

MANITOBA-MINNESOTA TRANSMISSION PROJECT

Biophysical Technical Data Reports

1.1 Physical Environment

1.1.1 Terrain and Soils

1.1.2 Groundwater

1.1.3 Air

1.1.4 Noise

1.1.5 Historic and Future Climate Study

1.1.6 Greenhouse Gas Lifecycle Assessment



**Manitoba-Minnesota
Transmission Project
Technical Data Report – Air**

Final Report



Prepared for:
Manitoba Hydro
360 Portage Avenue
Winnipeg, MB R3C 0G8

Prepared by:
Stantec Consulting Ltd.
500-311 Portage Avenue
Winnipeg, MB R3B 2B9

July 31, 2015

Sign-off Sheet

This document entitled Manitoba-Minnesota Transmission Project Technical Data Report – Air was prepared by Stantec Consulting Ltd. ("Stantec") for the account of Manitoba Hydro (the "Client"). Any reliance on this document by any third party is strictly prohibited. The material in it reflects Stantec's professional judgment in light of the scope, schedule and other limitations stated in the document and in the contract between Stantec and the Client. The opinions in the document are based on conditions and information existing at the time the document was published and do not take into account any subsequent changes. In preparing the document, Stantec did not verify information supplied to it by others. Any use which a third party makes of this document is the responsibility of such third party. Such third party agrees that Stantec shall not be responsible for costs or damages of any kind, if any, suffered by it or any other third party as a result of decisions made or actions taken based on this document.

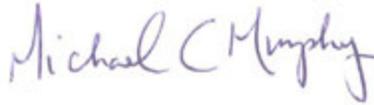
Prepared by: _____



(signature)

Terry Duddridge, B.Env.St. and Roger Rempel, P.Eng.

Reviewed by: _____



(signature)

Mike Murphy, Ph.D, P.Eng.

Approval to transmit: _____



(signature)

George Rempel, M.Sc. P.Eng.

Table of Contents

ABBREVIATIONS	I
GLOSSARY	II
1.0 INTRODUCTION	1.1
1.1 BACKGROUND	1.1
1.1.1 Project Overview	1.1
1.1.2 Spatial Boundaries.....	1.1
1.2 PURPOSE.....	1.2
2.0 REVIEW OF EXISTING DATA SOURCES AND BASELINE DATA GAPS	2.1
2.1 SUMMARY OF EXISTING DATA SOURCES	2.1
2.2 DATA GAPS AND LIMITATIONS.....	2.1
2.3 ASSUMPTIONS	2.2
3.0 METHODS	3.1
3.1 ANALYTICAL METHODS.....	3.1
4.0 EXISTING ENVIRONMENT: AIR QUALITY	4.1
4.1 EXISTING AIR QUALITY	4.1
4.2 AIR QUALITY REGULATORY FRAMEWORK.....	4.1
5.0 AIR EMISSIONS ASSESSMENT RESULTS	5.1
5.1 RESULTS SUMMARY	5.1
5.1.1 Construction.....	5.1
5.1.2 Operations and Maintenance	5.7
5.2 TOTAL EMISSIONS LOADINGS.....	5.8
6.0 SUMMARY	6.1
7.0 REFERENCES	7.1

LIST OF TABLES

Table 5-1: Emissions Estimates for Access Road Construction (tonnes)	5.2
Table 5-2: Emissions Estimates for Support Activities (tonnes).....	5.3
Table 5-3: Emissions Estimates for MMTP Clearing Activities (tonnes)	5.4
Table 5-4: Emissions Estimates for MMTP Foundation Construction (tonnes).....	5.5
Table 5-5: Emissions Estimates for MMTP Assembly and Erection of Towers (tonnes)	5.5
Table 5-6: Emissions Estimates for MMTP Conductor Stringing (tonnes)	5.6
Table 5-7: Emissions Estimates for MMTP Construction Workforce Traffic (tonnes)	5.7

**MANITOBA-MINNESOTA TRANSMISSION PROJECT
TECHNICAL DATA REPORT – AIR**

Table 5-8: Emissions Estimates for MMTP Annual Maintenance Activities
(tonnes) 5.8

Table 5-9: Emissions Estimates for MMTP Vegetation Maintenance Activities
(tonnes) 5.8

Table 5-10: Emissions Estimates for MMTP Construction and Operation Phases
(tonnes) 5.9

LIST OF APPENDICES

APPENDIX A MAP SERIES 1-100 – PROJECT DEVELOPMENT AREA, LOCAL
ASSESSMENT AREA AND RECEPTORS

Abbreviations

CCME	Canadian Council of Ministers of the Environment
CEPA	Canadian Environmental Protection Agency
CSA	Canadian Standards Association
US EPA	United States Environmental Protection Agency
GHG	Greenhouse gas
LAA	Local Assessment Area
NERC	North American Electric Reliability Corporation
MRO	Midwest Reliability Organization
MISO	Midcontinent Independent System Operator
PDA	Project Development Area
RAA	Regional Assessment Area
ROW	Right-of-Way

Glossary

AP-42	US EPA compilation of air pollutant emission factors and process information for more than 200 air pollution source categories for specific industries.
Ambient air quality	Refers to the quality of air in the surrounding environment.
Atmosphere	Refers to the layer of gases surrounding the Earth, which protects life by absorbing ultraviolet solar radiation, warms the surface through heat retention, and regulates day and night temperature extremes.
Dispersion modeling	Mathematical simulation of how air pollutants disperse in the ambient atmosphere.
Fugitive dust	Particulate matter which becomes airborne.
Localized	(Air emissions) originating at a particular place.
Physical disturbance	Temporary change in environmental conditions that causes a pronounced change in an ecosystem.

MANITOBA-MINNESOTA TRANSMISSION PROJECT TECHNICAL DATA REPORT – AIR

Introduction
July 31, 2015

1.0 INTRODUCTION

Manitoba Hydro is proposing construction of the Manitoba-Minnesota Transmission Project which includes construction of a 500 kV AC transmission line in southeastern Manitoba. The proposed Project would originate at the Dorsey Converter Station northwest of Winnipeg, then travel south around Winnipeg within planned utility corridors including the Southern Loop Transmission Corridor (SLTC) and the Riel to Vivian Transmission Corridor (RVTC) to just east of PTH 12. The line then continues southward across the rural municipalities of Springfield, Tache, Ste. Anne, La Broquerie, Stuartburn and Piney to the Manitoba-Minnesota border crossing located south of the community of Piney. The Project also includes the construction of terminal equipment at the Dorsey Converter Station, and electrical upgrades within the Dorsey and Riel converter stations, and modifications at the Glenboro South Station requiring re-alignment of transmission lines entering the station.

This Technical Data Report (TDR) for air quality was developed to support of the overall Environmental Impact Statement (EIS). It is intended to assess the potential effects of air emissions generated by the Project on the Air Environment. For this assessment, air is considered a pathway to an effect on a Valued Component (VC), rather than a VC itself.

1.1 BACKGROUND

1.1.1 Project Overview

The Project is described in three general regions: the upgrade work to the three stations, the additional transmission line constructed in the existing planned transmission utility corridors extending from Dorsey Converter Station to just east of PTH 12, and the new transmission line extending south from the Anola area to the border by Piney, Manitoba.

1.1.2 Spatial Boundaries

The following spatial boundaries were used to collect and assess information and data for the Project:

1.1.2.1 Project Development Area (PDA):

The Project Development Area (PDA) is the area of physical disturbance from Project activities, within areas of construction activity for the Project, namely the Transmission Line ROW (80-100 m) and the three converter station improvement sites.



MANITOBA-MINNESOTA TRANSMISSION PROJECT

TECHNICAL DATA REPORT – AIR

Introduction
July 31, 2015

1.1.2.2 Local Assessment Area (LAA)

The LAA for the transmission line and converter stations consists of a 1 km buffer extending from edges of the PDA. The LAA represents the area where direct and indirect effects on local air quality are likely to be most pronounced or identifiable. The LAA and locations of occupied homes are shown in **Map Series 1-100 in Appendix A**.

The LAA is defined using the anticipated extent to which air contaminants may be generated and released to the atmosphere during construction and operations activities. The spatial extent is based on the perceived range (presence of odours or airborne dust) of Project-related effects related to site preparation, construction vehicle movements, and construction tasks.

This assessment focuses on the effects of air contaminant loadings to the atmosphere predicted to be generated within the LAA by the Project.

1.1.2.3 Regional Assessment Area (RAA)

The RAA includes the PDA and the boundaries of all Rural Municipalities traversed by the PDA. From north to south RMs considered include: Rosser, Headingley, Macdonald, Ritchot, Springfield, Tache, Ste. Anne, La Broquerie, Stuartburn, Piney and South Cypress (for the Glenboro South Station component only). The RAA is the area in which cumulative effects are assessed and it is anticipated other projects or activities occurring within the same RMs may have the potential to act cumulatively with the Project.

1.2 PURPOSE

Activities associated with the Project can increase air emissions near the Project. The largest source of air emissions during construction is the operation of machinery (i.e., bulldozers, transportation vehicles, clearing equipment, and cranes). Typically the largest source of air emissions during Project operation relate to maintenance activities that will be conducted using equipment including quads, snowmobiles, and possible infrequent use of helicopters.

Assessment of Project-generated air emissions was conducted for construction phases associated with the transmission line and converter station improvements including movement of personnel, materials and support equipment and activities conducted as part of normal operations and maintenance for the Project.

The purpose of this TDR is therefore to:

- Characterize baseline air quality in the local assessment area of the Project.

MANITOBA-MINNESOTA TRANSMISSION PROJECT TECHNICAL DATA REPORT – AIR

Introduction
July 31, 2015

- Describe and estimate criteria emissions, including sulfur oxides (SO_x), nitrogen oxides (NO_x), particulate matter less than 10 microns in diameter (PM₁₀) and carbon monoxide (CO) generated by combustion exhausts from construction vehicle and machinery use during construction phases of the Project as well as from transportation of construction crews and materials to/from the construction sites.
- Discuss the relative magnitude of the estimated emissions related to Project construction, maintenance and operation within the current environment, and compare these loadings to those generated by accepted activities generating emissions in the course of their operations within the RAA.
- Provide an estimate of loadings to the atmosphere to assess potential effects on VCs, which include:
 - Wildlife and Wildlife Habitat.
 - Vegetation and Wetlands.
 - Human Health Risk.

MANITOBA-MINNESOTA TRANSMISSION PROJECT TECHNICAL DATA REPORT – AIR

Review of Existing Data Sources and Baseline Data Gaps
July 31, 2015

2.0 REVIEW OF EXISTING DATA SOURCES AND BASELINE DATA GAPS

2.1 SUMMARY OF EXISTING DATA SOURCES

The following sources were reviewed for applicable air information related to the construction, operation and maintenance of the Project:

- Manitoba Conservation Air Quality reports and bulletins (most current report published is for years spanning 2003-2005).
- Province of Manitoba Ambient Air Quality Guidelines available at: https://www.gov.mb.ca/conservation/envprograms/airquality/pdf/criteria_table_update_july_2005.pdf.
- Manitoba Hydro, 2012. Keeyask Generation Project Environmental Impact Statement Chapter 6, pg. 6-25. June, 2012.
- Manitoba Hydro, 2011. Bipole III Environmental Impact Statement. Chapter 6, pg. 6-20. December, 2011.
- The Pembina Institute, April 2015. *Greenhouse Gas Life Cycle Assessment of Manitoba-Minnesota Transmission Line*.
- Stantec, February 2015. *Manitoba-Minnesota Transmission Project Traffic Impact Study*.
- MMTP construction, operations and maintenance equipment deployments by construction phase, and Project activity summary lists provided by Manitoba Hydro, Transmission, Licensing and Environmental Assessment Department. April, 2015.
- City of Winnipeg Council Minutes: Draft Green Fleet Plan July 2010, City of Winnipeg Green Fleet Management Agency.

2.2 DATA GAPS AND LIMITATIONS

The following data gaps and limitations were noted with regard to the available information on air quality:

- Literature values were identified and applied in the absence of Project-specific baseline and construction air quality monitoring data. The construction and operation equipment required for this Project includes equipment with available emissions estimates in the existing literature. Because of the availability of existing data, the scale of the Project, and the construction equipment required, Project-specific monitoring was not conducted in support of this TDR.
- Manitoba Conservation and Water Stewardship operates a network of air quality monitoring stations that report monitoring results from continuous ambient air sampling locations in selected regions of the province. None of these available stations are located within the Project Development Area. Stations located within Winnipeg exist in this network; however



MANITOBA-MINNESOTA TRANSMISSION PROJECT

TECHNICAL DATA REPORT – AIR

Review of Existing Data Sources and Baseline Data Gaps
July 31, 2015

they are representative of highly urban locations, rendering these station locations as inapplicable for evaluation of rural air quality characteristics.

2.3 ASSUMPTIONS

Upon completion of the construction for the Project, operation and maintenance will take place within an environment that will remain categorized as primarily rural, and agricultural-activity based.

The construction and operation of MMTP will generate air contaminants associated with the operation of vehicles and machinery. The emissions characterized in this TDR are air contaminants emitted from diesel engine operation and resulting products of combustion exhausts, including sulfur oxides (SO_x), nitrogen oxides (NO_x), particulate matter less than 10 microns in diameter (PM₁₀) and carbon monoxide (CO). Assumptions regarding vehicle deployments have been derived from operational details provided in the Pembina Institute MMTP Life Cycle GHG emissions report, the MMTP traffic impacts study report (Stantec 2015), and US EPA emission factors for construction activities and internal combustion engines as reported in the US EPA AP-42 compilation of emission factors for gasoline and diesel industrial engines (U.S. Environmental Protection Agency AP-42 Compilation of Emission Factors, Chapter 3.3, Gasoline and Diesel Industrial engines).

Additional assumptions include:

- GHG emissions were assessed in an analysis specific to GHGs, prepared by the Pembina Institute and provided under a separate report (Pembina Institute 2015).
- Air contaminant emission rates were estimated based on construction vehicle deployments as specified by Manitoba Hydro in their provided summary listing titled: "500kv Manitoba-Minnesota Transmission Project – Construction Equipment."
- U.S. EPA emission factors were sought from EPA's AP-42 emissions factor database to correspond with Hydro's specified construction vehicles defined for deployment in each construction phase. These vehicles are assumed to be a maximum of 10 years old.
- Project-related trips associated with construction of transmission lines comprise two primary traffic streams: workforce traffic and material delivery traffic. These are described in greater detail in Section 6 of the Traffic Impact Study. (Stantec 2015)
- A main marshalling yard will be located at Riel (Appendix A: Map 1-100-07) and will facilitate storage of equipment and materials required for shipment to the various work locations. There is a possibility that two additional marshalling yards will be used: one near La Broquerie and another at an undetermined site near Steinbach. For calculation of estimates, Winnipeg was the assumed primary accommodation location, with an assumed average, one-way trip of 70 km to any of the transmission line locations. For crew traffic to any of the converter station sites, a 20 km average one-way trip was assumed. For maintenance operations, these were assumed to occur annually and require travel along the ROW for the entire transmission line corridor within Manitoba for the Project.



MANITOBA-MINNESOTA TRANSMISSION PROJECT TECHNICAL DATA REPORT – AIR

Review of Existing Data Sources and Baseline Data Gaps
July 31, 2015

- Data on volumes and types of cleared materials was not available. Due to the difficulty of estimating material volumes, material moisture content, etc., no estimate of possible cleared debris burning was developed.
- It is assumed the majority of workers will be commuting from Winnipeg. Many workers' homes or temporary accommodations will be located at a distance to construction sites that allows for daily commuting for the duration of the Project.
- Construction of the Project will occur on a 10-hour workday basis, and is assumed to occur 7 days per week for a total Project duration from summer 2017 to winter 2020.
- Maintenance and inspection crews are assumed to travel along the corridor at a speed of 5 km/h, along the ROW for their annual transmission line inspection programs.

MANITOBA-MINNESOTA TRANSMISSION PROJECT

TECHNICAL DATA REPORT – AIR

Methods
July 31, 2015

3.0 METHODS

Potential air contaminants generated from construction, maintenance and operation activities are expected to include Sulphur dioxide (SO₂), carbon monoxide (CO), nitrogen oxides (NO_x), and PM₁₀. The approach to estimating these emissions is provided in the following section.

