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Table 1, Attachment A

Revised and Updated Air Quality Report

Canadian Premium Sand Inc.

Wanipigow Sand Extraction Project Air Dispersion Modelling Report

Prepared by:

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Prepared for:

Canadian Premium Sand Inc.

Date: March 2019

Project #: 60588114

Distribution List

# Hard Copies	PDF Required	Association / Company Name
	X	Canadian Premium Sand Inc.

Revision History

Rev #	Date	Revised By:	Revision Description
0	08Nov2018	JL/PS/PT	Initial Draft
1	13Dec2018	JL/PS/PT	Draft Report Issued
2	14Dec2018	PT	Draft Report Issued
3	06Mar2019	JL/PS/MG	Draft Report Issued with Revisions
4	11Mar2019	JL/PS/MG	Final Report Issued

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AECOM: 2015-04-13

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1. Introduction

1.1 Overview

AECOM was retained by the Canadian Premium Sand Inc. (“the Proponent”) to conduct an air dispersion model for the Wanipigow Sand Extraction Project (“the Project”).

The Proponent is proposing to develop a sand deposit as a source of high-quality silica sand for a variety markets such as oil and gas operations and the glass production industry. The Project is located on the east shore of Lake Winnipeg, Manitoba, approximately 160 km northeast of Winnipeg, within the boundaries of the Incorporated Community of Seymourville. Seymourville, governed by a mayor and council under The Northern Affairs Act, is part of a group of four communities also including Manigotagan, Hollow Water First Nation, and Aghaming (**Figure 1**)

The Project will have an estimated annual production rate of 1 million tonnes of silica sand at full operation that will be processed on-site (washed and dried) and will be trucked to Winnipeg for loading onto rail cars for shipping to markets in Canada and the United States. The anticipated life of the Project will be 54 years. Key components of the Project will include:

- An active open-pit sand quarry each year of operation, including progressive annual site reclamation of closed quarries;
- Silica sand production process, including a fully enclosed sand wash and dry facility;
- Ancillary facilities, including portable office and storage buildings;
- A main access road approximate 6 km-long; and
- An access road approximately 1.5 km-long for use during Project construction and for emergencies during Project operation.

The Project operations were assessed in accordance with the *Draft Guidelines for Air Quality Dispersion Modelling Manitoba* (MCWS, November 2006) using AERMOD to predict maximum ground-level concentrations, as well as maximum predicted concentrations at selected nearby sensitive receptors, of the following:

- Nitrogen Dioxide (NO_2);
- Carbon Monoxide (CO); and
- Particulate Matter (PM_{10} and $PM_{2.5}$) and,
- Sulfur Dioxide (SO_2).

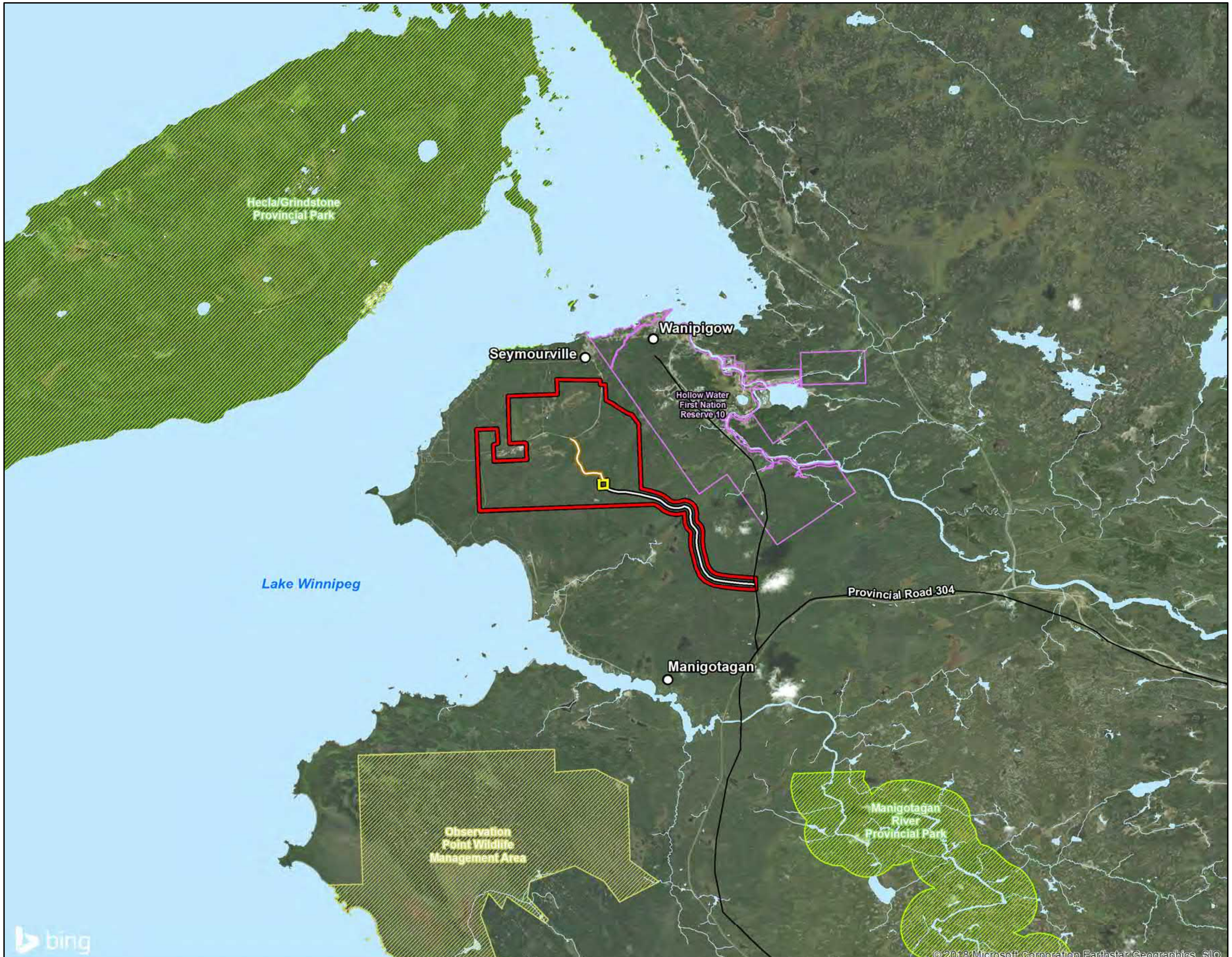
Model results were compared with the *Manitoba Ambient Air Quality Criteria* (MAAQC, 2005).

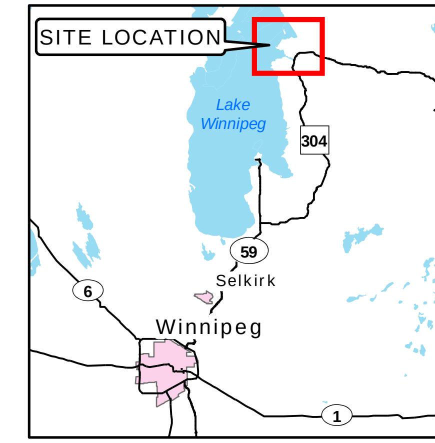
1.2 Revisions

The following revisions were made to the original December 2018 draft air dispersion modelling report for the Project (Appendix E of the Environmental Act Proposal [EAP] for this Project):

- The annual production of silica sand product was increased from 200,000 tonnes/year to 1,000,000 tonnes/year to be consistent with the Project description information in the EAP. This revised annual silica sand production amount increased the emission rates for NO_2, PM_{10} and $PM_{2.5}$ associated with the sand wash and dry facility dryer and screen components. Emission rates and calculations for the sources can be found in **Section 4.9** and **Attachment B**.

- Access roads were originally modelled using six (6) point sources, at even points on the 6 km-long access road. In this version of the report the access road is modelled using a line volume source, consisting of 176 evenly spaced volume sources. This changed the modelling results as the increased number of sources allows for more accurate dispersion modelling estimates of the pollutants. Results and conclusions are discussed in **Section 5**.





Key Map

Project Components

Plant Location

Project Site Area Boundary

Access Road for Project Construction and Emergency Use

Main Access Road

First Nation

Hollow Water First Nation Reserve 10

Parks and Protected Areas

Provincial Park

Wildlife Management Area

N
W E
S

1:100,000
NAD 1983 UTM Zone 14N

1 0.5 0 1 2 3 km

Basemap:
Additional Sources:
Ortho-Imagery:

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Figure: 1

PROJECT LOCATION

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2018-12-13

Last saved by: KNOTTJ (2018-12-13) Last Plotted: Thu Dec 13, 2018 Project Management Initials: Designer: Checked: Approved: ANSI B 279.4mm x 431.8mm
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2. Facility Location

The Project is located on the east shore of Lake Winnipeg, in the Canadian Province of Manitoba, approximately 160 kilometres (km) northeast of the capital city of Winnipeg (**Figure 1**). The deposit is found within the boundaries of the Incorporated Community of Seymourville, governed by a mayor and council under *The Northern Affairs Act*.

Seymourville is one of a group of four communities including Manigotagan, Hollow Water First Nation and Aghaming that are in close proximity (approximately 10 km) to the Project. The community lies on the southeast boundary of Hollow Water's reserve and is about 70 km by road north of Pine Falls (the nearest service center). The community of Manigotagan is southeast of the Project, situated near the mouth of the Manigotagan River on the east shore of Lake Winnipeg at Provincial Road #304 ("PR #304"). Cottage developments can also be found to the northwest, west and southwest of the deposit along the shores of Lake Winnipeg.

