Hamilton Transit

BUS MAINTENANCE & STORAGE FACILITY

Appendix E

Air Quality

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Prepared for

Hamilton

Prepared by

IBI GROUP

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ORTECH
a Kontrol Energy Company

Report:

IBI Group
Hamilton Maintenance and Storage Facility (MSF)
Air Quality Environmental Assessment

Date: September 9, 2019



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Hamilton Maintenance and Storage Facility (MSF)
Air Quality Environmental Assessment

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Revision History

Version	Date	Summary Changes/Purpose of Revision
1	July 5, 2019	Draft Report
2	July 19, 2019	Final Report
3	September 9, 2019	Generator spec change; MECP comment updates (threshold screening calculation correction & contaminants assessed against ACB List limits in addition to AAQC)

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EXECUTIVE SUMMARY

The City of Hamilton has retained IBI Group to undertake the study and design of a new bus maintenance and storage facility (MSF) for use by Hamilton Transit (HSR) at Birch Avenue and Brant Street, Hamilton. In turn, IBI Group retained ORTECH Consulting Inc. (ORTECH) to prepare an Air Quality Assessment report in support of a facility Environmental Assessment for the proposed Hamilton MSF. The Air Quality Assessment is an evaluation of the potential impacts on air quality in the area surrounding the proposed facility.

The purpose of the transit bus facility project is to increase maintenance and storage capacity for existing and new buses which are required to improve transit service across Hamilton. The proposed facility will provide overnight inside storage facilities for up to 300 compressed natural gas (CNG) buses and will have 30 maintenance bays. The facility will also include administrative offices and staff parking.

This air quality assessment studied potential impacts from the facility during construction and operation. Construction impacts will be minimized with the implementation of a best management practices plan. Air contaminant emissions during operations of the facility were estimated and impacts of the emissions were determined taking into account existing air quality for the significant contaminants.

Existing air quality in the Hamilton Region is characterized by a provincial air quality monitoring station located in Hamilton. The most recent ambient air quality data from that network is from 2016. The annual ambient air quality data available for the previous 5 years (2012, 2013, 2014, 2015, 2016) at the Hamilton station are summarized in the report. Generally, air quality in Hamilton has been improving over the last 5 years; however the Hamilton Region still experiences exceedances of the Ministry of the Environment, Conservation and Parks (MECP) ambient air quality guideline limits for particulate matter and benzene.

Emissions from the heating systems, emergency generators, vehicle maintenance, and vehicles operations on the site are considered in the report. The emission estimates were entered into the AERMOD dispersion model used to assess the effects of the new facility on air quality in the area surrounding the facility for the Environmental Assessment.

The maximum combined concentrations for each contaminant were determined to be below their respective guidelines or limits. The report discusses the conservative nature of the emission estimates used in the modelling suggesting that typical levels will be much lower than predicted from modelling. It is anticipated that the surrounding community air quality will not be adversely impacted by the activities and emissions from the facility.

1. INTRODUCTION

The City of Hamilton has retained IBI Group to undertake the study and design of a new bus maintenance and storage facility (MSF) for use by Hamilton Transit (HSR) at Birch Avenue and Brant Street, Hamilton. In turn, IBI Group retained ORTECH Consulting Inc. (ORTECH) to prepare an Air Quality Assessment report in support of a facility Environmental Assessment for the proposed Hamilton MSF. The Air Quality Assessment is an evaluation of the potential impacts this development might have on air quality in the area surrounding the proposed facility.

1.1 Project and Facility Description

The purpose of the transit bus facility project is to increase maintenance and storage capacity for existing and new buses which are required to improve transit service across Hamilton. The proposed facility will provide overnight inside storage facilities for up to 300 compressed natural gas (CNG) buses and will have up to 30 maintenance bays. Buses returning daily will pass through the service lane for cleaning, fueling, and washing prior to being stored inside the building. Out of service vehicles will be housed in the maintenance bays while being serviced. The facility will also include administrative offices and staff parking. A site plan of the proposed building shown is provided in Appendix A.

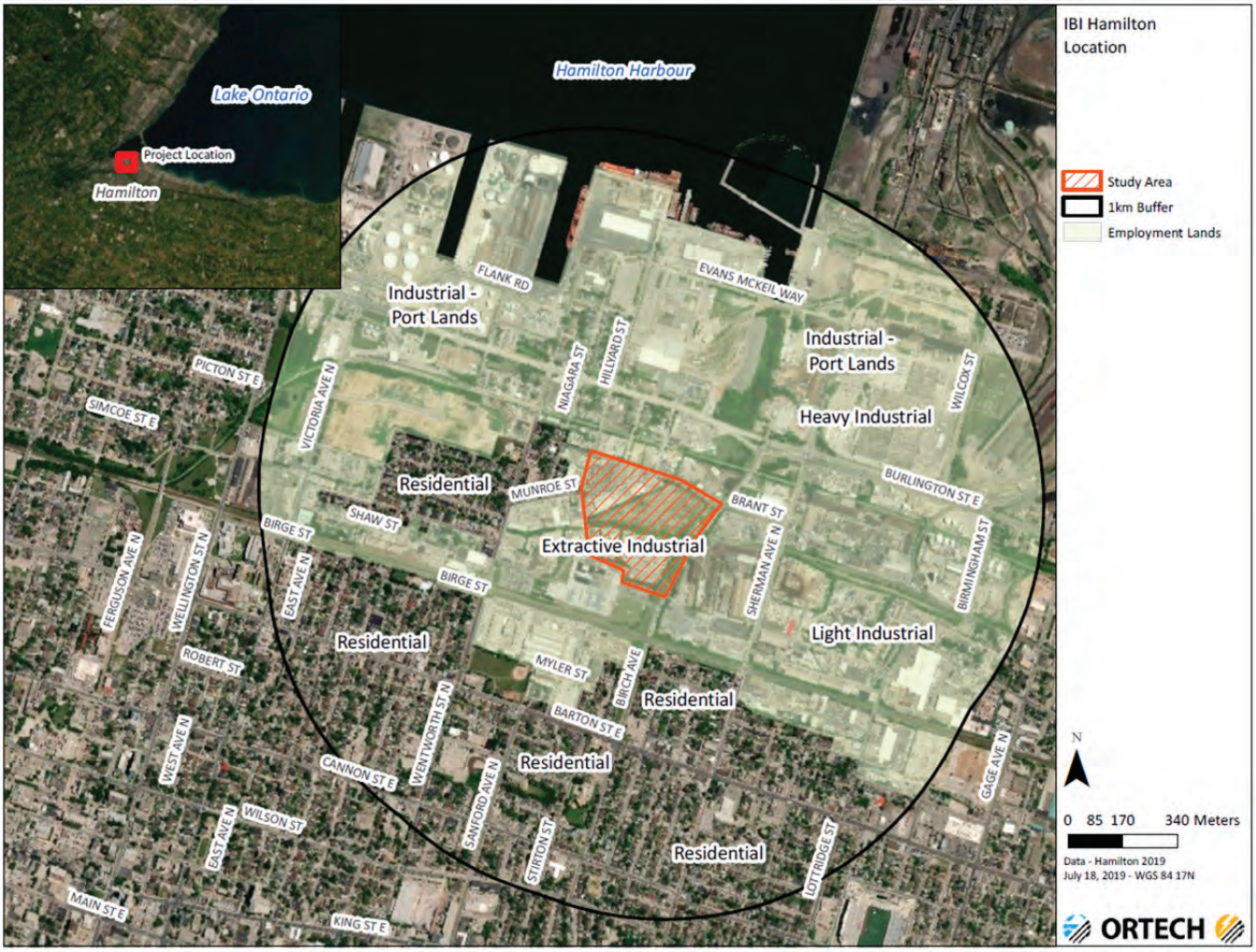
The proposed facility is located at Birch Avenue and Brant Street, in the City of Hamilton. Figure 1 shows the proposed project site. The nearest sensitive receptors (residences) are located directly west of the proposed site. The proposed site is zoned Extractive Industrial.

