Appendix H2: Air Dispersion Modelling Study

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List of Acronyms and Abbreviations

BPIP	Building Profile Input Program
CO	carbon monoxide
ECCC	Environment and Climate Change Canada
FEED	Front-End Engineering Design
FEL-2	Front-End Loading - Stage 2
FEL-3	Front-End Loading - Stage 3
FID	final investment decision
GHD	GHD Limited
GLC	Ground Level Concentration
ha	hectares
HFO	Heavy Fuel Oil
HGP	Hydrogen Generation Plant
HHV	Higher heating value
HP	Hydrogenation Plant
K	Kelvin
kg/hr	kilograms per hour
km	kilometre
kV	kilovolt
kW	kilowatt
LAA	Local Assessment Area
LOHC	Liquid Organic Hydrogen Carrier
m	metres
MCH	methylcyclohexane
MMBtu	Million British thermal units
MW	megawatt
NAD83	North American Datum 83
NAPS	National Air Pollution Surveillance
NL	Newfoundland and Labrador
NL AQS	Newfoundland and Labrador Air Quality Standards
NL DECC	Newfoundland and Labrador Department of Environment and Climate Change
NL DOEC	Newfoundland and Labrador Department of Environment & Conservation
NL IET	Newfoundland and Labrador Department of Industry, Energy, and Technology
NLH	Newfoundland and Labrador Hydro
NO_2	nitrogen dioxide
NOOBS	No Observation
North Atlantic	North Atlantic Refining Corp.
PA	Project Area

PEM	Proton Exchange Membrane
PM_{10}	particulate matter < 10 microns
$PM_{2.5}$	particulate matter < 2.5 microns
POI	point of impingement
ppmw	parts per million, weight basis
SEM	Sikumiut Environmental Management Ltd.
SO_2	sulphur dioxide
TSP	total suspended particulate
ULSD	Ultra-low sulphur diesel
UTM	Universal Transverse Mercator
WRF	Weather Research and Forecasting

1.0 Introduction

North Atlantic Refining Corp. (North Atlantic) is proposing to undertake the development of a Wind to Hydrogen Project (the Project) on the Isthmus of Avalon Region in Newfoundland and Labrador (NL). This Project will entail development, construction, operation and eventual decommissioning of a 324-megawatt (MW) Wind Farm consisting of 45 wind turbines on an undeveloped peninsula situated between Sunnyside and Deer Harbour. The Wind Farm will provide renewable electricity via a 138 kilovolt (kV) transmission line to a newly developed Hydrogen Generation Plant (HGP), from where generated hydrogen will be transported to a Hydrogenation Plant (HP) for transformation into a Liquid Organic Hydrogen Carrier (LOHC), which will then be shipped from North Atlantic's port facilities to international markets for use in various decarbonization technologies.

1.1 Purpose of this Report

GHD Limited (GHD) was retained by North Atlantic to prepare an Air Dispersion Modelling Study (Study) for the Wind to Hydrogen Project located within the Placentia Bay and Trinity Bay region, NL. This Study has been prepared in support of the Environmental Assessment (Registration) of the Project. Air quality modelling is required in the context of the Registration of the Project and is used to evaluate the impacts of the emissions of particulate matter (total suspended particulate [TSP], particulate matter < 10 microns [PM_{10}] and particulate matter < 2.5 microns [$PM_{2.5}$]), nitrogen dioxide (NO_2), sulphur dioxide (SO_2) and carbon monoxide (CO) resulting from the various operations planned within the Project (stationary combustion, flaring, cooling towers, ocean vessels). The Registration addresses current standards as specified by the NL Air Pollution Control Regulations.

The modelling approach for this Study is based on the methodology presented in the Guideline for Plume Dispersion Modelling, 2nd revision by the Newfoundland and Labrador Department of Environment & Conservation (NL DOEC, 2012) (Guideline). The Study is also based on the Project description and additional technical information provided by North Atlantic.

The following sections present the selection of the modelling scenario along with the model, and the procedure used to assess the impact of operations air emissions to the air quality. The complete parameterization of the model is provided. The background concentrations retained are also presented along with the applicable standards. Finally, detailed results are presented and assumptions used in the modelling are discussed. Supporting maps are bundled at the end of the report.

2.0 Project Description

The Project will produce EU RED III RFNBO certified green hydrogen within the Placentia Bay / Trinity Bay region and transport to offtakes. The Project will utilize energy generated by the wind turbines, partially backed by power from NL Hydro, to generate green hydrogen. The hydrogen will then be converted into methylcyclohexane (MCH), an LOHC, for transport to European offtakes.

In partnership with provincial, regional and Indigenous organizations, North Atlantic has undertaken the following initiatives toward investigating options for preliminary design of the Project:

- April 2023: Initiation of baseline environmental surveys that adhere to the Guidance for Registration of Onshore Wind Energy Generation and Green Hydrogen Production Projects for the purpose of Project Environmental Assessment. This work is being executed by Sikumiut Environmental Management Ltd. (SEM);
- August 2023: ASL Energy supported the installation process for wind data collection and wind energy assessment in the area around Come By Chance. The 12-month resource assessment was completed August 2024;
- January 2024: Completion of a Wind Farm and HGP Pre-FEED (Front-End Engineering Design) / FEL-2 (Front-End Loading - Stage 2) engineering study for the Project, executed by Hatch Ltd. (Hatch);
- July 2024: 10,316 hectares (ha) land reserve awarded by NL Department of Industry, Energy, and Technology (NL IET);
- July 2024: Initiation of Geotechnical Drilling Campaign for the wind power, transmission line and HGP. Completion of the Campaign September 2024; and
- September 2024: Initiation of the LOHC Pre-FEED/FEL-2 (Front-End Loading - Stage 3) engineering study for the Project, being executed by Hatch Ltd.

North Atlantic will continue pre-development activities into 2025, including surveys for wind power, transmission line and plant sites, and a FEED/FEL-3 engineering study in support of the Registration process and a final investment decision (FID) in 2025. In addition, North Atlantic will undertake several capital projects to modernize its existing infrastructure to accommodate export of hydrogen and hydrogen derivatives. The following sections present preliminary descriptions of the main features of the Project based on the wind and hydrogen Pre-FEED report. More extensive and detailed information will become available as studies and detailed design proceed.

2.1 Wind Farm

The Wind Farm is between Sunnyside on the west and Deer Harbour on the east side on land, bounded by Bull Arm to the southwest and Trinity Bay (Figure H2-2.1-1). It will be comprised of 45 wind turbines with a rated power of 7.2 MW each, totalling 324 MW of installed capacity. The Wind Farm includes an access road network, electrical collection and transmission systems, and three substations.

Figure H2-2.1-1 Project layout and study areas.

2.2 Hydrogen Generation Plant

The HGP will be within the Come By Chance Industrial Site boundaries with several sites under consideration. The plant will utilize Proton Exchange Membrane (PEM) electrolyzers, with fresh water as feedstock.

2.3 Hydrogenation Plant

The HP will be within the Come By Chance Industrial Site boundaries. The Project will use MCH for the transportation of green hydrogen and will include a HP plant near the HGP as part of the Project scope.

The LOHC technology is a cyclical process for hydrogen storage and transport. In this process, electrolytic green hydrogen undergoes a chemical reaction with toluene in a hydrogenation step, producing the hydrogen carrier, MCH. The MCH is then transported to a receiving facility, where it is processed in a reactor to remove the hydrogen for offtake. This dehydrogenation step regenerates toluene, which is subsequently returned to the HP to complete the cycle.

2.4 Electrical Infrastructure

A dedicated 138 kV transmission line will connect the Wind Farm to the HGP. A separate grid feed will supply additional power to the HGP substation from the Sunnyside substation owned by Newfoundland and Labrador Hydro (NLH).

2.5 Other Infrastructure

The main Project components will be supported by the construction of access roads, laydown areas, an office building, warehouse, parking area, septic field, and firewater area. Potable water will be sourced from an artesian well and treated prior to use.

2.6 Transportation

Various Project components and materials will be transported to Newfoundland via existing port facilities. Containerized cargo is expected to be shipped to Newfoundland via Montreal or Halifax. Large equipment and materials (e.g., wind turbine components) are expected to be transported by geared multipurpose vessels for unloading at existing port and laydown facilities at St. John’s, Bull Arm or Come By Chance. The types of road trucks and trailers used will depend on the dimensions and weights of the materials being transported. Passenger vehicles will also be used.

2.7 Project Timeline

The anticipated Project timeline is as follows:

- Construction – The construction phase of the Project will be from Q4 2026 through Q4 2028, pending EA approval and receipt of other required permits and approvals. Early civil works are planned to start Q2/3 2026 through Q3 2027. Construction of the Wind Farm and associated infrastructure is expected to begin in Q4 2026 with completion in Q2 2029. The HGP will be constructed in phases from Q2/3 2026 to Q3 2028. The HP will be constructed in Q2/3 2026 to Q4 2028;
- Operation and Maintenance – Wind Farm commissioning is anticipated to start Q1 2029. The 240 MW electrolyzers and HP are expected to begin commissioning in Q3/4 2029. Commercial operation is anticipated for Q3 2029, with the operational life of the Project as 30 years; and
- Closure and Rehabilitation – After a 30 year operational life, the Closure and Rehabilitation Phase is anticipated to occur during 2059.

3.0 Existing Conditions & Baseline Atmospheric Study Results

An atmospheric baseline study was conducted by SEM to assess existing air quality and noise conditions within the defined study area. Baseline air quality conditions were evaluated using a combination of desktop analyses and field studies. The results of the baseline study were used to determine the appropriate background concentrations to use with the air dispersion modelling.

A relevant finding of the baseline study was minimal regional variation in air quality. Contaminant concentrations reported from the Mount Pearl National Air Pollution Surveillance (NAPS) station, located 130 km south of the Project Area (PA), were largely comparable to measured concentrations in the vicinity of the PA. This supports the use of air quality data from the NAPS station as representative of the air quality near the PA.

The results of the baseline study revealed that the ambient air quality within the study area generally met established air quality standards. Complete methodologies and findings can be found in Appendix A (Atmospheric Environment Component Study) of the Registration.

4.0 Scenario and Modelling Procedure

The aim of the air dispersion modelling is to evaluate the geographic scope and magnitude of the potential air emissions by the North Atlantic Wind to Hydrogen Project and to assess their potential impact on the air quality based on the NL Air Pollution Control Regulations. To do so, the worst-case emissions scenario was modelled over a 3-year meteorological conditions in the search for the worst dispersion conditions. The modelled scenario was reflective of Project operations and does not include emissions associated with construction activities.

4.1 Identification of Primary Emission Sources

Various equipment and operations associated with the North Atlantic Wind to Hydrogen Project are expected to emit particulate matter and gaseous compounds under normal operating conditions. Based on the Project description provided by North Atlantic, the primary sources of air emissions have been identified and are summarized below.