Access to the Project (and its markets) is provided by the paved PR #304 and a paved 6 km all-weather road to be sited and built as part of the Project. The Project Site area includes the project footprint which is the area that will encompass the land on which project components are located and immediate surrounding area. The Project Site occurs within quarry lease areas issued to the proponent.

3. Legislation and Policy

The air dispersion model was conducted according to the *Draft Guidelines for Air Quality Dispersion Modelling Manitoba* (MSWS, November 2006), and model results were compared with *Manitoba Ambient Air Quality Criteria* (MAAQC). The assessment was prepared for the Environmental Act Proposal.

A summary of the applicable Regulations and Guidelines is shown in **Table 1**, below.

Table 1. Legislation and Policy used for the Air Dispersion Modelling Assessment

Authorization / Guideline	Agency	Rationale
Draft Guidelines for Air Dispersion Modelling in Manitoba	Manitoba Conservation and Water Stewardship	This guideline is a resource that provides consistency in dispersion modelling across all regulatory applications.
Manitoba Ambient Air Quality Criteria (MAAQC)	Manitoba Conservation and Water Stewardship	Manitoba provides a listing of Ambient Air Quality Criteria and Guidelines for various air pollutants.
Alberta Air Quality Modelling Guideline	Alberta Environment and Sustainable Resource Development	This for dispersion modelling provides guidance on appropriate surface characteristics and receptor grids to supplement the Manitoba guidelines.
US EPA AERMOD Implementation Guide	Unites States Environmental Protection Agency	This guideline is a resource that helps with the use of the related modelling modules and programs (AERMOD, AERMAP, AERMET, AERSURFACE, AERSCREEN) and the required additional information

3.1 Air Quality Objectives

The evaluation of ambient air quality typically relies on comparison of modelled concentrations to regulatory standards or objectives. The regulatory standards or objectives are designed by the local, provincial, or federal authority to be conservative and protective of air quality. The MAAQC were used in this assessment.

The applicable air quality Objectives and Guidelines are summarized in **Table 2**, below.

Table 2. Ambient Air Quality Objectives

Compound	Averaging Period	MAAQC[1] (µg/m³)
Nitrogen Dioxide (NO_2)	1-hour	400
	24-hour	200
	Annual	100
Carbon Monoxide (CO)	1-hour	35,000
	8-hour	15,000
Sulfur Dioxide (SO_2)	1-hour	900
	24-hour	300
	Annual	60
Particulate Matter with a Diameter of 2.5 micrometers and Less ($PM_{2.5}$)	24-hour	30
Particulate Matter with a Diameter of 10 micrometers and Less (PM_{10})	24-hour	50

Notes:

[1] Manitoba Ambient Air Quality Criteria (MCWS, July 2005)

4. Methodology

The emissions from the Project were assessed based on information provided by the Proponent and supplemented by USEPA AP-42, and engineering estimates. These emissions were then used in the AERMOD dispersion model to assess maximum modelled ground-level concentrations. The Project was assessed in accordance with the *Draft Guidelines for Air Quality Dispersion Modelling in Manitoba* (MCWS, 2006) and the model results were compared to the MAAQC as shown in **Table 2**.

Details on the preparation of the source modeled emissions, stack parameters and the dispersion modelling methodology are discussed further below.

4.1 Dispersion Model

Air dispersion models are important tools that can be used to assess the possible effects of an operation on the air quality at a particular location. These dispersion models mathematically predict the behaviour of emitted plumes by accounting for emission rates, physical characteristics of the release, geometry and location of the sources and buildings as related to receptor locations, terrain effects, meteorology, and atmospheric dispersion.

The air dispersion modelling assessment for the Project was completed using the AERMOD dispersion model (Model Version 18081). AERMOD is specified in the MCWS as a refined model that is suitable for predicting the near-field (within 25 km) dispersion of multiple emission sources. AERMOD determines predicted air quality through air dispersion of emissions using boundary layer turbulence structure and scaling concepts. AERMOD was selected for this application because of its ability to account for:

1. Directional and seasonal variations in land-use;
2. Building induced plume downwash, which can affect the sources plume rise; and
3. Terrain influences.

In addition, AERMET and AERMAP (Model Version 8.9.0), AERMOD's meteorological and terrain pre-processors, were employed to process meteorological data and terrain data inputs for AERMOD. Modelling was conducted in accordance with the 2006 MCWS. Where further guidance was necessary, the AERMOD Implementation Guide (US EPA, 2009) was utilized.

4.1.1 Building Downwash

The AERMOD model includes PRIME (Plume Rise Model Enhancements) algorithms to model the effects of buildings downwash from nearby or adjacent point sources. The building information presented **Table 3** were used as an input for AERMOD PRIME. The building and stack locations are presented in **Figure 2**.

Table 3. Building Information

Building Number	Location (SW Corner or Centre Point)		Height (m)
	(mE)	(mN)	
1	687179.88	5670533.7	6
2	687206.15	5670594.61	6
3	687172.77	5670601.33	6
4	687178.26	5670496.95	6
5	687181.35	5670456.59	6
6	687164.44	5670564.61	6
7	687145.86	5670572.34	6
8	687200.2	5670642.38	6
9	687213.82	5670642.81	6
10	687213.39	5670655.32	6
11	687200.2	5670654.44	6

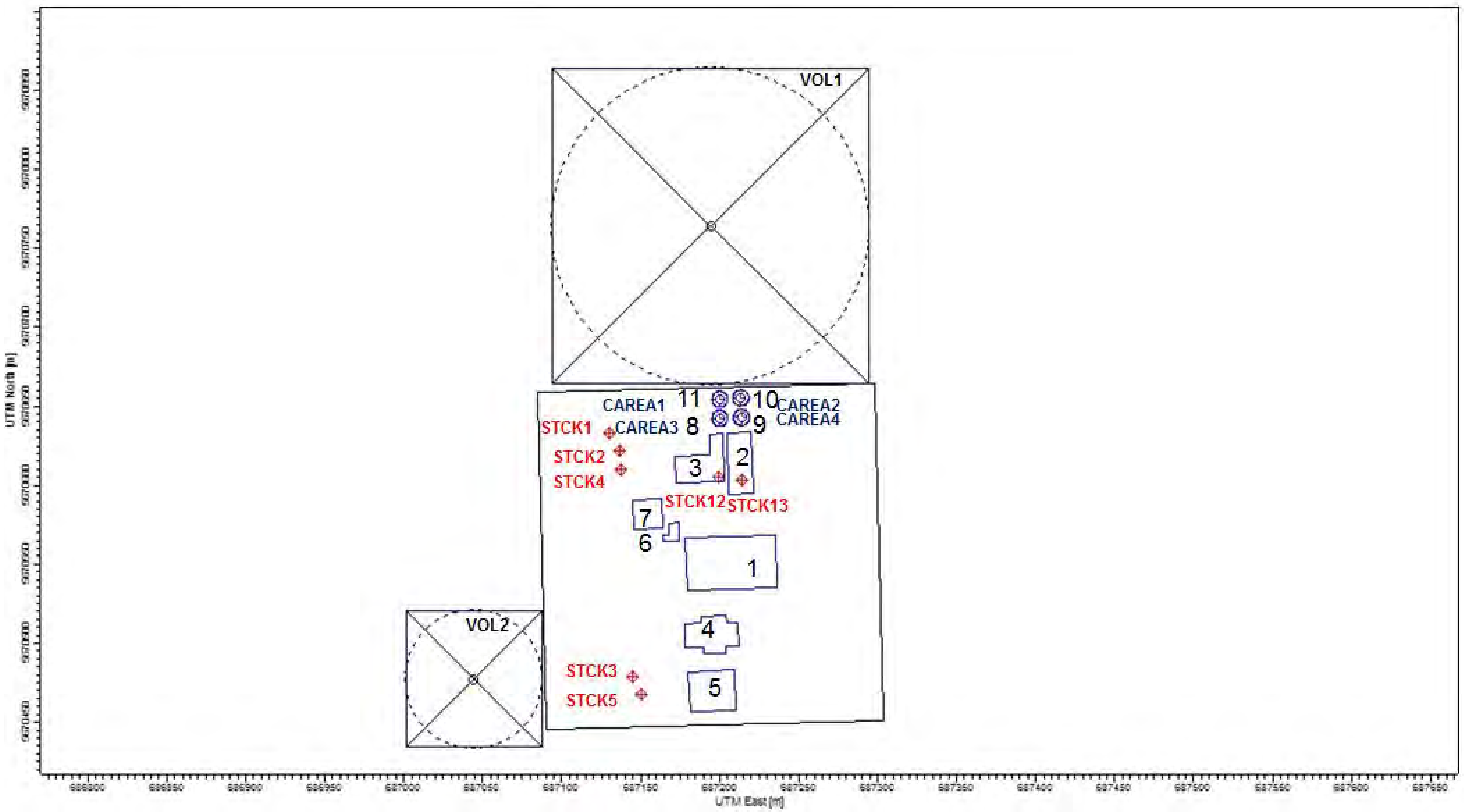


Figure 2. Building Locations

Note: ⌖ indicates stack location.