1.2 Scope of Environmental Assessment

This air quality assessment studied potential impacts from the facility during construction and operation. During construction existing buildings on site will be demolished, new buildings will be constructed and the site will need to be paved. Construction sites will have air emissions associated with the site specific construction operations such as dust, particulate, and combustion contaminants. The emissions from construction activities will be from low level sources and will have a low potential for dispersion beyond the immediate areas surrounding the site. In addition, construction activities will be limited in duration. Thus, no detailed modelling of the impact of these activities was completed. Instead, a best practices plan will be prepared for construction activities at the site to reduce air emissions from the construction and demolition activities.

Air contaminant emissions during operations of the facility were estimated and impacts of the emissions were determined taking into account existing air quality for the significant contaminants.

Figure 1: Project Site



2. CONTAMINANTS OF CONCERN

2.1 Emissions from Transit Bus Operations

The contaminants of interest from motor vehicles, including transit buses, have been determined by scientists and engineers with United States and Canadian government agencies such as the U.S. Environmental Protection Agency (EPA), the Ontario Ministry of the Environment, Conservation and Parks (MECP), Environment and Climate Change Canada (ECCC), Health Canada (HC), and the Ontario Ministry of Transportation (MTO). These contaminants are primarily emitted due to fuel combustion. The contaminants of interest from motor vehicles are categorized as Criteria Air Contaminants (CACs) and Volatile Organic Compounds (VOCs).

These contaminants in Table 1 have been selected for this assessment due to their potential effect on human health or the environment and, based on ORTECH's experience, represent the contaminants that have the potential to exceed government criteria for a facility of this nature. Toxic fractions of VOCs from CNG transit bus exhaust were selected based on the EPA report "Air Toxic Emissions from On-road Vehicles in MOVES2014", dated December 2014.

Table 1: Contaminants of Interest

Criteria Air Contaminants (CACs)	Volatile Organic Compounds (VOCs)
Nitrogen Dioxide (NO_2)	Benzene
Carbon Monoxide (CO)	Toluene
Fine Particulate Matter ($PM_{2.5}$) (<2.5 microns diameter)	Ethylbenzene
Coarse Particulate matter (PM_{10}) (<10 microns diameter)	Xylenes
	Formaldehyde
	Acetaldehyde

2.2 Emissions from Natural Gas Heating Equipment and Standby Generators

The main contaminants of concern associated with heating equipment and generator exhaust due to the combustion of natural gas, is oxides of nitrogen (NO_X), specifically nitrogen dioxide (NO_2) in relation to human health. For this assessment, NO_2 was assessed as the contaminant of concern from the natural gas-fired heating equipment. Contaminants of natural gas combustion other than NO_X are generally negligible in accordance with the MECP "Guideline A-10: Procedure for Preparing and Emission Summary and Dispersion Modelling Report Version 4.1" dated March 2018 (Guideline A-10).

2.3 Emissions from the Paint Booth and Shop Areas

Air emissions were also considered from the paint booth, body shop, and paint prep shop. Contaminants of concern from the paint booth are the VOCs and solids contained in products used for touch-up painting of the buses. Based on the EPA AP-42 document, contaminants of concern from the body shop are particulate matter, chromium, manganese, cobalt and nickel. An additional concern for emissions from the shop spaces is particulate matter from sanding and other maintenance activities.

2.4 Applicable Guidelines

In order to assess the impact of the project contaminant concentrations were calculated and compared to published guidelines. The applicable contaminant guidelines are:

- MECP Air Contaminants Benchmarks (ACB) List
- MECP Ambient Air Quality Criteria (AAQC)

The ACB List itemizes contaminants with corresponding benchmarks (standards, guidelines or screening levels), used by facilities to assess their contributions of a contaminant to air as predicted by air dispersion modelling. The benchmarks are based on a maximum ground-level concentration of a contaminant. For this assessment, the ACB List was used to assess negligibility and screen out contaminants prior to modelling. More details on this screening process are provided in Section 4.3 and Appendix C.

An AAQC is a desirable concentration of a contaminant in air, based on protection against adverse effects on health or the environment. Both the ACB List limit and the AAQC guideline for each contaminant and its applicable averaging period was used to assess the maximum predicted effect at off-site receptors derived from dispersion models, including the existing ambient concentrations for those contaminants. The applicable averaging periods for the contaminants of interest are based on 10 minute, 0.5, 1, 8 and 24 hour acute (short-term) exposures. The ACB List and AAQ values and averaging periods used in this assessment for the significant contaminants from the facility emission sources, including the transit buses and support activities such as the paint booth, are presented in Table 2.

