2018 Avian Monitoring Report
Bipole III Transmission Project
Rev 2

Prepared for:

Manitoba Hydro
P.O. Box 1287, Winnipeg, Manitoba R3C 2Z1

February 2019

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EXECUTIVE SUMMARY

Manitoba Hydro has been granted an Environment Act Licence by Manitoba Conservation and Water Stewardship, for the construction, operation, and maintenance of the Bipole III Transmission Project, a new 500 kilovolt high voltage direct current transmission line on the west side of Manitoba. As part of the Environment Act Licence, Manitoba Hydro has committed to a five-year monitoring project designed to study the impacts of Project construction and associated infrastructure on birds. As part of these commitments, Manitoba Hydro has implemented bird diverters at habitats with high-risk of collision and committed to studying the efficacy of these diverters during periods of high bird activity. Manitoba Hydro has also committed to Sharp-tailed Grouse lek monitoring during the construction and post-construction phases.

Along the transmission line, 29 mortality monitoring sites were visited twice during spring migration and twice during fall migration. At each site, a passive bird – wire collision survey was undertaken as well as transect surveys to record any bird carcasses. This data, as well as associated biases were then used to test the hypothesis that the installation of bird diverters reduces the quantity of bird-wire collisions.
For Sharp-tailed Grouse surveys a total of 128 survey stations were located at intervals of approximately 1.6 km and selected based on modeled Sharp-tailed Grouse habitat and previous surveys. At each survey point, all Sharp-tailed Grouse lekking activities and observations were recorded. Raptors utilizing the transmission line corridor were also noted.

No Species at Risk were detected as mortalities during collision surveys. Six Species at Risk were recorded during passage surveys. During the spring, evidence of 13 strikes were found during the initial site visit and an additional seven during the second site visit. During the fall, evidence of seven strikes were found during the initial site visit and an additional seven during the second site visit. During the passage surveys, a maximum of 739 birds and a minimum of 0 birds were observed crossing the transmission lines within each study area.

Although not statistically significant, passage of birds was approximately 40% higher at sites with diverters than at the control sites. Across all sites, the estimated daily mortality averaged 1.34 birds in spring and 0.85 birds in fall, with an overall estimated average of 1.09 birds per kilometre per day combining spring and fall migration. This results in an estimated total of 91.88 mortalities/km during the combined spring and fall migration periods (56.21 birds/km during spring and 35.66 birds/km during fall). The number of mortalities at each site was compared to the number of passages across or through the transmission corridor during passive surveys. There was no significant ($p = 0.5641$) correlation between these values, providing no evidence that sites with higher levels of bird passage will have higher levels of mortality when diverters have been installed.

Part of the explanation for this correlation is explained by qualitative observations made during passage surveys. Many of the birds observed crossing the corridor were noted reacting to and avoiding the transmission line, particularly if diverters were present. In particular, flocks of larger birds like pelicans, gulls and waterfowl were often seen circling at length to gain or lose altitude before crossing. At sites with diverters, it was regularly observed that birds would seem to avoid passing over the span of line with diverters, only to move down the transmission line and cross at a span without diverters. These qualitative observations corroborate the quantitative results and indicated that the diverters have been successfully placed at sites with higher bird activity and are effectively diverting mortalities. Although these observations are encouraging, they also potentially bias passage numbers and offer one explanation for the lack of correlation observed between mortalities and passage numbers.

Comparisons between studies can be very difficult as sources of bias can vary substantially even over small geographic areas. A comparison of spring and fall Estimated Daily Mortalities calculated during recent studies within Manitoba show a large variation. The value for the current study is well within the standard range of these local studies. A nearby study in the United States undertaken near sensitive wetland features also presented an Estimated Daily Mortality value only slightly higher than the current study which is consistent as both were designed to target areas with a high-risk of avian collision such as wetlands.

In total nine Sharp-tailed Grouse lekking locations have been confirmed within the study area, with one additional site suspected. Of the four leks where grouse could be visually counted in both 2017 and 2018, numbers increased at two sites and decreased at two sites. Several sites had lekking heard in only one year. Due to the small sample size, no statistical analysis of these results is possible. Numerous species of raptors considered potential predators of grouse have been observed within the study area. Qualitatively, raptor activity does not appear higher as a result of the transmission line and cleared corridor.

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1.0 Introduction

On August 14th, 2013, Manitoba Conservation and Water Stewardship granted an Environment Act Licence to Manitoba Hydro for the construction, operation, and maintenance of the Bipole III Transmission Project (the 'Project'). The Project is a new 500 kilovolt (kV) high voltage direct current (HVdc) transmission line on the west side of Manitoba extending from a new converter station to be located near the site of the proposed Conawapa Generating Station on the Nelson River to a new converter station to be located at the Riel site east of Winnipeg (~1,400 km total length). The Bipole III Project also includes new 230 kV transmission lines linking the northern converter station to the northern collector system at the existing 230 kV switchyards at the Henday Converter Station and Long Spruce Generating Station. Clearing for the Project began in the winter of 2014 and construction was scheduled for completion in the summer 2017. Due to delays in schedule, construction is expected to be completed in winter 2019.

1.1 Purpose and Objectives

As part of the Environment Act Licence for the Project, Manitoba Hydro has committed to a five-year monitoring project designed to study the impacts of Project construction and associated infrastructure on birds. Manitoba Hydro has implemented bird diverters (Illustration 1) in habitats with high-risk of collision (e.g., near waterfowl staging areas, brooding areas, and colonial sites) and committed to studying the efficacy of these diverters during periods of high bird activity. Areas of potentially high-risk of collision were identified in the Bipole III Environmental Impact Statement (EIS) as Environmentally Sensitive Sites (ESS's). In addition, Manitoba Hydro has committed to monitoring disturbance/avoidance impacts of the Project on birds along the transmission line route during construction, as right-of-way (ROW) clearing has been shown to affect bird abundance, density, richness and habitat use.

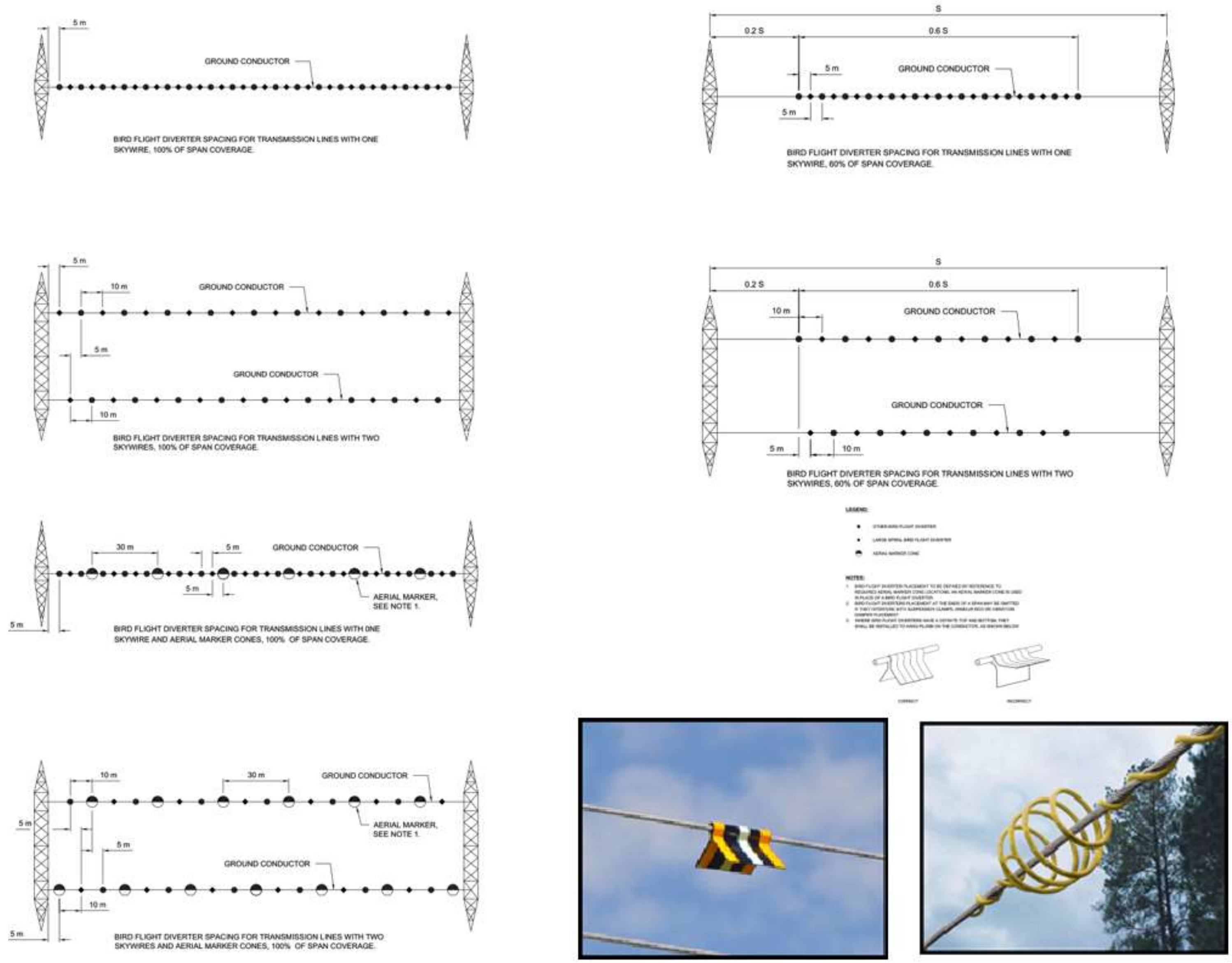
Based on these commitments, the goal of this environmental effects monitoring is to evaluate whether the construction and operation of the Project has an impact on birds, to determine which components are adversely affecting birds, and to estimate the magnitude of the effects.

The goals of the environmental effects monitoring for birds include the following:

- Conduct bird-wire collision mortality monitoring at areas of potential 'high-risk'.
- Determine the efficacy of bird diverters in preventing bird-wire collisions and implement adaptive management strategies where mortalities are higher than expected.
- Conduct disturbance/avoidance monitoring of Sharp-tailed Grouse Leks and evaluate potential increased predation by raptors.
- Conduct disturbance/avoidance monitoring of colonial nesting birds and species of conservation concern (SCC) birds.
- Conduct nest searching activities in areas where construction will occur during the active breeding bird season.

As the Project has progressed through the 5-year monitoring program, survey results and delays in schedule have resulted in several goals delayed or removed from the monitoring program. A summary of monitoring conducted since 2014, including monitoring postponed or removed, is provided in **Table 1**. This report represents Year 5 of the avian environmental effects monitoring and includes Bird – Wire Collision Mortality surveys and Sharp-tailed Grouse Lekking surveys.

Illustration 1: Example of Bird Diverters and Installation Prescription



wood.

Table 1: Summary of Monitoring Activities Across Monitoring Years

Task	Year 1 (2014)	Year 2 (2015)	Year 3 (2016)	Year 4 (2017)	Year 5 (2018)
Identify bird diverter locations	✓	✓	-	-	-
Conduct bird-wire collision mortality monitoring	-	-	1	1	✓
Determine the efficacy of bird diverters in preventing bird-wire collisions	-	-	1	1	✓
Conduct disturbance/avoidance monitoring of Sharp-tailed Grouse Leks	2	✓	1	✓	✓
Conduct disturbance/avoidance monitoring of colonial nesting birds	✓	3	3	3	3
Conduct disturbance/avoidance monitoring of species of conservation concern (SCC) birds	✓	✓	-	✓	-
Conduct nest searching activities	-	✓	-	-	-

Notes
[1] Postponed due to construction schedule delays
[2] Project start-up after seasonal survey window
[3] Removed from monitoring due to lack of colonial nesting sites within proximity to transmission corridor

1.2 Study Area

The Final Preferred Route (FPR) is approximately 1,400 kilometres (km) long and transects five distinct ecozones: Hudson Plains (3%), Taiga Shield (3%), Boreal Softwood Shield (37%), Boreal Taiga Plains (35%) and Prairie Potholes (23%). The Study Area for the avian monitoring extends the length of the FPR from the proposed Riel site east of Winnipeg to the proposed Conawapa Generating Station on the Nelson River, as well as the transmission lines linking the northern converter station to the northern collector system at the existing switchyards at the Henday Converter Station and Long Spruce Generating Station. The Study Area extends up to 3 km from the ROW. An illustration of the FPR is provided in Figure 1 (Appendix A) and the locations for surveys undertaken in 2018 are provided in Figure Series 2 and Figure Series 3 (Appendix A).

1.3 Environmentally Sensitive Site (ESS) Surveys

The 2014 and 2015 pre-construction surveys consisted of verification surveys to determine the relative significance of candidate Environmentally Sensitive Sites (ESS's) identified in the EIS based on the density and richness of bird species that have a greater potential for bird-wire collision (e.g., waterfowl, waterbirds, colonial nesting birds). The relative significance of each ESS with and without bird diverters was used to prioritize efforts to assess wire-collision mortalities.

Baseline studies for the Project identified 134 candidate ESS's for birds. Candidate ESS's were generated via desktop analysis of available data including Ducks Unlimited waterfowl pair density estimates, Important Bird Area (IBAs), surveys for colonial waterbird and waterfowl studies, known raptor migration routes, and other data which identified areas with high concentrations of birds. Data was overlaid with other imagery and reviewed for geographical features including river crossings, lakes, wetlands, and other features known to attract or concentrate birds. Bird habitat qualifying as ESS's included bird colonies, raptor nesting habitat, and waterbird nesting or migration stopover habitat. Of these pre-determined sites, certain candidate ESS's could be combined into a single site due to habitat linkages. This resulted in 120 candidate ESS's.

Aerial surveys to assess candidate ESS's were undertaken in 2014 (July 19th to 21st and September 25th to 28th) and 2015 (May 4th to 5th). The July 2014 survey aimed to identify the presence of breeding bird ESS's such as raptor nests, waterbird colonies, and waterfowl nesting sites. Conducting this breeding survey in July corresponded with waterfowl breeding such that waterfowl broods were hatched and actively feeding at the time of survey. Bird nesting was considered to be later in Manitoba in 2014 as a cold winter and widespread flooding likely delayed the onset of leafing-out across the province.

The September (2014) and May (2015) surveys were conducted in order to record fall and spring migration, respectively, for ducks, geese, swans and shorebirds (waterbirds), cranes and raptors. Both fall and spring migration surveys identified the presence of important stopover habitat and waterbird movement routes which intersect with the proposed Project. As flocks of larger birds are particularly susceptible to collisions with transmission wires (APLIC 2012), it is important to monitor concentrations of migrating birds, particularly large birds such as ducks, geese, swans, shorebirds, cranes and raptors. Fall migration of waterbirds occurs between late August and November and peaks between late September and mid-October (eBird 2014). More northerly breeding species such as geese and swans are particularly active during this period of the fall.

No aerial surveys of ESS's were conducted as part of the 2017 or 2018 avian monitoring programs. For details on ESS analysis criteria and diverter recommendations, refer to the 2014 and 2015 Avian Monitoring Reports (Amec Foster Wheeler 2015, 2016).

2.0 Study Design and Methodology

As identified in the EIS for Bipole III, the construction of the transmission line has the potential to affect birds directly (e.g., collisions with wires, bird nest sites) and indirectly (e.g., disturbance and/or avoidance). To detect direct and indirect effects on birds, baseline environmental monitoring was conducted prior to construction in 2014 (Amec Foster Wheeler 2015), within the first year of post-clearing conducted as part of this 2015 monitoring report and in 2017 (Amec Foster Wheeler 2016, 2017). The following sections outline the study design of the fifth year avian monitoring program which involved Bird – Wire Collision studies and Sharp-tailed Grouse Lekking studies.

For the purpose of implementing the environmental monitoring program, the project has been divided into three distinct periods:

- Pre-construction;
- Pre-tower and conductor construction (vegetation clearing in the proposed ROW); and
- Post-tower and conductor construction (wire stringing and operations).

This monitoring report provides methodologies for collecting post-tower and conductor construction (includes wire stringing in some areas).

2.1 Bird–Wire Collisions

2.1.1 Bird–Wire Collisions Study Design

Bird diverter monitoring is designed to test the hypothesis that bird diverters are sufficient in reducing mortality of birds due to collisions with the transmission line to a level that is negligible in areas determined to have a high-risk of collision. As such, the null and alternate hypotheses state:

- H^0 (null): The mortality of birds at high-risk areas with bird diverters will not be different than the mortality of birds at low-risk areas without bird diverters.
- H^1 (alternate): The mortality of birds at high-risk areas with bird diverters will be lower than the mortality of birds at low-risk areas without bird diverters.

To test this hypothesis, a Control-Impact study design was implemented. The Before-After Control-Impact study cannot be implemented for this study as mortality of birds is not expected prior to the installation of the transmission lines. For the purpose of this study, control sites will consist of ESS's and other sites where bird activity is expected to be elevated, but where diverters were not installed. Impact sites will consist of ESS's considered to be 'high-risk' where diverters were installed. If transmission lines containing diverters yield negligible avian mortality, then the mortality of birds relative to the number of bird passes at high-risk transmission lines with diverters should be comparable or lower than those at low-risk transmission lines without diverters. Using the ratio of mortality to number of bird passes instead of simply the numbers of avian mortality allows correction for differences in bird activity between high-risk and low-risk sites.

2.1.2 Bird–Wire Collisions Methodology

Along the transmission line route, 29 mortality monitoring sites were selected by Wood for bird-wire collision surveys. These 29 monitoring sites included 15 Environmentally Significant Sites (ESS) where diverters have been installed and 14 non-significant sites where no diverters have been installed due to the likely presence of fewer birds. The non-significant sites were chosen by selecting sites where bird activity was still thought to be above average. Each bird-wire collision survey site is between 391 to 562 m in length (Table 2), generally the wire span between two transmission towers (except where features such as waterbodies make this infeasible, or to ensure that a wetland or watercourse is properly surveyed). Each site was monitored twice during spring migration (April 24 to May 2, 2018) and twice during fall migration (August 28 to September 11, 2018) in order to monitor birds migrating to and from their breeding grounds, respectively. Due to logistics, timing and sometimes weather constraints, sites were revisited between three and ten days after the initial visit.

At each site, a passive bird – wire collision survey was undertaken for 90 minutes. During this time, all birds passing over (up to two times the height of the wires) or through the transmission line corridor were recorded. Information that was recorded included items such as date, observers, weather conditions, species observed and the number of crossings. Individual birds were re-counted if they crossed the line multiple times. If a bird was not identifiable to species, the highest level of identification possible was noted (e.g., duck species, blackbird species, and passerine species). Observers positioned themselves to best monitor the entire study area based on individual characteristics at each site, with factors such as having a view of the entire span and areas of high bird activity considered.

Immediately after the passive bird – wire collision survey, field staff walked straight transect lines along the hydro line corridor from one end of the site to the other. At each site, a total of ten transects, spaced 6 m apart, were walked resulting in reasonably complete coverage of the width of the study corridor. All bird carcasses were recorded along with species, location, sex, age and the condition of the remains.

Scavenger removal trials were also conducted at each site. Two chicken carcasses were placed and covered in feathers at known locations on the first site visit each season (spring and fall). On the second visit each season, it was noted whether the chicken carcasses were present and intact, completely scavenged (gone), or partially scavenged (still present). The proportion of carcasses scavenged was used to calculate the rate at which scavenging animals removed these carcasses, which can in turn be used to account for scavenger removal biases in the data.

At a subset of sites, searcher efficiency trials were conducted. Three chicken carcasses were placed at randomly chosen locations within the transect search area prior to the wire-collision surveys. The proportion of carcasses found during transects was used to calculate efficiency for each search team. These searcher efficiency trials are often used to account for searcher efficiency bias and can inadvertently increase searcher efficiency as the observers are on high alert during searches knowing they will be tested throughout the field program (CSW 2007). When possible, observers did not know in advance when they would tested for searcher efficiency. A total of five searcher efficiency trials were conducted over the spring and fall.

These data will be used to test the hypothesis that the use of bird diverters reduces the quantity of bird-wire collisions. Data will be corrected by determining the ratio of carcasses found to bird passes per hour. If this ratio is not significantly higher at high-risk sites with diverters, compared to low-risk sites without diverters, than this will be considered to be evidence that the diverters are preventing bird-wire collisions.

Table 2: 2018 Survey Stations and Survey Details

Site ID	Diverters/ Significant	Line Segment	Site Length (m)	1st Spring Visit	2nd Spring Visit	1st Fall Visit	2nd Fall Visit
New Point Road	Yes	S2	391	25-Apr	29-Apr	28-Aug	05-Sep
WS4	Yes	S2	471	24-Apr	29-Apr	28-Aug	05-Sep
WPT3	Yes	S2	562	24-Apr	28-Apr	28-Aug	06-Sep
Bird 3a	Yes	S2	500	24-Apr	28-Apr	28-Aug	06-Sep
Bird 4	No	S2	500	24-Apr	27-Apr	29-Aug	07-Sep
Bird 5	Yes	S2	506	24-Apr	27-Apr	29-Aug	07-Sep
WPT10/11/12	Yes	S2	421	25-Apr	02-May	29-Aug	07-Sep
WPT18	Yes	S1	489	25-Apr	02-May	29-Aug	06-Sep
Bird 11	No	S1	434	26-Apr	01-May	29-Aug	06-Sep
Bird 13	Yes	S1	409	25-Apr	01-May	30-Aug	05-Sep
Bird 33/35	Yes	C2	415	25-Apr	28-Apr	30-Aug	05-Sep
Bird 31	Yes	C2	468	25-Apr	28-Apr	30-Aug	08-Sep
Bird 29	No	C2	478	26-Apr	29-Apr	30-Aug	08-Sep
Bird 26	No	C2	464	26-Apr	30-Apr	31-Aug	04-Sep
Bird 39	No	C2	439	29-Apr	02-May	31-Aug	04-Sep
Bird 37	No	C2	477	25-Apr	27-Apr	01-Sep	09-Sep
Bird 44	No	C1	475	27-Apr	30-Apr	01-Sep	09-Sep
Bird 53	Yes	C1	491	28-Apr	01-May	31-Aug	10-Sep
Bird 53b	Yes	C1	503	28-Apr	01-May	31-Aug	10-Sep
Bird 79	No	C1	500	26-Apr	29-Apr	02-Sep	11-Sep
Bird 293	No	N4	500	26-Apr	29-Apr	02-Sep	11-Sep
WS62	Yes	N4	475	27-Apr	30-Apr	03-Sep	07-Sep
Bird 83	No	N4	506	27-Apr	30-Apr	03-Sep	07-Sep
WS69	Yes	N4	391	26-Apr	29-Apr	01-Sep	04-Sep
Bird 142	No	N3	487	26-Apr	29-Apr	01-Sep	04-Sep
Bird 140a	Yes	N3	458	27-Apr	30-Apr	02-Sep	05-Sep
Bird 130	No	N3	512	27-Apr	30-Apr	02-Sep	05-Sep
Bird 129	No	N3	466	28-Apr	01-May	03-Sep	06-Sep
Bird 142a	No	N3	468	28-Apr	01-May	03-Sep	06-Sep

2.1.3 Bird–Wire Collisions Data and Bias Analysis

Results from bird mortality searches can be biased based by various factors such as scavenger removal, searcher efficiency and habitat/ground cover. Some collision mortalities may be removed by scavengers before searches can be undertaken and some (especially in vegetated habitats) can be missed by searchers. Biases can be estimated though some limitations exist which can impact the accuracy of these estimations (Section 4.1). Separate analyses were conducted for the spring migration and the fall migration periods.

Bias based on searcher efficiency can be calculated by pooling the results of all searcher efficiency trials;

$$\text{Searcher Efficiency} = \frac{\text{\# of planted carcasses found}}{\text{\# of planted carcasses.}}$$

As each searcher efficiency test was setup only hours before the survey was undertaken there is assumed to be no chance of scavengers removing carcasses in the interim. Searcher efficiency trial results were averaged across all searchers.

The survey sites were divided into four groups, organised geographically and bias based on scavenger removal of carcasses was calculated separately within each group (Appendix B). For the purposes of this calculation, the rate of carcass removal is assumed to be linear over time. Within each group, a linear regression analysis relating number of carcasses remaining to time elapsed, with intercept set to 2 (as two carcasses are known to be present at time zero) was conducted. This provides an estimate of the rate of carcass removal. From this, the estimated time taken for 50% of carcasses to be removed can be calculated, which is equivalent to the average persistence time of carcasses;

$$\text{Carcass Persistence} = \frac{\text{estimated time for 100\% carcass removal}}{2}$$

Bias based on the actual area surveyed with inaccessible areas such as ponds, rivers and marshes accounted for can be calculated;

$$\text{Habitat bias} = \frac{\text{Actual area surveyed}}{\text{Formal search area}}$$

Habitat bias was calculated for six sites where terrain was unsuitable for surveys (typically deep marshes or ponds).