4.2 Boundaries

The following boundaries were used to assess modelled concentrations due to air emissions from the Project and follow guidance in the MCWS. Boundaries for the air quality modelling assessment are categorized in two ways: spatial and temporal. The modelled ground-level concentrations from the Project and comparison with MAAQCs were investigated within these defined boundaries.

4.2.1 Spatial Boundary

The study area for this assessment was the zone of influence of the Project's air emissions, including potential sensitive receptors nearest to the Project. A local study area of 20 km by 20 km surrounding the Project was used for this analysis; the appropriateness of this boundary selection was confirmed by the model outputs which showed that maximum concentrations of were found within a kilometer of the emission sources. Model receptor points are described in **Section 4.5**. All receptors were evaluated at ground-level (i.e. 0 m) elevation.

4.2.2 Temporal Boundary

Temporal boundaries for this assessment were developed in consideration of continuous operations and emissions from the stacks.

The temporal boundary also includes several time-averaging periods in accordance with the time periods outlined for the identified air quality guidelines in **Table 2**.

4.3 Meteorology

Air quality is dependent on the rate of pollutant emissions into the atmosphere and the ability of the atmosphere to disperse the pollutant emissions. The dispersion of air pollutants is affected by local meteorological patterns. The wind direction controls the path that air pollutants follow from the point of emission to the receptors. In addition, wind speeds affect the time taken for pollutants to travel from source to receptor and the distance over which air pollutants travel. As a result, wind speeds also impact the dispersion of air pollutants; therefore, it is important to consider local meteorological patterns when assessing potential air quality effects from an emission source.

AERMET (Model Version 8.9.0) was employed to process meteorological data and terrain data inputs for AERMOD. The hourly surface and upper air meteorological inputs to AERMOD were extracted from Winnipeg James Armstrong International Airport (MB, CA) and International Falls (MN, US), respectively.

AERMET produces surface scalar parameters and vertical profiles of meteorological data that were used as an input for AERMOD. In order to quantify the boundary layer parameters needed by AERMOD, AERMET also requires specification of site-specific land use characteristics including surface roughness (z_o), albedo (r) and Bowen ratio (B_o). These site characteristics are used by AERMET, along with the meteorological data to help characterize the atmospheric boundary layer and dispersion. The boundary layer is quantified by AERMET in calculating parameters such as:

- Sensible heat flux;
- Surface friction velocity;
- Convective velocity scale;
- Vertical potential temperature gradient above the convective mixing height;
- Height of convectively-generated boundary layer;

- Height of mechanically-generated boundary layer; and
- Monin-Obukhov length (m).

These boundary layer parameters are calculated on an hourly basis and are contained in AERMET's surface file. The surface file is read into AERMOD and then these values are used to quantify the atmospheric dispersion.

4.4 Surface Characteristics

The land use surface characteristics surrounding the Project was quantified for the air dispersion model and was based on specific land use surface characteristics provided to AERMET.

The AERMOD Implementation Guide (AIG) (EPA, 2009) (AIG) recommends that the surface characteristics be determined based on digitized land cover data. US EPA has developed a tool called AERMET (EPA 2013) that can be used to determine the site characteristics based on digitized land cover data in accordance with the recommendations from the AIG discussed above.

In the AERMET User's Guide and the Draft Guidelines for Air Quality Dispersion Modelling in Manitoba, the various land use categories are linked to a set of seasonal surface characteristics. As such, AERMET requires specification of the seasonal category for each month of the year. The following four seasonal categories are supported by AERSURFACE, with the applicable months of the year specified for this assessment:

1. Spring when vegetation is emerging or partially green (April-May);
2. Midsummer with lush vegetation (June-September);
3. Autumn when periods of freezing are common, grass is brown and no snow is present (October-November); and
4. Winter with continuous snow on ground and subfreezing temperatures (December-March);

4.4.1 Land-Use and Terrain Characteristics

The calculated albedo, Bowen ratio, and surface roughness values for this specific assessment were based on ArcGIS land use data.

The land use within three (3) km of the Project was analyzed using ArcGIS to determine the surface roughness for the modelling domain. ArcGIS did not have sufficient information for the particular modelling domain. The land use was assumed based on Google Earth imaging. The land use within 3 km of the Project are 50% deciduous forest, 36% coniferous forest, 11% cultivated land, and 3% water. The surface roughness, albedo and Bowen ratios for land use and seasons are default values outlined in the MCWS (2006) and can be seen in **Table 4, Table 5**, **Table** 6 and **Table 7** below.

Table 4. Land Use Factors for Coniferous Forest Category

Season	Surface Roughness[1] (m)	Albedo[1]	Bowen[1]
Spring	1.30	0.12	0.70
Summer	1.30	0.22	0.30
Autumn	1.30	0.12	0.80
Winter	1.30	0.35	1.50

Note: [1] Values from AQMG (AEP, 2013)

Table 5. Land Use Factors for Deciduous Forest

Season	Surface Roughness[1] (m)	Albedo[1]	Bowen[1]
Spring	1.00	0.12	0.70
Summer	1.30	0.12	0.30
Autumn	0.80	0.12	1.00
Winter	0.50	0.50	1.50

Note: [1] Values from AQMG (AEP, 2013)

Table 6. Land Use Factors for Cultivated Land

Season	Surface Roughness[1] (m)	Albedo[1]	Bowen[1]
Spring	0.03	0.14	0.3
Summer	0.20	0.20	0.50
Autumn	0.05	0.18	1.7-
Winter	0.01	0.60	1.50

Note: [1] Values from AQMG (AEP, 2013)

Table 7. Land Use Factors for Water

Season	Surface Roughness[1] (m)	Albedo[1]	Bowen[1]
Spring	0.0001	0.12	0.10
Summer	0.0001	0.10	0.10
Autumn	0.0001	0.14	0.10
Winter	0.0001	0.20	1.50

Note: [1] Values from AQMG (AEP, 2013)

4.5 Receptors

Receptor grids are required to define the locations where the model will predict ground-level concentrations. The receptor grid was designed to ensure that the model captures the maximum modelled concentrations associated with the Project’s emissions. A Cartesian receptor grid was developed to capture the maximum modelled ground-level concentrations associated with the stack emissions. The modelled receptor grid with the following spacing and distances was used, as per the AQMG (AEP, 2013):

- 20-m receptor spacing in the general area of maximum impact and the property boundary;
- 50-m receptor spacing within 0.5 km from the source;
- 250-m receptor spacing within 2 km from the sources of interest;
- 500-m spacing within 5 km from the sources of interest; and
- 1000-m spacing beyond 5 km.

In addition, the AQMG (AEP, 2013) recommends the inclusion of sensitive receptors near the facility. Receptor points are added to the model in addition to the receptor grid described above so that the model calculates concentrations specific to those locations. As outlined in the AQMG (AEP, 2013) sensitive receptors are identified as the nearest sensitive locations to the facility, such as areas zoned as residential. In consideration of the AQMP (AEP, 2013), the model includes sensitive receptors which are the nearest residence to the proposed facility, and reference points within the following four communities:

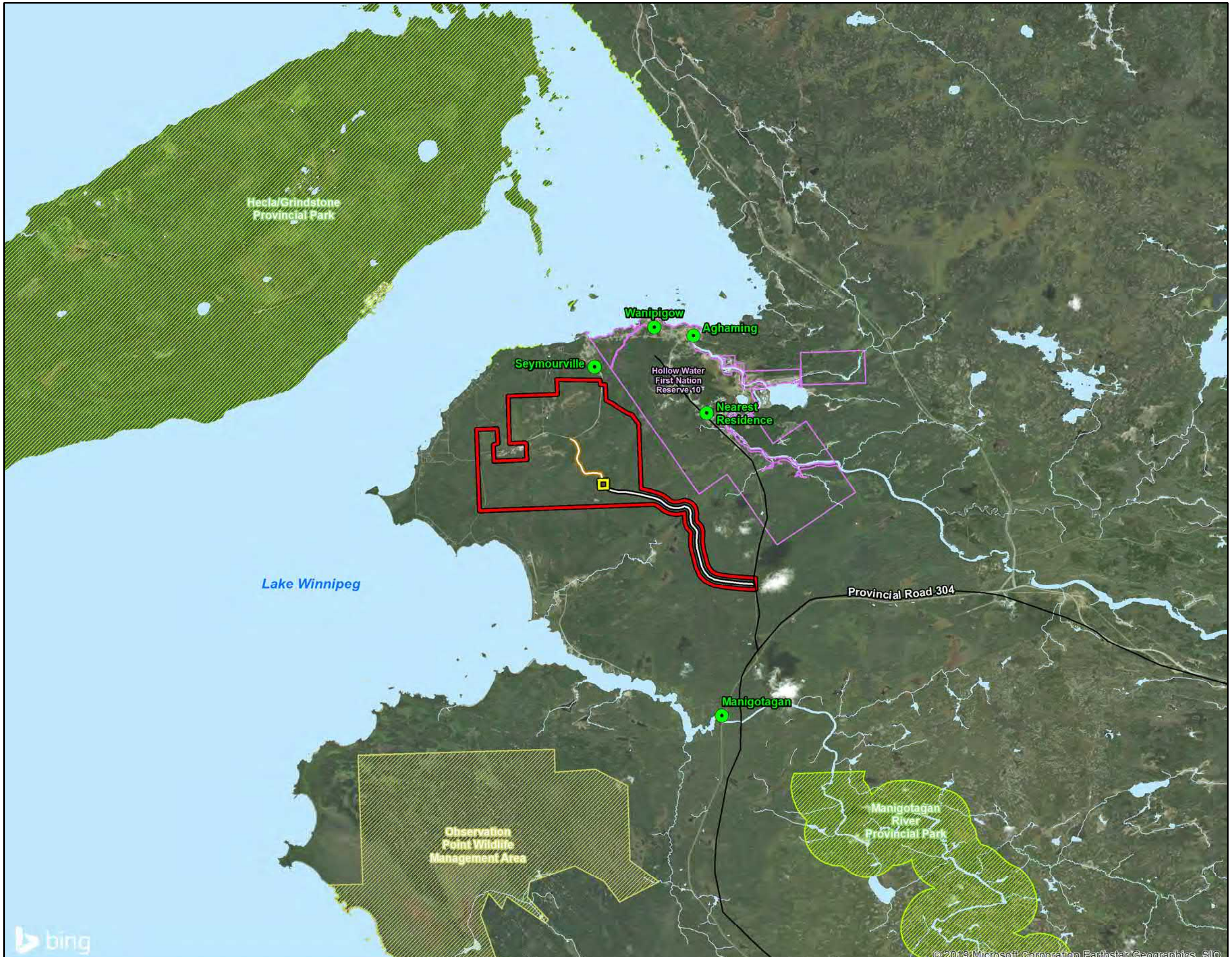
- Aghaming
- Manigotagan
- Seymourville and
- Wanipigow

