose Meadows is also locally referred to as Bellsite Swamp. 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). A Gasaway population survey of the MB portion of the Porcupine Hills was conducted by MB Gov in early February 2017; results indicate the Manitoba portion of the population is at 1057±16.4% (0.408 moose/km²) with a stable to growing trend. However, the long term population trend for the Porcupine Hills differs substantially with that observed for Moose Meadows sensitive moose area and the Swan-Pelican (GHA 14/14A). Typically, GHA 14 has been surveyed by MB Gov on its own, or in association with GHA 14A. As a moose population monitoring unit (Swan-Pelican MMU), moose in GHA 14/14A have experienced a significant decline beginning in the early-1990's (approx. 3,300 moose; 0.687 moose/km²) to the current level of about 150 moose (0.030 moose/km²; 89% below the long term mean) based on population surveys conducted in January 2011 and January 2014. There were no specific moose population surveys of Moose Meadows or the Swan-Pelican reference population conducted in Year 3, although this was recommended. No surveys are planned for Year 4 (2017/18) by MB Gov.

c) **Pine River (GHA 14A/19A)** – This sensitive local moose population 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/km²) in January 1992 to 213 (0.068 moose/km²) 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 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. A Gasaway population survey of Duck Mountain MMU conducted in early February 2017 by MB Gov suggests this population is stable and possibly beginning to increase. The Duck Mountain MMU winter population was estimated to be 1,958 ±15.1% (0.269 moose/km²), which is about 12.1% below the long term mean of 2,228 moose (0.310 moose/km²). A moose population survey led by MB Gov (in collaboration with MB Hydro) was recommended for this sensitive moose area for January 2017 as part of the Bipole III Mammals Monitoring Program. However, MB Gov advised that this population was not on the 2016/17 moose population survey schedule, nor is a survey planned for year 4 (2017/18).

5. **Split Lake -** This moose study area overlaps the northern portion of N2 and most of N1 construction segments of the Bipole III Transmission Project ROW. Although the area was not identified as a sensitive moose range, it was added to the Bipole III moose monitoring program because it represents an area occupied by moose on the boreal shield ecozone that is intersected by the Bipole III ROW. During January 2015 a moose population survey of the Keeyask survey area (including Split Lake study area) was conducted. Comparison

of population abundance survey data obtained from MB Hydro indicates no significant difference between January 2010 (961 ±21.0%) and January 2015 (1,349 ±22.6%) because the confidence intervals of both estimates overlap. However, the 2015 abundance estimate is larger, suggesting the population may be growing at a 10-year mean λ = 1.022.

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 Year 3 (2016/17) included:

- Parelaphostrongylus tenuis (P. tenuis) Monitoring
  - No sampling occurred 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.
  - Ground-based sampling was undertaken in Year 3 (2016/17), with 226 usable white-tailed deer pellet samples collected and submitted from 12 sampling locations. Positives (n = 93) were detected in samples from all collection sites, suggesting a P. tenuis prevalence of 41.1% in the regional white-tailed deer population. Prevalence was lower (25.4% of n = 114 samples) in samples collected north of Pasquia-Bog Woodland Caribou Range (i.e., from N3, *P. tenuis* Surveillance Area 1). Prevalence was greater (60.5% in n = 86 samples) in samples collected south of the Pasquia-Bog Woodland Caribou Range (N4, including *P. tenuis* Surveillance Area 2) and in C1 (46.2% in n = 26 samples).
- Deer and Elk Occurrence – multiple data collection methods are used to collect deer and elk occurrence data relative to the ROW which include: remote cameras, winter ground track transects, Ungulate-Wolf Distribution Surveys of woodland caribou study areas and a Multi-species Aerial Survey using transects parallel to the ROW at various distances. There is minimal evidence to date of white-tailed deer ingress into the P-Bog Caribou range and no evidence of elk ingress into areas outside of historical occurrence as a result of the ROW and associated Project disturbance.

- There have been 3 deer-vehicle collisions involving Project vehicles in proximity to the S1 construction segment. One collision occurred during year 2 (7 December 2015) and two occurred during Year 4 (August 6, 2017 and September 16, 2017).

Predation - Gray (Timber) Wolf and Black Bear

Results of wolf and black bear monitoring activities undertaken in Year 3 (2016/17) are summarized below:

1. **Predation Mortality** - Mortality investigations (n = 63) of collared adult females, indicates predation constituted 80.9% of known mortality sources (n = 42), primarily by wolves (76.8%). Wolf predations occurred in all months except December, with a distinct peak in July. To date there were 3 wolf predations in Wabowden range and 5 wolf + 1 bear predations in the P-Bog range since the ROW disturbance initiated. 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 confirmed predation mortalities were >11 km from the cleared Project ROW.

2. **Predation Risk -** predation-risk was assessed within each woodland caribou study area using Ungulate/Wolf Distribution Aerial Survey Data by comparing the distances of observed moose and woodland caribou from recent wolf sign and observed wolves. No statistical difference was detected in P-Bog range for Year 1, 2 or 3. Moose in Wabowden range were at greater risk in Year 1 and 2; no difference in Year 3. Woodland caribou in N-Reed and Charron Lake Ranges were at greater risk than moose in all 3 years. Among all monitored woodland caribou ranges, woodland caribou were at greatest risk to wolf predation in N-Reed as a function of distance to predator.

3. 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.

4. No bear hibernation dens were detected during Year 3 (2016/17) of monitoring.

Winter Ground Track Transect Surveys and associated **Remote IR Trail Cameras** were deployed along N2 and N3 construction segments in Year 1 (2014/15) to collect local occurrence data for multiple furbearer species including bears and wolves. The study was expanded to N1 construction segment in Year 2 (2015/16) and further expanded to N4 in Year 3 (2016/17). Statistical analysis of ground survey tracks revealed a significant positive relationship between track density and distance from the ROW for Gray Wolf. More wolf tracks were observed at distances farther from the ROW than near the ROW and were positively correlated with distance to ROW. Preliminary analyses of Remote IR Camera data indicate more observations of Wolves near the ROW, however not enough data has accumulated for robust statistical analysis. As more camera data accumulates a more comprehensive assessment will be undertaken to integrate the ground transect and Remote IR camera data as feasible for Gray Wolf. Black bears were detected via camera's less frequently in proximity to the ROW.

Fur-bearers

A summary of results of furbearer monitoring activities initiated in Year 3 (2016/17) are below:

1. **Winter Ground Track Transects** surveyed during Year 3 (n = 50) along construction segments N1, N2, N3, and N4 detected most of the expected furbearing species including weasel, marten/fisher, wolf, fox, coyote, otter, mink, lynx, snowshoe hare, squirrel, beaver (transect N2-16 only), as well as ungulate species including moose and white-tailed deer (transect N2-10 only); no boreal woodland caribou or elk were detected; no wolverine were detected. Analysis revealed a positive correlation between track density and distance to the Project for most species; tracks of these species were observed more frequently at distances farther away from the Project than closer to the Project during the winter construction period.

2. **Remote IR Trail Camera Data -** results from memory cards retrieved in Year 2 and Year 3 were used to compare occurrence of mammals near the ROW versus 1.5 km (all seasons and years pooled). No significant differences have been detected to date and results varied by species There were more observations of wolves, fox, fisher, woodland caribou, moose and white tailed deer at camera traps positioned close to the ROW compared to those 1.5 km from the ROW. There were fewer black bear, coyote, wolverine, marten, lynx and snowshoe hare detected at cameras near the ROW compared to 1.5 km from the ROW. An additional year of data is anticipated to improve the analysis and interpretation of this data set including the integration with ground transect data where statistically feasible. Behavior of some species may also change once construction is complete and sensory disturbance diminishes at the ROW from construction activities.

3. **Furbearer Harvest Monitoring -** Four furbearer species (beaver, marten, wolf, wolverine) were identified in the Bipole III Project EIS as having particular concern because of potential Project disturbance effects (i.e., access resulting in overharvest, direct habitat loss and/or sensory disturbance). Annual harvest for these four species is variable across construction segments. This is in part due to differences in the number (and physical extent) of traplines within each construction segment that are physically intersected or directly adjacent to the ROW. The same pattern is evident in the harvest rates for these species. The following summarizes preliminary harvest analyses for these 4 species:

- **Beaver -** Harvest statistics for beaver indicate harvest (number of pelts and harvest / license) during the initial construction phase (2014/15 and 2015/16) was consistently lower in construction segments N1-N4 relative to the 5-year (2009/10 to 2013/14) pre-construction means. This suggests there may be a reduced harvest of beavers from traplines intersected by the Bipole III ROW during construction.

- **Marten -** During the initial 2 years of construction, harvest statistics data indicate N3 harvest and harvest rate for marten was significantly higher in N3, and harvest was significantly lower in N4, compared to the 5-year (2009/10 to 2013/14) pre-construction means. However, no significant differences were evident when the data were pooled for the entire N1-N4 portion of the ROW.

- **Wolf -** No significant difference was detected when comparing pre-disturbance to initial construction phase with respect to harvest or harvest rate in the monitored construction segments or the pooled ROW harvest data.

- **Wolverine -** No significant difference was detected when comparing pre-disturbance to initial construction phase with respect to harvest or harvest rate in the monitored construction segments or the pooled ROW harvest data.

Human Access

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

1. MB Hydro installed trail cameras at all-weather construction access points (n = 14 locations during Year 2 and n = 9 locations during Year 3) to monitor human access of the ROW.

2. Trail cameras associated with the winter ground track transects were installed along the ROW in construction segments N2 and N3 during Year 2 (n = 18 locations sampled) and along N1, N2 and N3 during Year 3 (n = 24 locations sampled).

3. Results of the trail camera sampling effort along the ROW indicates the majority of ROW access for a known purpose was for Project construction (99.14% during Year 2 and 99.25% during Year 3) with limited local public access (0.84% during Year 2 and 0.75% during Year 3) for recreation and resource use.

Monitoring and Mitigation Recommendations

Based on the results of the 2016/17 (Year 3) report, the following are mitigation and monitoring recommendations for Year 4 and beyond:

1. **Capture-Mark-Recapture (CMR) Sampling using Non-invasive Genetic Survey (NGS) methods** – repeat sampling in all monitored boreal woodland caribou study areas in Year 5 (2018/19) to monitor population performance (abundance trend, lambda) though each Project phase (construction, operation); reassess sampling frequency after Year 5 analyses are completed.

2. Continue with annual winter **Boreal Woodland Caribou Recruitment Surveys** (aided by telemetry relocations) and concurrently conduct **Ungulate-Wolf Winter Distribution**

Surveys in all four monitored woodland caribou study areas to monitor for changes in mortality risk, white-tailed deer ingress, and altered predator-prey dynamics.

3. **Woodland Caribou Telemetry Study** - Continue to acquire boreal woodland caribou telemetry locations in each monitored caribou study area to evaluate behavioural responses to the Project, the effectiveness of the vegetation leave areas and monitor adult female boreal woodland caribou mortality and survival rates. Maintain an average sample of 20 collars/study area.