- **Flaring Systems** - A primary and a backup flare will be installed on site to combust a gas mixture consisting of methane, MCH, and hydrogen. This process will emit typical combustion by-products including CO, NO_2, and SO_2 as well as smaller quantities of particulate matter.
- **Cooling Towers** - Cooling towers will be incorporated into the Project's process infrastructure, emitting particulate matter such as total suspended particulates (TSP), particulate matter less than 10 microns (PM_{10}), and particulate matter less than 2.5 microns ($PM_{2.5}$) during operation.
- **Marine Transport Operations** - MCH will be loaded onto ocean-going vessels, with maneuvering supported by diesel-powered tugboats. Both vessel types will contribute combustion-related emissions during port activities.
- **Emergency Power Generation** – An emergency generator will be available to provide power during electricity supply interruptions. Operation of this generator is expected to be infrequent, only occurring during limited periods of testing or emergency conditions. As a result, the emergency generator was excluded from the air dispersion model. When operating, the emergency generator will produce emissions associated with combustion.

At this stage of project development, detailed specifications and exact locations of these emission sources are not finalized. For the purposes of this assessment, GHD applied conservative assumptions based on other green hydrogen facilities. These inputs are intended to provide conservative modelling results, such that the actual emissions from Project operations will be less than those modelled.

GHD understands that onsite terrestrial transportation will be minimal and not directly associated with electricity, hydrogen, or MCH production. Therefore, tailpipe and road dust emissions are considered negligible for the purposes of this Study.

4.2 Pollutants and Averaging Periods

In accordance with the Guideline (NL DOEC, 2012, Table 2.2.1) and the available ambient air quality limits applied to NL, the following pollutants and averaging periods have been selected for the atmospheric dispersion modelling:

- Total suspended particulate (TSP): 24-hour, annual;
- Particulate matter less than 10 microns (PM_{10}): 24-hour;
- Particulate matter less than 2.5 microns ($PM_{2.5}$): 24-hour, annual;
- Nitrogen dioxide (NO_2): 1-hour, 24-hour, annual;
- Sulphur dioxide (SO_2): 1-hour, 3-hour, 24-hour, annual; and
- Carbon monoxide (CO): 1-hour, 8-hour.

4.3 Selection of the Modelling Scenario

The assessment of the Project's potential impacts on air quality is based on the Project description and infrastructure layouts provided by North Atlantic.

To ensure a conservative approach, emissions estimates for standard operations assume that all relevant equipment operates continuously at maximum capacity – 24 hours per day, 365 days per year. This modelling scenario reflects a worst-case operational profile to capture the upper bound of potential impacts.

Emissions associated with construction activities have not been included in this analysis.

4.4 Dispersion Model Description

The modelling was accomplished using the CALMET diagnostic meteorological model version 6.5.0 and the CALPUFF dispersion modelling software version 7.3.2, which are approved by the NL Department of Environment and Climate Change (NL DECC, formerly NL Department of Environment and Conservation (NL DOEC)).

CALPUFF is an advanced non-steady-state meteorological and air quality modelling system developed by the Atmospheric Studies Group at TRC Companies Inc. It consists of three main components and a set of preprocessing and postprocessing programs. The main components of the modelling system are CALMET (a diagnostic 3-dimensional meteorological model), CALPUFF (an air dispersion model), and CALPOST (a postprocessing package). In addition to these components, the CALPUFF modelling system includes a series of preprocessing programs designed to interface the model with routinely-available meteorological and geophysical datasets.

CALMET is a meteorological model that includes a diagnostic wind field generator containing objective analysis and parameterized treatments of slope flows, kinematic terrain effects, terrain blocking effects, and a divergence minimization procedure, and a micro-meteorological model for overland and overwater boundary layers. It develops hourly wind and temperature fields on a three-dimensional gridded modelling domain and associated two-dimensional fields such as mixing heights, surface characteristics and dispersion properties. The CALMET diagnostic wind field module uses a two-step approach for the computation of the wind fields. In the first step, an initial-guess wind field is adjusted for kinematic effects of terrain, slope flows, and terrain blocking effects to produce a Step 1 wind field. The second step consists of an objective analysis procedure to introduce observational data into the Step 1 wind field to produce a final wind field.

CALPUFF is a non-steady-state Lagrangian Gaussian puff model taking into account complex terrain effects, overwater transport, coastal interaction effects, building downwash, wet and dry removal, and chemical transformations. It typically uses the fields generated by CALMET and model transport and dispersion of puffs of material emitted from various types of sources. The primary output files from CALPUFF contain either hourly concentrations or hourly deposition fluxes evaluated at selected receptor locations.

More specifically, CALPUFF presents the following features:

- considers variable punctual, area, linear and volume sources;
- estimates air dispersion of pollutants over distances from 10 metres (m), and up to 200 kilometres (km);
- computes air dispersion of pollutants featuring peculiar displacement path (particulate matter);
- takes into account chemical transformation of chemical compounds, and
- considers local topography features in the dispersion modelling.

Unlike simpler models which consider linear plume dispersion and treat meteorological conditions from one hour to the other independently, CALPUFF follows the trajectory of air parcels (“puffs”) according to a dynamical wind flow. The resulting concentrations calculated at a specific time and location are consequently, closer to the reality and lead to a better representativeness of the modelling.

Finally, the CALPOST module is used to recover CALPUFF calculation results and compute air concentration of the selected pollutants and appropriate averaging periods (e.g. 1-hour, 24-hour, annual) at each receptor.

4.5 Modelling Domain

The modelling domain defines the geographical limits for the modelling. For the current Study, one domain is used. The domain covers the HGP, HP, Wind Farm, and surrounding areas, encompassing the entire PA and Local Assessment Area (LAA).

A modelling domain of 20 km by 20 km, roughly centered at the HGP, has been selected for the Study. The south-west corner is located in the northern hemisphere, at X = 714.93 km; Y = 5,288.90 km in the zone 21T of the Universal Transverse Mercator projection (UTM), North American Datum 83 (NAD83).

5.0 Meteorological Model

The meteorological and geophysical data inputs, data processing procedures, and CALMET parameterization applied in the dispersion modelling are provided in Table H2-5.0-1, Table H2-5.0-2, Table H2-5.0-3, Table H2-5.0-4, Table H2-5.0-5, and Table H2-5.0-6. Inputs follow the requirements of the Guideline.

The closest Environment and Climate Change Canada (ECCC) meteorological station is Argentia Station, located approximately 54 km south of the proposed HGP location. Due to the distance, the station's data was deemed not representative of local conditions. As a result, the CALMET was set in NOOBS (No Observation) mode.

To generate the necessary meteorological inputs, prognostic data from the Weather Research and Forecasting (WRF) model was obtained through Lakes Environmental. This dataset spans a three-year period from January 1, 2022, to December 31, 2024, and covers a 50 km × 50 km domain with a 1 km grid resolution. The high-resolution WRF data provided required detailed parameters and was considered sufficient to characterize the mesoscale meteorological conditions in and around the PA.

Table H2-5.0-1 Seasonal land use timeframes.

Geographic Area	Non-winter	Winter – without snow cover	Winter – with snow cover
Avalon Peninsula, Burin Peninsula and South Coast	May 16 to October 31	April 1 to May 15 & November 1 to December 31	January 1 to March 31

Table H2-5.0-2 Land use parameterization – non-winter.

Input Category ID	z_0 (m)	Albedo (0 to 1)	Bown Ratio	Soil Heat Flux Parameter	Anthropogenic Heat Flux (W/m^2)	Leaf Index Area	Output Category ID
11	0.5	0.18	1	0.2	0	1	10
12	1	0.18	1.5	0.25	0	0.2	10
21	0.25	0.15	1	0.15	0	3	20
31	0.05	0.25	1	0.15	0	0.5	30
32	0.05	0.25	1	0.15	0	0.5	30
33	0.05	0.25	1	0.15	0	0.5	30
41	1	0.1	1	0.15	0	7	40
42	1	0.1	1	0.15	0	7	40
43	1	0.1	1	0.15	0	7	40
51	0.001	0.1	0	1	0	0	51
55	0.001	0.1	0	1	0	0	55
61	1	0.1	0.5	0.25	0	2	61
62	0.2	0.1	0.1	0.25	0	1	62
74	0.05	0.3	1	0.15	0	0.05	70
77	0.05	0.3	1	0.15	0	0.05	70
81	0.2	0.3	0.5	0.15	0	0	80
82	0.2	0.3	0.5	0.15	0	0	80
91	0.05	0.7	0.5	0.15	0	0	90

Table H2-5.0-3 Land use parameterization – winter without snow cover.

Input Category ID	z_0 (m)	Albedo (0 to 1)	Bown Ratio	Soil Heat Flux Parameter	Anthropogenic Heat Flux (W/m^2)	Leaf Index Area	Output Category ID
11	0.5	0.18	1	0.2	0	1	10
12	1	0.18	1.5	0.25	0	0.2	10
21	0.02	0.18	0.7	0.15	0	3	20
31	0.01	0.2	1	0.15	0	0.5	30
32	0.01	0.2	1	0.15	0	0.5	30
33	0.01	0.2	1	0.15	0	0.5	30
41	0.6	0.17	1	0.15	0	7	40
42	1.3	0.12	0.8	0.15	0	7	40
43	0.95	0.14	0.9	0.15	0	7	40
51	0.001	0.1	0	1	0	0	51
55	0.001	0.1	0	1	0	0	55

Input Category ID	z_0 (m)	Albedo (0 to 1)	Bown Ratio	Soil Heat Flux Parameter	Anthropogenic Heat Flux (W/m^2)	Leaf Index Area	Output Category ID
61	0.6	0.14	0.3	0.25	0	2	61
62	0.2	0.14	0.1	0.25	0	1	62
74	0.05	0.2	1.5	0.15	0	0.05	70
77	0.05	0.2	1.5	0.15	0	0.05	70
81	0.1	0.2	1	0.15	0	0	80
82	0.1	0.2	1	0.15	0	0	80
91	0.002	0.7	0.5	0.15	0	0	90

Table H2-5.0-4 Land use parameterization – winter with snow cover.

Input Category ID	z_0 (m)	Albedo (0 to 1)	Bown Ratio	Soil Heat Flux Parameter	Anthropogenic Heat Flux (W/m^2)	Leaf Index Area	Output Category ID
11	0.5	0.45	0.5	0.15	0	1	10
12	1	0.35	0.5	0.15	0	0.2	10
21	0.01	0.7	0.5	0.15	0	0	20
31	0.005	0.7	0.5	0.15	0	0.5	30
32	0.005	0.7	0.5	0.15	0	0.5	30
33	0.005	0.7	0.5	0.15	0	0.5	30
41	0.5	0.5	0.5	0.15	0	0	40
42	1.3	0.35	0.5	0.15	0	7	40
43	0.9	0.42	0.5	0.15	0	3.5	40
51	0.001	0.7	0.5	0.15	0	0	51
55	0.001	0.7	0.5	0.15	0	0	55
61	0.5	0.3	0.5	0.15	0	0	61
62	0.2	0.6	0.5	0.15	0	0	62
74	0.002	0.7	0.5	0.15	0	0	70
77	0.002	0.7	0.5	0.15	0	0	70
81	0.005	0.7	0.5	0.15	0	0	80
82	0.005	0.7	0.5	0.15	0	0	80
91	0.05	0.7	0.5	0.15	0	0	90

Table H2-5.0-5 Land use classifications.