3.1 ANALYTICAL METHODS

Emission rates pertaining to diesel engine construction vehicles were obtained from literature values published by the US Environmental Protection Agency, as specified in the US EPA AP-42 database and the US EPA MOBILE6 Vehicle Emission Modeling Software. MOBILE6 is an emission factor model for predicting gram per mile emissions of Hydrocarbons (HC), Carbon Monoxide (CO), Nitrogen Oxides (NO_x), Carbon Dioxide (CO₂), Particulate Matter (PM), and toxics from cars, trucks, and motorcycles under various conditions. (US EPA, AP-42 Compilation of Emission Factors, Chapter 3.3, Gasoline and Diesel Industrial engines).

Construction fleet vehicle usage was defined by Manitoba Hydro's Transmission, Licensing and Environmental Assessment Department (Manitoba Hydro, 2015) for each phase of construction, as well as operation and maintenance of the Project. This listing identified the quantity, type and duration of deployment of construction vehicles intended for use in each phase of the project. The construction vehicle usage data for each phase of the project were then applied with AP-42 emission factors and EPA Mobile6 software in order to develop estimates of the resulting overall emission loadings generated by each phase of the project.

Emission loadings associated with transport of construction crews and equipment/materials were also estimated, using trip statistics reported in the Traffic Impact Study (Stantec 2015) prepared for MMTP. These trip statistics cover crew and materials shipment traffic planned between the main project yard (at Riel) to the ROW and converter station site locations. The mileage travelled by these vehicle movements was used with AP-42 emission factors and EPA Mobile6 software in order to generate air emission loadings resulting from these trips and vehicle movements.

To place Project-generated atmospheric loadings into a relevant local context, a comparison was made to the emissions generated by the operation of Winnipeg Transit's Diesel Bus Fleet (over 500 diesel buses) within the City of Winnipeg for a single year. These vehicular movements represent routine vehicle emission loadings with commonly accepted impacts within Manitoba and also within the City of Winnipeg, and are considered a benchmark valid for comparison of relative emission loadings. Fuel consumption on an annual basis for the Winnipeg Transit Diesel Fleet was obtained from City of Winnipeg Green Fleet planning documents for the year 2010. The amount of annual fuel consumed by the Winnipeg Transit Diesel Bus fleet was used to estimate loadings of air contaminants in order to qualitatively compare with MMTP activities and their resulting emission loads. For each phase of construction activity, operations and

MANITOBA-MINNESOTA TRANSMISSION PROJECT TECHNICAL DATA REPORT – AIR

Methods

July 31, 2015

maintenance, the project-generated emissions are reported, summarized and then compared with the loadings generated by Winnipeg Transit's Diesel Bus fleet for a single year.

MANITOBA-MINNESOTA TRANSMISSION PROJECT TECHNICAL DATA REPORT – AIR

existing environment: air quality
July 31, 2015

4.0 EXISTING ENVIRONMENT: AIR QUALITY

4.1 EXISTING AIR QUALITY

The Project area is located in the southeastern part of Manitoba which generally experiences excellent air quality that is comparable or better than other regions of Canada (Manitoba Hydro 2011). Intermittent issues with air quality in the region have been reported, relating to burning of crop residues (stubble burning) and odors associated with livestock (hog) operations and manure lagoons. Air quality information collected for Winnipeg since 1987 has shown very little changes to concentrations of carbon monoxide, particulate matter, nitrogen dioxide, and ground-level ozone and fine particulate matter (PM_{2.5}). Emissions in Manitoba are generated by industrial and agricultural activities, vehicle activities, energy generation, waste and industrial combustion sources, and infrequent events such as wildfire, agricultural operation odours, property fire, and wind-swept particulate matter (Manitoba Conservation and Water Stewardship 2009). When compared to many other regions in Canada, the existing air quality in the region of the Project is typically considered excellent, owing to the predominantly flat topography (no emissions capture) and low-intensity industrial activity in this region of Manitoba.

4.2 AIR QUALITY REGULATORY FRAMEWORK

Air quality in Manitoba is regulated by Manitoba Conservation and Water Stewardship based on the Ambient Air Quality Objectives and Guidelines. These list maximum time-based pollutant concentration levels for the protection and preservation of ambient air quality (MCWS 2005). The main legislative instruments at the federal level in Canada, for managing air quality, are the Canadian Environmental Protection Act (CEPA) and from Canada-wide standards that have been developed under the Canadian Council of Ministers of the Environment (CCME) Canada-Wide Accord on Environmental Harmonization (CCME 1998).

MANITOBA-MINNESOTA TRANSMISSION PROJECT

TECHNICAL DATA REPORT – AIR

air emissions assessment results
July 31, 2015

5.0 AIR EMISSIONS ASSESSMENT RESULTS

The nature of vehicular and construction equipment movement during transmission line construction is comparable to most linear infrastructure projects; for example, road construction projects require movement of vehicles and equipment along a linear route similar to transmission line construction. However, the construction effort required to build roads requires substantially larger numbers of construction vehicles, materials, and crews compared with the erection of towers and the stringing of the transmission lines. Transmission line construction is a smaller scale construction effort with less effect on air quality. As the Project's construction activity will progress along the route defined by the transmission line ROW, impacts to local air quality are expected to be highly localized and temporary in their nature.

Estimates of emissions generated by each phase of construction, operation and maintenance are presented in this section, based upon construction vehicle fleet listings developed by Manitoba Hydro (indicating estimates of personnel and equipment by phase of the project), and related to their associated US EPA emission factors. The estimates of emission loadings were then related to currently acceptable vehicle fleet emission loadings (the emissions generated by the annual fuel consumed by Winnipeg Transit's entire bus fleet).

Total Project and annual emissions loadings estimates caused by the construction phase, and the operations and maintenance phase were examined in the context of location and timing of the construction activity. The estimates were then compared to emissions generated by other sectors of ongoing, commonly accepted activities in Manitoba.

The nature of the emissions generated by the Project are such that the sources will be mobile within the LAA, active for short periods of time at a given location and will be intermittent, as not all vehicles in the construction fleet will be in service simultaneously.

5.1 RESULTS SUMMARY

5.1.1 Construction

Construction of MMTP will contribute air contaminants to the atmosphere in the form of particulate matter, including airborne dust and combustion gases from equipment exhaust. Air contaminant loadings to the atmosphere have the potential to cause impacts to human health, biological habitat, mammals and birds through atmospheric pathways. This estimation of emissions generated by construction of MMTP focuses on the following activities identified in the MMTP Project Description Chapter (Manitoba Hydro, 2015):

- Construction of access roads
- Transporting materials, equipment, support vehicles, and miscellaneous activities
- Clearing



**MANITOBA-MINNESOTA TRANSMISSION PROJECT
TECHNICAL DATA REPORT – AIR**

air emissions assessment results
July 31, 2015

- Foundation construction
- Assembling and erecting towers
- Conductor stringing

These activities and associated equipment are expected to generate measurable but small localized quantities of exhaust gases and dusts made up of NO_x, SO₂, CO and PM_{2.5}.

Soils within the PDA, in particular areas with agricultural-based activities, may be susceptible to erosion; disruption of these soils has potential to generate fugitive dust. In forested areas, soils which have not been disturbed may become susceptible to erosion after clearing of the ROW and burning of cleared vegetation, resulting in potential wind-caused erosion and fugitive dust.

5.1.1.1 Access Roads

Access will generally be via existing public access roads or trails whenever possible. Minor deviations from the ROW may be necessary in severe terrain conditions. The majority of contributions to air emissions during access road construction will be generated by internal combustion gasoline and diesel engines for the duration of project construction. Access construction will likely include, but not limited to:

- Four (4) 850G John Deere bulldozers (185 horsepower)
- Two (2) 120 Cat motor graders (125 horsepower)
- Two (2) tractors with drags (210 horsepower)

Table 5-1 shows estimated emissions for construction of MMTP access roads.

Table 5-1: Emissions Estimates for Access Road Construction (tonnes)

Air Contaminant (all values in tonnes)	Total Project Access Road Construction Emissions	Annual Access Road Construction Emissions	Total Annual (2010) Winnipeg Transit Bus Fleet Diesel Emissions	Monthly Winnipeg Transit Bus Fleet Diesel Emissions (2010 year)	Percentage: Total MMTP Access Road Completion/ Annual Winnipeg Transit Diesel Bus Fleet Emissions
NO _x	2.81	1.05	1150	95.8	0.24%
CO	30.19	1.31	248	20.7	12.2%
SO ₂	0.048	0.18	76	6.3	0.06%
PM ₁₀	0.201	0.075	81	6.8	0.25%



**MANITOBA-MINNESOTA TRANSMISSION PROJECT
TECHNICAL DATA REPORT – AIR**

air emissions assessment results
July 31, 2015

5.1.1.2 Transporting Materials, Equipment, Support Vehicles and Miscellaneous Activities

There is a requirement for vehicles, heavy equipment, and miscellaneous equipment to perform various support functions for the Project throughout various phases of construction, which will contribute air emissions. Supporting equipment and vehicles are expected to include:

- Five (5) semi-trucks with flatbeds (475 horsepower)
- Three (3) mechanic's trucks (350 horsepower)
- Fifty (50) contractor ½ ton crew cab trucks (300 horsepower)
- Ten (10) Manitoba Hydro ½ ton crew cab trucks (300 horsepower)
- Three (3) ¾ ton fuel trucks (350 horsepower)
- One (1) 5 ton fuel truck (400 horsepower)
- Ten (10) generators/light stands (50 horsepower)

Table 5-2 shows estimated emissions for MMTP construction support activities.

Table 5-2: Emissions Estimates for Support Activities (tonnes)

Air Contaminant (all values in tonnes)	Total Project Construction Transport Materials and Equipment Emissions	Annual Construction Transport Materials and Equipment Emissions	Total Annual (2010) Winnipeg Transit Bus Fleet Diesel Emissions	Monthly Winnipeg Transit Bus Fleet Diesel Emissions (2010 year)	Percentage: Total Construction Transport Materials and Equipment/ Annual Winnipeg Transit Diesel Bus Fleet Emissions
NOx	14.2	5.35	1,150	95.8	1.23%
CO	14.8	5.55	248	20.7	5.97%
SO ₂	0.061	0.024	76	6.3	0.08%
PM ₁₀	0.263	0.100	81	6.8	0.32%

5.1.1.3 Clearing

Clearing and disposal of trees on the ROW will be undertaken in advance of construction activities using heavy equipment which will contribute air emissions over an anticipated 64-day period. Equipment expected to complete clearing of the ROW will include:

- Four (4) tiger cat drum cutters (500 horsepower)
- Four (4) mulchers (250 horsepower)
- Two (2) John Deere feller bunchers (286 horsepower)



**MANITOBA-MINNESOTA TRANSMISSION PROJECT
TECHNICAL DATA REPORT – AIR**

air emissions assessment results
July 31, 2015

- One (1) grapple skidder (225 horsepower)
- Two (2) hydro axe (135 horsepower)

Table 5-3 shows estimated emissions for MMTP clearing activities.

Table 5-3: Emissions Estimates for MMTP Clearing Activities (tonnes)

Air Contaminant (all values in tonnes)	Total Clearing Emissions	Annual Clearing Emissions	Total Annual (2010) Winnipeg Transit Bus Fleet Diesel Emissions	Monthly Winnipeg Transit Bus Fleet Diesel Emissions (2010 year)	Percentage: Total Clearing/ Annual Winnipeg Transit Diesel Bus Fleet Emissions
NOx	0.532	0.532	1,150	95.8	0.046%
CO	5.47	5.47	248	20.7	2.21%
SO ₂	0.009	0.009	76	6.3	0.012%
PM ₁₀	0.381	0.381	81	6.8	0.47%

Note: burning of cleared vegetation is not included in emission estimates

5.1.1.4 Foundation Construction

Equipment associated with construction of foundations required for self-supporting towers are anticipated to contribute air emissions over an 89-day period. Equipment required to complete foundations will include:

- Three (3) auger drills (400 horsepower)
- Three (3) concrete trucks (315 horsepower)
- Eight (8) CAT 320 excavators (138 horsepower)
- Two (2) CAT 200 excavators equipped with plate compactors (115 horsepower)

Table 5-4 shows estimated emissions for MMTP foundation construction.



**MANITOBA-MINNESOTA TRANSMISSION PROJECT
TECHNICAL DATA REPORT – AIR**

air emissions assessment results
July 31, 2015

Table 5-4: Emissions Estimates for MMTP Foundation Construction (tonnes)

Air Contaminant (all values in tonnes)	Total Project Foundation Construction Emissions	Annual Foundation Construction Emissions	Total Annual (2010) Winnipeg Transit Bus Fleet Diesel Emissions	Monthly Winnipeg Transit Bus Fleet Diesel Emissions (2010 year)	Percentage: Total Foundation Construction / Annual Winnipeg Transit Diesel Bus Fleet Emissions
NOx	0.404	0.379	1,150	95.8	0.035%
CO	3.47	3.472	248	20.7	1.400%
SO ₂	0.006	0.006	76	6.3	0.008%
PM ₁₀	0.024	0.024	81	6.8	0.030%

5.1.1.5 Assembly and Erecting Towers

Assembly and erection of guyed-suspension and lattice self-supporting towers will require the use of air emissions contributing equipment over an estimated 216-day period. Equipment required to assemble and erect towers will include:

- Two (2) CAT 972 loaders (287 horsepower)
- Four (4) Terex 3063B boom trucks (210 horsepower)
- Two (2) 100 ton cranes (262 horsepower)

Table 5-5 shows estimated emissions for MMTP assembly and erection of towers.

Table 5-5: Emissions Estimates for MMTP Assembly and Erection of Towers (tonnes)

Air Contaminant (all values in tonnes)	Total Project Assembly and Erecting Towers Emissions	Annual Assembly and Erecting Towers Emissions	Total Annual (2010) Winnipeg Transit Bus Fleet Diesel Emissions	Monthly Winnipeg Transit Bus Fleet Diesel Emissions (2010 year)	Percentage: Total Assembly and Erecting Towers / Annual Winnipeg Transit Diesel Bus Fleet Emissions
NOx	0.856	0.856	1,150	95.8	0.074%
CO	8.55	8.55	248	20.7	3.45%
SO ₂	0.014	0.014	76	6.3	0.018%
PM ₁₀	0.061	0.061	81	6.8	0.075%

**MANITOBA-MINNESOTA TRANSMISSION PROJECT
TECHNICAL DATA REPORT – AIR**

air emissions assessment results
July 31, 2015

5.1.1.6 Conductor Stringing

Stringing of conductors will be carried out using various equipment over an estimated 106-day period. Equipment required to string conductors will include:

- Six (6) Terex 3063B boom trucks (210 horsepower)
- Two (2) drum pullers (100 horsepower)
- Two (2) drum tensioners (100 horsepower)
- Two (2) CAT D8s for sagging (328 horsepower)
- Two (2) 100 ton cranes (262 horsepower)
- Two (2) 9 ton radial arm diggers (250 horsepower)
- Two (2) CAT 320 excavators (138 horsepower)

Table 5-6 shows estimated emissions for MMTP conductor stringing.

Table 5-6: Emissions Estimates for MMTP Conductor Stringing (tonnes)

Air Contaminant (all values in tonnes)	Total Project Conductor Stringing Emissions	Annual Conductor Stringing Emissions	Total Annual (2010) Winnipeg Transit Bus Fleet Diesel Emissions	Monthly Winnipeg Transit Bus Fleet Diesel Emissions (2010 year)	Percentage: Total Conductor Stringing/ Annual Winnipeg Transit Diesel Bus Fleet Emissions
NOx	0.784	0.784	1,150	95.8	0.068%
CO	8.46	8.46	248	20.7	3.41%
SO ₂	0.013	0.013	76	6.3	0.017%
PM ₁₀	0.056	0.056	81	6.8	0.069%

6.1.1.7 Construction Workforce Traffic

- Emissions generated by construction workforce traffic were estimated for the Project. Atmospheric loadings were estimated for construction worker commute traffic by standard pick-up truck related to construction workforce traffic trips between Winnipeg and the locations of the Dorsey Converter Station Site, the Riel Converter Station site, the Glenboro Converter Station site, and the Transmission Line Corridor. All trips were assumed to comprise a 20 km average one-way trip.

Table 5-7 shows estimated emissions for MMTP construction workforce traffic.