4. **Winter Ground Track Transects** of N1 – N4 construction segments during Year 4 (2017/18) – resample transects having remote cameras deployed (n = 40 transects), and opportunistically sample $\geq$10 additional transects (selected at random, subject to available budget) to improve statistical power for analyses of some furbearer species. In 2016, a power analysis was undertaken to assess the extent to which the current sample size of transects was sufficient for analytical requirements; results indicated that additional years of data were required for coyote, ermine/weasel, fox, wolf, lynx, squirrel, and wolverine but that sufficient samples was achieved for fisher/marten and rabbit/hare. In 2017, power analysis was run again with the newly acquired data and revealed that the larger mammals (caribou, moose, gray wolf and lynx) still required between 30 to 50 more transects to be sampled per year to achieve a power of 80% but aside from squirrel most of the remaining mid-sized species (fisher/marten, fox) had sufficient sample sizes for the analysis. Some furbearer species (i.e., black bear, coyote, mink, muskrat, otter, beaver, wolverine) require a lot of effort to sampled in winter because they are locally rare in the survey area, are wide ranging, hibernate, or are semiaquatic. The Project commitment is to sample annually during the construction phase, and for 3 years post-construction.

5. **Multi-species Arial Survey** – repeat survey in 2017/18 to sample mammal VECs during the final year of construction.

6. **Remote Trail Camera Study** - continue sampling to acquire additional data to compare construction phase (2014/15 - 2017/18) to operation phase (2018/19 - 2020/21; 3 years post-construction).

7. **Environmentally Sensitive Site (ESS) Monitoring –** with mechanized clearing completed and infrastructure installation nearing completion (anticipated early 2018), searching/monitoring for ungulate mineral licks, black bear winter hibernation dens, and wolverine maternal dens should no longer be required.

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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

TABLE OF CONTENTS

PAGE

TABLE OF CONTENTS (Cont'd)

PAGE

TABLE OF CONTENTS (Cont'd)

PAGE

LIST OF TABLES

PAGE

LIST OF TABLES (Cont'd)

PAGE

LIST OF FIGURES

PAGE

LIST OF FIGURES (Cont'd)

PAGE

LIST OF FIGURES (Cont'd)

PAGE

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PAGE

1.0 INTRODUCTION

On August 14, 2013, the Government of Manitoba (MB Gov) granted an *Environment Act* License (EA License; MB Gov 2013) to Manitoba Hydro (MB Hydro) for the construction, operation, and maintenance of the Bipole III Transmission Project (the 'Project'). Mechanized clearing for the Project began during the winter of 2013/14. 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 affected full implementation of ground-based mammal monitoring field programs as originally planned. Construction is scheduled for completion in 2018

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 began, monitoring emphasis switched 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 identifies and measures potential effects on these species, informs the mitigation strategy, and monitors 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 are modified or replaced where warranted.

Mammal valued ecosystem components (mammal 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 mammal 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 mammal 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 mammal VECs, disturbance thresholds (i.e., disturbance / displacement / avoidance) relative to mammal 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 mammals monitoring program was designed with multiple objectives per mammal VEC in mind, and with the intent to examine spatio-temporal behavioral responses, as well as population level responses of each mammal 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 mammal 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 (Amstrup 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 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.

Mammal-habitat relationships are fundamental to mammal ecology because of their central role in species distribution and biogeography, population dynamics, state and vital rates and individual life histories and behavioral ecology (Aldridge & Boyce 2008, Allen 1999, Cooper & Millspaugh 1999, Leblond et al. 2014).

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 mammal VECs 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 select mammal 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 mammal VECs.

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

There are species-specific monitoring objectives and parameters, which are summarized below.

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 and/or vehicle collisions) on boreal woodland caribou (P-Bog, N-Reed, Wabowden, Charron Lake populations), forest-tundra woodland 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, wolverine, and Environmentally Sensitive Sites (ESS; black bear dens, wolverine dens, wolf dens and rendezvous sites).

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 mammal 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 effects have been categorized into: 1) habitat effects; 2) population effects; and 3) community effects (section 2.2).

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 mammal 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 mammal 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 mammal VECs 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 mammal 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 section of this report (Section 4.0).

2.2 Study Design

To achieve the principal purpose of the follow-up mammals monitoring program for the Bipole III Transmission Project, key monitoring activities and the assessment of predicted and potential Project 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 mammal 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 mammal 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., 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 mammal 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 a and b) 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, the monitoring program examines Project 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 Gov, 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 mammal VECs are small fur bearing mammals 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 Gov 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 Gov 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 Gov.

To test mammal 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 mammal VEC, and used as the minimum boundary between impacted and non-impacted areas. For mammal 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	≤25 years 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 years	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 years 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 to 15 years or until suitable knowledge acquired	3 year intervals (integrate with MB Gov 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 years	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 the Project	3 years	Annual	Annual	Change in harvest success
Post-construction	Community trapping program	Sensitive sites (dens)	Community traplines proximate to the 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

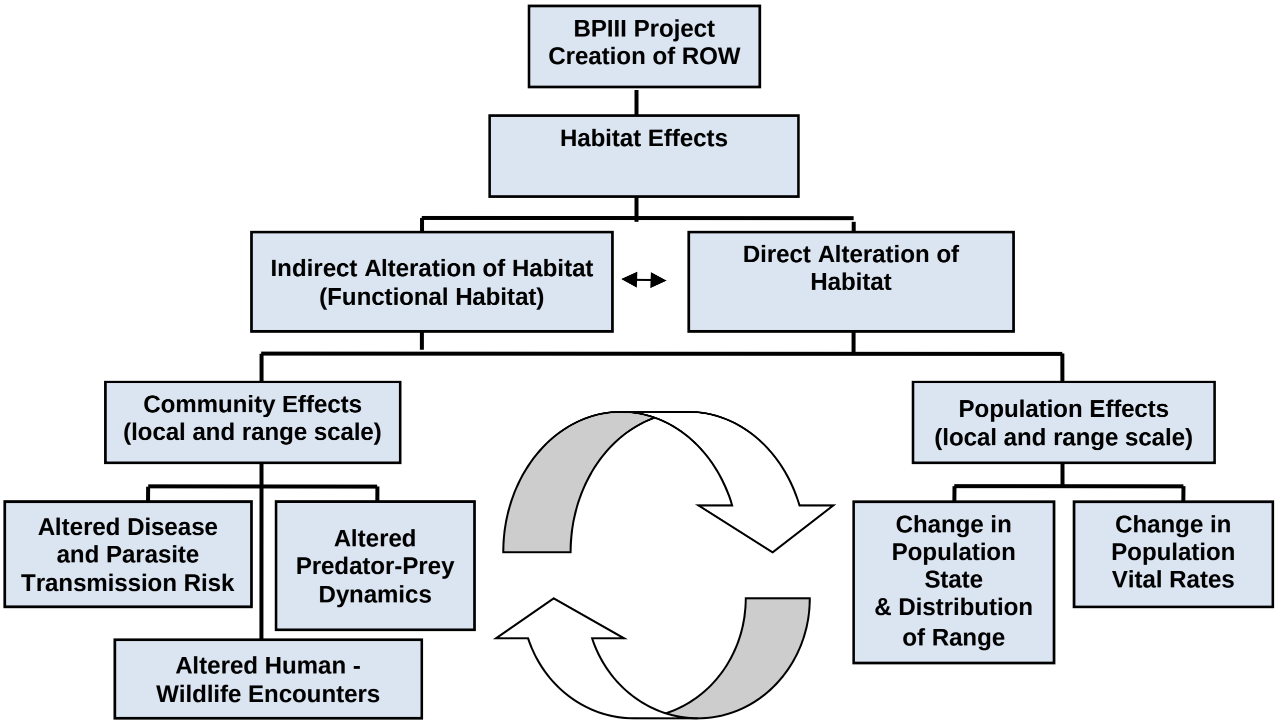
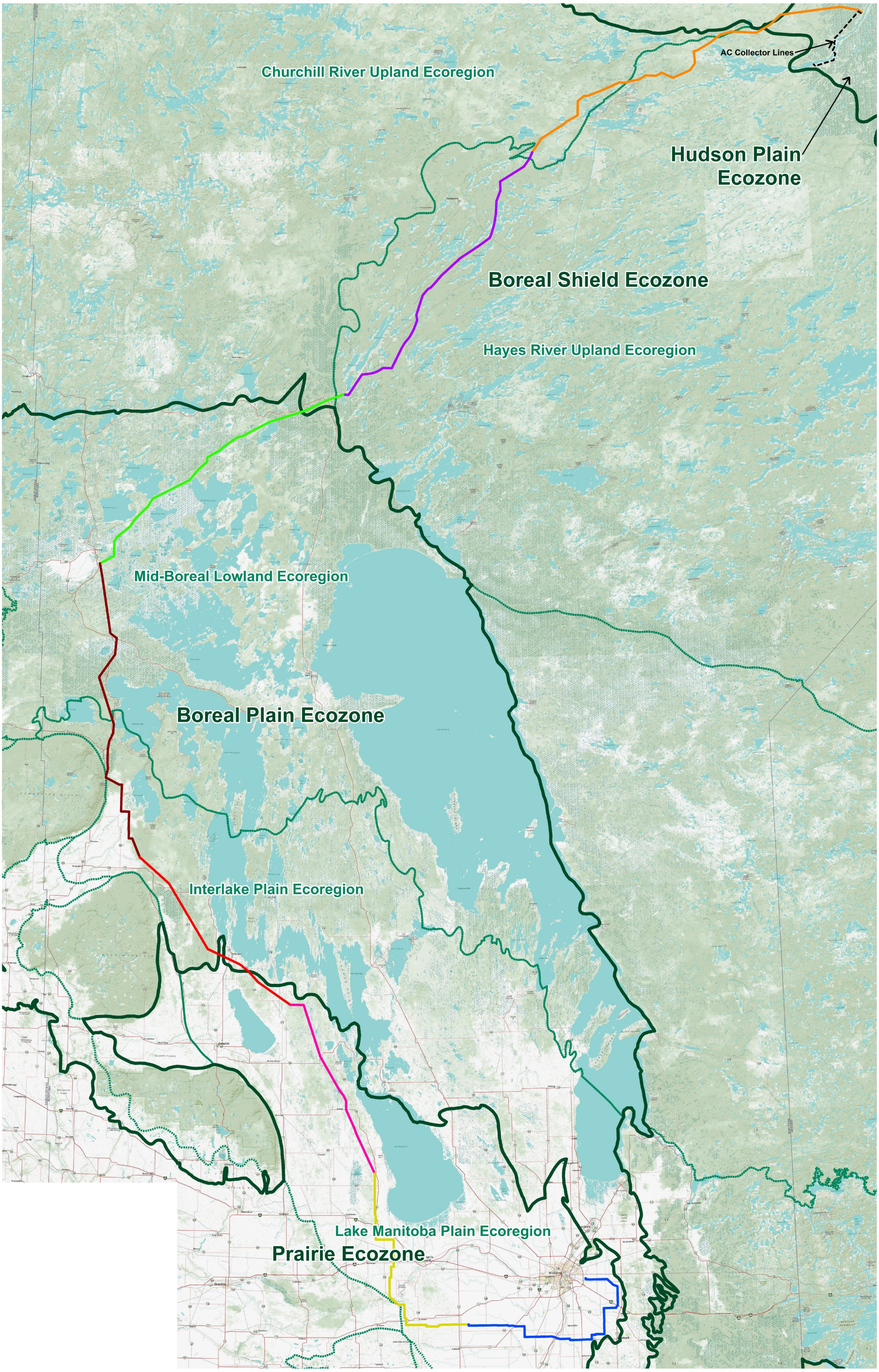


Figure 2-3-1: Monitoring Design Conceptual Overview of Effects Pathways



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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^{o}: WX17393

FIGURE: 2-3-2

SCALE: 1:2,300,000

DATE: March 2018

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's 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 monitoring workplan, and was presented at a meeting (September 17, 2014) with Manitoba Conservation and Water Stewardship (Arsenault & Hazell 2014a and b). Mammals monitoring results for Year 1 were presented in Amec Foster Wheeler 2016.