Table 2: Applicable AAQC Guidelines and ACB List Limits

Contaminant	Averaging Period	AAQ Guideline ($\mu g/m^3$)	ACB List Limit ($\mu g/m^3$)	Limiting Effect
Nitrogen dioxide	1-hour	400	400[1]	Health
	24-hour	200	200[1]	Health
Carbon monoxide	½-hour	-	6000	Health
	1-hour	36,200	-	Health
	8-hour	15,700	-	Health
Butyl acetate, n-	1-hour	15,000	15,000	Health
	10-min	1,000	1,000	Odour

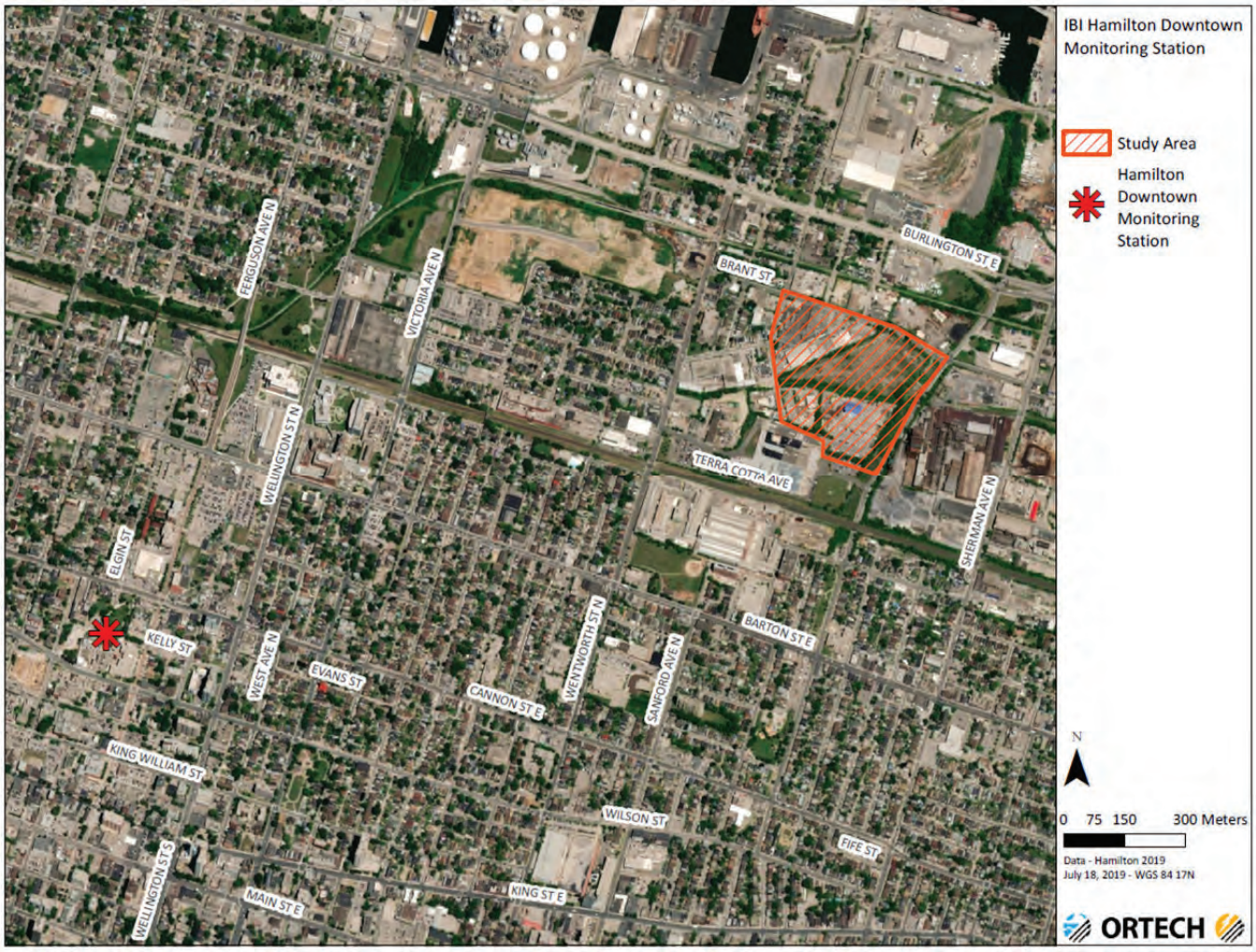
Notes:
[1] ACB List Limit is for Nitrogen Oxides

3. BACKGROUND (AMBIENT) CONDITIONS

3.1 Selection of Relevant Ambient Monitoring Stations

A review of MECP and National Air Pollution Surveillance (NAPS) ambient monitoring stations in Ontario was undertaken to identify the monitoring stations that are in relevant proximity to the study area and that would be representative of background contaminant concentrations in the study area. The MECP-operated Hamilton Downtown station (NAPS ID #60512) was determined to be the most representative as it is located less than 2 km from the study area. The location of this ambient monitoring station in relation to the study area is shown in Figure 2.

Figure 2: Relevant Monitoring Site



3.2 Selection of Worst-Case Ambient Conditions

The most recent five years of ambient air quality monitoring data publically available from the selected stations were summarized for the desired averaging periods, 1, 8 and 24 hour. For the CACs (NO_2 and CO) data was available for the years 2012-2016. Data for n-butyl acetate was not available from any MECP or NAPS ambient monitoring stations. The highest maximum value over the 5-year period for each contaminant and averaging period was selected to represent ambient (or existing) concentrations in the study area. Using the maximum ambient concentration is a very conservative assumption because it represents an absolute worst-case scenario, which likely only occurred for one hour or one day over the five-year period. For this reason, it is often suggested that the 90th percentile background concentration be selected to represent a reasonable worst-case scenario. However, in order to build conservatism into the results, the maximum background concentration was selected.

Table 3 provides the average, 90th percentile and maximum concentration for each contaminant determined to be significant (see Section 4.3). For both nitrogen dioxide and carbon monoxide the study area has consistently remained below their respective AAQC guidelines and ACB List limits. No data was available for n-butyl acetate.