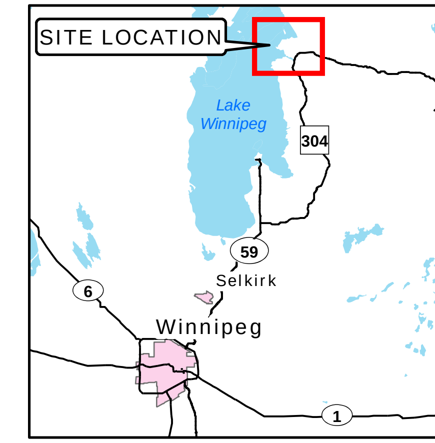
Table 8 and **Figure 3** illustrate the coordinates of the sensitive receptors and their distance from the Project.

Table 8. Sensitive Receptor Details

Sensitive Receptor	Approximate Distance from Facility (m)	UTM co-ordinate (mE)	UTM co-ordinate (mN)
Nearest Residence	3100	689787.00	5672336.00
Aghaming	4300	689457.00	5674288.00
Manigotagan	6500	690170.00	5664746.00
Seymourville	3200	686981.00	5673502.00
Wanipigow	4000	688481.00	5674502.00

For the dispersion modelling assessment, terrain data was based on Canadian Digital Elevation Data (CDED). This data was obtained from Geobase Canada (https://open.canada.ca/data/en/dataset?keywords=GeoBase). The appropriate region was based on the Universal Transverse Mercator (UTM) coordinates. AERMAP is a terrain pre-processor program that prepares the input receptor terrain elevation data file for AERMOD. AERMAP (model version 8.9.0) was run using the 1:50,000 CDED DEM files to assign elevations and critical hill heights to the receptors that were used for the modelling assessment.





Key Map

Sensitive Receptors

- Sensitive Receptors

Project Components

- Plant Location
- Project Site Area Boundary
- Access Road for Project Construction and Emergency Use
- Main Access Road

First Nation

- Hollow Water First Nation Reserve 10

Parks and Protected Areas

- Provincial Park
- Wildlife Management Area

N
W E
S

1:100,000
NAD 1983 UTM Zone 14N

1 0.5 0 1 2 3 km

Basemap:
Additional Sources:
Ortho-Imagery:

AECOM

Figure: 3

SENSITIVE RECEPTORS

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

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Approved:
Checked:
Designer:
Project Management Initials:
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4.7 Nitrogen Dioxide Modelling

Nitrogen Dioxide (NO_2) dispersion modelling was completed using the total conversion method.

4.8 Baseline/Background Concentrations

Baseline/background air quality includes chemical concentrations from natural sources, existing nearby sources, and unidentified, possibly distant sources.

4.8.1 Background Ambient Air Concentrations Considered in the Air Dispersion Model

As recommended by the MCWS (2006) for a refined modelling analysis, the modelled concentration for each compound was added to its corresponding baseline/background concentration to estimate a “total” modelled concentration that can then be compared to the MAAQC. The MAAQC also specifies statistical forms of the baseline or background ambient air quality that should be used for certain averaging periods.

The baseline/background air quality concentration data obtained from the Winnipeg Ellen St. and Thompson Manitoba monitoring stations used for this analysis was assessed on a basis of the 90th percentile as per the MCWS (2006).

Baseline/background concentrations for the parameters of concern used in the air quality assessment are shown in **Table 9**.

Table 9. Baseline/Background Concentrations

Parameter	Data Source Location	Averaging Period	Objective and/or Guideline[1] ($\mu g/m^3$)	Background ($\mu g/m^3$)
Nitrogen Dioxide (NO_2)	Winnipeg Ellen St., Manitoba	1-hour[2]	400	29.3
		24-hour	200	29.3
		Annual	100	10.9
Carbon Monoxide (CO)[3]	Winnipeg Ellen St., Manitoba	1-hour[2]	35,000	277
		8-hour	15,000	275
Sulfur Dioxide (SO_2)	Winnipeg Ellen St., and Thompson, Manitoba[4]	1-hour[2]	900	23.6
		24-hour	300	23.6
		Annual	60	1.81
Particulate Matter with a diameter of 2.5 micrometers and less ($PM_{2.5}$)	Winnipeg Ellen St., Manitoba	24-hour	30	11.7
Particulate Matter with a diameter of 10 micrometers and less (PM_{10})	Winnipeg Ellen St., Manitoba	24-hour	50	25.6

Notes:

[1] Manitoba Ambient Air Quality Criteria (MCWS, July 2005)

[2] 1-hour values represent the 90th percentile value

[3] Data availability for CO for 2017 was 22.5%, therefor 2016 data was used

[4] Data availability for SO_2 for 2017 was limited from Ellen St. Station; Thompson, Manitoba was used for 2017.

4.9 Modelling Scenarios & Emission Rates

The Project was modelled under one scenario. This scenario is considered “maximum normal” operation or emissions. The sources were conservatively modelled, considering continuous operation to simulate a “worst case” modelled hour of operation.

An “upset” scenario was not modelled, as the units are either on (near full load) or off; an upset condition would correspond with a unit being immediately taken offline.

The assumptions made for the modelling scenario are as follows:

- Activities will occur 24/7.
- One (1) track dozer operating no more than 75% of each hour;
- Two (2) dump trucks, each operating no more than 25% of each hour;
- Twenty four (24) haul trucks, each operating 100% of each hour;
- Two (2) loaders operating no more than 75% of each hour;
- The load factor for the equipment engines was assumed to be 20% on average; and
- Two (2) baghouses, one on the dryer and one on the screen are assumed to have 95% removal efficiency.

The source model input parameters are summarized in **Table 10**, **Table 11**, and **Table 12.** Emission rate calculations are provided in **Attachment B.**

Table 10. Modelled Source Parameters – Point Sources

Source ID	Source Description	Source parameters				UTM Coordinate		Emission Rates (g/s)				
		Height (m)	Diameter (m)	Temp (K)	Velocity (m/s)	mE	mN	$PM_{2.5}$	PM_{10}	NO_X	SO_2	CO
STCK1	DOZER1	2	0.122	709	50	687130.53	5670632.60	0.0472	0.0472	0.6611	0.0440	0.1431
STCK2	LOADER1	3	0.122	709	50	687136.18	5670622.18	0.0111	0.0111	0.1556	0.0103	0.0337
STCK3	LOADER2	3	0.122	709	50	687144.42	5670478.52	0.0111	0.0111	0.1556	0.0103	0.0337
STCK4	DUMP TRUCK 1	2	0.122	709	50	687137.04	5670609.60	0.0267	0.0267	0.3741	0.0249	0.0810
STCK5	DUMP TRUCK 2	2	0.122	709	50	687150.07	5670468.11	0.0267	0.0267	0.3741	0.0249	0.0810
STCK12	DRYER	6	0.5	AMBIENT	12	687198.91	5670605.29	0.0301	0.0301	0.507		
STCK13	SCREEN	6	0.5	AMBIENT	12	687213.95	5670603.85	0.00666	0.00666			

Table 11. Modelled Source Parameters – Volume Sources

Source ID	Source Description	Source Parameters		Emission Rates (g/s)				
		Height (m)	Length of Side (m)	$PM_{2.5}$	PM_{10}	NO_X	SO_2	CO
VOL1	OVERBURDEN	3	200	0.0344	0.227	0	0	0
VOL2	OVERBURDEN EMBANKMENT	5	20.05	0.0793	0.524	0	0	0
SLINE1	HAUL TRUCKS (ACCESS ROAD)	6.97	14.0	0.0142	0.401	0.00413	0.0000436	0.00102

Table 12. Modelled Source Parameters – Area Sources

Source ID	Source Description	Source Parameters		Emission Rates (g/s)				
		Height (m)	Diameter (m)	$PM_{2.5}$	PM_{10}	NO_X	SO_2	CO
CAREA1	SILO1	6	5	0.000000374	0.000000374	0	0	0
CAREA2	SILO2	6	5	0.000000374	0.000000374	0	0	0
CAREA3	SILO3	6	5	0.000000374	0.000000374	0	0	0
CAREA4	SILO4	6	5	0.000000374	0.000000374	0	0	0

4.10 Greenhouse Gas (GHG) Emissions

To estimate the annual greenhouse gas emissions from onsite activities, the activities of equipment associated with the Project operation was considered. Emission factors for Industrial Engines were taken from AP-42 (Section 3.3). The total emissions per year from each piece of equipment were estimated based on: engine size (hp), load factor, and the emission factors for each pollutant. Once those total yearly emissions were calculated, the Global Warming Potential (GWP) was applied to each pollutant. The GHGs included in the emissions calculation are carbon dioxide (CO_2), methane (CH_4) and Nitrous Oxide (N_2O).