Year 2 (2015/16) Monitoring - Results for Year 2 are provided in Amec Foster Wheeler 2017.

Year 3 (2016/17) Monitoring - Results for Year 3 are presented in this report.

3.1 Field Activities – Year 3 (2016/17)

Field survey programs conducted during the winter of 2016/17 (Year 3 of monitoring) included the following primary data collection methods (see Section 4.0 for details of survey design):

1. **Woodland Caribou Recruitment Survey** - Aerial surveys aided by GPS telemetry collar relocations, to obtain winter calf recruitment estimates and population structure in four boreal woodland caribou ranges (P-Bog, N-Reed, Wabowden and Charron Lake).

2. **Non-invasive Genetic Sampling (NGS)** for **Capture-Mark Recapture (CMR)** population abundance assessment of each woodland caribou study area (n = 4), replicating the same study design applied in Year 1.

3. **Ungulate-Wolf Winter Distribution Survey** -conducted in each boreal woodland caribou study area (P-Bog, Wabowden, N-Reed and Charron Lake) to collect information on ungulate, wolf and wolverine relative landscape distribution to assess predator-prey dynamics (i.e., changes in predation-risk to moose and woodland caribou).

4. **Woodland Caribou GPS Telemetry Study -** ongoing monitoring of caribou movements in each woodland caribou study area to assess Project effects on caribou occurrence and movement dynamics.

5. Boreal woodland caribou **Telemetry Collar Mortality Investigations** (conducted by MB Hydro)

6. **Multi-species Aerial Survey** – The winter distribution data collected from this survey are used to assess coarse scale shifts in large mammal winter distribution and use of areas proximate to the Bipole RoW through each Project phase. The information may also inform potential *P. tenuis* risk to woodland caribou in relation to changes in deer and elk distribution using the Bipole III RoW. The survey was conducted by MB Hydro via helicopter, using the same survey design applied in Year 2 by the Alaskan Trackers via fixed wing.

7. **Moose (Gasaway) Population Surveys** were conducted by MB Gov at Porcupine Hills (GHA 13/13A) and Duck Mountains (GHA 18/18A/18B/18C). Population surveys (led by MB Gov in collaboration with MB Hydro) of Moose Meadows (GHA14) and Pine River (GHA14A/19A) sensitive moose areas were not conducted in Year 3 per the Bipole III mammals monitoring program schedule. Discussions are ongoing between MB Hydro and MB Gov on moose population monitoring methods for the Bipole III Project.

8. **Winter Mammal Ground Track Transect Surveys** were initiated in N4 (n = 20 transects) and repeated in N1 (n = 15 transects), N2 (n = 10 transects with IR cameras and n = 3 without cameras) and N3 (n = 7 of 10 transects with IR cameras and n = 1 transect without cameras deployed) construction segments. A total of 56 transects were sampled to document mammal VEC occurrence on the ROW, and to supplement the data set for analyses of potentially altered habitat use by furbearer VECs at various distance bands from the ROW.

9. **Remote IR Camera Traps** were deployed on N4 (n = 20) and existing cameras were serviced on N1 (n = 11 of 20; 3 missing, 2 retrieved and 4 not refurbished), N2 (n = 17 of 19; 2 retrieved) and N3 (n = 15 of 18; 3 not refurbished) to collect data on seasonal mammal use proximate to the ROW and up to 1.5 km from the ROW. A total of 63 cameras were deployed/serviced in Year 3 (excludes 3 missing/stolen, 2 retrieved and 7 not refurbished).

10. **Human Access Monitoring** involved servicing of remote IR trail cameras at all-weather ROW access points (n = 10 locations), as well as those from the Remote Trail Camera Study situated at the ROW along N1 (n = 7 locations; excludes 1 location not serviced), N2 (n = 9 locations) and N3 (n = 7 locations, excludes 1 location not serviced) construction segments. Ten cameras were deployed along the N4 segment of the ROW.

11. **White-tailed Deer Fecal Pellet Collection** (*P. tenuis* sampling) was undertaken via ground targeted sampling of several locations within the two *P. tenuis* surveillance areas along the Bipole III footprint.

3.1.1 Data Acquisition

Boreal woodland caribou GPS satellite telemetry data collected by MB Hydro from 2010 to 2017 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) and 2016/17 (monitoring Year 3) were acquired from MB Gov 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 Gov for all 42 registered traplines intersected by the Bipole III ROW. Harvest results during Year 1 (2014/15) and Year 2 (2015/16) of Project disturbance were also acquired; harvest statistics for Year 3 (2016/17) 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 were collected via a Multi-species Aerial Survey (MB Hydro using helicopter) during Year 3 based on the transect survey design used in Year 2 (Alaskan Trackers using fixed-wing). In addition, woodland caribou telemetry collar mortality investigation results were obtained from MB Hydro.

3.2 Planned Monitoring Activities - Year 4 (2017/18)

Monitoring field activities planned for Year 4 (2017/18) include:

1. **Moose Population Surveys** (led by MB Gov) - participate/support surveys in any sensitive moose ranges or adjacent reference populations as required. Surveys of Moose Meadows (GHA 14) and Pine River (GHA 14A/19A) were scheduled in the Bipole III Mammals Monitoring Program for Year 3 but were not conducted by MB Gov.

2. **Woodland Caribou Recruitment Survey** (assisted by GPS telemetry relocations) and concurrent **Ungulate-Wolf Distribution Survey** in all woodland caribou study areas.

3. **Multi-species Aerial Survey** of the Bipole III ROW (N1-N4, and north portion of C1 construction segments).

4. **Winter Ground Track Transect Survey** of all transects with remote trail cameras (n = 40) and a minimum of 10 additional transects selected at random (number subject to available budget and staff resources).

5. **Remote Trail Camera Study** – service all trail cameras concurrent with Winter Ground Track Transect Survey.

6. **Woodland Caribou Telemetry Study** (MB Hydro led) – deploy telemetry collars to maintain sample of 20 collars/study area; continue with telemetry collar mortality signal investigations. Collar deployment effort should focus on P-Bog, Wabowden and Charron Lake ranges. Telemetry analysis do not indicate a significant interaction of N-Reed woodland caribou with the Project footprint.

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) 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: 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. Two of the woodland caribou ranges (P-Bog, Wabowden) 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. Caribou within the N-Reed range have not demonstrated frequent interaction with the Project footprint since the monitoring program was initiated in 2014. 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). These ranges were all delineated through long term monitoring data of GPS collared caribou and defined by MB Gov (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).

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. 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. 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 4 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.

4.1.1.1 Range Use

Kernel analysis was undertaken to ascertain the annual home range for each GPS collared animal and the relative probabilities of use within that home range (Worton 1989) using ArcGIS 10.1

Spatial Analyst Extension and Home Range extension v9. Kernels are used as one of the bases in the resource selection, zone of influence and site fidelity analysis.

Kernel volume contours are generated by connecting areas of equal probability of animal occurrence based on the utilization distribution, a measure of the geographic spread of observation points, and the defined smoothing factor (h). For example, a 90% kernel contour represents the region within which (during a given monitoring period), there is a 90% chance of finding the animal during the monitoring period.

The smoothing (h) factor defines the spread of the probability kernel generated over each observation point. The probability kernels are combined into a probability surface called the utilization distribution. The adaptive kernel method allows the kernel (smoothing factor) to vary slightly from the defined smoothing factor based on the density of observation points. This method is used to minimize both over and under estimation of the home range.

Home ranges per collared animal were generated using a 90% volume adaptive kernels (h=0.4). Seasonal range areas such as overwintering and calving areas were generated per animal using 70% volume adaptive kernels (h = 0.4). Core over-wintering areas included data from December 1 to February 28 and core calving areas included data from May 1 to June 30. Core overwintering areas are also used to inform the genetic CMR and calf recruitment surveys in January and February and based on the success of locating animals were accurate delineations of where high concentrations of caribou spend the winter months.

4.1.1.2 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, demonstrating site fidelity to an area suggests that Project activities have 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.

Studies of site fidelity have been hampered by arbitrary designations of spatial scale and the lack of null models for comparison, however Schaefer et al. (2000) developed a method to deal with both issues using empirical data to define null expectations. Following Schaefer et al. (2000), fidelity was defined as the propensity for consecutive year locations of an individual to be closer together than random pairs of locations from satellite collared caribou bounded by their distribution over a specified time. We defined the total population range as the space denoted by locations of all satellite collared animals within each respective range (i.e., Wabowden, P-Bog, N-Reed and Charron Lake) during all portions of the annual cycle. We defined the seasonal range as the space denoted by the locations of all satellite collared caribou within each respective range (i.e., Wabowden, P–Bog, N-Reed and Charron Lake) during a specific month of the annual cycle.

Null expectations of fidelity were generated at different scales and then compared to empirically based distances between consecutive year locations for each caribou. Null expectations define what we would expect to see *if caribou were behaving randomly and no particular behaviour or site selection was being demonstrated*. This analysis used an *informed* “null” such that random expectations are still derived from the empirical caribou telemetry locations themselves so are not completely random. Null expectations were generated at both a large population range scale and more local seasonal range scale. The population range null was defined by computing distances between random pairs of locations during any period of the annual cycle from any year of monitoring within each range (i.e., Wabowden, P-Bog, N-Reed and Charron Lake). A bootstrapping method was used to generate the null expectation, whereby a random subsample of 100 locations was repeatedly generated to calculate the mean distance of all possible pairs and the repeated until the estimate of the mean stabilized. Therefore, the null model is consistent across all months, representing the entire extent available for the year (Schaefer et al. 2000). The seasonal range was defined as the locations of all collared caribou within each range within each month. The null expectations were derived by calculating distances between all possible pairs of locations within each month within each range for any location at least one year apart. The null model was generated separately per month and could therefore vary from month to month.

For the observed pattern, distances between consecutive year “locations” were calculated using harmonic means of monthly range use for each collared caribou. Harmonic means are a measure of the centroid of use for a given period of time; they are an average “location” per sample period (in this case, per month). Ranges may still overlap from year to year but the centre of activity within a given range can change, making harmonic means an appropriate indicator of disturbance. Harmonic means were calculated for each month for each year for each collared caribou (2010 to 2014). Larger distances between monthly harmonic means from year to year indicate weaker fidelity, smaller distances between harmonic means indicates stronger fidelity.