Table 3: Hamilton Downtown Monitoring Station Data for Significant Contaminants

Contaminant (Averaging Period)	Statistic	Ambient Monitoring Data ($\mu g/m^3$)						% of Guideline/Limit
		2012	2013	2014	2015	2016	Max. Year	
NO_2 (1 hr)	Maximum	51	57	67	59	51	67	17%
	90th Percentile	25	25	24	24	24	25	6%
	Mean	12	12	12	12	12	12	3%
NO_2 (24 hr)	Maximum	34	36	48	34	41	48	24%
	90th Percentile	21	22	21	21	20	22	11%
	Mean	12	12	12	12	12	12	6%
CO (1 hr)	Maximum	1.7	2.0	2.9	1.3	1.4	2.9	<1%
	90th Percentile	0.4	0.4	0.4	0.4	0.4	0.4	<1%
	Mean	0.3	0.3	0.3	0.3	0.2	0.3	<1%
CO (8 hr)	Maximum	0.9	1.0	1.0	1.0	1.1	1.1	<1%
	90th Percentile	0.4	0.4	0.4	0.4	0.4	0.4	<1%
	Mean	0.3	0.3	0.3	0.3	0.2	0.3	<1%

In addition, the ambient concentrations of contaminants determined to be negligible were assessed. At the Hamilton Downtown monitoring station, particulate matter and benzene were determined to have ambient concentrations exceeding their respective guidelines. As the proposed facility will emit particulate matter and benzene in negligible amounts, it is unlikely that there will be an increase in the number of these exceedances due to the proposed facility operations. Table 4 provides the average, 90th percentile and maximum concentration for $PM_{2.5}$, PM_{10}, and benzene.

Table 4: Hamilton Downtown Monitoring Station Data for Contaminants that Exceed the Guidelines

Contaminant (Averaging Period)	Statistic	Ambient Monitoring Data (µg/m^3)						% of Guideline
		2012	2013	2014	2015	2016	Max. Year	
$PM_{2.5}$ (24 hr)	Maximum	41	47	45	37	31	47	157%
	90th Percentile	17	18	19	19	14	19	63%
	Mean	8	10	11	10	8	11	37%
PM_{10} (24 hr)	Maximum	76	87	83	68	57	87	174%
	90th Percentile	31	33	35	35	26	35	70%
	Mean	15	19	20	19	15	20	41%
Benzene (24 hr)	Maximum	6.2	4.3	4.0	2.9	2.1	6.2	269%
	90th Percentile	2.1	2.7	1.9	1.8	1.4	2.7	117%
	Mean	1.0	1.1	0.9	1.1	0.7	1.1	50%
Benzene (Annual)	Mean	1.0	1.1	0.9	1.1	0.7	1.1	253%

4. ASSESSMENT APPROACH

4.1 General Approach

In order to estimate the worst-case impacts resulting from contaminant emissions from the Hamilton MSF the following were conducted:

- Contaminant emission rates were estimated based on U.S. EPA and MECP published values;
- Contaminant emission rates were assessed for negligibility; and
- Air dispersion modelling was conducted, including maximum background concentrations to provide conservative predictions of worst-case impacts.

4.2 Operating Conditions and Emission Rates

4.2.1 Bus Operations

Based on the bus operations of similar Hamilton bus garages, it is expected that up to 90 buses move in or out of the facility per 1 hour period, 200 per 8 hour period, and 300 per 24 hour period. Emission rate estimates are based on these maximum operating conditions.

Idling emissions from inside the storage garage will be emitted through 12 air handling unit exhaust fans, each with an exhaust diameter of 2.4 m and a flow rate of 15.1 m^3/s. These fans exhaust 2.2 m above the rooftop. It was assumed that the emissions from buses in the storage bay would be evenly mixed and emitted through the air handling units serving this area. Based on the operations of similar Hamilton facilities, it was assumed that each vehicle moving in that time period (in or out of the facility) would idle for 10 minutes.

Vehicles may also idle in the maintenance bay while being worked on, and are connected up to a bus fume exhaust hose system which exhaust on the rooftop. Based on the operations of similar Hamilton facilities, it was assumed that one bus would be idling for up to 5 minutes through each of the six bus fume exhaust hose systems. These fans exhaust 3.3 m above the rooftop, and were modelled with a diameter of 0.45 m, which is conservative as it yields a low exit velocity and reduces dispersion of the exhaust. A flow rate of 1.2 m^3/s was provided in the mechanical schedule for four of the six fans. The remaining two fans will have a flow rate of 1.6 m^3/s.

Emissions from driving inside the storage garage and maintenance areas will be emitted through 25 air handling unit exhaust fans, including the 12 storage garage exhaust fans previously described. In addition, there are nine (9) maintenance garage exhaust fans and one body shop exhaust fan with the same stack parameters and three other exhaust fans (paint prep, service lanes and fueling area exhaust fans) with various stack parameters. It is assumed that driving emissions from buses in the storage garage and maintenance areas would be evenly mixed and emitted through the air handling units serving these areas. To be conservative, it was assumed that each vehicle moving in the time period (in or out of the facility) would drive for 0.5 km inside the building.

Emissions from driving outside of the building, but still onsite, were also considered. Buses were modelled leaving and entering the facility from the north entrance on McKinistry Street. Based on the planned bus route, it was assumed that each vehicle moving in the time period (in or out of the facility) would drive for 1 km outside of the building.

For this project, MOVES was used to generate and emission factor and estimate driving emissions from the CNG buses. MOVES is a computer program that provides estimates of current and future emission rates from motor vehicles based on a variety of factors such as local meteorology and vehicle fleet composition. MOVES 2014b, updated in November 2015, is the U.S. EPA's latest tool for estimating vehicle emissions due to the combustion of fuel, and brake and tire wear. The model is based on "an analysis of millions of emission test results and considerable advances in the Agency's understanding of vehicle emissions and accounts for changes in emissions due to proposed standards and regulations". Table 5 specifies the major inputs into MOVES.