The study sites varied in length (391 to 562 m), due both to varying distances between consecutive poles, and to inaccessible terrain (typically rivers and streams). Passage and mortality numbers were each adjusted in the following way for each site, to standardise them to a hypothetical 500 m site;

$$\text{Site length bias} = \frac{\text{Actual site length}}{\text{500 m}}$$

Crippling loss measures birds that are injured after a collision but survive long enough to leave the area directly under the transmission lines. Surveys for crippling loss are very resource-intensive, as direct observations of birds striking lines are required. In the current study, only one line strike was directly observed. Rioux et al. (2013) provide an estimated crippling loss of 80% based on four studies, a similar to value to other reports (e.g. 75% in Brown and Drewien 1995). This indicates that 4 out of 5 mortalities will not result in carcasses beneath power lines. This value of 20% for crippling loss bias was used for the current study.

The estimated daily mortality was calculated by pooling the mortality collisions to provide an estimated number for mortalities/site/day;

$$\text{Estimated daily mortality} = \frac{\text{\# of collision mortalities found}}{\text{Searcher Efficiency * Carcass Persistence * Habitat Bias * Site Length Bias * Crippling Loss Bias}}$$

These mortality figures can be averaged and extrapolated to provide an estimated figure for mortalities over the entire transmission line. The following assumptions were made for this analysis:

- The level of mortality empirically observed is consistent throughout six weeks of the spring migration period and six weeks of the fall migration period.
- Bird mortality is considered to be negligible outside of these six-week migration periods.
- The northern sections of line not surveyed during this study have a similar level of mortality to the area surveyed.
- The sites surveyed have similar mortality to an average section of the transmission line.

With these assumptions, the Estimated Collision Mortality for spring and fall migration can be estimated as follows;

$$\text{Estimated Migration Collision Mortality} = \text{Estimated Daily Mortality * 42 days}$$

The spring and fall numbers can be added together for an estimate of total mortality during the combined migration periods.

2.1.4 Bird-Wire Collisions Statistical Analysis

To test whether the sites selected for diverters had larger numbers of birds crossing them, a two-way ANOVA was performed using season and presence of diverters as independent variables and the seasonal total passage as the dependent variable.

To test whether measured bird passage was associated with higher levels of mortality, a linear regression was performed with total passage numbers and estimated daily mortality for each site in each season.

To test whether diverters reduced bird mortality, in each season, the total passage numbers were calculated, along with the percentage of passage that occurred at each site. These percentages were multiplied by the average daily mortality across all sites, to give an 'expected' mortality for each site. This number was subtracted from the estimated daily mortality for each site to provide a number indicating how much higher or lower mortality was at each site, compared to what would be expected based on mortality (the 'mortality difference'). Finally, a t-test was conducted with presence of diverters as the independent variable and mortality difference as the dependent variable.

An alpha equal to 0.05 was used to detect significant differences for all analyses.

2.2 Sharp-tailed Grouse Lekking

2.2.1 Sharp-tailed Grouse Lekking Survey Study Design

As part of the environmental monitoring for the Bipole III transmission line, Manitoba Hydro has committed to Sharp-tailed Grouse lek monitoring during the construction and post-construction phases. However, as of early 2017 there were no lek sites known along the Bipole III transmission line route, necessitating surveys to find as many active leks as possible for future monitoring. In April 2017, surveys were conducted and five confirmed lekking locations were found, as well as a number of other sightings of Sharp-tailed Grouse in the vicinity of the transmission line. Surveys were repeated in the same areas in April 2018.

Sharp-tailed Grouse (*Tympanuchus phasianellus*) is a species of gamebird found across most of Manitoba, although it is found at very low densities in the most heavily agricultural regions and much of the boreal forest. The species is typically found in open habitats dominated by dense herbaceous plants and shrubs, also occurring in more wooded habitats in winter. In early spring, grouse congregate at communal areas called leks, where males display to females to attract mates. These leks are typically found in areas of somewhat sparser vegetation and are often slightly raised above the surrounding landscape. Many lek locations will be used annually for many years. These lek locations are very important to the persistence of local populations and are also one of the only effective ways to survey this species, which is otherwise quiet and secretive (Connelly et al. 1998).

Lekking activity occurs in spring from approximately March to May and occurs from approximately one half hour before sunrise to two and half hours after sunrise. Lekking grouse may be detected visually or by call (Connelly et al. 1998).

The construction and installation of the Bipole III Transmission Line has the potential to adversely affect the abundance of Sharp-tailed Grouse at lekking sites by way of habitat loss or disturbance during construction. The Project also has the potential to increase rates of predation by raptors or mammals due to increased nesting sites on newly constructed transmission line towers and hydro corridor use, respectively. Due to limited sightings of grouse, no formal hypothesis testing is possible. So far, surveys have focused on finding leks in the vicinity of the transmission lines and observing grouse and raptor activity for any qualitative observations relevant to the potential impact of the transmission line.

2.2.2 Sharp-tailed Grouse Lekking Survey Methodology

During the aerial surveys in spring 2015, individual Sharp-tailed Grouse were mainly observed in section S1 and C2. These locations were examined more closely during ground surveys in spring 2015, but no Sharp-tailed Grouse lekking sites were confirmed within the project boundaries during ground surveys. Consultations with Manitoba Conservation established they also had no confirmed lekking sites within project boundaries. Follow-up ground surveys to identify Sharp-tailed Grouse lekking sites were conducted between April 18th – 22nd, 2017 and April 10th – 14th, 2018 to substantiate the previous findings.

No appropriate lek searching protocol was found during the planning stages. Sharp-tailed Grouse surveys were designed by referring to Sharp-tailed Grouse biology, the Wisconsin Sharp-tailed Grouse Survey Protocol (WDNR 2013) and Alberta Sensitive Species Inventory Guidelines (Government of Alberta 2013). Surveys were conducted entirely from public roadways and routes were selected based on modeled Sharp-tailed Grouse habitat, previously identified lekking sites, and locations where previous Amec Foster Wheeler aerial and ground surveys detected grouse. Routes were largely restricted by the need to use readily traversable roads as close as possible to the transmission line route. All surveys were conducted within approximately 2 km of the transmission line route. Survey sites and routes are shown in in Figure Series 3 (Appendix A).

Along the selected routes, surveys were undertaken at intervals of approximately 1.6 km. A total of 128 survey stations were located along the selected routes in sections C2, S1, and S2. Survey stations were located near intersections or field boundaries whenever possible to view as many fields as possible. At each survey point, observers listened for lekking grouse for three minutes, as well as carefully scanning nearby fields with binoculars. Surveys were conducted beginning one hour before sunrise and finishing three hours after sunrise. On several occasions, Sharp-tailed Grouse were flushed from the roadside or otherwise observed at some distance from a planned stop. In each case a survey was immediately conducted close to this location. All lekking activities were recorded as well as the number of grouse present, and any other relevant information.

In 2018, most areas surveyed in 2017 were repeated using the same protocol. Several sites could not be visited due to a colder spring season leading to heavier snow conditions on roads. However, lower amounts of precipitation during the survey period in 2018 allowed a number of additional areas to be surveyed, particularly east of Winnipeg.

Observers also incidentally noted any observations of raptors using transmission lines or towers as hunting perches, or that seemed to be utilizing the transmission line corridor.

3.0 Results

A total of 171 bird species have been recorded during the 2014, 2015, and 2017 monitoring programs. An additional 21 species were newly recorded during 2018 spring and fall migration surveys (American Pipit, American Tree Sparrow, Cackling Goose, Common Redpoll, Eastern Phoebe, European Starling, Fox Sparrow, Horned Lark, House Finch, Lapland Longspur, Merlin, Pine Warbler, Purple Martin, Red-breasted Merganser, Rock Pigeon, Semipalmated Plover, Snow Bunting, Snow Goose, Swainson's Hawk, Vesper Sparrow, and White-crowned Sparrow). Based on the addition of these new sightings, 192 total species have been recorded during the 5-year monitoring project. Eighty-two (82) of the species recorded are considered SCC birds, of which fourteen (14) species are listed under SARA, ten (10) species are listed under MESA, and 74 species are BCR 6 and/or BCR 11 priority species. The complete complied list of species is presented in Appendix **Error! Reference source not found.**. Only common names are provided within the body of the report; all scientific names are provided within Appendix **Error! Reference source not found.**.

3.1 Species at Risk

In 2018, no evidence of regulated Species at Risk (SAR) mortalities were recorded during collision mortality surveys. Six Threatened or Endangered bird species (see Appendix **Error! Reference source not found.**) were recorded during the passage surveys. In the spring, two Short-eared Owl passes were observed at two unique stations. In the fall, 158 Barn Swallow passes were observed at 11 unique stations in the fall, one Bobolink pass, one Canada Warbler pass, and two Red-headed Woodpecker passes were observed at one station, and three Rusty Blackbird passes at one station.

3.2 Bird–Wire Collisions

During the spring collision mortality searches, evidence of 13 strikes were found during the initial site visit and evidence of an additional seven were observed during the second site visit (Table 33, Appendix A – Figure Series 2). These collision mortalities were identified as: Dark-eyed Junco (6), Fox Sparrow (1), Snow Bunting (1), Ruffed Grouse (1), Mallard (1), Vesper Sparrow (1), Ruby-crowned Kinglet (1), Yellow-rumped Warbler (1), Black-billed Magpie (1), American Tree Sparrow (1), unidentified waterfowl species (2), unidentified gull species (1) and unidentified species (2).

During the fall collision mortality searches, evidence of seven strikes were found during the initial site visit and evidence of an additional seven were observed during the second site visit (Table 33, Appendix A – Figure Series 2). These collision mortalities were identified as: Double-crested Cormorant (2), American Redstart (2), American Crow (1), Sharp-tailed Grouse (1), Ovenbird (1), American White Pelican (1), Rock Pigeon (1), Common Yellowthroat (1), unidentified sparrow species (1) and unidentified species (3).

The mortalities detected ranged in condition from very fresh carcasses believed to be less than 24 hours old, to a few carcasses that were almost entirely decayed and potentially present for a month or more. Several of the recorded mortalities relate to small piles of feathers (five feathers or more in a square meter were counted; Barrientos et al. 2012, Wildlife Resource Consulting Services 2018). It is unknown whether these observations relate to crippled birds that moved away from the site, dead birds that had been scavenged, or birds that survived collision; however, all were recorded as mortalities. Single feathers were found occasionally but not recorded as mortalities. One American Tree Sparrow was recorded injured and apparently unable to fly underneath the transmission lines and this was recorded as a mortality. The cause of injury was unconfirmed but it was assumed to be a wire strike due to the location of the individual. Representative photos from the mortality monitoring are provided in Appendix C.

Table 3: Summary of Collision Mortalities During the 2018 Transect Surveys

Site ID[1]	No. of Collision Mortalities in Spring			No. of Collision Mortalities in Fall			Site Length (m)
	1st Round	2nd Round	Total	1st Round	2nd Round	Total	
New Point Road	2	1	**3**	0	0	**0**	391
WS4	3	1	**4**	0	0	**0**	471
Bird 4	0	0	**0**	1	4	**5**	500
WPT18	0	2	**2**	0	0	**0**	489
Bird 11	1	1	**2**	0	0	**0**	434
Bird 39	0	1	**1**	1	2	**3**	439
Bird 53	0	0	**0**	0	1	**1**	491
Bird 53b	1	0	**1**	2	0	**2**	503
Bird 79	1	0	**1**	0	0	**0**	500
Bird 293	3	0	**3**	0	0	**0**	500
WS69	0	0	**0**	2	0	**2**	391
Bird 140a	0	0	**0**	1	0	**1**	458
Bird 142	2	0	**2**	0	0	**0**	487
Bird 142a	0	1	**1**	0	0	**0**	468
Total	**13**	**7**	**20**	**7**	**7**	**14**	--

Notes
[1] Only Sites with mortalities in either spring or fall shown.

3.2.1 Searcher Efficiency, Scavenger Removal and Habitat Bias

Searcher efficiency was relatively high, calculated to be 80%. In all search trials, the five search teams found either two (60%) or three (100%) of the three placed carcasses with the average of 80% across all teams and all five trials. Average carcass persistence time was calculated to be as low as 1.77 days in the far northern areas, to as high as 5.83 days in central areas in the vicinity of Dauphin. Data on searcher efficiency and scavenger removal are presented for each site in Appendix B. A summary, including a seasonal breakdown are presented in Table 4 and Table 5. Searcher efficiency rates were similar during spring and fall surveys. Scavenging rates were higher in the spring than in the fall.

Habitat bias was calculated based on the size of each individual study area and the actual area surveyed accounting for marshes, ponds and rivers present within the study area boundaries (Appendix B). Habitat bias was calculated for six sites where terrain was unsuitable for surveys (typically deep marshes or ponds).

Table 4: Summary of Searcher Efficiency by Season

Team	Season	Success Rate	Total Seasonal Success Rate
1	Spring	3/3 = 100%	77.78%
2	Spring	2/3 = 66.67%	
3	Spring	2/3 = 66.67%	
4	Fall	2/3 = 66.67%	83.33%
5	Fall	3/3 = 100%	

Table 5: Summary of Scavenging Rates by Season

Geographic Area	Spring Scavenging Rate (Estimated Carcass Persistance Time)	Fall Scavenging Rate (Estimated Carcass Persistance Time)	Overall Scavenging Rate (Estimated Carcass Persistance Time)
1	2.79	5.02	4.384
2	2.43	6.45	5.834
3	1.93	5.14	4.2999
4	1.50	3.24	1.7666
Overall Seasonal Scavenging Rate	**2.31**	**5.16**	--

3.2.2 Passage Surveys

During the 90-minute observation sessions, a maximum of 739 birds (site Bird 53 in the spring, round 1) and a minimum of 0 birds (two sites; Bird 26 and Bird 29 in the fall, round 1) were observed crossing the transmission lines within each site. The mean number of birds observed was 109.7 ± 144.2.

With round 1 and round 2 data combined, in spring, site Bird 3a had the highest total passage observed (1030 birds), and site Bird 140a had the least (16 birds), with an overall average of 283.6 ± 270.0. In fall, site Bird 11 had the highest total passage observed (657 birds) and site Bird 29 had the least (2 birds), with an overall average of 155.1 ± 182.2. Over both seasons, site Bird 53 had the highest total passage observed (1562 birds) and site Bird 140a had the least (53 birds), with a mean of 438.7 ± 384.0.

A two-way ANOVA with total seasonal passage as the dependent variable and season and presence of diverters as the independent variables was conducted. Season had a significant effect ($p = 0.015$) on passage numbers (with higher numbers of birds in spring). Passage of birds was about 40% higher at sites with diverters (mean 128.9 birds per survey) than at the control sites (mean 89.1 birds per survey), although the difference was not found to be significant ($p = 0.13$). This indicates that diverters have been successfully placed at sites with higher bird activity. Note that the control sites were also selected to have the highest amount of bird activity possible at a site without diverters, and it is likely that bird passage would be much lower at an average point along the transmission line.

There were approximately two times as many birds seen during the spring migration surveys as during the fall migration surveys. There was an average of 283.6 birds seen at each site in the spring (94.5 birds / hour) and 155.1 birds seen at each site in the fall (51.7 birds / hour).

Several notable qualitative observations were made during passage surveys. At site WS69, one bird out of a flock of Double-crested Cormorants was observed striking a conductor bundle. This section of line has marker cones for aircraft visibility and it was not clear whether the bird struck the marker cone or the wires. The bird briefly dropped in altitude and circled around, but did not appear to be obviously injured, and soon continued flying south.

Many of the birds observed crossing the corridor at approximately the height of the transmission lines were also clearly seen reacting to and avoiding the conductor bundles and the optical ground wire, particularly if diverters were present. In particular, flocks of larger birds like pelicans, gulls and waterfowl were often seen circling at length to gain or lose altitude before passing over or under the transmission lines. At sites with diverters, it was regularly observed that birds would seem to avoid passing over the span of line with diverters, only to move down the transmission line and cross at a span without diverters. It is unknown to what degree these birds moving down the line will be more alert to the presence of wires and avoid them as a result. This may indicate that single spans with diverters are less effective than longer consecutive stretches..

Some sites, such as WS62 and WS4, were initially identified as significant due to the presence of large productive wetlands nearby (approximately 300 m and 1,000 m, respectively). Observers at these sites noted that very large numbers of waterfowl, cranes, gulls and other waterbirds were present in and around the wetlands. However, at these sites, there is little attraction for waterbirds on the opposite side of the transmission lines, and the number of birds observed passing over the line was much lower than would be expected based on the number present in the area.

At other sites, such as Bird 3a and Bird 5, the transmission line crosses a stream or river that is oriented in a north-south direction (parallel to the transmission line). On at least some observation dates, sizable numbers of birds were observed migrating while following the watercourse, with insignificant numbers feeding or resting near the site. At these sites, the watercourse could not be surveyed for mortalities as carcasses would not remain in place in the deep water. Therefore, birds crossing the transmission lines that were directly over the watercourse were also not counted, as the passage numbers were intended to be used as a control for the mortality numbers. This, however, means that the passage numbers obtained somewhat underestimate the scale of passage at that site.

Numerous birds were observed perching on transmission towers or lines, ranging from large raptors like Bald Eagle or Red-tailed Hawk, to small songbirds.

At several sites, reasonable numbers of birds were seen passing over the transmission lines at great height. One notable example is site Bird 142, where dozens of raptors and Sandhill Cranes were seen migrating south at such height as to be almost invisible. These birds were not included in the passage counts as the height of flight meant that a line strike event was implausible, however, it is possible that in different weather conditions these birds would migrate at a lower altitude.

3.2.3 Estimated Daily Mortality

Estimated daily mortalities, with searcher efficiency, scavenger removal, crippling loss, habitat and site length biases incorporated were calculated for each site in each season (Appendix Table B). Numbers ranged from a minimum of zero birds per kilometre per day (sites where no mortalities were detected) to a maximum of 7.3 birds per kilometre per day. However, these numbers should not be taken as conclusive due to the low sample size for each site. Across all sites, the estimated daily mortality averaged 1.34 birds in spring and 0.85 birds in fall, with an overall estimated average of 1.09 birds per kilometre per day across both migration periods.

The number of mortalities at each site was compared to the number of passages across or through the transmission corridor during passive surveys. There was no significant ($p = 0.5641$) correlation between these values, providing no support for the hypothesis that sites with higher levels of bird passage will have higher levels of mortality.

As birds were migrating (north-south movement) during the surveys, it was tested to see whether transmission lines oriented in an east-west direction had more mortalities than those running north-south. A linear regression of estimated daily mortality on line angle did not find a significant result ($p=0.22$), although mortality numbers were slightly higher at sites with east-west orientations. Of the study sites, six had an east-west orientation, eight had a north-south orientation, and the remaining sites had an intermediate orientation.

3.2.4 Effect of Diverters

Daily mortality rates were lower at sites with diverters, with an average of 1.02 birds at sites with diverters and 1.18 birds at sites without diverters. This is despite higher levels of bird passage measured at sites with diverters.

When comparing estimated mortality based on actual mortalities observed, to the levels expected based on passage survey data, sites without diverters were found to average 0.042 more daily mortalities than would be expected, while sites with diverters were found to average 0.085 less daily mortalities than would be expected, however, this difference is not significant ($p = 0.33$). This data is insufficient to reject the null hypothesis, although this data is an indication that the diverters may be preventing some bird mortalities.

3.2.5 Estimated Collision Mortality by Season

Estimated mortality figures can be averaged and extrapolated to provide an estimated figure for mortalities over the entire transmission line. The following assumptions were made for this analysis:

- The level of mortality empirically observed is consistent throughout six weeks of the spring migration period and six weeks of the fall migration period.
- Bird mortality is considered, for this study, to be negligible in the summer and winter months.
- The northern sections of line not surveyed during this study have a similar level of mortality to the area surveyed.
- The sites surveyed have similar mortality to an average section of the transmission line.

With these assumptions we can calculate an estimated mortality of 91.88 birds per kilometre during the combined spring and fall migration periods at the study sites. Seasonally, this is an estimated mortality of 56.21 birds per kilometre during the spring migration and 35.66 birds per kilometre during the fall migration period. See section 4.1.1 for discussion of the study limitations and accuracy of these numbers and note these numbers do not apply to the entire transmission line.

3.3 Sharp-tailed Grouse Lekking Sites

During the focused spring 2017 grouse surveys, at least 63 Sharp-tailed Grouse were detected at ten (10) locations. In 2018, at least 84 Sharp-tailed Grouse were detected at fourteen (14) locations (Table 66 and Table 7). The locations of Sharp-tailed Grouse sightings are provided in Appendix A – Figure Series 3.

In 2017, five locations were found with lekking grouse, of which two were seen, and three were heard only. At an additional two sites, lekking was suspected but not observed, and there were three additional sightings of Sharp-tailed Grouse with no evidence of lekking. All observations took place in the survey areas west and northwest of Portage la Prairie, along line sections S1 and C2. No grouse were observed in section S2 east of Winnipeg, although severe weather in the area meant surveys were cut short.

In 2018, six locations were found with lekking grouse, of which four were seen and two were heard only. Two of these sites were repeats from leks reported in 2017, and an additional lek was confirmed in 2018 at a site it was only suspected in 2017. At two locations where lekking was heard in 2017, no grouse were detected in 2018. At one confirmed lek in 2017, grouse were observed but not seen lekking in 2018, potentially due to the survey being undertaken slightly later than prefer lekking hours. As in 2017, no grouse were observed in the survey area in section S2 east of Winnipeg.

In total nine lekking locations have been confirmed in the areas surveyed, with one additional site suspected. Of the four leks where grouse could be visually counted in both 2017 and 2018, numbers increased at two sites (14 and 19 birds in 2018 compared to 11 and 7 birds respectively in 2017) and decreased at two sites (6 and 7 birds in 2018 compared to 8 and 15 birds respectively in 2017). Several sites had lekking heard in only one year. Due to the small sample size, no statistical analysis of these results is possible.

Numerous species of raptors have been observed within the study area during all of the avian surveys conducted since 2014. Potential predators of grouse which have been observed include: Northern Harrier, Northern Goshawk, Bald Eagle, Red-tailed Hawk, Rough-legged Hawk, Swainson's Hawk, Great Horned Owl, Snowy Owl and Great Gray Owl.

Red-tailed Hawk, Rough-legged Hawk and Northern Harrier were noted as occurring at high densities in the survey areas west of Portage la Prairie. In 2017, a Northern Harrier was observed flying into a lek, scattering the grouse. No quantitative results can be stated, but observers have generally not felt that raptor activity was higher as a result of the transmission line and cleared corridor. A number of raptors have been observed perching on transmission towers, dominated by Red-tailed Hawks and Bald Eagles. Common Ravens, a potential nest predator of Sharp-tailed Grouse, were also observed perching on transmission towers. During bird-wire collision surveys in 2018, Common Raven nests have been noted on Bipole III towers outside of the Sharp-tailed Grouse survey areas.

Sightings of mammalian predators were very limited. Coyotes were observed several times during surveys, including one in 2017 several hundred metres from an active lek. Domestic cats and dogs were also seen roaming free in many areas.

Table 6: Summary of Sharp-tailed Grouse Confirmed and Probable Lekking Sites

Lekking Grouse Observed 2017	Lekking Grouse Observed 2018	Approximate Distance from Bipole III Route	Section	UTM	
				Easting	Northing
11	14	2.0 km	S1	0531842	5522830
15	7 seen, not actively lekking	0.1 km	S1	0520829	5585065
Heard only	None	1.0 km	S1	0537240	5508044
8	6, but more thought to be present out of sight	1.6 km	S1	0537294	5503119
None	Heard only	1.8 km	S1	0519033	5565428
None	3	1.2 km	S1	0528546	5519528
None	Heard only	1.6 km	S1	0532545	5514626
Heard only	None	1.9 km	C2	0515791	5594947
7, not seen lekking	19	0.3 km	C2	0517799	5594952
15, not seen lekking	None	1.4 km	C2	0515389	5604798

Table 7: Incidental Sharp-tailed Grouse Sightings

Year	Grouse Observed	UTM	
		Easting	Northing
2017	1	0521663	5567009
2017	2	0514186	5598781
2017	1	0540547	5498298
2018	1	519890	5591665
2018	8	517139	5598223
2018	16	518703	5591668
2018	5	530841	5526135
2018	2	530519	5519542
2018	4	543160	5498313
2018	2	547227	5498343
2018	1	541753	5496658

4.0 Discussion

4.1 Bird-Wire Collisions

The result that passage of birds was approximately 40% higher at site with diverters indicates diverters were placed successfully at sites with higher levels of bird activity, especially as the control sites were selected in order to have above average bird passage. A comparison of estimated mortality (based on passage survey data) and actual mortalities observed resulted in sites without diverters averaging 0.042 more daily mortalities than expected and sites with diverters averaging 0.085 less daily mortalities than expected. Although this difference is not significant ($p = 0.33$), this is indication that the diverters may be preventing bird mortalities. Sites with high passage numbers did not have significantly ($p = 0.5641$) high collision mortality. While this was not a significant relationship, this could be due to many of the sites having no mortalities found rather than an actual lack of correlation, but it is a further indication that the diverters may be preventing bird mortalities.