Site fidelity was denoted as occurring when the null value was outside the confidence interval for that month. Analysis was undertaken for both the pre-construction and construction phases to assess whether any changes had occurred as a result of the Project. All statistical analyses were performed using R (The R Foundation for Statistical Computing).

4.1.1.3 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). The base RSF models were developed in 2016 for the Year 2 (2015/16) report (Amec Foster Wheeler 2017) and used for this current year to facilitate intra year comparisons of ZOI. The RSF model acts to control for habitat differences when quantifying the ZOI around the Project.

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) using "ClogitL1" in R (Reid & Tibshirani 2014). Random locations were selected within a buffer around the observed caribou location that represented the potential movement distance of that individual (Johnson et al. 2005). 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 (Amec Foster Wheeler 2016).

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 varied (Table 4-2 and 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

The base habitat model used in the ZOI analysis was developed in the Year 2 Monitoring Report (Amec Foster Wheeler 2017). 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 used. 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 for inclusion (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. Development of the model including statistical approaches to control variation and error in vegetation distribution are in Amec Foster Wheeler 2017. We selected the most parsimonious habitat model for each season using Akaike information criterion (AIC). The top model for each season was used to spatially predict the probability of occurrence and used in the ZOI analysis for the corresponding range and season. 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).

Other 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. Inclusion would allow for a more comprehensive assessment of behavioural responses to all disturbance types including the Project, however would require a much more comprehensive landscape mapping exercise to quantify these layers. A predation-risk layer generated from observations of wolves collected during the annual winter calf recruitment surveys can also be considered in future years, contingent on sample size.

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. Both ranges also have an accumulation of caribou telemetry locations within 10 km of the Project. 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 near the Project for this analysis.

Analysis for this 2017 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 there would be no pattern in the log likelihood or it 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.

4.1.1.4 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 constructed. 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 pre-existing linear corridor during the pre-construction phase, as well as widening of the ROW through the Project 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.

For this most recent report, we compared the difference between actual and random crossings during the construction phase. 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.

4.1.1.5 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. **Centerline Clearing -** are areas where vegetation mitigation has been applied. In these areas, the centerline of the ROW has been cleared, as well as any trees taller than the 40% line of sight (LOS) angle to the edge of the ROW and beyond. 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 more than areas that had not been mitigated. 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 currently 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 periods 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 Aerial Surveys

Woodland Caribou Recruitment Survey - Annual winter calf recruitment, population structure and distribution were assessed in Year 3 by aerial observations (aided by GPS telemetry relocations of collared woodland caribou), using the methods and survey design implemented in Year 1. Systematic transects spaced at 3 km intervals oriented in an east-west direction (Figure 4-1-1) were flown by helicopter at ±200m ground height and ±90 km/hr ground speed to search for caribou and caribou sign (tracks and cratering). At least 20 cm snow cover and minimal overcast are required for contrast to maximize detectability. Ideally the survey is conducted 2 or 3 days following a significant snow event to distinguish recent from old sign. The helicopter would stray off transect to relocated telemetry collar signals, or to verify caribou sign, or to classify caribou detected, before returning to transect. Classification of individuals to sex and age category was conducted by experienced caribou biologists to minimize observer bias. 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.

Ungulate-Wolf Distribution Survey - Moose, deer, elk, wolverine and wolf recent sign and observations were recorded in each woodland caribou survey area concurrently during the Woodland Caribou Recruitment Survey. These species provide insight into coarse (landscape) scale patterns of caribou distribution. The annual survey provides data for analysis of wolf predation risk, to monitor changes in community dynamics, to monitor changes in ungulate, wolverine and wolf relative distribution, as well as to assess disease risk (potential for *P tenuis* transmission from overlap of other ungulate species with caribou, or ingress of white-tailed deer into caribou range) relative to woodland caribou.

4.1.3 Non-invasive Genetic Sampling (NGS)

Non-invasive Genetic Sampling (NGS) of woodland caribou (via collection of fecal pellets at forage cratering sites) was repeated in Year 3 (2016/17) concurrent with the Woodland Caribou Recruitment Survey for initial fecal pellet sampling (i.e., genetic capture event; CMR1). Transects were then repeated 3 to 4 weeks later to resample (i.e., genetic re-capture event; CMR2) each caribou study area (Figure 4-1-1). The data obtained from subsequent genotyping analysis of fecal pellet samples are used for Capture-Mark-Recapture (CMR) population estimation.

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 Program. However, there is an 8-year (initiated in 2010) collaborative caribou satellite telemetry collar study involving MB Gov, 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. The 8-year telemetry study is nearing completion, with no further collar deployments or recruitment surveys planned.

Qamanirjuaq caribou may occasionally occur (during winter) in proximity to the Project (Figure 4-2-1), however the population range is adjacent to the northwest range bounds of the Cape Churchill population (Gunn et al. 2011). No formal field studies of Qamanirjuaq caribou are being conducted in proximity to the Bipole III Project.

4.2.2 Mitigation Monitoring

Mitigation measures involve avoiding effects from Project construction activities if/when herd migration movements overlap construction segment N1. MB Hydro environmental monitors from local communities are on site to advise if concentrations of forest-tundra or barren-ground caribou are in proximity of the Project during winter construction.

4.3 Moose

Three sensitive moose ranges 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 addition, MB Hydro conducts a periodic moose survey as a component of the Terrestrial Effects Monitoring Plan for the Keeyask Generation Project. Area 5 of the Keeyask moose survey (i.e., Split Lake Moose Monitoring Area) overlaps an eastern portion of GHA 9 that is intersected by construction segment N1 of the Bipole III ROW. The four monitored moose populations and adjacent reference populations are presented in Figure 4-3-1.

4.3.1 Aerial Surveys

Aerial Moose Population Surveys - Surveys using a modified Gasaway method (Gasaway et al. 1986, Lynch & Shumaker 1995) are conducted by MB Gov as determined by annual provincial survey priorities. MB Hydro participates in the survey effort when a survey is scheduled for a Bipole III sensitive moose range.

- **Year 1 (2014/15)** - A survey of the Split Lake Moose Monitoring Area (eastern portion of GHA 9) was conducted by MB Hydro in January 2015.

- **Year 2 (2015/16**) - Surveys were conducted in two GHAs (Tom Lamb/GHA 8 sensitive moose area, and in GHA 11) that overlap the Bipole III ROW in mid-January to mid-February 2016.

- **Year 3 (2016/17)** - Surveys of Moose Meadows (GHA14) and Pine River (GHA14A/19A) sensitive moose areas were scheduled to occur in Year 3 as a component of the Bipole III Mammals Monitoring Program. However, these surveys were deferred by MB Gov to a later year in order to prioritize modified Gasaway surveys of the Porcupine Hills (GHA 13+13A) and Duck Mountain (GHA18+18A+18B+18C) reference populations in late January/early February 2017.

Ungulate-Wolf Distribution Survey - Moose distribution (observed moose and fresh tracks) are recorded concurrent with the annual Woodland Caribou Recruitment Survey in each boreal woodland caribou survey area.

- **Year 1 (2014/15)** – first winter of construction **-** The survey was conducted in all caribou survey areas from January 19 through February 6, 2015 concurrent the Caribou NGS (first sampling) effort and concurrent with the Caribou Winter Recruitment Survey.

- **Year 2 (2015/16)** - The survey was conducted January 12 to 19, 2015 (N-Reed, Wabowden and Charron Lk survey areas) and February 25 and 26, 2016 (P-Bog survey area). The P-Bog survey was delayed because of a moose survey being conducted by MB Gov at the same time.

- **Year 3 (2016/17)** – The survey was conducted January 17 to February 5, 2017 concurrent with the Caribou NGS (first sampling) effort and Caribou Winter Recruitment Survey.

Multi-species Distribution Survey – The annual survey provides coarse scale information of winter wildlife (including moose) occurrence in proximity to the Bipole III ROW along construction segments N1-N4 and north portion of C1. The current survey design 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 are flown 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 4-3-2). The Project commitment is to conduct the survey annually for up to 4 years post-construction.

- **Pre-construction (2013/14) –** Survey was conducted by Alaskan Trackers along transect intervals of 0.25, 1.25 and 3.25 km parallel to the ROW.

- **Year 1 (2014/15)** - No survey conducted; Alaskan Trackers not available to conduct the survey.

- **Year 2 (2015/16)** - The survey was conducted by the Alaskan Trackers in late January through mid-February 2016 via fixed wing aircraft; the 5.25 and 10.25 km transect intervals were added to the survey design to improve data acquisition for wider ranging and/or sparsely distributed species (i.e., wolverine, wolf, ungulates).

- **Year 3 (2016/17)** - The survey was conducted by MB Hydro via helicopter in February 2017.

4.3.2 Population Modelling

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).

Time series population (demographic and abundance trend) models for each monitored population and adjacent reference populations were updated to incorporate 2016/17 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

The following summarizes sampling methods and efforts by monitoring year:

- **Year 1 (2014/15)** - Two surveillance areas were identified during Year 1 (2014/15) of the monitoring program 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 the Multi-species Aerial Survey conducted in January / February 2014 prior to significant Project disturbance from vegetation clearing of the ROW. However, no pellet sampling occurred because that portion of the Project Biophysical Monitoring Plan (MB Hydro 2015) had not yet been approved for the planned survey window.

- **Year 2 (2015/16)** – Boundaries of the two surveillance areas were modified and an aerial transect survey design was implemented (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 to obtain winter fecal pellet samples for *P. tenuis* analysis. However, access restrictions to private land precluded landing for pellet sample collection.

- **Year 3 (2016/17)** - Ground-based pellet collection was conducted February 21 to 23, 2017 by MB Hydro using UCN (University College of the North) and OCN (Opaskwayak Cree Nation) student volunteers to acquire deer fecal pellet samples from Surveillance Area 1 (south end of N3 near The Pas), Surveillance Area 2 (including additional areas along N4 to the south of Surveillance Area 2), and north end of C1 construction segment (Figure 4-4-2). The samples were submitted to Prairie Diagnostic Services (University of Saskatchewan) to assess via Baermann technique for presence of spiney-tailed larvae, which is indicative of probable *P. tenuis* infection. Sampling will be repeated in 5 years to assess for changes in deer distribution along the ROW as well as changes in *P. tenuis* prevalence.

4.4.2 White-tailed Deer Ingress

Deer ingress and elk occurrence along the ROW are assessed using several methods discussed elsewhere in this report, but include:

1. **Winter Ground Track Transect Survey** of N1, N2, N3 and N4 construction segments;
2. **Remote IR Camera Traps** associated with the **Winter Ground Track Transect** sampling design;
3. **Ungulate-Wolf Distribution Survey** of woodland caribou study areas concurrent with the annual Woodland Caribou Winter Calf Recruitment Survey;
4. **Aerial Moose Population Surveys** (modified Gasaway method) of sensitive moose ranges and GHAs intersected by the ROW;
5. **Multi-species Aerial Survey** of C1 (north portion) and N1-N4 construction segments of the Bipole III ROW; and
6. **Incidental observations** of deer and deer sign by the Project Environmental Monitors.

