Appendix J.2

Ambient Air Quality Assessment -
Fifteen Mile Stream Gold Project,
Wood Environment & Infrastructure Americas

Ambient Air Quality Assessment - Final

Proposed Fifteen Mile Stream Mine Site
Halifax County, Nova Scotia
TAV1987501

Prepared for:

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1.0 AIR QUALITY

An air impact assessment was conducted for the proposed Fifteen Mile Stream (FMS) Gold Project (the Project) to identify and describe potential environmental effects on air quality as a result of the Project, determine compliance with existing air quality criteria, and to identify measures to mitigate any adverse environmental effects on air quality.

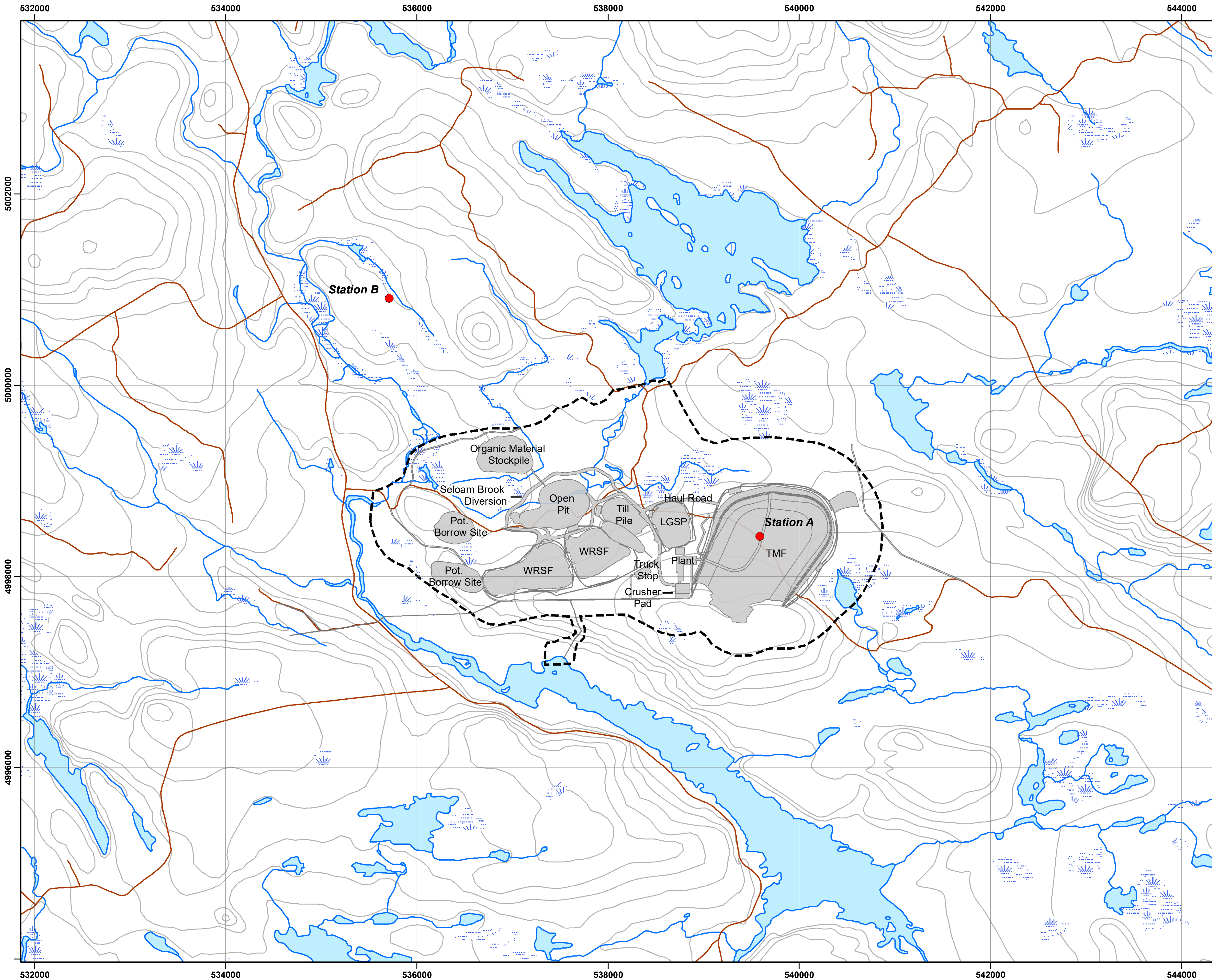
1.1 Project Setting

The Project is located in the County of Halifax, close to (within 5 km) the Guysborough County line (Figure 1-1). The immediate area surrounding Fifteen Mile Stream is primarily rural and with very few people residing in the area. The dominant industries near the mine site are forestry and farming. The closest village, Sheet Harbor, is located 33 km to the south of the mine site with a population of approximately 800 people. Upper Musquodoboit, with an approximate population of 470 people, is located 30 km to the west.

There are no existing or future planned industrial sources in the immediate area of Fifteen Mile Stream. The two closest industrial sources to the proposed mine site are the Scotia Atlantic Biomass Company located approximately 40 km to the west in Upper Musquodoboit and the Touqouy Gold Mine operation located approximately 35 km to the southwest along Mooseland Road.

Some potential future opportunities for the region include other gold mining operations including the proposed Beaver Dam project located approximately 20 km to the west and the proposed Cochrane Hill project located 40 km to the east.

The main sources of air quality emissions in the immediate FMS Mine Site are forestry activities, gasoline and diesel fueled vehicles on highways and the potential for forest fires.

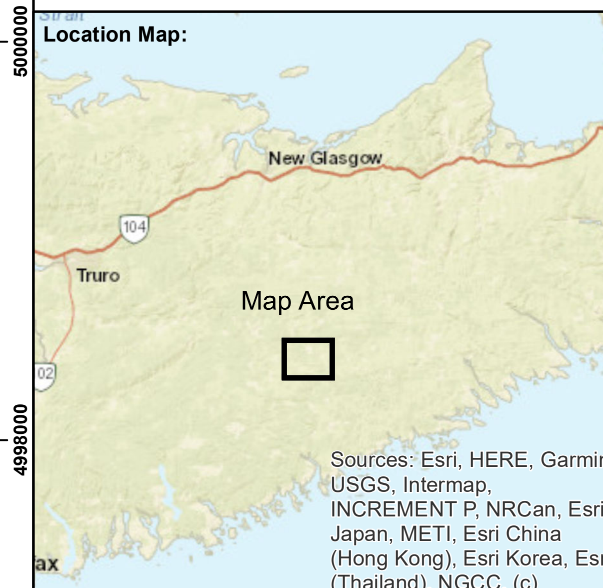


wood.

Legend

- FMS Mine Site
- Preferred Infrastructure Layout
- Air Monitoring Stations

Location Map:



Coordinate System: NAD 1983 CSRS UTM Zone 20N
Projection: Transverse Mercator
Datum: North American 1983 CSRS
Units: Meter

0 500 1,000 2,000 Meters

1:38,000

15/08/2019

Project: Fifteen Mile Stream
Trafalgar, NS

Title: Environmental Air Quality Impact Assessment

Project No.	Figure No.
TV184005	1-1

1.2 Nova Scotia Climate

Nova Scotia has a "temperate continental" climate (Rudloff, 1981) marked by relatively large daily and day-to-day ranges of temperature, especially during the spring and fall, and moderate rainfall. Nova Scotia lies in the "prevailing westerlies" characteristic of mid-latitudes in the northern hemisphere. Within this general circulation are embedded air masses originating at higher or lower latitudes that interact to produce storm systems. Nova Scotia experiences a relatively large number of storm systems that contribute to a roughly twice-weekly shift between fair and cloudy and stormy weather.

The continental climate is modified by Nova Scotia's surrounding waters (EC, 2005a). The Atlantic and Bay of Fundy waters are relatively cold (8-12 °C) which helps to keep the air temperature over southwestern Nova Scotia on the cool side in spring and summer. In January, when water temperatures are between 0 and 4 °C, winter temperatures are moderated. Farther offshore to the east, southeast, and south are the comparatively warm 16 °C waters of the Gulf Stream that are credited with prolonging warm weather well into October.

Ice conditions in the Gulf of St. Lawrence retard the arrival of spring. Cool summer seas also help stabilize overriding air masses, thus suppressing local storm development. In addition, the merging of contrasting ocean currents (i.e., warm Gulf Stream and the cold Labrador Current) produces a great deal of sea fog that often moves far inland. The climatic normals of the assessment area are described in detail below.

1.2.1 Climate Normals for the Region

The climate of the FMS Mine Site is best characterized by long-term meteorological data collected by EC at Upper Stewiacke (Table 1-1) and at Upper Stewiacke station (Table 1-2).

Upper Stewiacke is at an elevation of 22.9 m with latitude 45° 09′ N and longitude 61° 59′ W and is located approximately 38 km west of the FMS Mine Site. The Halifax Stanfield Airport Weather Station is at an elevation of 51 m with latitude 44° 38′ N and longitude 63° 30′ W and is located approximately 75 km southwest of the FMS Mine Site and is included for its wind speed and direction data since these parameters are not available from the Upper Stewiacke station. These distances from the site support their spatial representativeness since they place them in the same general synoptic flow regime as well as most mesoscale systems. The Upper Stewiacke and Halifax Stanfield Airport Weather Stations are also located in a similar geographic setting as the FMS Mine Site. These stations are the closest to the FMS Mine Site and provide the commonly observed meteorological parameters.

Table 1-1 Upper Stewiacke Climate Normals (1981-2010) and Extremes (1916-2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature												
Daily Average (°C)	-6.8	-5.8	-1.6	4.2	9.9	14.7	18.4	18.1	14.0	8.3	3.3	-2.8
Daily Maximum (°C)	-1.5	-0.4	3.5	9.3	16.0	21.1	24.7	24.3	20.1	13.7	7.5	1.9
Daily Minimum (°C)	-12.0	-11.1	-6.6	-0.9	3.7	8.3	12.1	11.9	7.9	2.9	-0.9	-7.4
Extreme Maximum (°C)	16.5	16.7	23.5	28.0	34.4	34.4	35.0	**36.1**	33.3	29.4	21.7	17.8
Date (yyyy/dd)	1995/16	1976/02	1998/31	2004/30	1977/18	1944/29	1949/30	**1935/19**	1942/01	1930/13	1961/05	1927/01
Extreme Minimum (°C)	**-41.1**	-38.9	-30.5	-26.7	-8.3	-3.9	-1.7	-1.7	-7.2	-10.0	-24.4	-36.0
Date (yyyy/dd)	**1920/31**	1922/17	1985/07	1923/01	1945/03	1918/20	1919/08	1942/27	1971/27	1936/28	1916/17	1989/30
Precipitation												
Rainfall (mm)	66.2	59.2	79.4	88.1	98.4	98.4	94.6	94.4	113.6	109.9	122.7	90.7
Snowfall (cm)	71.4	53.5	45.5	13.3	0.5	0	0	0	0	0.1	13.2	50.6
Precipitation (mm)	137.5	112.7	124.9	101.5	98.9	98.4	94.6	94.4	113.6	109.9	135.9	141.3
Extreme Daily Rainfall (mm)	77.7	61.0	56.4	64.4	54.6	56.2	85.9	**132.6**	82.3	90.4	69.9	77.4
Date (yyyy/dd)	1978/14	1953/09	2003/31	1982/28	1952/28	1998/15	1970/11	**1971/15**	1936/20	1967/10	1934/07	1990/08
Extreme Daily Snowfall (cm)	86.0	59.0	32.6	24.2	8.9	0	0	0	0	15.5	25.4	44.8
Date (yyyy/dd)	2005/23	1992/01	1993/11	1997/01	1972/10	1916/01	1916/01	1916/01	1969/22	1955/20	1955/01	2004/27
Days With												
Maximum Temperature >0°C	12.1	12.9	22.6	29.5	31	30	31	31	30	31	28.0	19.3
Measurable Rainfall	7.6	6.1	9.2	13.2	15	14.9	13.5	14.4	14.4	15.8	15.7	10.9
Measurable Snowfall	13.9	10.1	9.6	3.4	0.24	0	0	0	0	0.17	3.8	9.8
Measurable Precipitation	18.4	14.5	15.9	15.2	15	14.9	13.5	14.4	14.4	16	17.8	17.9

Source: EC, 2018-06-19;
http://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnProv&lstProvince=NS&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=6495&dispBack=0

Table 1-2 Halifax Climate Normals (1981-2010) and Extremes (1969-2010)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Wind Speed													
Speed (km/hr)	17.7	18.3	18.5	18.3	16.5	15.2	14.2	13.2	14.4	16.0	17.5	18.3	16.5
Most Frequent Direction	NW	NW	N	N	S	S	S	S	S	W	NW	W	S
Maximum Hourly Speed	80	89	77	71	64	65	79	65	85	68	93	85	
Date (yyyy/dd)	1973/29	1969/10	1976/17	1975/04	1961/26	2008/13	1975/28	2009/30	2003/29	1972/07	2007/04	1976/27	
Maximum Gust Speed (km/hr)	117	127	126	115	92	97	130	91	120	109	113	132	
Date (yyyy/dd)	1978/09	1976/02	1976/17	1982/04	1961/28	1973/17	1975/28	2009/30	2010/04	1972/07	2007/04	1976/26	
Direction of Maximum Gust	SE	SW	SW	SE	SE	N	SE	S	SE	SE	SE	SE	SW

Source: EC, 2018-01-01;
http://climate.weather.gc.ca/climate_normals/results_1981_2010_e.html?searchType=stnName&txtStationName=Halifax&searchMethod=contains&txtCentralLatMin=0&txtCentralLatSec=0&txtCentralLongMin=0&txtCentralLongSec=0&stnID=6358&dispBack=0

1.2.1.1 Precipitation

In general, precipitation in Nova Scotia is well distributed throughout the year with a slight fall to early winter (October to January) maximum in the southern and coastal areas. Nova Scotia is wettest over the highlands of Cape Breton Island, where over 1600 mm of precipitation fall in an average year. The southern coast experiences almost as much, with totals of 1500 mm. By contrast, the north shore along the Northumberland Strait has less than 1000 mm a year.

Precipitation is slightly greater in the late fall and early winter because of the more frequent and intense storm activity. In most years there is a good supply of rain during the spring and summer. However, drought is not unknown in Nova Scotia.

On average, only about 15% of Nova Scotia's total annual precipitation originates as snow. Snowfall is relatively light near the warm Atlantic shore and near the entrance to the Bay of Fundy, where less than 150 cm may fall in one winter. Here, copious rain and freezing rain make up for the scanty snowfalls. Inland, the yearly snowfall increases to 250 cm. As a rule, elevated areas receive the greatest snowfall and have the longest snow cover season.

The snow-cover season, that is, the period when there is at least 2.5 cm of snow on the ground, varies considerably. Usually its duration extends from about 110 days a year along the southern coast to 140 days inland and in areas adjacent to the frozen seas. In coastal areas the snow-cover may come and go. The average annual precipitation reported at the Upper Stewiacke station is 1363.6 mm, of which approximately 18.1% per cent is in the form of snow. The extreme daily precipitation recorded between the years from 1916 to 2010 was 132.6 mm, which occurred in August, 1971 (Table 5.3-1). Total monthly average precipitation range from 94.4 mm in August to 141.3 mm in December.

1.2.1.2 Fog and Sunshine

Each year there is an average of 122 days with fog at the Halifax International Airport. The period from mid-spring to early summer is the foggiest time. Bands of thick, cool fog lie off the coast, produced where the chilled air above the Labrador Current mixes with warm, moisture-laden air moving onshore from the Gulf Stream. With onshore winds these banks of fog move far inland. Sea fog often affects the headlands by day, moving inland and up the bays and inlets at night. At other times of the year fog is much more transient and local in nature.

Because of the extensive fogs, as well as mists, and low cloud, sunshine amounts throughout the province are usually less than half the total possible. Sunshine totals range from 1700 to 1969 hours a year. August is the sunniest month along the coast. Sunless days (days with less than 5 minutes of bright sunshine) amount to between 75 and 90 a year, with a marked seasonal high from November to February. Sunny days, on which less than 70% of the sky is covered with cloud in the early afternoon, amount to between 130 to 160, with a peak from July through October.

1.2.1.3 Severe Weather

Storms frequently pass close to the Atlantic coast of Nova Scotia and cross the southern part of Newfoundland, producing highly changeable and generally stormy weather. This region has more storms over the year than any other region of Canada. With a variety of weather conditions from hurricane-force winds to heavy precipitation, storm systems can pass rapidly through or stall and batter the region for several days. Other conditions associated with these storms include freezing spray, reduced visibility in snow, rain, or fog, and numbing wind chills, especially in the storm's wake.

In late summer and fall the remnants of a hurricane or tropical storm are felt at least once a year in Nova Scotia. For example, in September 2003, Hurricane Juan struck Atlantic Canada with peak winds of 165 km/hr. Juan resulted in eight fatalities and over 200 million dollars in damage and was described as the worst storm to hit Halifax since 1893 (Environment Canada, 2003).

Thunderstorms are infrequent in Nova Scotia and occur on about 10 days of the year. The most winter lightning in Canada occurs in an area south of Sable Island, in the Atlantic Ocean. Cold air moving down from the Arctic collides with warmer air rising from the Gulf Stream. This collision creates ideal conditions for thunderstorms and lightning (EC, 2007b).

Tornadoes have been recorded but are rare. Reports of waterspouts over near-shore waters are received yearly. Other severe weather phenomena include ice storms and blizzards. Each year one or two 25 cm plus snowfalls occur in Nova Scotia. When combined with strong winds, impacts can include property damage and loss of life.

1.2.1.4 Thermal Inversions

Under certain conditions, an atmospheric thermal inversion layer occurs. Thermal inversions result when a layer of cooler air is trapped near ground level by a layer of warmer air above. Under these conditions, the vertical motion of air flow is strongly suppressed. If the base of the inversion lies above the level of the plume, then the volume of air available for dilution is limited. The elevated inversion acts as a lid, restricting vertical mixing, reducing dilution and increasing ground-level concentrations in areas with high emissions.

Temperature Inversions are expected to be experienced for short durations in the assessment area due to the influence of the sea-land interphase. The temperature inversions are particularly important due to the ability to hinder dispersion or to promote a phenomenon known as fumigation.

1.2.1.5 Temperatures

The range of temperatures at the site is rather large from winter to summer. Summers are relatively cool; for example, the warmest average daily maximum temperature recorded at the Upper Stewiacke station during summer months was 24.7 °C in the month of July. The record high temperature at the Upper Stewiacke station was 36.1 °C in the month of August. Winters are cold with an average daily minimum temperature in January at Upper Stewiacke of -6.8°C. The lowest recorded temperature at Upper Stewiacke was -41.1 °C. The most significant aspect of winter is the marked day-to-day variation caused by the alternation of Arctic and maritime air.

1.2.1.6 Winds

The wind at any given location is often quite different from the wind conditions which prevail even at distances a short distance away. The variation that occurs in both wind direction and speed results from the characteristics of natural and man-made obstructions, topography, and surface cover. Along the coast, an onshore sea breeze circulation often sets up, particularly during a warm, sunny afternoon in the spring or early summer.

Unfortunately, wind data is not available from the Upper Stewiacke Station. Wind information is available from the Halifax Stanfield Airport Weather Station which is located approximately 75 km west of the FMS Mine Site. Winds at Halifax Stanfield Airport Weather Station are fairly light with the highest speeds occurring in the winter with an average of 18.2 km/h for those months. A peak gust of 132 km/h was recorded in December 1976. The lightest winds occur in summer with a monthly average wind speed of 13.2 km/h in August. The mean wind speed for the year is 16.5 km/h. The prevailing wind direction at the Halifax Stanfield Airport Station is from the south from May through September and from the west, northwest and north from October through April.

1.3 Regulatory Regime

Nova Scotia has an Environment Act, which includes the Air Quality Regulation. The Air Quality Regulation contains maximum permissible ground level concentrations for air quality in Nova Scotia. The Environment Act states that "no person shall knowingly commence or continue any activity designated by the regulation as requiring an approval unless that person holds the appropriate approval." The Activities Designation Regulation indicates which sectors require an Approval to Construct and/or an Approval to Operate (NSEL, 2007b).

The Approvals to Operate are valid up to 10 years. The Province has also developed guidelines and standards with respect to industrial air emissions, though these are not binding unless they are included in the Approval. Quantification methodologies are prescribed in the Approvals, as are reporting requirements. The Air Quality regulations also indicate reporting requirements for specific scenarios and emission thresholds.

The quantification and reporting information collected is used to determine compliance with Approvals. NSEL has established maximum permissible ground level concentrations for ambient air quality in Nova Scotia. All approvals issued by the Minister of Environment and Labour contain provisions to ensure that the maximum permissible ground level concentrations are not exceeded. Table 1-3 shows the applicable provincial criteria relating to ambient air quality.

Table 1-3 Provincial Ambient Air Quality Maximum Permissible Ground Level Concentrations

Pollutant	Averaging Time Period	NOVA SCOTIA Maximum Permissible
Nitrogen Dioxide (μg/m^3)	1 hour	400
	24 hour	-
	Annual	100
Sulphur Dioxide (μg/m^3)	1 hour	900
	24 hour	300
	Annual	60
Total Suspended Particulate Matter (μg/m^3)	24 hour	120
	Annual	70
PM_{10} (μg/m^3)	24 hour	-
$PM_{2.5}$ (μg/m^3)	24 hour	-
Arsenic (μg/m^3)	24 hour	-
Carbon Monoxide (mg/m^3)	1 hour	34, 600
	8 hour	12, 700

Unfortunately, Nova Scotia does not have objectives available for PM with aerodynamic diameter less than 10 microns in diameter (PM_{10}), PM with aerodynamic diameter less than 2.5 microns in diameter ($PM_{2.5}$), and arsenic.

The Canadian Council of Ministers of the Environment (CCME) have developed a Canada-Wide Standard (CWS) for $PM_{2.5}$ of 30 μg/m^3, based on a 24-hour average over three consecutive years.

The Ontario Ministry of Environment Conservation and Parks (MECP) provide ambient air quality criteria of 0.3 μg/m^3 for arsenic 50 μg/m^3 for PM_{10} based on a 24-hour averaging period.