**MANITOBA-MINNESOTA TRANSMISSION PROJECT
TECHNICAL DATA REPORT – AIR**

air emissions assessment results
July 31, 2015

Table 5-7: Emissions Estimates for MMTP Construction Workforce Traffic (tonnes)

Air Contaminant (all values in tonnes)	Total Project Construction Worker Traffic Emissions	Annual Construction Worker Traffic Emissions	Total Annual (2010) Winnipeg Transit Bus Fleet Diesel Emissions	Monthly Winnipeg Transit Bus Fleet Diesel Emissions (2010 year)	Percentage: Total Project Construction Worker Traffic/ Annual Winnipeg Transit Diesel Bus Fleet Emissions
NO _x	21.2	8.72	1,150	95.8	1.84%
CO	2.01	0.83	248	20.7	0.81%
SO ₂	0.15	0.063	76	6.3	0.20%
PM ₁₀	0.56	0.23	81	6.8	0.69%

5.1.2 Operations and Maintenance

Operations and maintenance activities to support MMTP will generate emissions to the atmosphere in the forms of particulate matter, including airborne dust and combustion pollutants from equipment exhaust. This estimation of emissions generated by operations and maintenance of the Project focuses on the following activities:

- Annual maintenance patrols
- Vegetation maintenance

These activities and associated equipment are expected to generate measurable but small quantities of exhaust gases and dusts, resulting in air contaminant loadings (NO_x, SO₂, CO and PM) to the atmosphere.

5.1.2.1 Annual Maintenance Patrols

Manitoba Hydro will perform annual patrols of the Project's associated infrastructure and ROW by ground crews and potentially by helicopter. Equipment required to perform annual inspections will include:

- Eight (8) ½ ton crew cab trucks (300 horsepower)
- Quads
- Snowmobiles
- Trooper (two-tracked machine)
- Helicopter (potentially)

Table 5-8 shows estimated emissions for MMTP annual maintenance activities.



**MANITOBA-MINNESOTA TRANSMISSION PROJECT
TECHNICAL DATA REPORT – AIR**

air emissions assessment results
July 31, 2015

Table 5-8: Emissions Estimates for MMTP Annual Maintenance Activities (tonnes)

Air Contaminant (all values in tonnes)	Total Annual Maintenance Emissions	Total Annual (2010) Winnipeg Transit Bus Fleet Diesel Emissions	Monthly Winnipeg Transit Bus Fleet Diesel Emissions (2010 year)	Percentage: Total Annual Maintenance/ Annual Winnipeg Transit Diesel Bus Fleet Emissions
NOx	0.007	1,150	95.8	0.0006%
CO	0.095	248	20.7	0.038%
SO ₂	0.001	76	6.3	0.001%
PM ₁₀	0.0006	81	6.8	0.0007%

5.1.2.2 Vegetation Maintenance

Manitoba Hydro expects to perform annual vegetation maintenance of the Project's ROW by spraying (every 3-7 years) and brushing (every 7-10 years) using ground crews. Equipment required to perform annual vegetation maintenance will include:

- Spraying (Quads)
- Brushing (850G John Deere bulldozers [185 horsepower], brusher, chainsaws)

Table 5-9 shows estimated emissions for MMTP vegetation maintenance activities.

Table 5-9: Emissions Estimates for MMTP Vegetation Maintenance Activities (tonnes)

Air Contaminant (all values in tonnes)	Total Vegetation Maintenance Emissions	Total Annual (2010) Winnipeg Transit Bus Fleet Diesel Emissions	Monthly Winnipeg Transit Bus Fleet Diesel Emissions (2010 year)	Percentage: Total Vegetation Maintenance/ Annual Winnipeg Transit Diesel Bus Fleet Emissions
NOx	0.012	1,150	95.8	0.001%
CO	0.124	248	20.7	0.05%
SO ₂	0.0002	76	6.3	0.003%
PM ₁₀	0.0015	81	6.8	0.002%

5.2 TOTAL EMISSIONS LOADINGS

The emissions associated with the Construction Phase, (construction activities, construction workforce commuting traffic) and Operations Phase (Regular Maintenance and Vegetation Control) were estimated and reported in Section 5.1. Total emissions generated by the construction and operations phases of the Project are tabulated below:



**MANITOBA-MINNESOTA TRANSMISSION PROJECT
TECHNICAL DATA REPORT – AIR**

air emissions assessment results
July 31, 2015

Table 5-10: Emissions Estimates for MMTP Construction and Operation Phases (tonnes)

Air Contaminant (all values in tonnes)	Total Project: Construction and Operation Phase Emissions	Total Annual (2010) Winnipeg Transit Bus Fleet Diesel Emissions	Monthly Winnipeg Transit Bus Fleet Diesel Emissions (2010 year)	Percentage: Total MMTP Construction and Operation Phases/ <u>Annual</u> Winnipeg Transit Bus Fleet Diesel Emissions	Percentage: Total MMTP Construction and Operation Phases/ <u>Monthly</u> Winnipeg Transit Bus Fleet Diesel Emissions
NOx	40.81	1,150	95.8	3.55%	42.6%
CO	73.17	248	20.7	29.5%	343.5%
SO ₂	0.26	76	6.3	0.34%	4.1%
PM ₁₀	1.56	81	6.8	1.93%	22.9%

In Table 5.10 above, Total MMTP Construction and Operations Phase emissions related to NOx, CO, SO₂ and PM₁₀ are summarized and expressed as Total Emission Loadings over the duration of the Project. These totals are compared with the emission loadings of NOx, CO, SO₂ and PM₁₀ generated by Winnipeg Transit's operation of over 500 diesel transit buses in the City of Winnipeg in a single year, based upon reported fuel consumption for Winnipeg Transit Diesel buses as reported to City Council in 2010.

The Total MMTP emissions generated from construction and operation of the Project are estimated to be substantially less than emissions resulting from the Winnipeg Transit Diesel bus fleet's emission loading in a single year. When comparing Total MMTP emission loadings to Monthly Winnipeg Transit diesel bus fleet emissions, the Total MMTP emission loadings remain a fraction of the monthly estimated emission loadings generated by the Winnipeg Transit bus fleet, except for total CO emissions generated by MMTP, which are estimated to be over 3.5 times that of the CO emissions generated in a single month by Winnipeg Transit's diesel bus fleet.

MANITOBA-MINNESOTA TRANSMISSION PROJECT TECHNICAL DATA REPORT – AIR

summary
July 31, 2015

6.0 SUMMARY

Project-related activities that generate and release air contaminants to the atmosphere are expected to be temporary, primarily distributed along highways and transmission line ROWs, and intermittent in nature. Estimates for Project emission loadings were developed for each Project phase based upon equipment deployment estimates specific to each phase of the Project. Manitoba Hydro provided listings of anticipated equipment intended for use in each phase of the Project, each vehicle's power rating in horsepower, number of vehicles intended for deployment in each Project phase and the expected duration of use. Emission factors were identified for the specified equipment from EPA Mobile Emissions (Mobile6) software and AP-42 database values. Emission loadings were estimated and compared with known vehicle movements considered commonly acceptable by citizens and regulators within the City of Winnipeg – the emissions resulting from the operation of Winnipeg Transit's entire diesel bus fleet (>500 buses) on an annual and monthly basis.

Comparison of the total MMTP Project emissions with the annual and monthly Winnipeg Transit Diesel Bus Fleet, emissions indicates that the relative effects to air quality in response to the Project are expected to be minor, resulting in temporary, short-term reduction in local air quality in areas in close proximity to the construction sites, and unlikely to result in exceedance of Manitoba's Ambient Air Quality Guidelines (MCWS 2005).

MANITOBA-MINNESOTA TRANSMISSION PROJECT TECHNICAL DATA REPORT – AIR

References
July 31, 2015

7.0 REFERENCES

Canadian Council of Ministers of the Environment (CCME). 1998. *A Canada-wide Accord on Environmental Harmonization*. Accessed on April 14, 2015 from [http://www.ccme.ca/en/resources/harmonization/index.html]

City of Winnipeg Council Minutes: Draft Green Fleet Plan July 2010, City of Winnipeg Green Fleet Management Agency.

Enviro-fleets: reducing emissions from municipal heavy-duty vehicles, A Guide to Helpful Resources, June 2010, Federation of Canadian Municipalities.

Greenhouse Gas Emissions Baseline for the City of Winnipeg, May 31, 2007 Winnipeg, MB Centre for Sustainable Transportation, University of Winnipeg.

Manitoba Conservation and Water Stewardship, 2005. *Ambient Air Quality Criteria*. July 2005. Accessed on April 15 from https://www.gov.mb.ca/conservation/envprograms/airquality/pdf/criteria_table_update_july_2005.pdf.

Manitoba Conservation and Water Stewardship, 2012. *Manitoba's Report on Climate Change for 2012*. Manitoba Conservation and Water Stewardship. Accessed on April 15, 2015 from [http://www.gov.mb.ca/conservation/climate/pdf/2012_climate_change_web.pdf].

Manitoba Conservation, 2009 and Water Stewardship. *Provincial 2009 Sustainability Report for Manitoba*.

Manitoba Conservation and Water Stewardship. Accessed on April 15, 2015 from [http://www.gov.mb.ca/conservation/pdf/sustainability_report_2009.pdf].

Manitoba Hydro, 2015. MMTP construction, operations and maintenance equipment deployments by construction phase, and Project activity summary lists provided by Manitoba Hydro, Transmission, Licensing and Environmental Assessment Department. April, 2015.

Manitoba Hydro, 2015. MMTP Environmental Impact Statement, Project Description Chapter. July 21, 2015.

Manitoba Hydro, 2012. Keeyask Generation Project Environmental Impact Statement Chapter 6, pg. 6-25. June, 2012.



**MANITOBA-MINNESOTA TRANSMISSION PROJECT
TECHNICAL DATA REPORT – AIR**

References
July 31, 2015

Manitoba Hydro, 2011. Bipole III Environmental Impact Statement. Chapter 6, pg. 6-20.
December, 2011.

The Pembina Institute, 2015. *Greenhouse Gas Life Cycle Assessment of Manitoba-Minnesota
Transmission Line*. April 2015.

Stantec, 2015. *Manitoba-Minnesota Transmission Project Traffic Impact Study*. July 2015.

Thalheimer, E. 1996. Construction noise control program and mitigation strategy for the Central
Artery/Tunnel Project. ASA/INCE Noise Control Conference. Seattle, WA.

U.S. Environmental Protection Agency AP-42 Compilation of Emission Factors, Chapter 3.3,
Gasoline and Diesel Industrial engines.

**APPENDIX A:
MAP SERIES 1-100 – PROJECT
DEVELOPMENT AREA, LOCAL
ASSESSMENT AREA AND RECEPTORS**

Manitoba-Minnesota Transmission Project

Project Infrastructure

- Final Preferred Route (FPR)
- Station Expansion
- Converter Station Footprint

Infrastructure

- Existing 500 kV Transmission Line
- Existing 230kV Transmission Line

Receptor¹

- Occupied House

Assessment Area

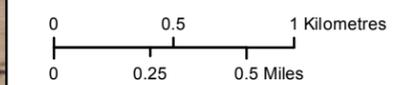
- Project Development Area (PDA)
- Local Assessment Area

Landbase

- | | |
|----------------------|--------------------------|
| Community | Ecological Reserve |
| Trans Canada Highway | Crown Land |
| Provincial Highway | Wildlife Management Area |
| Provincial Road | Provincial Park |
| City / Town | Watercourse |
| First Nation Lands | Waterbody |
| Rural Municipality | |

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



1:30,000

Receptor Locations

Map 1-100-01



G:\GIS\Project_Folder\05-Hydro\11420050-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP-AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd

Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Infrastructure

Existing 230kV Transmission Line

Receptor¹

Occupied House

Assessment Area

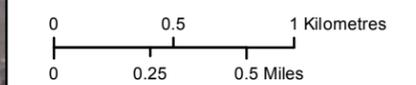
Project Development Area (PDA)
 Local Assessment Area

Landbase

Community	Ecological Reserve
Trans Canada Highway	Crown Land
Provincial Highway	Wildlife Management Area
Provincial Road	Provincial Park
City / Town	Watercourse
First Nation Lands	Waterbody
Rural Municipality	

Source:
 1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
 Data Source: MBHydro, ProvMB, NRCAN
 Date Created: August 11, 2015



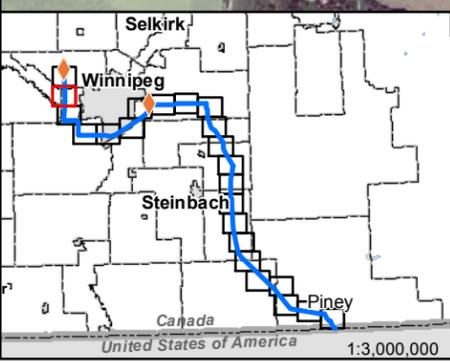
1:30,000

Receptor Locations

Map 1-100-02



G:\GIS\Projects\Folder005_Hydro\11420000_MMP\EA\Figures\TechnicalReports\PhysicalEnvironment\1_00-01-MMTP_TECHREP_AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Infrastructure

- Electrical Station
- Existing 230kV Transmission Line
- St. Vital Transmission Complex (Proposed)
- Existing 115-230kV Transmission Line

Receptor¹

Occupied House

Assessment Area

- Project Development Area (PDA)
- Local Assessment Area

Landbase

- | | |
|----------------------|--------------------------|
| Community | Ecological Reserve |
| Trans Canada Highway | Crown Land |
| Provincial Highway | Wildlife Management Area |
| Provincial Road | Provincial Park |
| City / Town | Watercourse |
| First Nation Lands | Waterbody |
| Rural Municipality | |

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015

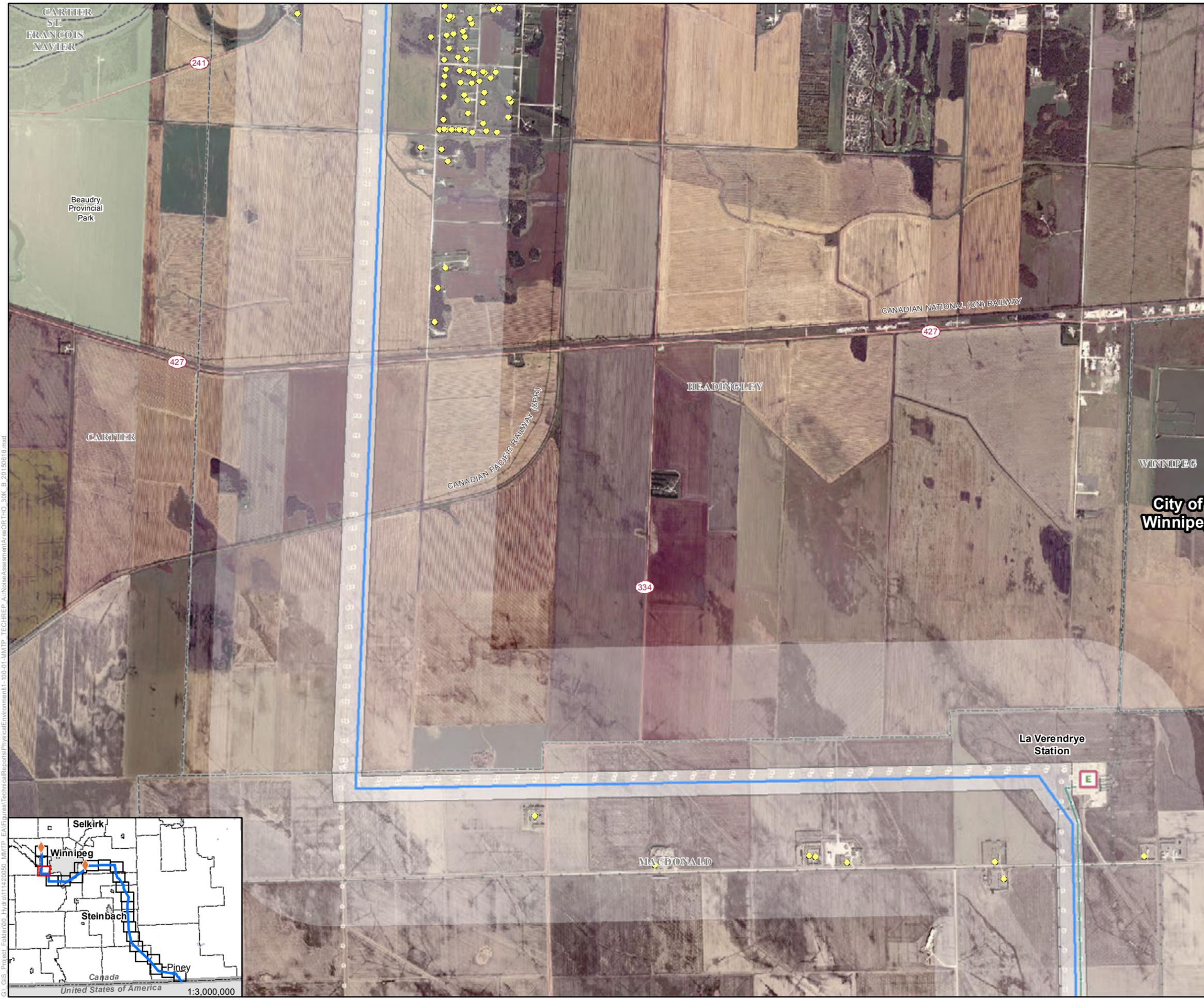


0 0.5 1 Kilometres
0 0.25 0.5 Miles

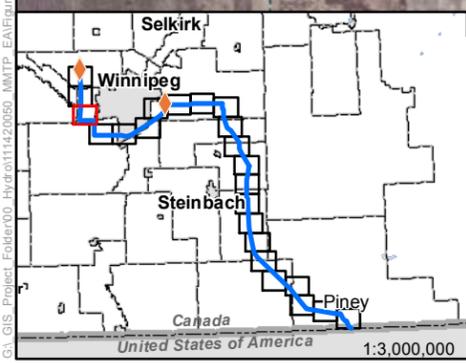
1:30,000

Receptor Locations

Map 1-100-03



G:\GIS\Project_Folder\00-Hydro\11420000-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP-AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Infrastructure