Code #	Land Use Type
11	Residential
12	Industrial / Commercial
21	Cropland and Pasture
31	Herbaceous Rangeland
32	Shrub and Brush Rangeland
33	Mixed Rangeland
41	Deciduous Forest Land

Code #	Land Use Type
42	Evergreen Forest Land
43	Mixed Forest Land
51	Fresh Water
55	Salt Water
61	Forested Wetland
62	Non-forested Wetland
74	Bare Exposed Rock
77	Mixed Barren Land
81	Shrub and Brush Tundra
82	Herbaceous Tundra
91	Perennial Snow

Table H2-5.0-6 CALMET parameters used in the modelling.

Parameter	Parameter Description	Selected Value	
NOOBS	No Observation Mode	2	No surface, overwater, or upper air observations Use MM4/MM5/3D for surface, overwater, and upper air data
MCLOUD	Method to compute cloud fields	3	Gridded cloud cover from Prognostic Relative humidity at 850 mb
IEXTRP	Surface wind observations extrapolation to upper layers	1	No extrapolation is done
IPROG	Use gridded prognostic wind field model output fields as input to the diagnostic wind field model	14	Use winds from MM5/3D.DAT file as initial guess field
ISTEPPGS	Timestep of the prognostic model input data	3600	
ITPROG	3D temperature from observations or from prognostic data	2	No surface or upper air observations Use MM5/3D for surface and upper air data
ISURFT	Surface met. Station use for surface temperature	-1	
DGRIDKM	Grid spacing	1 km	
NZ	Number of vertical layers	10	
ZFACE	Cell face heights	0, 20, 40 ,80, 160, 300, 600, 1000, 1500, 2000, 2500	
RMAX1	Maximum radius of influence over land in the surface layer	0 (no observation station)	
RMAX2	Maximum radius of influence over land aloft	0 (no observation station)	
TERRAD	Radius of influence of terrain features	3.1 km	
R1	Weighting parameter in the surface layers	0 (no observation station)	
R2	Weighting parameter in the layers aloft	0 (no observation station)	

6.0 Modelling and Sources Description

6.1 Source Description

The following sections present a general description of the emission sources taken into account in the atmospheric dispersion modelling, along with technical considerations for their characterization and integration within the model. Mitigation measures and their impacts are also discussed. Source parameters are presented in Table H2-6.1-1.

Table H2-6.1-1 Source parameters.

Source ID	Description	Stack Config	Stack Exit Velocity (1) (2)	Exhaust Gas Temperature (1) (2)	Stack Diameter (1) (2)	Roof Height (1)	Source Height Above Roof (1)	Source Height Above Grade	UTM Coordinates (3)	
			(m/s)	(ºC)	(m)	(m)	(m)	(m)	x (m)	y (m)
FLR-01	LOHC Flare	Point, Vertical	1.89	1273	2.33	N/A	N/A	14.48	725191	5297487
CT-01	Cooling Tower Cell 1	Point, Vertical	5.50	70	8.00	N/A	N/A	8.00	724354	5299062
CT-02	Cooling Tower Cell 2	Point, Vertical	5.50	70	8.00	N/A	N/A	8.00	724352	5299054
CT-03	Cooling Tower Cell 3	Point, Vertical	5.50	70	8.00	N/A	N/A	8.00	724350	5299045
CT-04	Cooling Tower Cell 4	Point, Vertical	5.50	70	8.00	N/A	N/A	8.00	724349	5299035
CT-05	Cooling Tower Cell 5	Point, Vertical	5.50	70	8.00	N/A	N/A	8.00	724347	5299025
OGV-01	Ocean-going MCH tanker	Point, Vertical	22.80	500	2.00	30.00	5.00	35.00	723319	5298420
TUG-01	Tugboat 1	Point, Vertical	15.00	500	0.42	N/A	N/A	8.40	723333	5298383
TUG-02	Tugboat 2	Point, Vertical	15.00	500	0.42	N/A	N/A	8.40	723300	5298258

Notes
(1) Exact parameters not provided, approximate parameters based on facility capacity and source parameters from similar facilities.
(2) Flare stack exit velocity, stack diameter, and source height above grade are pseudo-parameters used for modelling purposes.
(3) Exact coordinates not provided; approximate locations selected based on facility diagram.

6.1.1 Flaring

The Project is understood to have two flare stacks: one used during normal operations, and one used for emergencies. During normal operations, flare gas will consist of a low flow rate of off-gas from the hydrogenation unit. This gas will flow to the flare stack, where it will be mixed with air and combusted. For the purposes of the Study, the primary flare has been assumed to run 24 hours per day, 365 days per year, with a flare gas flow rate of 178 kg/hr, and a maximum heat output rating of 10.79 MMBtu. The emergency flare has been assumed to have negligible emissions, as it would be used only in rare emergency situations, with no operational configuration where both flares would be operating. On the rare occasions it is operating, emissions from the emergency flare are expected to be comparable to emissions from the primary flare's normal operation.

Flares are a unique emission source in that they have pseudo-parameters. While both a typical exhaust stack and a typical flare have a given height, diameter, and exit velocity, a flare also has an effective stack height, effective stack diameter, and effective stack velocity. These "effective" parameters or pseudo-parameters are the result of flare emissions originating from the tip of the flame, not the exit of the stack. For the purposes of the Study, pseudo-parameters were calculated using methods described in Modelling Open Flares under O. Reg. 419.05 (Ontario Environmental Monitoring and Reporting Branch, February 2017). These pseudo-parameters were then applied to the air dispersion model.

The composition and flow rate of flare gas was provided by North Atlantic. Emissions associated with flaring are NO_2, CO, TSP, PM_{10}, and $PM_{2.5}$. The pseudo-parameters and emission rates assigned to the flares can be found in Table H2-6.1-2 and Table H2-6.1-3.

Table H2-6.1-2 Flare estimated physical parameters and calculated pseudo-parameters.

Source ID	Equipment Name	Nozzle Velocity V_{nozzle} (1)	Exhaust Gas Temperature T_{stack} (1)	Nozzle Diameter D_{nozzle} (1)	Source Height Above Grade H_{stack} (1)	Effective Stack Height H_{eff} (2)	Effective Exit Velocity V_{eff} (2)	Effective Stack Diameter D_{eff} (2)
		(m/s)	(K)	(m)	(m)	(m)	(m/s)	(m)
FLR-01	LOHC Flare	30.00	1,273	0.08	12	14.5	1.89	2.3

Notes

(1) Exact parameters not provided, approximate parameters based on facility capacity and source parameters from similar facilities.

(2) Calculated using the methodologies in MODELLING OPEN FLARES under O. Reg. 419/05 and the parameters below:

Q_n = 2,214,491 J/s

Q_T = 3,163,558 J/s

f = 30%

F_m = 1.100 m^4/s^2

ρ_{gas} = 1.065 kg/m^3

ρ_{air} = 1.225 kg/m^3

F_b = 19.473 m^4/s^3

T_{amb} = 288.15 K

$C_{p,air}$ = 1006 J/kg·K

g = 9.81 m/s^2

Table H2-6.0-3 Flare estimated maximum emission rates.

Source ID	Equipment Name	Fuel	Maximum Heat Output Rating (2) (3)	Maximum TSP/PM_{10}/$PM_{2.5}$ Emission Rate (1) (2)	Maximum NO_x Emission Rate (1) (2)	Maximum NO_2 Emission Rate (1) (2) (4)	Maximum NO Emission Rate (1) (2) (4)	Maximum CO Emission Rate (1) (2)
			(Btu/hr)	(g/s)	(g/s)	(g/s)	(g/s)	(g/s)
FLR-01	LOHC Flare	See speciation	10,794,507.50	0.087	0.092	0.055	0.037	0.422

Notes

(1) Based on the following emission factors from USEPA AP-42 Chapter 13.5: Industrial Flares

TSP (kg·10^{-3}/m^3 fuel)	7.48E-01
NOx (lb/MMBtu)	6.80E-02
CO (lb/MMBtu)	3.10E-01

Emissions are conservatively based on continuous operations: 24 hrs per day, 365 days per year

(2) Based on the following flare composition provided by North Atlantic

Compound	*Composition (wt %)*	*Composition (mol %)*	*HHV (MJ/kg)*	*Molecular Weight (g/mol)*	*Density (kg/m^3)*
Methane (CH_4)	0.67	0.40	55.5	16.04	0.6570
Methylcyclohexane ($CH_3C_6H_{11}$)	0.21	0.02	46.6	98.19	770
Hydrogen (H_2)	0.12	0.58	141.8	2.016	0.0899
TOTAL	1.00	1.00	63.98	31.61	0.4246

(3) Based on the following flare stream properties provided by North Atlantic

Molar flow (kmol/hr)	5.63
Mass flow (kg/hr)	178
Volume flow (m^3/hr)	419.22

(4) Based on a NO_2/NO ratio of 0.6

6.1.2 Cooling Towers

The Project is understood to have one cooling tower with five cells. The cooling tower will remove excess heat from process fluids by flowing hot water over fill material, increasing the water's surface area and causing a portion of the water to evaporate. The evaporation removes heat from the remaining water, which is then recirculated back into the process. For the purposes of the Study, the cooling tower has been conservatively assumed to run 24 hours per day, 365 days per year.

At the time of the Study, the exact location and operating specifications of the cooling towers were unknown. As a result, conservative estimates were applied. The cooling towers have been estimated to be larger than is likely required for a facility the size of the Project, and they have been placed relatively close to a fenceline to capture worst-case scenarios. The modelling results for cooling tower emissions are greater than the expected real-world emissions.

Emissions associated with the cooling tower are TSP, PM_{10}, and $PM_{2.5}$. Particulates originate as dissolved or suspended solids in the water, or material from the cooling tower itself. These particulates are then carried upward by the water vapour in the cooling tower exhaust. The emission rates assigned to the cooling towers can be found in Table H2-6.1-4.

Table H2-6.1-4 Cooling tower estimated maximum emission rates.

Source ID	Equipment Name	Circulating Water	Maximum TSP/PM_{10}/$PM_{2.5}$ Emission Rate (1), (2)
		(m^3/hr)	(g/s)
CT-01	Cooling Tower Cell 1	2,303	0.384
CT-02	Cooling Tower Cell 2	2,303	0.384
CT-03	Cooling Tower Cell 3	2,303	0.384
CT-04	Cooling Tower Cell 4	2,303	0.384
CT-05	Cooling Tower Cell 5	2,303	0.384

Notes

(1) Based on Total Liquid Drift of 0.005%, Total Dissolved Solids of 12,000 parts per million weight (ppmw), and assumed year round operating period. Calculations were completed using the "Induced draft Cooling Tower PM Emissions" calculator created by Environment and Climate Change Canada.

(2) To account for unknown dissolved solids, particulate matter emissions are conservatively assumed to be the same for TSP, PM_{10}, and $PM_{2.5}$.

6.1.3 Ocean Vessels

The Project is understood to have two types of ocean vessels: ocean-going vessels used for the transportation of MCH from the Project, and tugboats used for maneuvering the ocean-going vessels. For the purposes of the Study, the ocean-going vessels have been assumed to have dimensions similar to a Seawaymax ship, as well as a 5,400 kilowatt (kW) engine and 4,652 kW of boilers, both consuming heavy fuel oil (No. 6 Fuel Oil). The tugboats have been assumed to have a 1,540 kW engine, consuming diesel (Distillate Oil). Due to the uncertainty of exact shipping routes, the ocean-going vessel and the tugboats have all been set up as point sources next to the existing North Atlantic Refining Limited (NARL) Logistics Terminal loading arm. GHD understands that up to 18 ocean-going vessels movements will occur per year. For the purposes of the Study, all ocean vessels have been conservatively assumed to run 24 hours per day, 365 days per year. In practice, the ocean vessels are only expected to operate during vessel movements, and only for 24 to 72 hours per movement.