Bird collision mortality is considered biologically significant only if it results in the decline of a population. Previous studies have indicated bird mortalities as a result of transmission line collisions are often insignificant at the population level. It can become significant in certain circumstances especially when species at risk (designated as Threatened or Endangered) are affected (Manitoba Hydro 2010). Many Manitoba Species at Risk birds, particularly those species classified as Endangered, have restricted ranges to the south or southwest parts of the province, and have little to no overlap with the Bipole III transmission line. Of the six Species at Risk recorded during the surveys, three are classified as Threatened, and three are not classified provincially but are classified as Threatened or Special Concern federally. The only species recorded in significant numbers was Barn Swallow, which although declining rapidly, is still relatively common across Manitoba and much of Canada. Additionally, this species is highly maneuverable in flight and does not fall into the high-risk species composition (Manitoba Hydro 2010, APLIC 2012, Barrientos et al. 2012, Rioux et al. 2013). All of the species detected as mortalities are considered common residents or migrants in Manitoba.

Higher risk species are species with lower maneuverability due to factors such as high wing loading (small wings), low aspect ratios (broad wings), body size and weight. Aerial hunters such as raptors and swallows are often acrobatic and have high maneuverability and quick reactions which enable them to avoid line strikes. Whereas species such as ducks, cranes and grouse are less able to react and avoid a line strike (Manitoba Hydro 2010, APLIC 2012, Barrientos et al. 2012, Rioux et al. 2013). The number of passerine mortalities found during the current study was higher than expected. Of the recorded mortalities, 50% were identified as small songbirds (e.g., sparrow, warblers). These elevated passerine mortality results are similar to those found during the Manitoba-Minnesota and Keeyask Transmission Projects (Stantec 2015, Wildlife Resource Consulting 2018).

The estimate of 91.88 mortalities/km during spring and fall migration periods (56.21 birds per kilometre during spring migration and 35.66 birds per kilometre during fall migration) for the Bipole III transmission line can be compared to those in other studies. These estimated seasonal collision mortalities are similar to those found in other bird-wire collision studies undertaken for Manitoba Hydro projects as shown in Table 8. It is difficult to make comparisons between projects as sources of bias can vary substantially between sites even in relatively close proximity. Other studies with similar values include Faanes (1987) which had an estimated mortality of 69 birds/km during migration near sensitive wetland features which are known for supporting high avian activity.

Table 8: Comparison of Bird-Wire Collision Estimated Mortalities within Manitoba

Study	Spring Migration Period (6 weeks) (birds/km)	Fall Migration Period (6 weeks) (birds/km)
Current Bipole III Project*	56.21	35.66
Current Bipole III Project (without crippling loss incorporated)	11.24	7.13
Keeyask Transmission Project 2016	--	10.32
Keeyask Transmission Project 2017	469.09**	7.27
Lake Winnipeg East System Improvement Transmission Project 2018	5.98	0
Wuskwatim Generation Project	--	46.01

*note that other than the current study, those listed in Table 8 did not incorporate crippling biases into their estimates, as such the current project has presented an alternate value without crippling bias for a more accurate comparision.

**anomalous high value likely driven by extremely efficient local scavengers.

The current study had an average daily mortality rate of 1.09 birds/km (with a range of 0 – 7.3 birds/km). Other studies have had variable, but not radically different results. Barrientos et al. (2012) found an average of 0.27 birds/km, Morkill and Anderson (1991) found a range of 0.02 – 7.14 birds/km, and Costantini et al (2017) found a range of 0.06 – 2.68 birds/km. This last low value may have been underestimated due to a lack of adjustment for scavenger bias.

The scavenger bias results in this study can be compared to other studies. Although the numbers are estimates rather than direct observations, the numbers can be used to calculate scavenger bias as expressed in Rioux et al. (2013) as percent carcasses remaining after seven days. The results from our study give scavenger biases ranging from 60% to nearly 100%, significantly higher than the average value of 0.39 in Rioux et al. (2013). However, the scavenger bias results from previous studies are highly variable, and many studies have found very high scavenger biases up to 100% or as low as 0% (Rioux et al. 2013).

Previous studies have often shown that the presence of diverters lowers the level of avian mortality due to wire strikes. The percentage difference varies between studies and has been shown to reduce mortalities anywhere from 9.6 – 80% with many around 50 - 60% (Beaulaurier 1981, Morkill and Anderson 1991, Brown and Drewien 1995, CEC 2008, APLIC 2012, Wildlife Resource Consulting 2018). As surveys were not conducted at lines prior to the installation of diverters, it is not possible to perform a Before-After Control-Impact study to directly compare the results in the current survey to these numbers.

The qualitative observations of birds, particularly large flocking birds, avoiding the diverters are highly encouraging. Very few large birds were detected as mortalities, limited to one American White Pelican and two Double-crested Cormorant, as well as several medium-sized birds like ducks and crows. The resulting sample size is too low to make any conclusions, but given the behaviour observed it is likely that diverters are successfully eliminating a large portion of mortalities among these larger birds.

Passage of birds was higher in spring than in fall. This does not necessarily indicate a real difference in passage and could be explained by survey timing and daily weather conditions.

4.1.1 Survey Design Limitations

Several factors could have biased the study results, including a few that are notable, but were deemed unavoidable are discussed below. These biases can make accurate estimates of avian mortality a challenge.

One of the factors in choosing the 2018 monitoring sites was that they were all accessible by road, but as a result, they are all located in the southern two-thirds of the Bipole III route. The northern most one-third section of the study area would require helicopter access. Wood and Manitoba Hydro did not feel that it was necessary to have bird-wire collision survey sites in the northernmost areas as there is not likely to be a notably higher or lower chance of bird-wire collisions in the north, and therefore, there is limited inherent sampling bias to concentrating sites in the southern two-thirds of the study area.

The small sample size resulting from only two visits to each site per season resulted in having about half of sites with no mortalities recorded at all. As sites were chosen based on a high likelihood of high bird activity, it is unlikely that any of the sites studied have actual mortality values near zero. These zero values bias total mortality estimates downwards, as corrections for searcher efficiency, scavenger removal and crippling loss still results in a zero value. Brown and Drewien (1995) compensated for zero mortality values by using a constant (0.2) so that corrected estimated mortality rates could be calculated for all sites. This was not done for the current study but would be worth considering in a study with a larger sample size and a smaller proportion of zero values. It is important to note that searcher efficiency, scavenger removal rates and estimated mortality rates are within ranges comparable to other previous studies. As such, the high proportion of sites without mortalities is not indicative of a problem with the methodology. If mortalities had been discovered at most sites, the mortality rates implied would be very high.

No significant correlation was noted between passage numbers and mortalities found. One possible explanation is the qualitative changes noted in bird behaviour due to the presence of diverters as discussed above. As diverters were placed at areas with higher levels of bird activity, any reduction of mortality as a result of diverters may also help to explain this lack of correlation. This possibility is difficult to assess as a Before-After Control-Impact study was not be implemented for this study as mortality of birds was not expected prior to the installation of the transmission lines. An additional limitation is that some mortalities may occur at night as this is when passerine migration tends to occur. The current methodology for passage surveys does not provide any measure of nocturnal avian passage.

The bird carcasses used for the searcher efficiency and scavenger removal trials were raw chickens purchased retail and supplemented with feathers. These do not accurately represent many of the small, cryptic species which are found in the environs of the study area. Every effort was made by surveyors to ensure realistic camouflage for searcher efficiency trials. Due to program logistics and study site locations, it was often predictable when 'testing' would occur for searcher efficiency as it was completed when two teams were in close proximity to each other. Additionally, to provide robust data on searcher efficiency, a minimum of 20 carcasses should be planted over multiple tests (CWS 2007) which was not possible based on team movements and study logistics.

Several of the study sites had habitat and ground cover not conducive to the transect surveys. Some areas of open water and marsh were encountered as well as some tall graminoid and overgrown shrubby vegetation. Care was taken in these habitats to ensure the transect searches were undertaken to the best ability of the searcher (i.e., slowing the transect walking speed to ensure coverage); however, finding carcasses in these scrubby habitats is extremely difficult (CSW 2007). At other sites, such as bare cropfields in the spring, any mortalities were extremely obvious.

Due to the enormous scale and associated travel times of the Bipole III transmission line, and a desire to sample sites across this large geographic area, the sampling at each site was restricted to two visits undertaken 2 – 10 days apart in each migration season. An ideal methodology would involve a minimal duration of 6-8 weeks with visits every three days to gather sufficient data to provide robust statistical analyses and predictions (CWS 2007). However such large-scale projects are rarely feasible, and the methodology of the current study is comparable to other similar studies within the industry. Short studies tend to overestimate mortality due to intensive rounds of surveys during times of peak avian movement (Morkill and Anderson 1991, APLIC 2012, Rioux et al. 2013, Wildlife Resource Consulting 2018). In addition, in the case of our study, mortality may have been underestimated due to the fact that up to 50% of small avian species carcasses are scavenged within 24 hours (Rioux et al. 2013) as opposed to larger species (as would be represented by the chickens in the scavenger trials).

The annual mortality numbers were estimated based on a series of assumptions, including the assumption that mortality is negligible in the summer and winter months, which will bias the estimate downwards, and the assumption that mortality is steady throughout the spring and fall migration periods , which could bias the estimate upwards as surveys were done at times of high bird activity. Some other studies (e.g. Rioux et al. 2013) have measured and extrapolated numbers across the entire spring, summer and fall period. This is not reasonable in the current study due to the timing of surveys during peak migration, but the actual mortality numbers are likely to be somewhat higher than those reported in the study. Bird-wire collision surveys for the Keeyask Transmission Project (Wildlife Resources 2017) found similar estimated daily mortalities between their late breeding season surveys (10.8 birds/km) and their fall migration surveys (10.32 birds/km) indicating that some locations do have similar levels of mortalities at times outside peak migration periods. Of note in the current Bipole III study, four of the mortalities detected are from primarily non-migratory species (Ruffed Grouse, Sharp-tailed Grouse, Black-billed Magpie and Rock Pigeon), indicating that some degree of mortality must be occurring outside of migration activities, and presumably outside of migration periods..

During scavenger removal trials, many sites had both carcasses removed at the time of checking. Many of these carcasses were likely removed well before the return visit. As a result, the estimates for scavenger activity are likely somewhat lower than actual values, which will bias mortality numbers downwards.

Both rounds of visits in each season involved transect searches for bird carcasses and evidence of wire strikes. It is not possible to accurately determine or estimate when mortalities occurred before the initial search (first round). The second round can be estimated relatively accurately as occurring since the first round (with the assumption the carcass would have been found on the first round of searches). This unknown could skew the data; however, with the current field investigation, numbers of mortalities were low enough that it is unlikely to have had much effect.

It can be difficult to extrapolate data from individual sites to a regional / provincial scale due to significant differences in habitats, bird species composition and abundance and scavenger species composition and abundance (Rioux et al. 2013). Avian mortalities are not evenly distributed along an entire corridor, rather they can be unevenly distributed spatially and temporally. As stated previously, due to the fact that both the impact and control sites were selected in order to have the highest amount of bird activity possible at a site with and without diverters, it is likely that bird passage would be much lower at an average point along the transmission line that at the 2018 study sites. This bias is likely significant, and the reported mortality values should not be extrapolated over the whole corridor.

There is a paucity of literature and data that can reliably predict bird wire – collision mortalities and the associated biases. All of these results can be extremely variable both spatially and temporally in different geographic areas, habitats, years, seasons, habitats, weather conditions and other factors. Long-term site-specific studies are required to gain an understanding and a more accurate estimated avian mortality figure.

4.2 Sharp-tailed Grouse

When surveys were initially planned in 2017, full results from the Manitoba Breeding Bird Atlas were not available. However, the results now show that the surveys conducted in sections S1 and C2 occur in the section of the Bipole III line with the highest abundance of Sharp-tailed Grouse (Taylor 2018). Much lower abundances have been reported along S2 east of Winnipeg. Breeding bird atlas results also indicate that the transmission line passes through an area of relatively high grouse abundance in the vicinity of The Pas. This area has not been surveyed to date for Sharp-tailed Grouse except during aerial surveys.

The spring of 2018 was much colder than the spring of 2017, and surveys were also conducted slightly earlier in the season. In 2017, the calls of migrating birds and breeding frogs were noted as potentially blocking out the calls of lekking Sharp-tailed Grouse. Calling frogs were not heard during 2018 surveys, and very few migrating birds were present. Although there was concern that conditions would be too cold for lekking grouse, actively lekking birds were found despite harsh conditions on several days, with temperatures typically being between zero degrees Celsius (ºC) and -10 ºC.

For sites where lekking activity can be compared, two sites had fewer birds observed and two sites had more birds observed in 2018. Several sites had lekking heard in only one year, and this likely represents difficulty in detection of the birds over large distances rather than a real change in distribution. One additional lek was found visually in 2018, but it is not known if this is a newly established lek, or a lek that was missed in 2017. Although no statistical analysis was possible due to sample size, there is no evidence that there has been any change in Sharp-tailed Grouse populations from 2017 to 2018. Numbers of grouse observed overall were higher in 2018, but this could be a result of easier detection due to a slightly earlier survey date and colder spring.

Nine confirmed lekking sites are now available for population monitoring. Unless very dramatic declines are observed, for which there is no evidence of yet, this number is likely still too low to allow any statistical analysis of the population.

The survey areas in section S1 and C2 had a high density of raptors in 2017, before most of the transmission towers and lines had been installed. Numbers were much lower in 2018, but this is potentially due to colder weather, with very few migratory birds having arrived yet. The landscape in these areas consists of a diverse patchwork of forest, grassland and cropfields. Numerous nesting and perching locations for raptors are present as well as adjacent open fields for hunting. Due to these pre-established conditions, the transmission corridor clearing is not likely to have had a significant effect on the suitability of the area for most raptor species.

Bald Eagles and Common Ravens have been widely observed nesting on transmission towers elsewhere in Manitoba during other surveys, although no nests were observed in the Sharp-tailed Grouse survey areas in 2018. There are numerous alternative nesting sites (trees and other transmission and distribution lines) in most of section S1 and C2. In these areas, although many Sharp-tailed Grouse were observed, it is unlikely that the transmission line will have any major impact on raptor predation.

In the heavily cropfield dominated area surveyed east of Winnipeg, as well as many other parts of sections S1 and S2, trees are much rarer, and it is possible that raptor activity in these areas will be increased as a result of the Bipole III transmission line. However, there were no Sharp-tailed Grouse sightings in this area and the Manitoba Breeding Bird Atlas data indicates that Sharp-tailed Grouse are found at very low densities in this area (Taylor 2018).

Surveys were not conducted in the remote northern sections of the transmission line. In this section, there are large areas of stunted trees or open fen with few to no nesting or roosting sites for raptors. It is possible that raptor activity will increase in this area due to the Bipole III transmission line. Sharp-tailed Grouse are found across this area; however, aerial surveys conducted along the transmission line corridor for Sharp-tailed Grouse had very few sightings in this area and the Manitoba Breeding Bird Atlas shows the species being present at negligible densities north of The Pas (Taylor 2018). Nonetheless, it is not possible to rule out that increased activity from predators (including Red-tailed Hawk, Bald Eagle and Common Raven) could have an effect on the small grouse populations in this area.

5.0 Conclusion

No Species at Risk were detected as mortalities during collision surveys. Six Species at Risk were recorded during passage surveys.

Although not statistically significant, passage of birds was approximately 40% higher at sites with diverters than at the control sites. Across all sites, the estimated total mortality averaged 91.88 mortalities/km during spring and fall migration periods with 56.21 birds/km during spring and 35.66 birds/km during fall. The number of mortalities at each site was compared to the number of passages across or through the transmission corridor during passive surveys. There was no significant ($p = 0.5641$) correlation between these values, providing no evidence that sites with higher levels of bird passage will have higher levels of mortality when diverters have been installed. This is likely due to the success of the diverters and the accuracy of their placement rather than a lack or correlation to an unmitigated scenario.

Many of the birds observed crossing the corridor were observed reacting to and avoiding the transmission line, particularly if diverters were present. In particular, flocks of larger birds like pelicans, gulls and waterfowl were often seen circling at length to gain or lose altitude before crossing. At sites with diverters, it was regularly observed that birds would seem to avoid passing over the span of line with diverters, only to move down the transmission line and cross at a span without diverters. These qualitative observations corroborate the quantitative results and indicate that the diverters have been successfully placed at sites with higher bird activity and are effectively diverting mortalities.

Comparisons between studies can be very difficult as sources of bias can vary substantially even over small geographic areas. A comparison of spring and fall Estimated Daily Mortalities calculated during recent studies within Manitoba show a large variation. The value for the current study is well within the standard range of these local studies. A nearby study in the United States undertaken near sensitive wetland features also presented an Estimated Daily Mortality value only slightly higher than the current study which is consistent as both were designed to target areas with a high-risk of avian collision such as wetlands.

In total nine Sharp-tailed Grouse lekking locations have been confirmed within the study area, with one additional site suspected. Of the four leks which could be quantitatively compared between 2017 and 2018, numbers increased at two sites and decreased at two sites. Several sites had lekking heard in only one year. Due to the small sample size, currently no statistical analysis of these results is possible. Numerous species of raptors considered potential predators of grouse have been observed within the study area however, raptor activity does not appear higher as a result of the transmission line and cleared corridor.

6.0 Closure

If you should have any questions regarding this submittal or require further information, please contact the undersigned at 905-568-2929.

Sincerely,

Wood Environment & Infrastructure Solutions
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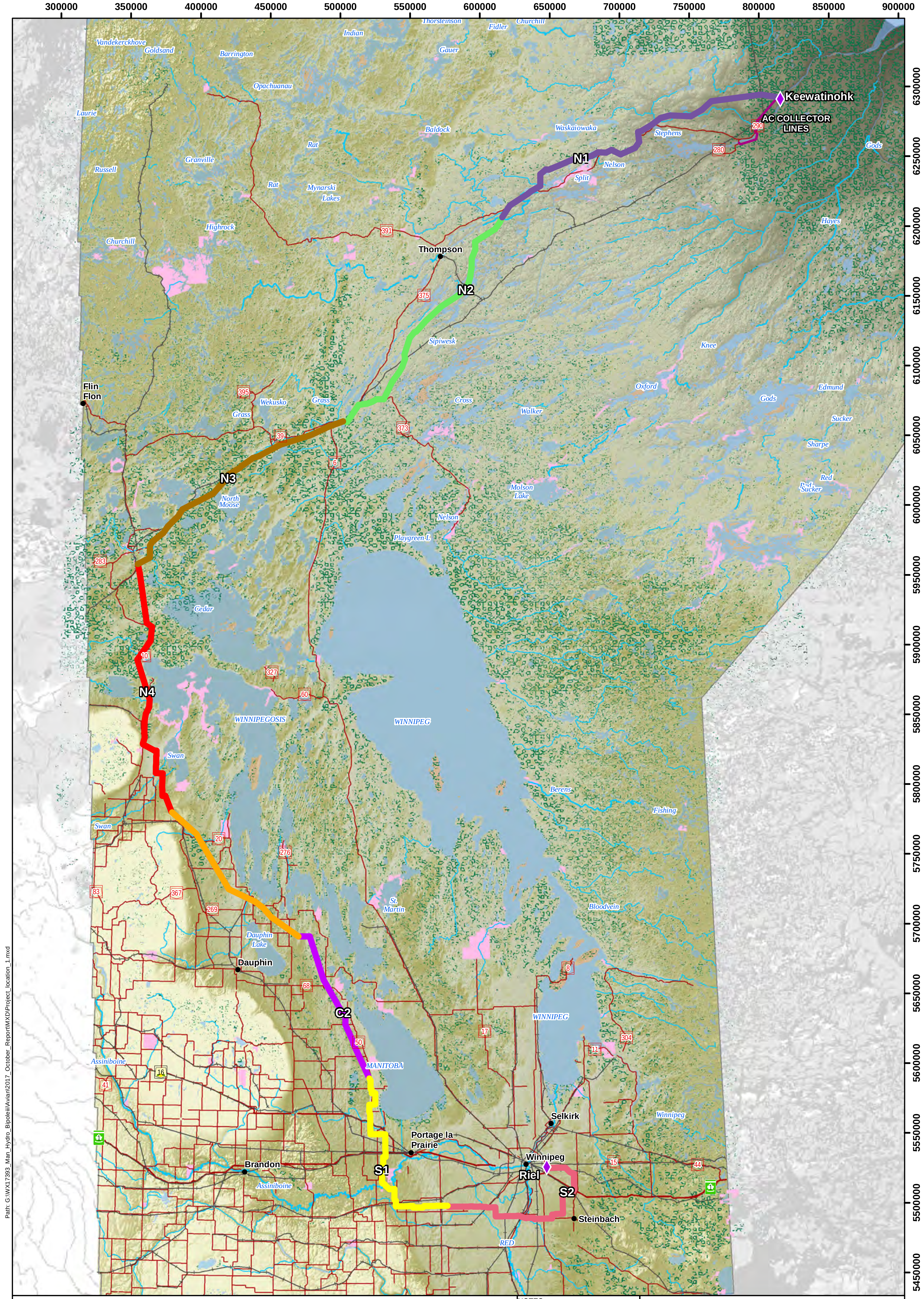
Appendix A
Figures



LEGEND

Final Preferred Route (FPR)

- Section C1
- Section C2
- Section N1
- Section N2
- Section N3
- Section N4
- Section S1
- Section S2
- Converter Station
- City
- AC Collector Lines
- Major River
- Medium River
- Rail
- Provincial Highway
- First Nations Communities
- Island
- Waterbody
- Wetland

NOTES:
-Topographic data extracted from Manitoba Land Iniative and NRCan.
- DEM extracted from Geobase

Datum: NAD83
Projection: UTM Zone 14N

0 50 100 150 200 250 Kilometres

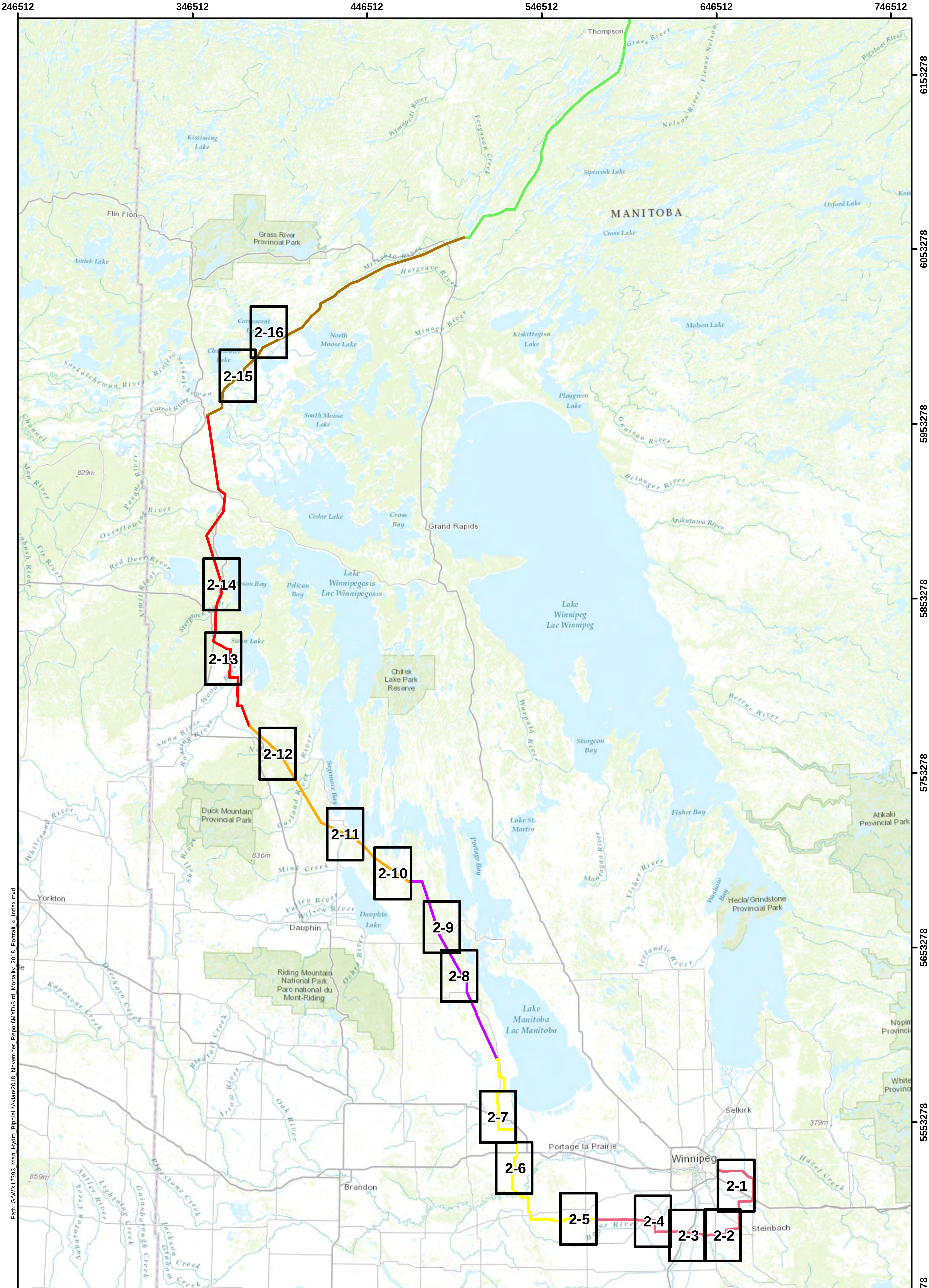
amec foster wheeler

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Project Location

PROJECT N^{o}: WX17393 | **FIGURE: 1**

SCALE: 1:2,500,000 | DATE: May 2018



LEGEND

Key Map

BPIII Final Preferred Route (by segment)