- Existing 230kV Transmission Line
- St. Vital Transmission Complex (Proposed)
- Existing 115-230kV Transmission Line

Receptor¹

Occupied House

Assessment Area

- Project Development Area (PDA)
- Local Assessment Area

Landbase

- Community
- Trans Canada Highway
- Provincial Highway
- Provincial Road
- City / Town
- First Nation Lands
- Rural Municipality
- Ecological Reserve
- Crown Land
- Wildlife Management Area
- Provincial Park
- Watercourse
- Waterbody

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015

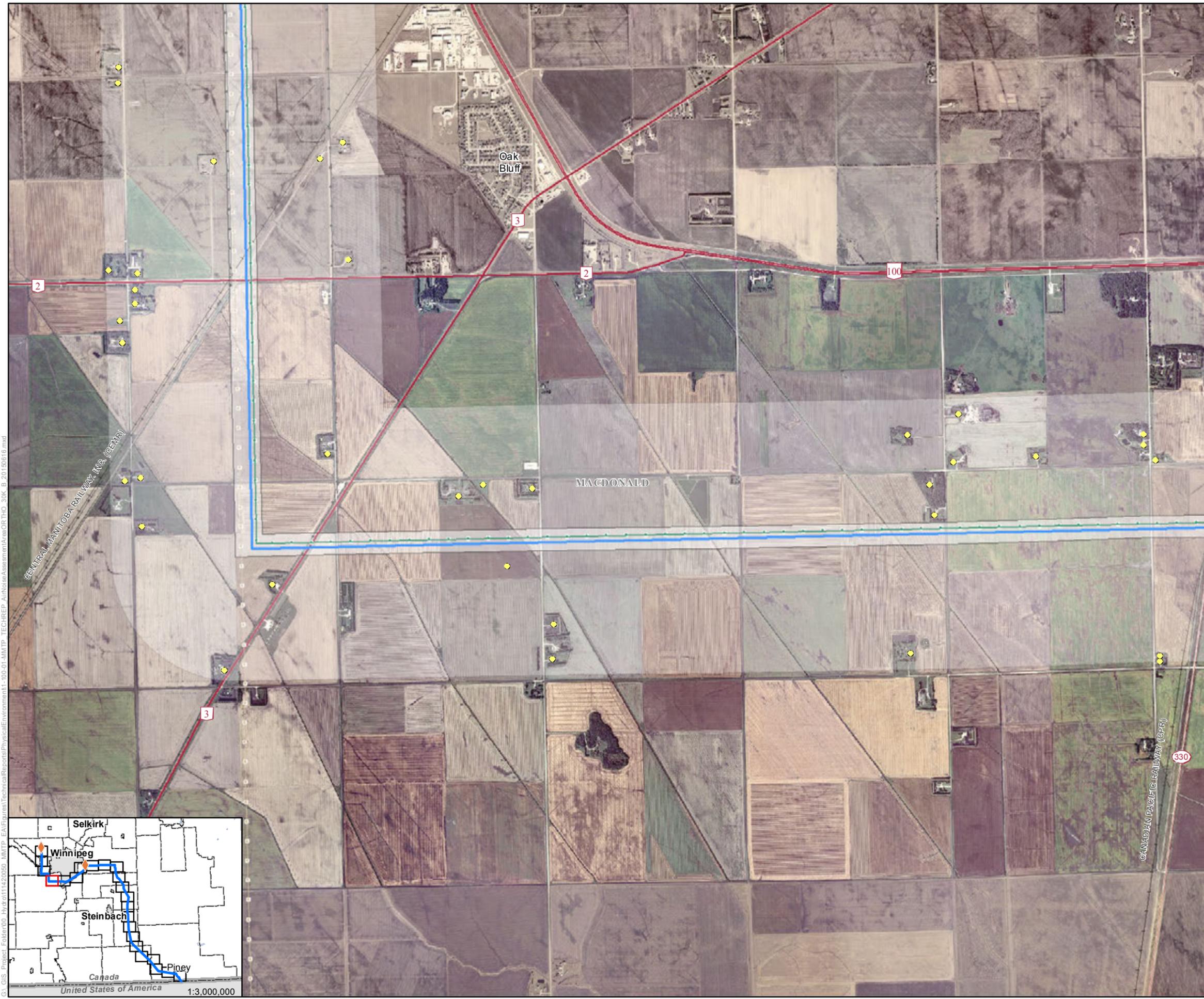
0 0.5 1 Kilometres
0 0.25 0.5 Miles



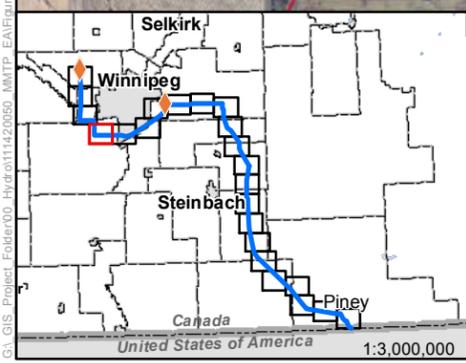
1:30,000

Receptor Locations

Map 1-100-04



G:\GIS\Project_Folder\05-Hydro\11420000-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP-AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Infrastructure

St. Vital Transmission Complex (Proposed)

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- Community
- Ecological Reserve
- Trans Canada Highway
- Crown Land
- Provincial Highway
- Wildlife Management Area
- Provincial Road
- Provincial Park
- City / Town
- Watercourse
- First Nation Lands
- Waterbody
- Rural Municipality

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015

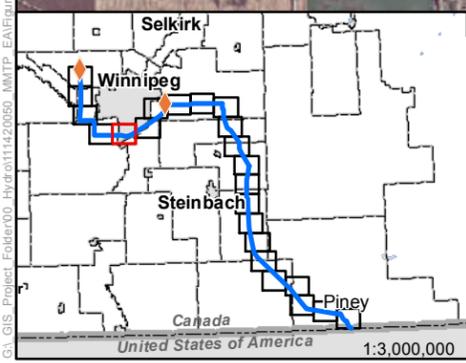


0 0.5 1 Kilometres
0 0.25 0.5 Miles

1:30,000

Receptor Locations

Map 1-100-05



G:\GIS\Project_Folder\05-Hydro\11420050-MMP-EA\Figures\Technical\PhysicalEnvironment\1-00-01-MMP-TECHREP-AirNoiseAssessment\AreaOrtho-30K-B-20150616.mxd

Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Infrastructure

St. Vital Transmission Complex (Proposed)

Existing 115-230kV Transmission Line

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

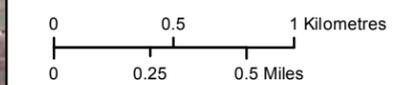
Local Assessment Area

Landbase

- Community
- Trans Canada Highway
- Provincial Highway
- Provincial Road
- City / Town
- First Nation Lands
- Rural Municipality
- Ecological Reserve
- Crown Land
- Wildlife Management Area
- Provincial Park
- Watercourse
- Waterbody

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

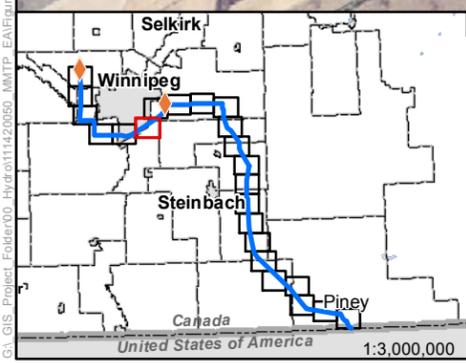
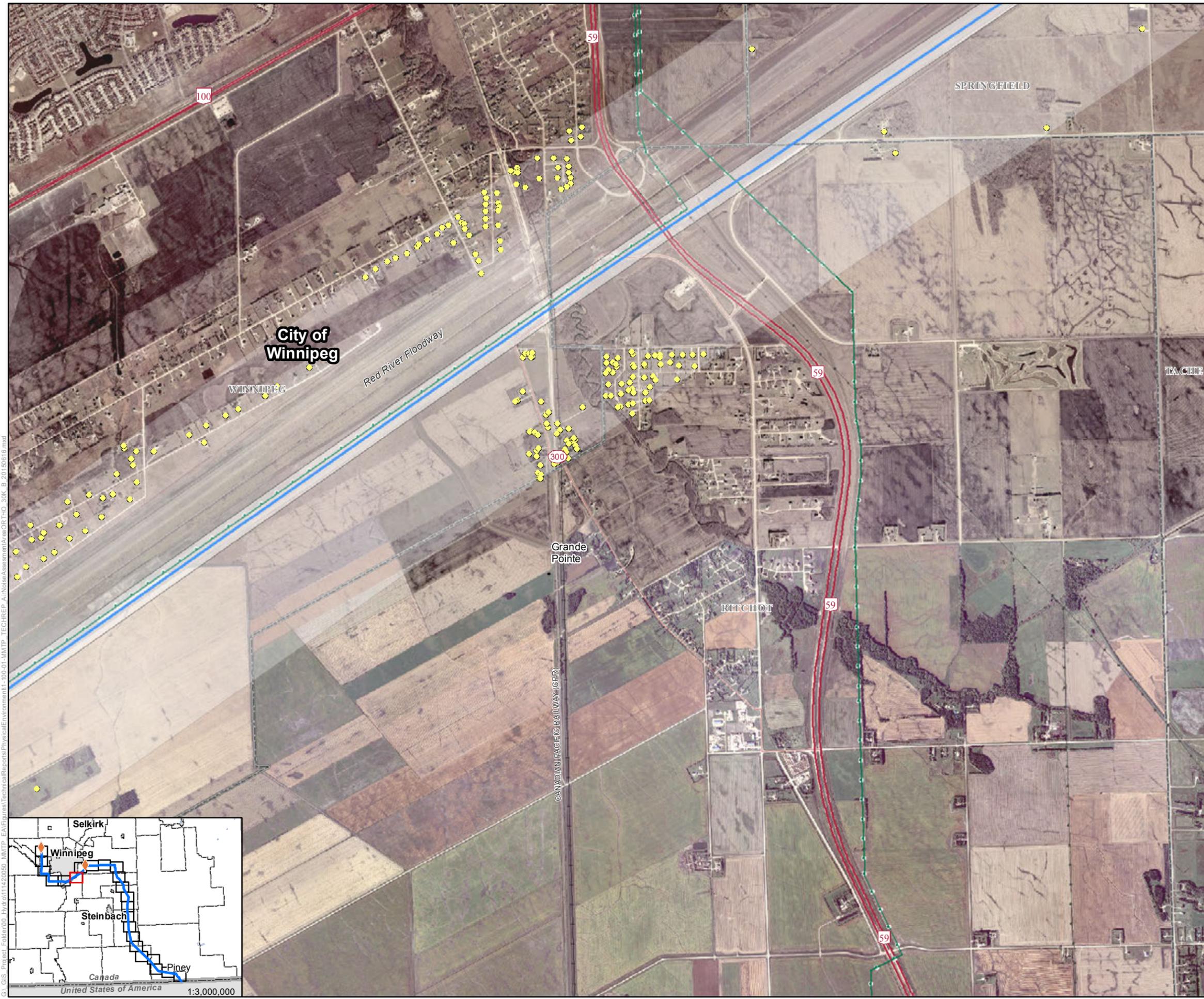
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



1:30,000

Receptor Locations

Map 1-100-06



G:\GIS\Project_Folder\05-Hydro\11420000-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP-AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd

Manitoba-Minnesota Transmission Project

Project Infrastructure

- Final Preferred Route (FPR)
- Converter Station Footprint

Infrastructure

- Electrical Station
- Existing 500 kV Transmission Line
- Existing 230kV Transmission Line
- Bipole III Transmission Line (Approved)
- St. Vital Transmission Complex (Proposed)
- Existing 115-230kV Transmission Line

Receptor¹

- Occupied House

Assessment Area

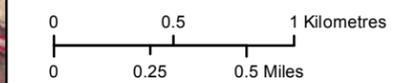
- Project Development Area (PDA)
- Local Assessment Area

Landbase

- | | |
|----------------------|--------------------------|
| Community | Ecological Reserve |
| Trans Canada Highway | Crown Land |
| Provincial Highway | Wildlife Management Area |
| Provincial Road | Provincial Park |
| City / Town | Watercourse |
| First Nation Lands | Waterbody |
| Rural Municipality | |

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

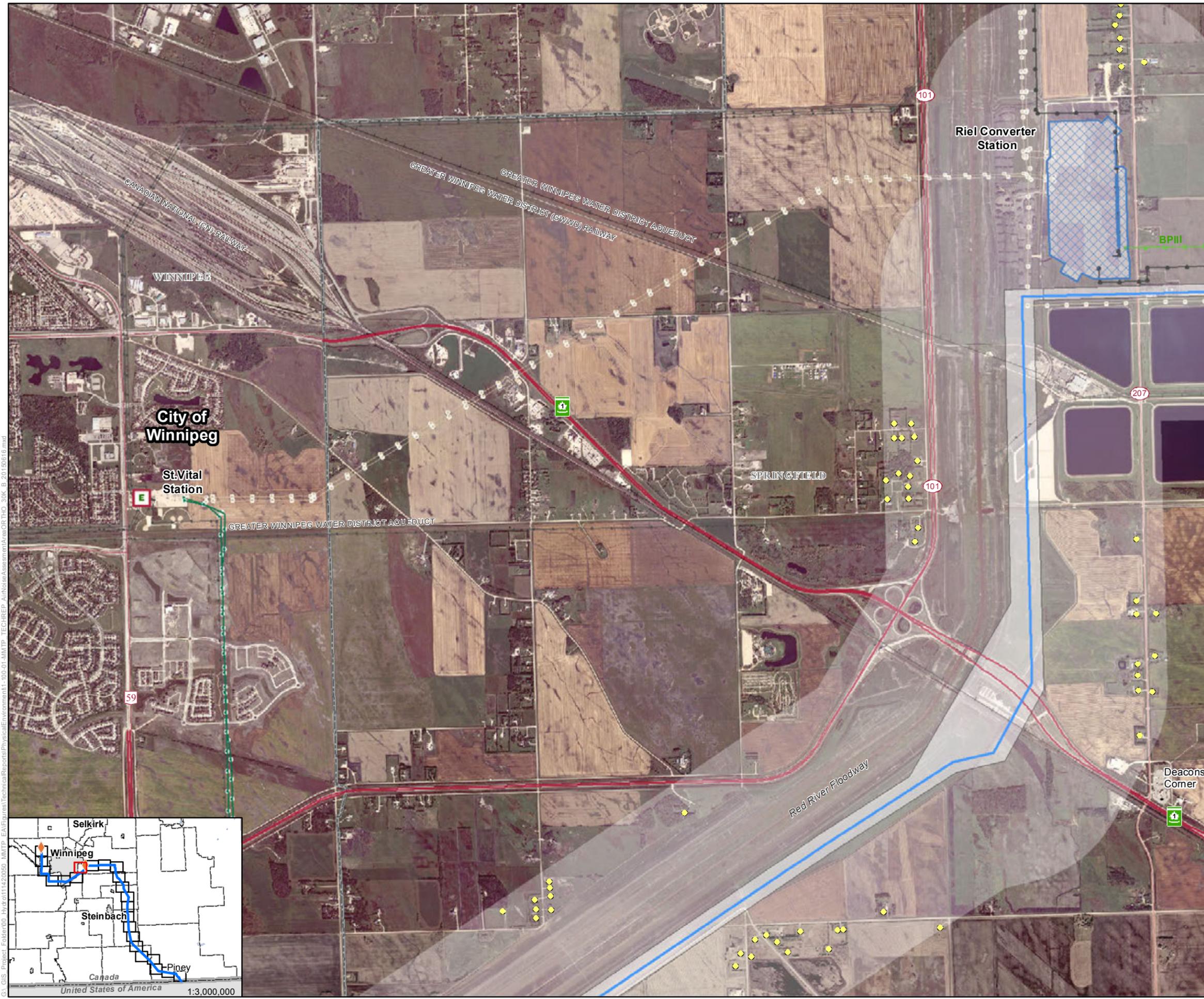
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