During maneuvering near the Terminal and while at the Terminal, emissions from the ocean-going vessel are associated with power generation using the engine for “hoteling”, and steam generation using the boilers for heat. Emissions from the tugboats are associated with engine operation for maneuvering. All three of these result in emissions of NO_2, CO, SO_2, TSP, PM_{10}, and $PM_{2.5}$. The emission rates assigned to the ocean vessels can be found in Table H2-6.1-5.

Table H2-6.1-5 Ocean vessel maximum estimated emission rates.

Source ID	Equipment Name	Fuel	Maximum Movement Frequency	Fuel Consumption, Hoteling (3)	Fuel Consumption, Boilers (3)	Fuel Consumption, Maneuvering (4)	Maximum $TSP/PM_{10}/PM_{2.5}$ Emission Rate (1) (2)	Maximum NO_x Emission Rate (1) (2)	Maximum NO_2 Emission Rate (1) (2) (5)
			(y/r)	(m^3/hr)	(m^3/hr)	(m^3/hr)	(g/s)	(g/s)	(g/s)
OGV-01	Ocean-going MCH tanker	HFO	18	1.205	0.130	N/A	0.517	8.810	0.881
TUG-01	Tugboat 1	ULSD	18	N/A	N/A	0.158	0.038	0.378	0.076
TUG-02	Tugboat 2	ULSD	18	N/A	N/A	0.158	0.038	0.378	0.076

Notes

(1) Based on USEPA AP-42 Chapter 1.3 Fuel Oil Combustion, Table 1.3-1, Boilers < 100 Million Btu/hr, No. 6 Fuel Oil

$TSP/PM_{10}/PM_{2.5}$ (kg/m^3)	3.88E-01
NO_x (kg/m^3)	6.60E+00
CO (kg/m^3)	6.00E-01
SO_2 (kg/m^3)	1.88E-02

(2) Based on USEPA AP-42 Chapter 1.3 Fuel Oil Combustion, Table 1.3-1, Boilers < 100 Million Btu/hr, Distillate Oil

$TSP/PM_{10}/PM_{2.5}$ (kg/m^3)	2.40E-01
NO_x (kg/m^3)	2.40E+00
CO (kg/m^3)	6.00E-01
SO_2 (kg/m^3)	1.70E-02

(3) Based on an ocean-going vessel with the following specifications:

Power rating, engine (kW)	5,400
Power rating, boilers (kW)	4,652
Thermal efficiency, engine (%)	40%
Thermal efficiency, boilers (%)	80%
Hoteling load factor	25%
Fuel consumption, hoteling (m^3/hr)	1.2051
Fuel consumption, boilers (m^3/hr)	0.1298
Fuel type	No. 6 oil (HFO)
Fuel HHV (kJ/kg)	42,450

Fuel density (kg/m^3)	950
Sulphur content, (wt %)	0.10%

(4) Based on a tugboat with the following specifications:

Power rating (kW)	1,540
Thermal efficiency, engine (%)	40%
Maneuvering load factor	45%
Fuel consumption, maneuvering (m^3/hr)	0.1575
Fuel type	Distillate oil (MDO)
Fuel HHV (kJ/kg)	44,000
Fuel density (kg/m^3)	900
Sulphur content, (wt %)	0.10%

(5) Based on a NO_2/NO_X ratio for power boilers of 0.1, from the Guideline

6.1.4 Stationary Combustion

The Project is understood to have a single stationary combustion emissions source: an emergency generator. During normal operations, the generator will operate infrequently, being started up for testing a limited number of hours per month. During upset conditions where the Project's electricity supply is interrupted, the generator will be running at full capacity. For the purposes of the Study, the generator has been assumed to be a negligible source of emissions due to the limited runtime. As a result, emission rates from the generator have been set to zero in the air dispersion model.

The generator has an output capacity of 300 kW and consumes diesel. Emissions associated with the generator are NO_2, CO, SO_2, TSP, PM_{10}, and $PM_{2.5}$. As stated above, these emissions are understood to be negligible for the purposes of the Study and were excluded from the air dispersion model. For completeness and consistency with the Guidance for Registration of Onshore Wind Energy Generation and Green Hydrogen Production Projects, the emission rates calculated for the emergency generator during operation at maximum capacity can be found in Table H2-6.1-6.

Table H2-6.1-6 Stationary combustion maximum estimated emission rates.

Source ID	Equipment Name	Maximum Heat Input Rating (1)	Maximum Heat Input Rating (1)	Maximum TSP/PM_{10}/$PM_{2.5}$ Emission Rate (2)(3)	Maximum NO_2 Emission Rate (2)(3)	Maximum CO Emission Rate (2)(3)	Maximum SO_2 Emission Rate (2)(3)
		(kW)	(Btu/hr)	(g/s)	(g/s)	(g/s)	(g/s)
SC-01	Emergency Generator	300	2,559,107	0.100	1.422	0.306	0.094

Notes

(1) Based on equipment specifications provided by North Atlantic.

(2) Based on USEPA AP-42 Chapter 3.3, emission factors for uncontrolled diesel combustion engines

PM/$PM_{2.5}$ (lb/MMBtu)	3.10E-01
NO_x (lb/MMBtu)	4.41E+00
CO (lb/MMBtu)	9.50E-01
SO_2 (lb/MMBtu)	2.90E-01

(3) For diesel-fired equipment, the maximum emission rates are not representative of the annual emissions, as the equipment is only expected to operate for a fraction of the year (<150 hours/year for the emergency generator).

6.1.5 Other Sources

The emission sources occasionally operated or presenting a marginal contribution to the total emissions associated with the operations of the Project have not been taken into account in the modelling. These sources include numerous light-duty vehicles, a limited amount of heavy vehicles, and unpaved roads used occasionally or presenting low emissions.

6.2 Building Effects Adjustment

Considering that some punctual emission sources (stacks and flares) are located within the vicinity of buildings or large stationary structures subject to alter the wind flow, the downwash effect is taken into account. The procedure followed is given in Section 2.5 of the Guideline. The Building Profile Input Program (BPIP) is run a first time treating adjacent buildings as one building, using the coordinates of the perimeter. Secondly, BPIP is run with each unique building section defined as a separate building with its correct building dimensions and height. Finally, the building dimension parameters (BUILDWID, BUILDLEN, XBADJ and YBADJ) values are merged from step one with the building height (BUILDHGT) values from step two to generate the appropriate downwash parameterization. The result is then reported into the model in order for CALPUFF to apply the resulting building effect adjustment in the calculations.

Downwash effects are computed for the point sources in proximity to buildings. The locations and dimensions of the buildings included in the Study has been approximated based on draft Project layouts provided by North Atlantic. Included are four large tanks that currently exist at the Project location.

6.3 Receptor Grid and Discrete Receptors

According to the Guideline, the maximum spacing between the receptors is set to:

- 50 m from the centre of the operation out to 500 m;
- 100 m from 500 m out to 1000 m;
- 200 m from 1000 m out to 2000 m; and
- 500 m beyond 2000 m.

Additional discrete receptors are used to take into account a total of 30 cabins and residences located within the area. The locations of the 19 sensitive receptors closest to the Project are also shown on Figure H2-6.3-1. The 11 sensitive receptors located farther away are not expected to have any impacts to air quality beyond those identified at the closer receptors.

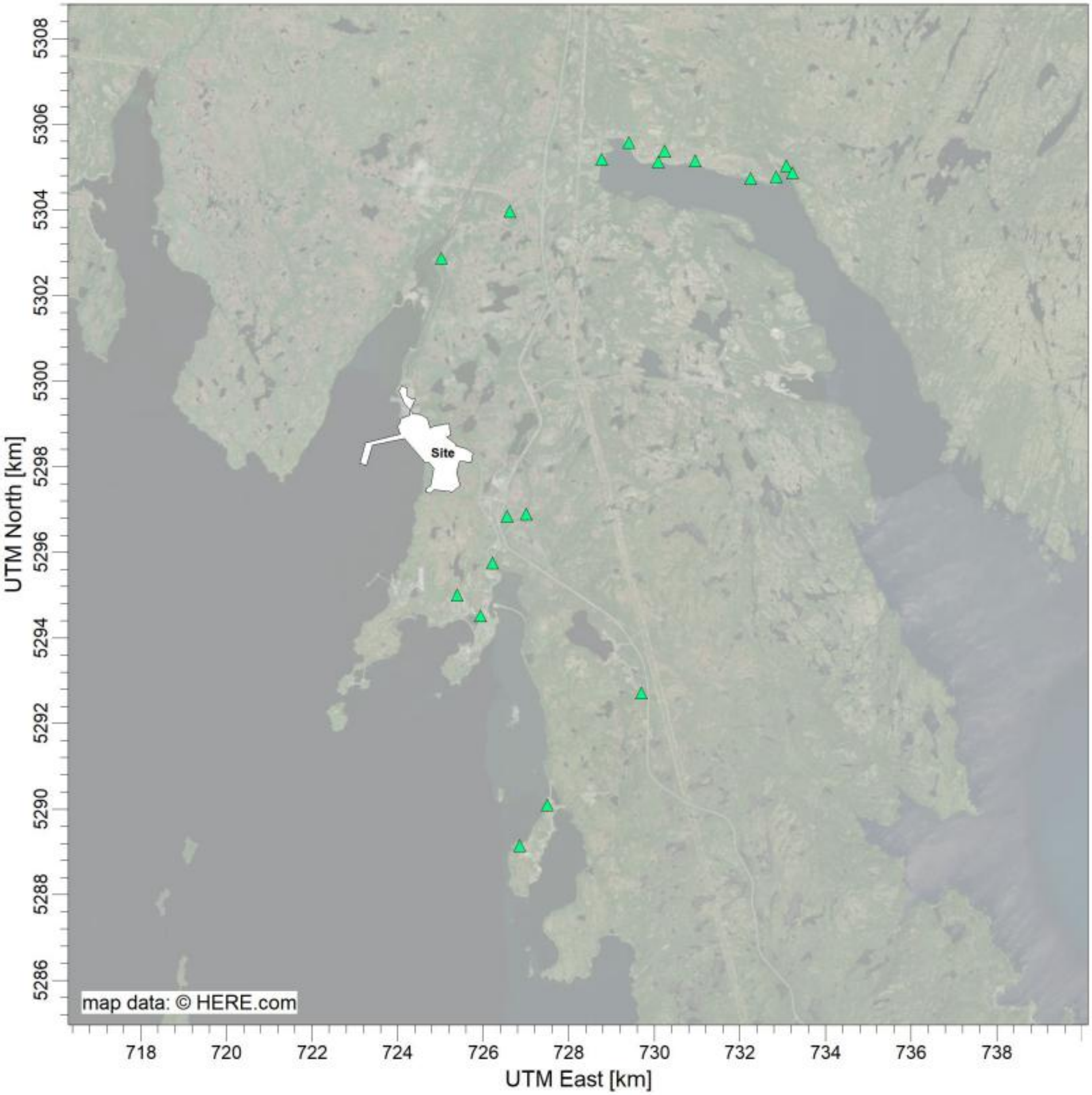

Figure H2-6.3-1 Locations of sensitive receptors in proximity to the Project.