Table 5: MOVES Input Parameters

Parameter	Input
Scale	Custom County Domain
Years	2022 (expected project completion)
Geographical Bounds	Custom County Domain
Fuels	Compressed Natural Gas
Source Use	Transit Bus
Road Type	Restricted Urban
Pollutants and Processes	NO_2 / CO / $PM_{2.5}$ / PM_{10} / Benzene / Toluene / Ethyl Benzene / Xylenes / Formaldehyde/ Acetaldehyde
Vehicle Age Distribution	All vehicles 10 years old (conservative assumption)

The MOVES program generates emission factors for driving CNG transit buses; however, it cannot generate idling emission factors for CNG transit buses. To determine an idling CNG emission factor, the idling emission factors for diesel buses from the EPA document "Average In-Use Emissions from Urban Buses and School Buses", dated October 2008 were scaled based on the MOVES emission factor for CNG transit bus driving and the EPA emission factor for diesel transit bus driving. That is to say, the ratio of the MOVES driving emission factor (CNG transit bus) to the EPA driving emissions factor (diesel transit bus) was applied to the EPA idling emission factor (diesel transit bus) to determine an emission factor for CNG transit bus idling. The final CNG emission factors used in the assessment for idling and moving buses are shown in Table 6. Details of the bus operation emission rate calculations are provided in Appendix B.

Table 6: CNG Transit Bus Operations Emission Factors

	Emission Factor	
Contaminant	Driving - 20 km/hr (g/km)	Idle (g/min)
NO_2	2.20E-01	9.42E-03
CO	9.85E+00	1.13E+00
$PM_{2.5}$	2.54E-03	1.04E-03
PM_{10}	2.88E-03	1.14E-04
Benzene	1.12E-03	8.97E-05
Toluene	3.48E-03	2.79E-04
Ethylbenzene	5.80E-04	4.65E-05
Xylenes	2.81E-03	2.25E-04
Formaldehyde	7.18E-02	5.75E-03
Acetaldehyde	6.09E-02	4.88E-03

4.2.2 Natural Gas Heating Equipment and Generators

The facility will contain natural gas-fired make-up air units, water heaters, and boilers. For conservatism, all heating equipment is assumed to be running continuously, at maximum capacity. The nitrogen oxide emissions from this equipment were calculated based on the U.S. AP-42 Section 1.4 emission factor of 100 lb/10^6scf for uncontrolled boilers.

The heating input for each individual piece of equipment assessed is provided in Appendix B. Air handling units were modelled with a flue diameter of 0.1 m and the boilers with a flue diameter of 0.2 m. Flow rates for each unit were calculated from the stoichiometric balance for the combustion of natural gas, and are also listed in Appendix B.

The facility will also have seven (7) 750 kW life safety generators. The standby power generators will be used for standby power only with periodic testing. The emissions from the standby generators will be considered negligible in accordance with Guideline A-10.

4.2.3 Paint Booth and Shop Areas

The paint spray booth emissions were estimated using 13 standard Hamilton bus paint primers, activators, solvents, and paint colour coats which will be applied with spray guns. The paint booth will be used for small repairs and touch-up painting, and subsequently not for complete bus painting. The coatings will be applied at a maximum rate of 2 L/day. The paint booth will be equipped with dry paint arrestor filters and will be exhausted at a total of 32 m^3/s through six roof top stacks, each having an exit diameter of 0.7 m, extending at least 3.7 m above the roof.

The maximum emissions from the paint booth are based on 100% of VOCs being released to the atmosphere. For solids, the maximum emission is based on a 60% transfer efficiency and 97% filter efficiency. It was assumed that only one product would be used at a time. A full list of the products with chemical composition and their calculated emission rates is provided in Appendix B.

Small carbon steel bus parts will be repaired at four welding stations using an E70S carbon steel welding wire at a maximum consumption of 2 spools per year (40 kg/year). A maximum consumption of 1 kg/day is conservatively assumed. Emissions from welding will be controlled with a fume extractor; however, emissions were conservatively estimated using uncontrolled emission factors. Uncontrolled emissions were estimated using AP-42 Section 12.19 emission factors for E70S welding wire for gas metal arc welding, or MIG welding. Details of the welding emission rate calculations are provided in Appendix B.

The paint prep shop will have two sanding stations. The sanding stations will have will have point of use air pollution control equipment consisting of dust point of capture nozzles and filters. It is assumed that this equipment will be used when needed, and all dust will be collected through the dust collector and not exhausted to the atmosphere outside of the building.

4.3 Assessment of Negligibility

Many of the contaminants produced by the proposed facility will be emitted in small amounts. As such, a screening-out assessment of contaminants that are emitted in negligible amounts was conducted in accordance with MECP Guideline A-10. Emission rates for each contaminant were assessed against the emission threshold, using the urban dispersion factor at 20 m, the smallest separation distance provided in Guideline A-10. If the emission rate was less than the emission threshold, the contaminant was determined negligible and not assessed further. Contaminants that were not found to be negligible were modelled in AERMOD and assessed against their applicable guidelines for the applicable averaging periods. Details for the assessment of negligibility are shown in Appendix C.

4.4 Modelling Methods

The U.S. EPA's AERMOD dispersion model, based on the Gaussian plume equation, was used to predict air quality impacts from emissions at the Hamilton MSF. The model inputs include background concentration, local building information, topography, sensitive receptor locations, meteorology, emission rates, and stack parameters. AERMOD uses this information to calculate hourly, 8 hour or 24 hour averages for the contaminants of interest at off-site receptor locations. Combined impacts were assessed for all emissions from the buses, and heating equipment. Impacts from the contaminants from the paint booth were assessed separately, as contaminants did not overlap with the remaining activities. Table 7 contains a summary of the inputs used.

The maximum ambient concentration value for each contaminant (except n-butyl acetate) and averaging period was included in the model to represent background concentrations. It should be noted that this approach, combining the maximum values to the maximum ambient measurements is extremely conservative. It is not likely that the maximum facility concentration will occur at the same time as the maximum ambient concentration.