4.10.1 Construction Phase

To estimate the annual greenhouse gas emissions from activities, the activities of equipment associated with the Project construction were considered. Equipment includes dozers, feller bunchers, graders, 4x4 pick-up trucks, cranes and man-lifts. The assumptions made for the GHG calculations are as follows:

- Activities will occur 12/7, unless stated otherwise.
- Two (2) track dozers operating no more than 75% of each hour, for 8 months;
- Four (4) feller bunchers, each operating no more than 75% of each hour, for 2 months;
- Two (2) graders, each operating no more than 75% of each hour, for 8 months;
- Eight (8) 4x4 pick-up trucks, each operating no more than 75% of each hour, half of the time in transit and half idling, for 8 months;
- Four (4) cranes, each operating no more than 75% of each hour, 6 hours a day for 8 months;
- Two (2) man-lifts, each operating no more than 75% of each hour, 6 hours a day for 8 months;
- The load factor for the equipment engines was assumed to be 20% on average.

4.10.2 Operation Phase

To estimate the annual greenhouse gas emissions from onsite activities, the activities of equipment associated with the Project operation was considered. Equipment includes a dozer, loaders, dump trucks, haul trucks and the rotary dryer. The assumptions made for the GHG calculations are as follows:

- Activities will occur 24/7.
- Two (2) track dozer operating no more than 75% of each hour;
- Two (2) dump trucks each, each operating no more than 25% of each hour;
- Twenty four (24) haul trucks, each operating 100% of each hour;
- Two (2) loaders operating no more than 75% of each hour; and
- One (1) grader operating no more than 75% of each hour;
- Eight (8) 4x4 pick-up trucks, each operating no more than 25% of each hour, half of the time in transit and half idling;
- The load factor for the equipment engines was assumed to be 20% on average.

4.10.3 Decommissioning/Closure Phase

To estimate the annual greenhouse gas emissions from activities, the activities of equipment associated with the Project decommissioning and closure plans were considered. Equipment includes dozers, dump trucks, cranes, graders and 4x4 pick-up trucks. The assumptions made for the GHG calculations are as follows:

- Activities will occur 12/7 for two months, unless stated otherwise.
- Two (2) track dozers operating no more than 75% of each hour;
- Two (2) dump trucks operating no more than 75% of each hour;
- Four (4) cranes, each operating no more than 75% of each hour, for 6 hours a day;
- Two (2) graders, each operating no more than 75% of each hour;
- Eight (8) 4x4 pick-up trucks, each operating no more than 75% of each hour, half of the time in transit and half idling;

4.10.4 Summary of GHG Emissions and Mitigation

Estimated GHG emissions are summarized in **Table 13.** For context, the reported emissions in 2017 were 20.9 Mt CO_2e from Manitoba, and 704 Mt CO_2e from Canada. By the year 2030, Canada has a target of 513 Mt CO_2e per year, a 131 Mt reduction from the reported 2017 values. In the year 2030 the total GHG emissions from the Project is 0.0026% of Canada's targeted GHG emissions. Manitoba does not have published emissions reduction targets.

Table 13. Greenhouse Gas Emissions (CO_2e)

Project Phases and Activity	GHG Components			CO_2e (tonnes/year)[1]	Proposed Schedule
	CO_2 (tonnes/year)	CH_4 (tonnes/year)	N_2O (tonnes/year)		
Construction	917	2	11	929	April 2019-October 2019
Annual Operation	12,948	2	2	13,359	2019
Cumulative Operations (53 years)	686,229	93	132	708,034	2019-2073
Decommissioning and Closure	337	1	3	341	November, 2073
Total CO_2e per Project Life Time				722,663	April 2019-November 2073

*Note: [1] CO_2e=Total Emission (tonnes/year)*GWP; as such, the rows in the table do not balance.*

While the construction and decommissioning CO_2e emissions are relatively low in comparison to the operations phase, mitigation measures were still applied as they apply to all phases of the project. The construction, operation and decommissioning phase will adopt best practices for operation of heavy equipment. These practices will include using the correct size of equipment, performing regular scheduled maintenance of equipment, obeying traffic regulations (e.g., speed), and educating drivers to improve behaviours (e.g., minimizing idling). If feasible, lower-emission vehicles may be used for the activities (e.g. electric or natural-gas powered) to further mitigate these emissions.

5. Results & Conclusion

AERMOD was executed with emission rates for the Project emissions sources as specified in **Table 10**, **Table 11** and **Table 12** MCWS. Background parameters of concern were monitored by the Winnipeg Ellen St., and Thompson, Manitoba monitoring stations.

The maximum modelled ground-level concentrations resulting from emissions from the Project are shown in **Table 14** and **Table 15**.

The model predicted possible exceedances of the MAAQC for particulate matter (PM_{10} and $PM_{2.5}$) that are associated with the project site operations as well as trucking activities. The predicted maximum model output was within the facility boundary, adjacent to operations. Predicted model results for PM_{10} at sensitive receptor 4 and 5 was slightly higher than the MAAQC, as shown in **Table 14** and **Table 15,** below. No drilling, blasting or crushing activities are anticipated to be required for quarry development. Occasional 'lumps' of sand may be encountered which will require breaking in the quarry by use of a horizontal shaft breaker. The sand that is extracted from the active quarry has inherent moisture content (i.e., it is not 'dry'); therefore, dust related to the sand being extracted from the quarry will be minor to negligible with the possible exception of 'worst-case scenario' days of extended long, dry, hot weather during non-winter months coupled with high winds. The model predicted exceedances are occurring on 'worst-case scenario' days and the meteorological conditions at locations within the model vary; therefore, exceedances may be seen at some locations and not others. These exceedances are the highest concentration at a particular location for a five-year period and they are not time related.

The model also predicted possible exceedances of the MAAQC for NO_2 associated with the internal combustion by-products of equipment operation. These possible exceedances are limited to an area adjacent to these emission sources, and model predictions of NO_2 concentrations at sensitive receptors are below the MAAQC. Furthermore, full conversion of NO_x to NO_2 was considered for the modelling and is conservative as a result. Refining of the NO_x to NO_2 would likely result in lower predicted ambient concentrations of NO_2.

Predicted maximum concentrations of SO_2 and CO were below the associated MAAQC across the modelling domain.

Isopleths (concentration plots) are provided in **Attachment A** for the short-term averaging periods. The locations the maximum modelled ground-level concentrations and the locations of sensitive receptors can also be seen in the figures in **Attachment A**. The intention of the isopleth figures is to provide a graphical depiction of the modelled concentrations, the magnitude of the modelled impacts, and how they vary spatially.

Table 14. Maximum Modelled Concentrations

Compounds	Averaging Period	Objective and/or Guideline (µg/m³)	Maximum Applicable Model Output (µg/m³)	Maximum Applicable Model Output + background (µg/m³)	Maximum Applicable Model Output Location		Background Concentration (µg/m³)	Date of Maximum Modelled Concentration (year/month/day, hour)
					UTM (mE)	UTM (mN)		
NO_2	1 hr	400	524	554	687298.49	5670664.28	29.3	2013/07/03, 05:00
	24 hr	200	173	203	687085.19	5670658.92	29.3	2014/04/24, 24:00
	Annual	100	28.4	39.3	687085.19	5670658.92	10.9	—
SO_2	1 hr	900	24.5	48.1	687085.19	5670658.92	23.6	2015/10/02, 22:00
	24 hr	300	9.46	33.1	687085.19	5670658.92	23.6	2014/04/24, 24:00
	Annual	60	1.47	3.28	687085.19	5670658.92	1.81	—
CO	1 hr	35000	79.8	357	687085.19	5670658.92	277	2015/10/02, 22:00
	8 hr	15000	52.7	328	687085.19	5670658.92	275	2014/04/24, 16:00
PM_{10}	24 hr	50	153	178	687090.55	5670445.63	25.6	2014/12/17, 24:00
$PM_{2.5}$	24 hr	30	23.7	35.4	687090.55	5670445.63	11.7	2014/12/17, 24:00