- Section C1
- Section C2
- Section N1
- Section N2
- Section N3
- Section N4
- Section S1
- Section S2

0 50 100 150 200 Kilometres

NOTES:
- Topographic map extracted from ESRI

Datum: NAD83
Projection: UTM Zone 14N

N S E W

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

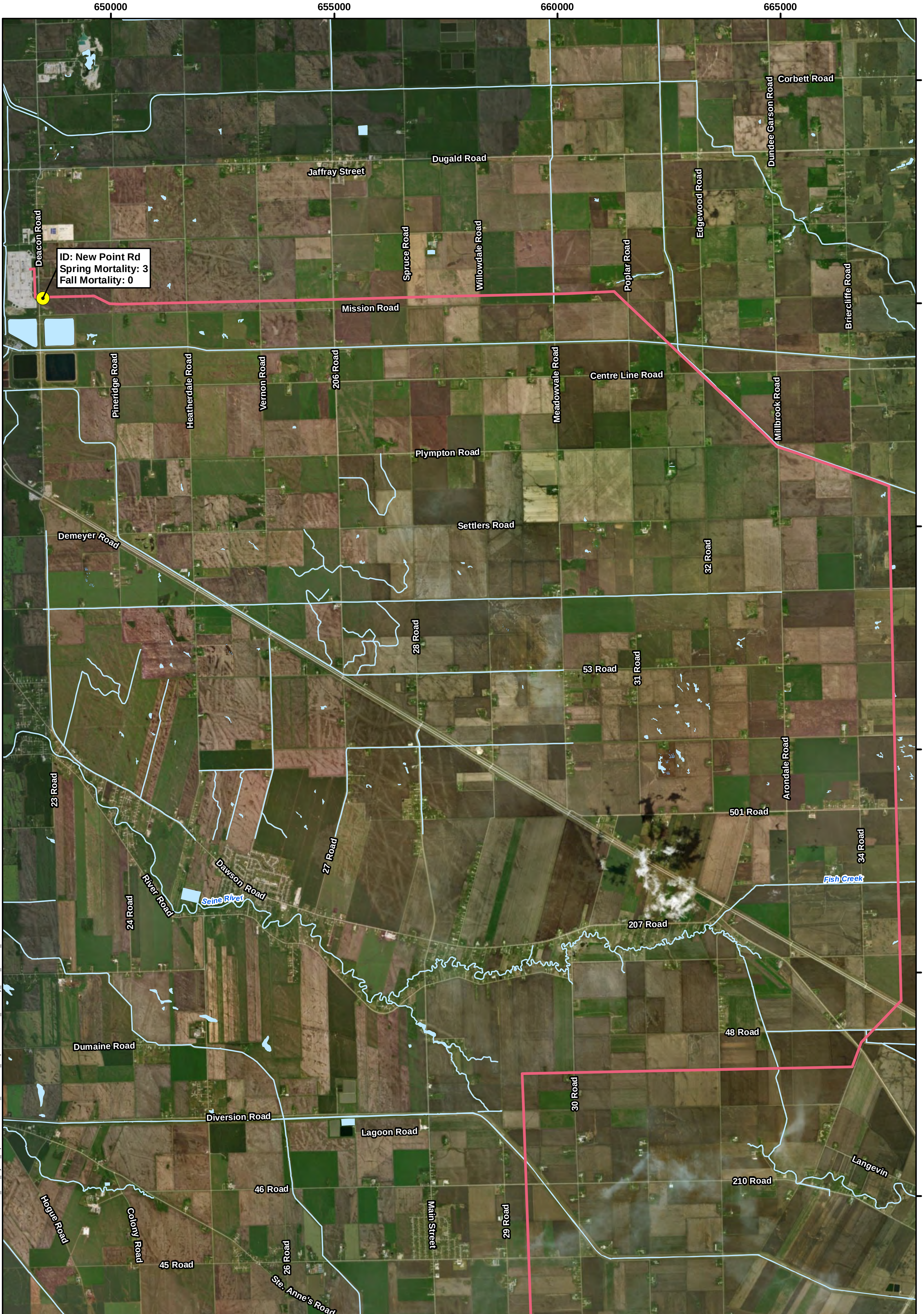
Bird Mortality Key Map

PROJECT N°: WX17393

FIGURE: 2

SCALE: 1:2,000,000

DATE: December 2018



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LEGEND

- Significant Site with Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section S2

0 2 4 6 8 10 Kilometres

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

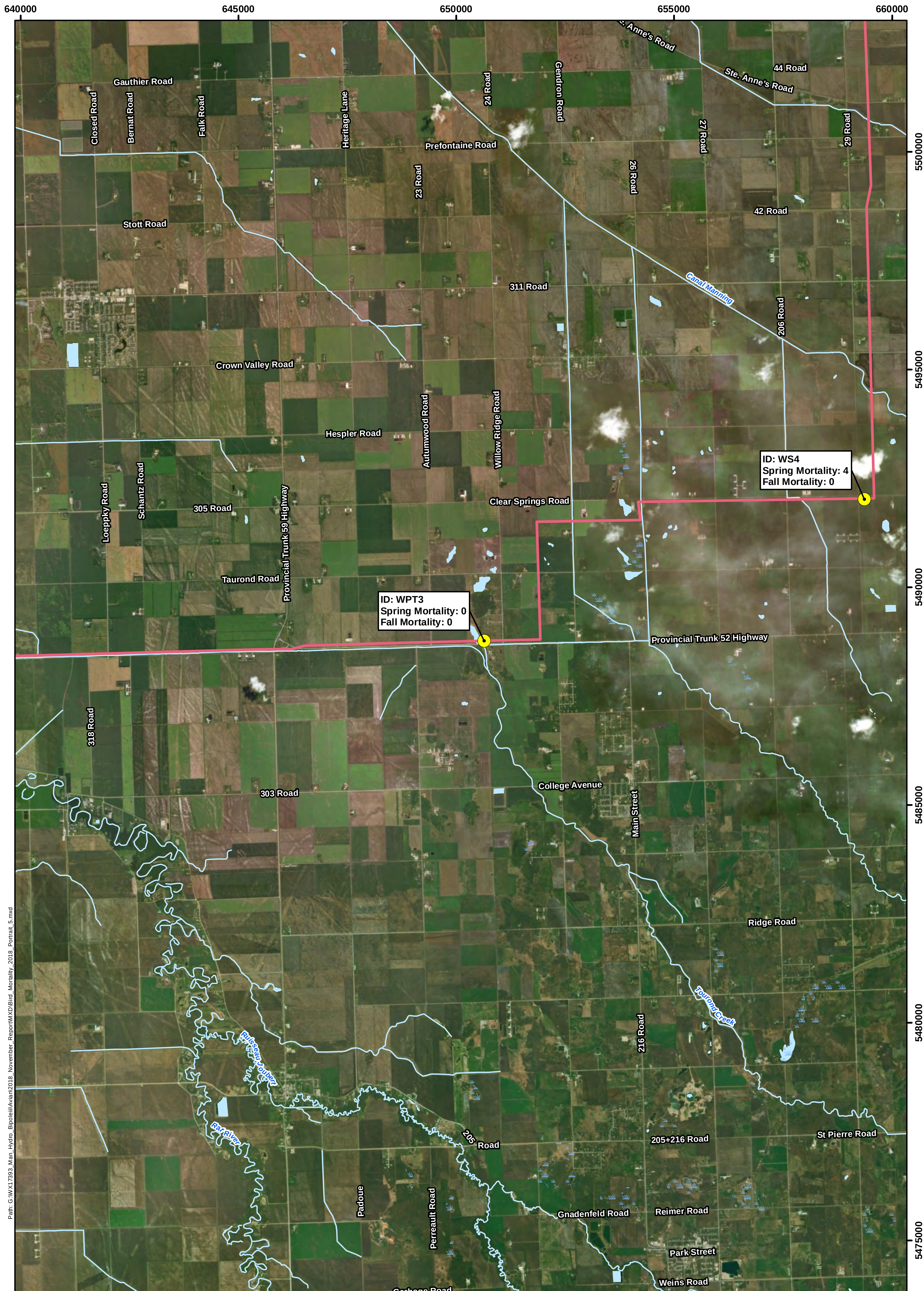
Datum: NAD83
Projection: UTM Zone 14N

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT Nº: WX17393	FIGURE: 2-1
SCALE: 1:80,000	DATE: December 2018



LEGEND

- Significant Site with Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section S2

0 2 4 6 8 10 Kilometres

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

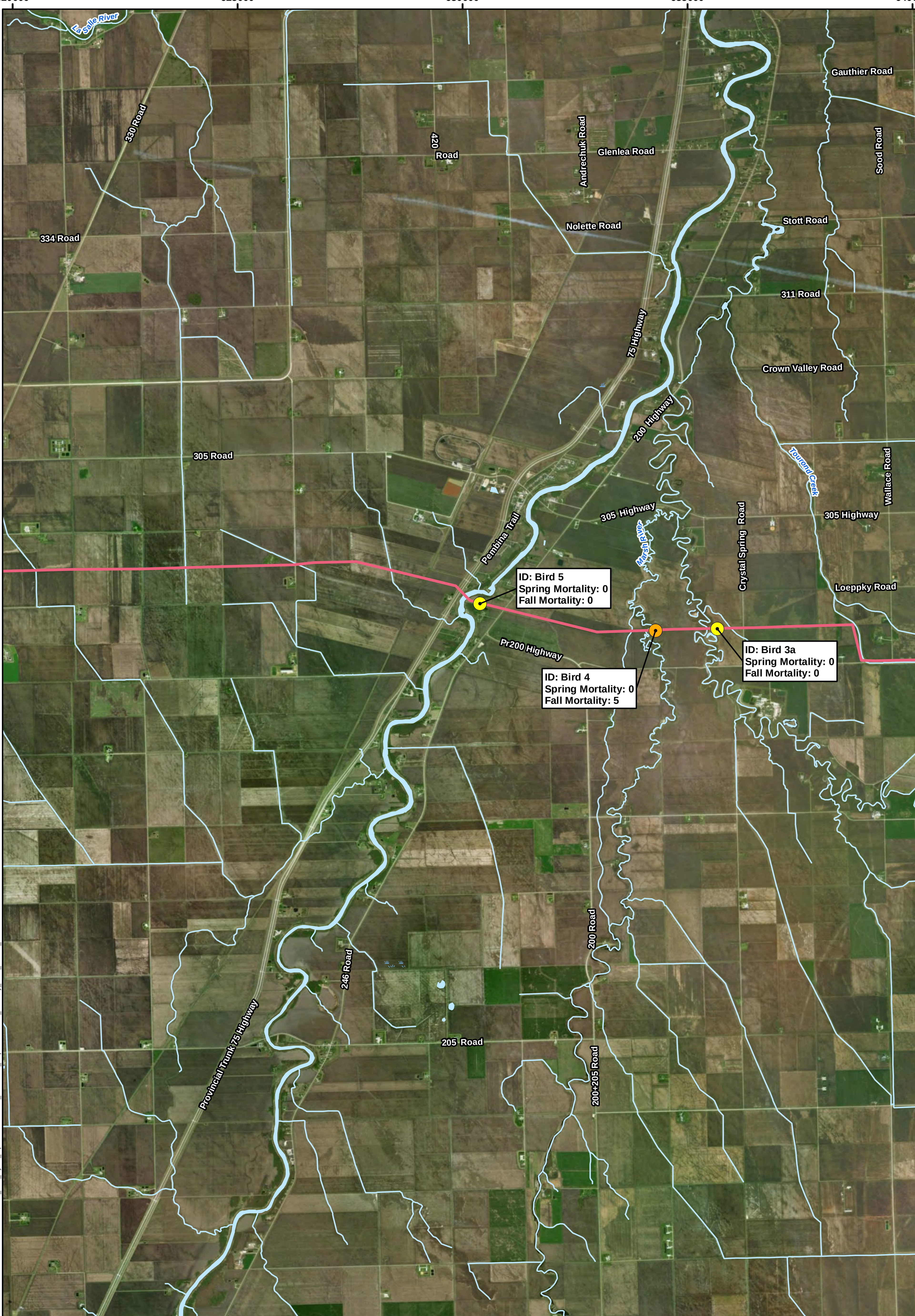
N W E S

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N^{o}: WX17393	**FIGURE: 2-2**
SCALE: 1:80,000	DATE: December 2018



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LEGEND

- Non-significant Site without Diverters
- Significant Site with Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section S2

0 2 4 6 8 10 Kilometres

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

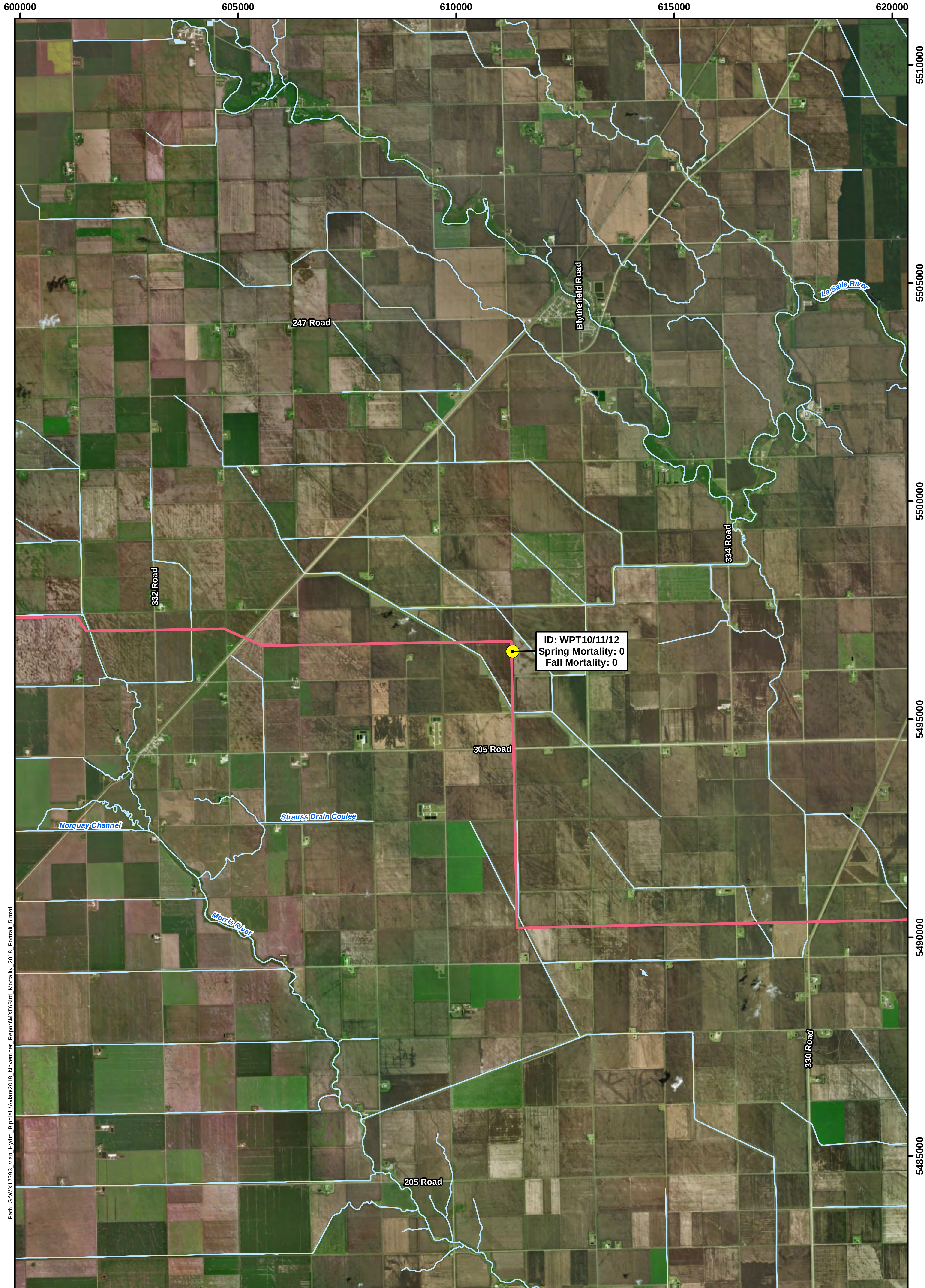
N E S W

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N^{o}: WX17393	**FIGURE: 2-3**
SCALE: 1:80,000	DATE: December 2018



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LEGEND

- Significant Site with Diverters
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section S2

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

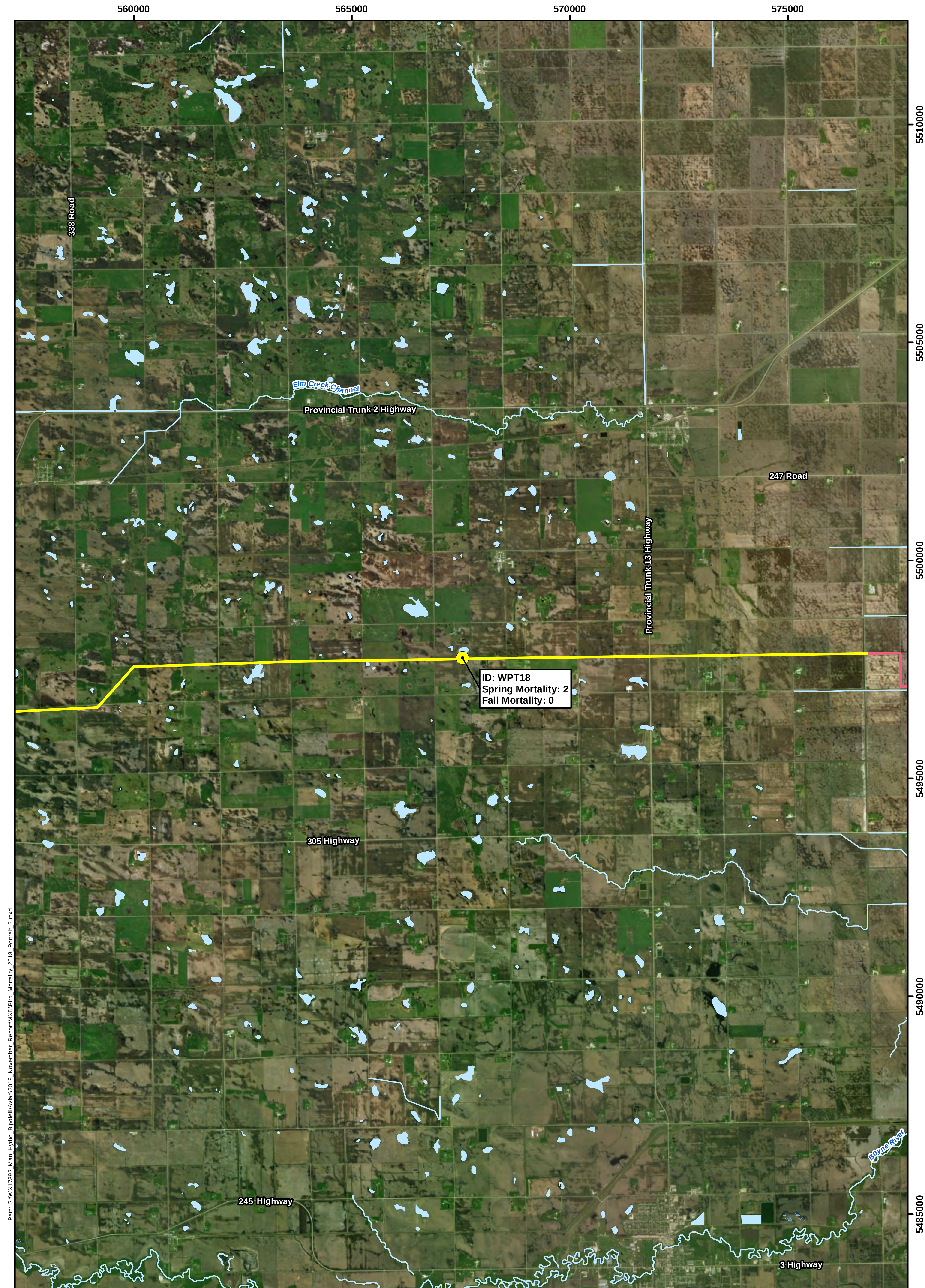
0 2 4 6 8 10 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N^{o}: WX17393	**FIGURE: 2-4**
SCALE: 1:80,000	DATE: December 2018



LEGEND

- Significant Site with Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section S1
- Section S2

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

0 2 4 6 8 10 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N°: WX17393	**FIGURE: 2-5**
SCALE: 1:80,000	DATE: December 2018

Path: G:\WX17393_Man_Hydro_Bipole\Avian\2018_November_Report\MXD\Bird_Mortality_2018_Portrait_5.mxd

LEGEND

- Non-significant Site without Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section S1

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

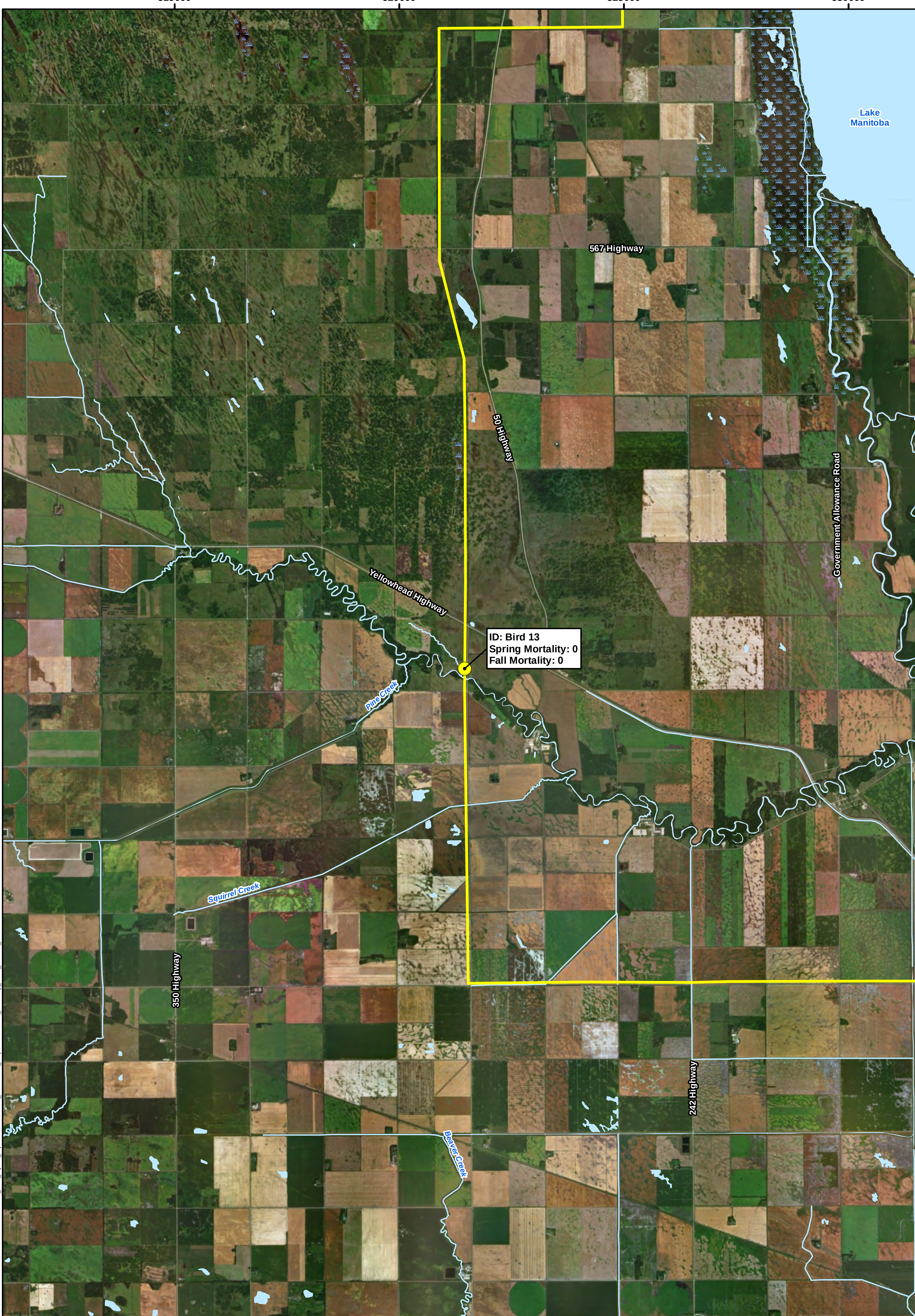
0 2 4 6 8 10 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N°: WX17393	**FIGURE: 2-6**
SCALE: 1:80,000	DATE: December 2018



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LEGEND

- Significant Site with Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section S1

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

wood.