Table 7: AERMOD Model Input Summary Table

Parameter	Input
Source of Contaminant Emission Rates	Emission rate estimations are described in Section 4 of this report. Refer to Section 4 and Appendix B for details.
Stack Parameters	As described in Section 4 of this report.
Meteorological Conditions	The MECP's regional meteorological data files processed with AERMET 16216 (August 3, 2016) were downloaded from the Ministry's website.
Terrain Data	DEM data made available on the MECP's website was used.
Area of Modelling Coverage	Receptor grid determined in accordance with the MECP document "Air Dispersion Modelling Guideline for Ontario" (ADMGO), up to an extent of 5 km from the Facility. A default flagpole receptor height was set to 4 m to represent ambient conditions. No on-site receptors.
Averaging Periods	1-hr, 8-hr, 24-hr. For a 10-min averaging period the 1-hr output was multiplied by 1.65 and for a ½-hr averaging period the 1-hr output was multiplied by 1.2 in accordance with MECP's ADMGO.
Urban/rural classification	Urban
Background concentration	Maximum background concentration for each applicable contaminant and averaging period, as described in Section 3 of this report.

5. AIR DISPERSION ASSESSMENT RESULTS

The maximum ambient concentration for each contaminant as a result of the proposed facility and current worst-case ambient concentrations are shown in Table 8. The results of the AERMOD modelling showed that the maximum concentration for each contaminant remained below its respective AAQC guideline and ACB List limit. This maximum concentration is the highest concentration at any off-site receptor in the model. Contour plots showing the concentrations surrounding the facility for each contaminant and averaging period are provided in Appendix C. These contour plots show that the highest concentrations of the contaminants occur at, or next to the property line, and decrease with greater distance from the facility. Therefore, it is anticipated that the surrounding community air quality will not be adversely impacted by the activities and emissions from the facility.

Table 8: Air Quality Assessment Summary

Contaminant	Averaging Period (hours)	Current Maximum Ambient Concentration ($\mu g/m^3$)	Maximum Ambient Concentration with Proposed Facility ($\mu g/m^3$)	Guideline ($\mu g/m^3$)	Guideline Reference	Limiting Effect	Percent of Guideline (%)
Nitrogen dioxide	24	48	113	200	AAQC/ ACB List	Health	56.3%
Nitrogen dioxide	1	67	221	400	AAQC/ ACB List	Health	55.3%
Carbon monoxide	8	1.1	23	15,700	AAQC	Health	0.1%
Carbon monoxide	1	2.9	103	36,200	AAQC	Health	0.3%
Carbon monoxide	0.5	n/a [1]	124	6,000	ACB List	Health	2.1%
Butyl acetate, n-	1 hr	n/a [2]	23	15,000	AAQC/ ACB List	Health	0.2%
Butyl acetate, n-	10 min	n/a [2]	38	1,000	AAQC/ ACB List	Odour	3.8%

Notes:

[1] Ambient concentration of 2.9 $\mu g/m^3$ was used in the 1 hour carbon monoxide model.

[2] No background data was available for n-butyl acetate.

6. CONCLUSIONS AND RECOMMENDATIONS

The potential effects of the proposed facility on local air quality have been assessed. The following conclusions and recommendations are a result of this assessment:

- Construction impacts will be minimized with the implementation of a best management practices plan.
- Generally, air quality in Hamilton has been improving over the last 5 years; however the Region still experiences exceedances of the Ministry of the Environment, Conservation and Parks (MECP) guideline limits for particulate matter and benzene. As the proposed facility will emit particulate matter and benzene in negligible amounts, it is unlikely that there will be an increase in the number of these exceedances due to the proposed facility operations.
- The maximum combined concentrations for each contaminant and averaging period were all below their respective guidelines or limits. The report discusses the conservative nature of the emission estimates used in the modelling suggesting that typical surrounding community levels will be much lower than predicted from modelling.
- No background data was available for n-butyl acetate, however, since the modelled concentrations of n-butyl acetate are well below their respective health and odour guidelines (<4% of guideline) with no background concentration considered, it is not expected the proposed facility will cause exceedances.
- The maximum concentrations of the contaminants occur at, or next to the property line, and decrease with greater distance from the facility. Therefore, it is anticipated that the surrounding community air quality will not be adversely impacted by the activities and emissions from the facility.
- If any major changes are made to the facility design or operations as outlined in this report the modelling should be repeated to assess what changes might result.
- It is recommended that the design team plan the generator exhausts in accordance with O. Reg. 524/98 section 1.6.3 (i.e. vertical, uncapped stacks).
- Upon final selection of equipment and exhaust fans for the facility, the City of Hamilton will need to register in the Environmental Activity and Sector Registry (EASR).