The Ontario MECP criteria for PM_{10} and arsenic and CWS for $PM_{2.5}$ will be used for the project where Nova Scotia ambient air quality objectives are not available.

It should be noted that in October 2012 jurisdictions, with the exception of Quebec, agreed to begin implementing a new federal air quality management system (AQMS). AQMS is a comprehensive approach for improving air quality in Canada and is the product of collaboration by the federal, provincial and territorial governments and stakeholders. It includes:

- New Canadian Ambient Air Quality Standards (CAAQS) to set the bar for outdoor air quality management across the country;
- Industrial emissions requirements that set a base of performance for major industries in Canada;

- A framework for air zone air management within the provinces and territories that enables action tailored to specific sources of air emissions in a given area;
- Regional airsheds that facilitate coordinated action where air pollution crosses a border; and
- Improved intergovernmental collaboration to reduce emissions from the transportation sector.

The CAAQS will be established as objectives under the *Canadian Environmental Protection Act 1999*, and will replace the existing Canada-Wide Standards under CCME. Table 1-4 provides a list of the CAAQS fine particulate matter, ozone, NO_2 and SO_2 standards.

Table 1-4 Canadian Ambient Air Quality Standards (CAAQS) for Fine Particulate Matter ($PM_{2.5}$), Ozone, Nitrogen Dioxide and Sulfur Dioxide

Pollutant	Averaging Time	Standards (numerical values)		Metric
		2015	2020	
$PM_{2.5}$	24-hour (calendar day)	28 µg/m³	27 µg/m³	The 3-year average of the annual 98th percentile of the daily 24 hour average concentrations.
$PM_{2.5}$	Annual (calendar year)	10 µg/m³	8.8 µg/m³	The 3-year average of the annual average concentrations.
Ozone	8-hour	63 ppb	62 ppb	The 3-year average of the annual 4th highest daily maximum 8 hour average concentrations.
NO_2	1-hour	-	60 ppb	Achievement based on the 3-year average of the NO_2 daily maximum 1 hour average concentrations.
	Annual	-	17 ppb	Achievement based on average over a single calendar year of all the 1-hour average NO_2 concentrations.
SO_2	1-hour	-	70 ppb	Achievement based on 99th percentile of daily 1 hour maximum, averaged over three consecutive years.
	Annual	-	5 ppb	Achievement based on annual average of 1-hour concentrations over one year.

The AQMS is designed to address the challenges of air quality management, including cross-jurisdictional issues, and deliver a Canada-wide approach that provides flexibility to deal with regional differences in air quality issues while, at the same time, ensuring a level of consistency so that Canadians can be assured of good air quality outcomes.

For industry, the AQMS proposes establishing base-level industrial emissions requirements (BLIERS) in major industrial sectors, initially for SO_2, NOx, VOCs and TPM. Eventually other pollutants may be addressed. The BLIERS are intended to ensure that all significant industrial sources in Canada, regardless of where facilities are located, meet an acceptable benchmark of environmental performance. Wherever possible, the BLIERS would build on existing pollution controls, agreements and protocols that assure the appropriate standard of emissions performance.

BLIERS would be set under a federally lead, time-limited federal/provincial/territorial consensus process, with stakeholder involvement, and will be reviewed regularly to ensure they reflect technological improvements.

Environment and Climate Change Canada is implementing BLIERs using a mix of regulatory and non-regulatory instruments. The sectors considered under AQMS are:

- Aluminum and alumina
- Base metal smelting
- Cement
- Chemicals
- Electricity
- Fertilizers
- Iron ore pellets
- Iron, steel and ilmenite
- Oil sands
- Petroleum refining
- Pipelines
- Potash
- Pulp and paper
- Upstream oil and gas

Currently, gold mining is not a targeted sector under the BLIER's system.

2.0 BASELINE AIR QUALITY

The specific air contaminants that are of most interest relative to the Fifteen Mile Stream project consist of the following:

- Total suspended particulates (TSP), Particulate Matter less than 10 micron (PM_{10}), and Particulate Matter less than 2.5 micron ($PM_{2.5}$); and
- Metals (arsenic).

Construction activities can generally be categorized into site preparation, buildings construction (stockpile processing building and administration building), and road construction activities. During construction, activities will include the use of internal combustion engines in various cranes, backhoes, dozers, loaders, pavers, trucks, welders, generators, air compressors, pumps, pile drivers, miscellaneous heavy construction equipment, and worker commuting vehicles. The operation of these vehicles will result in exhaust emissions containing nitrogen oxides (NOx), sulphur dioxide (SO_2), carbon monoxide (CO), PM_{10}, $PM_{2.5}$, and volatile organic compounds (VOCs).

Operations at the FMS Mine Site will mainly consist of earth moving, piling, storage and transporting of material mined from the open pit. The primary emissions from these activities will include TSP, PM_{10}, and metals. Particulate and metals originating from soil materials may be transported by the wind during these earthmoving activities. Arsenic is naturally found in soils in Nova Scotia, especially in areas that have deposits of metals.

There are two main issues with uncontrolled particulate emissions containing metals leaving a site. The first is the potential impact to air quality when guidelines area exceeded. The second is the accumulation over time of metals on soil which eventually may result in exceedance to soil quality criteria. It should be understood meeting air quality objectives does not mean that soil will not accumulate metals above soil criteria.

The following are other air contaminants that will generated but will be less of a concern:

- Sulphur dioxide (SO_2), formed when fuel containing sulphur, such as coal and oil, is burned, and when gasoline is extracted from oil, or metals are extracted from ore;
- Nitrogen oxides (NOx), generated when fuel is burned at high temperatures as in a combustion process;
- Carbon monoxide (CO), formed from the incomplete combustion of carbon-containing fuel; and
- Volatile Organic Compounds (VOCs).

SO_2, NO_x, CO, and VOC emissions will be generated from the operation of diesel fired equipment such as excavators, haul trucks, and graders. Similar emissions will be generated from non-site related vehicle traffic driving along Route 374.

The following sections provide a discussion of criteria air contaminant and greenhouse gas inventories for the region, a summary of representative baseline data and a discussion on Provincial greenhouse gas commitments and policies.

2.1 Criteria Air Contaminants and Greenhouse Gases

It is useful to examine the existing releases of air contaminants from local sources in the assessment area. This serves as a benchmark for comparing the emissions related to the proposed Project and to assist in the assessment of cumulative environmental effects. These existing releases of air contaminants are generally classified into two categories: criteria air contaminants (CACs), which include particulate matters, sulphur dioxide, nitrogen oxides, carbon monoxide, and greenhouse gases (GHGs).

2.1.1 Criteria Air Contaminant Emissions

This section provides a summary of CAC emissions for all sources in Nova Scotia (Table 2-1) and for major regulatory permitted industrial sources (Table 2-2) in the area that submit emissions information to the National Pollutant Release Inventory (NPRI). The NPRI is a legislated, nation-wide, publicly accessible inventory of pollutants released, disposed of, and recycled by facilities in Canada. Facilities which meet reporting requirements are required to report to the NPRI under the Canadian Environmental Protection Act (CEPA).

Table 2-1 NPRI 2015 CAC Emissions of Nova Scotia (tonnes/year)

Category	TPM	PM_{10}	$PM_{2.5}$	SOx	NOx	VOC	CO	Pb (kg)
Total Ores and Mineral Industries	3667	1436	269	425	380	46	250	79.4
(Mining and Rock Quarrying)	2095	1017	104	-	-	-	-	-
Total Oil and Gas	78	76	76	1089	1042	1133	328	-
Total Electric Power Generation	806	520	348	60227	15646	32	2331	23.6
Total Manufacturing	2305	1725	953	373	636	2126	1232	0.7
Total Transportation	1541	1509	1180	1269	50084	6314	63051	200.1
Total Agriculture	2815	797	242	-	3	2470	-	-
Total Commercial/Residential/Institutional	11732	11058	11001	453	2909	16993	74483	227.4
Total Incineration and Waste	156	117	101	13	43	354	512	5.5
Total Paints and Solvents	-	-	-	-	-	8358	-	-
Total Dust	296425	75562	13536					
Total Fires	9	9	9	-	1	9	51	-
Total	319535	89809	27713	68830	70744	37836	142239	536.6

Source: EC, 2018 http://ec.gc.ca/inrp-npri/donnees-data/ap/index.cfm?do=ap_result&process=true&sector=&lang=en&year=2015&substance=all&location=NS&submit=Submit

A review of Table 2-1 indicates that the majority of particulate matter emissions in the province originate from total dust. The total dust category includes coal transportation, construction operations, mine tailings, paved roads and unpaved roads. Dust from paved roads contributed 50.2% to total particulate, 37.9% to PM_{10}, and 50.8% to $PM_{2.5}$ totals. Dust from unpaved roads contributed 48.2% to total particulate, 59% to PM_{10}, and 47.2% to $PM_{2.5}$ totals.

Table 2-2 provides a summary of CAC emissions from regulatory permitted point sources within a 50 km radius of the Fifteen Mile Stream site.

Table 2-2 Emissions from Permitted Point Sources in the Assessment Area - 2015

Source	Criteria Air Contaminant Emissions (tonnes/year)						
	CO	NO_X	SO_2	VOCs	TSP	PM_{10}	$PM_{2.5}$
Scotia Atlantic Biomass (8070)	45	34	--	224	284	68	6.6

Source: EC, 2018; https://pollution-waste.canada.ca/national-release-inventory/archives/index.cfm?do=facility_substance_summary&lang=en&opt_npri_id=0000008070&opt_report_year=2015
A review of Table 5.3-6 indicates that the only reported permitted source in 2016 is the Scotia Atlantic Biomass Company located in Upper Musquodoboit.

According to a 2015 emissions inventory reported by EC, the only other significant source of air emissions in the region is the Scotia Atlantic Biomass Company located in Upper Musquodoboit approximately 40 km to the west of Fifteen Mile Stream.

2.1.2 Greenhouse Gases

Greenhouse gasses (GHGs) including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) can be emitted from a number of natural and anthropogenic sources. Emissions from biogenic or other sources generally exhibit little variation from one year to the next, and are considered to be nominal when compared to those resulting from the combustion of fossil fuels.

The Canada total GHG emissions for the years 1990 and 2005 and 2015 are presented in Table 2-3 (Environment Canada, 2012d).

Table 2-3 Greenhouse Gas Emissions: Canada

	1990 Emissions (Mt CO_2e)	2005 Emissions (Mt CO_2e)	2015 Emissions (Mt CO_2e)
Oil and Gas	107	157.9	189.5
Transportation	121.8	163.2	173
Buildings	73.5	85.5	85.6
Electricity	94.5	116.9	78.7
Heavy Industry	96.6	86	74.6
Agriculture	60.1	74.4	72.8
Waste and others	56.9	54.4	47.6
Total	610.4	738.3	721.8

Source: EC 2018; https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions/canadian-economic-sector.html

In 2015, oil and gas accounted for almost 81% of the CO_2e emitted in Canada. There is an decreasing trend in GHG emissions in the last decade. Between 2005 and 2015, Canada saw GHG emissions fall by 16.5 megatonnes (MT) CO_2e (approximately 2.2%).

The Nova Scotia total GHG emissions for the years 1990, 2005 and 2015 are presented in Table 2-4.

Table 2-4 Greenhouse Gas Emissions: Nova Scotia(1)

Sector	1990 Emissions (kt CO_2e)	2005 Emissions (kt CO_2e)	2015 Emissions (kt CO2e)
Total	19800	23200	16200

Note: (1) Source: EC 2018; https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/greenhouse-gas-emissions/province-territory.html

Between 2005 and 2015, Nova Scotia saw GHG emissions fall by 7,000 kilotonnes (kt) CO_2e (approximately 30%).

2.2 Baseline Ambient Air Concentrations

The immediate area surrounding Fifteen Mile Stream is primarily rural and with very few people residing in the area, and as a result, the ambient air concentrations for particulate are expected to be low due to the lack of sources in the area. Baseline data has been collected at the following three mine sites: Fifteen Mile Stream, Cochrane Hill and Beaver Dam. All these sites are located on the eastern shore of Nova Scotia within 60 km of each other and are similar with respect to the remoteness of each location. There is limited baseline data for particulate levels near the Fifteen Mile Stream area. At Fifteen Mile Stream, in November of 2017, Wood collected TSP (including arsenic) and PM_{10} samples for two 24-hour events at two separate locations (Figure 1-1). Sampling was performed using Tisch reference method high volume samplers with diesel fired generators providing power. In addition, some baseline particulate data using similar sampling methods was collected for all three projects and this data is included in this section in order to provide as much data as possible for this part of the province. Table 2-5 provides a summary of data collected for all three mining projects.

Table 2-5 Summary of Baseline Particulate and Metals Concentration in µg/m³

Fifteen Mile Stream, Cochrane Hill and Beaver Dam

Location	Date of Sampling	# of Events	TSP	PM_{10}	Arsenic
Fifteen Mile Stream(1)	Nov. 2017	One 24 hour sampling event; two locations	9.6 and 14	9.2 and 9.5	Not detected in two samples(2)
Cochrane Hill(1)	Nov. 2017	One 24 hour sampling event; two locations	10.7 and 10.7	9.7 and 10.5	Not detected in two samples
Beaver Dam	2008	Two locations	Range 1.7 to 41.7(3)	7.1 to 13	NA
	2014	One location	4.6	NA	NA

Note:
(1) Sampling was performed at 2 locations near the site boundaries.
(2) Arsenic (<0.00071 to <0.0013 µg/m³) was not detected in the TSP samples.
(3) Recent clear cutting (in 2008) resulted in the elevated concentration of 41.7 µg/m³. This location was resampled in 2014 with a concentration of 4.6 µg/m³

A review of the data included in Table 2-5 confirms the general assumption particulate levels in these areas are low. Recent data collected at Fifteen Mile Stream and Cochrane Hill provide an average of 11.3 µg/m³ for TSP and 9.7 µg/m³ for PM_{10}. The metal arsenic as not detected in any of the four TSP samples. For purposes of assessing background data for TSP and PM_{10} for the Fifteen Mile Stream project, the data for Fifteen Mile Stream and Cochrane Hill will be used.

Nova Scotia provides an ambient air objective for TSP of 120 µg/m³ for a 24-hour averaging period. Although there are no ambient air objectives provided by Nova Scotia for PM_{10} and metals, the Ontario Ministry of the Environment does provide an ambient air quality criteria of 50 µg/m³ for PM_{10}; and 0.3 µg/m³ for arsenic for a 24-hour averaging period. All results were below their respective regulatory values.

There is a lack of background data for the criteria air pollutants such as NO_2 and SO_2 for the area. Currently, there are minimal emissions sources in the immediate area that would generate these parameters. NSE does monitor for these parameters throughout the province, however, most areas monitored are either urban or suburban and do not represent a remote rural area such as Fifteen Mile Stream. The closest rural area in which the NO_2 and SO_2 parameters were monitored is Goldboro, NS, located approximately 70 km east of the site. Monitoring was required near the Goldboro Gas Plant as part of the ExxonMobil project. Continuous monitoring for NO_2 and SO_2 near the Goldboro Plant was conducted in Seal Harbour from June 10th, 2004, through August 10th, 2004. The highest monitored 24-hour NO_2 concentration during this 2-month period was approximately 5.2 µg/m³ and the highest SO_2 value was 10.4 µg/m³. Nova Scotia provides an ambient air objective for NO_2 of 200 µg/m³ and an objective for SO_2 of 300 µg/m³ for a 24-hour averaging period.

Monitoring $PM_{2.5}$ was also conducted for three 24-hour periods at Seal Harbour in each of July, August, and September of 2004. The highest monitored $PM_{2.5}$ value was 4.0 µg/m^3. Seal Harbour is located approximately 60 km to the east of Fifteen Mile Stream. A review of NAPS stations in Nova Scotia determined there is only one area, Aylesford, which is considered rural where $PM_{2.5}$ is monitored. In 2016, the annual average for $PM_{2.5}$ at the Aylesford station was 5.7 µg/m^3 (Province of NS, 2016). The CCME provides a CWS for $PM_{2.5}$ of 30 µg/m^3, based on a 24-hour average over three consecutive years.

Although the above referenced data for the ExxonMobil project was collected almost 14 years ago, there has not been any other major industrial sources added to the eastern shore area of the Province.

2.3 Climate Change

Nova Scotia is committed to playing a constructive role in responding to climate change and moving forward in a manner that ensures the province will be a model of economic and environmental sustainability. In 2009, Nova Scotia developed a Climate Change Action Plan to reduce Nova Scotia's contribution to climate change by reducing greenhouse gas emissions and to prepare for changes to Nova Scotia's climate that are already inevitable. In 2009 Nova Scotia also released the Greenhouse Gas Emissions Regulations that establish GHG emission caps on the electricity sector.

In 2011, the Province developed two documents that address climate change:

- Guide to Considering Climate Change in Project Development in Nova Scotia, February, 2011; and
- Guide to Considering Climate Change in Environmental Assessments in Nova Scotia, February, 2011.

In 2012, Nova Scotia developed the Environmental Goals and Sustainable Prosperity Act (EGSPA). The EGSPA is a piece of legislation that imposes aggressive targets to reduce greenhouse gas emissions, promote renewable energy, improve air and water quality and protect ecosystems.

Climate change is an important issue for Nova Scotia. Changes in seasonal weather patterns can affect energy demand and supply along with the agricultural and forestry growing seasons. One of the most dramatic and potential costly impacts of climate change will be more extreme weather. Climate change is expected to result in warmer weather with an increase in total precipitation falling in fewer but more intense events. Increases in precipitation, especially intensity of precipitation, could impact local infrastructure which is critical to ensuring services such as health care and education can be provided without disruption. At the same time, changes in winter snow conditions or periods without rain may impact run-off and overall water quality

Nova Scotia's Guide to Considering Climate Change in Environmental Assessments in Nova Scotia recognizes that Environmental Assessment (EA) is an important planning tool that is used to guide project developments to:

- minimize impacts on the environment;
- identify effects of the environment on the project; and
- to incorporate sustainability into project planning, development, operation, and decommissioning.

Through the EA, the environmental effects of a proposed project are predicted and evaluated, and a conclusion is made on the acceptability of the project from an environmental perspective. An EA also serves to promote sustainable development by identifying measures to protect and conserve the environment for future generations. By identifying and addressing environmental effects at the earliest stages of project development, the EA may also help proponents save time and money.

A key element of environmental sustainability will be how project proponents incorporate climate change considerations - greenhouse gas emissions reductions and climate change adaptation – into their respective projects.

The importance of an EA process as an effective tool for climate change mitigation and adaptation planning and management has been identified by the United Nations Framework Convention on Climate Change (UNFCCC) as well as by the World Bank, United Nations and other international development agencies. As such, climate change is increasingly becoming a key part of the EA process worldwide. This is because in the context of global climate change, it has been recognized that EAs should consider not only energy use/conservation and effects of emissions or sequestration of greenhouse gases, *i.e.* a project's contribution to climate change, but also the impacts of climate change on a project.

In 2009, Nova Scotia released the Greenhouse Gas Emissions Regulations establishing GHG emission caps on the electricity sector. As of 2014, Nova Scotia has already reduced GHG emissions 17% below 1990 levels, the most of any province in Canada, and is on track to reach 24% by 2020. This far surpasses the Provinces target of 10% below 1990 levels by 2020 (Province of Nova Scotia, 2018). Under the Paris Agreement, Canada has committed to reducing GHG emissions by 30% below 2005 levels by 2030.

3.0 AIR QUALITY EFFECTS ASSESSMENT

An assessment of the potential air quality effects of the proposed mining operation in accordance with generally accepted air quality assessment methodologies was completed.

The Air Quality Assessment methodology involved the following distinct steps:

- Identify the significant emissions sources associated with the mine site construction and operation phases;
- Identify key, or target, pollutants released to the atmosphere from the identified sources;
- Determine the baseline ambient air quality conditions in the absence of the project for each of the target pollutants;
- Identify the relevant regulatory air quality standards and criteria, and establish the appropriate assessment criteria for the site;
- Estimate the air emission rates for each of the target contaminants using appropriate estimation methods and established data sources;
- Perform dispersion modelling using the U.S. Environmental Protection Agency AERMOD Model, a model typically used on previous EIAs in Nova Scotia;
- Compare the dispersion modelling output to the assessment criteria, comparing predicated offsite effects on ambient air with corresponding air quality standards or criteria.

3.1 Construction Air Quality Impacts

The use of equipment to construct the site will result in temporary, short-term emissions of air pollutants that will be restricted to the construction period for onsite road construction and buildings construction and will terminate once construction has been completed. These emissions will likely not result in significant adverse impacts to the air quality within the vicinity of the FMS Mine Site. Best Management Practices for fugitive dust control measures will be implemented.

Mine site construction activities can generally be categorized into site preparation, buildings construction (stockpile processing building and administration building), and road construction activities. During building construction, activities will include the use of internal combustion engines in various cranes, backhoes, dozers, loaders, pavers, trucks, welders, generators, air compressors, pumps, pile drivers, miscellaneous heavy construction equipment, and worker commuting vehicles will result in emissions of NO_X, SO_2, CO, PM_{10}, $PM_{2.5}$, and VOCs.

At Fifteen Mile Stream, rock waste requirements of 1.2 MT for tailings dam construction and 0.3 MT for haul road construction will be mined before preproduction and any in-situ ore that must be moved will be stockpiled.

Fugitive dust emissions from activities such as site preparation, grading, road construction and vehicle traffic will occur during construction periods. Prior to paving or revegetation of disturbed soil areas within the FMS Mine Site, wind erosion of displaced soil may also generate fugitive dust emissions. Atlantic Mining NS Corp will use construction Best Practices to minimize the fugitive dust emissions associated with construction of the mine site. These measures may include the application of water or other approved dust suppressants on storage piles, unpaved areas and haul roads; covering of haul trucks; use of paved roads to the extent possible; limiting onsite vehicle speed; limiting track-out onto paved sections; and stabilizing disturbed areas.

It is expected that construction activities may last as long as 1 year. As the site is isolated and unpopulated, the impacts to the public are expected to be insignificant, approaching background concentrations at off-site locations. The closest residence is more than 4.9 km from the mine site.