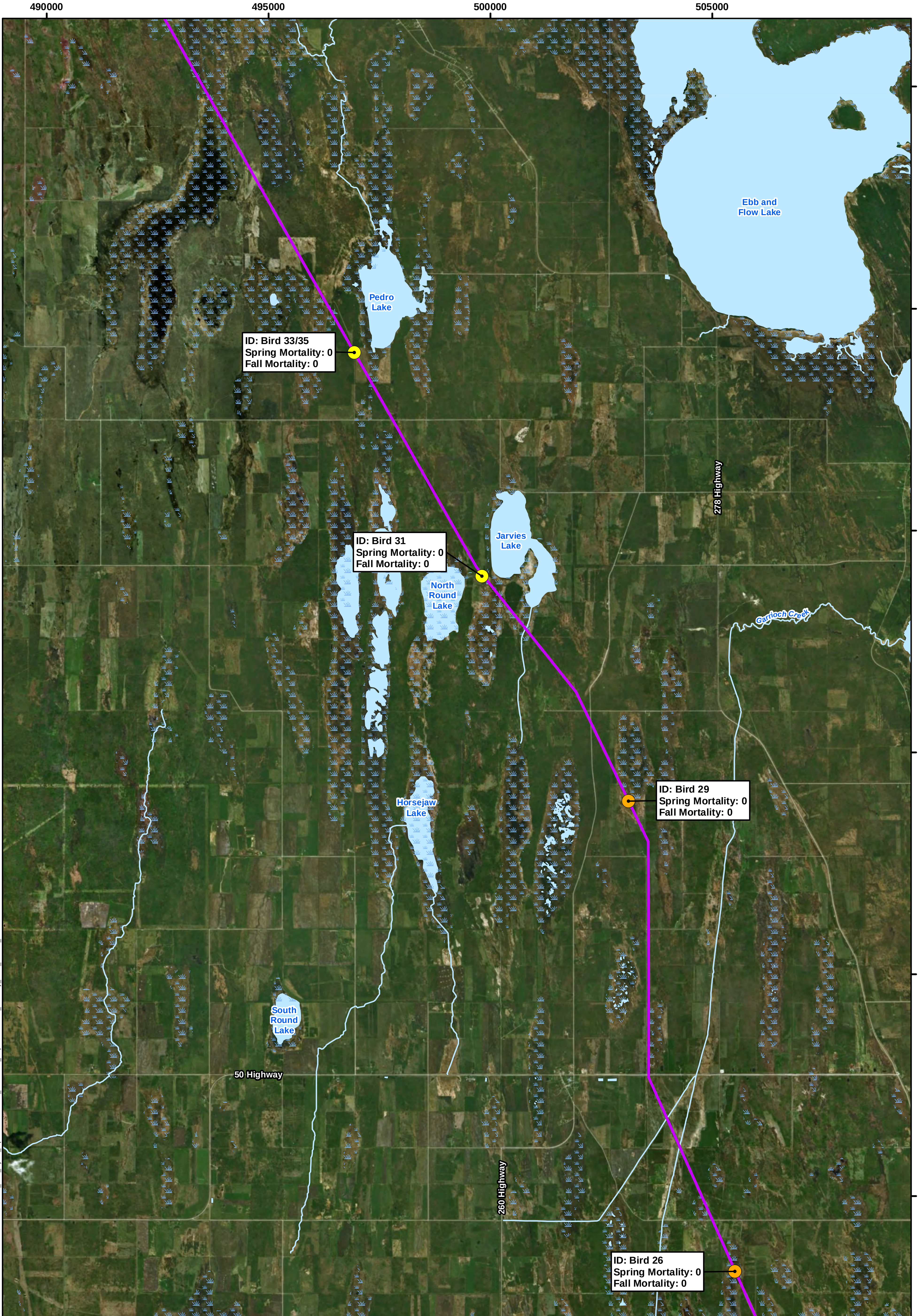
MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

Datum: NAD83
Projection: UTM Zone 14N

0 2 4 6 8 10 Kilometres

PROJECT N°: WX17393	**FIGURE: 2-7**
SCALE: 1:80,000	DATE: December 2018



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LEGEND

- Non-significant Site without Diverters
- Significant Site with Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section C2

0 2 4 6 8 10 Kilometres

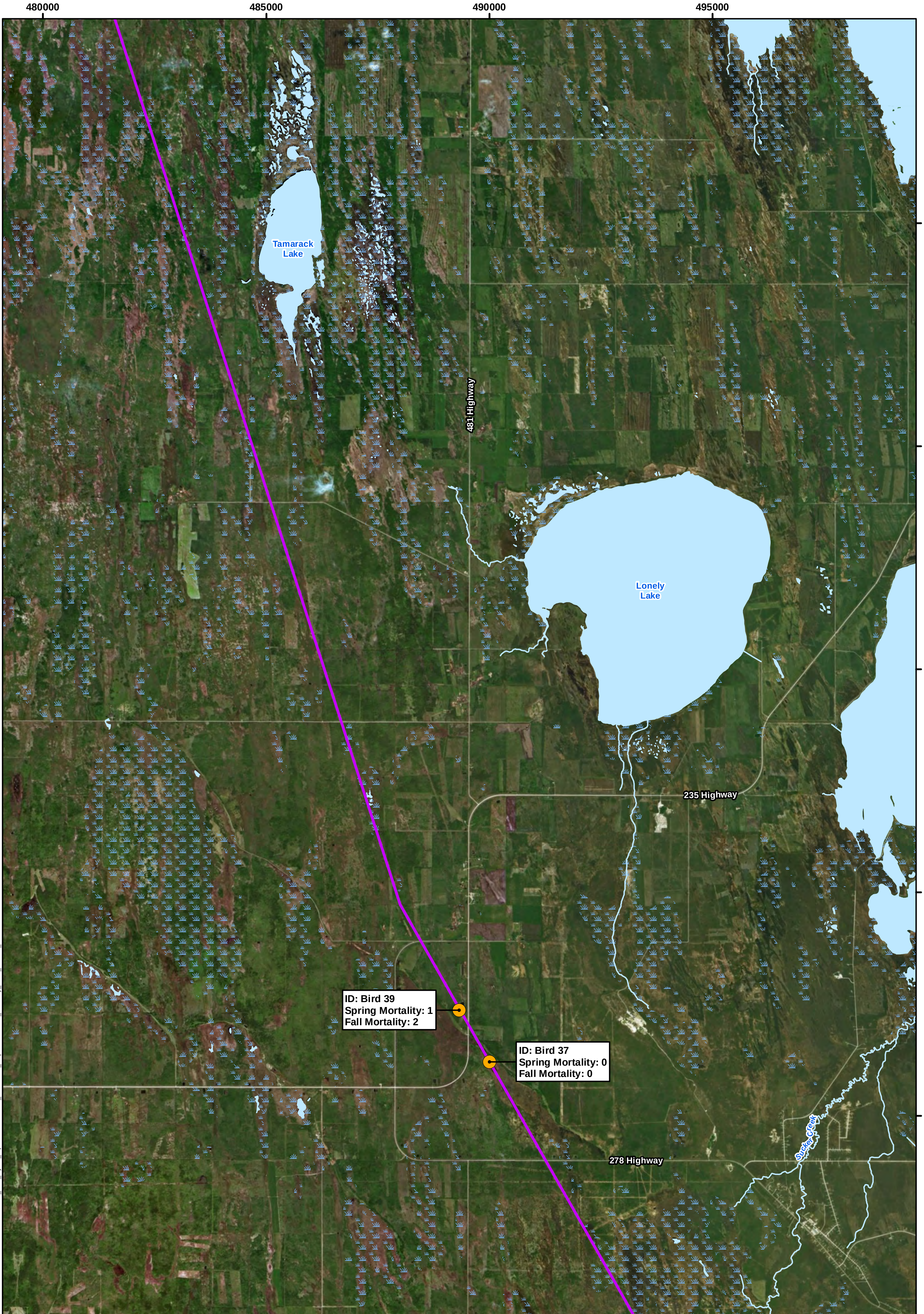
NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

N W E S

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT	
Bird Mortality Survey	
PROJECT N^{o}: WX17393	**FIGURE: 2-8**
SCALE: 1:80,000	DATE: December 2018



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LEGEND

- Non-significant Site without Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section C2

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

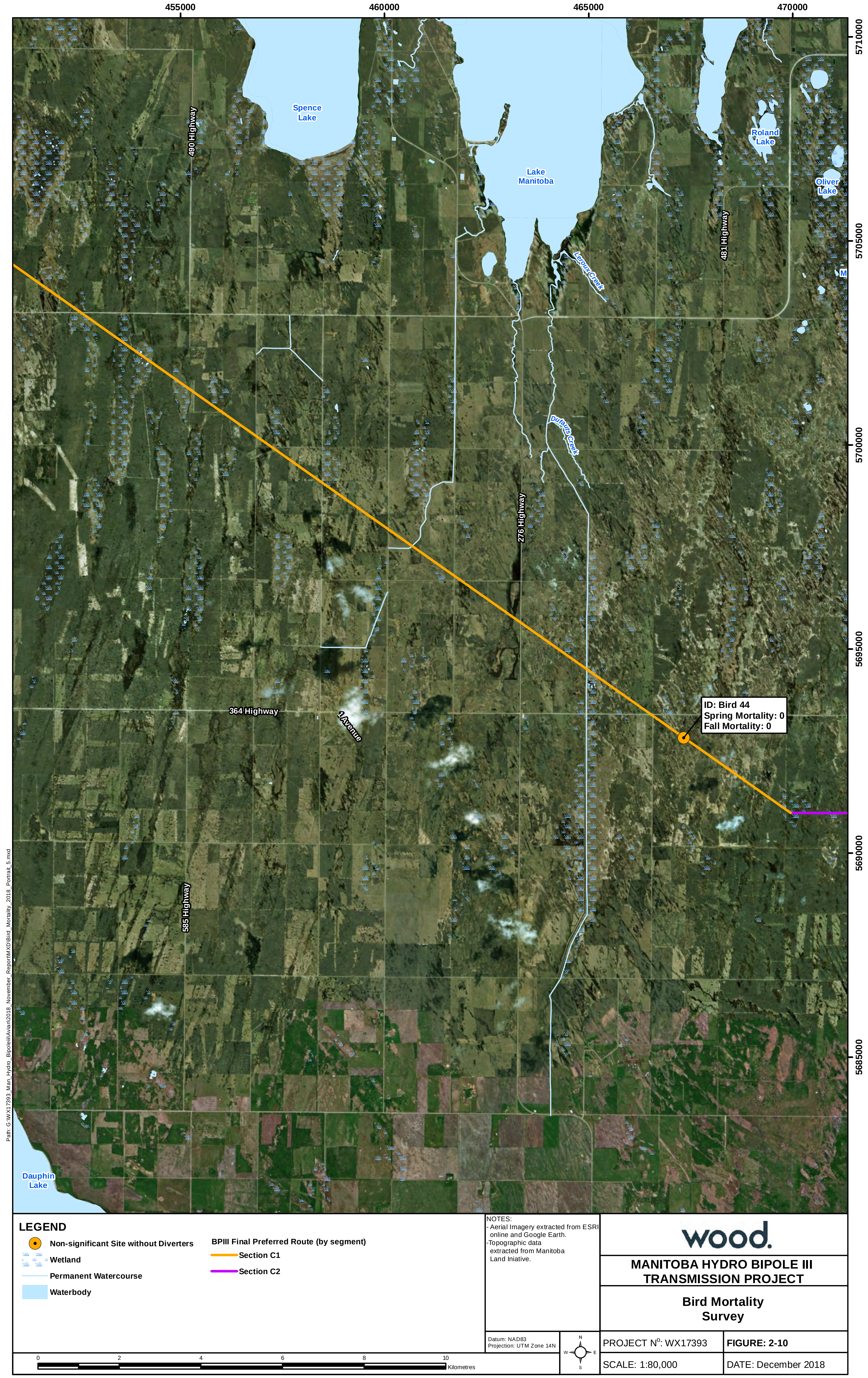
0 2 4 6 8 10 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N°: WX17393	**FIGURE: 2-9**
SCALE: 1:80,000	DATE: December 2018



LEGEND

- Non-significant Site without Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section C1
- Section C2

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N°: WX17393

FIGURE: 2-10

SCALE: 1:80,000

DATE: December 2018

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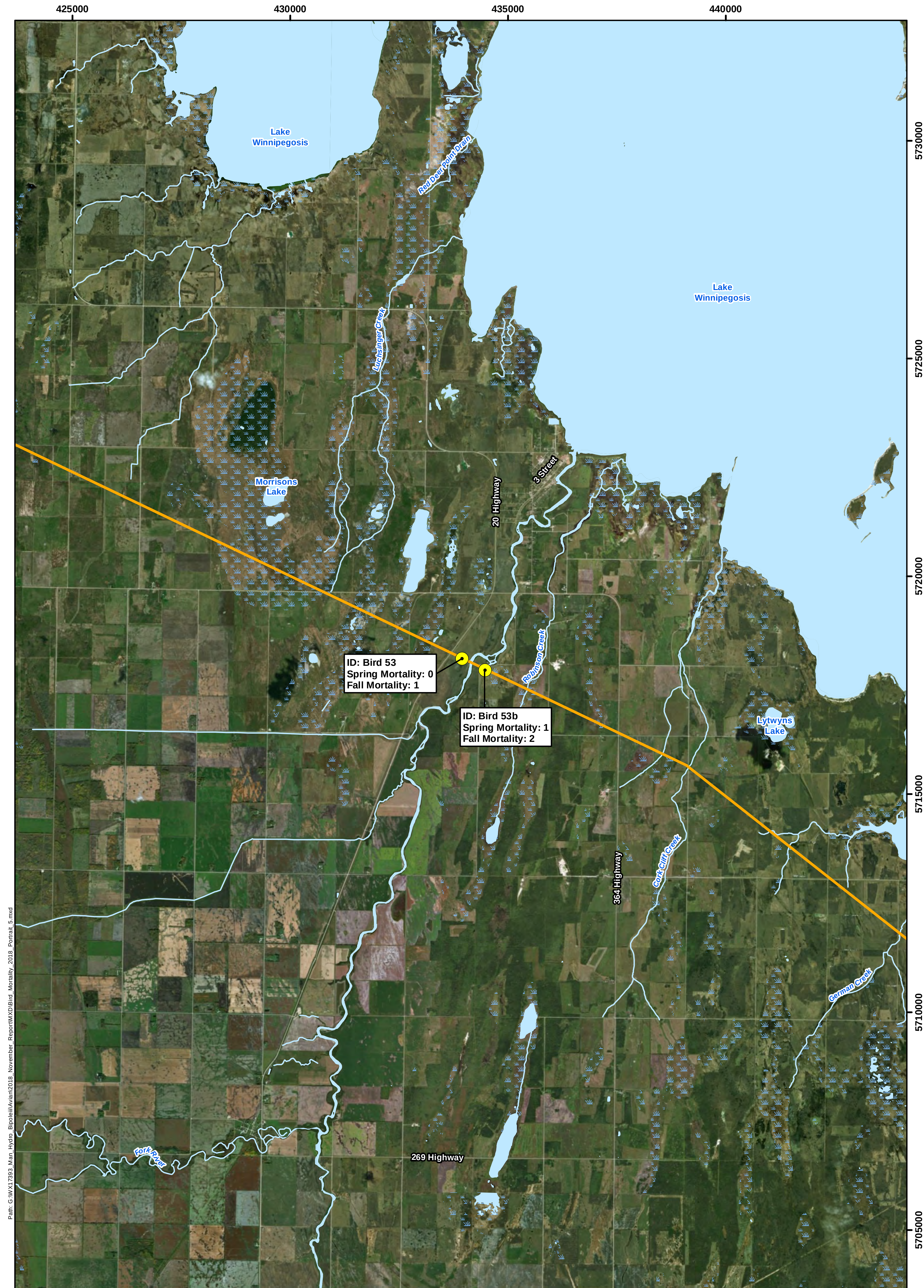

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LEGEND

- Significant Site with Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section C1

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

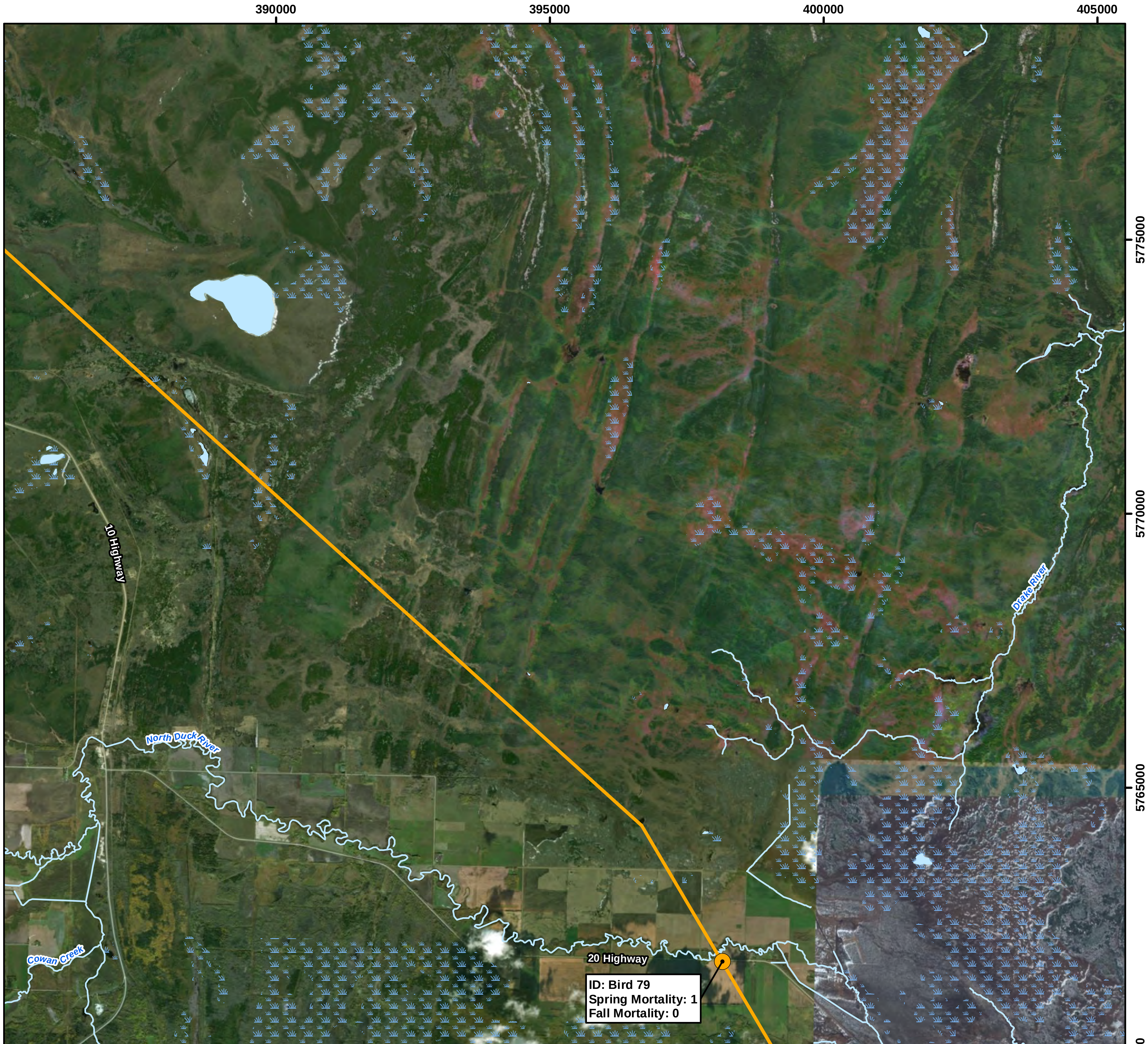
0 2 4 6 8 10 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N^{o}: WX17393	**FIGURE: 2-11**
SCALE: 1:80,000	DATE: December 2018



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LEGEND

- Non-significant Site without Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section C1

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

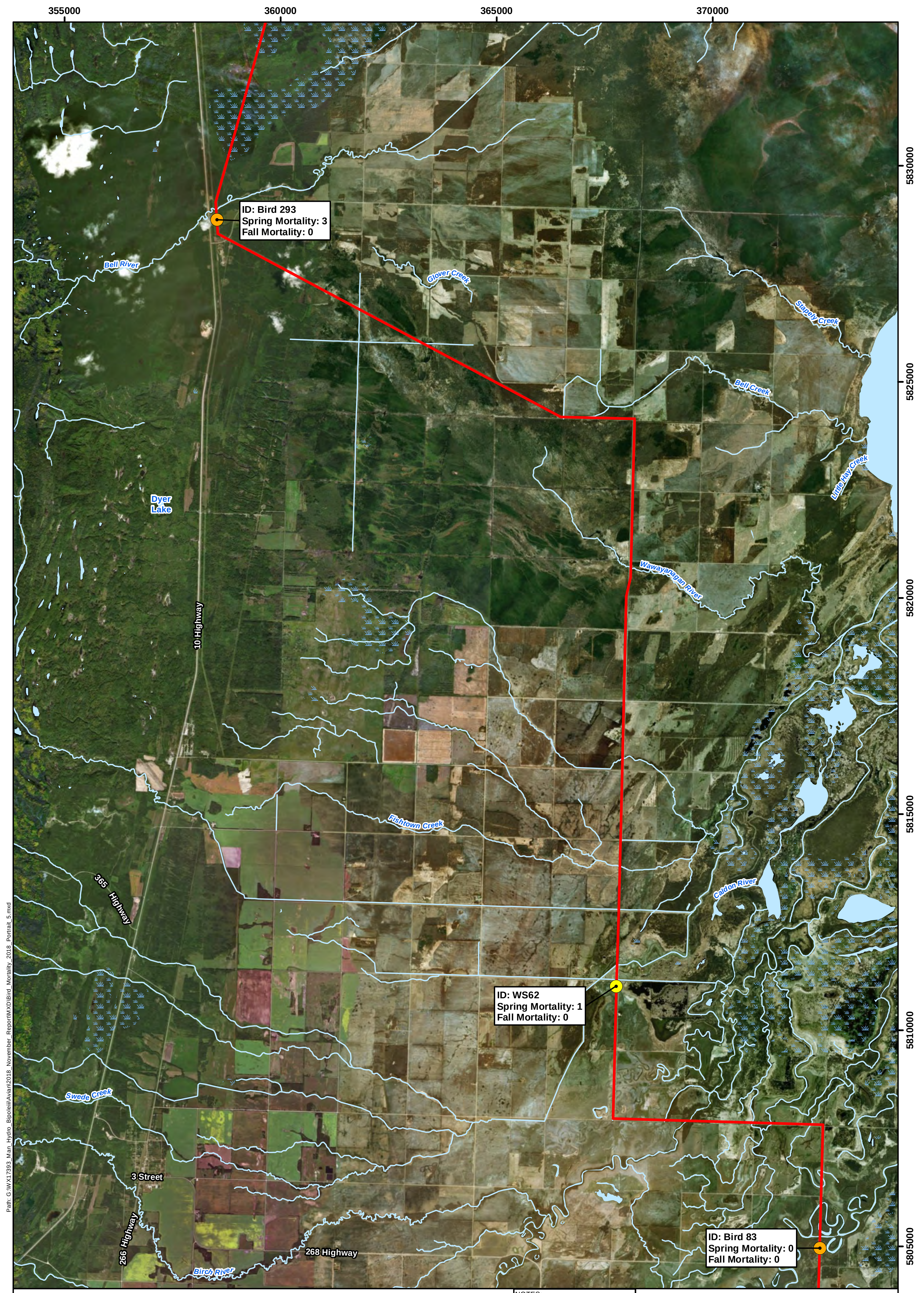
0 2 4 6 8 10 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N^{o}: WX17393	**FIGURE: 2-12**
SCALE: 1:80,000	DATE: December 2018