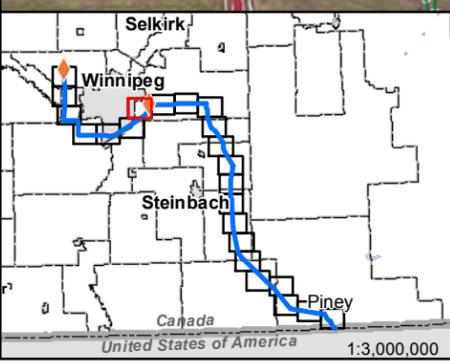
1:30,000

Receptor Locations

Map 1-100-07



G:\GIS\Projects\Folder003-Hydro\11420000-MMP\EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMP-TECHREP_AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

- Final Preferred Route (FPR)
- M602F Modification (Salvage)
- M602F Modification (New)

Infrastructure

- Existing 500 kV Transmission Line
- Existing 230kV Transmission Line
- Bipole III Transmission Line (Approved)
- Existing 115-230kV Transmission Line

Receptor¹

- Occupied House

Assessment Area

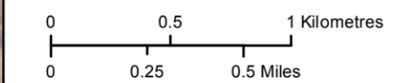
- Project Development Area (PDA)
- Local Assessment Area

Landbase

- | | |
|----------------------|--------------------------|
| Community | Ecological Reserve |
| Trans Canada Highway | Crown Land |
| Provincial Highway | Wildlife Management Area |
| Provincial Road | Provincial Park |
| City / Town | Watercourse |
| First Nation Lands | Waterbody |
| Rural Municipality | |

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

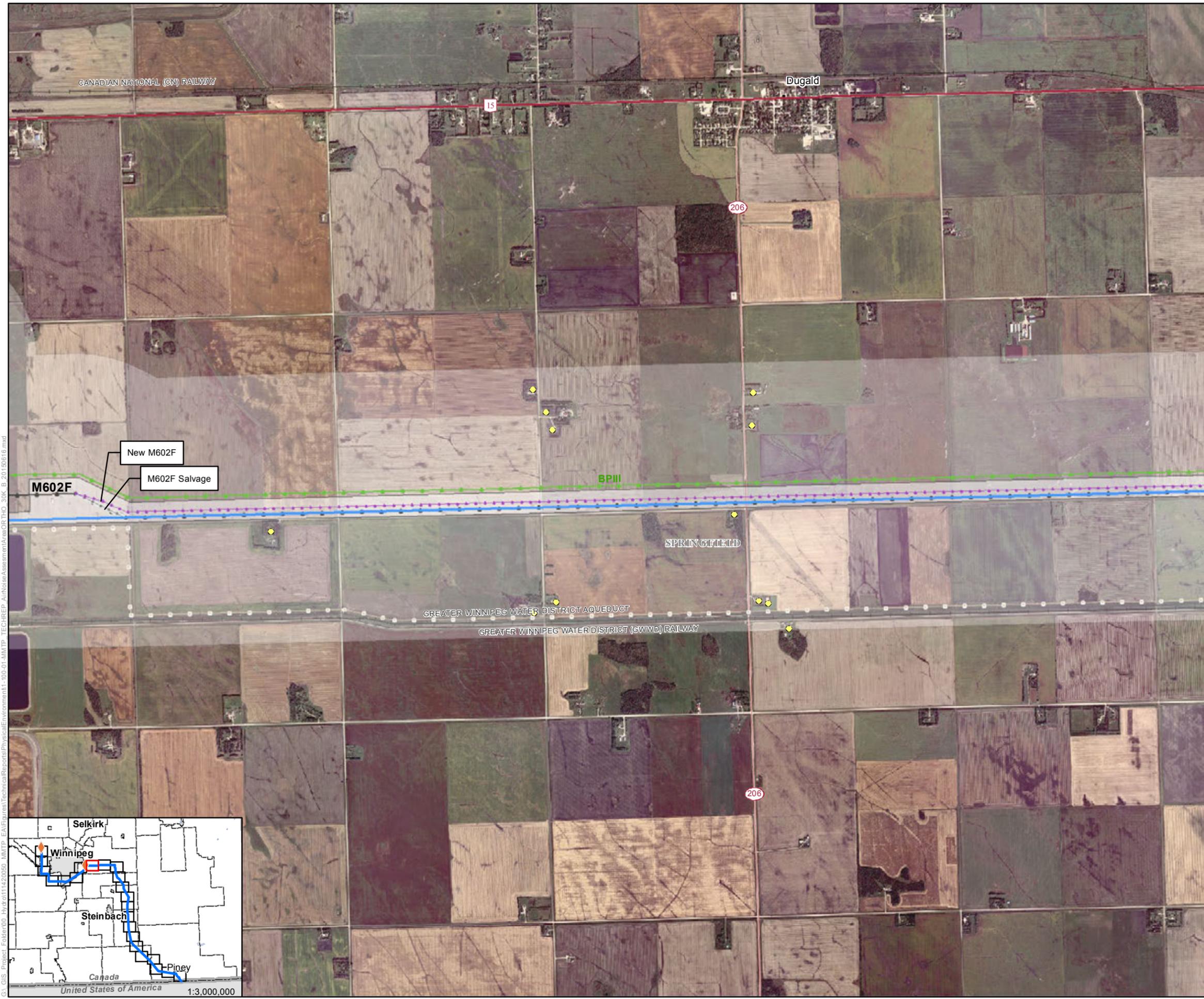
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



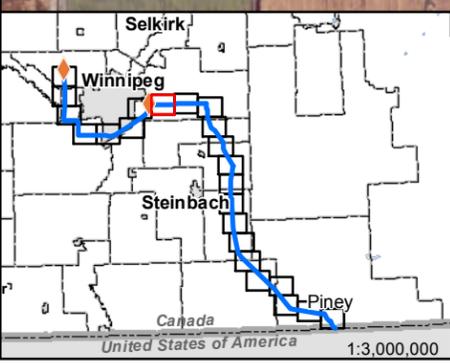
1:30,000

Receptor Locations

Map 1-100-08



G:\GIS\Projects\Folder005-Hydro\11420000-MMP-BA\Figures\TechnicalReports\PhysicalEnvironment\1-100-01-MMP-TECHREP-AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

- Final Preferred Route (FPR)
- - - M602F Modification (New)

Infrastructure

- Existing 500 kV Transmission Line
- Existing 230kV Transmission Line
- Bipole III Transmission Line (Approved)
- Existing 115-230kV Transmission Line

Receptor¹

- Occupied House

Assessment Area

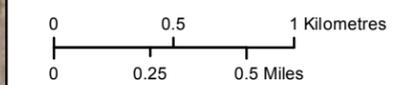
- Project Development Area (PDA)
- Local Assessment Area

Landbase

- | | |
|---|--|
| ● Community | Ecological Reserve |
| — Trans Canada Highway | Crown Land |
| — Provincial Highway | Wildlife Management Area |
| — Provincial Road | Provincial Park |
| City / Town | — Watercourse |
| First Nation Lands | Waterbody |
| Rural Municipality | |

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

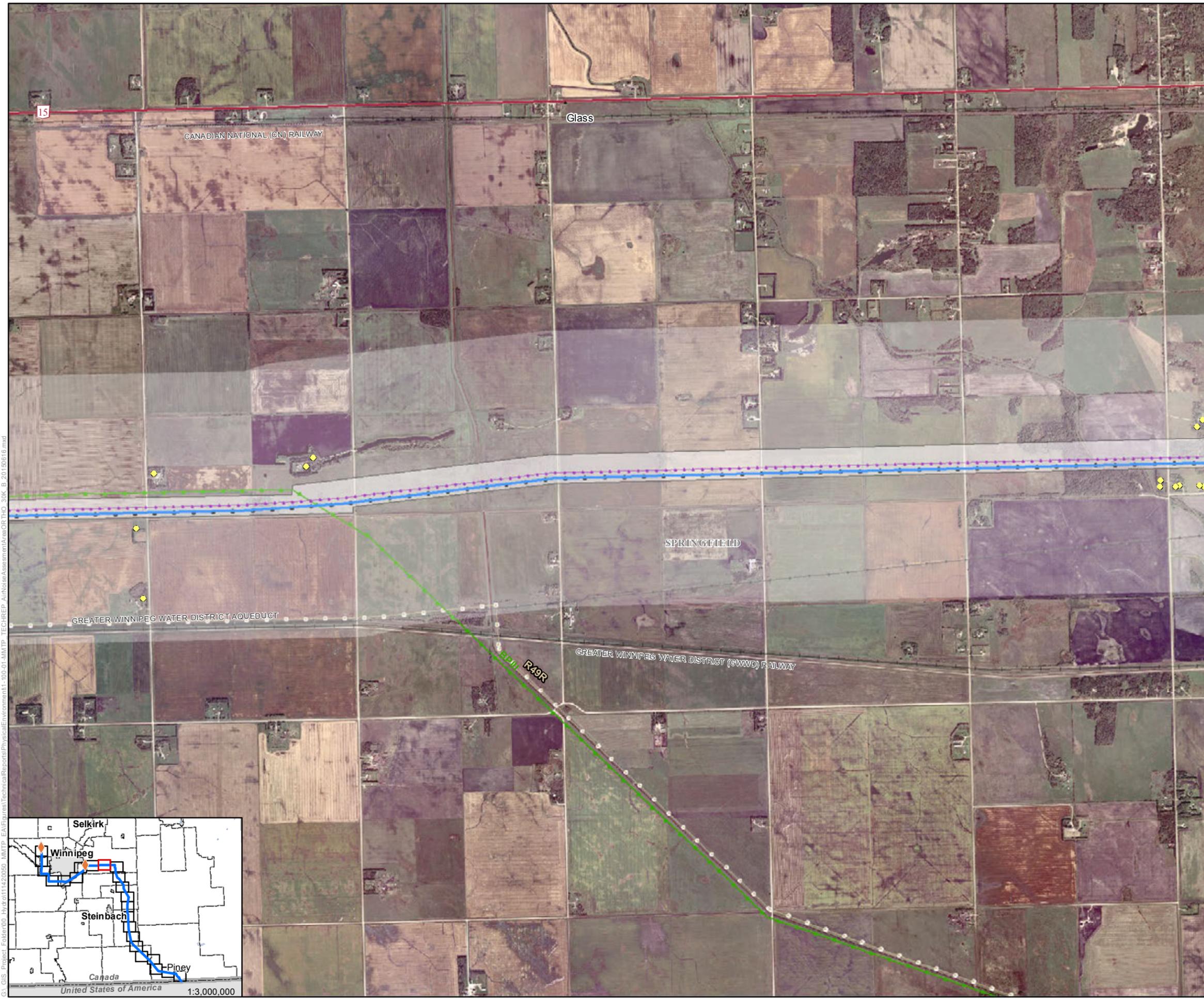
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



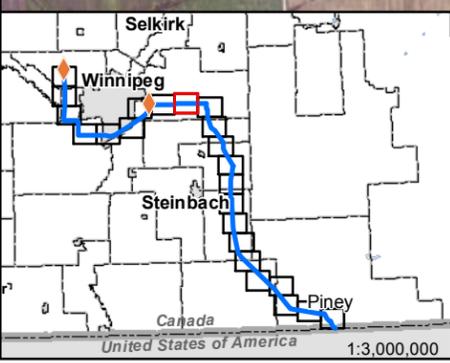
1:30,000

Receptor Locations

Map 1-100-09



G:\GIS\Project_Folder\05-Hydro\11420000-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP-AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

- Final Preferred Route (FPR)
- M602F Modification (Salvage)
- M602F Modification (New)
- M602F Extension and Salvage

Infrastructure

- Existing 500 kV Transmission Line
- Existing 230kV Transmission Line
- Existing 115-230kV Transmission Line

Receptor¹

- Occupied House

Assessment Area

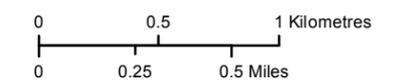
- Project Development Area (PDA)
- Local Assessment Area

Landbase

- | | |
|----------------------|--------------------------|
| Community | Ecological Reserve |
| Trans Canada Highway | Crown Land |
| Provincial Highway | Wildlife Management Area |
| Provincial Road | Provincial Park |
| City / Town | Watercourse |
| First Nation Lands | Waterbody |
| Rural Municipality | |

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

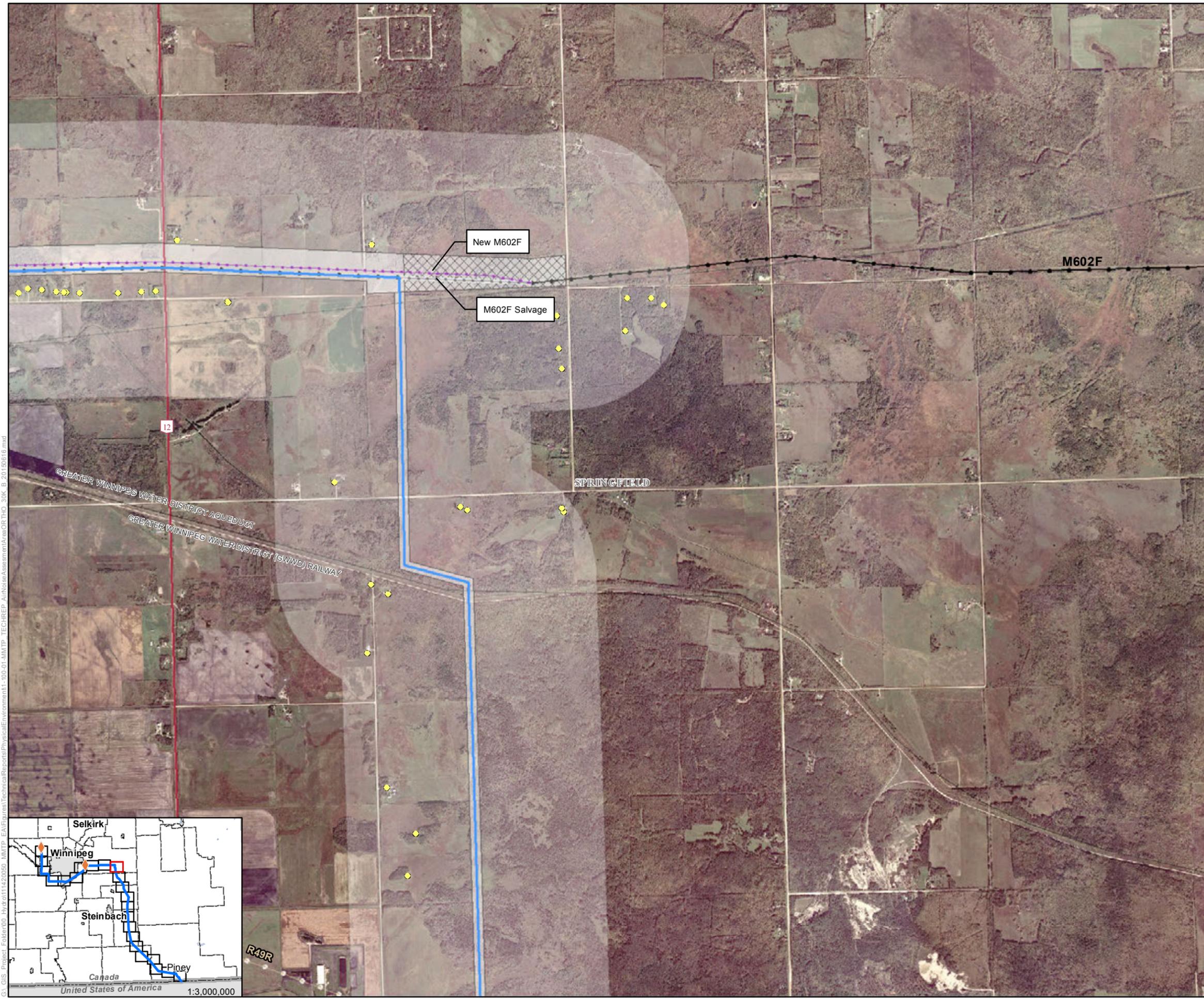
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