6.4 CALPUFF Parameterization

CALPUFF was run in two parts for each of the three years within the modelling period for a total of six runs.

The parameterization of the CALPUFF model takes into account all the requirements provided in Table 4.2.1 of the Guideline, except for the wet deposition due to a lack of precipitation data. The parameters used for the Study are presented in Table H2-6.4-1. The remaining CALPUFF parameters not referenced in Table 4.2.1 of the Guideline have been set to their default values.

Table H2-6.4-1 CALPUFF parameters used in the modelling.

Parameter	Parameter Description	Selected Value	Value Description
NSPEC	Number of species modelled	5	CSPEC = NO_x, SO_2, TSP, PM_{10}, and $PM_{2.5}$
MBDW	Method used to simulate building downwash	2	PRIME method
MSHEAR	Vertical wind shear modeled above stack top	0	No
MSPLIT	Puff splitting allowed	0	No puff splitting is needed for short-range modelling
MCHEM	Chemical mechanism	0	Chemical transformation not modeled
MAQCHEM	Aqueous phase transformation	0	Aqueous phase transformation not modeled
MLWC	Liquid water content	1	Gridded cloud water data read from CALMET water content output files
MWET	Wet removal modeled	0	No
MDRY	Dry deposition modeled	0	No
MDISP	Method used to compute dispersion coefficients	2	Dispersion coefficients from internally calculated sigma v, sigma w using micrometeorological variables (u*, w*, L, etc.)
MPDF	PDF for dispersion under convective conditions	1	Yes
MREG	Test options specified to see if they conform to regulatory values	0	No checks are made

7.0 Air Quality Standards and Background Levels

7.1 Air Quality Standards

The air quality standards retained for the evaluation of the impacts of the Project on the air quality are taken from the Air Pollution Control Regulations, 2004 under the **Environmental Protection Act** (O.C. 2004-232) of NL Regulation 39/04. These standards are presented in Table H2-7.2-1 and define levels that the Minister deems to be acceptable for the protection of the environment, including human life, wildlife and vegetation.

In that context, compliance with the standards assures safety for human health and the environment. Consequently, effects of particulate matter and gaseous compound emissions can be considered as negligible when the standards are respected.

7.2 Background Levels

In order to verify compliance with air quality standards, the background concentration for each pollutant must be added to the maximum concentrations calculated in the modelling. The total anticipated concentrations may then be compared with the air quality standards. For the purposes of the Study, background concentrations were assigned based on the data presented in Appendix A (Atmospheric Environment Component Study) of the Registration. The background concentrations applied are included in Table H2-7.2-1.

Table H2-7.2-1 Background concentrations and air quality limits applied to the Study.

Contaminant	CAS No.	Averaging Period	Background Concentration (1) (2) (3)	Background Concentration (1) (2) (3)	Limit	Limit	Limit Reference (4)
			(ppb)	(µg/m³)	(ppb)	(µg/m³)	
Carbon monoxide	630-08-0	1-hr	280	322.00	30,582	35,000	NL AQS
		8-hr	220	253.00	13,107	15,000	NL AQS
Nitrogen dioxide	10102-44-0	1-hr	16	30.08	213	400	NL AQS
		24-hr	12	22.56	106	200	NL AQS
		Annual	1	1.88	12	23	NL AQS_{2025}
Particulate matter <= 2.5 microns ($PM_{2.5}$)	-	24-hr	-	16.00	-	25	NL AQS
		Annual	-	5.00	-	8.8	NL AQS
Particulate matter <= 10 microns (PM_{10})	-	24-hr	-	28.00	-	50	NL AQS
Total suspended particulate matter (TSP)	-	24-hr	-	33.57	-	120	NL AQS
		Annual	-	12.45	-	60	NL AQS
Sulphur dioxide	7446-09-5	1-hr	4.6	12.05	65	171	NL AQS_{2025}
		3-hr	0.3	0.79	229	600	NL AQS
		24-hr	2.2	5.76	115	300	NL AQS
		Annual	0.3	0.79	4	11	NL AQS_{2025}

Notes

(1) Based on continuous monitoring data from the Mount Pearl NAPS Station from January 1, 2020, to December 31, 2022.

(2) Background concentrations are calculated as follows:
For hourly values, the maximum hourly concentration observed outside the Project fenceline
For 3-hour values, the 3-hour rolling average of 90th percentile hourly concentrations
For 24-hour values, the maximum 24-hour average
For annual values, the maximum annual average

(3) TSP is not monitored at the Mount Pearl NAPS Station. Background concentrations of TSP were estimated using the background concentrations of PM_{10} and the average ratio of PM_{10} to TSP observed during the field study (0.834).

(4) NL AQS = Newfoundland and Labrador Air Quality Standards (NL AQS) effective as of March 2022
NL AQS_{2025} = Newfoundland and Labrador Air Quality Standards (NL AQS) effective as of January 2025

8.0 Results and Discussion

The following sections present the results of the dispersion modelling assessment. Modelled concentrations for each pollutant were combined with background concentrations and compared against applicable ambient air quality standards. Maximum predicted concentrations, including percentages of ambient air quality standards reached at each maximum point of impingement (POI), are summarized in Table H2-8.0-1. Maximum predicated concentrations at sensitive receptors are presented in Table H2-8.0-2. Finally, corresponding isopleth maps are provided in Appendix H2-1 following the main body of the Study.

It is important to note that emission rates were conservatively estimated using the maximum expected values for all sources operating under normal conditions. These "worst-case" emissions were applied in combination with worst-case meteorological conditions throughout the entire modelling period to ensure that the maximum potential impact was captured. No meteorological anomalies were removed from the dataset. In practice, the simultaneous occurrence of these peak emissions and adverse meteorological conditions is highly unlikely.

The same conservative emission assumptions were also applied in estimating annual average concentrations. Despite this approach, all predicted concentrations remain below applicable air quality standards, indicating that no exceedances are expected. As such, additional refinement of the modelling inputs was not considered necessary.

Table H2-8.0-1 Air dispersion modelling results summary.

Contaminant	CAS No.	Total Facility Emission Rate (g/s)	Maximum Modelled GLC (µg/m³)	Averaging Period	Percentile (1) (2) (nth)	Background Concentration (3) (4) (5) (µg/m³)	Maximum Total GLC (µg/m³)	Limit (µg/m³)	Percentage of POI Limit
Carbon monoxide	630-08-0	1.41E+00	54.29	1-hr	Maximum	322.00	376.29	35,000	1.1%
		1.41E+00	34.01	8-hr	Maximum	253.00	287.01	15,000	1.9%
Nitrogen dioxide	10102-44-0	9.66E+00	529.59	1-hr	Maximum	30.08	559.67	400	139.9%
		9.66E+00	247.75	24-hr	Maximum	22.56	270.31	200	135.2%
		9.66E+00	22.17	Annual	Maximum	1.88	24.05	23	109.3%
Particulate matter <= 2.5 microns ($PM_{2.5}$)	-	2.60E+00	33.99	24-hr	Maximum	16.00	49.99	25	200.0%
		2.60E+00	1.72	Annual	Maximum	5.00	6.72	8.8	76.4%
Particulate matter <= 10 microns (PM_{10})	-	2.60E+00	33.99	24-hr	Maximum	28.00	61.99	50	124.0%
Total suspended particulate matter (TSP)	-	2.60E+00	33.99	24-hr	Maximum	33.57	67.57	120	56.3%
		2.60E+00	1.72	Annual	Maximum	12.45	14.18	60	23.6%
Sulphur dioxide	7446-09-5	3.05E-02	1.71	1-hr	Maximum	12.05	13.77	171	8.1%
		3.05E-02	1.47	3-hr	Maximum	0.79	2.25	600	<1%
		3.05E-02	0.82	24-hr	Maximum	5.76	6.58	300	2.2%
		3.05E-02	0.13	Annual	Maximum	0.79	0.91	11	9.1%

Notes

(1) For all averaging periods, the worst-case modelling result was considered without adjusting for any meteorological anomalies. Due to the unavailability of onsite source information, this approach, along with the use of conservative source assumptions, was employed to capture the maximum possible worst-case impact.
(2) For the Annual average periods, the modelling results are based on the worst-case result of each year within the 3-year modelling period.
(3) Based on continuous monitoring data from the Mount Pearl NAPS Station from January 1, 2020, to December 31, 2022
(4) Background concentrations are calculated as follows:
For hourly values, the maximum hourly concentration observed outside the Project fenceline
For 3-hour values, the 3-hour rolling average of 90th percentile hourly concentrations
For 24-hour values, the maximum 24-hour average
For annual values, the maximum annual average
(5) TSP is not monitored at the Mount Pearl NAPS Station. Background concentrations of TSP were estimated using the background concentrations of PM_{10} and the average ratio of PM_{10} to TSP observed during the field study (0.834).

Table H2-8.0-2 Maximum modelled concentrations at sensitive receptors.

Sensitive Receptor ID	UTM Coordinates (m)		CO Maximum Total GLC (1) (µg/m³)		NO_2 Maximum Total GLC (1) (µg/m³)			$PM_{2.5}$ Maximum Total GLC (1) (µg/m³)		PM_{10} Maximum Total GLC (1) (µg/m³)	TSP Maximum Total GLC (1) (µg/m³)		SO_2 Maximum Total GLC (1) (µg/m³)		
	x	y	1-hr	8-hr	1-hr	24-hr	annual	24-hr	annual	24-hr	24-hr	annual	1-hr	24-hr	annual
NL AQS (2)	-	-	**35,000**	**15,000**	**400**	**200**	**22**	**25**	**9**	**50**	**120**	**60**	**170**	**300**	**10**
SR01	727003	5296897	327.60	255.42	72.36	26.83	2.15	16.38	5.03	28.38	33.95	12.49	12.14	5.78	0.79
SR02	725028	5302870	325.00	254.06	75.99	28.71	2.41	16.45	5.06	28.45	34.03	12.51	12.15	5.78	0.79
SR03	729703	5292719	323.89	253.72	57.59	25.92	2.01	16.19	5.01	28.19	33.76	12.46	12.11	5.77	0.79
SR04	733084	5305030	323.04	253.39	42.36	24.76	2.03	16.26	5.02	28.26	33.84	12.47	12.08	5.77	0.79
SR05	733229	5304871	323.05	253.45	44.51	24.99	2.02	16.25	5.02	28.25	33.82	12.47	12.08	5.77	0.79
SR06	732852	5304780	323.12	253.42	42.49	24.76	2.03	16.27	5.02	28.27	33.85	12.47	12.08	5.77	0.79
SR07	732247	5304739	323.05	253.43	45.27	25.10	2.06	16.31	5.02	28.31	33.88	12.47	12.08	5.77	0.79
SR08	730959	5305145	323.57	253.60	52.67	25.37	2.12	16.40	5.03	28.40	33.97	12.48	12.10	5.77	0.79
SR09	730087	5305124	323.54	253.44	52.20	25.40	2.13	16.27	5.03	28.27	33.85	12.48	12.10	5.77	0.79
SR10	730242	5305371	323.47	253.46	50.81	25.33	2.13	16.26	5.03	28.26	33.83	12.48	12.10	5.77	0.79
SR11	729402	5305573	323.50	253.48	50.79	24.78	2.13	16.28	5.04	28.28	33.85	12.49	12.10	5.77	0.79
SR12	728765	5305180	323.31	253.49	49.02	25.12	2.16	16.29	5.04	28.29	33.87	12.50	12.09	5.77	0.79
SR13	726562	5296837	328.12	255.47	88.74	28.75	2.19	16.44	5.04	28.44	34.02	12.49	12.18	5.78	0.79
SR14	726215	5295755	325.72	254.15	85.50	29.11	2.18	16.35	5.03	28.35	33.92	12.48	12.17	5.78	0.79
SR15	725398	5295000	325.64	254.13	73.87	30.78	2.22	16.47	5.02	28.47	34.04	12.47	12.17	5.79	0.79
SR16	725940	5294512	324.77	254.02	67.87	29.02	2.11	16.31	5.02	28.31	33.89	12.47	12.14	5.78	0.79
SR17	727502	5290095	323.37	253.84	50.19	26.83	2.03	16.20	5.01	28.20	33.78	12.46	12.09	5.77	0.79
SR18	726858	5289150	323.40	253.43	45.53	24.89	1.98	16.16	5.01	28.16	33.73	12.46	12.09	5.77	0.79
SR19	726625	5303961	324.15	253.75	62.43	28.24	2.31	16.42	5.06	28.42	33.99	12.51	12.12	5.78	0.79