LEGEND

- Non-significant Site without Diverters
- Significant Site with Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section N4

0 2 4 6 8 10 Kilometres

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

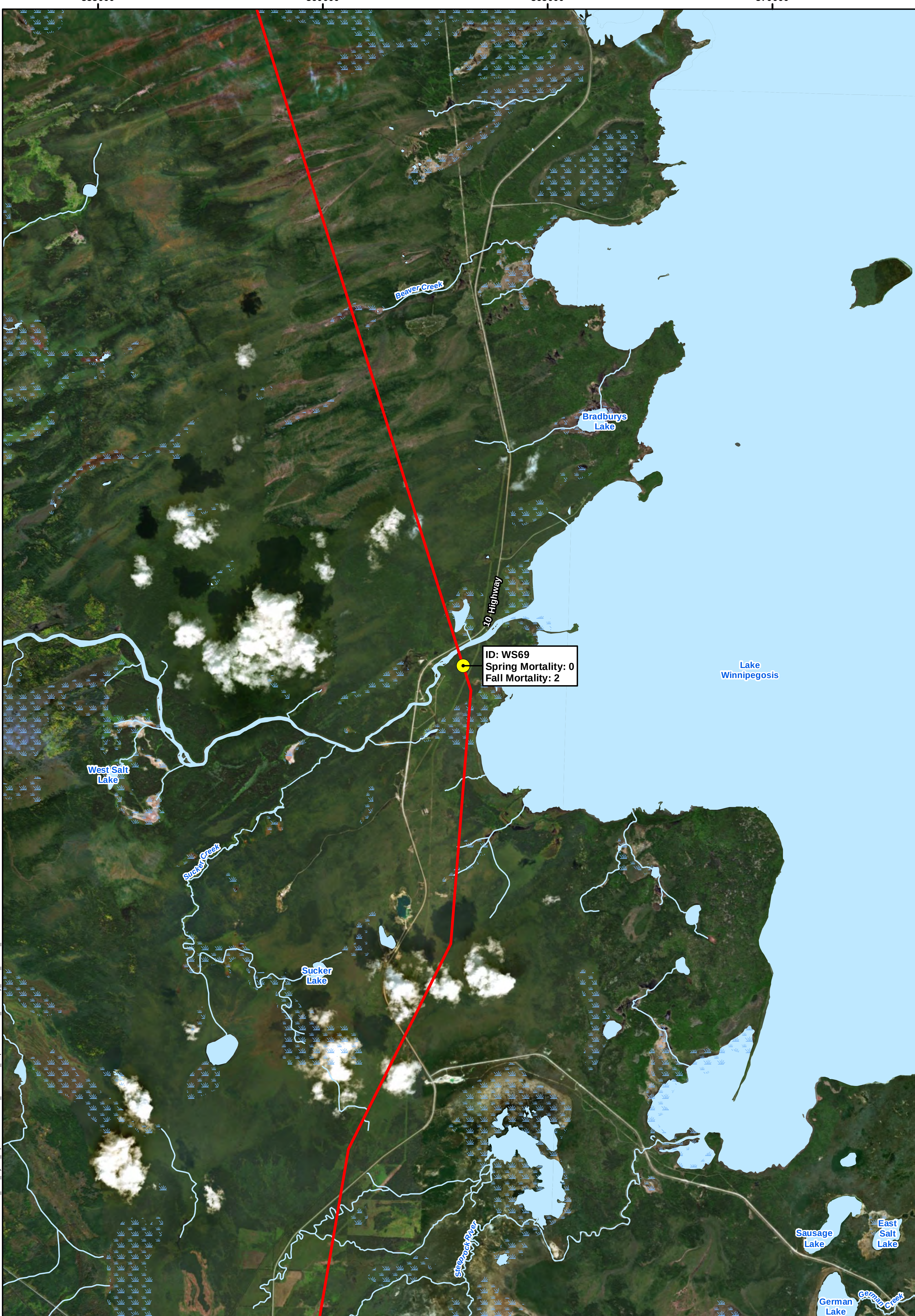
N E S W

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT Nº: WX17393	**FIGURE: 2-13**
SCALE: 1:80,000	DATE: December 2018



Path: G:\WX17393_Man_Hydro_Bipole\Avian\2018_November_Report\MXD\Bird_Mortality_2018_Portrait_5.mxd

LEGEND

- Significant Site with Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section N4

0 2 4 6 8 10 Kilometres

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

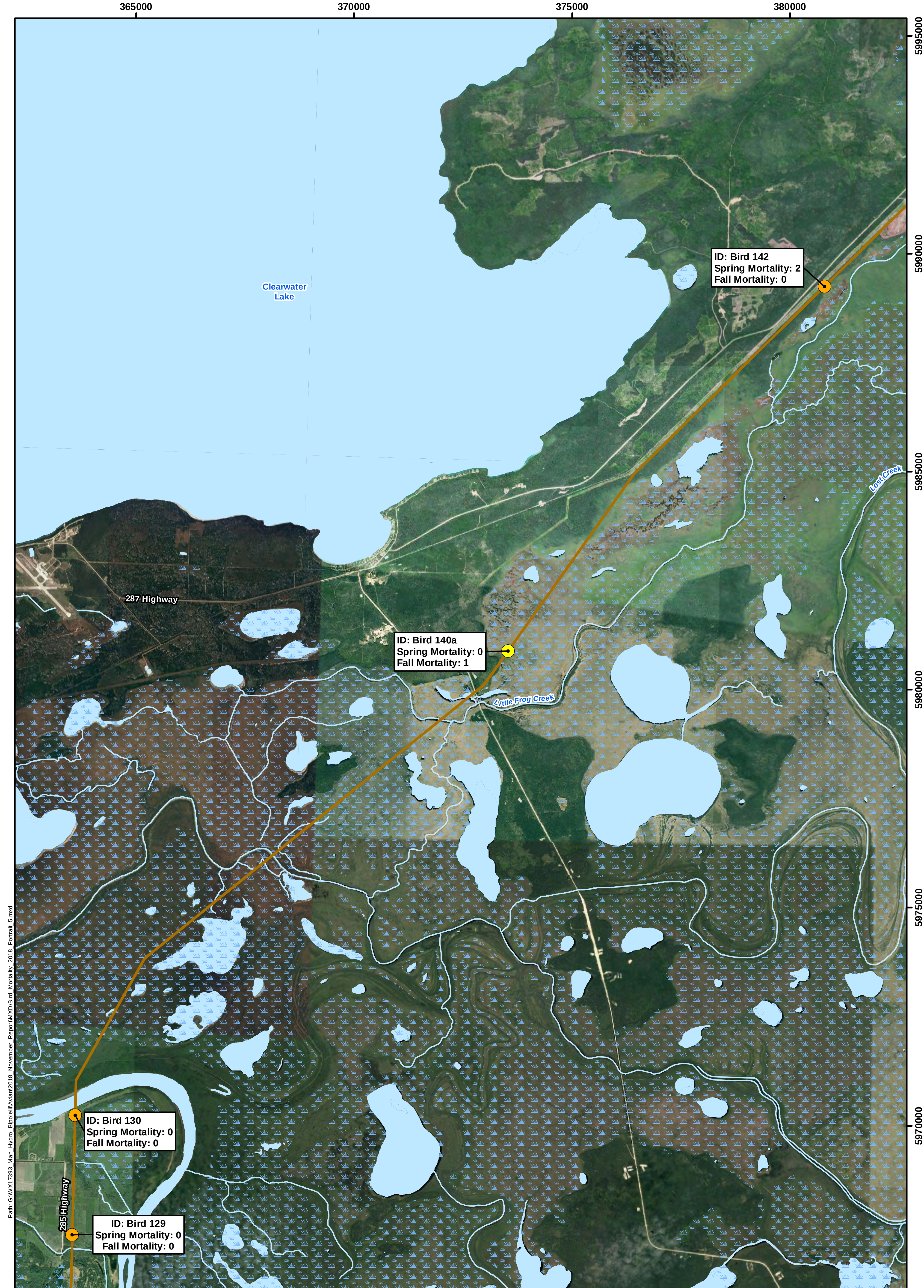
N W E S

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N^{o}: WX17393	**FIGURE: 2-14**
SCALE: 1:80,000	DATE: December 2018



LEGEND

- Non-significant Site without Diverters
- Significant Site with Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section N3

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

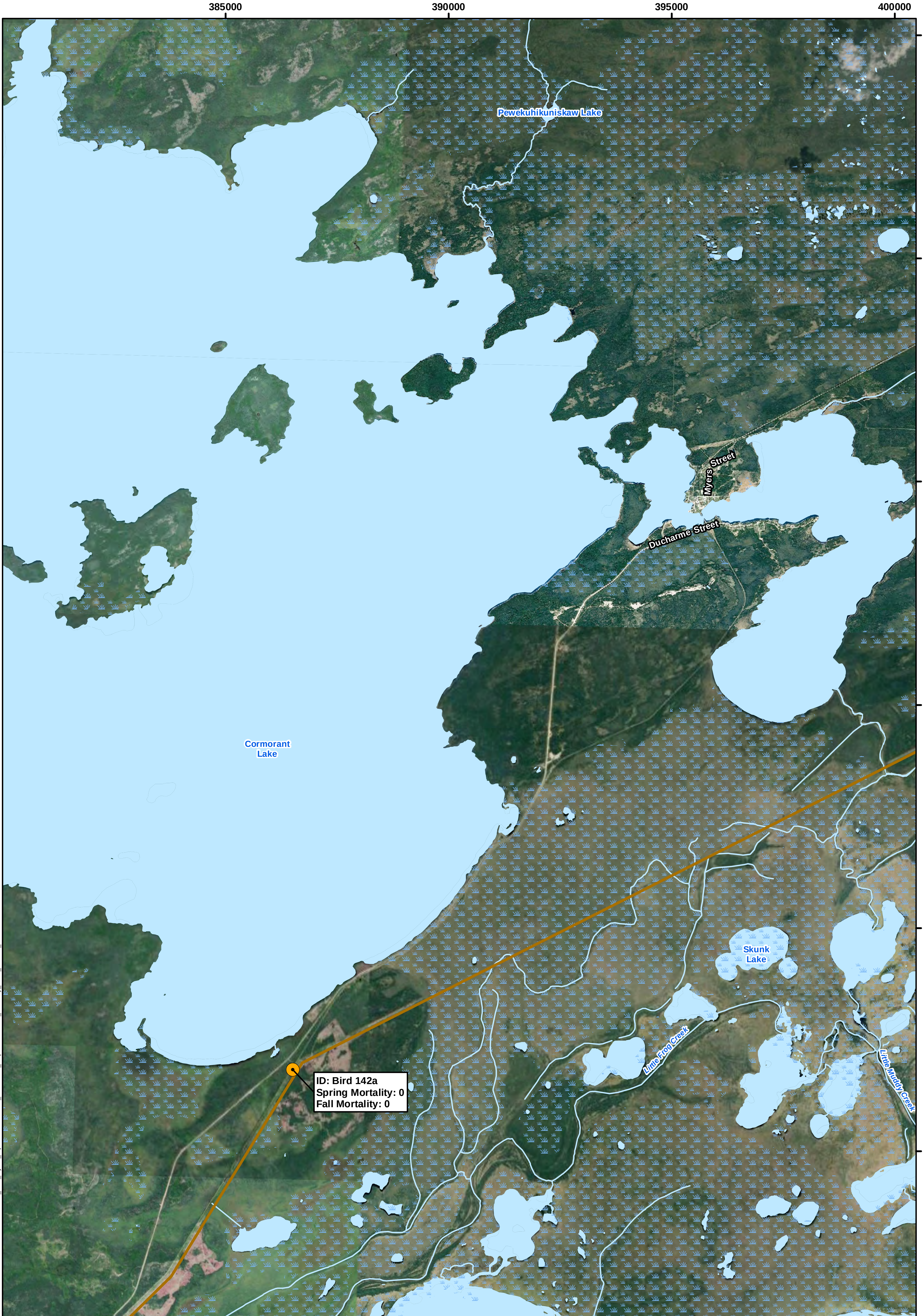
0 2 4 6 8 10 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N^{o}: WX17393	**FIGURE: 2-15**
SCALE: 1:80,000	DATE: December 2018



Path: G:\WX17393_Man_Hydro_Bipoleiii\Avian\2018_November_Report\MXD\Bird_Mortality_2018_Portrait_5.mxd

LEGEND

- Non-significant Site without Diverters
- Wetland
- Permanent Watercourse
- Waterbody

BPIII Final Preferred Route (by segment)

- Section N3

0 2 4 6 8 10 Kilometres

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

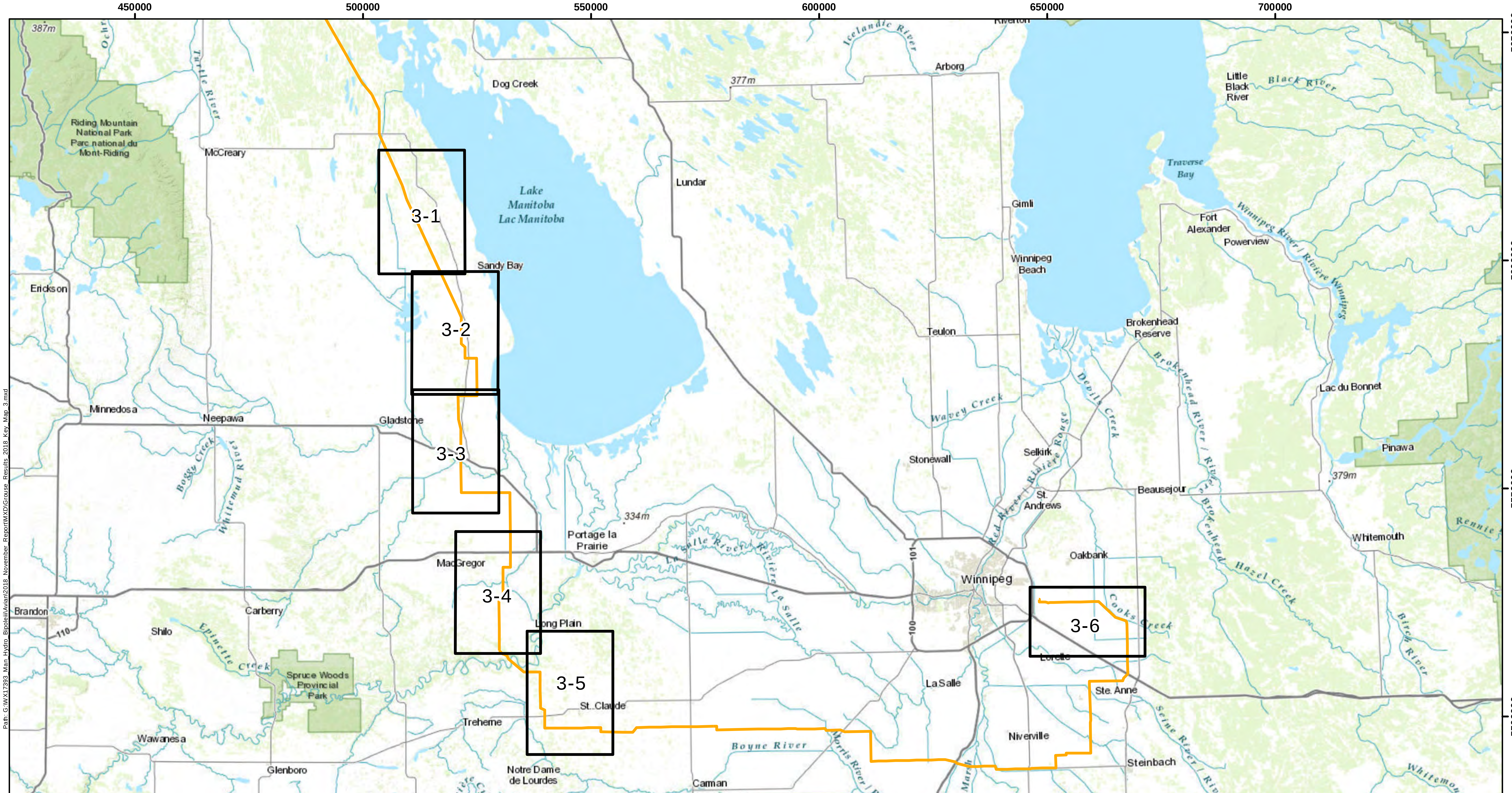
N W E S

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Bird Mortality Survey

PROJECT N°: WX17393	**FIGURE: 2-16**
SCALE: 1:80,000	DATE: December 2018



LEGEND

Key Map

Transmission Line

NOTES:
-Topographic map extracted from ESRI online.

Datum: NAD83
Projection: UTM Zone 14N

0 40 80 120 160 200 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Sharp-tailed grouse Survey Key Map

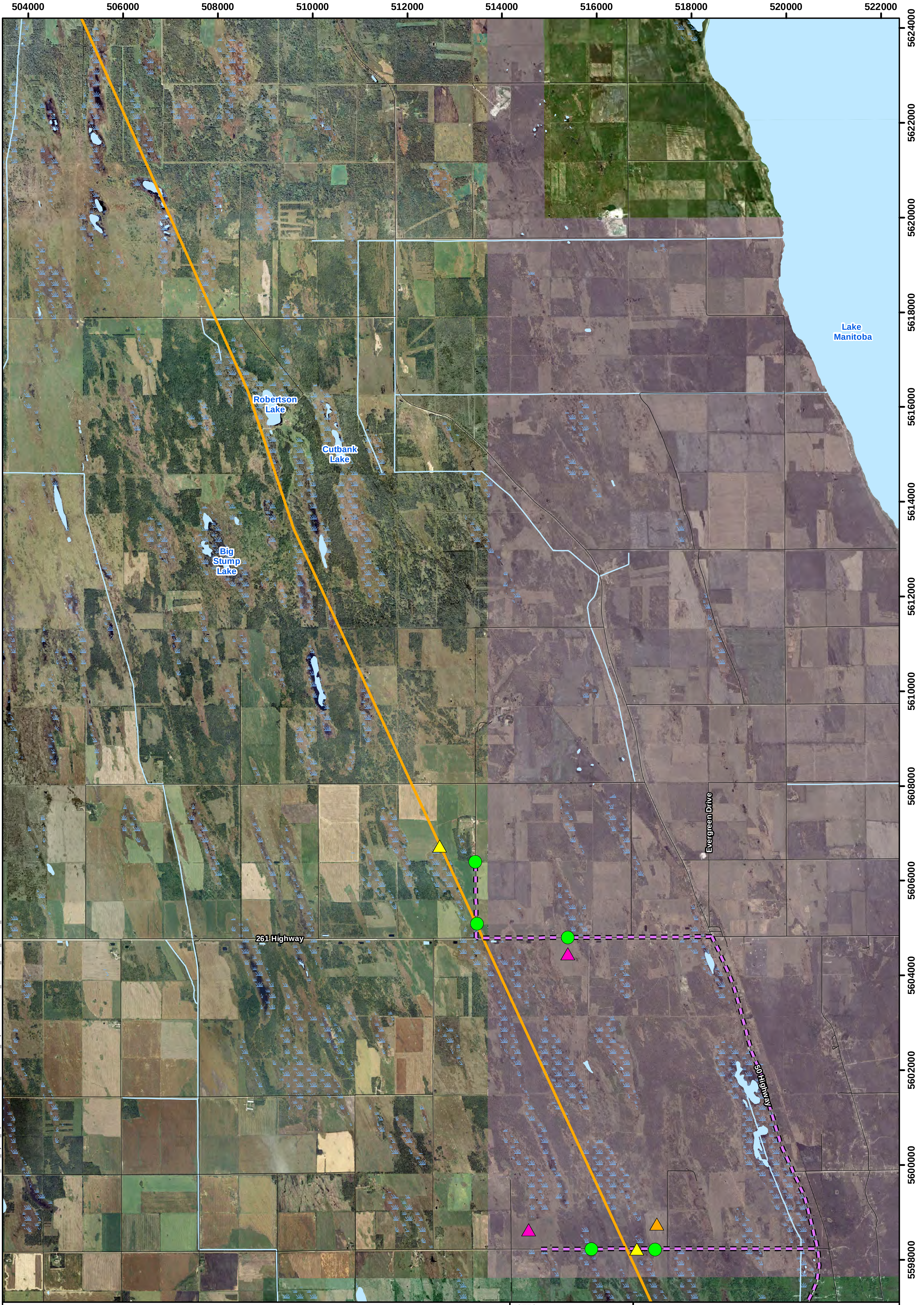
PROJECT N°: WX17393

FIGURE: 3

SCALE: 1:800,000

DATE: December 2018

Path: G:\WX17393_Man_Hydro_Bipole\Avian\2018_November_Report\MXD\Grouse_Results_2018_Key_Map_3.mxd



Path: G:\WX17393_Man_Hydro_Bipole\Avian\2018_November_Report\MXD\Grouse_Results_2018_Portrait_3.mxd

LEGEND

- Survey Locations (2018)
- Survey Route (2018)
- Transmission Line
- Permanent Watercourse
- Wetland
- Waterbody

Sharp-tailed Grouse Observations

- 2018
- 2017
- 2015

Observation Type

- Confirmed Leks
- Other Grouse Sightings

0 2 4 6 8 10 Kilometres

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

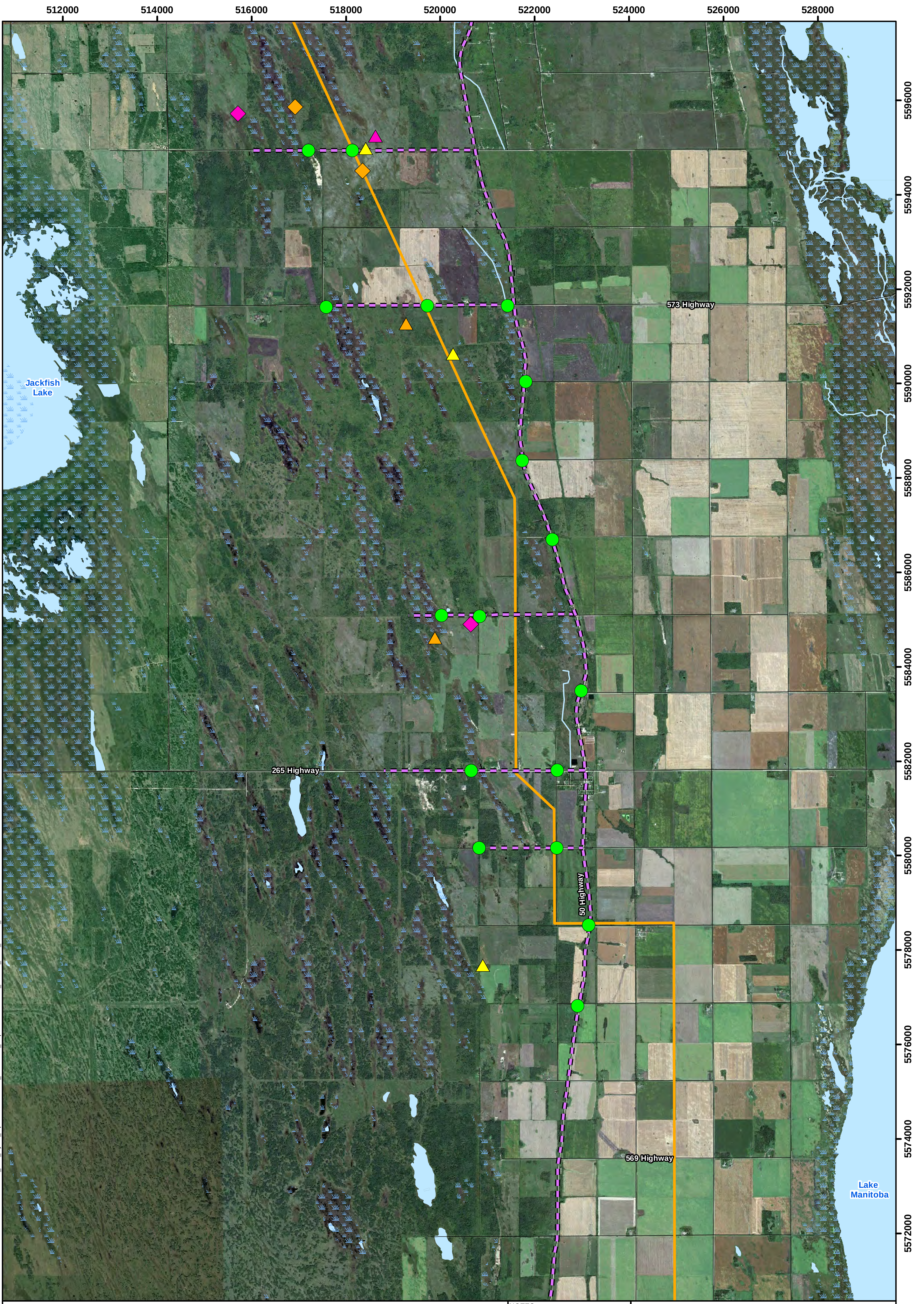
N E S W

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Sharp-tailed Grouse Survey

PROJECT N°: WX17393	**FIGURE: 3-1**
SCALE: 1:74,000	DATE: December 2018



Path: G:\WX17393_Man_Hydro_BipoleIII\Avian\2018_November_Report\MXD\Grouse_Results_2018_Portrait_3.mxd