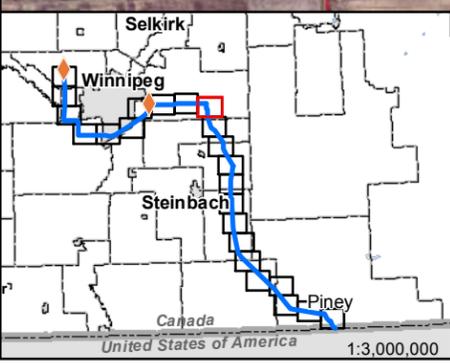
1:30,000

Receptor Locations

Map 1-100-10



G:\GIS\Project_Folder\05-Hydro\11420050-MMP\EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MM\TP-TECHREP-AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Infrastructure

Existing 230kV Transmission Line

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- | | |
|----------------------|--------------------------|
| Community | Ecological Reserve |
| Trans Canada Highway | Crown Land |
| Provincial Highway | Wildlife Management Area |
| Provincial Road | Provincial Park |
| City / Town | Watercourse |
| First Nation Lands | Waterbody |
| Rural Municipality | |

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015

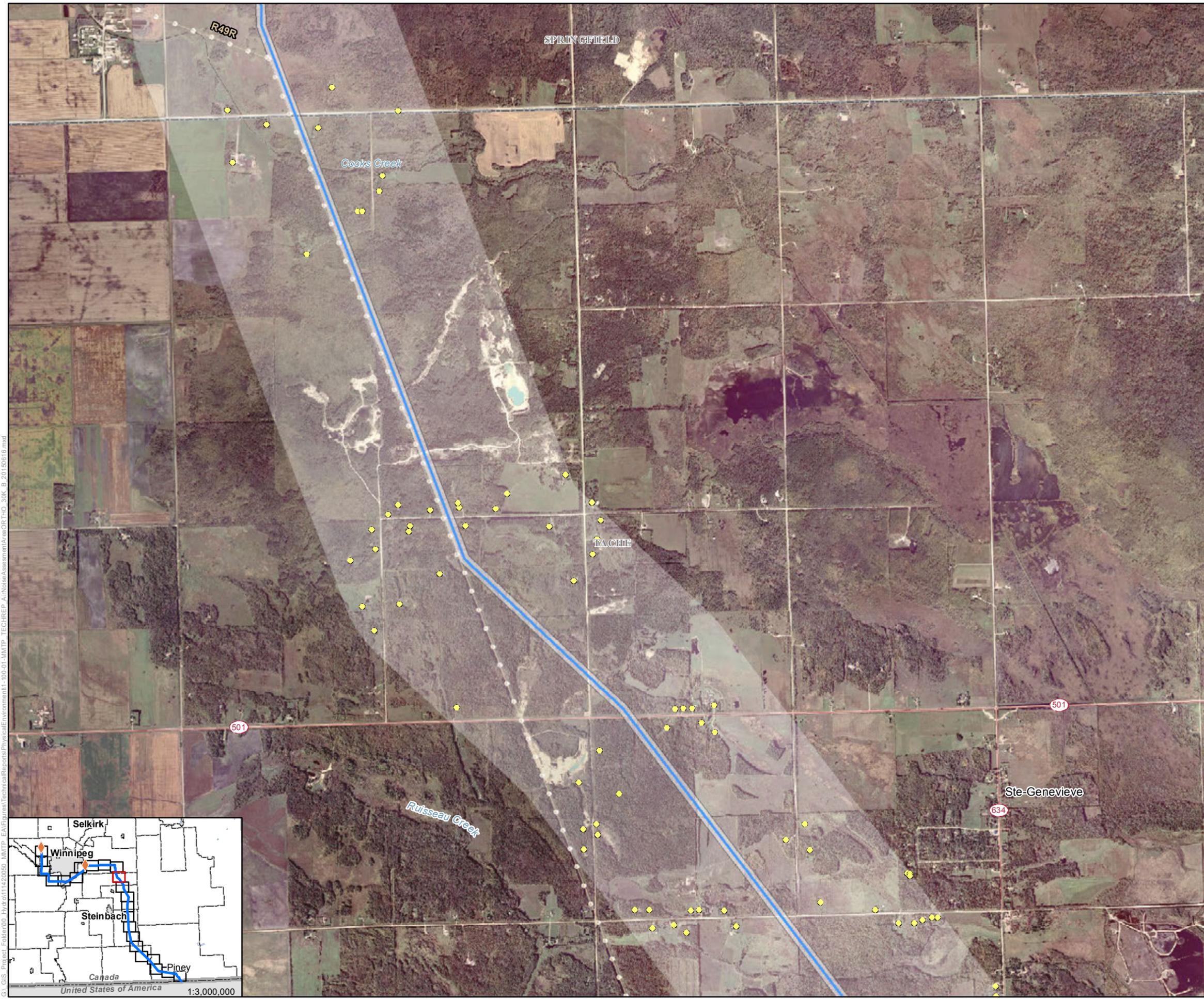


0 0.5 1 Kilometres
0 0.25 0.5 Miles

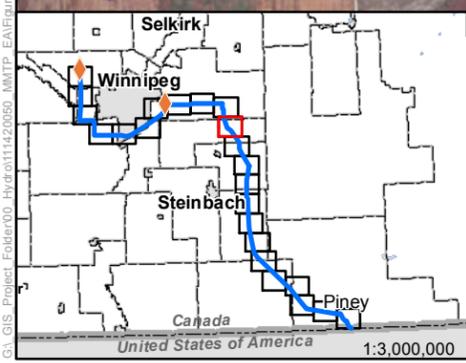
1:30,000

Receptor Locations

Map 1-100-11



G:\GIS\Project_Folder\05-Hydro\11420000-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP_AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Infrastructure

Existing 230kV Transmission Line

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)
 Local Assessment Area

Landbase

Community	Ecological Reserve
Trans Canada Highway	Crown Land
Provincial Highway	Wildlife Management Area
Provincial Road	Provincial Park
City / Town	Watercourse
First Nation Lands	Waterbody
Rural Municipality	

Source:
 1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
 Data Source: MBHydro, ProvMB, NRCAN
 Date Created: August 11, 2015

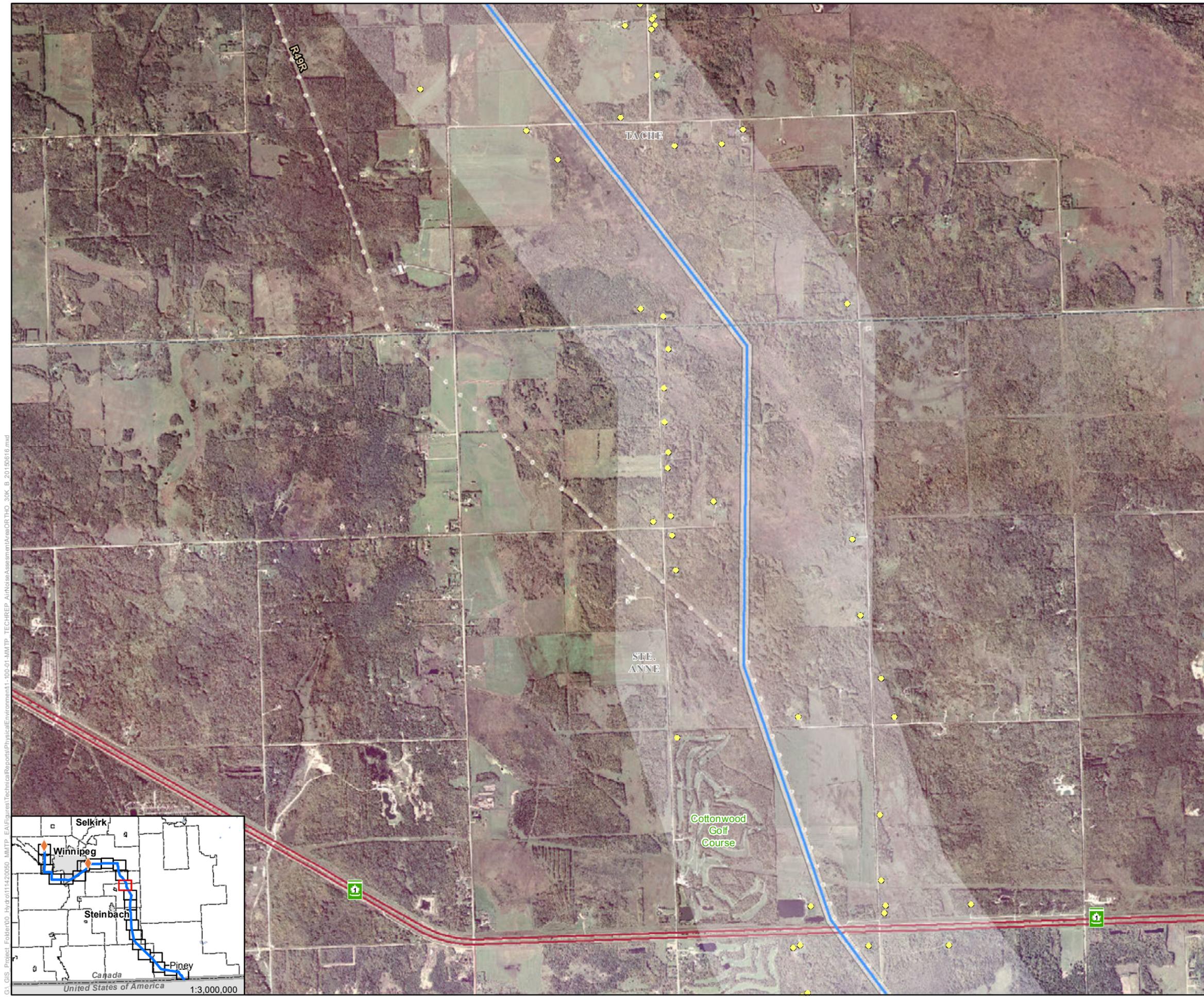


0 0.5 1 Kilometres
 0 0.25 0.5 Miles

1:30,000

Receptor Locations

Map 1-100-12



G:\GIS\Project_Folder\GIS_Hydro\11420000_MMTP_EA\Figures\TechnicalReports\PhysicalEnvironment\1_00-01-MMTP_TECHREP_AirNoiseAssessmentArea\ORTH0_30K_B_20150616.mxd

Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Infrastructure

Electrical Station

Existing 230kV Transmission Line

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- Community
- Trans Canada Highway
- Provincial Highway
- Provincial Road
- City / Town
- First Nation Lands
- Rural Municipality
- Ecological Reserve
- Crown Land
- Wildlife Management Area
- Provincial Park
- Watercourse
- Waterbody

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015

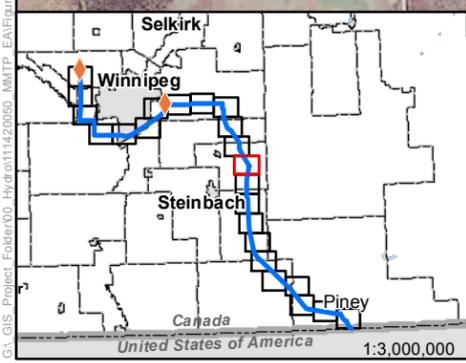
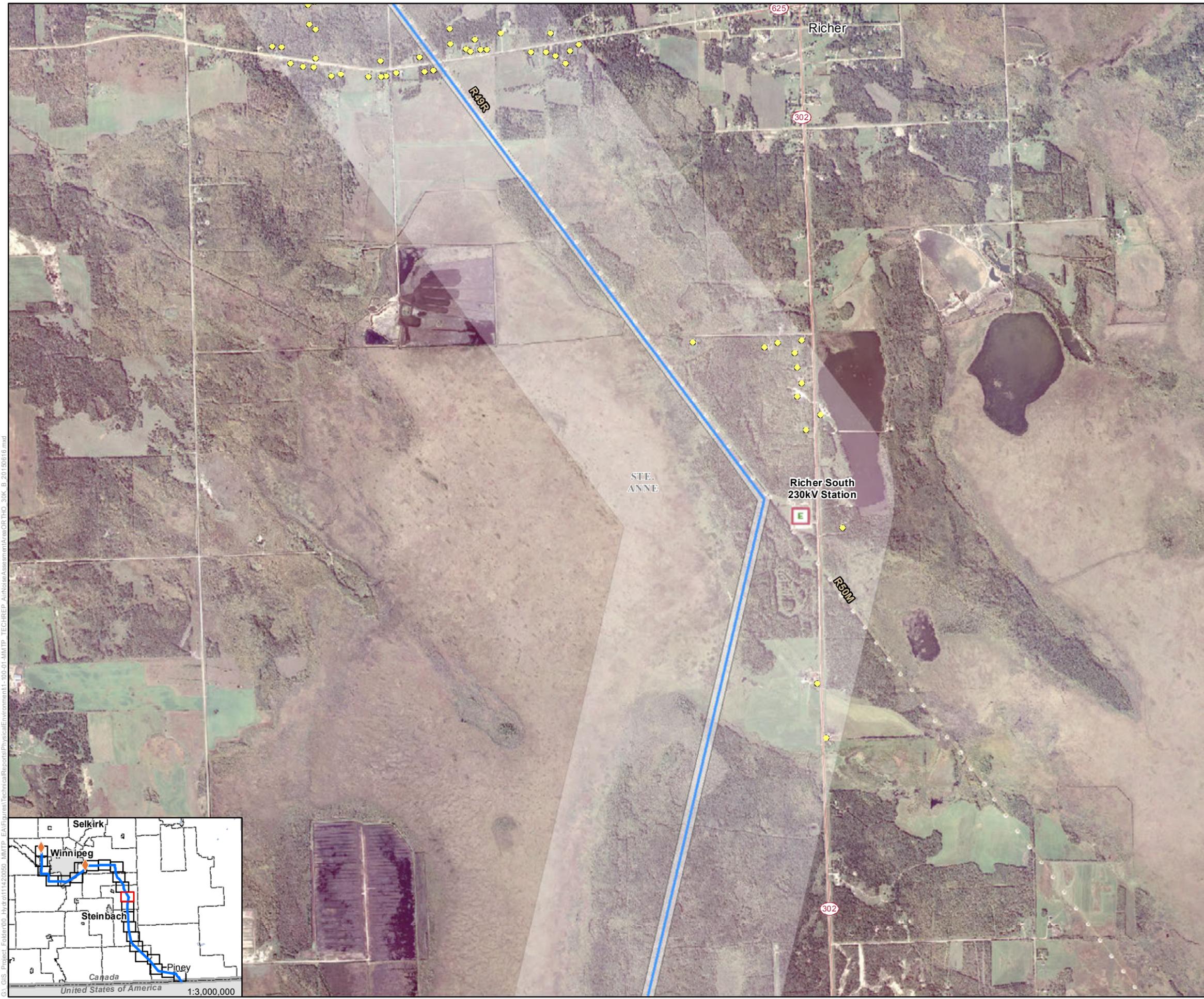


0 0.5 1 Kilometres
0 0.25 0.5 Miles

1:30,000

Receptor Locations

Map 1-100-13



G:\GIS\Project_Folder\00-Hydro\11420000-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-100-01-MMTP-TECHREP_AirNoiseAssessment\AreaORTHO_30K_B_20150616.mxd

Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Infrastructure

Existing 230kV Transmission Line

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

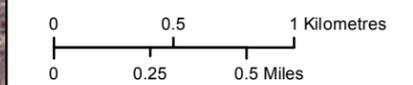
Local Assessment Area

Landbase

- | | |
|----------------------|--------------------------|
| Community | Ecological Reserve |
| Trans Canada Highway | Crown Land |
| Provincial Highway | Wildlife Management Area |
| Provincial Road | Provincial Park |
| City / Town | Watercourse |
| First Nation Lands | Waterbody |
| Rural Municipality | |

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

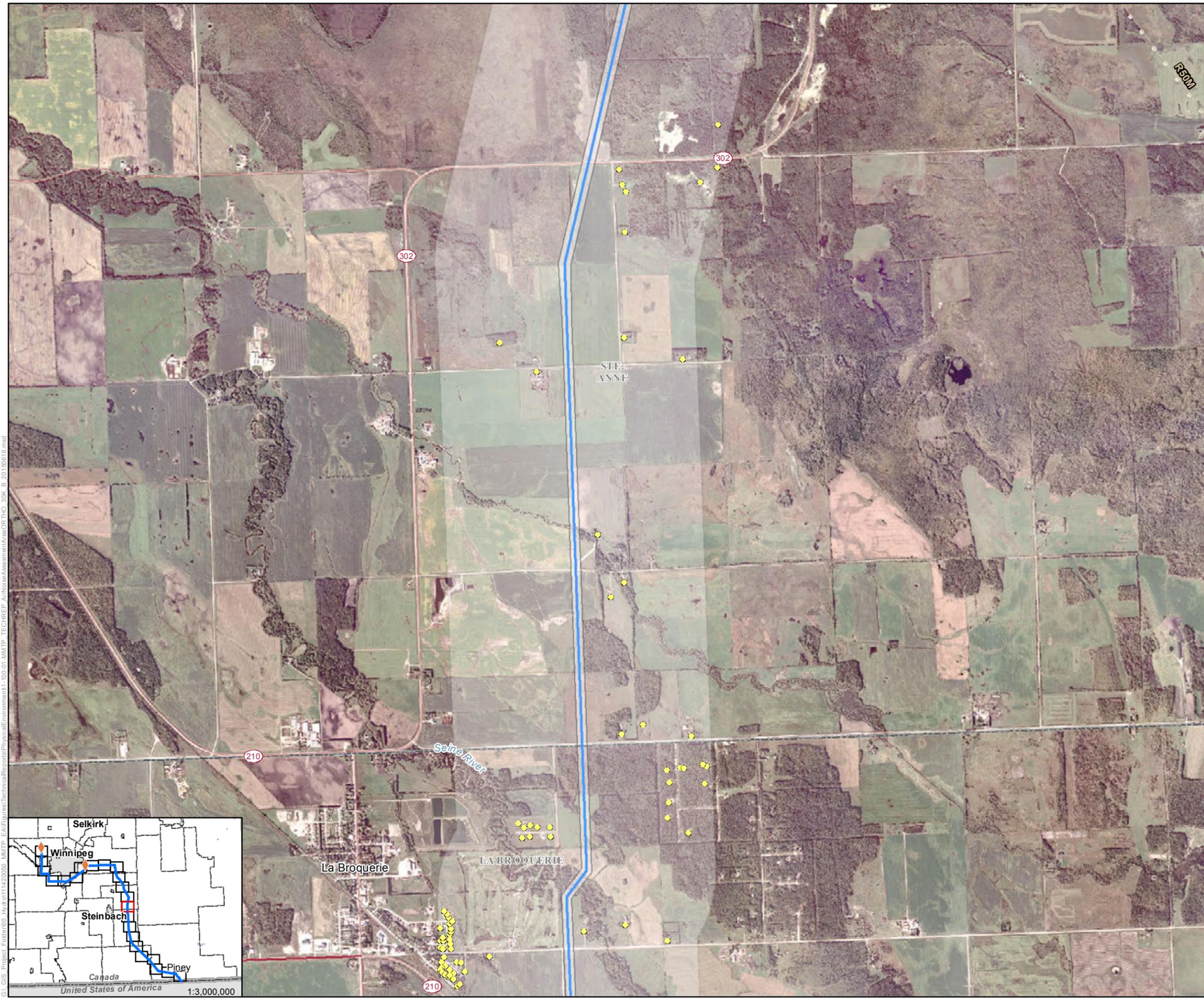
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



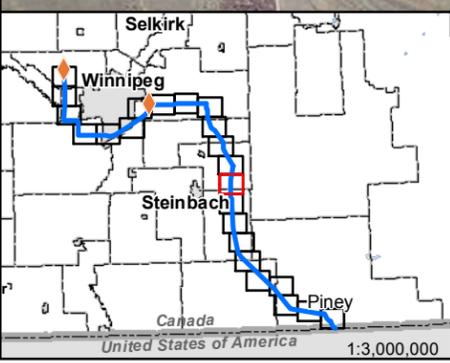
1:30,000

Receptor Locations

Map 1-100-14



G:\GIS\Projects\Folder00-Hydro\11420000-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP_AirphotoAssessmentArea\ORTH0_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- | | |
|----------------------|--------------------------|
| Community | Ecological Reserve |
| Trans Canada Highway | Crown Land |
| Provincial Highway | Wildlife Management Area |
| Provincial Road | Provincial Park |
| City / Town | Watercourse |
| First Nation Lands | Waterbody |
| Rural Municipality | |

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



0 0.5 1 Kilometres
0 0.25 0.5 Miles

1:30,000

Receptor Locations

Map 1-100-15



G:\GIS\Project_Folder\05_Hydro\11420000_MMTP_EA\Figures\TechnicalReports\PhysicalEnvironment\1-100-01-MMTP_TECHREP_AirNotesAssessmentAreaORTH0_30K_B_20150616.mxd

Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- Community
- Trans Canada Highway
- Provincial Highway
- Provincial Road
- City / Town
- First Nation Lands
- Rural Municipality
- Ecological Reserve
- Crown Land
- Wildlife Management Area
- Provincial Park
- Watercourse
- Waterbody

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015

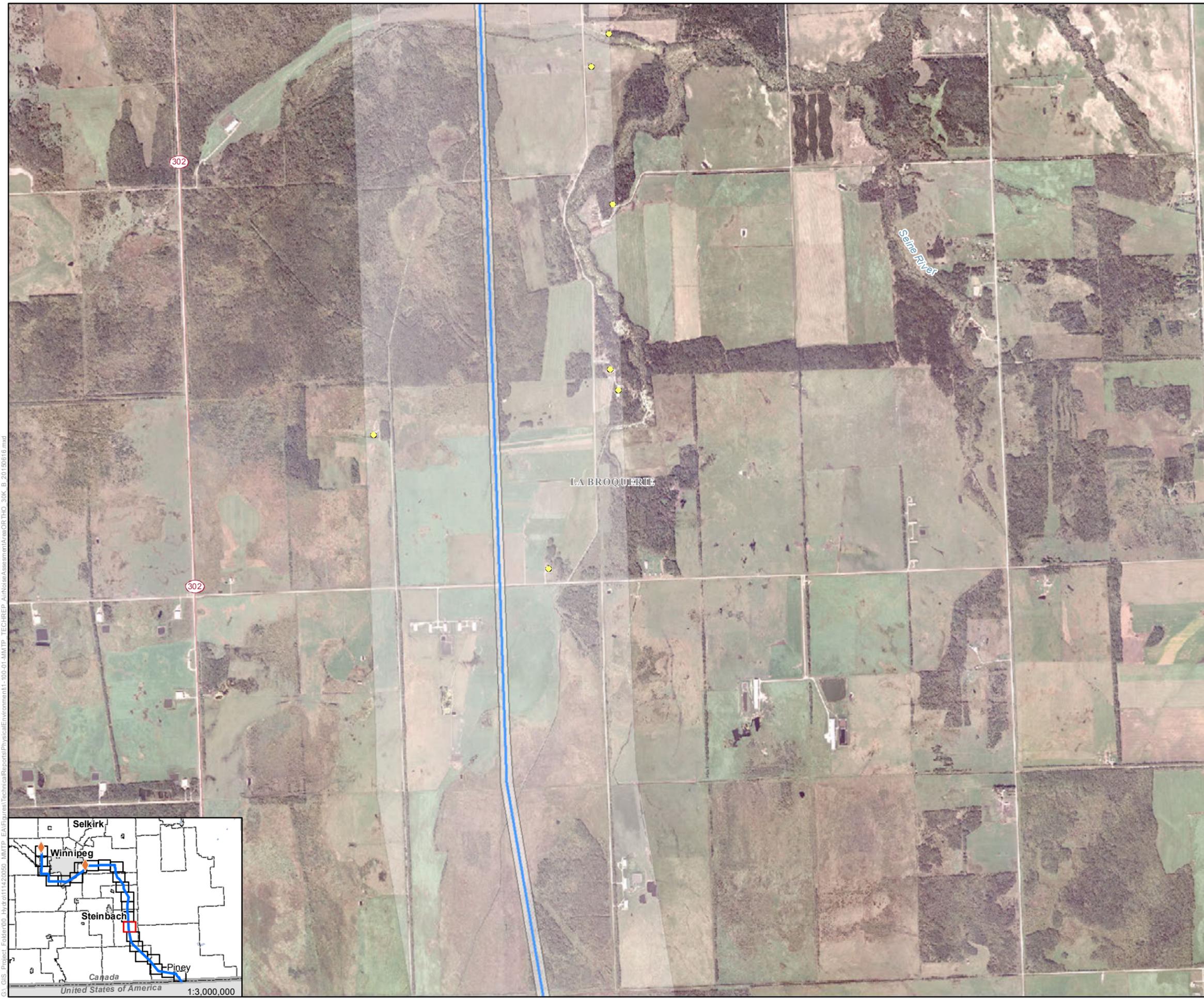


0 0.5 1 Kilometres
0 0.25 0.5 Miles

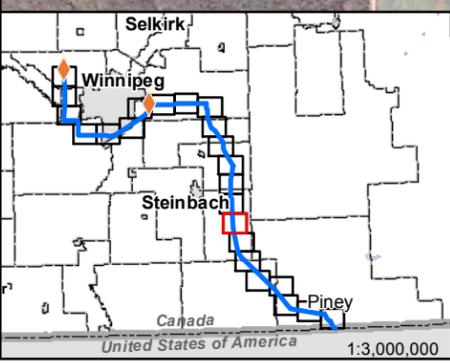
1:30,000

Receptor Locations

Map 1-100-16



G:\GIS\Projects\Folder005-Hydro\11420000-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP-AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- Community
- Trans Canada Highway
- Provincial Highway
- Provincial Road
- City / Town
- First Nation Lands
- Rural Municipality
- Ecological Reserve
- Crown Land
- Wildlife Management Area
- Provincial Park
- Watercourse
- Waterbody

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

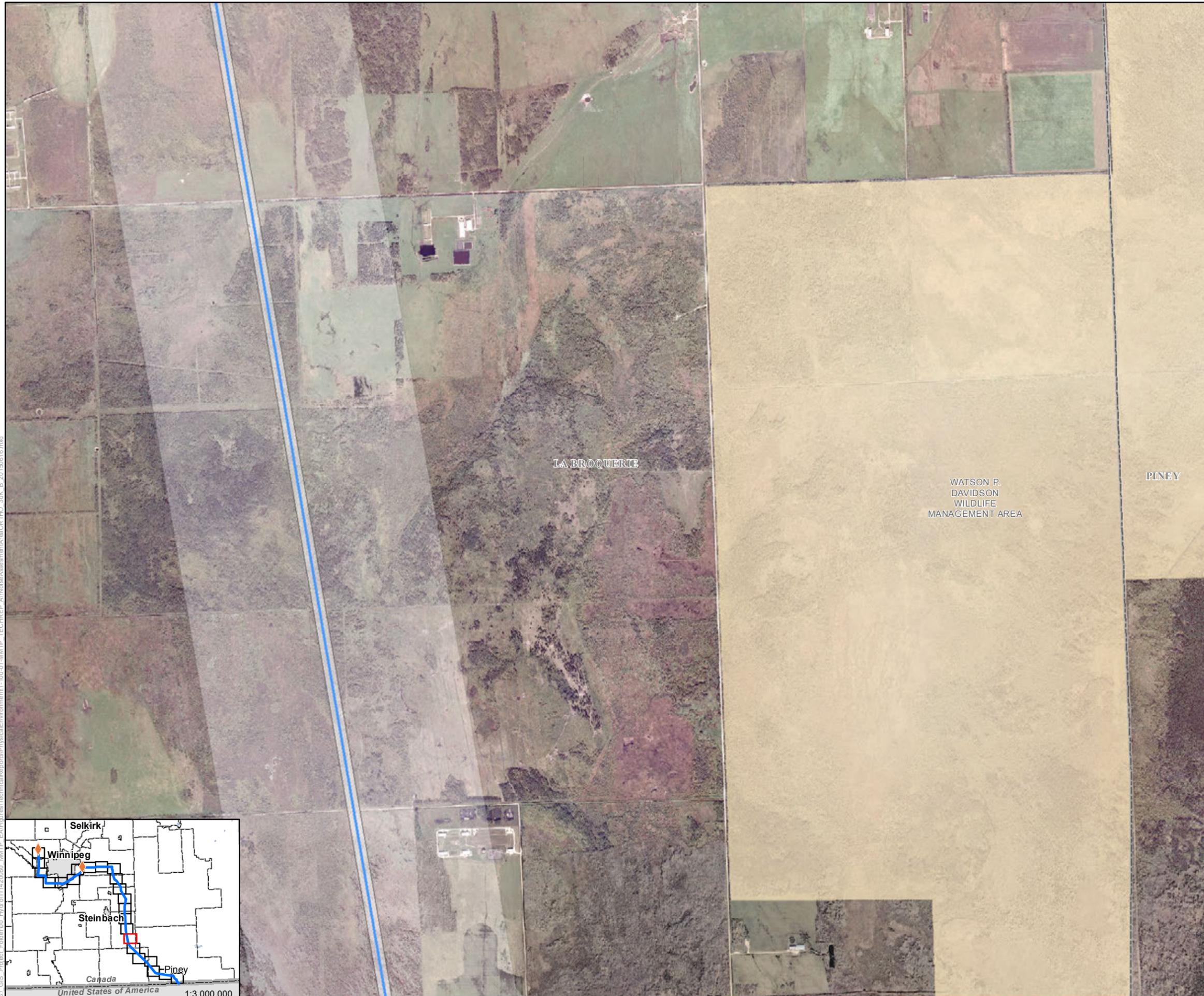
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



0 0.5 1 Kilometres
0 0.25 0.5 Miles

1:30,000

Receptor Locations



G:\GIS\Project_Folder\00-Hydro\11420000-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP-AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd

Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- Community
- Trans Canada Highway
- Provincial Highway
- Provincial Road
- City / Town
- First Nation Lands
- Rural Municipality
- Ecological Reserve
- Crown Land
- Wildlife Management Area
- Provincial Park
- Watercourse
- Waterbody