Table 15. Maximum Modelled Concentrations at Sensitive Receptors

Compounds	Averaging Period	Objective and/or Guideline (µg/m³)	Nearest Residence (µg/m³)	Nearest Residence + background (µg/m³)	Aghaming (µg/m³)	Aghaming + background (µg/m³)	Manigotagan (µg/m³)	Manigotagan + background (µg/m³)	Seymourville (µg/m³)	Seymourville + background (µg/m³)	Wanipigow (µg/m³)	Wanipigow + background (µg/m³)	Background Concentration (µg/m³)
NO_2	1 hr	400	121	150	94.8	124	12.6	41.9	146	175	95.8	125	29.3
	24 hr	200	9.11	38.4	11.2	40.5	1.16	30.5	25.4	54.7	8.97	38.3	29.3
	Annual	100	0.446	11.3	0.356	11.3	0.0320	10.9	1.41	12.3	0.416	11.3	10.9
SO_2	1 hr	900	3.84	27.4	3.76	27.4	0.786	24.4	6.97	30.6	3.99	27.6	23.6
	24 hr	300	0.308	23.9	0.342	23.9	0.071	23.7	1.11	24.7	0.425	24.0	23.6
	Annual	60	0.0147	1.82	0.0128	1.82	0.00150	1.81	0.0572	1.9	0.0161	1.83	1.81
CO	1 hr	35000	12.5	290	12.2	289	2.56	280	22.7	300	13.0	290	277
	8 hr	15000	2.85	278	2.61	278	0.627	276	7.05	282	3.10	278	275
PM_{10}	24 hr	50	12.0	38	13.6	39	0.519	26	29.0	54.6	27.4	53.0	25.6
$PM_{2.5}$	24 hr	30	2.17	13.9	2.36	14.1	0.109	11.8	5.18	16.9	4.24	15.9	11.7

6. References

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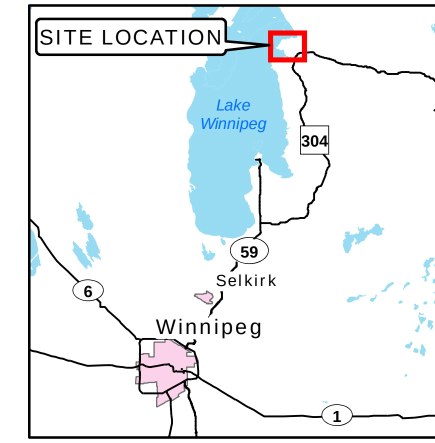
Attachment A

Isopleths



Key Map

Sensitive Receptors

- Nearest Residence
- Aghaming
- Manigotagan
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

1 Hour Average NO_2 Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 400 $\mu g/m^3$

- < 400 100% Transparent
- 400 - 450
- 450 - 500
- 500 - 550
- > 550
- Maximum Concentration ($\mu g/m^3$)

N W E S

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

AECOM

Figure: A-1

MAXIMUM 1 HOUR AVERAGE NO_2 CONCENTRATIONS ($\mu g/m^3$) INCLUDING BACKGROUND CONCENTRATIONS

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

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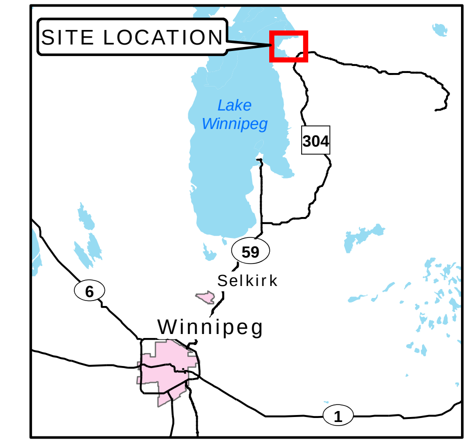


Key Map

Sensitive Receptors

- Nearest Residence
- Aghaming
- Manigotagan
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

24 Hour Average NO_2 Concentrations (µg/m^3)

Ambient Air Quality Limit = 200 µg/m^3

- < 200 100% Transparent
- > 200
- Maximum Concentration (µg/m^3)

N W E S

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

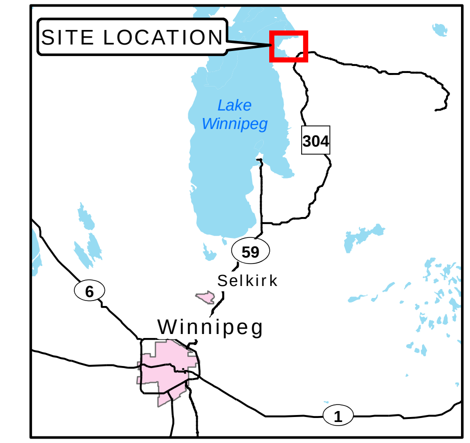
MAXIMUM 24 HOUR AVERAGE NO_2 CONCENTRATIONS (µg/m^3) INCLUDING BACKGROUND CONCENTRATIONS

AECOM

Figure: A-2

Figure: A-3

MAXIMUM ANNUAL AVERAGE NO_2 CONCENTRATIONS ($\mu g/m^3$) INCLUDING BACKGROUND CONCENTRATIONS



Key Map

Sensitive Receptors

- Aghaming
- Manigotagan
- Nearest Residence
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

Annual Average NO_2 Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 100

- < 100 100% Transparent
- Maximum Concentration ($\mu g/m^3$)

N W E S

1:50,000
NAD 1983 UTM Zone 14N

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Basemap:
Additional Sources:
Ortho-Imagery:

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WANIPIGOW SAND EXTRACTION PROJECT
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CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

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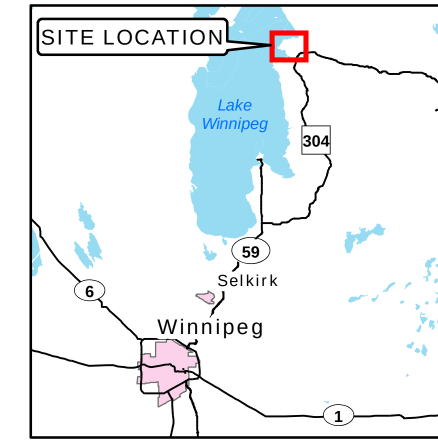

Key Map

Sensitive Receptors

- Nearest Residence
- Aghaming
- Manigotagan
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area

1 Hour Average SO_2 Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 900 µg/m

- < 900 100% Transparent
- Maximum Concentration ($\mu g/m^3$)

N W E S

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

AECOM

Figure: A-4

MAXIMUM 1 HOUR AVERAGE SO_2 CONCENTRATIONS ($\mu g/m^3$) INCLUDING BACKGROUND CONCENTRATIONS

WANIPIGOW SAND EXTRACTION PROJECT AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

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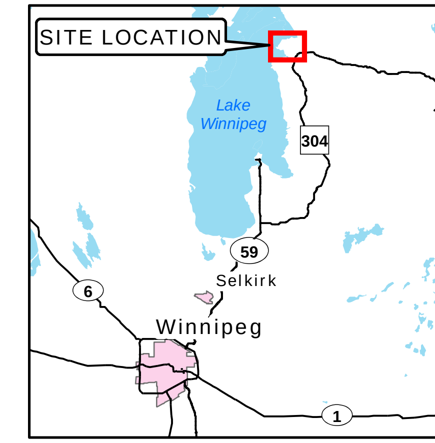

Key Map

Sensitive Receptors

- Nearest Residence
- Aghaming
- Manigotagan
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

24 Hour Average SO_2 Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 300 µg/m

< 300
100% Transparent

Maximum Concentration ($\mu g/m^3$)

N
W E
S

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

AECOM

Figure: A-5

MAXIMUM 24 HOUR AVERAGE SO_2 CONCENTRATIONS ($\mu g/m^3$) INCLUDING BACKGROUND CONCENTRATIONS

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

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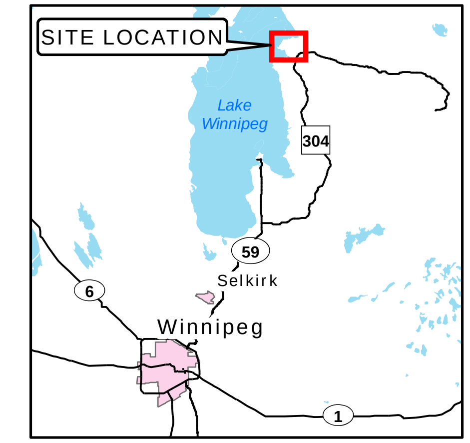

Key Map

Sensitive Receptors

- Nearest Residence
- Aghaming
- Manigotagan
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area

Annual Average SO_2 Concentrations (µg/m³)

Ambient Air Quality Limit = 60 µg/m3

- < 60 100% Transparent
- Maximum Concentration (µg/m³)