4.5 Furbearers

4.5.1 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 Gov to calculate baseline harvest statistics by furbearer species for each construction segment intersecting the registered traplines. The objective is to compare the pre-disturbance phase (baseline harvest statistics 2001/02 to 2013/14) to the construction phase (2014/15 - 2017/18), and to continue to monitor for effects for the first 3 years of the operation phase. Focal species for furbearer harvest monitoring include American beaver, pine marten, wolf and wolverine. However, additional harvested species including coyote, red fox (cross, red, silver), arctic fox (white), fisher, lynx, mink, muskrat, otter, red squirrel, and weasel are also assessed.

Community trapline data were collected (pilot program on 2 traplines in Year 3) though a community-based monitoring program for select community traplines. The program is a partnership between Opaskwayak Cree Nation (OCN) Natural Resource Council, Opaskwayak Educational Authority and MB Hydro. The purpose of the program is to help MB Hydro and local communities better understand the effects of the Bipole III facilities on furbearer behaviour and trapper success.

The monitored community lines include:

- N3 - Elk Youth Trapline (Summerberry STA 620-ELK) - Opaskwayak Cree Nation (OCN) Natural Resource Council; and
- N2 - Wabowden Community Trapline (Wabowden 430-21) - Opaskwayak Educational Authority.

Monitoring by the students involved weekly trap monitoring by youth in the program along with remote trail cameras to observe the trapsets, and recording of furbearer sign and observations along the trapline.

4.5.2 Distribution Monitoring

4.5.2.1 Winter Ground Track Transect Survey

Annual winter ground transect intercept sampling was undertaken to compare furbearer occurrence (by species) as a function of the distance to the Project during the construction phase. Sampling focuses on those furbearer species that are active in winter on terrestrial habitat (excludes black bear, beaver, muskrat). The data are used to determine whether there is evidence of local displacement of furbearer species relative to Project location. Analysis is focused on quantifying patterns over time starting in the construction phase as local furbearer track data relative to the Project footprint during the pre-disturbance phase is not available for locations where the Project ended up being installed on the landscape.

The ground transect intercept sampling design utilizes L-shaped transects spaced at ±10 km intervals along construction segments N1 - N4 of the ROW (n = 80 transects; 20 transects / construction segment; Figure 4-5-2). Each L-shaped transect has a 500 m segment placed diagonally across the ROW, and a 1,000 m segment place perpendicular to the ROW with the direction from the ROW initially selected at random. Transect sampling is integrated with remote camera traps (i.e., 2 cameras on approximately every second transect; one placed near the ROW at the start of the 1,000 m segment and a second placed at the far end of the 1,000 m segment). The cameras are intended to collect supplementary data on mammal VECs and human access across seasons. After the initial year of camera deployments along a particular construction segment, priority of repeat sampling (annually in February) is on those transects with cameras (n = 40 transects). Additional transects (n = ±10 transects with no cameras deployed) are sampled annually subject to available budget, weather conditions and staff resources, to improve statistical power of distance-to-feature analyses.

The following summarizes sampling effort by monitoring year:

- **Year 1 (2014/15)** - Sampling was initiated on construction segments N2 (n = 20 transects) and N3 (n = 19 transects) in conjunction with remote camera deployments on every second transect. Sampling and camera deployments were conducted March 13 to 19,

2015. N1 and N4 were not sampled during Year 1 because of access restrictions and limited ROW clearing progress along those construction segments. A total of 39 transects were sampled.

- **Year 2 (2015/16) -** Sampling was expanded to construction segment N1 (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 18-25 February 2016, and included memory card retrieval and servicing of remote cameras deployed in March 2015 in construction segments N2 and N3; access restrictions prevented sampling of N4. A total of 35 transects were sampled.

- **Year 3 (2016/17) -** Sampling was conducted from 4-14 February 2017, and included remote camera servicing of most accessible cameras that were previously deployed on N1, N2 and N3 construction segments. Sampling was expanded to N4 (n = 20 transects) and was repeated in N1 (n = 15 transects), N2 (n = 10 transects with IR cameras and n = 3 without cameras) and N3 (n = 7 of 10 transects with IR cameras and n = 1 transect without cameras deployed) construction segments. A total of 56 transects were sampled to improve statistical power of distance-to-feature analyses for select mammal VECs.

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. Data were then binned by intervals of 200 m from the Project. The short leg of each transect was considered as distance 0 m from the Project and the long leg of each transect was divided into 200 m bins. Observations were summed within each bin and corrected for distance surveyed. To obtain covariates for habitat type within the survey area, a point was generated at every 10 m along each transect and land cover type at each point was extracted from vegetation classes from EOSD mapping (http//www.geobase.ca /geobase/en/data/landcover/index.html). These land cover covariates were made into multiple columns (one per land cover code) of binary data. Land cover type binary values were summed and transformed into proportions of each land type within each bin. A separate categorical column was also created for the dominant land type within each segment. Snow depths were averaged along both the long and short legs of each transect. For all other covariates (temperature, wind speed, cloud cover, snow type and noise level) a single value was measured for each survey of each transect.

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. Up to 753 models were tested with 'distance to ROW' and 'year' as fixed effects, 'transect' as a random factor, and 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 (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.

4.5.2.2 Remote IR Camera Traps

The purpose of camera trapping was to monitor Project disturbance effects on mammal species and relative predator distribution at fine scale by comparing occurrence and distribution near the Project ROW vs away from the Project ROW across seasons and Project phases during the construction and initial operation (3 years post-construction) phases (see Amec Foster Wheeler 2016 for a description of the sampling design). In addition, the camera traps document large predator (wolf, black bear and wolverine) occurrence relative to the ROW, as well as potential white-tailed deer ingress proximate to the Project ROW. The following summarizes sampling effort by year:

- **Year 1 (2014/15)** - 37 remote cameras were systematically deployed March 13 to 19, 2015 on winter ground survey transects in N2 (n = 18 cameras on 10 transects) and N3 (n = 19 cameras on 10 transects).

- **Year 2 (2015/16)** - All remote cameras deployment locations on N2 (n=18) and N3 (n=19) winter ground transects were accessed to service cameras. On N2 construction segment, 3 cameras failed and were replaced, one camera was stolen and not replaced, and 2 additional cameras were installed, resulting in 19 active remote cameras deployed in N2 after servicing. 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 replaced, resulting in 18 active cameras in N3 after servicing. N1 construction segment had 20 cameras deployed. No cameras were deployed in N4 construction segment because of access restrictions. A total of 57 remote cameras were in service on N1 - N3 ground transects after servicing/deployment was completed during February 18 to 25, 2016.

- **Year 3 (2016/17)** - 11 cameras deployed in N1 (n = 20) were serviced, 2 were retrieved, 3 were missing (presumed stolen) and 4 were not serviced or retrieved because the locks were seized or keys not available at time of transect sampling to access or retrieve the cameras. This resulted in 11 active and 4 inactive cameras deployed on 10 transects in N1 after transect sampling. On N2 (n = 19), 16 cameras were serviced, 2 were retrieved, and 1 was replaced, resulting in 17 active cameras deployed on 10 transects in N2 after transect sampling. On N3 (n = 18), 13 cameras were serviced, 2 were retrieved with replacements deployed, and 3 were not serviced because of active line stringing in proximity of the transect, and/or sampling time constraints, resulting in 15 active and 3 inactive cameras deployed on 10 transects in N3 after transect sampling. On N4, 20 active cameras were deployed on 10 transects. A total of 63 active and 7 unserviced remote cameras were deployed on 40 transects in N1 – N4 after servicing/deployment was completed during February 4 to 14, 2017.

Figure 4-5-2 provides an overview of the Remote IR Camera Trap sampling design. Trail camera data was compared using one-tailed t-tests to access differences in occurrence (near versus away from the ROW) for individual furbearer species where sufficient location data had accumulated over the past 2 years of camera deployment.

4.5.2.3 Beaver Presence/Absence Survey

During Year 2 (2015/16) MB Hydro Environmental Monitors were provided a survey methodology to conduct presence/absence surveys for beaver activity at Project ROW intersections with riparian habitat including ±200m on either side of the crossing. Data requested included date, observer name, crossing location (construction segment, UTM coordinates), record of presence / absence within 200 m of the ROW, and observation type (i.e., lodge, dam, individuals seen, fresh vs old foraging sign). The survey was not repeated in Year 3. The Multi-species Aerial Survey includes detection of beaver lodges within the transect survey design.

4.5.2.4 Aerial Surveys

Multi-species Aerial Survey – The survey was conducted along via helicopter during Year 3 by MB Hydro. The survey provides coarse scale winter local distribution data on medium and large furbearer species (i.e., wolf, wolverine) species in proximity to the ROW, and predator-prey distribution (i.e., ungulates and wolf).

Ungulate-Wolf Winter Distribution Survey - The survey provides opportunity to record supplemental distribution (observations and sign) data for wolverine and wolf in P-Bog, N-Reed and Wabowden woodland caribou study areas relative to ROW disturbance. However, the primary purpose of the survey is to collect data on wolf distribution relative to potential ungulate prey species to evaluate changes in predation risk for ungulate species, and to monitor for white-tailed deer ingress into woodland caribou range, as potential effects of the ROW.

All data manipulation and statistical analyses were conducted in R (The R Foundation for Statistical Computing). The distance sampling (ds) function in the R package ‘Distance’ (Miller, 2017) was used to estimate density of animals within the area surveyed along each transect to assess how density varied with distance from the ROW. Density of animals is estimated with a Horvitz-Thompson-like estimator and a detection function that models the probability of detection based on the distribution of counts with distance from the observer to correct for this bias (Miller et al., 2016; Thomas et al., 2002). Confidence intervals (95%) for each estimate are calculated and when comparing density of animals at different distances from the ROW, overlap in confidence limits between two distance groups signified that they were not statistically significant (Ridgway, 2010).

A total of 17 models were tested, each containing one of three detection functions: halfnormal, hazard-rate, or uniform (Miller et al., 2016). Each candidate model also contained a combination of covariates which included: 1) land cover type (Table 4-1-4); 2) the type of observation (tracks/animal/other); and; 3) observer. Three of the models tested did not contain covariates, but a strict constraint on monotonicity was specified for their detection functions since, in the absence of covariates, it is likely that the number of detections would decrease with distance from the observer (Miller, 2017). The fit of each model to the data was tested with a Cramer-von Mises goodness of fit test and final model selection was made by comparing AIC values. Separate analyses were conducted for each species and for each year to detect potential differences in density patterns across years.