REFERENCES

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GLOSSARY

Abbreviations

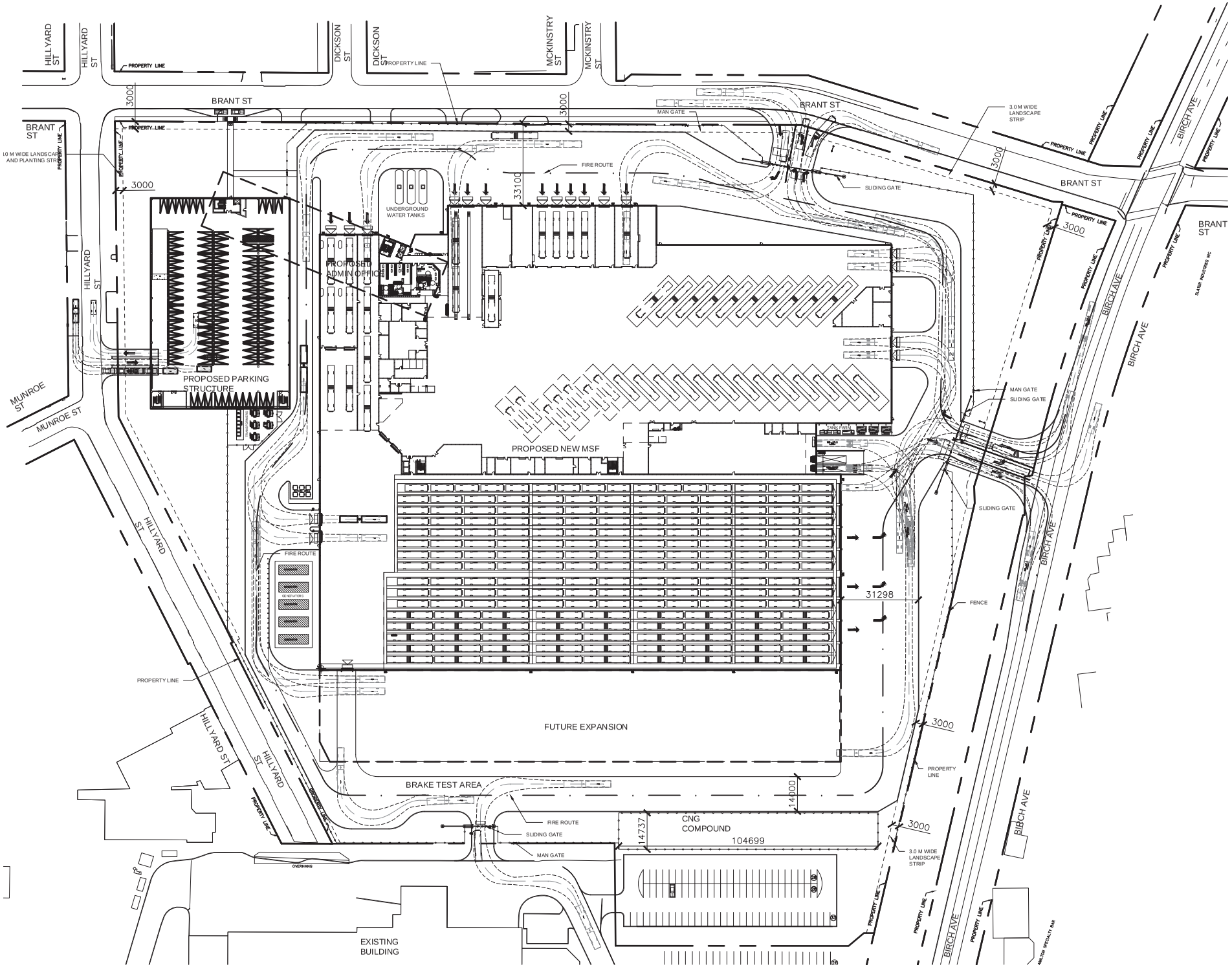
AAQC	Ambient Air Quality Criteria
ACB	Air Contaminants Benchmarks
ADMGO	Air Dispersion Modelling Guideline for Ontario
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
CAC	Criteria Air Contaminant
CNG	Compressed Natural Gas
CO	Carbon Monoxide
EASR	Environmental Activity and Sector Registry
ECCC	Environment and Climate Change Canada
EPA	Environmental Protection Agency
HC	Health Canada
HSR	Hamilton Transit
MECP	Ministry of the Environment, Conservation and Parks
MOVES	Motor Vehicle Emission Simulator
MSF	Maintenance and Storage Facility
MTO	Ministry of Transportation
NAPS	National Air Pollution Surveillance
NO2	Nitrogen Dioxide
NOx	Nitrogen Oxides
PM	Particulate Matter
PM10	Coarse Particulate matter
PM2.5	Fine Particulate Matter
VOC	Volatile Organic Compound

Units

BTU	British thermal unit
g	grams
hr	hour
kJ	kilojoules
km	kilometers
kW	kilowatt
L	liters
m	meters
min	minute
s	seconds
scf	standard cubic foot
µg	micrograms

APPENDIX A

Site Plan
(1 Page)


HILLYARD ST
DICKSON ST
MCKINSTRY ST
PROPERTY LINE
BRANT ST
3000
10 M WIDE LANDSCAPE AND PLANTING STRIP
UNDERGROUND WATER TANKS
FIRE ROUTE
33100
MAN GATE
SLIDING GATE
3.0 M WIDE LANDSCAPE STRIP
BIRCH AVE
PROPOSED ADMIN OFFICE
PROPOSED PARKING STRUCTURE
MUNROE ST
PROPOSED NEW MSF
FENCE
31298
FUTURE EXPANSION
BRAKE TEST AREA
14000
CNG COMPOUND
104699
14737
OVERHANG
EXISTING BUILDING

APPENDIX B

Emission Rate Calculations
(9 Pages)

B.1 Bus Operations - Maintenance Idling

Emission rate estimates for maintenance idling were calculated using the equation below. The emission factors for each contaminant were determined as described in Section 4.2.1 of this report. The maximum operating conditions used are listed in Table B.1 and the calculated emission rates are provided in Table B.2.

$$Emission\ Rate\ (\frac{g}{s}) = Emission\ Factor\ (\frac{g}{min}) \times\ Max.\#\ of\ Buses\ Idling \times Idling\ time\ per\ bus\ (min) \div \frac{s}{period}$$

Table B.1: Bus Operations - Maintenance Idling Maximum Operating Conditions

	1-hr	8-hr	24-hr
Maximum # of Buses Idling	6	6	6
Idling time per bus (min)	5	5	5
Total Idling time (min)	30	30	30

Table B.2: Bus Operations - Maintenance Idling Emission Rates

Contaminant	Emission Factor (g/min)	1-hr ER (g/s)	8-hr ER (g/s)	24-hr ER (g/s)
NO_2	9.42E-03	7.85E-05	9.82E-06	3.27E-06
CO	1.13E+00	9.43E-03	1.18E-03	3.93E-04
$PM_{2.5}$	1.04E-03	8.65E-06	1.08E-06	3.60E-07
PM_{10}	1.14E-04	9.52E-07	1.19E-07	3.97E-08
Benzene	8.97E-05	7.48E-07	9.35E-08	3.12E-08
Toluene	2.79E-04	2.32E-06	2.90E-07	9.68E-08
Ethylbenzene	4.65E-05	3.87E-07	4.84E-08	1.61E-08
Xylenes	2.25E-04	1.87E-06	2.34E-07	7.81E-08
Formaldehyde	5.75E-03	4.79E-05	5.99E-06	2.00E-06
Acetaldehyde	4.88E-03	4.07E-05	5.09E-06	1.70E-06

B.2 Bus Operations - Start-up Idling

Emission rate estimates for start-up idling were calculated using the equation below. The emission factors for each contaminant were determined as described in Section 4.2.1 of this report. The maximum operating conditions used are listed in Table B.3 and the calculated emission rates are provided in Table B.4.

$$Emission\ Rate\ (\frac{g}{s}) = Emission\ Factor\ (\frac{g}{min}) \times\ Max.\#\ of\ Buses\ Idling \times Idling\ time\ per\ bus\ (min)\ \div \frac{s}{period}$$