Notes

(1) Maximum Total GLC is the sum of the maximum modelled GLC and the background concentrations identified in Table H2-7.2-1

(2) Ambient air quality limits are from NL AQS or NL AQS_{2015} as shown in Table H2-7.2-1.

8.1 Total Suspended Particulate

Results for total suspended particulates (TSP) were evaluated for both 24-hour and annual averaging periods. In the vicinity of all identified sensitive receptors, the modelling results demonstrate compliance with applicable 24-hour and annual air quality standards.

No exceedances were predicted, with the maximum modeled concentrations, including observed background concentrations, being below the limit. The highest modeled TSP emissions reached 57% of the 24-hour limit and 24% of the annual limit. Due to the low concentrations predicted, isopleths of TSP emissions are not included in this report.

8.2 Particulate Matter Less Than 10 Microns

Results for Particulate Matter Less Than 10 Microns (PM_{10}) were assessed for the 24-hour averaging period. In the vicinity of all identified sensitive receptors, the modelled concentrations comply with the applicable 24-hour air quality standard.

Predicted exceedances of the 24-hour standard are confined to areas within 100 m of the northern fenceline. These exceedances are attributed to the assumed location of the cooling towers near the north boundary, which is subject to refinement as the Project design is finalized. No exceedances of the annual standard are predicted.

Should PM_{10} emissions remain a concern, GHD recommends remodelling the scenario using confirmed source locations and operating parameters. Based on the current modelling outcomes—developed using conservative assumptions—GHD considers the potential for PM_{10} emissions to negatively impact human health to be low.

Isopleths of PM_{10} emissions for the 24-hour averaging period are presented in Appendix H2-1.

8.3 Particulate Matter Less Than 2.5 Microns

Results for particulate matter less than 2.5 microns ($PM_{2.5}$) were assessed for both the 24-hour and annual averaging periods. In the vicinity of all sensitive receptors, the modelled concentrations comply with the applicable 24-hour and annual air quality standards.

Exceedances of the 24-hour standard are predicted. Exceedances are expected to occur either within 250 m of the northern fenceline, or within 100 m of an ocean-going vessel. Given the nature of the 24-hour averaging period, and considering that the maximum modelled 24-hour concentrations were used for the Study, the areas with predicted exceedances would likely experience these exceedances for only a few days each year.

The 24-hour exceedances are based on the approximated location of the cooling towers near the northern fenceline, which is subject to refinement as the Project design progresses. Should $PM_{2.5}$ emissions remain a concern, GHD recommends remodelling the scenario with finalized source locations and operating parameters. Based on the current modelling results, GHD considers the likelihood of $PM_{2.5}$ emissions causing adverse health impacts to be low.

Isopleths of $PM_{2.5}$ emissions for the 24-hour and annual averaging periods are presented in Appendix H2-1.

8.4 Carbon Monoxide

Results for carbon monoxide (CO) were assessed for both the 1-hour and 8-hour averaging periods. In the vicinity of all sensitive receptors, the modelled concentrations comply with both the 1-hour and 8-hour air quality standards.

No exceedances are predicted, and the maximum modelled concentrations, including observed background concentrations, are well below the limit, comprising less than 2% of the regulatory threshold. Given the low concentrations predicted, isopleths of CO emissions are not presented in this report.

8.5 Nitrogen Dioxide

Results for nitrogen dioxide (NO_2) were assessed for the 1-hour, 24-hour, and annual averaging periods. In the vicinity of all sensitive receptors, the modelled concentrations comply with the applicable 1-hour, 24-hour, and annual air quality standards.

While exceedances of the 1-hour and 24-hour limits are predicted, these are confined to areas immediately adjacent to the ocean-going vessel, within approximately 100 m of the vessel's docking location. Exceedances are only expected when an ocean-going vessel is present, during which time members of the public would be unlikely to be within 100 m of the vessel due to safety and security concerns. When no vessel is present, no exceedances are predicted.

Based on the current modelling results, GHD expects the likelihood of NO_2 emissions having a negative impact on human health to be low.

Isopleths of NO_2 emissions for the 1-hour averaging period are presented.

8.6 Sulphur Dioxide

Results for sulphur dioxide (SO_2) were assessed for the 1-hour, 3-hour, 24-hour, and annual averaging periods. In the vicinity of all sensitive receptors, the modelled concentrations comply with the 1-hour, 24-hour, and annual air quality standards.

No exceedances are predicted, and the maximum modelled concentrations, including observed background concentrations, are well below the limit, comprising less than 10% of the regulatory threshold. Given the low concentrations predicted, isopleths of SO_2 emissions are not presented in this report.

9.0 Conclusion

North Atlantic is proposing the development of the Project in the Isthmus of Avalon region adjacent to the Avalon Peninsula, NL. As part of the Registration process, air quality modelling was undertaken to assess the potential impacts of emissions from Project-related activities. The modelling focused on TSP, PM_{10}, $PM_{2.5}$, NO_2, SO_2, and CO from various sources including stationary combustion, flaring, cooling towers, and ocean-going vessels.

The Study was informed by the Project description, supplementary technical information provided by North Atlantic, and conservative assumptions based on facility type and GHD’s prior modelling experience. Emission rates were estimated conservatively using available data. The modelling followed the methodology outlined in the Guideline and utilized the CALPUFF modelling system to evaluate dispersion.

At and around all identified sensitive receptors (cabins and residences), no exceedances of regulatory air quality objectives were predicted. While isolated exceedances of PM_{10}, $PM_{2.5}$, and NO_2 were modelled, these were infrequent and occurred near the Project footprint in areas with limited or no public access. For particulate matter, exceedances were primarily associated with emissions from the cooling towers; however, given the nature and composition of these emissions, the potential for adverse health impacts is considered low. Conservative assumptions were applied to all sources such that the modelled emissions are greater than the expected actual emissions during operations.

Numerical modelling results are presented in this report, with isopleth maps included in the appendices. Based on current findings, GHD concludes that the likelihood of Project-related emissions resulting in negative health impacts is low. To strengthen this conclusion, GHD recommends updating the dispersion modelling once final source locations and operating parameters are confirmed.

10.0 References

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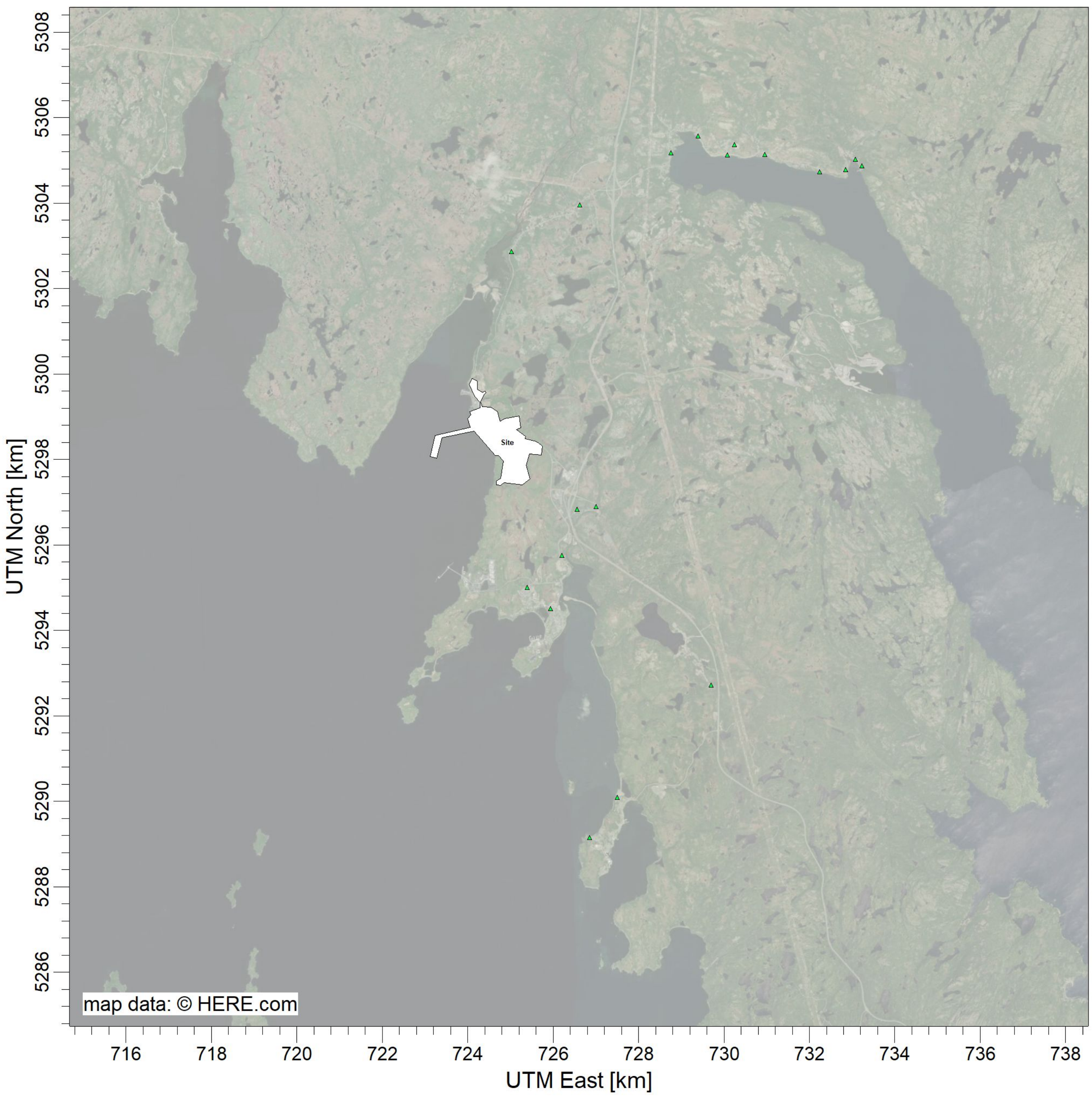
Appendix H2-1: Isopleths

PM_{10} 24-hour average maximum modeled concentration, excluding background concentrations



COMMENTS:

No exceedances of the selected ambient air quality limit.