Dispersion modelling was not performed for the construction phase since the activities (materials handling, dumping, grading, etc.) occurring during construction are similar in nature and magnitude to those performed during operations. The operations modelling results will also be representative of impacts generated from construction.

3.2 Operational Air Quality Impacts

In general, emissions from the operation of the Fifteen Mile Stream mine site will be managed in a manner to meet ambient air quality objectives that fall under the Nova Scotia Department of Environment (NSE) Act (Section 112 of the Environment Act S.N.S 1994-95, c. 1).

The Fifteen Mile Stream project is being planned along with other Atlantic Mining NS Corp mine sites including Beaver Dam and Cochrane Hill and the Touquoy mine site which is currently in operation. Fifteen Mile Stream construction is scheduled for 2020/2021 with operations to start late 2021. The concentrate from Fifteen Mile Stream will be transported on 69.3 km of paved road and 12.9 km of unpaved road to Touquoy facility for final ore production. An estimated 40.5 MT of material will be excavated over the expected 10-year life span of the mine.

The mining operations will include the drilling and blasting of in-situ rock in 5 m benches so that suitable fragmentation will be created to allow for efficient loading and hauling of both ore and waste rock. Till and topsoil will not require blasting. Loading in ore zones will be completed with hydraulic excavators on either 2.5 or 5 m benches, depending on grade control requirements and in waste zones with hydraulic excavators and wheel loaders.

Ore and waste rock will be hauled out of the pit using off-highway haul trucks.

Mining operations will be based on 365 years per year within two 12-hour shifts. An allowance of 10 days of no mine production has been built into the mine schedule to allow for adverse weather conditions.

Grade control drilling will be carried out with 135 mm diesel hydraulic RC drills. Production drilling will be carried out with 110 mm diesel hydraulic DTH drills at each operation. Hydraulic excavators

($4.5 \ m^3$ bucket), front end wheel loaders ($7.0 \ m^3$ bucket), rigid frame haul trucks (64 t payload) and articulated haul trucks (41 t payload) will be used in the pit.

Graders will be used to maintain the haul routes for the haul trucks and other equipment within the pits and on all routes to various waste storage locations and the crusher. Haul road maintenance will also include on-highway trucks that are outfitted with a water tank and a gravel spreader. Track dozers (237 kW) will also be included to handle waste rock, till, and topsoil to the various waste storage locations. In addition, front end wheel loaders ($4.0 \ m^3$ bucket) and hydraulic excavators ($3 \ m^3$ bucket) will also be available to provide pit support.

Custom fuel/lube trucks will be used to supply fuel in the pit.

In summary, the main components of the mining site are:

- Open pit;
- WRSF NPAG material stockpile;
- WRSF PAG material stockpile;
- Low grade ore stockpile;
- Covered ore storage and processing facility; and
- TMF facility.

In order to control emissions and prevent loss of product, all trucks leaving the site with processed materials will be covered. In addition, the stockpiled fine ore concentrate will be housed in a warehouse onsite. Almost all the waste material from this processing will be pumped as a slurry from the warehouse to the TMF facility. As a result of the material being pumped wet, particulate emissions will be minimal for the TMF operations.

The assessment of air emissions from the operation of the mine site included the following:

1. An inventory of all combustion emissions and greenhouse gases was developed and compared to the emissions inventory for the Province of Nova Scotia;
2. An air dispersion modelling study was performed to predict the impacts on air quality at the Proposed Property Boundaries.

3.2.1 Emissions Inventory - Operations

The following sections provide an assessment of air emissions projected to be generated from the operation of the Fifteen Mile Stream gold mine.

The approach developed to assess the impact of air emissions from the project is based on information provided through meetings with the Atlantic Mining NS Corp project engineer and information from the *Technical Report on Moose River Consolidated Mine, Nova Scotia, NI 43-101 Technical Report, March 25, 2019*.

Air emissions for the project were assessed based on the following activities:

- Excavating material and loading haul trucks in the open pit;
- Haul trucks transporting material from the open pit to a stock pile and processing area enclosed in a building;
- Haul trucks transporting material to the WRSF, Low Grade Ore and TMF areas; and
- Trucks transporting the material to offsite and eventually to the Touquoy facility for further processing.

The following sections provide an inventory of emissions estimated to be generated from these activities. The inventory includes an assessment of emissions from the following primary equipment sources which are the most used pieces of equipment during the 365 day per year operation:

- Two 110 mm holes diesel hydraulic DTH drills;
- Two 135 mm holes diesel hydraulic RC drills;
- Three hydraulic excavators (4.55 m^3 bucket);
- One wheel loaders (7.0 m^3 bucket);
- Nine haul trucks (64 t payload); and
- Two articulated haul trucks (41 t payload).

Table 3-1 provides a summary of the annual air emissions estimated to be produced by the operation at full production of the proposed mine site.

Table 3-1 Estimated Annual Emissions – Proposed Fifteen Mile Stream Mine Operations (Tonnes/Year)

	Activity	CO	NO_X	PM	SO_2	VOC
	110 mm Drills	3.2	6.7	0.2	0.02	0.7
	135 mm Drills	6.2	13.4	0.41	0.04	1.5
	Hydraulic Excavators	5.5	7.3	0.42	0.01	1
	Wheel Loader	0.8	2.2	0.08	0.004	0.25
	Haul Trucks	19.2	55.6	1.94	0.08	6.6
	Transport Trucks(1)	1.9	5.2	0.11	0.009	0.3
	Articulated Haul Trucks	2.9	8.5	0.3	0.01	1
TOTAL		**39.7**	**98.9**	**3.28**	**0.17**	**11.4**

Note: (1) Emission factors for 2018 SCAB Fleet Average Emission factors were used to calculate the totals per year.

CAC emissions were estimated using the following guidance documents:

- South Coast Air Quality Management District Off-road Mobile Source Emissions Factors (Scenario Years 2007-2025), Table C1.1-7 Unmitigated Case: Emission Factors for On-road Diesel Trucks for EMFAC2007 Model, 2018 for on road heavy diesel trucks;
- California Air Resources Board. Mobile Source Emissions Inventory – Off Road Diesel Vehicles. SCAB Fleet Average Emission Factors (Diesel), 2018 for the 110 and 135 mm drills, hydraulic excavators, wheel loaders and haul trucks.

It is estimated that the operation of the proposed Fifteen Mile Stream mine will produce 39.7 tonnes of carbon monoxide, 98.9 tonnes for NOx, 3.28 tonnes of total particulate matter, 0.17 tonnes of SO_2, and 11.4 tonnes of VOC per year.

3.2.2 Estimate of Greenhouse Gas Emissions

Table 3-2 provides a summary of greenhouse gas emissions for the proposed mining project.

Table 3-2 Estimated Annual Greenhouse Gas Emissions - Proposed Fifteen Mile Stream Mine Operations (Tonnes/Year)

	Activity	Equipment	CO_{2e}
	Production Drilling	Two 110 mm DTH Drills	3385.3
	Bench Scale Exploration	Two 135 mm RC Drills	5376.7
	Production Loading	Three Hydraulic Excavators	3436.9
	Production Loading Stockpile Re-handle	One Wheel Loader	498.8
	Production Hauling	Nine Haul Trucks	17241.4
	Trucking	Eleven Trucks per day from Fifteen Mile Stream to Touquoy	3352.2
	Articulated Haul Trucks	Two Articulated Haul Trucks	1724.1
TOTAL CO2e			**35,015.4**

In 2015 the estimated GHG emissions generated in Nova Scotia was 16,200 kt CO_2e. The project is expected to generate an estimated 35 kt of carbon dioxide, which would result in an increase in carbon dioxide emissions of approximately 0.2% to the Provincial levels.

3.2.3 Comparison of Project Inventory with Provincial Inventory

Table 3-3 provides a summary of criteria air contaminant (CAC) emissions for all sources in Nova Scotia compared to the total estimated CAC emissions for the proposed Fifteen Mile Stream mine.

Table 3-3 Comparison of Project CAC Emissions with Nova Scotia CAC Emissions

Category	TPM	SO_2	NOx	VOC	CO
Total Project CAC Emissions for Fifteen Mile Stream	3.28	0.17	98.9	11.4	39.7
Nova Scotia Total CAC Emissions (2015)	319,535	68,830	70,744	37,836	142,239

Note: (1) Value represents estimated hydrocarbon emissions from the proposed project.

A comparison of total CAC emissions in the Province with estimated emissions from the proposed mine site determined that the operation will increase provincial emissions of particulate matter by 0.001%, SO_2 by 0.00025%, NOx by 0.14%, VOCs by 0.03% and CO by 0.03%.

4.0 AIR DISPERSION MODELLING METHODOLOGY

Air quality impacts to both environment and human health are assessed by comparing ground level concentrations of priority pollutants to Nova Scotia ambient air quality objectives. Nova Scotia provides objectives for nitrogen dioxide, sulphur dioxide, total suspended particulate and carbon monoxide for different averaging periods including 1 hour, 24 hour and annual. The emission rates developed in the previous sections were used in an air dispersion model computer simulation program to predict ground level concentrations at and beyond the Proposed FMS Mine Site property boundaries.

The specific sources of continuous and intermittent air contaminant emissions during routine operation include the following:

- Blasting;
- Production Drilling;
- Bench Scale Exploration;
- Production Hauling.
- Material Handling in the open pit;
- Production Loading;
- Wind erosion at TMF and stockpiles;
- Road dust emissions (re-entrained dust); and
- Dust from managing mine rock, ore, and overburden.

It should be noted that after being mined from the open pit, all material is sent to a warehouse where it is stockpiled for processing. All processing is performed inside buildings on the site, therefore minimizing releases of particulate to the site from these activities. In addition, most of the tailings from this processing is sent from the processing facility as a wet slurry through a pipe to the TMF. The wet nature of the material along with the majority of it being kept under water at the TMF will also minimize releases of particulate to the site in the TMF area.

It should be noted that other routine activities such as haul road maintenance, pit support, mobile fuel/lube service, utility material movement, pit sump dewatering, and employee transportation were not included in the assessment since many of these activities are intermittent and will generate much less emissions compared to above primary sources.

The specific air pollutants emitted from some or all of these units that have been evaluated for their impacts consist of the following:

- TSP, PM_{10}, and $PM_{2.5}$ are particles found in air including dust, dirt, soot, smoke and liquid droplets;
- NOx, generated when fuel is burned at high temperatures as in a combustion process;
- SO_2 formed when fuel containing sulphur is burned; and
- CO formed from the incomplete combustion of carbon containing fuel.

4.1 Model Description

The AERMOD dispersion model was selected for use in this study. In 2005, AERMOD was adopted by USEPA (the U.S. Environmental Protection Agency) and promulgated as their preferred refined regulatory model. It is applicable to rural and urban areas, flat and complex terrain, surface and elevated releases, and multiple sources (including, point, area and volume sources).

The specific model inputs include meteorological data, terrain and building inputs and the various source emissions data.

The model was configured to assess the operation of the facility during normal operations.

Five years of sequential hourly meteorological data were used in the modelling. The dataset of meteorology statistically covers all wind speed and stability conditions that are anticipated to occur in the modelled area. The data source is from the Halifax Airport weather station for the years from 2007 to 2012.

4.2 Meteorological Data

AERMOD requires hourly surface meteorological data for calculating downwind concentrations. The data required for each simulation are:

- Wind speed;
- Wind direction;
- Dry-bulb temperature;
- Cloud cover;
- Ceiling height;
- Station pressure; and
- Vertical profiles of temperature, pressure and relative humidity.

The Halifax Airport weather station is located approximately 75 km southwest of the mine site. The distance from the site supports its spatial representativeness since it places it in the same general synoptic flow regime as well as most mesoscale systems. The Halifax Airport Weather station is also located in a similar geographic setting as the mine site being situated approximately 25 km inland from the eastern Nova Scotia coastline. The Halifax Airport Weather station collects the following information: wind direction, wind speed, dry bulb temperature, relative humidity, station pressure, ceiling height and cloud opacity. The meteorological file was supplemented with precipitation data from the Upper Stewiacke weather station, which is located approximately 38 km to the west of the mine site.

The meteorological data were processed using the AERMET pre-processor program along with the definition of the surface characteristics within the modelling domain. These surface characteristics of albedo (i.e., ratio of reflected to incident solar radiation), Bowen ratio (i.e., ratio of sensible latent heat fluxes from the earth's surface) and surface roughness length (i.e., height above ground at which the mean wind speed becomes zero) are specified by season as a function of distance and direction from the mine site based on land use information and the AERMOD User's Guide recommended values of these parameters.

Upper air sounding data was developed by the Pre-processor AERMET. The specific parameters obtained from the station are provided in Table 4-1.

Table 4-1 Meteorological Stations

Type of Station	Surface Station		Surface Station
Station Name	Halifax Airport Weather Station		Upper Stewiacke
Location	Halifax Airport, NS		Upper Stewiacke, NS
Years	2007 – 2012		2007 – 2012
Parameters	Wind Speed Wind Direction Temperature Pressure	Relative Humidity Ceiling Height Cloud Cover	Precipitation

Note: Meteorological data was sourced from the Environment Canada's National Climate Data and Information Archive.

Meteorological data for AERMOD was processed with the most recent release of the AERMET meteorological pre-processor AERMET. The major purpose of AERMET is to calculate boundary layer parameters for use by AERMOD. A meteorological interface module, internal to AERMOD, uses these parameters to generate profiles of the needed meteorological variables.

Refer to Figure 4-1 for a wind rose for the 5 years (2008 to 2012) of Stanfield Airport Weather Station data.

4.3 Emissions Source Data

The source data required to run the model include the following parameters for each source: the physical location of the emission point, dimensions of area to be disturbed and the mass emission rates of each pollutant.

Conceptual design for the project was developed through information provided by Atlantic Mining NS Corp. Emission rates for the project were developed using the following USEPA documentation:

- USEPA Air Superfund National Technical Guidance Study Series. Estimation of Air Impacts for Excavation of Contaminated Soil. EPA-405/1-92-004, March 1992; and
- USEPA Air Superfund National Technical Guidance Study Series. AP-42 Section 13.2.2, Miscellaneous Sources, Unpaved Roads. Vol. II, 1995.
- USEPA Air Superfund National Technical Guidance Study Series. Compilation of Air Pollutant Emission Factors, Volume 1, Fifth Edition, AP-42. October, 1997.
- USEPA Air Superfund National Technical Guidance Study Series. AP-42 Section 13.2.3, Miscellaneous Sources, Heavy Construction Operations. Vol. II, 1995.
- South Coast Air Quality Management District Off-road Mobile Source Emissions Factors (Scenario Years 2007-2025), Table C1.1-7 Unmitigated Case: Emission Factors for On-road Diesel Trucks for EMFAC2007 Model, 2018 for on road heavy duty diesel trucks;
- California Air Resources Board. Mobile Source Emissions Inventory – Off Road Diesel Vehicles. SCAB Fleet Average Emission Factors (Diesel), 2018 for the 110 and 135 mm drills, hydraulic excavators, wheel loaders and haul trucks.

Figure 4-1 Wind rose for Stanfield Airport Weather Station data (2008 to 2012)

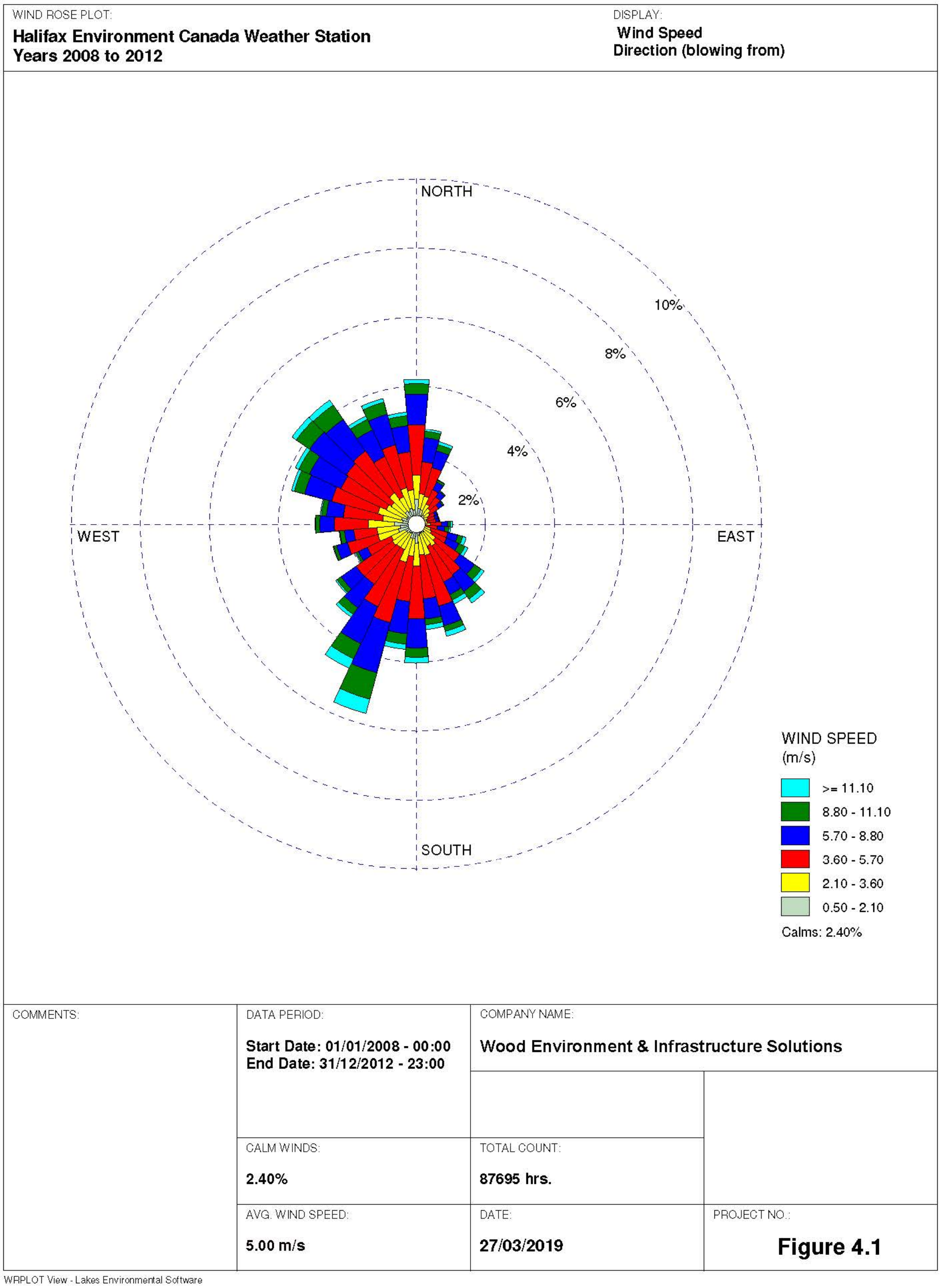


Table 4-2 provides a summary of specific model inputs used to calculate TSP and PM_{10} emission factors.

Table 4-2 Summary of TSP, PM_{10}, $PM_{2.5}$, and Metals Emission Factors

	TSP(1)	PM_{10}(1)	$PM_{2.5}$	As	Source Characteristics	Equipment
Open Pit ($g/s/m^2$)	0.002	0.0006	$6x10^{-5}$	$3x10^{-9}$	45 m x 45 m per day affected area	2 Excavators, 1 Wheel Loader driving over unpaved areas
Open Pit Excavation Operations (g/s)	0.033	0.016	$1x10^{-3}$	$4.6x10^{-8}$	-(2)	Excavator Filling Haul Trucks
Dumping Ore at Mill (g/s)	0.013	0.006	$4x10^{-4}$	$1.8x10^{-8}$	-(2)	Haul Trucks Dumping Ore
Dumping at WRSF PAG (g/s)	0.007	0.003	$2x10^{-4}$	$1.0x10^{-8}$	-(2)	Haul Trucks Dumping Ore
Dumping at WRSF NPAG (g/s)	0.005	0.002	$1.5x10^{-4}$	$6x10^{-9}$	-(2)	Haul Trucks Dumping Ore
Dumping at TMF (g/s)	0.01	0.005	$3x10^{-4}$	$1.4x10^{-8}$	-(2)	Haul Trucks Dumping Ore
Dumping at Low Grade Ore (g/s)	0.005	0.002	$1.5x10^{-4}$	$1.4x10^{-8}$	-(2)	Haul Trucks Dumping Ore
WRSF ($g/s/m^2$)	$5.3x10^{-5}$	$8.3x10^{-6}$	$1.6x10^{-6}$	$9.4x10^{-11}$	20 m x 20 m per day affected area	1 Grader
TMF ($g/s/m^2$)	$1.1x10^{-4}$	$2.1x10^{-5}$	$3.3x10^{-6}$	$2x10^{-10}$	20 m x 20 m per day affected area	1 Grader
Haul Road to Highway (g/s)	4.3	1.36	0.13	0.0006	3.65 km unpaved road	11 Trucks
Haul Road to WRSF NPAG (g/s)	3.03	0.97	0.09	0.00042	0.4 km unpaved road	2 Haul Trucks
Haul Road to WRSF PAG (g/s)	2.83	0.45	0.08	0.0004	0.4 km unpaved road	2 Haul Trucks
Haul Road to Low Grade Ore (g/s)	7	2.2	0.21	0.00097	0.56 km unpaved road	1 Haul Truck

Haul Road to TMF (g/s)	11.5	3.7	0.35	0.0016	1.35 km unpaved road	2 Haul Trucks 1 Articulated Truck
Haul Road to Organic (g/s)	0.28	0.09	0.008	0.00004	0.28 km unpaved road	1 Articulated Truck
Wind Erosion Ore Stockpile ($g/s/m^2$)	9.3e-6	4.6e-6	2.8e-7	1.28e-9	6400 m^2	
Wind Erosion TMF ($g/s/m^2$)	9.3e-6	4.6e-6	2.8e-7	1.28e-9	35000 m^2	

Note: (1) "-" denotes not available.

Refer to Attachment A for a summary of calculations, inputs and assumptions used in the model.

The mine will operate continuously 365 days a year. Based on discussions with Atlantic Mining NS Corp engineers, the following utilization was applied to each piece of equipment: 85% for the 110 drill; 80% for the 135 drill; 25% for the wheel loaders; 55% for the excavators, loaders, graders and 65% for the haul trucks.