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

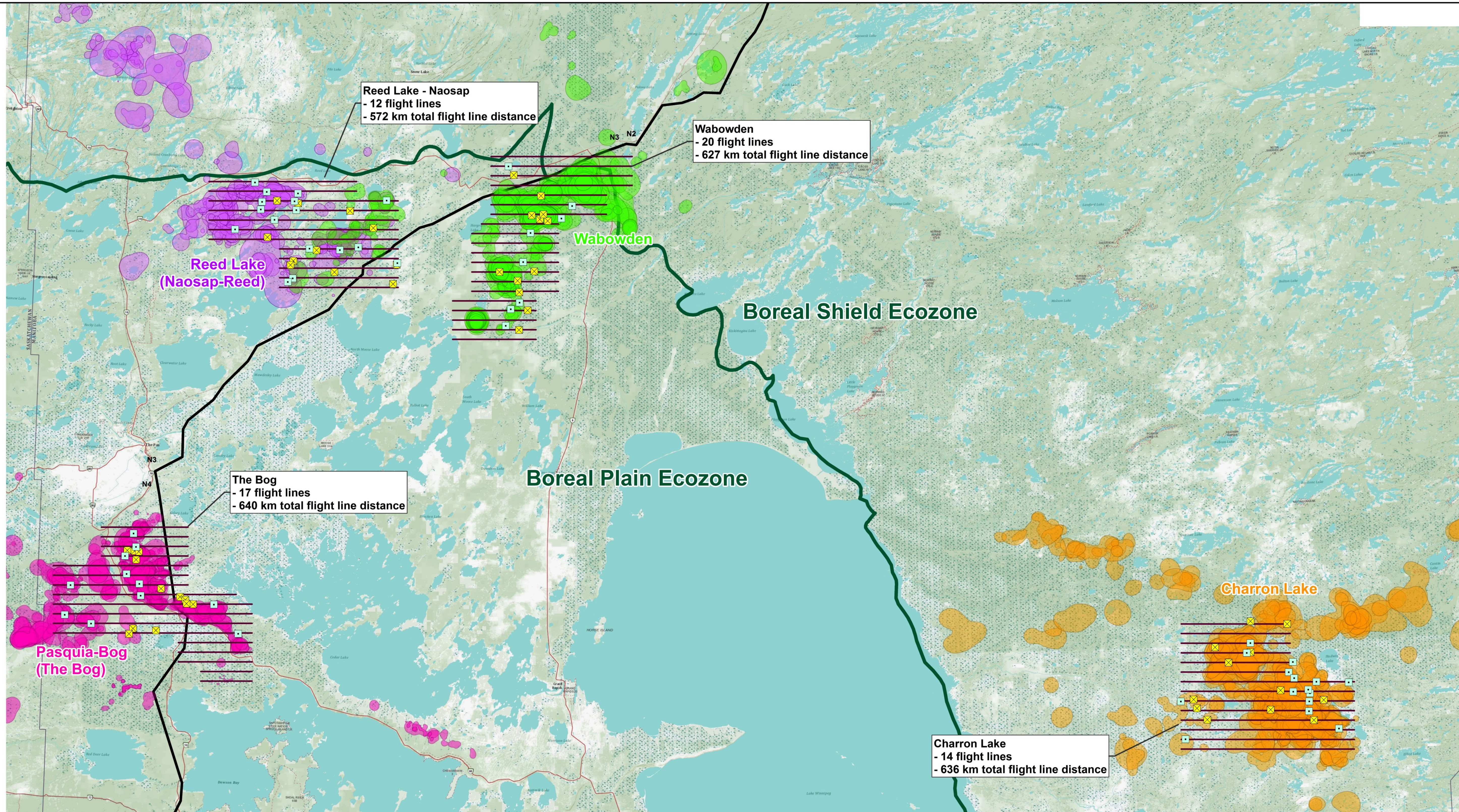
Season	Number of Individuals	Number of Locations	Average Number of Locations / Individual	Average Percent Contribution per Individual	Maximum Percent Contribution for an Individual
Early Winter	15	1350	90	6.7	6.7
Fall	17	1218	71	5.9	6.2
Late Winter	15	892	59	6.7	6.8
Spring	14	840	60	7.1	7.1
Summer	19	1333	70	5.7	5.7

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	16	1245	77.8	6.3	7.2
Fall	16	1200	75.0	6.3	6.3
Late Winter	11	610	55.4	9.1	10.0
Spring	9	534	59.3	11.1	11.2
Summer	19	1241	65.3	5.3	6.1

Table 4-1-4: Descriptions of Vegetation Classifications for the Earth Observatory for Sustainable Development (EOSD) Landsat

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



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LEGEND

- Survey Area Flight Lines
- BPIII Transmission Line Route
- Ecozones

Caribou Pellet Sampling Locations (2017)

- Round 1 Pellet Collection Sites (capture/mark, CMR1)
- Round 2 Pellet Collection Sites (re-capture, CMR2)

Over-wintering kernels per Caribou Monitoring Range

- 70% Adaptive Kernel Contours for Pasquia-Bog Collars (darker pink areas indicate greater amount of Over-Wintering overlap)
- 70% Adaptive Kernel Contours for Reed Lake-Naosap Collars (darker purple areas indicate greater amount of Over-Wintering overlap)
- 70% Adaptive Kernel Contours for Wabowden Collars (darker green areas indicate greater amount of Over-Wintering overlap)
- 70% Adaptive Kernel Contours for Charron Lake Collars (darker orange areas indicate greater amount of Over-Wintering overlap)

NOTES:
- Background topographic map extracted from ESRI online basemap services
- Collars from 2010 to 2017 are shown on the map
- Over-wintering kernels are based on telemetry locations between December and end of February
- CMR1 survey conducted between Jan. 17, 2017 and Feb. 5, 2017
- CMR2 survey conducted between Mar. 10, 2017 and Mar. 22, 2017

Datum: NAD83
Projection: UTM Zone 14N

0 60 120 180 240 300 Kilometres

Manitoba Hydro

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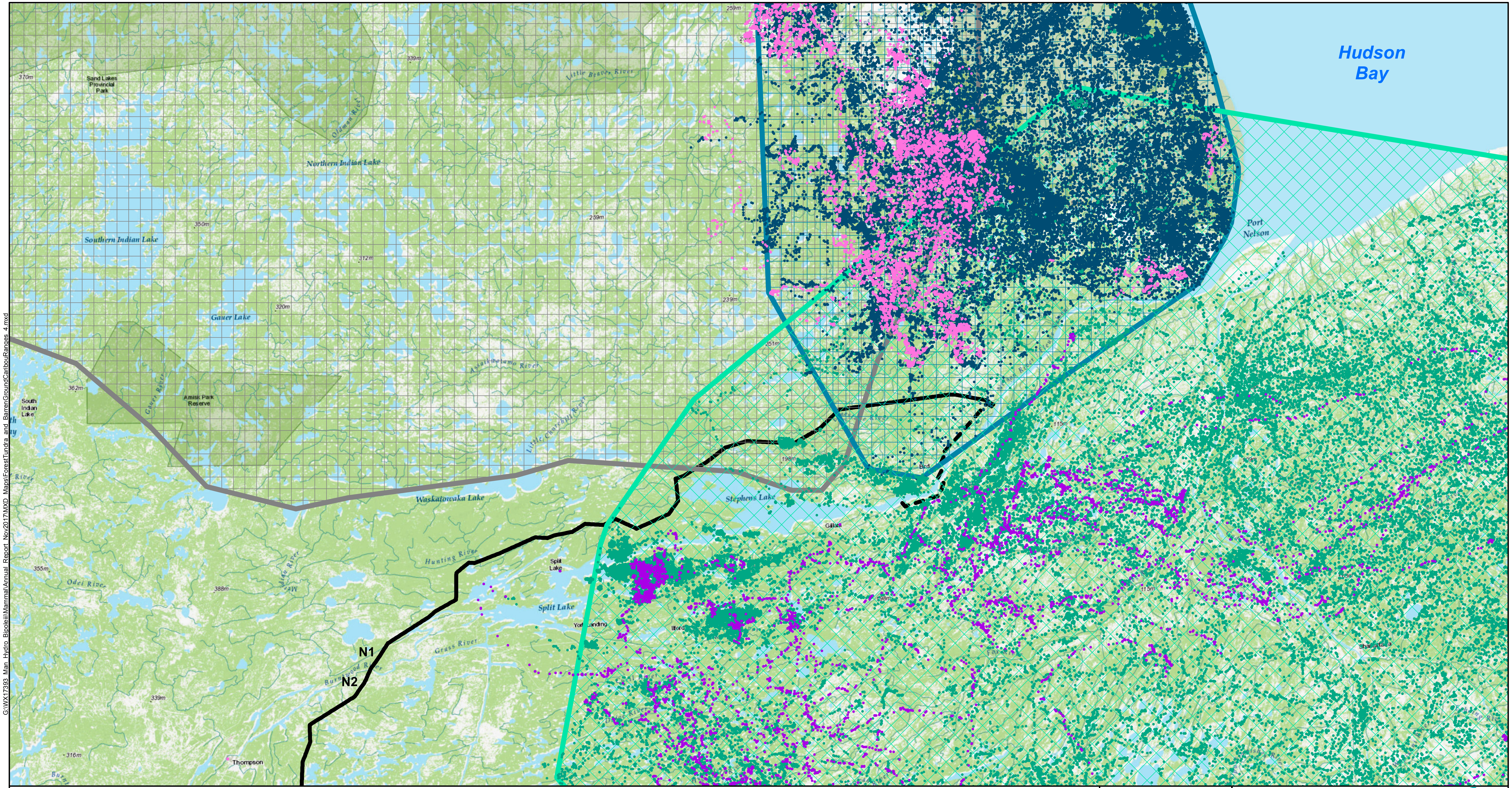
MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Boreal Woodland Caribou Survey Areas in Relation to Bipole III Transmission Project

PROJECT N°: WX17393	FIGURE: **4-1-1**
SCALE: 1:1,190,000	DATE: March 2018



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LEGEND

- BPIII Transmission Line Route
- AC Collector Lines

Caribou Coastal/Forest-tundra/Barren ground Ranges

- Cape Chruchill Range Boundary (2013)
- Pen Islands Range Boundary (2013)
- Beverly Qamanirjuaq Range Boundary (2010)
- Pen Islands Winter Telemetry Points (December - March)
- Cape Churchill Winter Telemetry Points (December - March)
- Pen Islands Telemetry Points (all season 2010 - January 2015)
- Cape Churchill Telemetry Points (all season 2010 - January 2015)

0 60 120 180 240 300 Kilometres

NOTES:
- Background topographic map extracted from ESRI online basemap services
- Telemetry point for Pen and Cape ranges from 2010 to mid-January 2015.
- Winter telemetry selected as January-February-March