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

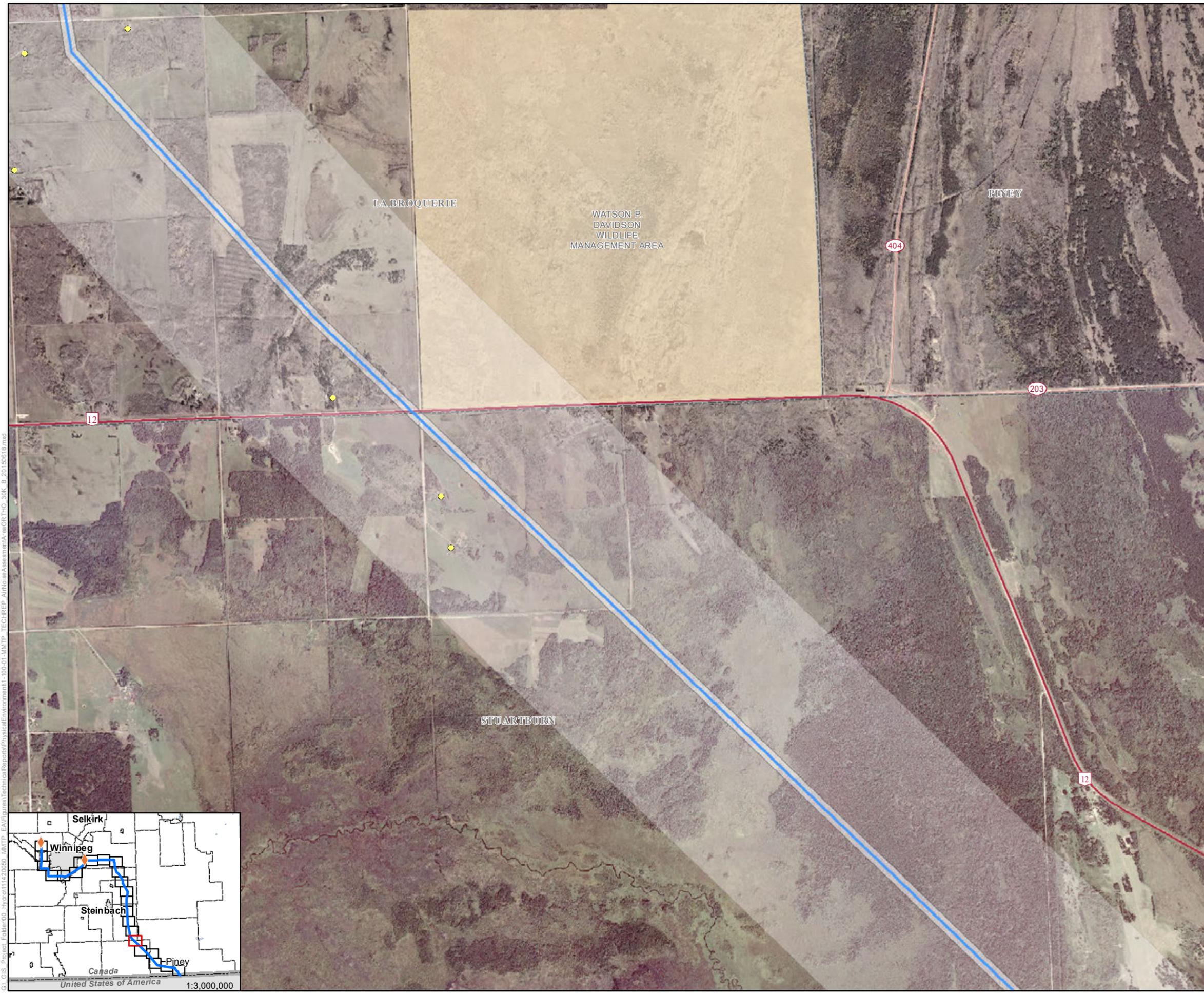
Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



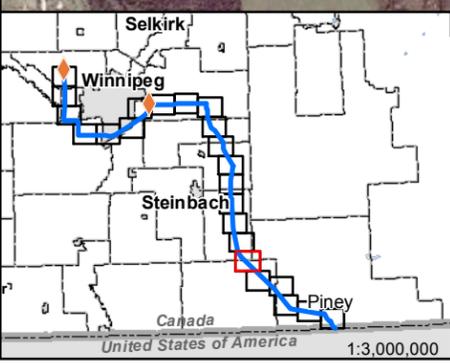
0 0.5 1 Kilometres
0 0.25 0.5 Miles

1:30,000

Receptor Locations



G:\GIS\Project_Folder\05_Hydro\11420050_MHTP_EA\Figures\TechnicalReports\PhysicalEnvironment\1_00-01-MMTP_TECHREP_AirNoiseAssessment\AreaORTHO_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- Community
- Trans Canada Highway
- Provincial Highway
- Provincial Road
- City / Town
- First Nation Lands
- Rural Municipality
- Ecological Reserve
- Crown Land
- Wildlife Management Area
- Provincial Park
- Watercourse
- Waterbody

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



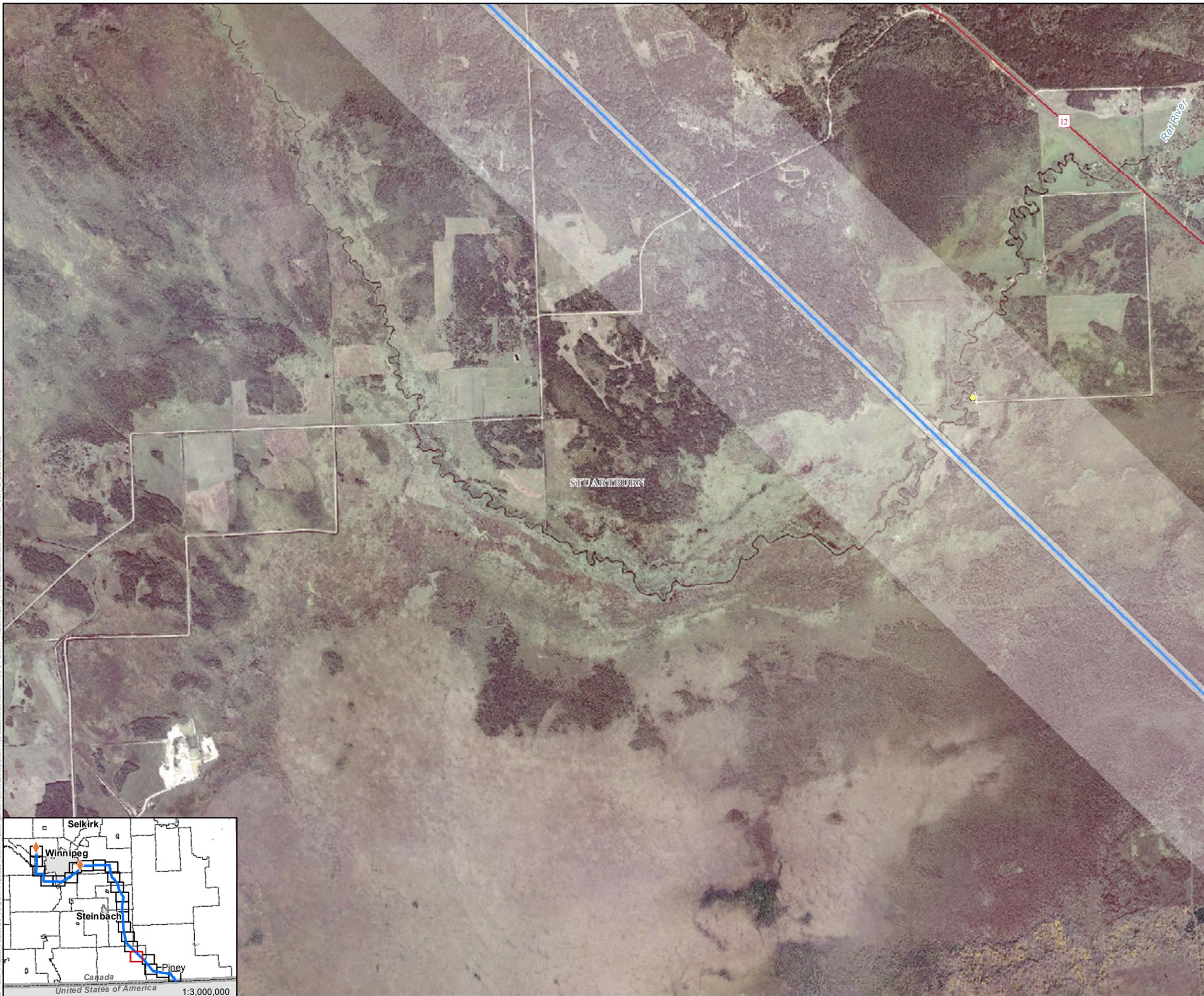
0 0.5 1 Kilometres
0 0.25 0.5 Miles

1:30,000

Receptor Locations

Map 1-100-19

G:\GIS\Project_Folder\005_Hydro\1142\0050_MMP\EA\Figures\TechnicalReports\PhysicalEnvironment\1_00-01-MM\TP_TECHREP_AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

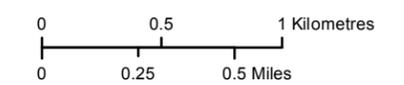
Local Assessment Area

Landbase

- Community
- Trans Canada Highway
- Provincial Highway
- Provincial Road
- City / Town
- First Nation Lands
- Rural Municipality
- Ecological Reserve
- Crown Land
- Wildlife Management Area
- Provincial Park
- Watercourse
- Waterbody

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



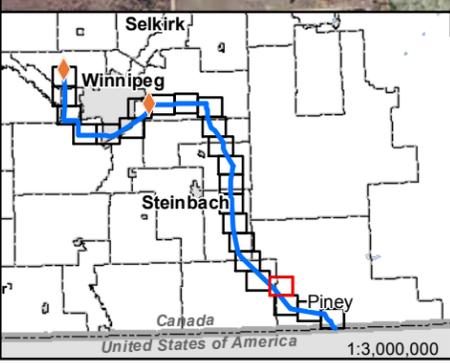
1:30,000

Receptor Locations

Map 1-100-20



G:\GIS\Project_Folder\05-Hydro\11420000-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP-AirNoiseAssessment\AreaOrtho_30K_B_20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- Community
- Trans Canada Highway
- Provincial Highway
- Provincial Road
- City / Town
- First Nation Lands
- Rural Municipality
- Ecological Reserve
- Crown Land
- Wildlife Management Area
- Provincial Park
- Watercourse
- Waterbody

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



0 0.5 1 Kilometres
0 0.25 0.5 Miles

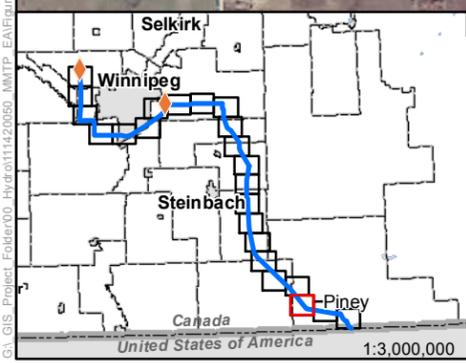
1:30,000

Receptor Locations

Map 1-100-21



G:\GIS\Project_Folder\05-Hydro\11420050-MMP\EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MM-TP-TECHREP-AirNoiseAssessment\Area\ORTH0_30K_B_20150616.mxd



1:3,000,000

Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- Community
- Trans Canada Highway
- Provincial Highway
- Provincial Road
- City / Town
- First Nation Lands
- Rural Municipality
- Ecological Reserve
- Crown Land
- Wildlife Management Area
- Provincial Park
- Watercourse
- Waterbody

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015



0 0.5 1 Kilometres
0 0.25 0.5 Miles

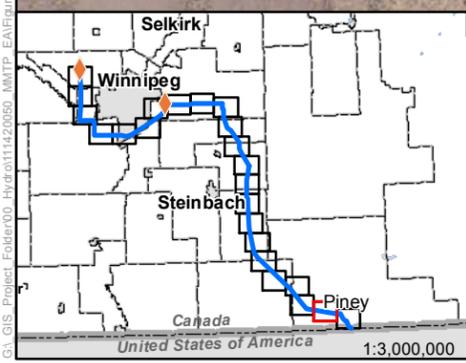
1:30,000

Receptor Locations

Map 1-100-22



G:\GIS\Project_Folder\05-Hydro\11420050-MMTP-EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MMTP-TECHREP-AirNoiseAssessment\AreaOrtho-30K-B-20150616.mxd



Manitoba-Minnesota Transmission Project

Project Infrastructure

Final Preferred Route (FPR)

Receptor¹

Occupied House

Assessment Area

Project Development Area (PDA)

Local Assessment Area

Landbase

- | | | | |
|--|----------------------|--|--------------------------|
| | Community | | Ecological Reserve |
| | Trans Canada Highway | | Crown Land |
| | Provincial Highway | | Wildlife Management Area |
| | Provincial Road | | Provincial Park |
| | City / Town | | Watercourse |
| | First Nation Lands | | Waterbody |
| | Rural Municipality | | |

Source:
1. Occupied House, 2013-15, Manitoba Hydro and Stantec (Data acquired through air photo interpretation and windshield survey)

Coordinate System: UTM Zone 14N NAD83
Data Source: MBHydro, ProvMB, NRCAN
Date Created: August 11, 2015

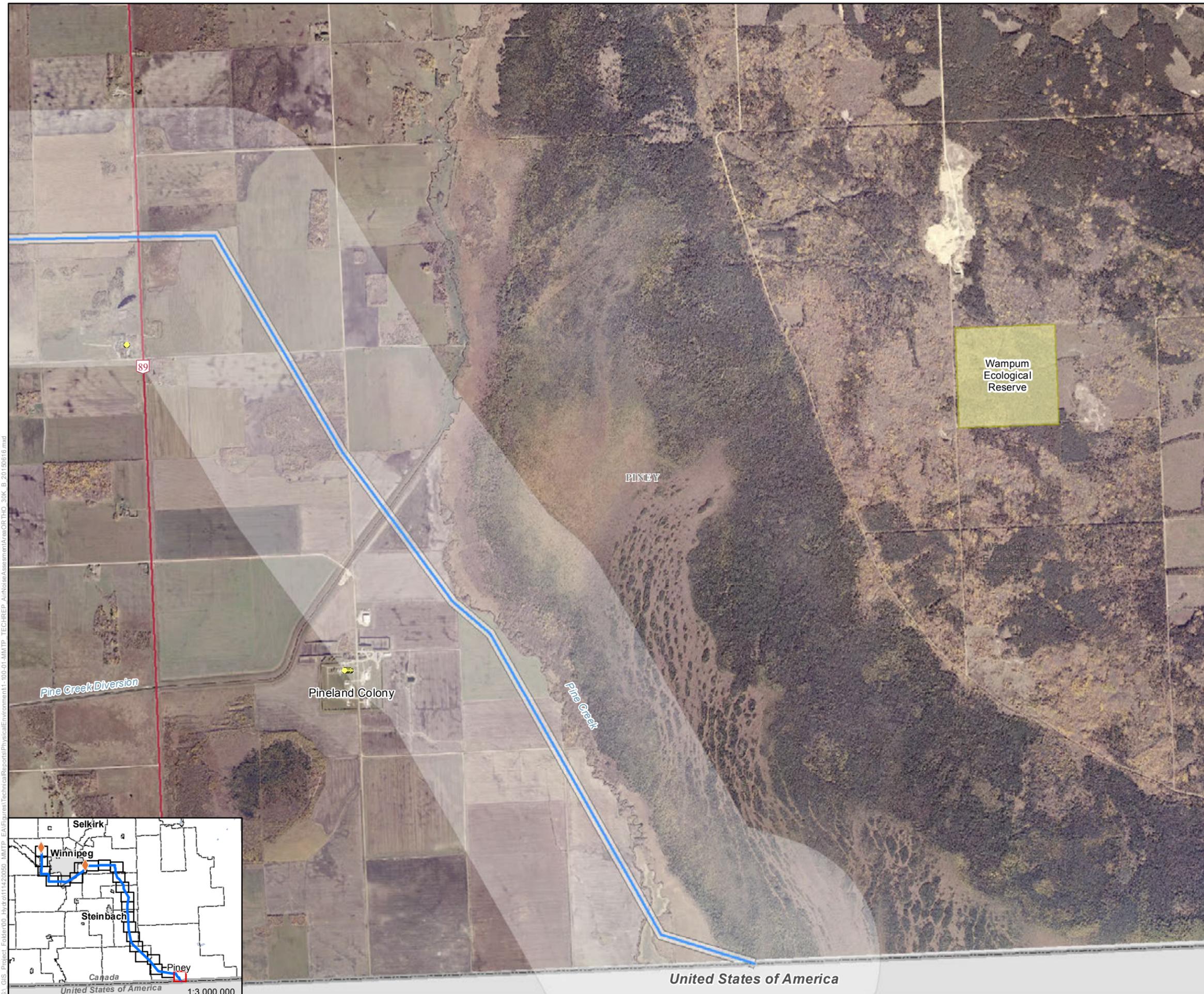


0 0.5 1 Kilometres
0 0.25 0.5 Miles

1:30,000

Receptor Locations

Map 1-100-23



G:\GIS\Project_Folder\05-Hydro\11420050-MMP\EA\Figures\TechnicalReports\PhysicalEnvironment\1-00-01-MM\TP-TECHREP-AirNoiseAssessment\Area\ORTH0-30K-B-20150616.mxd