The above emission factor estimates were based on an annual total ore milled of 2000 kt/a at the process facility which is designed to recover and concentrate gold from ore mined at the proposed Fifteen Mile Stream open pit. Based on the process rate it was assumed at maximum production the WRSF areas would receive 1848 kt per year and the TMF area 1586 kt transported by trucks.

Earth crustal levels of certain metals will be present in the particulate matter that is generated as fugitive dust on the site and potentially dispersed offsite. The dust is assumed to have the same metals composition as the mine rock used in road construction and the unprocessed ore. Trace metals are also likely released from various ore processing activities such as crushing, conveying and ore handling. The measures that are designed to control fugitive dust releases and effects will also serve to control the emission and deposition of metals that are a component of the dust. At the time of this assessment, the Beaver Dam project was undergoing a similar environmental assessment which included the sampling of onsite materials using a drill rig and laboratory analysis of these materials for metals content. The geometric mean for arsenic in these samples is 137.55 ppm (0.0138%). Inputs into the model for metals included the average concentration identified for these two metals. The results are representative of the concentrations of the material be worked with at different depths on the mine site. For the purpose of this assessment, it is assumed the metals concentrations at the Fifteen Mile Stream mine site will be similar.

It is also likely that the concentrations in soil overburden layers outside of the property boundary will be less than those onsite where there is a known concentration of metals. In order to determine offsite baseline concentrations, Intrinsic Corp. performed soil sampling to establish background levels outside mine site boundaries for the Beaver Dam mine project. The soil samples were collected along a 12 km section of Haul Road. Based on the analysis of eleven samples, the 90th percentile for arsenic in soil for samples collected away from the mine site was 10 mg/kg (Intrinsic, 2019). A 10 mg/kg concentration will also be used as a baseline soil concentration for arsenic for Fifteen Mile Stream.

Modelling for the onsite haul roads followed guidance under the USEPA Memorandum Haul Road Workgroup Final Report Submission to EPA-OAQPS. As per the documents preferred approach to modelling haul roads, all haul road sources were treated as volume sources.

Modelling for grading and materials transfer activities followed guidance under the USEPA AP-42 document.

Since the ore concentrate stockpiles are housed in a building, the ROM waste rock pile consists of large diameter rock and the materials in the TMF facility contain a high moisture content, wind erosion was not assessed for these areas.

Table 4-3 provides a summary of emission factors for the NO_2 and SO_2 and CO parameters.

Table 4-3 Emission Factors for Fifteen Mile Stream Mine Site

Location	NO_2 (g/sec)	CO (g/sec)	SO_2 (g/sec)
110 mm Drills	0.21	0.1	0.0006
135 mm Drills	0.42	0.2	0.001
Excavator	0.23	0.17	0.0003
Wheel Loader	0.07	0.03	0.0001
Haul Trucks(2)	1.77	0.61	0.003
Articulated Haul Trucks	0.3	0.1	0.0004

Note: (1) Includes unpaved road emissions.

Table 4-4 provides a summary of emission factors for particulate from blasting.

Table 4-4 Emission Factors for Fifteen Mile Stream Mine Site - Blasting

Location	TSP (g/sec)	PM_{10} (g/sec)	$PM_{2.5}$ (g/sec)
Blasting	0.232	0.12	0.007

Note: (1) Includes unpaved road emissions.

4.4 Terrain data

The area surrounding the site can be characterized as unpopulated, remote and rural in nature. The Fifteen Mile Stream mine site terrain elevations vary from 90 to 200 m above sea level.

The modelling domain in terms of receptor grid development is selected such that the impacts of both the low level and elevated facility emissions are correctly estimated and are relevant for the analysis. The topography of the project site and modelling domain are obtained using digital topographic data for the site region.

The UTM coordinate system is used to generate a Cartesian receptor grid starting at the center of the mine site and extending out to a distance as needed such that the maximum air impacts are captured by the modelling runs. A grid spacing of 400 m was used from the Fifteen Mile Stream mine site boundary out a distance of 10 km in each direction so that a 20 km Cartesian grid was developed. Sensitive receptors were placed along the site mine boundary. No receptors were placed near residential areas since the closest residence is located more than 4.9 km from the mine site. The area is very rural, consisting of sparsely distributed residences ranging from a few permanent homes to seasonal camps.

The topographic elevations for the receptors in the modelling domain are developed using the AERMAP pre-processor along with Digital Elevation Model equivalent terrain files covering the modelling domain.

5.0 AIR DISPERSION MODELLING RESULTS

The following sections provide a summary of air dispersion modelling results during mine operations, additive effects assessment and recommended mitigation measures to be used on the site. The following section provides dispersion modelling results for the following activities:

- Routine Mine Site operations (Table 5-1);
- Blasting (Table 5-2); and
- Exhaust emissions from diesel construction equipment (Table 5-3).

5.1 Mine Operation Modelling Results

Table 5-1 provides a summary of predicted air dispersion modelling results compared to the Nova Scotia ambient air quality objectives. These results represent impacts from the project alone and do not include baseline information. Exceedances to regulatory guidelines are highlighted in bold.

Table 5-1 Dispersion Modelling Results for Mine Operation – Maximum Ground Level Concentrations

Pollutant	Averaging Time Period	Normal Operating Conditions Location with the Highest Predicted GLC Site Boundary Locations (X coordinates, Y coordinates)	Normal Operating Conditions – with Mitigation Controls Location with the Highest Predicted GLC Offsite Exceedances (X coordinates, Y coordinates)	Nova Scotia Objectives
NO_2 (µg/m^3)	1 hour	334 (536741,4999377)	none	400
	Annual	1.6 (537350,4999594)	none	100
SO_2 (µg/m^3)	1 hour	0.56 (536741,4999377)	none	900
	24 hour	0.04 (536937,4999429)	none	300
	Annual	0.002 (536937,4999429)	none	60
TSP (µg/m^3)	24 hour	**335** (537907,4997509)	none(1)	120
	Annual	24 (537907,4997509)	none	70
PM_{10} (µg/m^3)	24 hour	**98.8** (537907,4997509)	none(1)	50(2)
$PM_{2.5}$ (µg/m^3)	24 hour	10.1 (536937,4999429)	none	27(3)
	Annual	0.59 (536937,4999429)	none	8.8
Arsenic (µg/m^3)	24 hour	0.05 (537907,4997509)	none	0.3(2)
CO (µg/m^3)	1 hour	133 (536741,4999377)	none	34, 600
	8 hour	14.5 (536937,4999429)	none	12,700

Note : (1) Highest GLC for TSP at site boundary is 100.9 µg/m^3; highest GLC for PM_{10} at site boundary is 32.6 µg/m^3.
(2) OMECP AAQC.
(3) Canadian Wide Standard.

A comparison of maximum ground level concentrations (GLCs) results with Nova Scotia objectives indicates that, with the exception of one area for TSP and PM_{10} to the south of the site, all results are well within the objectives for NO_2, SO_2, CO and TSP, OMECP AAQCs for arsenic, CWS for $PM_{2.5}$.

The off-site particulate exceedances to the south of the FMS Mine Site are located within 500 m of the site boundary in a wooded area. The TSP exceedance (334 µg/m^3) is above the Nova Scotia

24-hour objective of 120 µg/m^3; the $PM_{2.5}$ exceedance (98.8 µg/m^3) is above the OMECP criterion of 50 µg/m^3 for a 24-hour averaging period. It should be noted the above-mentioned results represent conditions without dust control mitigation measures applied. A review of the modelling data determined the estimated total number of exceedances per year to the 24-hour TSP objective and 24-hour PM10 criterion is 3 days and 2 days, respectively.

The model was run a second time with a 75% reduction in road emissions for the 3.65 km section of road from the plant to highway 375; 75% reduction for the 1.3 km road from the open pit to the plant and a 55% reduction on the remainder of the site roads. There were no offsite exceedances with these reductions applied. As previously mentioned, the need to control emissions on onsite roads will be required an estimated 3 times per year when weather and onsite operations are unfavourable and may cause offsite exceedances. Based on a literature review, Environment Canada states if an unpaved road is watered twice a day a 55% reduction in particulate emissions can be achieved (Environment Canada, 2018). Further reductions (to 75%) in particulate emissions can be achieved using magnesium chloride. These mitigation measures will reduce offsite impacts to below the Nova Scotia 24-hour objective for TSP and OMECP for PM_{10}. The use of mitigation measures will also further reduce impacts from other similar particulate emission parameters, such as arsenic, that are associated with dust generation from the site.

Refer to Attachment B for contour plot diagrams for parameters modelled.

Table 5-2 provides a summary of predicted air dispersion modelling results compared to the Nova Scotia ambient air quality objective for TSP, Ontario MECP criterion for PM_{10} and the Canada Wide Standard for $PM_{2.5}$ for blasting activities. These results represent impacts from the project alone and do not include baseline information.

Table 5-2 Dispersion Modelling Results for Blasting – Maximum Ground Level Concentrations

Pollutant	Averaging Time Period	Normal Operating Conditions Location with the Highest Predicted GLC Offsite Exceedance	Normal Operating Conditions Location with the Highest Predicted GLC Site Boundary Locations	Normal Operating Conditions – 50% Mitigation Controls Location with the Highest Predicted GLC Offsite Exceedance	Nova Scotia Objectives (µg/m^3)
TSP (µg/m^3)	24 hour	none	1.97 (536937,4999429)	none	120
PM_{10} (µg/m^3)	24 hour	none	1.01 (536937,4999429)	none	50(1)
$PM_{2.5}$ (µg/m^3)	24 hour	none	0.26 (536937,4999429)	none	27(2)

Note : (1) OMECP AAQC.
(2) Canadian Wide Standard.

All predicated results were below their respective ambient air guidelines during the blasting scenario.

Table 5-3 provides a summary of predicted air dispersion modelling results compared to the Ontario MECP criteria for benzene and benzo(a)pyrene for 24 hour averaging periods. The benzene and benzo(a)pyrene were chosen as surrogate parameters to assess volatile organic compounds (VOCs) and polyaromatic compounds (PAHs) in diesel exhaust. These parameters were chosen since the ambient criteria are the typically the most stringent compared other VOCs and PAHs present in diesel exhaust. These results represent impacts from the project alone and do not include baseline information.

Table 5-3 Dispersion Modelling Results for Diesel Emissions – Maximum Ground Level Concentrations

Pollutant	Averaging Time Period	Normal Operating Conditions Location with the Highest Predicted GLC Offsite Exceedance	Normal Operating Conditions Location with the Highest Predicted GLC Site Boundary Locations	Normal Operating Conditions – 50% Mitigation Controls Location with the Highest Predicted GLC Offsite Exceedance	Ontario MECP AAQC (μg/m³)
Benzene[1] (μg/m³)	24 hour	none	0.02 (536937,4999429)	none	0.23[2]
Benzo(a)pyrene[1] (μg/m³)	24 hour	none	0[3] (536937,4999429)	none	0.00005[2]

Note :

(1) Emission rates were calculated based on emission factors provided in Table 3.3-2 Speciated Organic Compound Emission Factors for Uncontrolled Diesel Engines. Section 3.3 Gasoline and Diesel Industrial Engines, USEPA, AP-42.
(2) OMECP AAQC.
(3) Concentration provided by AERMOD is calculated so low it is displayed as 0 in the model results.

All predicated results were below their respective ambient air guidelines for diesel equipment operating on-site.

5.2 Mine Operation Deposition Modelling Results

Table 5-4 provides a summary of predicted air dispersion modelling deposition results, and an estimate of the monthly and annual particulate and metals deposition.

Table 5-4 Deposition Modelling Results for Mine Operation

Pollutant	Averaging Time Period	Predicted Typical Deposition Levels at Site Boundary	Predicted Typical Deposition Levels at 1 km from Site Boundary	Ontario MECP AAQC (g/m^2)
TSP (g/m^2)	Monthly	0.1	0.02	7
	Annual	1.4	0.35	4.6
Arsenic (g/m^2)	Annual	$2x10^{-4}$	$4x10^{-5}$	-(2)

Note : (1) OMECP AAQC.
(2) " -" denotes not available.

Table 5-5 provides the cumulative deposition results for the life of the Fifteen Mile Stream mine operation.

Table 5-5 Cumulative Deposition Results for the Life of the Mine Operation

	Year										
	1	2	3	4	5	6	7	8	9	10	Total
Estimated Annual % Production	0	3.75	95	100	100	100	100	100	70.4	0	
Annual Deposition Contribution TSP (g/m^2)	0	0.05	1.3	1.4	1.4	1.4	1.4	1.4	0.99	0	9.34
Annual Deposition Contribution As (g/m^2)	0	0	$8x10^{-6}$	$1.8x10^{-4}$	$2x10^{-4}$	$2x10^{-4}$	$2x10^{-4}$	$2x10^{-4}$	$1.4x10^{-4}$	0	$1.1x10^{-3}$

Table 5-5 also provides an estimate of the total deposition of metals for the life of the project at the mine site boundary. This estimate is considered worst case and deposition amount will decrease further from the site; the deposition amount will decrease by an estimated 75% one km from the site boundary.

The dispersion modelling provided a worst case one-year estimate for deposition. Information from the Fifteen Mile Stream production schedule was used to estimate the amount of material handled in each year of operation. Table 5-5 provides the estimated total metals deposition based on the estimated production rates. The total estimated metals deposition for the life of the project is 1.1×10^{-3} g/m^2 for arsenic.

Refer to Attachment C for contour plot diagrams for each of deposition parameters modelled.

As previously mentioned, a study for the Beaver Dam site performed by Intrinsic Corp. estimated a background concentration of 10 mg/kg (90th percentile) for soils located outside of the Beaver

Dam mine site boundary. This background concentration will also be used as an estimate for the Fifteen Mile Stream soils located outside of mine site boundary. The estimated concentration of arsenic is 1 gram per metre squared assuming the metal settles in the top 5 cm of soil and a soil density of 2300 kg/m^3 (clay).

Based on these estimates, at site boundary the site will contribute an estimated 0.096% arsenic to the existing assumed baseline arsenic concentration. At one km from the site boundary, it is estimated the site will contribute an estimated 0.02% to the assumed baseline concentration.

6.0 ADDITIVE IMPACTS ASSESSMENT

On November 21st, 2017, background TSP, PM_{10} and arsenic was collected in the FMS Mine Site. Sampling was performed at two locations near the Proposed Mine Site Boundary. The TSP concentrations for a 24-hour sampling period ranged from a low of 9.6 µg/m^3 to a high of 14.0 µg/m^3. The PM_{10} concentrations for a 24-hour sampling period ranged from a low of 9.2 µg/m^3 to a high of 9.5 µg/m^3.

Continuous monitoring for NO_2 and SO_2 near the Goldboro plant was conducted in Seal Harbour from June 10th, 2004, through August 10th, 2004. There are no other longer-term background air quality data available that are representative of this area. The highest monitored 24-hour NO_2 concentration during this 2-month period was approximately 5.2 µg/m^3 and the highest SO_2 value was 10.4 µg/m^3. The annual average concentration of $PM_{2.5}$ at the Aylesford station was 5.7 µg/m^3 in 2016.

For parameters with available annual regulatory criteria, an assessment of additive impacts on air quality was performed by adding the predicated dispersion modelling results from the location with the highest predicted annual average ground level concentration to measured TSP concentrations at Fifteen Mile Stream and to the air monitoring data obtained at the Goldboro Gas Plant in 2004 for the NO_2 and SO_2 parameters. The combined calculated value representing the measured background and predicted concentrations from the site were then compared to the Nova Scotia ambient air quality objectives. It is assumed there will be no other project development during the 7.75 years of Fifteen Mile Stream mine operation that will be close enough to impact the airshed around the vicinity of the mine. Refer to Table 6-1 for a summary of estimated additive impacts for locations with the highest average annual GLCs. Long term additive effects could not be assessed for PM_{10}, and As since there are no long term annual regulatory criteria available for these parameters. Predicted annual concentrations added to actual field measurements were included in the table. All results were well below shorter time period 24 hour averaging criteria (referenced in Table 6-1).

Table 6-1 Assessment of Additive Effects

Pollutant (µg/m^3)	Averaging Time Period	FMS Mine Site Monitoring Results (A)	Highest Annual GLCs (B)	Additive Impacts (A) + (B)	Nova Scotia Annual Objectives
NO_2	Annual	3.8(1)	1.6	5.4	100
SO_2	Annual	10.5(1)	0.002	10.5	60
TSP	Annual	11.3(2)	7.6(3)	18.9	70
PM_{10}	Annual	9.7(2)	2.7(3)	12.4	NA
$PM_{2.5}$	Annual	5.7	0.59	6.3	8.8
As	Annual	<0.0013(2)	0.0002(3)	0.0015	NA

Note :
(1) The values are an average for a 2 month period and were measured near the Goldboro Gas Plant in 2004.

(2) TSP, PM_{10}, and As values are representative of average 24 hour result obtained over a 2 events at Fifteen Mile Stream in November 2017.
(3) Represents with mitigation.

A comparison of the calculated additive impact numbers indicate that all values are lower than the Nova Scotia annual objectives. For the TSP and PM_{10} parameters it should be noted the calculated additive concentration is likely a conservative number since the monitoring occurred over a small period of time. A longer duration for monitoring would be preferable, however, site constraints resulted in difficultly in collecting data over a longer time frame.

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Attachment A

Emission Rate Calculations

Attachment A

Emission Rate Calculations

Table 1a: Per Vehicle TSP Emissions from Excavator and Loader Open Pit anc

$$E = K(s/12)^a(w/3)^b$$ [1]

Constants for PM30 (TSP)[1]
a = 0.7
b = 0.45
K = 4.9

Scenario		Open Pit	
Vehicle Type		Excavator (CAT 390D)	Wheelloader (CAT 950G Series II)
# of Equipment		2	
Mean Weight (w)[2]	(kgs)	86370	49658
	(tons)	95.0	54.6
Emissions on Fifteen Mile Stream Unpaved Roads s^4 = 15	(lb/vmt)	27.12	21.14
	(g/vkmt)	7645.6	5960.0
Operating Speed	(km/h)	3	5
Max travel per day	(km)	39.6	30
Amount of time moving	%	0.3	0.85
Daily Emissions on Fifteen Mile Stream	(g/d)	90830.2	151979.7
Area	(m^2)	2025.0	2025.0
Arsenic (138 ppm)		0.000138	0.000138
TSP Emission Rate	(g/s)	2.103	1.759
TSP Emission Rate	($g/s/m^2$)	0.0010	0.0009
As Emission Rate	($g/s/m^2$)	0.000000001	0.000000001

Sources: 1. USEPA AP-42, 5th ed.
CAT products: product guide brochures (http://www.cat.com/cda)

Table 1b: Per Vehicle PM10 Emissions from Excavator and Loader Open Pit

E = K(s/12)^a(w/3)^b[1]

Constants for PM10
a = 0.9
b = 0.45
K = 1.5

Scenario		Open Pit	
Vehicle Type		Excavator (CAT 390D)	Wheelloader (CAT 950G Series II)
# of Equipment		2	
Mean Weight (w)[2]	(kgs)	86370	49658
	(tons)	95.0	54.6
Emissions on Fifteen Mile Stream s[4] = 15	(lb/vmt)	8.68	6.77
	(g/vkmt)	2447.3	1907.8
Operating Speed	(km/h)	3	5
Max travel per day	(km)	39.6	30
Amount of time moving	(%)	0.3	0.85
Daily Emissions	(g/d)	29074.2	48647.8
Area	(m2)	2025.0	2025.0
Emissions Rate	(g/sec)	0.673	0.563
Emissions Rate	(g/s/m2)	0.00033	0.0003

Sources: 1. USEPA AP-42, 5th ed.

CAT products: product guide brochures (http://www.cat.com/cda)

Table 2a: TSP (PM30) Emissions from Transfer Operations

$$E = K*0.0016*M*((U/2.2)^{1.3})/((m/2)^{1.4})$$ [1]

K[1] =	0.74
U[2] (m/s) =	5
Umax[2] (m/s) =	10

Scenario	Excavator Filling Haul Trucks	Dumping	Dumping	Dumping	Dumping	Dumping
Substrate/location	Open Pit	Ore to Mill	WRSF PAG	WRSF NPAG	TMF	Low Grade Ore
m (%Moisture content)[3]	15	15	15	15	15	15
Volume (m3/day)[4]	7000	2700	1550	950	2150	950
Density (kg/m3)[5]	2000	2000	2000	2000	2000	2000
M (mass; kg/day)	14000000	5400000	3100000	1900000	4300000	1900000
E (g/day)	2870.16	1107.06	635.53	389.52	881.55	389.52
E at Umax (g/day)	7067.15	2725.90	1564.87	959.11	2170.63	959.11
% As in soil	0.000138	0.000138	0.000138	0.000138	0.000138	0.000138
E (g/sec) Transfer Operations	0.033	0.013	0.007	0.005	0.010	0.005
As Emission Rate (g/sec)	0.000000046	0.000000018	0.000000010	0.000000006	0.000000014	0.000000006

Sources: 1. USEPA AP-42, 5th ed. K is a particle size multiplier.

Table 2b: PM10 Emissions from Transfer Operations

$$E = K*0.0016*M*((U/2.2)^{1.3})/((m/2)^{1.4})$$ [1]

K[1] =	0.35
U[2] (m/s) =	5
Umax[2] (m/s) =	10

Scenario	Excavator Filling Haul Trucks	Dumping	Dumping	Dumping	Dumping	Dumping
Substrate/location	Open Pit	Ore to Mill	WRSF PAG	WRSF NPAG	TMF	Low Grade Ore
m (%Moisture content)[3]	15	15	15	15	15	15
Volume (m3/day)[4]	7000	2700	1550	950	2150	950
Density (kg/m3)[5]	2000	2000	2000	2000	2000	2000
M (mass; kg/day)	14000000	5400000	3100000	1900000	4300000	1900000
E (g/day)	1357.51	523.61	300.59	184.23	416.95	184.23
E at Umax (g/day)	3342.57	1289.28	740.14	453.63	1026.65	453.63
E (g/sec) Transfer Operations	0.016	0.006	0.003	0.002	0.005	0.002

Sources: 1. USEPA AP-42, 5th ed. K is a particle size multiplier.