Datum: NAD83
Projection: UTM Zone 14N

N S E W

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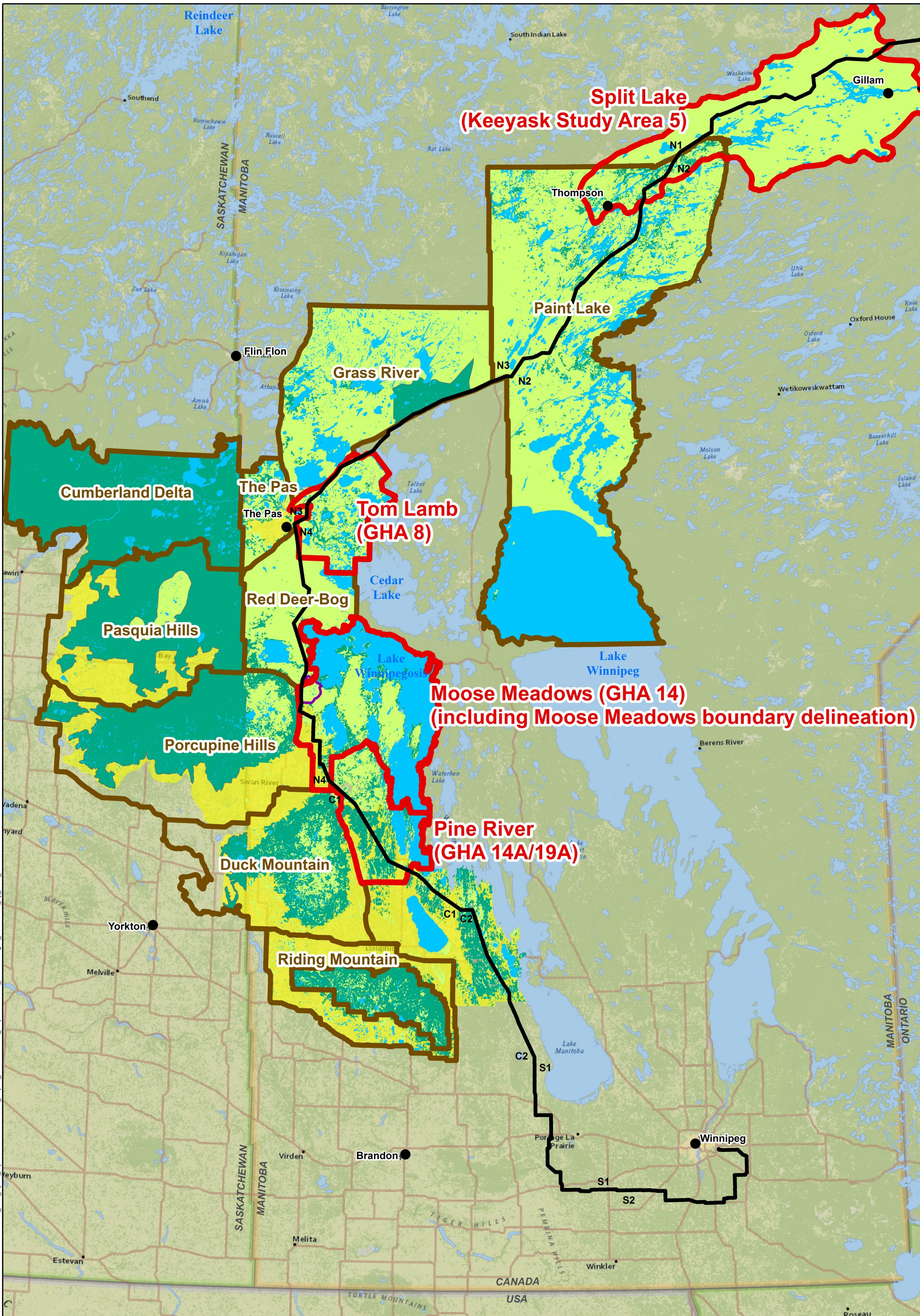
MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Forest-tundra Caribou and Barren Ground Ranges and Wintering Occurrences in Relation to Bipole III Transmission Project

PROJECT N°: WX17393	**FIGURE: 4-2-1**
SCALE: 1:1,170,000	DATE: March 2018



LEGEND

- BPIII Transmission Line Route (labelled at segment divides)
- AC Collector Lines
- Monitored Moose Populations (labelled with name)
- Reference Moose Populations (lebelled with name)
- Moose Meadows Boundary

Moose Range

- Primary Range
- Secondary Range (Forest)
- Secondary Range (Agriculture)
- Waterbody within Moose Ranges

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

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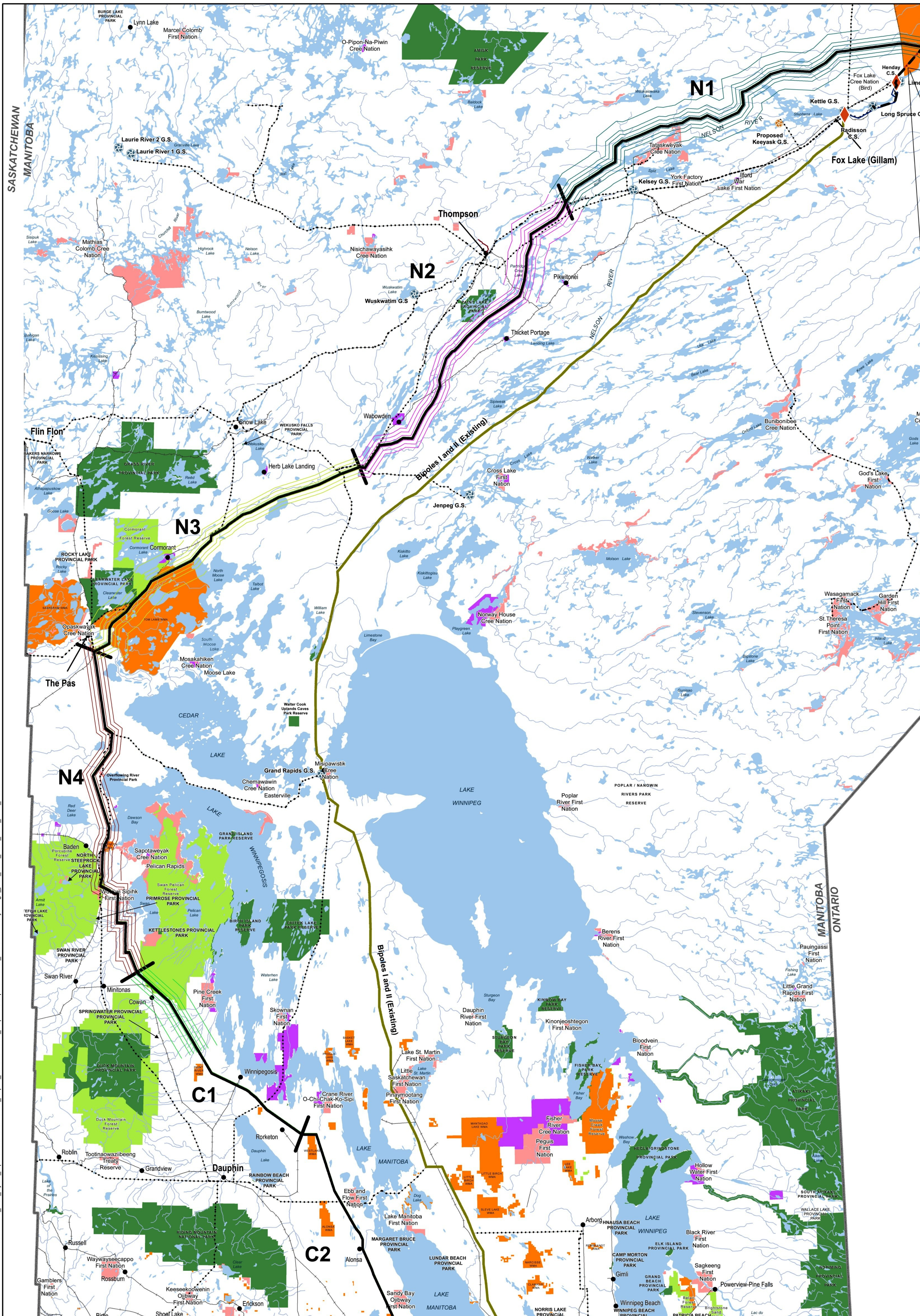
MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Sensitive and Monitored Moose Ranges Intersected by the Bipole III Transmission Project

PROJECT N°: WX17393	FIGURE: 4-3-1
SCALE: 1:2,500,000	DATE: March 2018



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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 and 2017
- N1 - Western 3/4 flown in 2016 and 2017 (10km line not flown)
- N2 - Not flown in 2014, 2016 or 2017
- N3 - Southern 1/2 flown in 2017, 2016 and 2014 (10km line and parts of 5km line not flown, expanded areas > 2.5km only flown in 2016 and 2017)
- N4 - Flown in 2014, 2016 and 2017 (10km line not flown in 2014, parts of 5km not flown in 2017, 2016 or 2014)
- ACCollector - North portion flown in 2016 and 2017

- 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:
- Map extracted from Manitoba Hydro "BPIII Transmission Project" map.

Datum: NAD83
Projection: UTM Zone 14N

Manitoba Hydro

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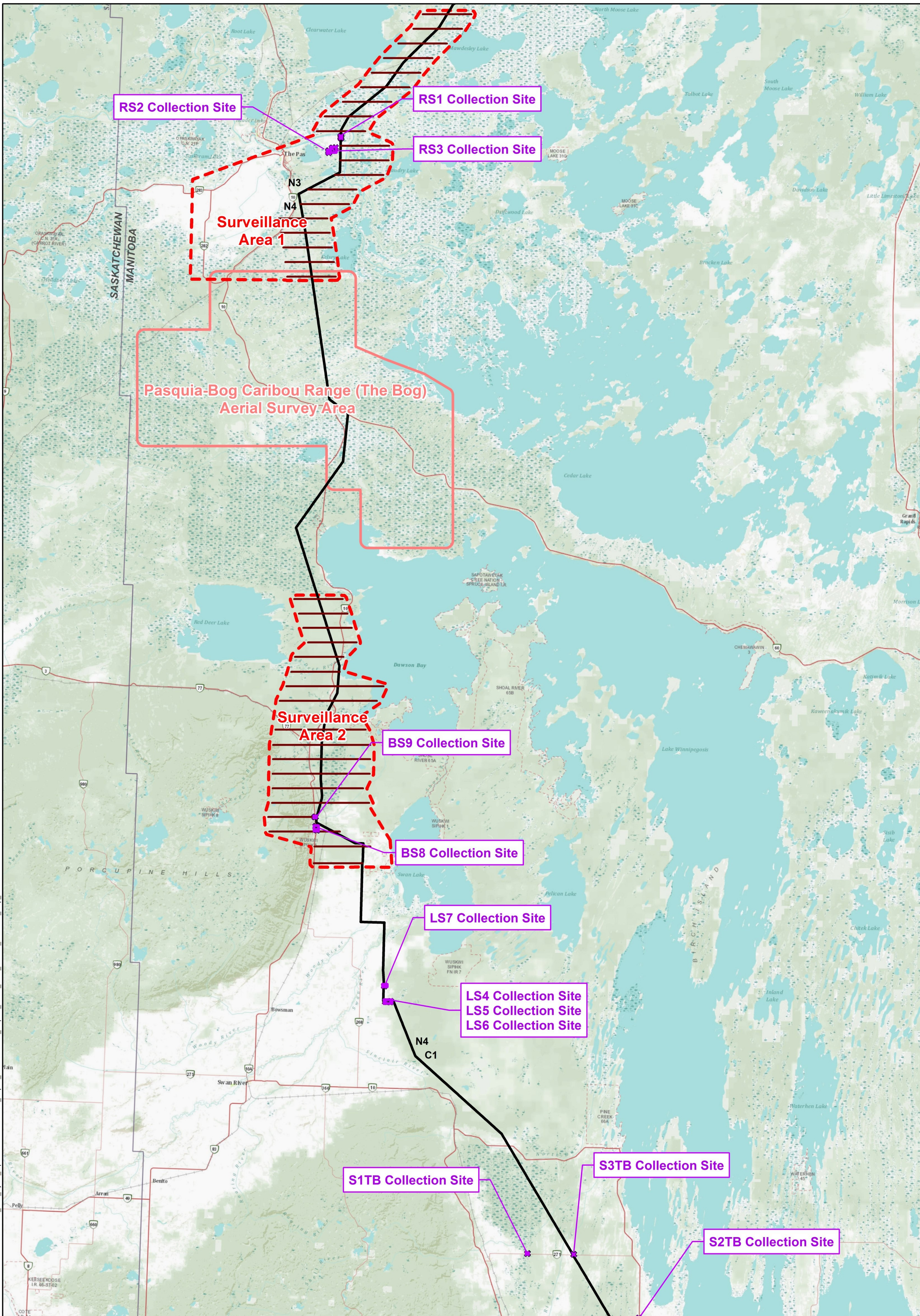
MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Multi-species Aerial Transect Survey Design for BPIII for 2014 - 2017