N W E S

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

AECOM

Figure: A-6

MAXIMUM ANNUAL AVERAGE SO_2 CONCENTRATIONS (µg/m³) INCLUDING BACKGROUND CONCENTRATIONS

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

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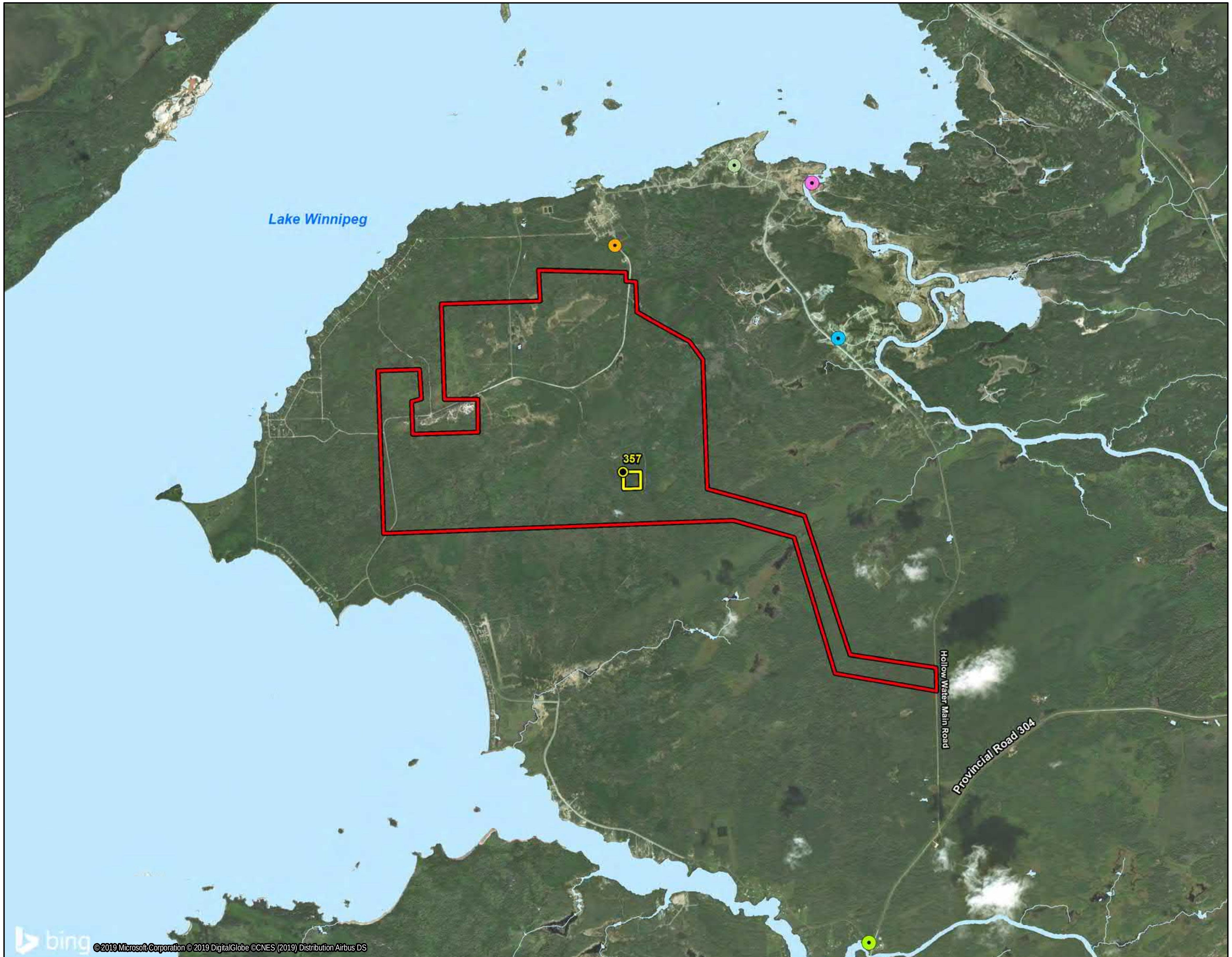

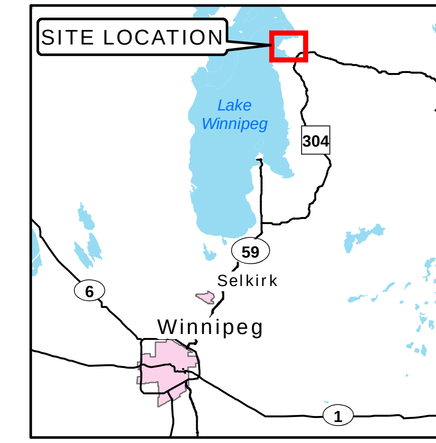

Key Map

Sensitive Receptors

- Nearest Residence
- Aghaming
- Manigotagan
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area

1 Hour Average CO Concentrations (µg/m³)

Ambient Air Quality Limit = 35,000 µg/m

- < 35,000 100% Transparent
- Maximum Concentration (µg/m3)

N W E S

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
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Figure: A-7

MAXIMUM 1 HOUR AVERAGE CO CONCENTRATIONS (µg/m³) INCLUDING BACKGROUND CONCENTRATIONS

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

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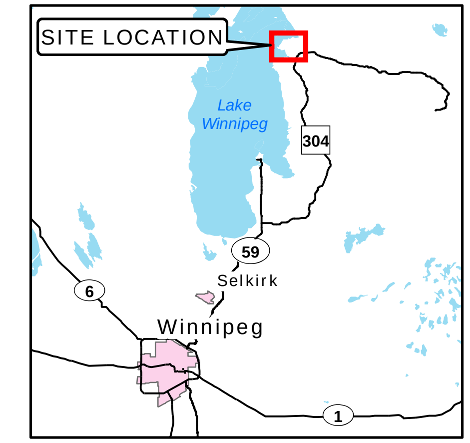

Key Map

Sensitive Receptors
- Nearest Residence
- Aghaming
- Manigotagan
- Seymourville
- Wanipigow

Project Infrastructure
- Facility
- Project Site Area Boundary

8 Hour Average CO Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 15,000 $\mu g/m^3$

- < 15,000 100% Transparent
- Maximum Concentration ($\mu g/m^3$)

N W E S

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

MAXIMUM 8 HOUR AVERAGE CO CONCENTRATIONS ($\mu g/m^3$) INCLUDING BACKGROUND CONCENTRATIONS

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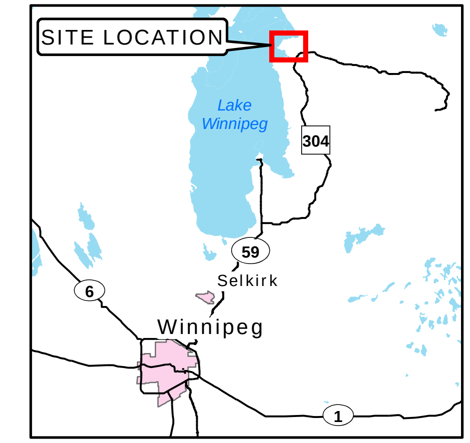
Figure: A-8



Key Map

Sensitive Receptors

- Nearest Residence
- Aghaming
- Manigotagan
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area Boundary

24 Hour Average PM_{10} Concentrations ($\mu g/m^3$)

Ambient Air Quality Limit = 50 µg/m

- < 50 100% Transparent
- 50 - 100
- 100 - 150
- > 150
- Maximum Concentration ($\mu g/m^3$)

N W E S

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

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Figure: A-9

MAXIMUM 24 HOUR AVERAGE PM_{10} CONCENTRATIONS ($\mu g/m^3$) INCLUDING BACKGROUND CONCENTRATIONS

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

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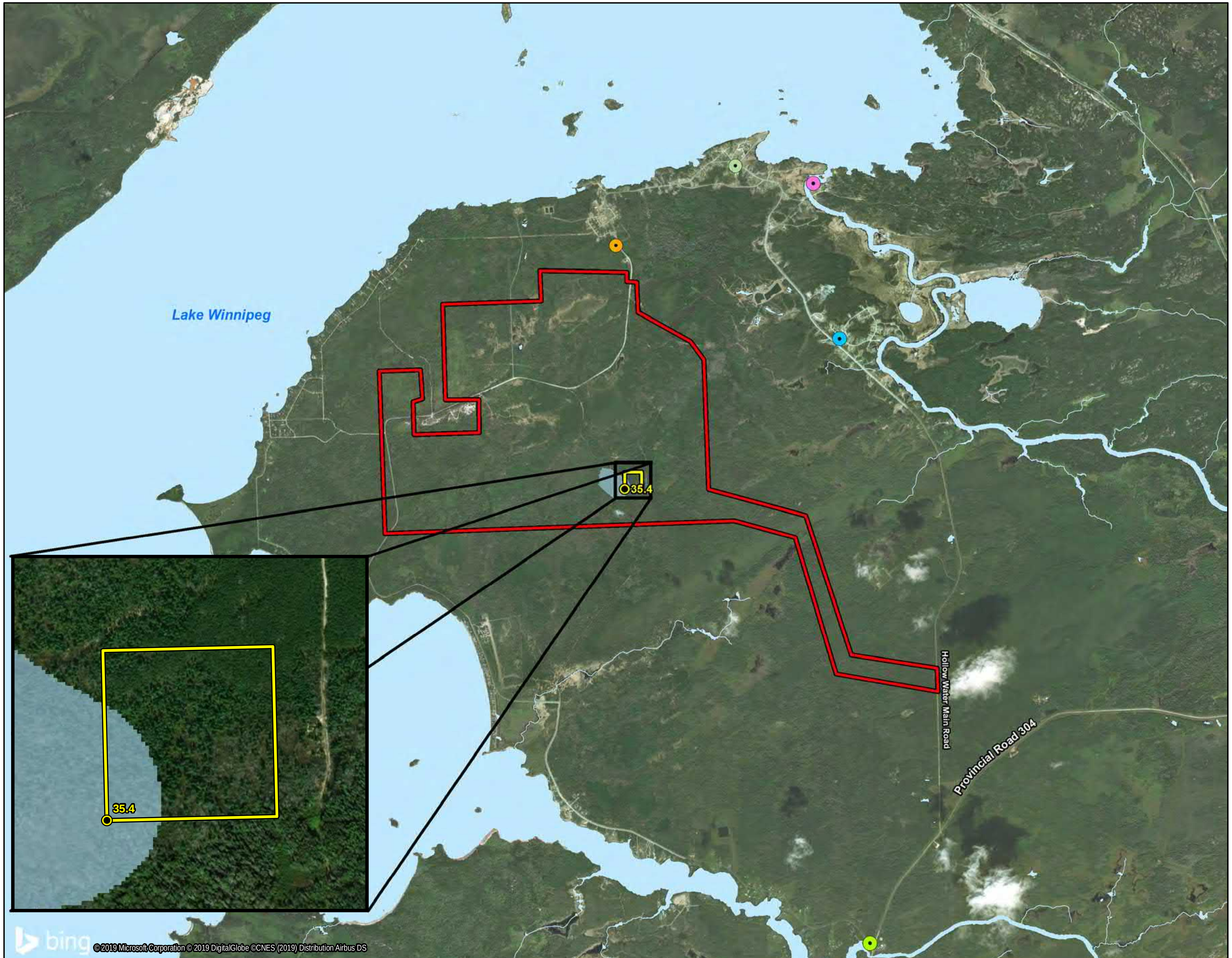
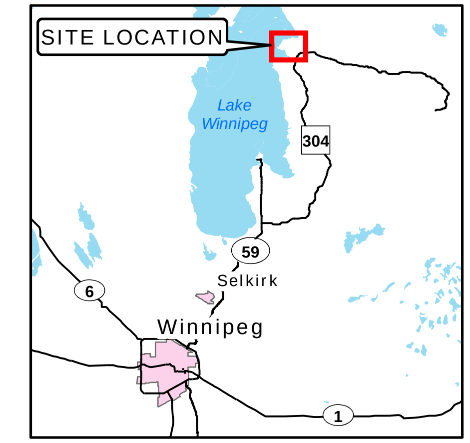
Project Management Initials: Designer: Checked: Approved: ANSI B 279.4mm x 431.8mm