LEGEND

- Survey Locations (2018)
- Survey Route (2018)
- Transmission Line
- Permanent Watercourse
- Wetland
- Waterbody

Sharp-tailed Grouse Observations

- 2018
- 2017
- 2015

Observation Type

- Confirmed Leks
- Other Grouse Sightings

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

N W E S

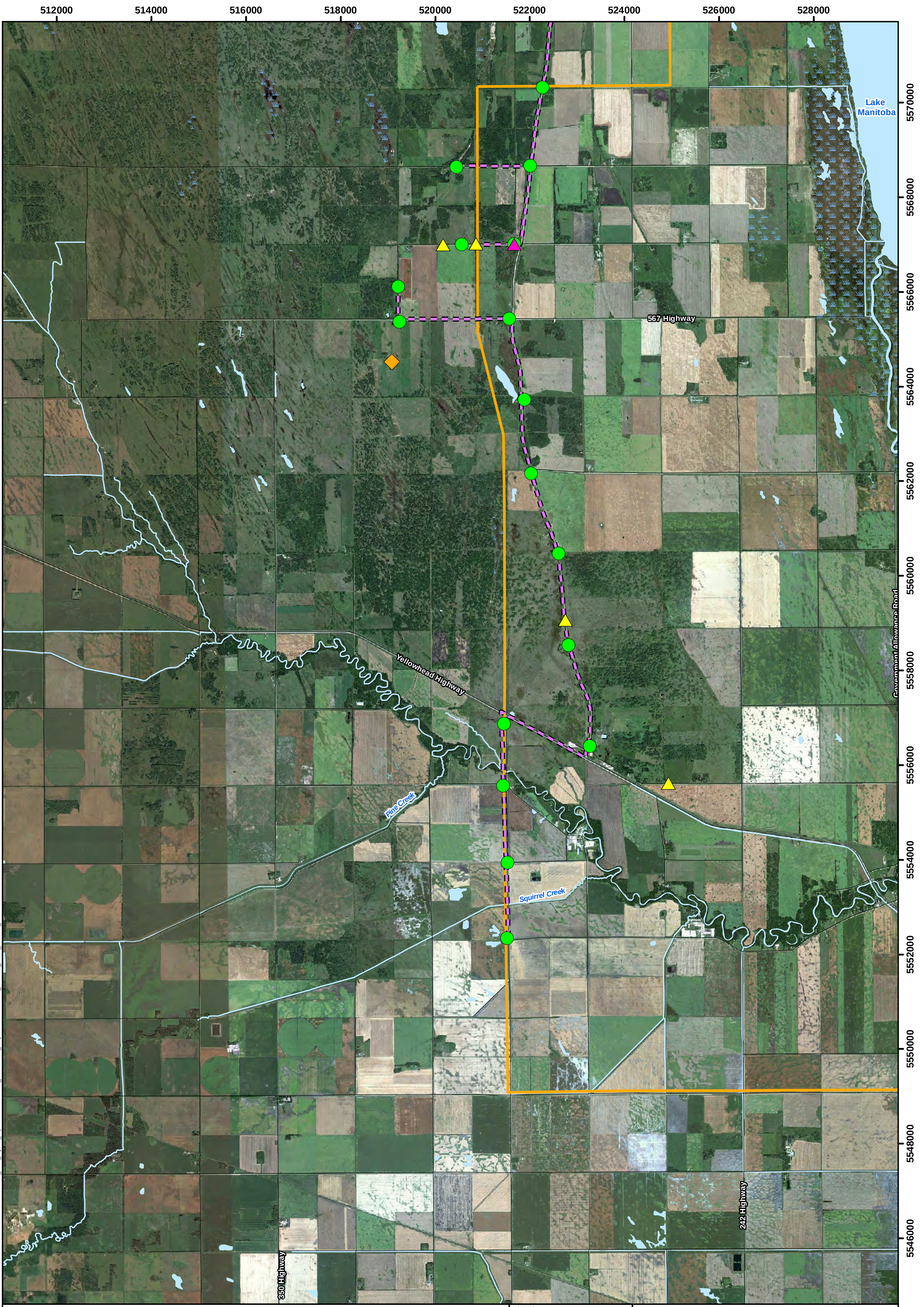
0 2 4 6 8 10 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Sharp-tailed Grouse Survey

PROJECT N^{o}: WX17393	**FIGURE: 3-2**
SCALE: 1:74,000	DATE: December 2018



Path: G:\WX17393_Man_Hydro_Bipole\Avian\2018_November_Report\MXD\Grouse_Results_2018_Portrait_3.mxd

LEGEND

- Survey Locations (2018)
- Survey Route (2018)
- Transmission Line
- Permanent Watercourse
- Wetland
- Waterbody

Sharp-tailed Grouse Observations
- 2018
- 2017
- 2015

Observation Type
- Confirmed Leks
- Other Grouse Sightings

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
-Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

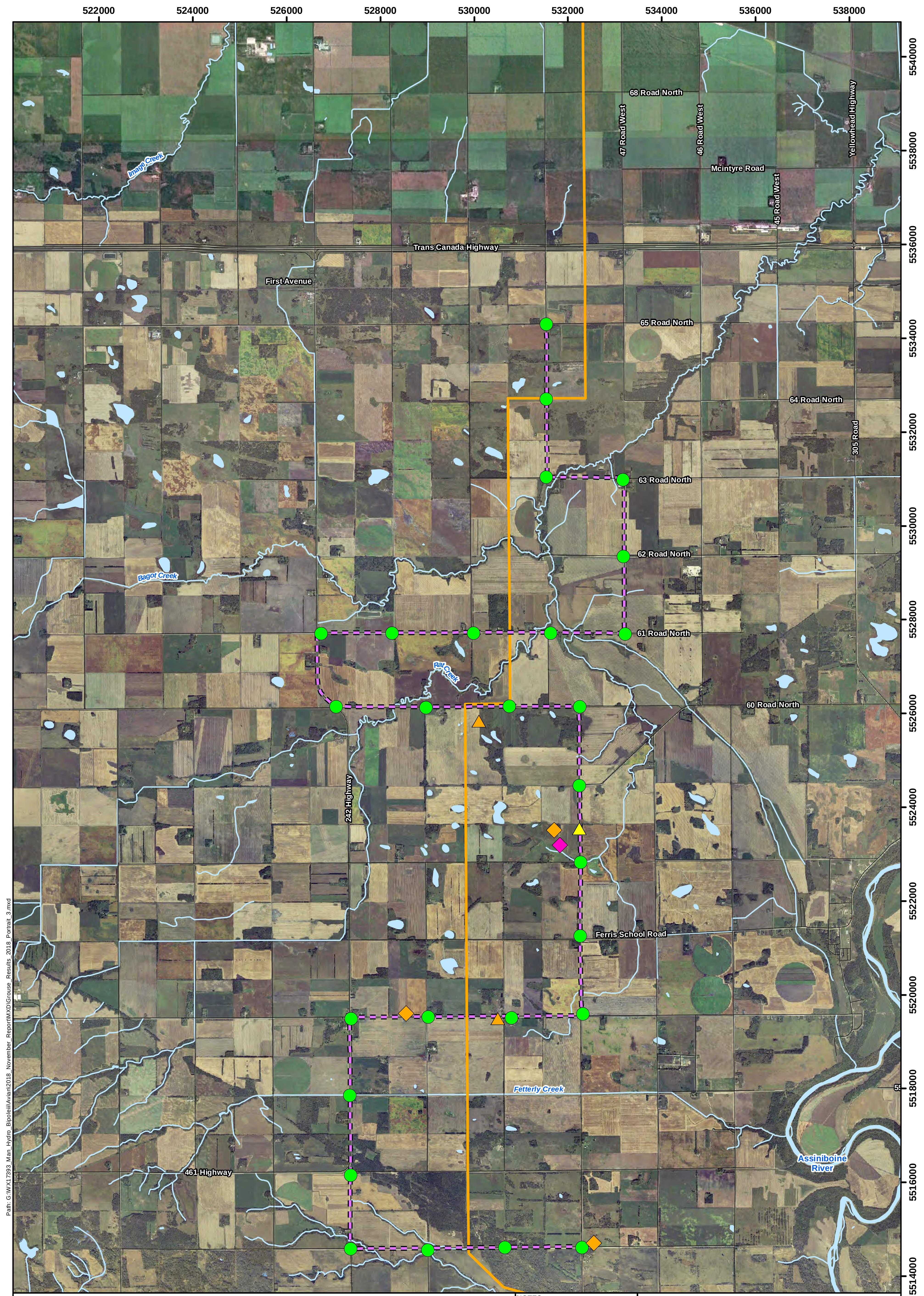
0 2 4 6 8 10 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Sharp-tailed Grouse Survey

PROJECT N°: WX17393	FIGURE: 3-3
SCALE: 1:74,000	DATE: December 2018



LEGEND

- Survey Locations (2018)
- Survey Route (2018)
- Transmission Line
- Permanent Watercourse
- Wetland
- Waterbody

Sharp-tailed Grouse Observations

- 2018
- 2017
- 2015

Observation Type

- Confirmed Leks
- Other Grouse Sightings

0 2 4 6 8 10 Kilometres

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

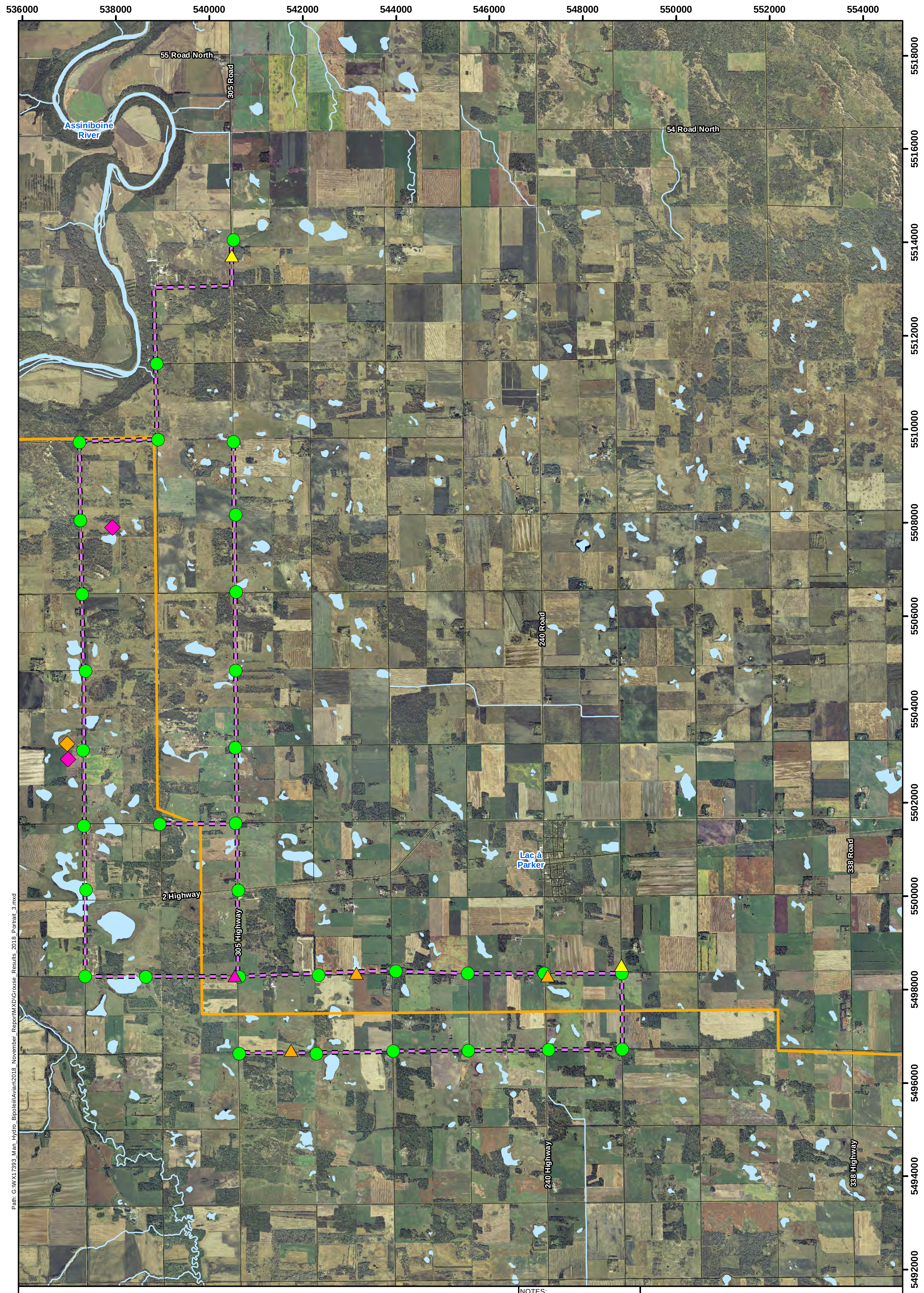
N E S W

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Sharp-tailed Grouse Survey

PROJECT N^{o}: WX17393	**FIGURE: 3-4**
SCALE: 1:74,000	DATE: December 2018



LEGEND

- Survey Locations (2018)
- Survey Route (2018)
- Transmission Line
- Permanent Watercourse
- Wetland
- Waterbody

Sharp-tailed Grouse Observations

- 2018
- 2017
- 2015

Observation Type

- Confirmed Leks
- Other Grouse Sightings

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

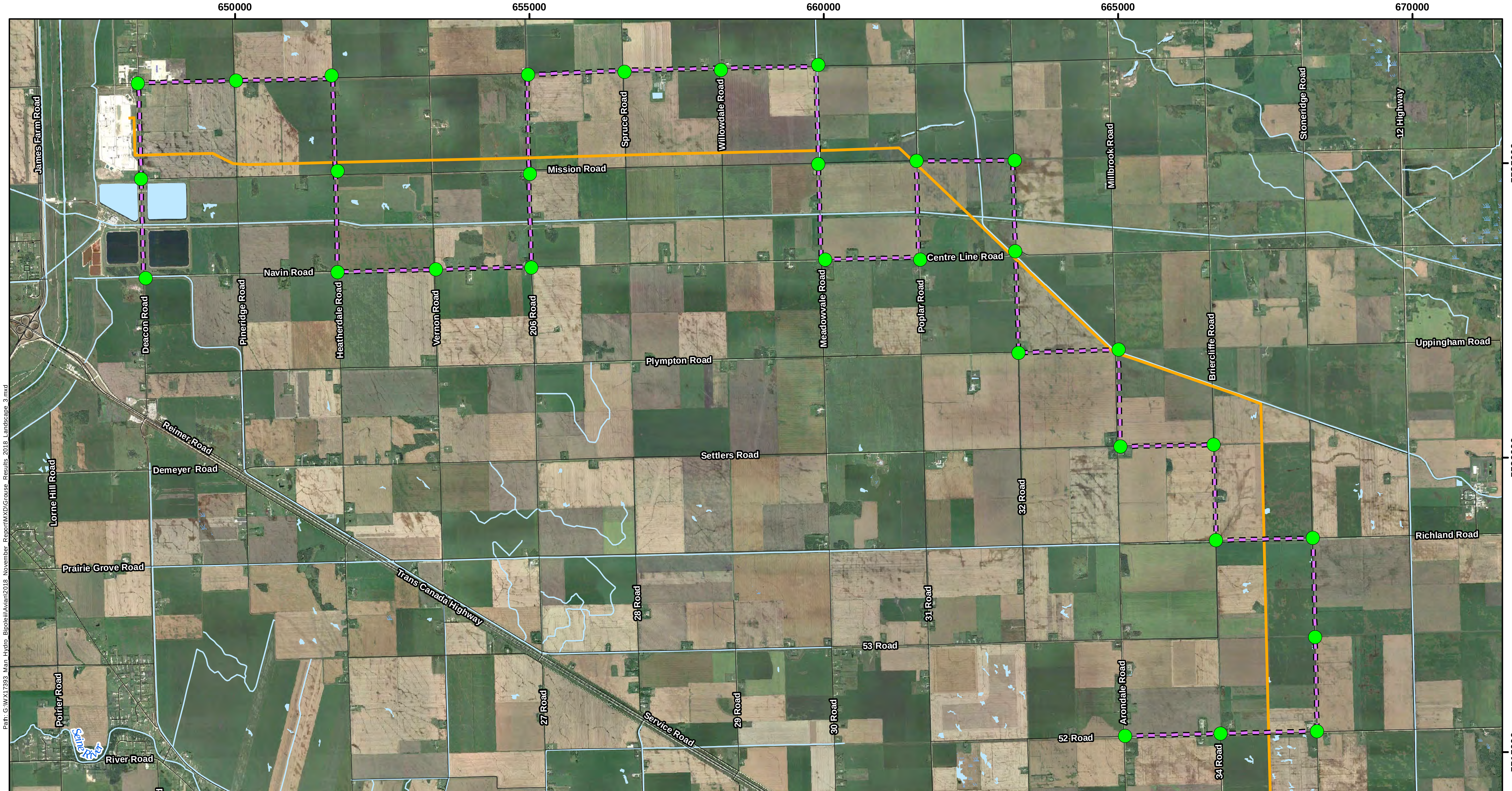
0 2 4 6 8 10 Kilometres

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Sharp-tailed Grouse Survey

PROJECT N°: WX17393	FIGURE: 3-5
SCALE: 1:74,000	DATE: December 2018



LEGEND

- Survey Locations (2018)
- Survey Route (2018)
- Transmission Line
- Permanent Watercourse
- Wetland
- Waterbody

Sharp-tailed Grouse Observations

- 2018
- 2017
- 2015

Observation Type

- Confirmed Leks
- Other Grouse Sightings

0 2 4 6 8 10 Kilometres

NOTES:
- Aerial Imagery extracted from ESRI online and Google Earth.
- Topographic data extracted from Manitoba Land Iniative.

Datum: NAD83
Projection: UTM Zone 14N

wood.

MANITOBA HYDRO BIPOLE III TRANSMISSION PROJECT

Sharp-tailed Grouse Survey

PROJECT N^{o}: WX17393	FIGURE: 3-6
SCALE: 1:62,000	DATE: December 2018

Appendix B
Data Tables

Appendix Table B1: Summary of 2018 Site Data and Location, Survey Dates, and Bias Data

Site ID	Diverters/ Significant	Line Section	Geographic Area for Scavenger Trials	Site Length (m)	1st Spring Visit	2nd Spring Visit	1st Fall Visit	2nd Fall Visit	Carcass Persistence (Scavenging Rate)	Habitat Bias	Searcher Efficiency Bias	Survey Area Start	Survey Area End
New Point Road	Yes	S2	1	391	25-Apr	29-Apr	28-Aug	05-Sep	4.384	1.00	0.8	Tower 7338	Tower 7337
WS4	Yes	S2	1	471	24-Apr	29-Apr	28-Aug	05-Sep	4.384	1.00	0.8	Tower 7212	Tower 7211
WPT3	Yes	S2	1	562	24-Apr	28-Apr	28-Aug	06-Sep	4.384	0.85	0.8	Tower 7187	Tower 7185
Bird 3a	Yes	S2	1	500	24-Apr	28-Apr	28-Aug	06-Sep	4.384	1.00	0.8	500 m from Rat River	Rat River
Bird 4	No	S2	1	500	24-Apr	27-Apr	29-Aug	07-Sep	4.384	1.00	0.8	500 m from Marsh River	Marsh River
Bird 5	Yes	S2	1	506	24-Apr	27-Apr	29-Aug	07-Sep	4.384	1.00	0.8	Tower 7137	Tower 7136
WPT10/11/12	Yes	S2	1	421	25-Apr	02-May	29-Aug	07-Sep	4.384	1.00	0.8	Tower 7082	Tower 7081
WPT18	Yes	S1	1	489	25-Apr	02-May	29-Aug	06-Sep	4.384	0.68	0.8	Tower 6313	Tower 6312
Bird 11	No	S1	1	434	26-Apr	01-May	29-Aug	06-Sep	4.384	1.00	0.8	Tower 6164	Rat Creek
Bird 13	Yes	S1	1	409	25-Apr	01-May	30-Aug	05-Sep	4.384	1.00	0.8	Rat Creek	Tower 6071
Bird 26	No	C2	2	464	25-Apr	28-Apr	30-Aug	05-Sep	5.834	0.85	0.8	Tower 5180	Tower 5179
Bird 29	No	C2	2	478	25-Apr	28-Apr	30-Aug	08-Sep	5.834	1.00	0.8	Tower 5155	Tower 5154
Bird 31	Yes	C2	2	468	26-Apr	29-Apr	30-Aug	08-Sep	5.834	1.00	0.8	Tower 5142	Tower 5141
Bird 33/35	Yes	C2	2	415	26-Apr	30-Apr	31-Aug	04-Sep	5.834	1.00	0.8	Tower 5129	Tower 5128
Bird 37	No	C2	2	477	29-Apr	02-May	31-Aug	04-Sep	5.834	0.78	0.8	Tower 5098	Tower 5097
Bird 39	No	C2	2	439	25-Apr	27-Apr	01-Sep	09-Sep	5.834	0.86	0.8	Tower 5095	Tower 5094
Bird 44	No	C1	3	475	27-Apr	30-Apr	01-Sep	09-Sep	4.2999	1.00	0.8	Tower 4284	Tower 4283
Bird 53b	Yes	C1	3	503	28-Apr	01-May	31-Aug	10-Sep	4.2999	1.00	0.8	Tower 4192	Tower 4191
Bird 53	Yes	C1	3	491	28-Apr	01-May	31-Aug	10-Sep	4.2999	1.00	0.8	Mossy River	Highway 20
Bird 79	No	C1	3	500	26-Apr	29-Apr	02-Sep	11-Sep	4.2999	1.00	0.8	500 m southeast of North Duck River	North Duck River
Bird 83	No	N4	3	506	26-Apr	29-Apr	02-Sep	11-Sep	4.2999	1.00	0.8	Tower 3365	Tower 3364
WS62	Yes	N4	3	475	27-Apr	30-Apr	03-Sep	07-Sep	4.2999	1.00	0.8	Tower 3341	Tower 3340
Bird 293	No	N4	3	500	27-Apr	30-Apr	03-Sep	07-Sep	4.2999	1.00	0.8	500 m south of Bell River	Bell River
WS69	Yes	N4	3	391	26-Apr	29-Apr	01-Sep	04-Sep	4.2999	1.00	0.8	Tower 3216	Tower 3215
Bird 129	No	N3	4	466	26-Apr	29-Apr	01-Sep	04-Sep	1.7666	1.00	0.8	Tower 2369	Tower 2368
Bird 130	No	N3	4	512	27-Apr	30-Apr	02-Sep	05-Sep	1.7666	1.00	0.8	Tower 2364	Tower 2363
Bird 140a	Yes	N3	4	458	27-Apr	30-Apr	02-Sep	05-Sep	1.7666	0.75	0.8	Tower 2329	Tower 2328
Bird 142	No	N3	4	487	28-Apr	01-May	03-Sep	06-Sep	1.7666	1.00	0.8	Tower 2306	Tower 2305
Bird 142a	No	N3	4	468	28-Apr	01-May	03-Sep	06-Sep	1.7666	1.00	0.8	Tower 2286	Tower 2285