PROJECT N°: WX17393	FIGURE: 4-3-2
SCALE: 1:2,000,000	DATE: March 2018



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LEGEND

- BPIII Transmission Line Route (labelled at segment divides)
- 2017 Collection Site (labelled with ID)
- P. tenuis Flight Line Transects (Year 2 - Feb. 2016)
- P. tenuis Surveillance Area Boundary
- Pasquia-Bog (The Bog) Aerial Survey Area Boundary

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

Datum: NAD83
Projection: UTM Zone 14N

0 20 40 60 80 100 Kilometres

Manitoba Hydro

amec foster wheeler

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

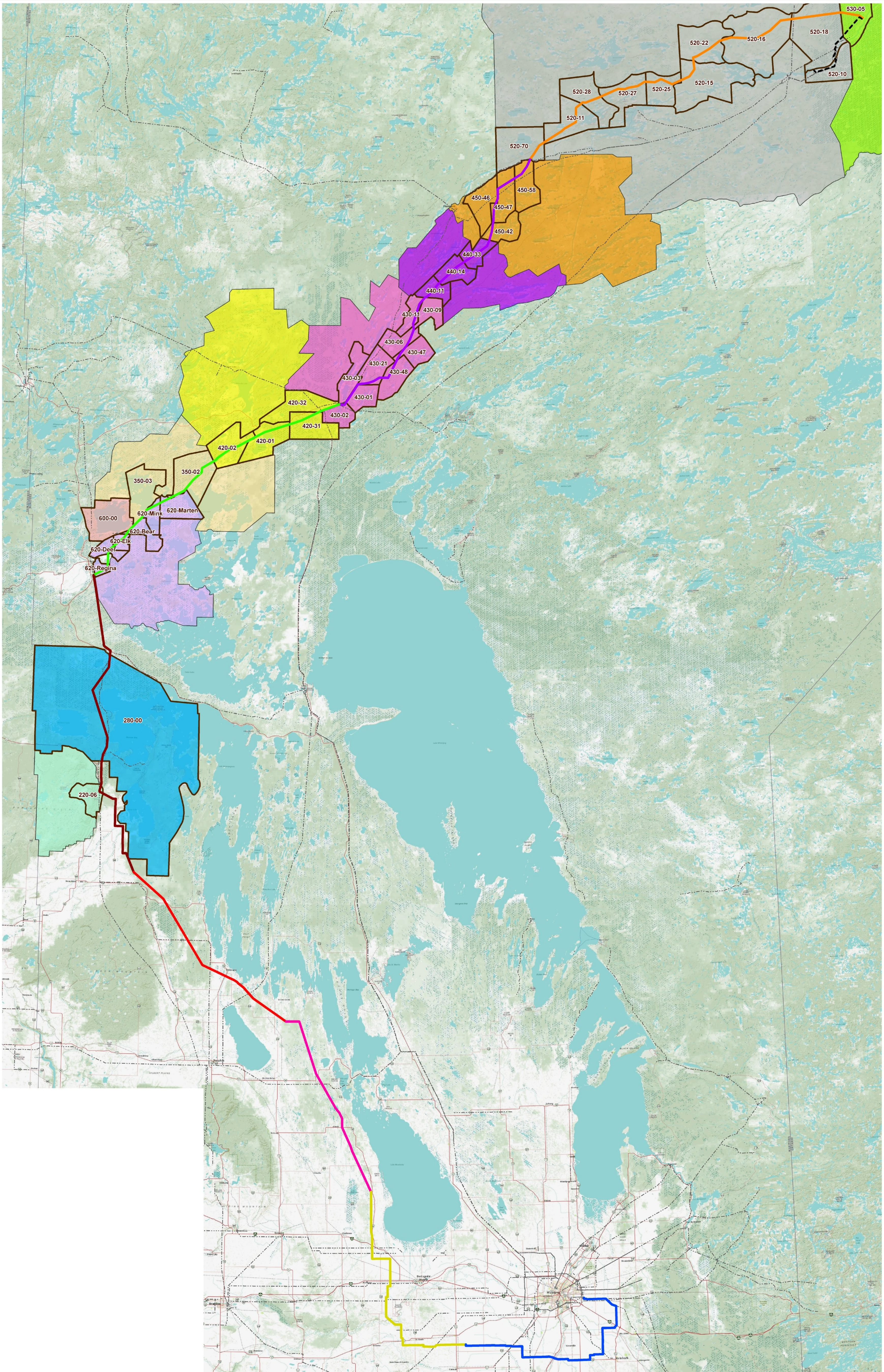
P. tenuis Sampling Survey Design and 2017 Ground Sampling Locations

PROJECT N°: WX17393

FIGURE: **4-4-1**

SCALE: 1:745,000

DATE: March 2018



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LEGEND

530-05 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

0 60 120 180 240 300 Kilometres

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

Datum: NAD83
Projection: UTM Zone 14N

N W E S

Manitoba Hydro

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MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

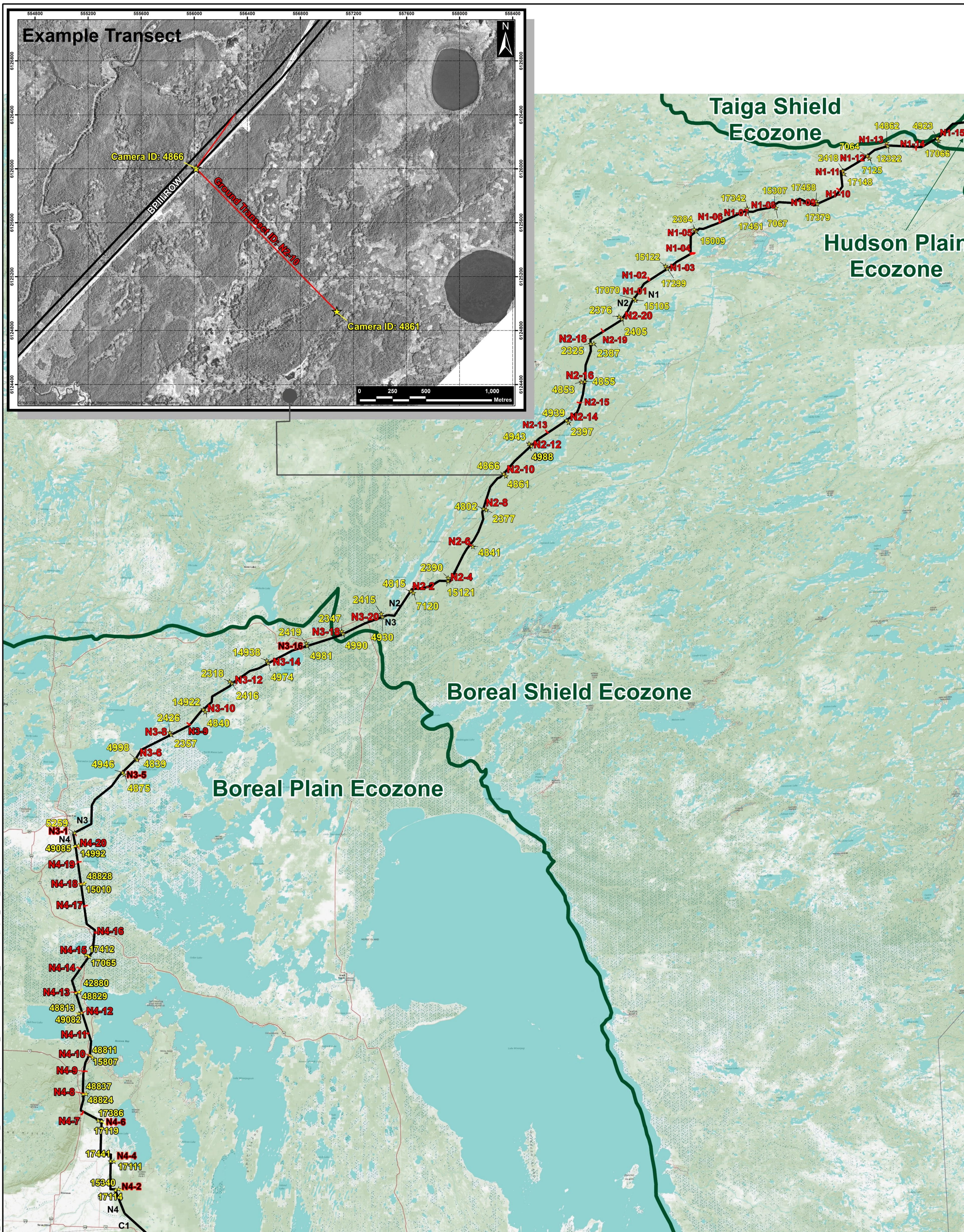
Registered Traplines intersected by the Bipole III Transmission Project

PROJECT N^{o}: WX17393

FIGURE: 4-5-1

SCALE: 1:2,300,000

DATE: March 2018



G:\WX17393_Man_Hydro_Bipoleiii\Mammal\Annual_Report_Nov2017\MXD_Maps\Winter_GroundTransects_and_Cameras_2017_2.mxd
G:\WX17393_Man_Hydro_Bipoleiii\Mammal\Annual_Report_Nov2017\MXD_Maps\Winter_GroundTensects_and_CameraDeployed_2017_BASE_1.mxd

LEGEND

- 4841 — Remote IR Cameras Visited or Deployed in 2017 (labelled with camera label ID)
- Winter Ground Transects (labelled with transect ID)
- N2-9 — Ground Transect Surveyed in 2017 with or without camera visit/deployment (label colour)
- N2-9 — Ground Transect not Surveyed in 2017, but cameras visited or deployed (label colour)
- BPIII Transmission Line Route
- Ecozones

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

Datum: NAD83
Projection: UTM Zone 14N

0 50 100 150 200 250
Kilometres

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MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Winter Ground Transects Completed and Remote IR Cameras Visited or Deployed in 2017

PROJECT N°: WX17393 | FIGURE: 4-5-2

SCALE: 1:1,770,000 | DATE: March 2018

Available in accessible formats upon request