Table 3a: TSP (PM30) Emissions from Grading Activities

ER = (0.72*(s^1.2))/(m^1.3)[1]

Scenario	Grading	Grading
Substrate/location	WRSF	TMF
s (%Silt content)[2]	8	15
m (%Moisture content)[2]	90	90
ER (g/sec)	0.0251	0.0535
Utilization (%)	85	85
ER (g/sec)	0.0214	0.0455
Daily Affected Area (m^2)	400	400
As in soil (138 ppm)	0.000138	0.000138
TSP Emissions (g/sec/m^2)	5.344E-05	1.136E-04
As Emissions (g/sec/m^2)	7.375E-11	1.568E-10

Sources: 1. USEPA AP-42, 5th ed.

2. Dust Emissions document, 17 October 2005.

Table 3b: PM10 Emissions from Grading Activities

$$ER = (0.094*(s^{1.5}))/(m^{1.4})$$ [1]

Scenario		Grading	Grading
Substrate/location	Units	WRSF	TMF
s	(%Silt content)[2]	8	15
m	(%Moisture content)[2]	90	90
ER	(g/sec)	0.0039	0.0100
Utilization	(%)	85.00	85.00
ER	(g/sec)	0.00	0.01
Daily Affected Area	(m^2)	400	400
Emissions	(g/sec/m^2)	8.302E-06	2.131E-05

Sources: 1. USEPA AP-42, 5th ed.

2. Dust Emissions document, 17 October 2005.

Table 4a: Haul Truck TSP Emissions - Fifteen Mile Stream

$$E = K(s/12)^a(w/3)^b$$ [1]

Constants for PM30 (TSP)[1]
a = 0.7
b = 0.45
K = 4.9

Scenario		Open Pit to Processing Plant		Open Pit to WRSF (NPAG)		Open Pit to WRSF (PAG)		Open Pit to Low Grade Ore		Open Pit to TMF		Open Pit to Topsoil		Covered Stockpile to Highway 375	
Vehicle Type		Haul Trucks Loaded CAT775F	Haul Trucks Unloaded CAT 775F	Haul Trucks Loaded CAT775F	Haul Trucks Unloaded CAT 775F	Haul Trucks Loaded CAT775F	Haul Trucks Unloaded CAT 775F	Haul Trucks Loaded CAT775F	Haul Trucks Unloaded CAT 775F	Haul Trucks Loaded CAT775F	Haul Trucks Unloaded CAT 775F	Haul Trucks Loaded CAT745	Haul Trucks Unloaded CAT 745	Trucks Loaded Mack Granite	Haul Trucks Unloaded Mack Granite
Length of Haul Road[(2)]		1.3 km		0.4 km		0.4 km		0.56 km		1.35 km		0.28 km		3.65 km	
# of Trucks[(3)]		2		2		2		1		3		1		11	
Mean Weight (w)[2]	(kgs)	110000	48104	110000	48104	110000	48104	110000	48104	110000	48104	74519	33433	43150	17000
	(tons)	121.0	52.9	121.0	52.9	121.0	52.9	121.0	52.9	121.0	52.9	82.0	36.8	47.5	18.7
Emissions on Fifteen Mile Stream Unpaved Roads; s^4 = [(4)] 15	(lb/vmt)	30.24	20.84	30.24	20.84	30.24	20.84	30.24	20.84	30.24	20.84	25.38	17.69	19.85	13.05
	(g/vkmt)	8524.7	5875.3	8524.7	5875.3	8524.7	5875.3	8524.7	5875.3	8524.7	5875.3	7154.4	4988.0	5594.9	3679.2
Operating Speed	(km/h)	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Km/day/vehicle	(km/day)	52	52	9.1	9.1	8.5	8.5	42	42	23	23	2	2	3.65	3.65
Max travel per day all vehicles	(km)	104	104	18.2	18.2	17	17	42	42	69	69	2	2	40.15	40.15
Daily Emissions	(g/d)	886564.539	611033.7289	155148.79	106930.9026	144919.2035	99880.51339	358035.6792	246763.6213	588201.473	405397.3779	14308.709	9976.063643	224634.8937	147719.515
Emissions Rate Fifteen Mile Stream	(g/s)	10.261	7.072	1.796	1.238	1.677	1.156	4.144	2.856	6.808	4.692	0.166	0.115	2.600	1.710
Composite Total	(g/s)		17.33		3.03		2.83		7.00		11.50		0.28		4.31
Median As Conc.	(mg/kg)	138													
Arsenic in soil (138 ppm)		0.000138													
As Emissons Rate	(g/s)		0.002392		0.000419		0.000391		0.000966		0.00159		0.000039		0.000595

Sources: 1. USEPA AP-42, 5th ed.

2. Section 18.3.1.1 (Page 18-6) Moose River Consolidated Project, Nova Scotia, Canada, NI 43-101 Technical Report on Moose River Consolidated Phase 1 and Phase 2 Expansion. Jan. 28, 2018.

3 Table 16-15 Fleet Units by Operations (all deposits), Moose River Consolidated Project, Nova Scotia, Canada, NI 43-101 Technical Report on Moose River Consolidated Phase 1 and 2 Expansion. Jan. 28, 2018.

4 Section 6.4.3.1 (Page 221) Beaver Dam Mine Project Environmental Impact Statement, Marinette, NS, June 12, 2017

5 CAT products: product guide brochures (http://www.cat.com/cda)

Table 4b: Haul Truck PM10 Emissions from Haul Roads - Fifteen Mile Stream

E = K(s/12)^a(w/3)^b[1]

Constants for PM10
a = 0.9
b = 0.45
K = 1.5

Scenario		Open Pit to Processing Plant		Open Pit to WRSF (NPAG)		Open Pit to WRSF (PAG)		Open Pit to Low Grade Ore		Open Pit to TMF		Open Pit to Topsoil		Covered Stockpile to Highway 375	
Vehicle Type		Haul Trucks Loaded CAT775F	Haul Trucks Unloaded CAT 775F	Haul Trucks Loaded CAT775F	Haul Trucks Unloaded CAT 775F	Haul Trucks Loaded CAT775F	Haul Trucks Unloaded CAT 775F	Haul Trucks Loaded CAT775F	Haul Trucks Unloaded CAT 775F	Haul Trucks Loaded CAT775F	Haul Trucks Unloaded CAT 775F	Haul Trucks Loaded CAT745	Haul Trucks Unloaded CAT 745	Trucks Loaded Mack Granite	Trucks Loaded Mack Granite
Length of Haul Road[(2)]		1.3 km		0.4 km		0.4 km		0.56 km		1.35 km		0.28 km		3.65 km	
# of Trucks[(3)]		2		2		2		1		3		1		11	
Mean Weight (w)[2]	(kgs)	110000	48104	110000	48104	110000	48104	110000	48104	110000	48104	74519	33433	43150	17000
	(tons)	121.0	52.9	121.0	52.9	121.0	52.9	121.0	52.9	121.0	52.9	82.0	36.8	47.5	18.7
Emissions on Fifteen Mile Stream $s^4 =$ [(4)]	(lb/vmt)	9.68	6.67	9.68	6.67	9.68	6.67	9.68	6.67	9.68	6.67	8.12	5.66	6.35	4.18
15	(g/vkmt)	2728.7	1880.7	2728.7	1880.7	2728.7	1880.7	2728.7	1880.7	2728.7	1880.7	2290.1	1596.6	1790.9	1177.7
Operating Speed	(km/h)	15	15	15	15	15	15	15	15	15	15	15	15	15	15
Km/day/vehicle	(km/day)	52	52	9.1	9.1	8.5	8.5	42	42	23	23	2	2	3.65	3.65
vehicles	(km)	104	104	18.2	18.2	17	17	42	42	69	69	2	2	39.6	39.6
Mile Stream	(g/d)	283783.7596	195588.0719	49662.15793	34227.91259	46387.72993	31971.12714	114604.9798	78987.49059	188279.6097	129765.1631	4580.128305	3193.275528	70919.23402	46636.36481
PM10 Emissions Rate	(g/s)	3.285	2.264	0.575	0.396	0.537	0.370	1.326	0.914	2.179	1.502	0.053	0.037	0.821	0.540
Composite Total	(g/s)		5.55		0.97		0.91		2.24		3.68		0.09		1.36

Sources: 1. USEPA AP-42, 5th ed.

2. Section 18.3.1.1 (Page 18-6) Moose River Consolidated Project, Nova Scotia, Canada, NI 43-101 Technical Report on Moose River Consolidated Phase 1 and 2 Expansion. Jan. 28, 2018.

3 Table 16-15 Fleet Units by Operations (all deposits), Moose River Consolidated Project, NS, Canada, NI 43-101 Technical Report on Moose River Consolidated Phase 1 and 2 Expansion. Jan. 28, 2018.

4 Section 6.4.3.1 (Page 221) Beaver Dam Mine Project Environmental Impact Statement, Marinette, NS, June 12, 2017

5 CAT products: product guide brochures (http://www.cat.com/cda)

Table 5a: TSP (PM30) Emissions from Blasting Activities
EF (kg/blast) = (0.00022*(A^1.5)[1]

Scenario	Blasting
Substrate/location	Open Pit
A (Area m^2)[2]	15
EF (g/sec)	0.0128
Utilization (%)	85
ER (g/sec)	0.0109
Daily Affected Area (m^2)	400
TSP Emissions (g/sec/m^2)	2.716E-05

Sources: 1. USEPA AP-42, 5th ed.
2. Dust Emissions document, 17 October 2005.

Table 6b: PM10 Emissions from Wind Erosion on Erodible Surfaces

E = kΣPi ; E = kPA

P = 58(u*- u*t)^2 + 25(u*- u*t)[1]

k^2 =	0.5	0.5
u* (m/s)[3] =	1.15	1.15

	Scenario	K	K
		Dust from erodible surfaces	Dust from erodible surfaces
	Stockpile Type	Ore Stockpile	TMF
E = kPA	**Area (m2)[4]**	6400	35000
	u_t (m/s)[5]	1.12	1.12
	P (g/m2)	0.8022	0.8022
	E (g/d)	2567.04	14038.5
	E (g/s)	0.0297	0.1625
	E (g/s/m2)	4.642E-06	4.642E-06

Sources:
1. All equations from USEPA's AP-42, 5th ed.
2. Particle size multiplier (AP-42, 5th ed.)
3. Friction velocity (Value for Portland ME is used)
4. Dust Emissions document, 17 October 2005
5. AP-42, 5th ed., Table 13.2.5-1; modal particle size based on AMEC sediment analyses, July 2005.

Table 6a: TSP (PM30) Emissions from Wind Erosion on Erodible Surfaces

$$E = k\Sigma P_i\ ;\ \ E = kPA$$

$$P = 58(u^* - u^*_t)^2 + 25(u^* - u^*_t)$$ [1]

	k^2 =	1	1
	u^* (m/s)[3] =	1.15	1.15
		Arsenic	0.000138
	Scenario	K	K
		Dust from erodible surfaces	Dust from erodible surfaces
	Stockpile Type	Ore Stockpile	TMF
E = kPA	**Area (m2)**[4]	6400	35000
	u_t (m/s)[5]	1.12	1.12
	P (g/m2)	0.8022	0.8022
	E (g/d)	5134.08	28077
	E (g/s)	0.0594	0.3250
	TSP E (g/s/m2)	9.285E-06	9.285E-06
	Arsenic E (g/s/m2)	1.281E-09	1.281E-09

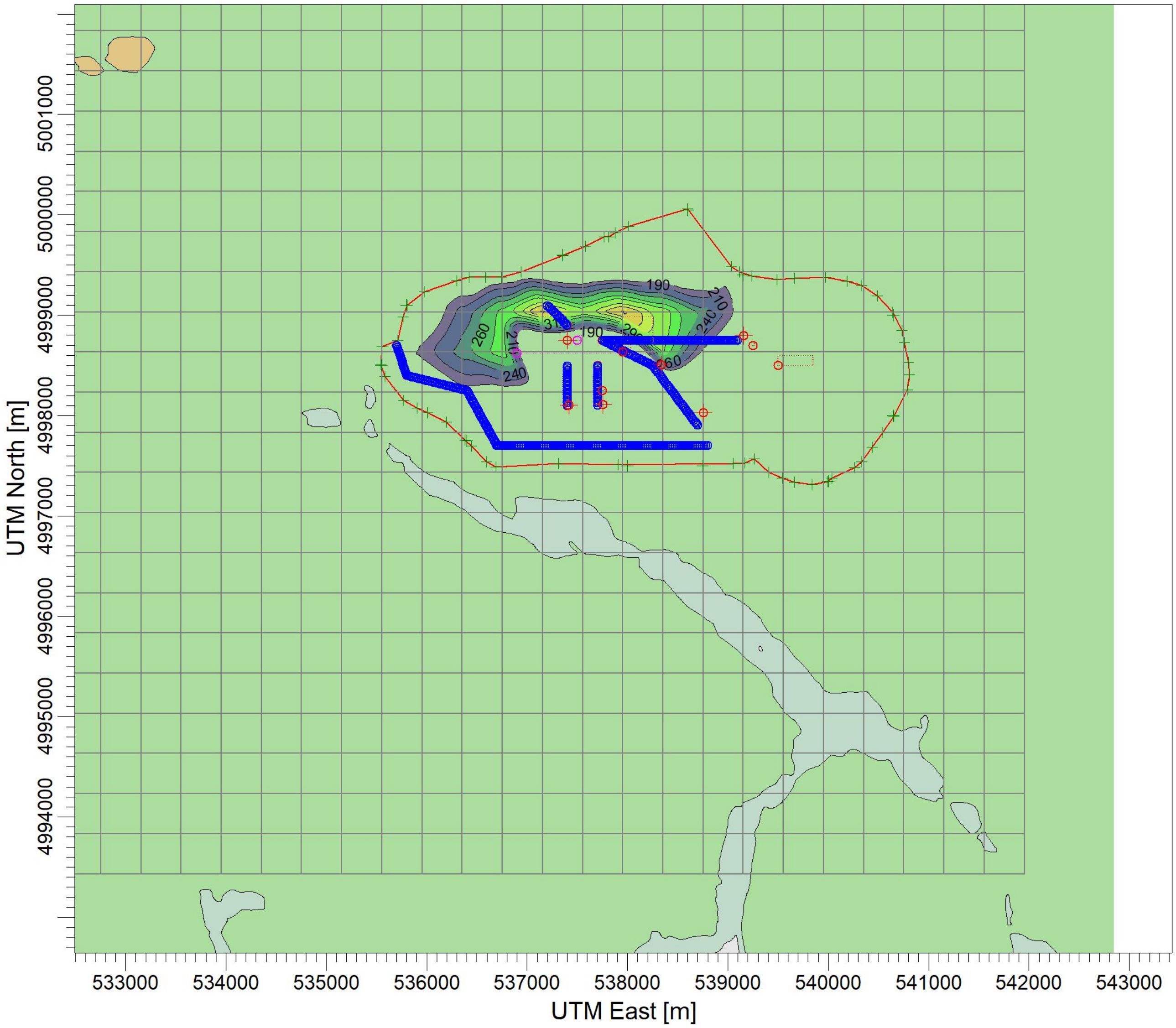
Sources:
1. All equations from USEPA's AP-42, 5th ed.
2. Particle size multiplier (AP-42, 5th ed.)
3. Friction velocity (Value for Portland ME is used)
4. Dust Emissions document, 17 October 2005
5. AP-42, 5th ed., Table 13.2.5-1; modal particle size based on AMEC sediment analyses, July 2005.

Attachment B

AERMOD Contour Plots - Concentration

PROJECT TITLE:

1 Hour Nitrogen Dioxide - No Mitigation



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 398 [ug/m^3] at (537153.90, 4999032.50)

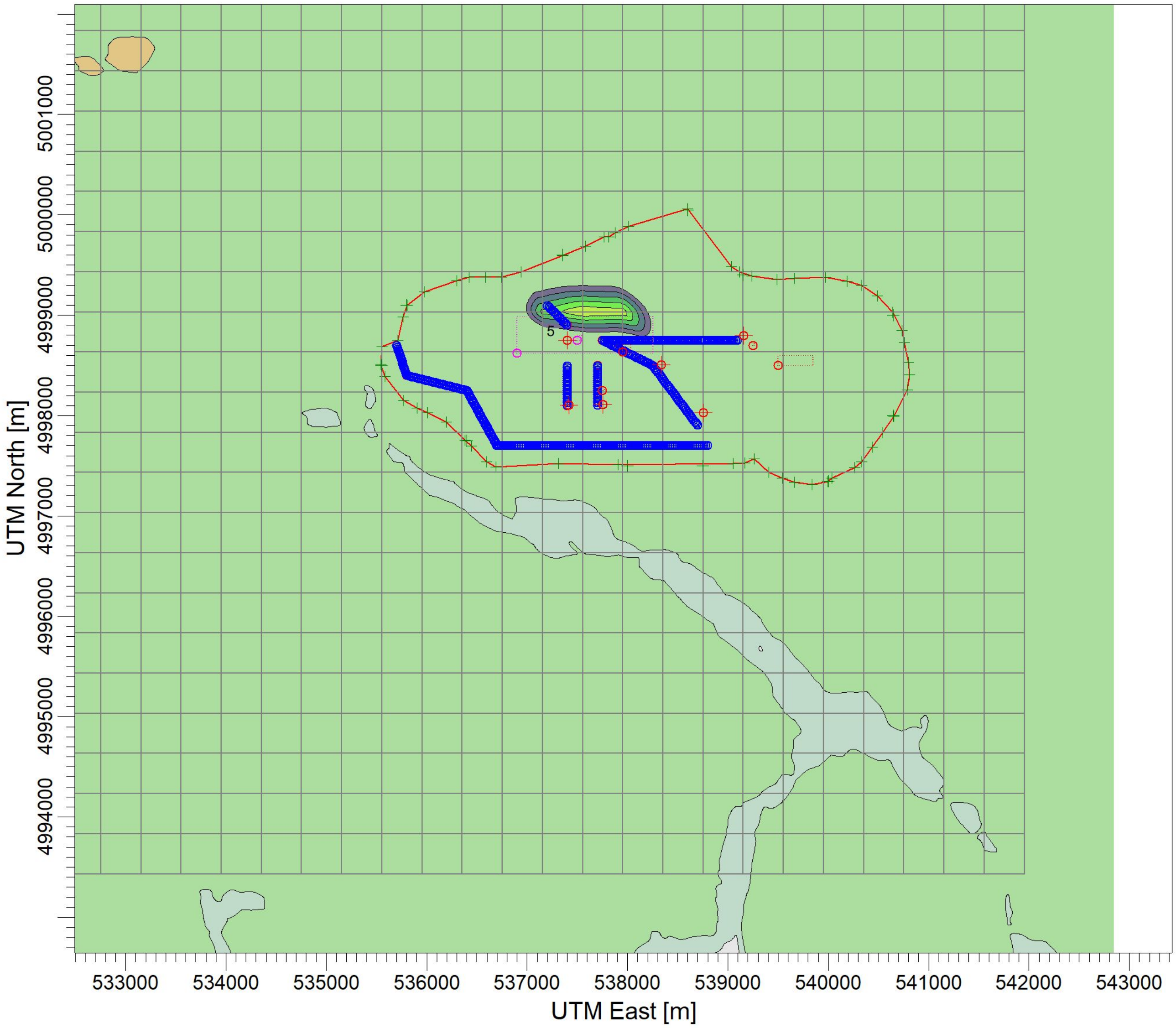
190 210 240 260 290 310 340 360 390 398

COMMENTS:	SOURCES:	COMPANY NAME:	
Figure 1	**22**		
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:68,745 (0 — 2 km)	
	MAX: **398 ug/m^3**	DATE: **8/2/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\bill.chew\Documents\AERMOD View\FMS3\FM4\FMS6\FMS6TSPMit\FMS6PM10Mit\FM6PM10\FMS6As\FMSNO2\FMSNO2.isc

PROJECT TITLE:

Annual Nitrogen Dioxide - No Mitigation



PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

ug/m^3

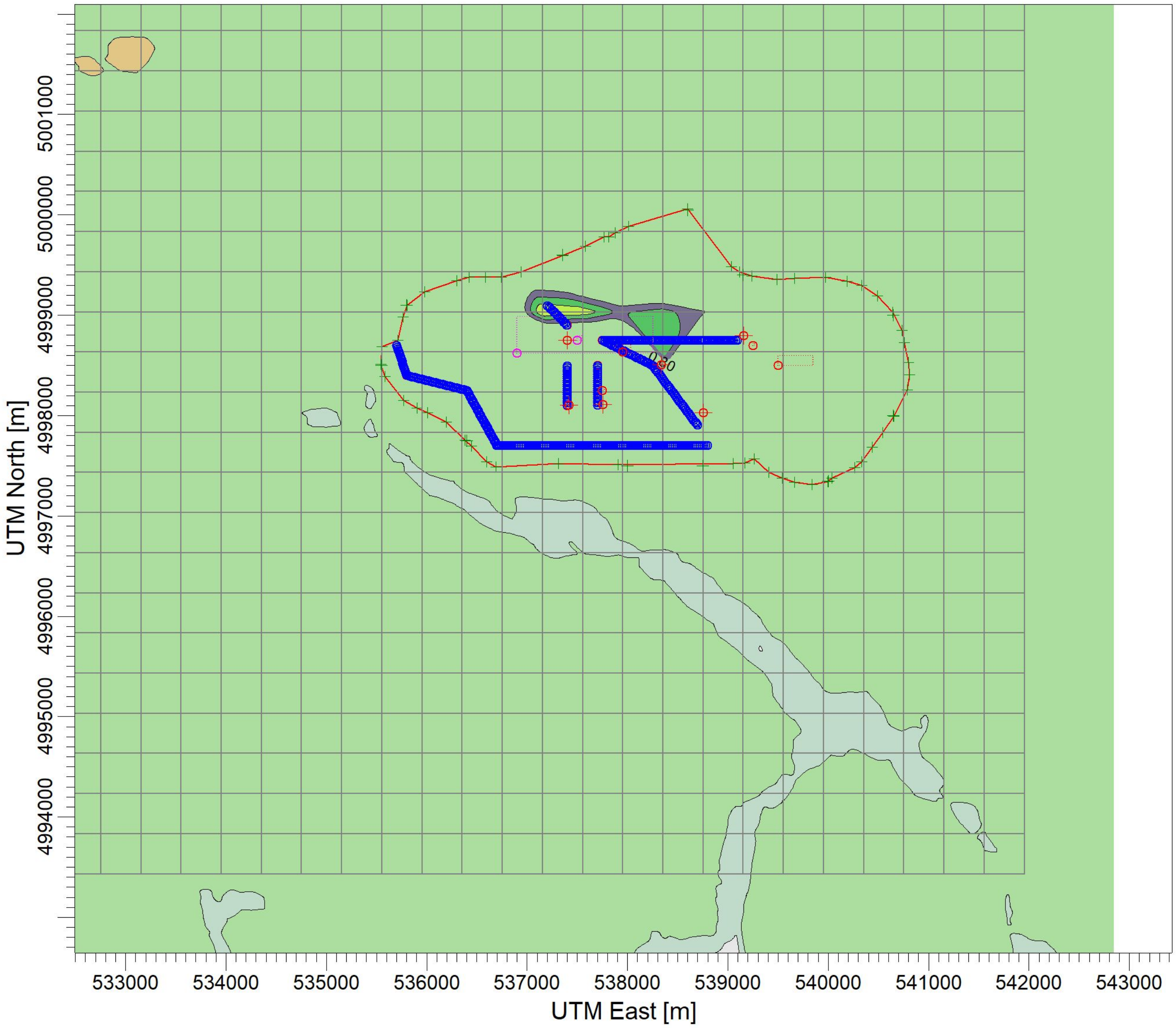
Max: 10.06 [ug/m^3] at (537553.90, 4999032.50)