Key Map

Sensitive Receptors

- Nearest Residence
- Aghaming
- Manigotagan
- Seymourville
- Wanipigow

Project Infrastructure

- Facility
- Project Site Area

24 Hour Average $PM_{2.5}$ Concentrations (µg/m³)

Ambient Air Quality Limit = 30 µg/m³

- < 30 100% Transparent
- > 30
- Maximum Concentration (µg/m³)

N E S W

1:50,000
NAD 1983 UTM Zone 14N

500 250 0 500 1,000 1,500 m

Basemap:
Additional Sources:
Ortho-Imagery:

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Figure: A-10

MAXIMUM 24 HOUR AVERAGE $PM_{2.5}$ CONCENTRATIONS (µg/m³) INCLUDING BACKGROUND CONCENTRATIONS

WANIPIGOW SAND EXTRACTION PROJECT
AIR DISPERSION MODELLING REPORT
CANADIAN PREMIUM SAND INC.
Project No.: 60588114 Date: 2019-03-06

ANSI B 279.4mm x 431.8mm Approved: Checked: Designer: Project Management Initials:

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Attachment B

Emission Rate Calculations

Overburden Stockpile

Site Specific Information: Stockpile capacity, area and moisture content specified by Canadian Premium Sand Inc.

Emission Factors: The following equation from US EPA AP-42 CH13.2.4 was used for emission factor calculation:

$$EF = K \times (0.0016) \times \frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \frac{kg}{t}$$

U is wind speed (4.89 average value from hourly surface data); M is moisture content (for lump ore =0.5%); K=Size factor (PM_{10}=0.35, $PM_{2.5}$= 0.053)

Sample Calculation (PM_{10}):

$$ER = 0.35 \times (0.0016) \times \frac{\left(\frac{4.89}{2.2}\right)^{1.3}}{\left(\frac{0.5}{2}\right)^{1.4}} \frac{kg}{t} \times 1000 \frac{g}{kg} \times 650000 \frac{t}{day} \times \frac{1}{365 \times 3600 \times 24} \frac{day}{s} = 0.227 \frac{g}{s}$$

Silica Sand Silos

Site Specific Information: Silo sizes specified by Canadian Premium Sand Inc.

Emission Factors: Emission factors for PM_{10} and $PM_{2.5}$ were taken from US EPA AP 42 Section 11.12 Concrete Batching.

	Emission factors (sand transfer)	
	$PM_{2.5}$	*PM_{10}*
US EPA AP-42 CH.13.2.4 Sand Transfer	*0.00051*	*0.00051*

Sample Calculation (PM_{10}):

$$ER = 0.00051 \frac{kg}{t} \times 1000 \frac{g}{kg} \times 1814 \frac{t}{day} \times \frac{1}{365 \times 3600 \times 24} \frac{day}{s} = 0.0000293 \frac{g}{s}$$

Dozer

Site Specific Information: Track Dozers

Assumptions: Each operating no more than 75% of each hour
Engine power: 850 hp
Load Factor: 0.20

	Emission factors (g/hp-hr)				
	$PM_{2.5}$	PM_{10}	CO	NOx	SO2
US EPA AP-42-CH3.3 Industrial Engines	1.00	1.00	3.03	14.0	0.931

Sample Calculation (NO_x):

$$ER = 14.0\frac{g}{hp-hr} \times 850\ hp \times 0.20 \times \frac{1}{3600 \times 24 \times 0.75}\frac{day}{s} = 0.661\frac{g}{s}$$

Trucks Paved Road

Site Specific Information: 24 haul trucks per day
12 km road
Trucks use diesel as a fuel

Assumptions: The onsite road is paved, modelled as a line volume source

	Emission factors (g/v-km)				
	$PM_{2.5}$	PM_{10}	CO	NOx	SO2
Paved road from US EPA AP-42 CH12.3	42	1200	-	-	-
Emission factors from MOVES	0.06	0.23	0.30	1.24	0.01

Sample Calculation (PM_{10}):

$$ER = (120 + 0.23)\frac{g}{v-km} \times 24\frac{truck}{day} \times 12.0\frac{km}{truck} \times \frac{1}{3600 \times 24}\frac{day}{s} = 0.401\frac{g}{s}$$

Rotary Dryer

Site Specific Information: Operated by electrical power
The facility processes 1,000,000 tonnes/year

Assumptions: 95% removal efficiency for the bag house

	Emission factors (kg/Mg)		
	$PM_{2.5}$	PM_{10}	NOx
US EPA AP-42 CH 11.19.1 Sand Dryer	0.019	0.019	0.016

Sample Calculation (PM_{10}):

$$ER = 0.019\frac{g}{t} \times (1 - 0.95) \times 1000000\frac{t}{day} \times \frac{1}{365 \times 3600 \times 24}\frac{day}{s} = 0.0301\frac{g}{s}$$

Screen

Site Specific Information: Operated by electrical power
The facility process 1,000,000 tonnes/year

Assumptions: 95% removal efficiency for the bag house

	Emission factors (kg/Mg)	
	$PM_{2.5}$	PM_{10}
US EPA AP-42 CH 11.19.1 Screen	0.0042	0.0042

Sample Calculation (PM_{10}):

$$ER = 0.0042\frac{g}{t} \times (1 - 0.95) \times 1000000\frac{t}{day} \times \frac{1}{365 \times 3600 \times 24}\frac{day}{s} = 0.00666\frac{g}{s}$$

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Table 1, Attachment B

Sand Resource Mineral Constituent Analysis

Wanipigow Sand Extraction Project: Sand Resource Mineral Constituent Analysis*

13.2.1 Head Analysis

A sub-sample of Master Composite was submitted for Whole Rock Analysis ("WRA") by XRF, ICP scan, mercury and total sulphur analysis, as well as gold and silver determination by fire assay. The sample was 95.9% SiO_2 prior to processing. Refer to Table 13.1.

TABLE 13.1
HEAD ASSAYS

Element	Unit	Master Composite	Element	Unit	Master Composite
SiO_2	%	95.9	Ag	g/t	< 2
Al_2O_3	%	1.73	As	g/t	< 30
Fe_2O_3	%	0.6	Ba	g/t	24.5
MgO	%	0.09	Be	g/t	0.14
CaO	%	0.16	Bi	g/t	< 20
Na_2O	%	< 0.01	Cd	g/t	< 2
K_2O	%	0.29	Co	g/t	5
TiO_2	%	0.09	Cu	g/t	20.1
P_2O_5	%	0.02	Li	g/t	14
MnO	%	< 0.01	Mo	g/t	< 5
Cr_2O_3	%	< 0.01	Ni	g/t	< 20
V_2O_5	%	< 0.01	Pb	g/t	< 30
LOI	%	1.38	Sb	g/t	< 10
Sum	%	100.2	Se	g/t	< 30
			Sn	g/t	< 20
			Sr	g/t	28.2
			Tl	g/t	< 30
			U	g/t	< 20
			Y	g/t	4.3
			Zn	g/t	6
			Hg	g/t	< 0.3
			S	%	0.22
			Au	g/t	< 0.02
			Ag	g/t	< 10

Sub-samples of the Master Composite were also submitted for specific gravity and bulk density determination. The specific gravity is 2.69 and the uncompacted bulk density is 1.56.

* Exerpt from: P&E Mining Consultants Inc. 2014. Technical Report and Preliminary Economic Assessment on the Seymourville Silica Sand Project, Manitoba, Canada. Report for Claim Post Resources Inc. Technical Report NI-43-101 & 43-101F1.