Appendix Table B2: Summary of 2018 Passage and Mortality Survey Results

Site ID	Diverters/ Significant	Line Section	Passage Observed (number of birds)									Mortalities Detected (number of birds)			Estimated Daily Mortality (birds/km/day)		
			Spring				Fall				Grand Total						
			Waterbirds	Songbirds	Other Landbirds	Total	Waterbirds	Songbirds	Other Landbirds	Total		Spring	Fall	Total	Spring	Fall	Overall
New Point Road	Yes	S2	114	67	13	**194**	11	13	7	**31**	**225**	3	0	**3**	5.47	0	**2.73**
WS4	Yes	S2	58	131	2	**191**	11	13	1	**25**	**216**	4	0	**4**	6.06	0	**3.03**
WPT3	Yes	S2	11	135	5	**151**	35	14	15	**64**	**215**	0	0	**0**	0	0	**0**
Bird 3a	Yes	S2	144	864	22	**1,030**	4	47	7	**58**	**1,088**	0	0	**0**	0	0	**0**
Bird 4	No	S2	36	127	12	**175**	2	49	36	**87**	**262**	0	5	**5**	0	7.13	**3.56**
Bird 5	Yes	S2	111	460	21	**592**	65	170	17	**252**	**844**	0	0	**0**	0	0	**0**
WPT10/11/12	Yes	S2	0	170	1	**171**	0	4	1	**5**	**176**	0	0	**0**	0	0	**0**
WPT18	Yes	S1	192	252	12	**456**	21	296	3	**320**	**776**	2	0	**2**	4.29	0	**2.15**
Bird 11	No	S1	28	159	8	**195**	1	633	23	**657**	**852**	2	0	**2**	3.28	0	**1.64**
Bird 13	Yes	S1	40	639	16	**695**	321	280	20	**621**	**1,316**	0	0	**0**	0	0	**0**
Bird 26	No	C2	15	39	8	**62**	0	7	0	**7**	**69**	0	0	**0**	0	0	**0**
Bird 29	No	C2	19	218	5	**242**	0	1	1	**2**	**244**	0	0	**0**	0	0	**0**
Bird 31	Yes	C2	44	30	0	**74**	26	9	6	**41**	**115**	0	0	**0**	0	0	**0**
Bird 33/35	Yes	C2	26	29	9	**64**	1	36	5	**42**	**106**	0	0	**0**	0	0	**0**
Bird 37	No	C2	57	170	31	**258**	0	11	4	**15**	**273**	0	0	**0**	0	0	**0**
Bird 39	No	C2	138	57	19	**214**	34	56	8	**98**	**312**	1	3	**4**	1.42	4.26	**2.84**
Bird 44	No	C1	34	62	20	**116**	124	202	10	**336**	**452**	0	0	**0**	0	0	**0**
Bird 53b	Yes	C1	175	85	2	**262**	20	21	19	**60**	**322**	1	2	**3**	1.44	2.89	**2.17**
Bird 53	Yes	C1	948	75	1	**1,024**	173	339	26	**538**	**1,562**	0	1	**1**	0	1.48	**0.74**
Bird 79	No	C1	10	229	11	**250**	0	108	19	**127**	**377**	1	0	**1**	1.45	0	**0.73**
Bird 83	No	N4	219	341	36	**596**	0	48	11	**59**	**655**	0	0	**0**	0	0	**0**
WS62	Yes	N4	100	179	10	**289**	29	167	18	**214**	**503**	0	0	**0**	0	0	**0**
Bird 293	No	N4	3	325	1	**329**	59	169	9	**237**	**566**	3	0	**3**	4.36	0	**2.18**
WS69	Yes	N4	64	58	7	**129**	31	153	15	**199**	**328**	0	2	**2**	0	3.72	**1.86**
Bird 129	No	N3	25	6	3	**34**	1	122	3	**126**	**160**	0	0	**0**	0	0	**0**
Bird 130	No	N3	20	338	4	**362**	6	249	7	**262**	**624**	0	0	**0**	0	0	**0**
Bird 140a	Yes	N3	3	12	1	**16**	23	13	1	**37**	**53**	0	1	**1**	0	5.15	**2.57**
Bird 142	No	N3	16	14	1	**31**	0	21	3	**24**	**55**	2	0	**2**	7.26	0	**3.63**
Bird 142a	No	N3	8	5	8	**21**	15	40	13	**68**	**89**	1	0	**1**	3.78	0	**1.89**

Appendix Table B3: Compiled Bird Species List from the 2014, 2015, 2017 and 2018 Monitoring Program

Common Name	Latin Name	Songbird Surveys	Marsh / Crep. Bird Surveys	Aerial Surveys	Wire Collision Surveys	SARA[1]	MESA[2]	BCR 6[3]	BCR 11[3]	Guild
Alder Flycatcher	*Empidonax alnorum*	✓						✓		Edge/Shrub/Successional
American Avocet	*Recurvirostra americana*			✓					✓	Wetland/Open Water
American Bittern	*Botaurus lentiginosus*	✓	✓	✓				✓	✓	Wetland/Open Water
American Coot	*Fulica americana*		✓	✓	✓					Wetland/Open Water
American Crow	*Corvus brachyrhynchos*	✓		✓	✓					Forest
American Goldfinch	*Carduelis tristis*	✓			✓					Edge/Shrub/Successional
American Kestrel	*Falco sparverius*	✓		✓	✓			✓		Edge/Shrub/Successional
American Pipit	*Anthus rubescens*				✓					Grassland/Open Country
American Redstart	*Setophaga ruticilla*	✓			✓					Edge/Shrub/Successional
American Robin	*Turdus migratorius*	✓			✓					Edge/Shrub/Successional
American Three-toed Woodpecker	*Picoides dorsalis*	✓						✓		Forest
American Tree Sparrow	*Spizella arborea*				✓					Forest
American White Pelican	*Pelecanus erythrorhynchos*	✓		✓	✓			✓	✓	Wetland/Open Water
American Wigeon	*Anas americana*	✓		✓	✓				✓	Wetland/Open Water
Bald Eagle	*Haliaeetus leucocephalus*	✓		✓	✓					Forest
Baltimore Oriole	*Icterus galbula*	✓			✓			✓		Edge/Shrub/Successional
Barn Swallow	*Hirundo rustica*	✓			✓	THR		✓		Edge/Shrub/Successional
Bay-breasted Warbler	*Setophaga castanea*	✓						✓		Forest
Belted Kingfisher	*Ceryle alcyon*	✓			✓					Wetland/Open Water
Black Tern	*Chlidonias niger*			✓				✓	✓	Wetland/Open Water
Black-and-white Warbler	*Mniotilta varia*	✓								Forest
Black-backed Woodpecker	*Picoides arcticus*	✓						✓		Forest
Black-billed Cuckoo	*Coccyzus erythropthalmus*	✓						✓	✓	Edge/Shrub/Successional
Black-billed Magpie	*Pica hudsonia*	✓		✓	✓					Edge/Shrub/Successional
Blackburnian Warbler	*Setophaga fusca*	✓			✓			✓		Forest
Black-capped Chickadee	*Poecile atricapillus*	✓			✓					Forest
Blackpoll Warbler	*Setophaga striata*	✓						✓		Forest
Black-throated Green Warbler	*Setophaga virens*	✓						✓		Forest

Common Name	Latin Name	Songbird Surveys	Marsh / Crep. Bird Surveys	Aerial Surveys	Wire Collision Surveys	SARA[1]	MESA[2]	BCR 6[3]	BCR 11[3]	Guild
Blue Jay	*Cyanocitta cristata*	✓			✓					Forest
Blue-headed Vireo	*Vireo solitarius*	✓								Forest
Blue-winged Teal	*Anas discors*	✓		✓	✓				✓	Wetland/Open Water
Bobolink	*Dolichonyx oryzivorus*	✓			✓	THR		✓	✓	Grassland/Open Country
Bonaparte's Gull	*Chroicocephalus philadelphia*			✓	✓					Wetland/Open Water
Boreal Chickadee	*Poecile hudsonica*	✓						✓		Forest
Brewer's Blackbird	*Euphagus cyanocephalus*	✓	✓		✓					Edge/Shrub/Successional
Broad-winged Hawk	*Buteo platypterus*	✓			✓			✓		Forest
Brown Creeper	*Certhia americana*	✓			✓			✓		Forest
Brown Thrasher	*Toxostoma rufum*	✓			✓				✓	Edge/Shrub/Successional
Brown-headed Cowbird	*Molothrus ater*	✓			✓					Edge/Shrub/Successional
Bufflehead	*Bucephala albeola*	✓		✓	✓				✓	Wetland/Open Water
Cackling Goose	*Branta hutchinsii*				✓			✓	✓	Wetland/Open Water
California Gull	*Larus californicus*		✓					✓		Wetland/Open Water
Canada Goose	*Branta canadensis*	✓		✓	✓				✓	Wetland/Open Water
Canada Warbler	*Cardellina canadensis*	✓			✓	THR	THR	✓		Forest
Cape May Warbler	*Setophaga tigrina*	✓			✓			✓		Forest
Canvasback	*Aythya valisineria*			✓	✓				✓	Wetland/Open Water
Cedar Waxwing	*Bombycilla cedrorum*	✓			✓					Edge/Shrub/Successional
Chestnut-sided Warbler	*Setophaga pensylvanica*	✓								Edge/Shrub/Successional
Chimney Swift	*Chaetura pelagica*	✓				THR	THR	✓	✓	Edge/Shrub/Successional
Chipping Sparrow	*Spizella passerina*	✓			✓					Edge/Shrub/Successional
Clay-colored Sparrow	*Spizella pallida*	✓			✓			✓	✓	Edge/Shrub/Successional
Common Goldeneye	*Bucephala clangula*	✓		✓	✓					Wetland/Open Water
Common Grackle	*Quiscalus quiscula*	✓			✓					Edge/Shrub/Successional
Common Loon	*Gavia immer*	✓		✓	✓			✓	✓	Wetland/Open Water
Common Merganser	*Mergus merganser*			✓	✓					Wetland/Open Water
Common Nighthawk	*Chordeiles minor*		✓			THR	THR	✓	✓	Grassland/Open Country
Common Raven	*Corvus corax*	✓		✓	✓					Forest
Common Redpoll	*Acanthis flammea*				✓					Forest
Common Tern	*Sterna hirundo*			✓				✓	✓	Wetland/Open Water

Common Name	Latin Name	Songbird Surveys	Marsh / Crep. Bird Surveys	Aerial Surveys	Wire Collision Surveys	SARA[1]	MESA[2]	BCR 6[3]	BCR 11[3]	Guild
Common Yellowthroat	*Geothlypis trichas*	✓			✓			✓	✓	Edge/Shrub/Successional
Connecticut Warbler	*Oporornis agilis*	✓						✓		Forest
Cooper's Hawk	*Accipiter cooperii*									Forest
Dark-eyed Junco	*Junco hyemalis*	✓			✓					Forest
Double-crested Cormorant	*Phalacrocorax auritus*			✓	✓					Wetland/Open Water
Downy Woodpecker	*Picoides pubescens*	✓			✓					Forest
Eared Grebe	*Podiceps nigricollis*			✓				✓	✓	Wetland/Open Water
Eastern Bluebird	*Sialia sialis*	✓			✓					Grassland/Open Country
Eastern Kingbird	*Tyrannus tyrannus*	✓								Edge/Shrub/Successional
Eastern Phoebe	*Sayornis phoebe*				✓			✓		Forest
Eastern Towhee	*Pipilo erythrophthalmus*	✓								Edge/Shrub/Successional
Eastern Whip-poor-will	*Antrostomus vociferus*		✓			THR	THR	✓	✓	Forest
Eastern Wood-Pewee	*Contopus virens*	✓				SC				Forest
European Starling	*Sturnus vulgaris*				✓					Cultural
Evening Grosbeak	*Coccothraustes vespertinus*	✓			✓					Forest
Fox Sparrow	*Passerella iliaca*				✓					Forest
Franklin's Gull	*Leucophaeus pipixcan*	✓		✓	✓				✓	Wetland/Open Water
Gadwall	*Anas strepera*			✓	✓					Wetland/Open Water
Golden-crowned Kinglet	*Regulus satrapa*	✓								Forest
Golden-winged Warbler	*Vermivora chrysoptera*	✓				THR	THR	✓	✓	Edge/Shrub/Successional
Grasshopper Sparrow	*Ammodramus savannarum*	✓							✓	Grassland/Open Country
Gray Catbird	*Dumetella carolinensis*	✓			✓					Edge/Shrub/Successional
Gray Jay	*Perisoreus canadensis*	✓			✓					Forest
Great Blue Heron	*Ardea herodias*	✓		✓	✓				✓	Wetland/Open Water
Great Crested Flycatcher	*Myiarchus crinitus*	✓								Forest
Great Gray Owl	*Strix nebulosa*	✓		✓						Forest
Great Horned Owl	*Bubo virginianus*		✓	✓						Forest
Greater White-fronted Goose	*Anser albifrons*			✓						Wetland/Open Water
Greater Yellowlegs	*Tringa melanoleuca*	✓		✓	✓			✓		Wetland/Open Water
Green-winged Teal	*Anas cracca*	✓		✓	✓				✓	Wetland/Open Water

Common Name	Latin Name	Songbird Surveys	Marsh / Crep. Bird Surveys	Aerial Surveys	Wire Collision Surveys	SARA[1]	MESA[2]	BCR 6[3]	BCR 11[3]	Guild
Hairy Woodpecker	*Picoides villosus*	✓			✓					Forest
Hermit Thrush	*Catharus guttatus*	✓			✓					Forest
Herring Gull	*Larus argentatus*	✓			✓			✓		Wetland/Open Water
Hooded Merganser	*Lophodytes cucullatus*			✓	✓					Wetland/Open Water
Horned Lark	*Eremophila alpestris*				✓				✓	Grassland/Open Country
House Finch	*Haemorhous mexiacus*				✓					Forest
House Wren	*Troglodytes aedon*	✓			✓					Edge/Shrub/Successional
Indigo Bunting	*Passerina cyanea*	✓								Edge/Shrub/Successional
Killdeer	*Charadrius vociferus*	✓		✓	✓			✓	✓	Grassland/Open Country
Lapland Longspur	*Calcarius lapponicus*				✓					Grassland/Open Country
Least Bittern	*Ixobrychus exilis*		✓			THR	END		✓	Wetland/Open Water
Least Flycatcher	*Empidonax minimus*	✓						✓	✓	Edge/Shrub/Successional
Le Conte's Sparrow	*Ammodrammus leconteii*	✓						✓	✓	Grassland/Open Country
Lesser Scaup	*Aythya affinis*			✓	✓				✓	Wetland/Open Water
Lesser Yellowlegs	*Tringa flavipes*	✓						✓		Wetland/Open Water
Lincoln's Sparrow	*Melospiza lincolnii*	✓			✓					Edge/Shrub/Successional
Long-eared Owl	*Asio otus*		✓						✓	Forest
Magnolia Warbler	*Setophaga magnolia*	✓			✓					Forest
Mallard	*Anas platyrhynchos*	✓		✓	✓				✓	Wetland/Open Water
Marbled Godwit	*Limosa fedoa*			✓	✓			✓		Grassland/Open Country
Marsh Wren	*Cistothorus palustris*	✓			✓					Wetland/Open Water
Merlin	*Falco columbarius*				✓			✓		Forest
Mourning Dove	*Zenaida macroura*	✓			✓					Edge/Shrub/Successional
Mourning Warbler	*Geothlypis philadelphia*	✓						✓		Forest
Nashville Warbler	*Oreothlypis ruficapilla*	✓			✓					Forest
Nelson's Sparrow	*Ammodramus nelsoni*	✓						✓	✓	Grassland/Open Country
Northern Flicker	*Colaptes auratus*	✓			✓			✓	✓	Forest
Northern Goshawk	*Accipiter gentilis*	✓			✓			✓		Forest
Northern Harrier	*Circus cyaneus*	✓		✓	✓			✓	✓	Grassland/Open Country
Northern Pintail	*Anas acuta*			✓	✓				✓	Wetland/Open Water
Northern Shoveler	*Anas clypeata*			✓					✓	Wetland/Open Water
Northern Waterthrush	*Parkesia noveboracensis*	✓								Forest

Common Name	Latin Name	Songbird Surveys	Marsh / Crep. Bird Surveys	Aerial Surveys	Wire Collision Surveys	SARA[1]	MESA[2]	BCR 6[3]	BCR 11[3]	Guild
Olive-sided Flycatcher	*Contopus borealis*	✓				THR	THR	✓	✓	Edge/Shrub/Successional
Orange-crowned Warbler	*Oreothlypis celata*	✓								Edge/Shrub/Successional
Osprey	*Pandion haliaetus*			✓	✓					Wetland/Open Water
Ovenbird	*Seiurus aurocapilla*	✓			✓					Forest
Palm Warbler	*Setophaga palmarum*	✓			✓					Edge/Shrub/Successional
Philadelphia Vireo	*Vireo philadelphicus*	✓								Forest
Pied-billed Grebe	*Podilymbus podiceps*	✓	✓	✓	✓			✓	✓	Wetland/Open Water
Pileated Woodpecker	*Dryocopus pileatus*	✓			✓			✓		Forest
Pine Grosbeak	*Pinicola enucleator*	✓								Forest
Pine Siskin	*Carduelis pinus*	✓			✓					Forest
Pine Warbler	*Setophaga pinus*				✓					Forest
Purple Finch	*Haemorhous purpureus*	✓			✓					Forest
Purple Martin	*Progne subis*				✓			✓		Wetland/Open Water
Red-breasted Merganser	*Mergus serrator*				✓					Wetland/Open Water
Red-breasted Nuthatch	*Sitta canadensis*	✓			✓					Forest
Red-eyed Vireo	*Vireo olivaceus*	✓			✓					Forest
Redhead	*Aythya americana*			✓					✓	Wetland/Open Water
Red-headed Woodpecker	*Melanerpes erythrocephalus*	✓			✓	THR	THR	✓	✓	Forest
Red-necked Grebe	*Podiceps grisegena*			✓				✓	✓	Wetland/Open Water
Red-tailed Hawk	*Buteo jamaicensis*	✓		✓	✓					Forest
Red-winged Blackbird	*Agelaius phoeniceus*	✓			✓					Wetland/Open Water
Ring-billed Gull	*Larus delawarensis*	✓		✓	✓					Wetland/Open Water
Ring-necked Duck	*Aythya collaris*			✓					✓	Wetland/Open Water
Rock Pigeon	*Columba livia*				✓					Cultural
Rose-breasted Grosbeak	*Pheucticus ludovicianus*	✓			✓					Forest
Rough-legged Hawk	*Buteo lagopus*			✓	✓					Grassland/Open Country
Ruby-crowned Kinglet	*Regulus calendula*	✓			✓					Forest
Ruby-throated Hummingbird	*Archilochus colubris*	✓			✓					Forest
Ruddy Duck	*Oxyura jamaicensis*			✓					✓	Wetland/Open Water
Ruffed Grouse	*Bonasa umbellus*	✓			✓					Forest
Rusty Blackbird	*Euphagus carolinus*	✓			✓	SC		✓	✓	Wetland/Open Water

Common Name	Latin Name	Songbird Surveys	Marsh / Crep. Bird Surveys	Aerial Surveys	Wire Collision Surveys	SARA[1]	MESA[2]	BCR 6[3]	BCR 11[3]	Guild
Sandhill Crane	*Grus canadensis*	✓		✓	✓					Grassland/Open Country
Savannah Sparrow	*Passerculus sandwichensis*	✓			✓					Grassland/Open Country
Sedge Wren	*Cistothorus platensis*	✓						✓	✓	Wetland/Open Water
Semipalmated Plover	*Charadrius semipalmatus*				✓					Wetland/Open Water
Sharp-shinned Hawk	*Accipiter striatus*			✓	✓					Forest
Sharp-tailed Grouse	*Tympanuchus phasianellus*			✓	✓			✓	✓	Grassland/Open Country
Short-eared Owl	*Asio flammeus*	✓			✓	SC	THR	✓	✓	Grassland/Open Country
Snow Bunting	*Plectrophenax nivalis*				✓					Grassland/Open Country
Snow Goose	*Chen caerulescens*				✓					Wetland/Open Water
Solitary Sandpiper	*Tringa solitaria*	✓		✓	✓			✓		Wetland/Open Water
Song Sparrow	*Melospiza melodia*	✓			✓					Edge/Shrub/Successional
Sora	*Porzana carolina*	✓	✓	✓	✓			✓	✓	Wetland/Open Water
Spotted Sandpiper	*Actitis macularia*	✓		✓					✓	Wetland/Open Water
Swainson’s Hawk	*Buteo swainsoni*				✓					Grassland/Open Country
Swainson's Thrush	*Catharus ustulatus*	✓								Forest
Swamp Sparrow	*Melospiza georgiana*	✓			✓					Wetland/Open Water
Tennessee Warbler	*Oreothlypis peregrina*	✓			✓					Edge/Shrub/Successional
Tree Swallow	*Tachycineta bicolor*	✓			✓					Edge/Shrub/Successional
Trumpeter Swan	*Cygnus buccinator*			✓			END		✓	Wetland/Open Water
Tundra Swan	*Cygnus colombianus*			✓	✓					Wetland/Open Water
Turkey Vulture	*Cathartes aura*	✓		✓	✓					Forest
Veery	*Catharus fuscescens*	✓								Forest
Vesper Sparrow	*Pooecetes gramineus*				✓					Grassland/Open Country
Virginia Rail	*Rallus limicola*	✓	✓	✓				✓	✓	Wetland/Open Water
Warbling Vireo	*Vireo gilvus*	✓								Edge/Shrub/Successional
Western Meadowlark	*Sturnella neglecta*	✓			✓				✓	Grassland/Open Country
White-breasted Nuthatch	*Sitta carolinensis*	✓			✓					Forest
White-crowned Sparrow	*Zonotrichia leucophrys*				✓					Edge/Shrub/Successional
White-throated Sparrow	*Zonotrichia albicollis*	✓			✓			✓		Edge/Shrub/Successional
White-winged Crossbill	*Loxia leucoptera*	✓						✓		Forest
Willet	*Tringa semipalmata*			✓						Wetland/Open Water
Wilson's Snipe	*Gallinago delicata*	✓			✓			✓	✓	Edge/Shrub/Successional

Common Name	Latin Name	Songbird Surveys	Marsh / Crep. Bird Surveys	Aerial Surveys	Wire Collision Surveys	SARA[1]	MESA[2]	BCR 6[3]	BCR 11[3]	Guild
Wilson's Warbler	*Cardellina pusilla*	✓			✓					Forest
Winter Wren	*Troglodytes troglodytes*	✓								Forest
Wood Duck	*Aix sponsa*			✓	✓					Forest
Yellow Rail	*Coturnicops noveboracensis*		✓			SC			✓	Wetland/Open Water
Yellow Warbler	*Setophaga petechia*	✓			✓					Edge/Shrub/Successional
Yellow-bellied Flycatcher	*Empidonax flaviventris*	✓								Forest
Yellow-bellied Sapsucker	*Sphyrapicus varius*	✓			✓			✓		Forest
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*			✓	✓					Wetland/Open Water
Yellow-rumped Warbler	*Setophaga coronata*	✓			✓					Forest

Notes

[1] SARA = *Species at Risk Act, 2002*

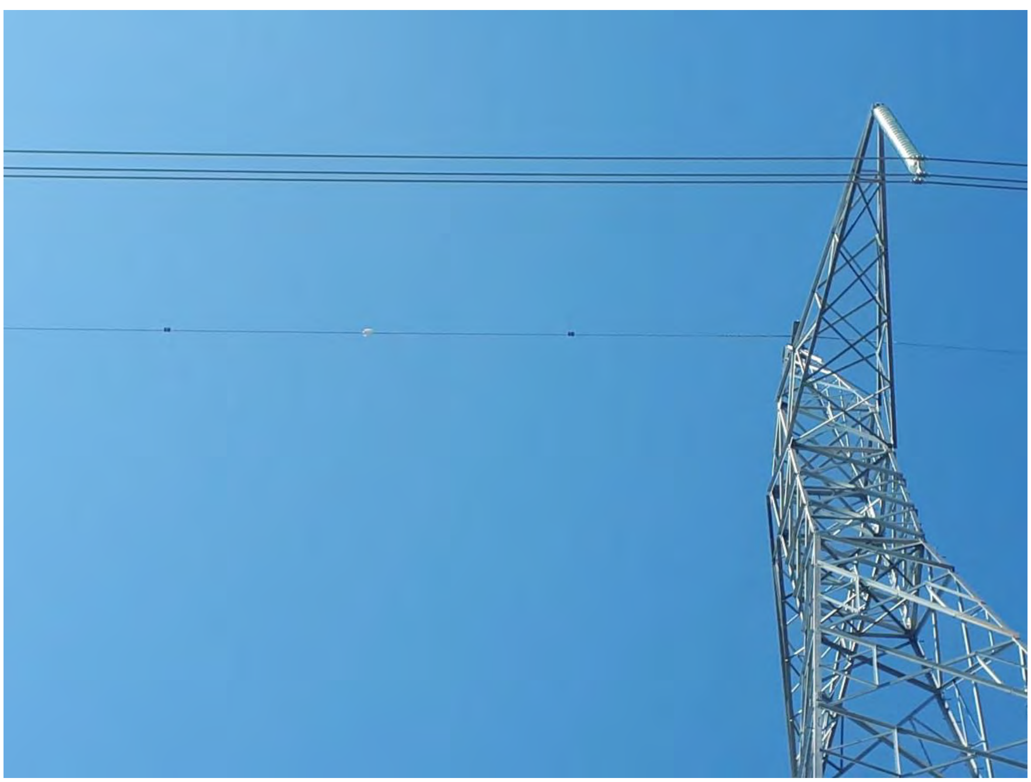
[2] MESA = *Manitoba Endangered Species Act, 1990*

[3] Bird Conservation Region (BCR) Priority Species

Appendix C
Representative Photos

Appendix C: Representative Photos

Transmission line with bird diverters installed



Bird diverters installed

Transmission line without bird diverters installed

Vesper Sparrow mortality

Dark-eyed Junco mortality

Rock Pigeon Mortality