5.00 6.00 7.00 8.00 9.00 10.00 10.06

COMMENTS:	SOURCES:	COMPANY NAME:	
Figure 2	**22**		
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:68,745 (0 — 2 km)	
	MAX: **10.06 ug/m^3**	DATE: **8/2/2019**	PROJECT NO.:

PROJECT TITLE:

1 Hour Sulfur Dioxide - No Mitigation



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL — ug/m^3

Max: 1.11 [ug/m^3] at (537153.90, 4999032.50)

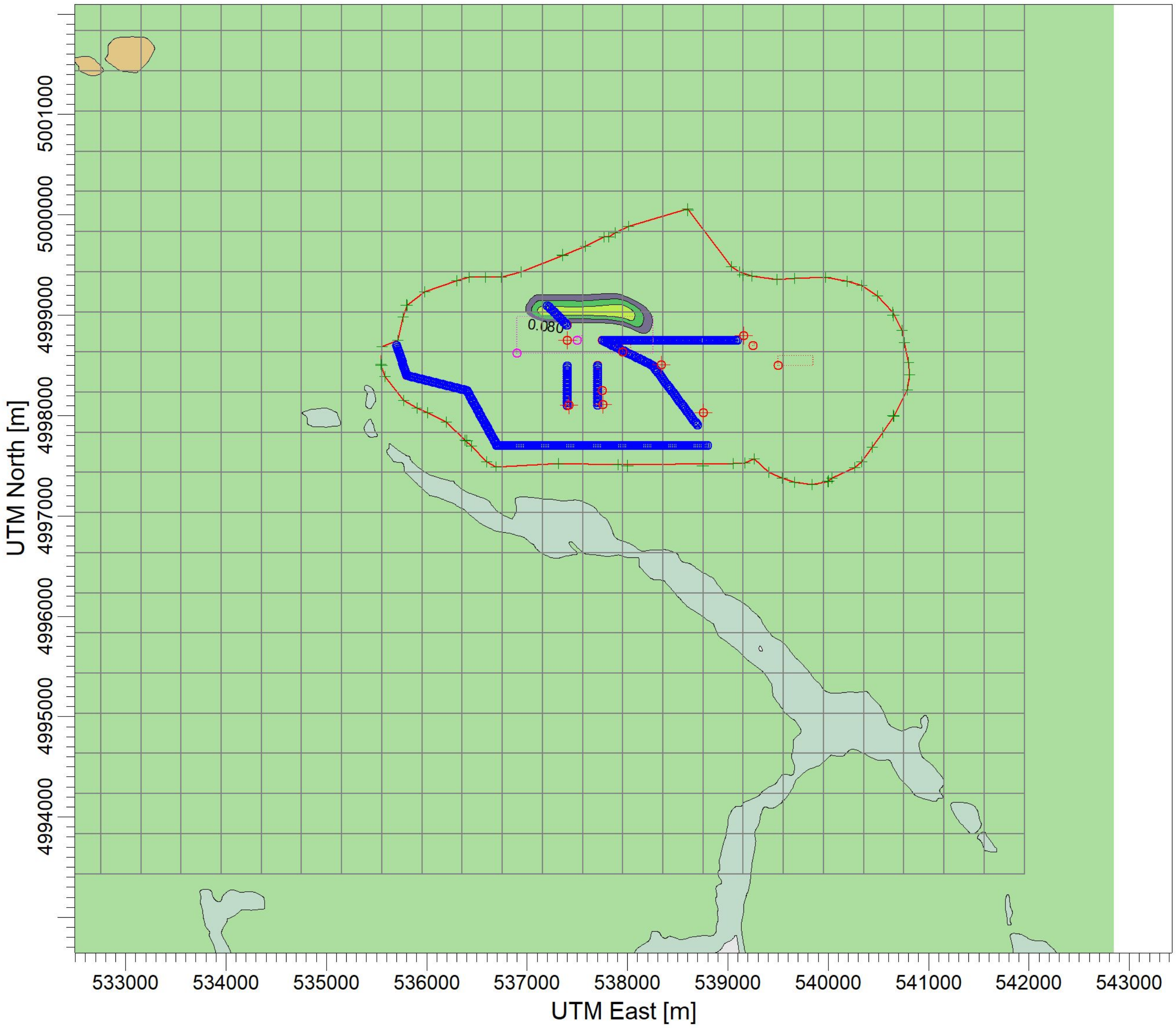
0.80 | 0.90 | 1.00 | 1.11

COMMENTS:	SOURCES:	COMPANY NAME:	
Figure 3	**22**		
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:68,745 (0 — 2 km)	
	MAX: **1.11 ug/m^3**	DATE: **8/2/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\bill.chew\Documents\AERMOD View\FMS3\FM4\FMS6\FMS6TSPMit\FMS6PM10Mit\FM6PM10\FMS6As\FMSNO2\FMSNO2.isc

PROJECT TITLE:

24 Hour Sulfur Dioxide - No Mitigation



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 0.113 [ug/m^3] at (537953.90, 4999032.50)

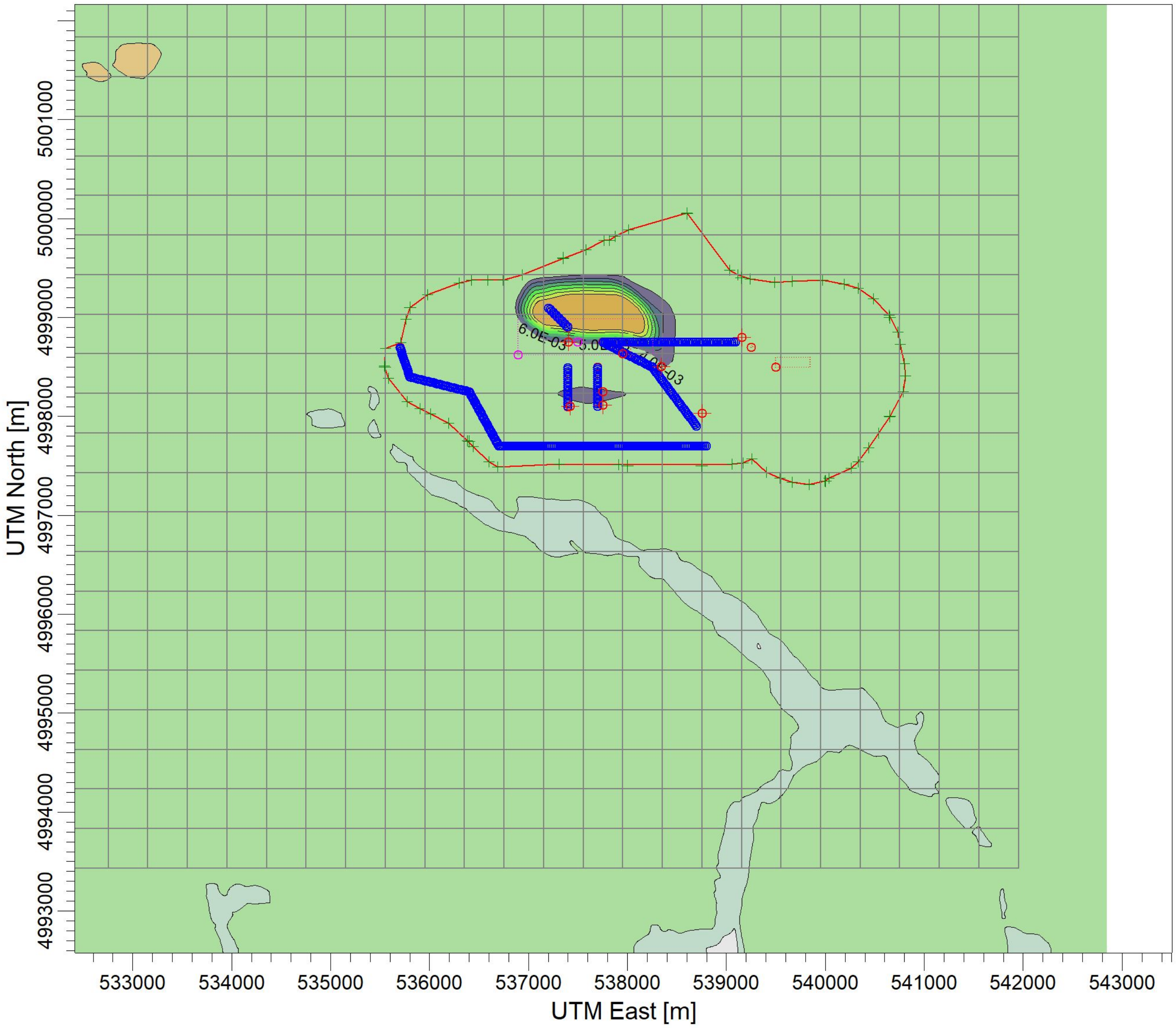
0.080 | 0.090 | 0.100 | 0.113

COMMENTS:	SOURCES:	COMPANY NAME:	
Figure 4	**22**		
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:68,745 (0 — 2 km)	
	MAX: **0.113 ug/m^3**	DATE: **8/2/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\bill.chew\Documents\AERMOD View\FMS3\FM4\FMS6\FMS6TSPMit\FMS6PM10Mit\FM6PM10\FMS6As\FMSNO2\FMSNO2.isc

PROJECT TITLE:

Annual Sulfur Dioxide - No Mitigation



PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 1.7E-02 [ug/m^3] at (537553.90, 4999032.50)

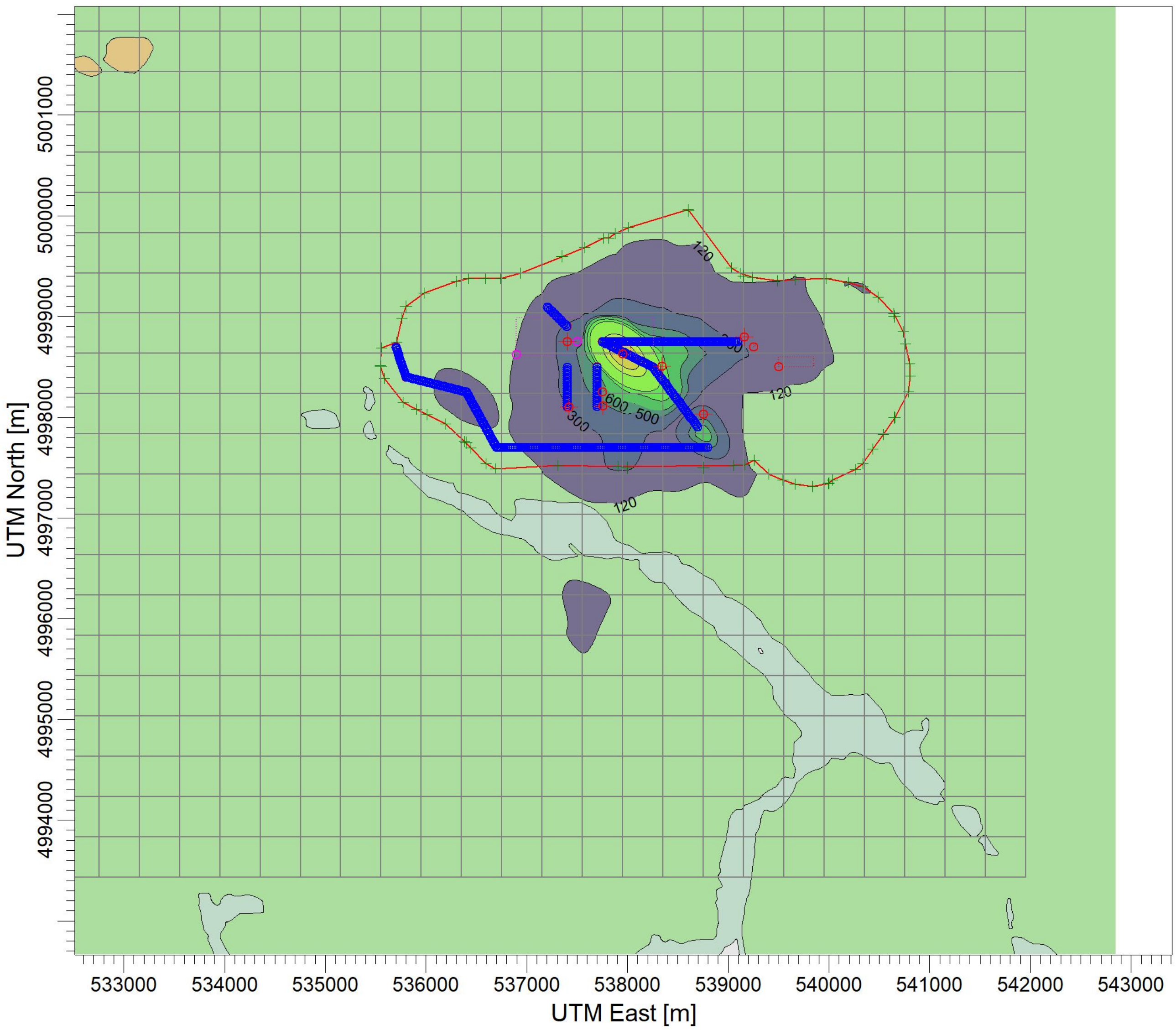
4.0E-03 5.0E-03 6.0E-03 7.0E-03 8.0E-03 9.0E-03 1.0E-02 1.7E-02

COMMENTS:	SOURCES:	COMPANY NAME:	
Figure 5	**22**		
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:69,745 (0 — 2 km)	
	MAX: **1.7E-02 ug/m^3**	DATE: **8/2/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\bill.chew\Documents\AERMOD View\FMS3\FM4\FMS6\FMS6TSPMit\FMS6PM10Mit\FM6PM10\FMS6As\FMSNO2\FMSNO2.isc

PROJECT TITLE:

24 Hour TSP - No Mitigation



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 3576 [ug/m^3] at (537953.90, 4998632.50)

120 300 500 600 800 1000 2000 2500 3500 3576

COMMENTS:

Figure 6a

SOURCES:

22

COMPANY NAME:

RECEPTORS:

745

MODELER:

OUTPUT TYPE:

Concentration

SCALE:

1:68,499

0 2 km

MAX:

3576 ug/m^3

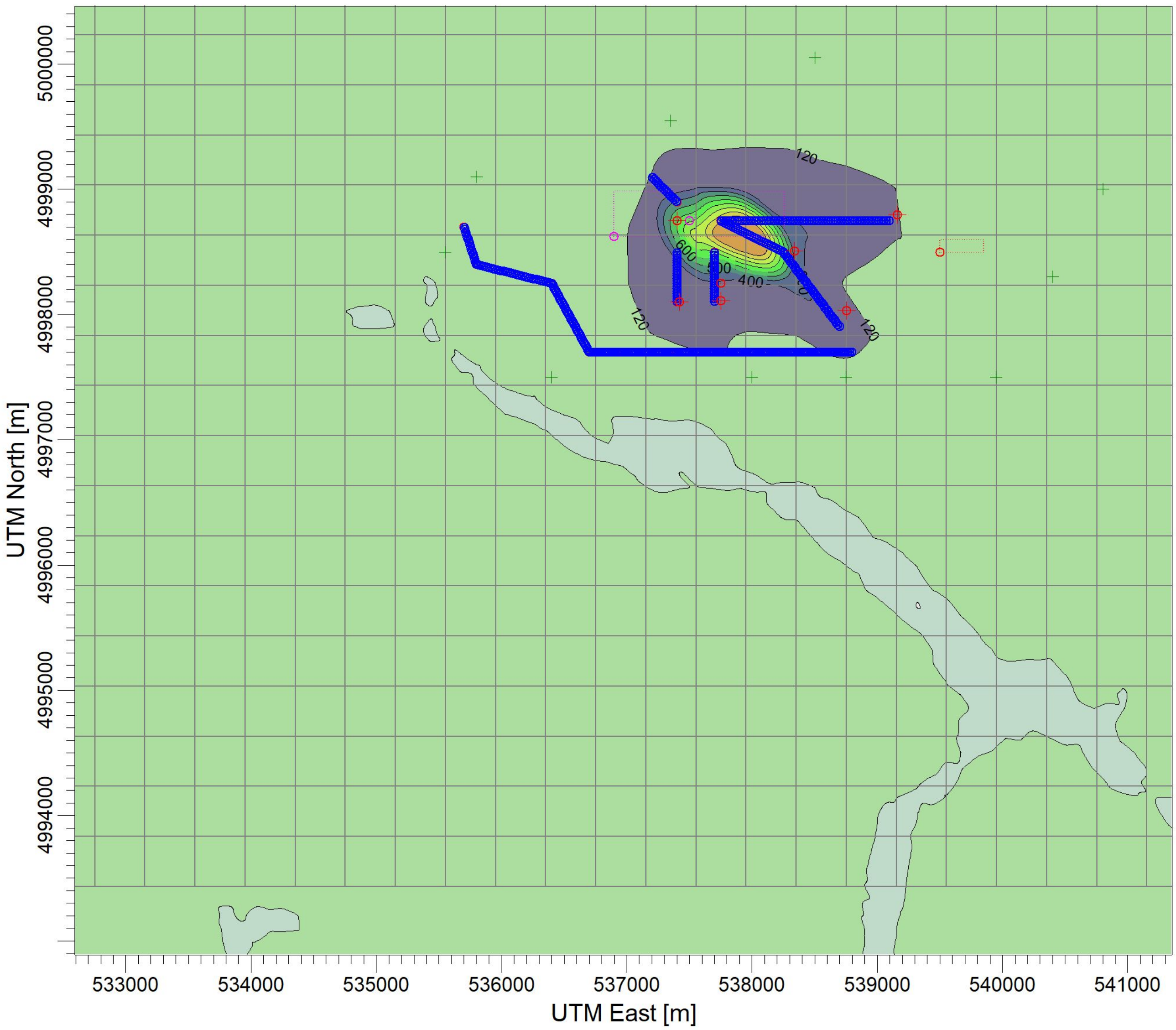
DATE:

8/1/2019

PROJECT NO.:

PROJECT TITLE:

24 Hour TSP - Mitigation on Haul Roads



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 1486 [ug/m^3] at (537953.90, 4998632.50)

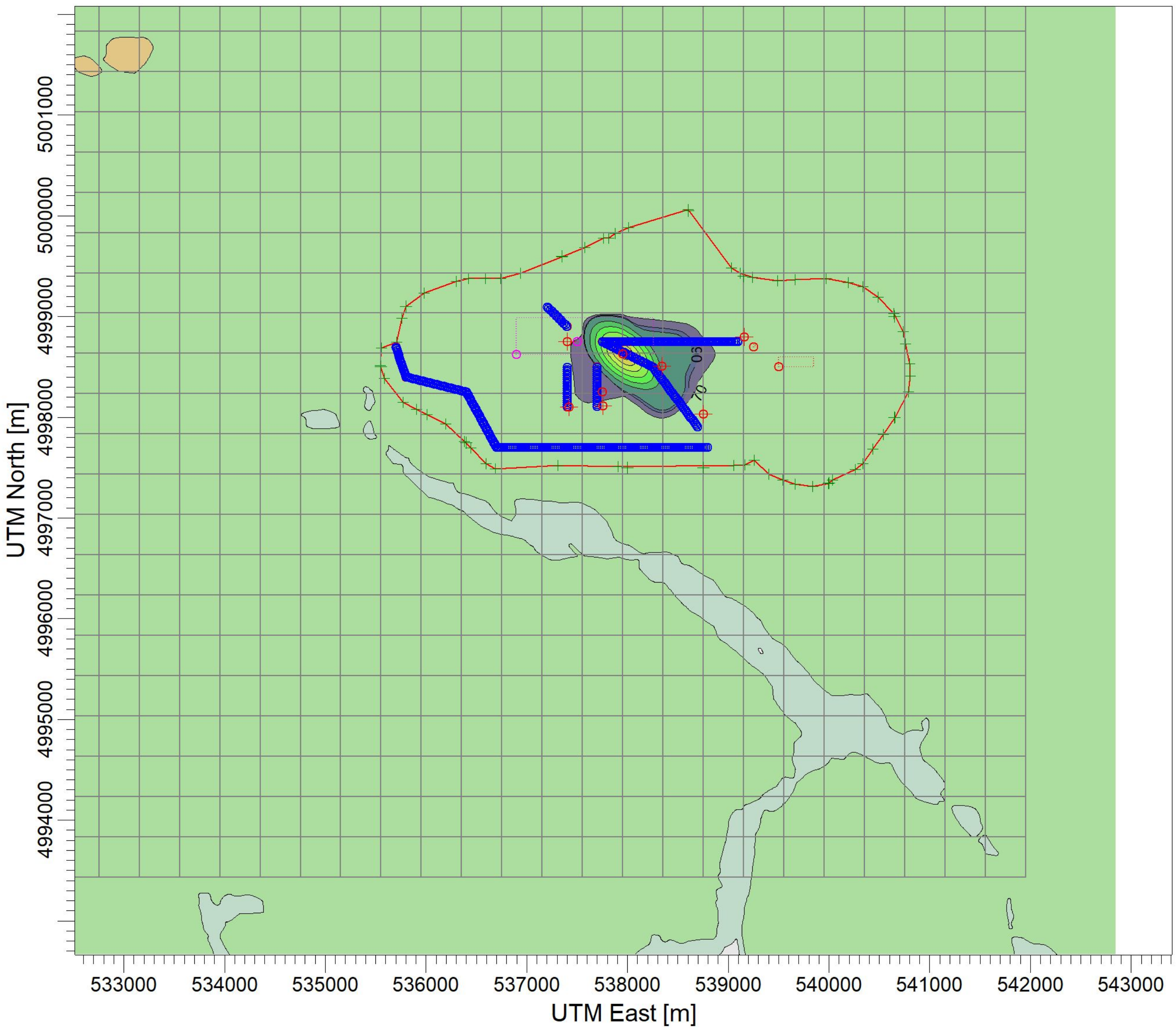
120 300 400 500 600 700 800 900 1000 1486