COMPANY NAME:

North Atlantic Refining Corp

MODELER:

GHD

SCALE: 1:150,000

0 5 km

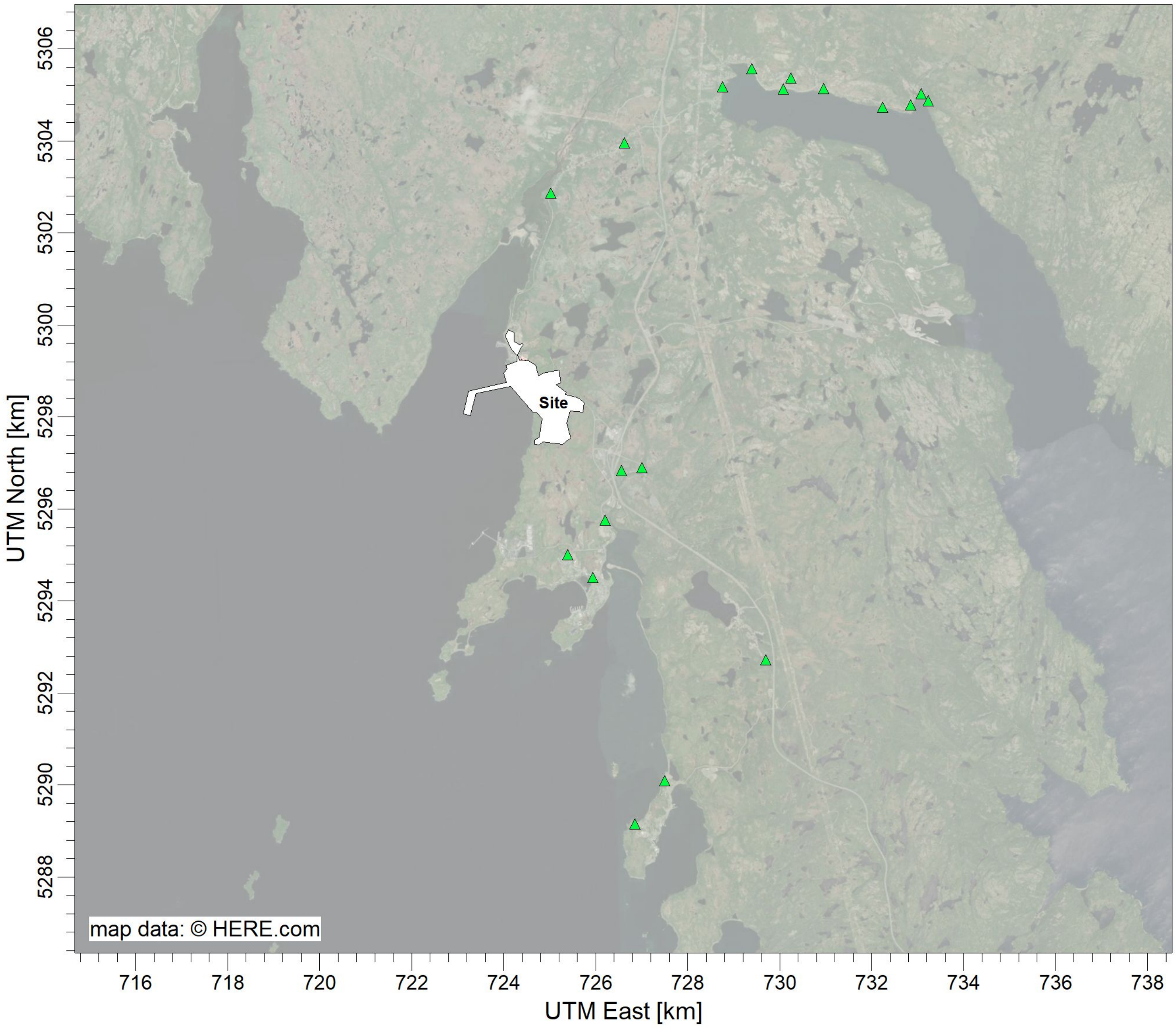
DATE:

6/16/2025

PROJECT NO.:

12611275

PM_{10} 24-hour average maximum modeled concentration, including background concentrations



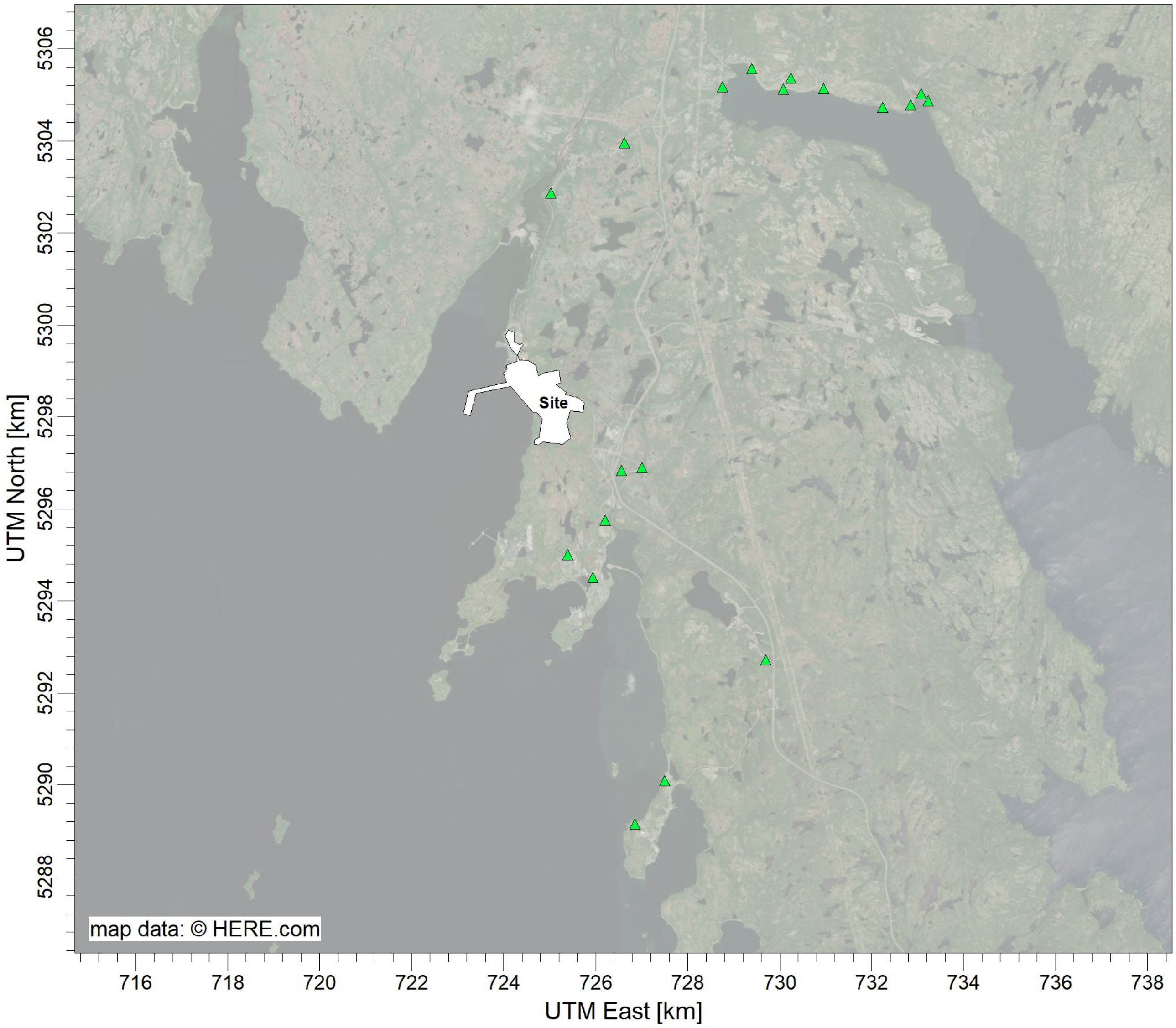
VALUE 24 HOUR AVERAGE CONCENTRATION (PM10) ug/m**3

Max = 62.0 [ug/m**3] at (X = 724381.00, Y = 5299234.00)

50.0 | 57.5 | 65.0

COMMENTS:	COMPANY NAME: **North Atlantic Refining Corp**
	MODELER: **GHD**
	SCALE: 1:150,000 (0 — 5 km)
	DATE: **6/16/2025**
	PROJECT NO.: **12611275**

$PM_{2.5}$ 24-hour average maximum modeled concentration, excluding background concentrations



VALUE 24 HOUR AVERAGE CONCENTRATION (PM2.5)

ug/m**3

Max = 34.0 [ug/m**3] at (X = 724381.00, Y = 5299234.00)

25.0 | 30.0 | 35.0

COMMENTS:

COMPANY NAME:
North Atlantic Refining Corp

MODELER:
GHD

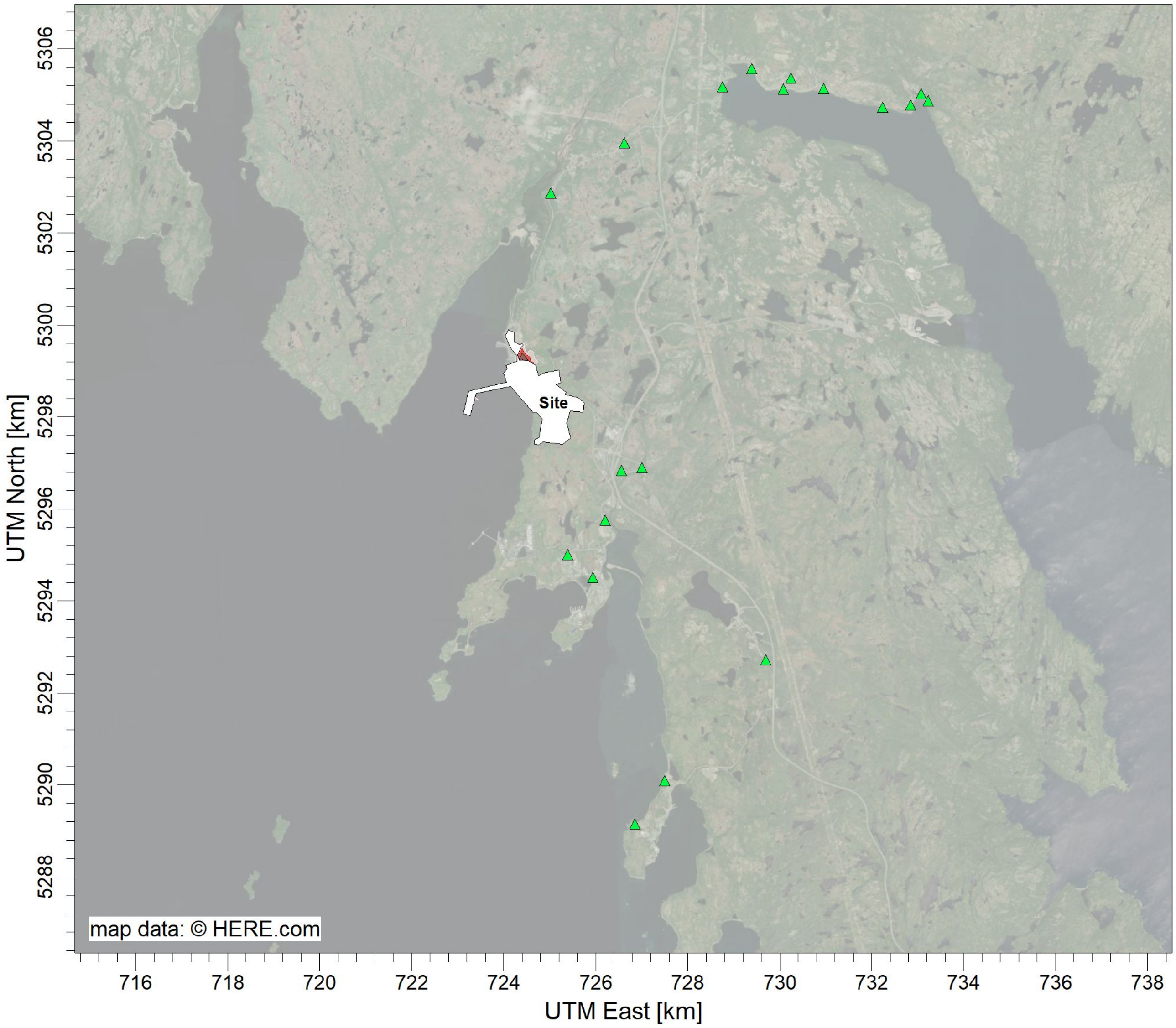
SCALE: 1:150,000

0 — 5 km

DATE:
6/16/2025

PROJECT NO.:
12611275

$PM_{2.5}$ 24-hour average maximum modeled concentration, including background concentrations



VALUE 24 HOUR AVERAGE CONCENTRATION (PM2.5) ug/m**3

Max = 50.0 [ug/m**3] at (X = 724381.00, Y = 5299234.00)

25.0 30.0 35.0

COMMENTS:

COMPANY NAME:
North Atlantic Refining Corp

MODELER:
GHD

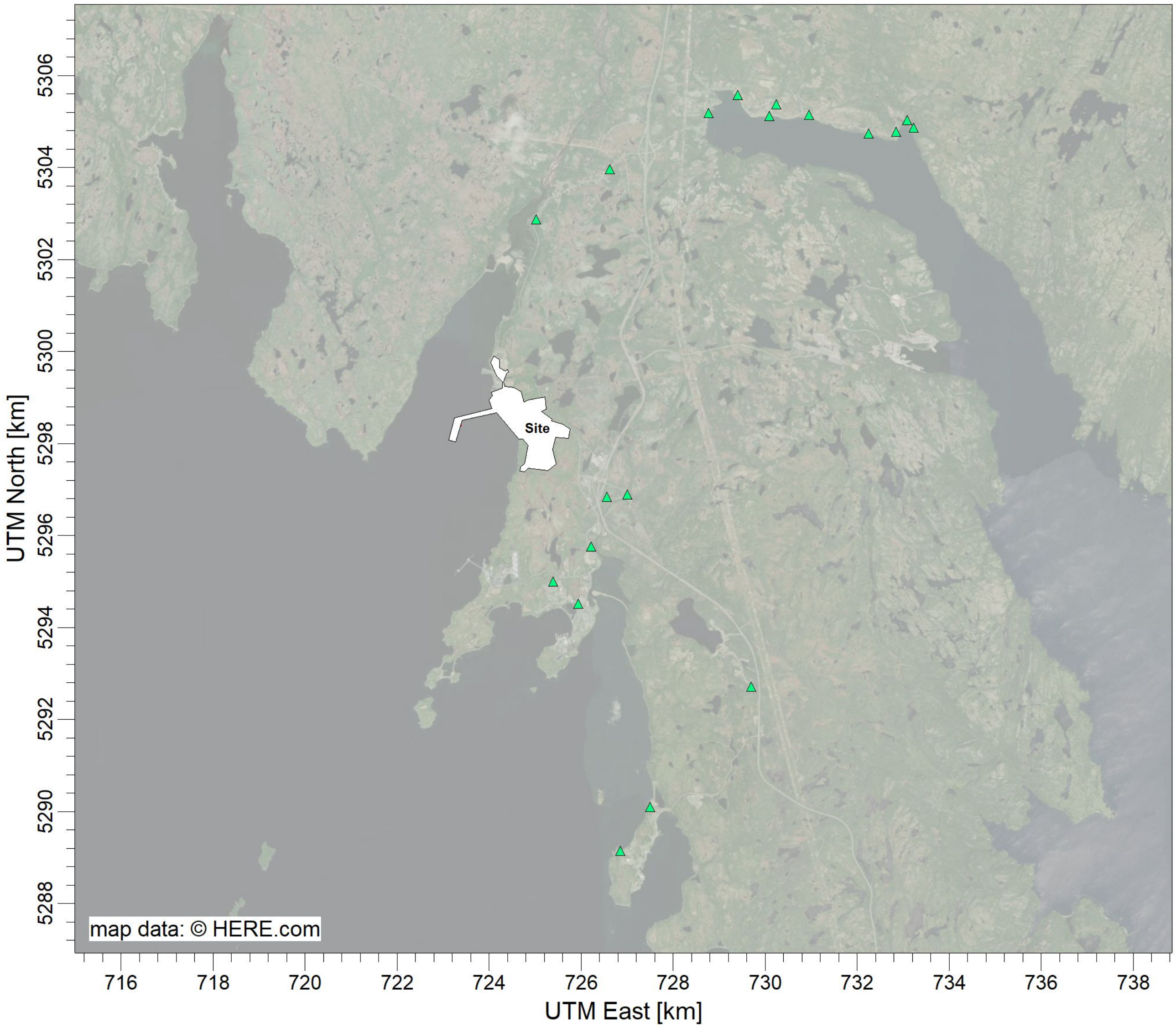
SCALE: 1:150,000

0 5 km

DATE:
6/16/2025

PROJECT NO.:
12611275

NO_2 1-hour average maximum modeled concentration, excluding background concentrations



VALUE 1 HOUR AVERAGE CONCENTRATION (NOX) ug/m**3

Max = 530 [ug/m**3] at (X = 723374.00, Y = 5298391.00)

400 | 450 | 500

COMMENTS:

Maximum value listed above colour scale occurs within Project fenceline - disregard.
Maximum value outside fenceline is presented in the Study.

COMPANY NAME:
North Atlantic Refining Corp

MODELER:
GHD

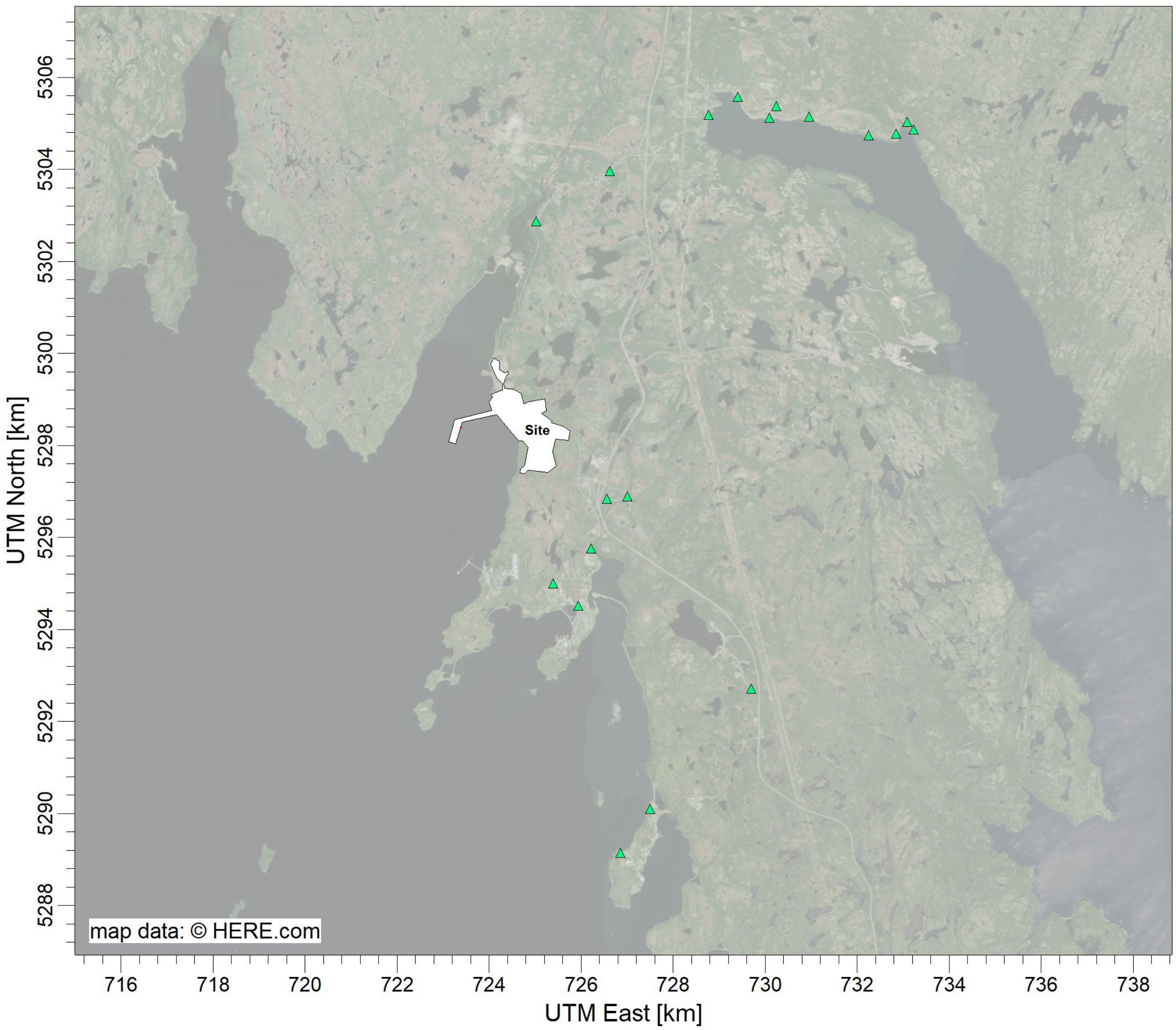
SCALE: 1:150,000

0 — 5 km

DATE:
5/1/2025

PROJECT NO.:
12611275

NO_2 1-hour average maximum modeled concentration, including background concentrations



VALUE 1 HOUR AVERAGE CONCENTRATION (NOX) ug/m**3

Max = 560 [ug/m**3] at (X = 723374.00, Y = 5298391.00)

COMMENTS:

Maximum value listed above colour scale occurs within Project fenceline - disregard.
Maximum value outside fenceline is presented in the Study.

COMPANY NAME:

North Atlantic Refining Corp

MODELER:

GHD

SCALE: 1:150,000

0 5 km

DATE:

5/1/2025

PROJECT NO.:

12611275