COMMENTS:	SOURCES:	COMPANY NAME:	
Figure6b	**20**		
	RECEPTORS: **686**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:55,095 0 — 2 km	
	MAX: **1486 ug/m^3**	DATE: **8/8/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\bill.chew\Documents\AERMOD View\FMS3\FM4\FMS6\FMS6TSPMit\FMS6TSPMit.isc

PROJECT TITLE:

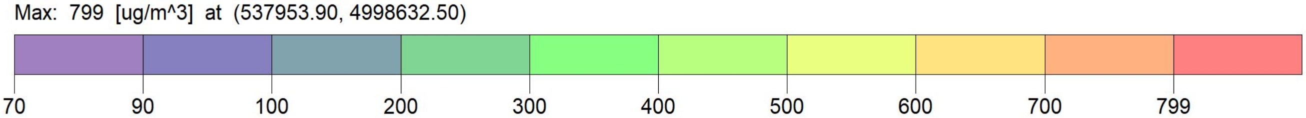
Annual TSP - No Mitigation



PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

ug/m^3

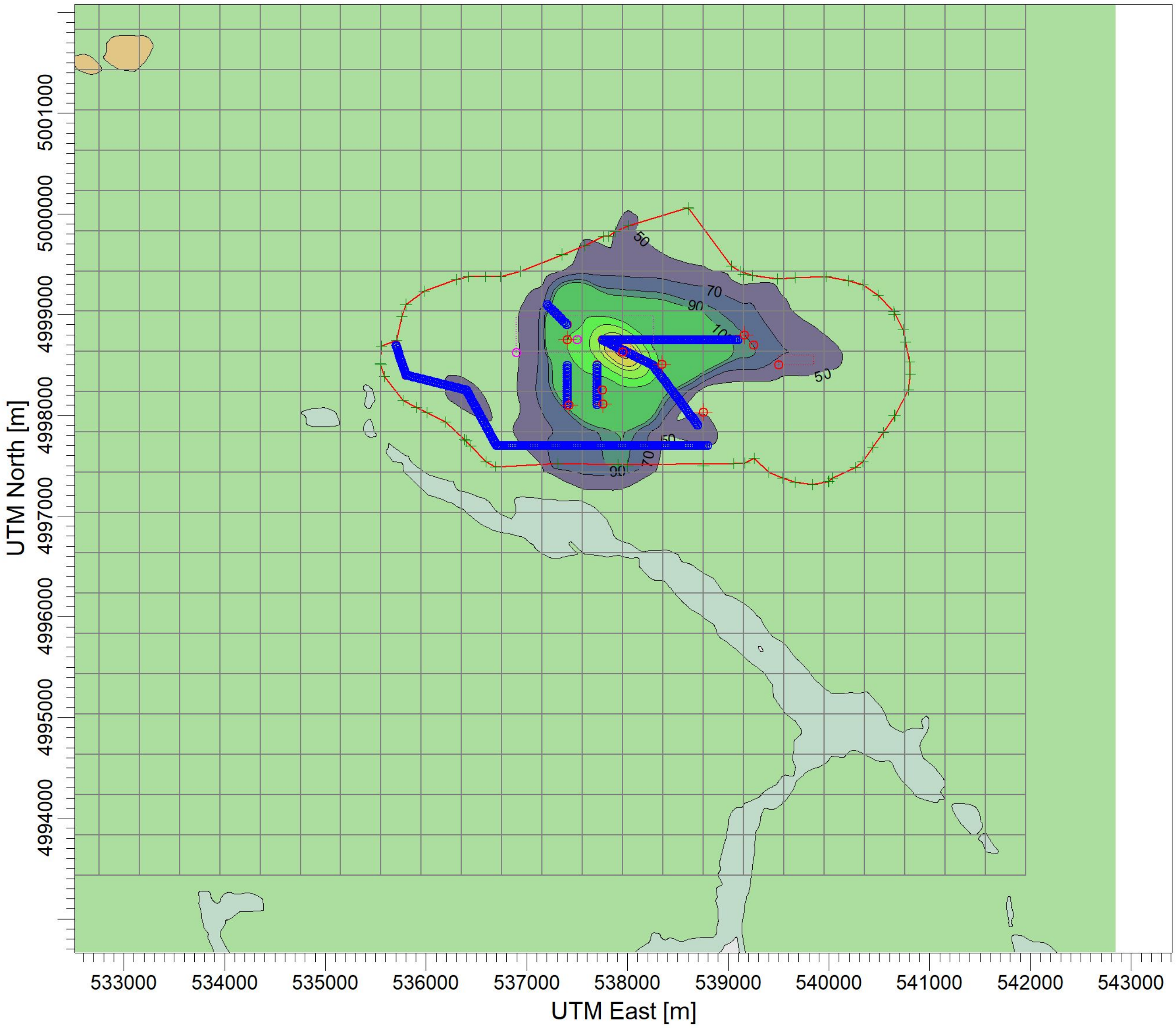
Max: 799 [ug/m^3] at (537953.90, 4998632.50)



COMMENTS: Figure 7a	SOURCES: **22**	COMPANY NAME:	
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:68,499 0 ——— 2 km	
	MAX: **799 ug/m^3**	DATE: **8/1/2019**	PROJECT NO.:

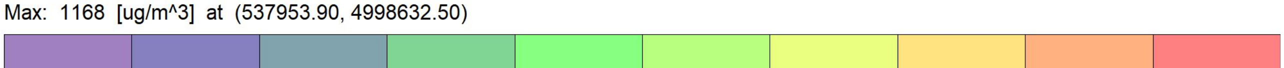
PROJECT TITLE:

24 Hour PM10 - No Mitigation



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

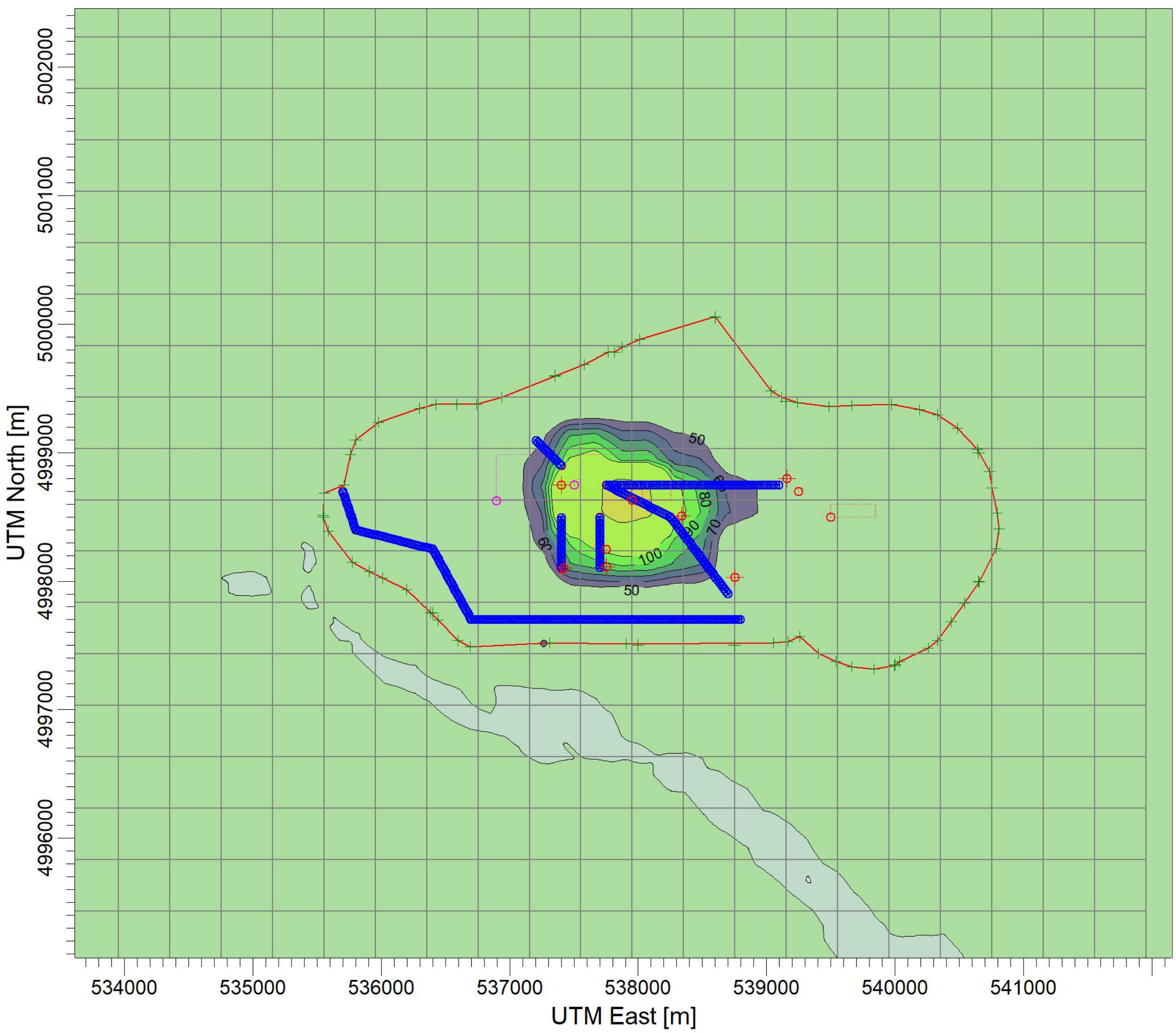
Max: 1168 [ug/m^3] at (537953.90, 4998632.50)



COMMENTS:	SOURCES:	COMPANY NAME:	
Figure 8a	**22**		
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:68,499 (0 — 2 km)	
	MAX: **1168 ug/m^3**	DATE: **8/1/2019**	PROJECT NO.:

PROJECT TITLE:

24 Hour PM10 - 55% Mitigation on Haul Roads



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

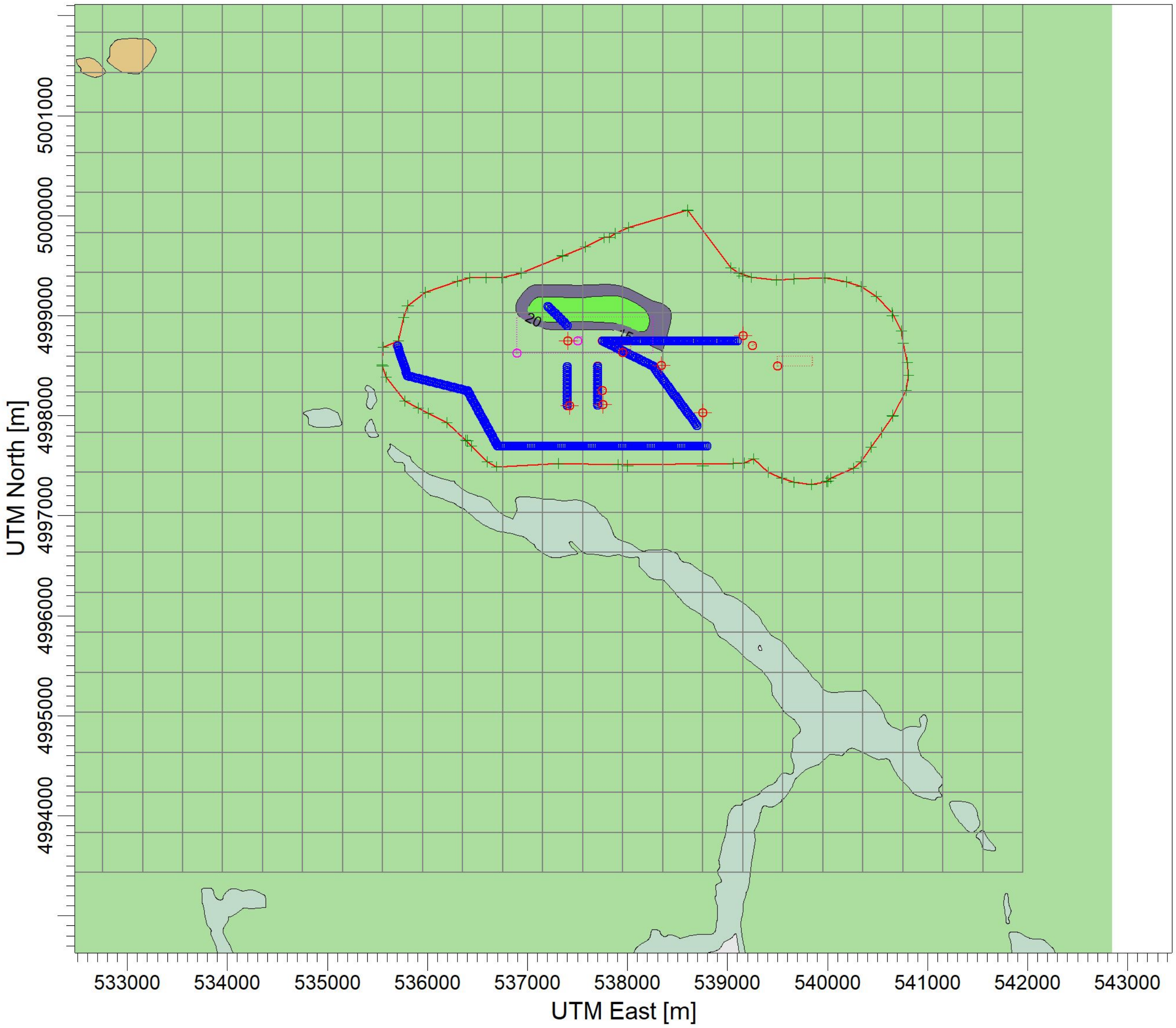
Max: 364 [ug/m^3] at (537953.90, 4998632.50)

50 60 70 80 90 100 200 300 364

COMMENTS: Figure 8b	SOURCES: **22**	COMPANY NAME:
	RECEPTORS: **745**	MODELER:
	OUTPUT TYPE: **Concentration**	SCALE: 1:53,738 0 2 km
	MAX: **364 ug/m^3**	DATE: **8/1/2019**
		PROJECT NO.:

PROJECT TITLE:

24 Hour PM2.5 - No Mitigation



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 27.2 [ug/m^3] at (537953.90, 4999032.50)

15.0 | 20.0 | 27.2

COMMENTS:

Figure 9

SOURCES:

22

COMPANY NAME:

RECEPTORS:

745

MODELER:

OUTPUT TYPE:

Concentration

SCALE:

1:68,990

0 — 2 km

MAX:

27.2 ug/m^3

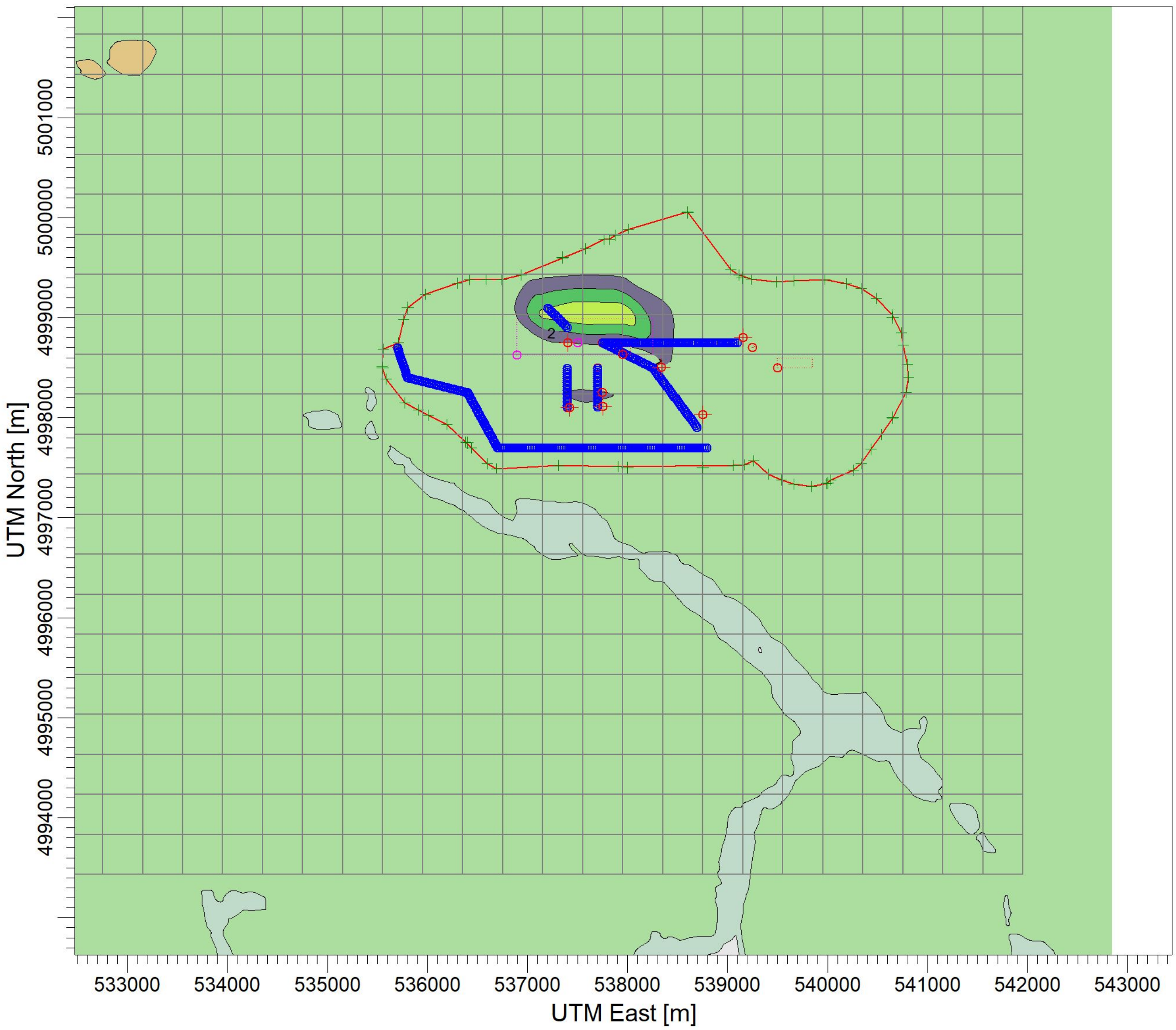
DATE:

8/6/2019

PROJECT NO.:

PROJECT TITLE:

Annual PM2.5 - No Mitigation



PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

ug/m^3

Max: 4.00 [ug/m^3] at (537553.90, 4999032.50)

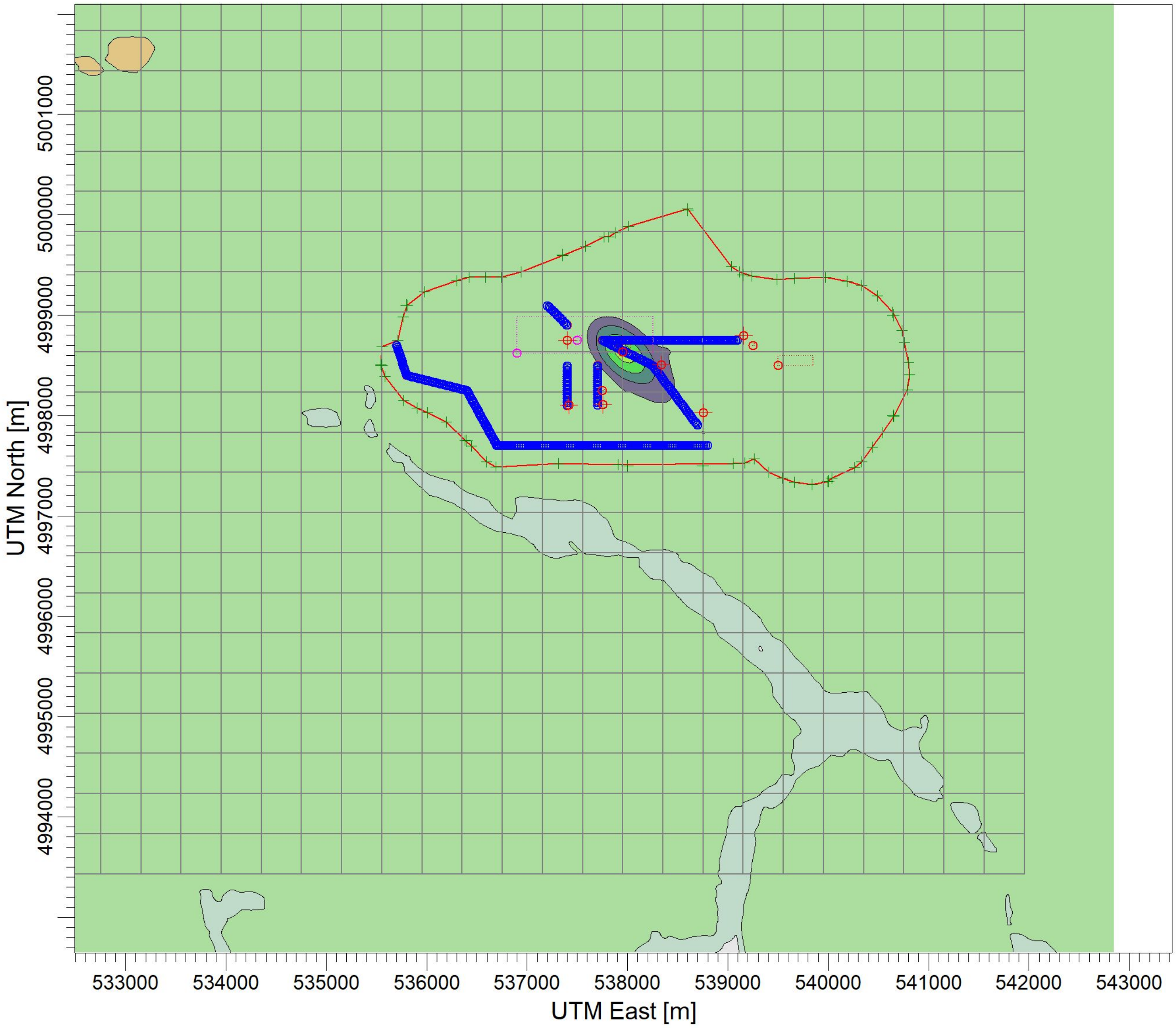
1.00 | 2.00 | 3.00 | 4.00

COMMENTS: Figure 10	SOURCES: **22**	COMPANY NAME:	
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:68,990 0 — 2 km	
	MAX: **4.00 ug/m^3**	DATE: **8/6/2019**	PROJECT NO.:

AERMOD View - Lakes Environmental Software C:\Users\bill.chew\Documents\AERMOD View\FMS3\FM4\FMS6\FMS6TSPMit\FMS6PM10Mit\FM6PM10\FMS6As\FMSNO2\FMSNO2.isc

PROJECT TITLE:

24 Hour Arsenic - No Mitigation



PLOT FILE OF HIGH 1ST HIGH 24-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

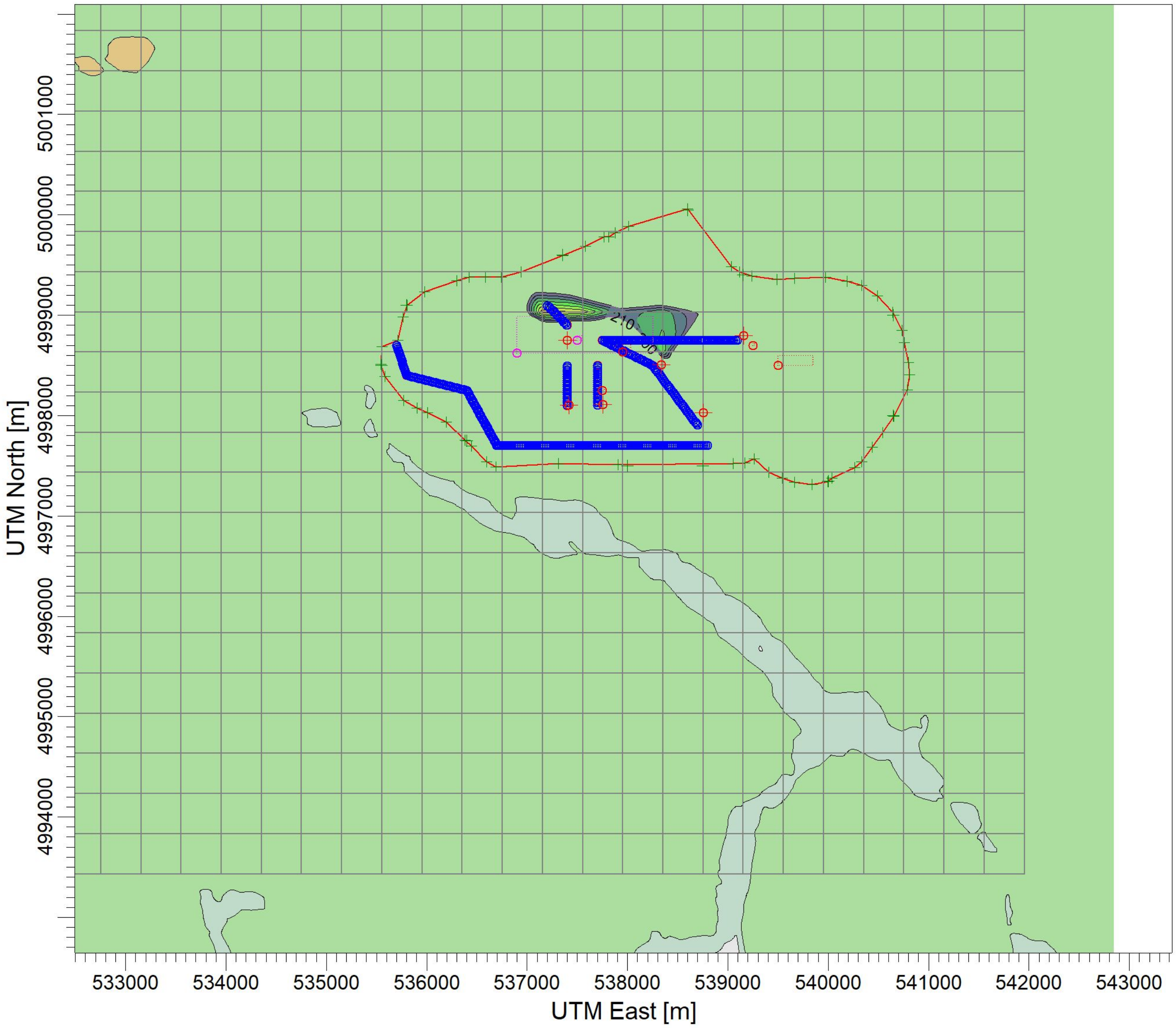
Max: 0.503 [ug/m^3] at (537953.90, 4998632.50)

0.100 0.200 0.300 0.400 0.500 0.503

COMMENTS:	SOURCES:	COMPANY NAME:	
Figure 11	**22**		
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:68,745 0 2 km	
	MAX: **0.503 ug/m^3**	DATE: **8/2/2019**	PROJECT NO.:

PROJECT TITLE:

1 Hour Carbon Monoxide - No Mitigation



PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

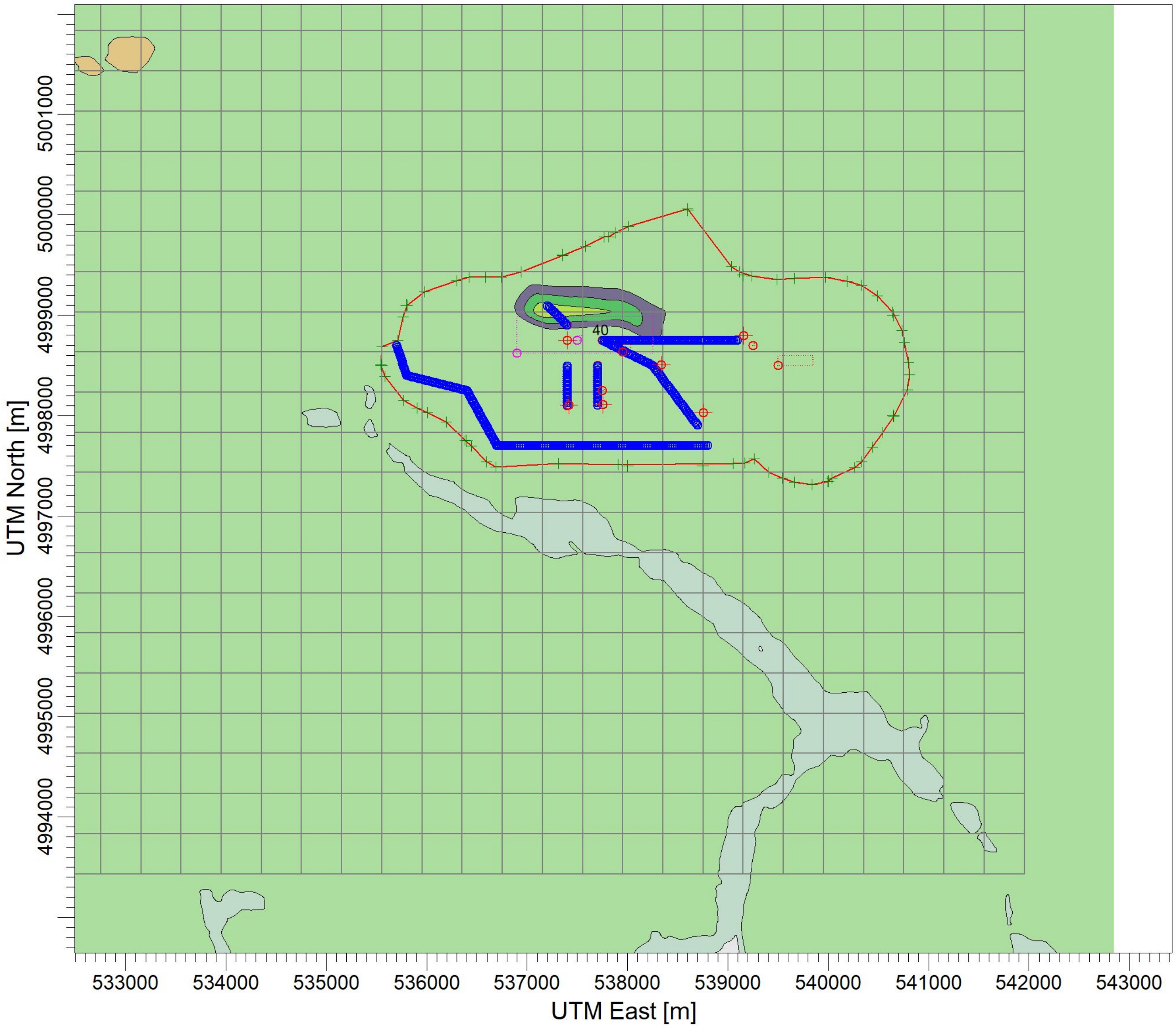
Max: 267 [ug/m^3] at (537153.90, 4999032.50)

200 210 220 230 240 250 260 267

COMMENTS: Figure 12	SOURCES: **22**	COMPANY NAME:	
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Concentration**	SCALE: 1:68,745 0 ——— 2 km	
	MAX: **267 ug/m^3**	DATE: **8/2/2019**	PROJECT NO.:

PROJECT TITLE:

8 Hour Carbon Monoxide - No Mitigation



PLOT FILE OF HIGH 1ST HIGH 8-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 69.8 [ug/m^3] at (537153.90, 4999032.50)

40.0 50.0 60.0 69.8

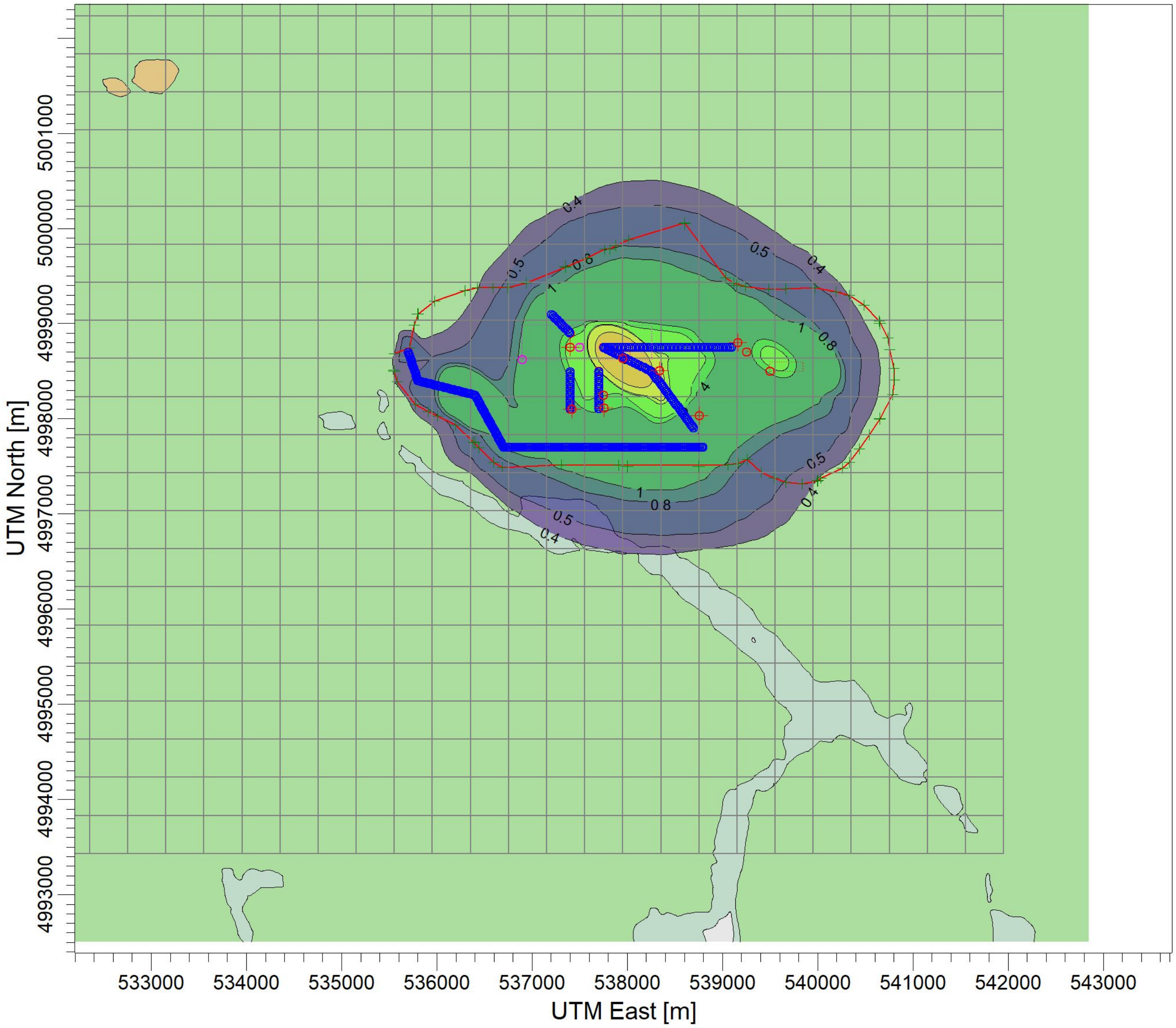
COMMENTS: Figure 13	SOURCES: **22**	COMPANY NAME:
	RECEPTORS: **745**	MODELER:
	OUTPUT TYPE: **Concentration**	SCALE: 1:68,745 0 — 2 km
	MAX: **69.8 ug/m^3**	DATE: **8/2/2019**
		PROJECT NO.:

Attachment C

AERMOD Contour Plots - Deposition

PROJECT TITLE:

Annual Particulate Deposition



PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

g/m^2

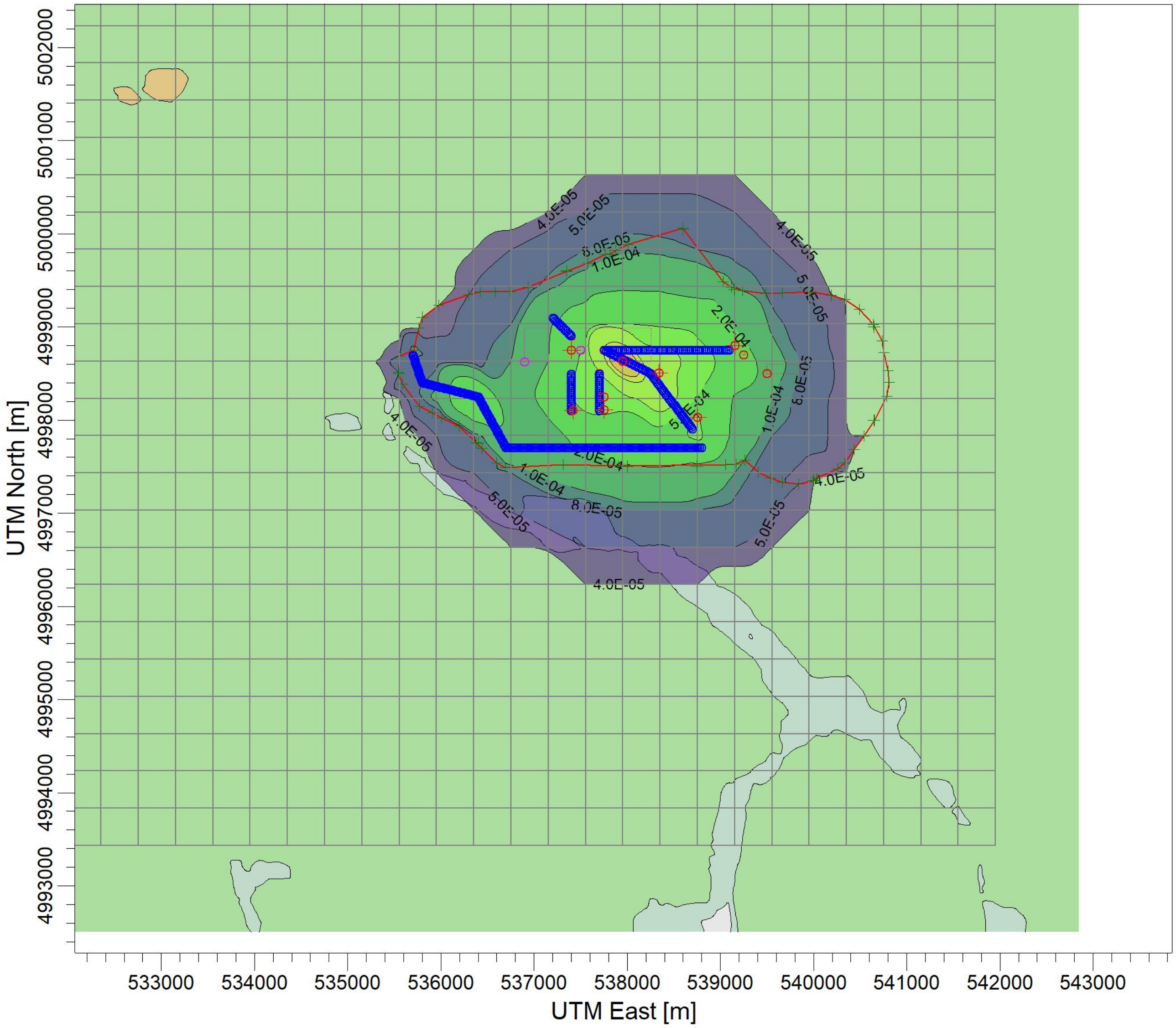
Max: 56.6 [g/m^2] at (537953.90, 4998632.50)

0.4 0.5 0.8 1.0 4.0 5.0 9.0 10.0 20.0 50.0 56.6

COMMENTS:	SOURCES: **22**	COMPANY NAME:
	RECEPTORS: **745**	MODELER:
	OUTPUT TYPE: **Total Depos.**	SCALE: 1:72,480 (0 — 2 km)
	MAX: **56.6 g/m^2**	DATE: **8/8/2019**
		PROJECT NO.:

PROJECT TITLE:

Annual Arsenic Deposition



PLOT FILE OF ANNUAL VALUES FOR SOURCE GROUP: ALL

g/m^2

Max: 7.8E-03 [g/m^2] at (537953.90, 4998632.50)

4.0E-05 | 5.0E-05 | 8.0E-05 | 1.0E-04 | 2.0E-04 | 5.0E-04 | 1.0E-03 | 4.0E-03 | 5.0E-03 | 7.0E-03 | 7.8E-03

COMMENTS:	SOURCES: **22**	COMPANY NAME:	
	RECEPTORS: **745**	MODELER:	
	OUTPUT TYPE: **Total Depos.**	SCALE: 1:74,062 0 ▬ 2 km	
	MAX: **7.8E-03 g/m^2**	DATE: **8/7/2019**	PROJECT NO.:

Attachment D

Limitations

LIMITATIONS

1. The work performed in the preparation of this report and the conclusions presented are subject to the following:
   (a) The Standard Terms and Conditions which form a part of our Professional Services Contract;
   (b) The Scope of Services;
   (c) Time and Budgetary limitations as described in our Contract; and
   (d) The Limitations stated herein.
2. No other warranties or representations, either expressed or implied, are made as to the professional services provided under the terms of our Contract, or the conclusions presented.
3. The conclusions presented in this report were based, in part, on visual observations of the Site and attendant structures. Our conclusions cannot and are not extended to include those portions of the Site or structures, which are not reasonably available, in Wood's opinion, for direct observation.
4. The environmental conditions at the Site were assessed, within the limitations set out above, having due regard for applicable environmental regulations as of the date of the inspection. A review of compliance by past owners or occupants of the Site with any applicable local, provincial or federal by-laws, orders-in-council, legislative enactments and regulations was not performed.
5. The Site history research included obtaining information from third parties and employees or agents of the owner. No attempt has been made to verify the accuracy of any information provided, unless specifically noted in our report.
6. Where testing was performed, it was carried out in accordance with the terms of our contract providing for testing. Other substances, or different quantities of substances testing for, may be present on Site and may be revealed by different or other testing not provided for in our contract.
7. Because of the limitations referred to above, different environmental conditions from those stated in our report may exist. Should such different conditions be encountered, Wood must be notified in order that it may determine if modifications to the conclusions in the report are necessary.
8. The utilization of Wood's services during the implementation of any remedial measures will allow Wood to observe compliance with the conclusions and recommendations contained in the report. Wood's involvement will also allow for changes to be made as necessary to suit field conditions as they are encountered.
9. This report is for the sole use of the party to whom it is addressed unless expressly stated otherwise in the report or contract. Any use which any third party makes of the report, in whole or the part, or any reliance thereon or decisions made based on any information or conclusions in the report is the sole responsibility of such third party. Wood accepts no responsibility whatsoever for damages or loss of any nature or kind suffered by any such third party as a result of actions taken or not taken or decisions made in reliance on the report or anything set out therein.
10. This report is not to be given over to any third party for any purpose whatsoever without the written permission of Wood.
11. Provided that the report is still reliable, and less than 12 months old, Wood will issue a third-party reliance letter to parties that the client identifies in writing, upon payment of the then current fee for such letters. All third parties relying on Wood's report, by such reliance agree to be bound by our proposal and Wood's standard reliance letter. Wood's standard reliance letter indicates that in no event shall Wood be liable for any damages, howsoever arising, relating to third-party reliance on Wood's report. No reliance by any party is permitted without such agreement.

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