Table B.3: Bus Operations - Start-up Idling Maximum Operating Conditions

	1-hr	8-hr	24-hr
Maximum # of Buses Idling	90	200	300
Idling time per bus (min)	10	10	10
Total Idling time (min)	900	2000	3000

Table B.4: Bus Operations - Start-up Idling Emission Rates

Contaminant	Emission Factor (g/min)	1-hr ER (g/s)	8-hr ER (g/s)	24-hr ER (g/s)
NO_2	9.42E-03	2.36E-03	3.31E-04	6.54E-04
CO	1.13E+00	2.83E-01	3.97E-02	7.85E-02
$PM_{2.5}$	1.04E-03	2.60E-04	3.65E-05	7.21E-05
PM_{10}	1.14E-04	2.86E-05	4.01E-06	7.94E-06
Benzene	8.97E-05	2.24E-05	3.15E-06	6.23E-06
Toluene	2.79E-04	6.97E-05	9.79E-06	1.94E-05
Ethylbenzene	4.65E-05	1.16E-05	1.63E-06	3.23E-06
Xylenes	2.25E-04	5.62E-05	7.90E-06	1.56E-05
Formaldehyde	5.75E-03	1.44E-03	2.02E-04	3.99E-04
Acetaldehyde	4.88E-03	1.22E-03	1.72E-04	3.39E-04

B.3 Bus Operations - Driving Inside Building

Emission rate estimates for driving inside the building were calculated using the equation below. The emission factors for each contaminant were determined as described in Section 4.2.1 of this report. The maximum operating conditions used are listed in Table B.5 and the calculated emission rates are provided in Table B.6.

$$Emission\ Rate\ (\frac{g}{s}) = Emission\ Factor\ (\frac{g}{km}) \times\ Max.\#\ of\ Buses\ Moving \times Distance\ per\ bus\ (km) \div \frac{s}{period}$$

Table B.5: Bus Operations - Driving Inside Building Maximum Operating Conditions

	1-hr	8-hr	24-hr
Maximum # of Buses Moving	90	200	300
Distance per bus (km)	0.5	0.5	0.5
Total distance travelled (km)	45	100	150

Table B.6: Bus Operations - Driving Inside Building Emission Rates

Contaminant	Emission Factor (g/km)	1-hr ER (g/s)	8-hr ER (g/s)	24-hr ER (g/s)
NO_2	2.20E-01	2.75E-03	7.64E-04	3.82E-04
CO	9.85E+00	1.23E-01	3.42E-02	1.71E-02
$PM_{2.5}$	2.54E-03	3.18E-05	8.83E-06	4.42E-06
PM_{10}	2.88E-03	3.59E-05	9.98E-06	4.99E-06
Benzene	1.12E-03	1.40E-05	3.89E-06	1.94E-06
Toluene	3.48E-03	4.35E-05	1.21E-05	6.04E-06
Ethylbenzene	5.80E-04	7.25E-06	2.01E-06	1.01E-06
Xylenes	2.81E-03	3.51E-05	9.74E-06	4.87E-06
Formaldehyde	7.18E-02	8.97E-04	2.49E-04	1.25E-04
Acetaldehyde	6.09E-02	7.62E-04	2.12E-04	1.06E-04

B.4 Bus Operations - Driving Outside Building

Emission rate estimates for driving outside the building were calculated using the equation below. The emission factors for each contaminant were determined as described in Section 4.2.1 of this report. The maximum operating conditions used are listed in Table B.7 and the calculated emission rates are provided in Table B.8.

$$Emission\ Rate\ (\frac{g}{s}) = Emission\ Factor\ (\frac{g}{km}) \times\ Max.\#\ of\ Buses\ Moving \times Distance\ per\ bus\ (km) \div \frac{s}{period}$$

Table B.7: Bus Operations - Driving Outside Building Maximum Operating Conditions

	1-hr	8-hr	24-hr
Maximum # of Buses Moving	90	200	300
Distance per bus (km)	1	1	1
Total distance travelled (km)	90	200	300

Table B.8: Bus Operations— Driving Outside Building Emission Rates

Contaminant	Emission Factor (g/km)	1-hr ER (g/s)	8-hr ER (g/s)	24-hr ER (g/s)
NO_2	2.20E-01	5.50E-03	1.53E-03	7.64E-04
CO	9.85E+00	2.46E-01	6.84E-02	3.42E-02
$PM_{2.5}$	2.54E-03	6.36E-05	1.77E-05	8.83E-06
PM_{10}	2.88E-03	7.19E-05	2.00E-05	9.98E-06
Benzene	1.12E-03	2.80E-05	7.78E-06	3.89E-06
Toluene	3.48E-03	8.70E-05	2.42E-05	1.21E-05
Ethylbenzene	5.80E-04	1.45E-05	4.03E-06	2.01E-06
Xylenes	2.81E-03	7.01E-05	1.95E-05	9.74E-06
Formaldehyde	7.18E-02	1.79E-03	4.98E-04	2.49E-04
Acetaldehyde	6.09E-02	1.52E-03	4.23E-04	2.12E-04

B.5 Natural Gas Heating Equipment

The nitrogen oxides (NO_X) emission rates for the Natural Gas Heating Equipment were calculated using the equation below. The emission factor for small uncontrolled boilers (<100 MMBtu/hr) presented in Table 1.4-1 of the US EPA AP-42 document was used. Specifically, Table 1.4-1 indicates an emission factor for nitrogen oxides of 100 lb/10^6 scf. A heating value of natural gas of 1020 Btu/scf, for natural gas was assumed. The calculated emission rates are provided in Table B.9. For reference, the exhaust flowrate for each piece of equipment in also provided in in Table B.9.

$$Emission\ Rate\ \left(\frac{g}{s}\right) = Equipment\ Capacity\ \left(\frac{Btu}{hr}\right) \times \frac{1}{1020}\left(\frac{scf}{btu}\right) \times \frac{1}{1{,}000{,}000}\left(\frac{10^6 scf}{scf}\right) \times 100\left(\frac{lb\ NOx}{10^6 scf}\right) \times\ 454\left(\frac{g}{lb}\right) \div 3600\frac{s}{hour}$$

Table B.9: Natural Gas Heating Equipment Emission Rates

Equipment ID	Equipment Type	Exhaust Flowrate (m^3/s)	Heat Input		NO_X ER (g/s)	
			MMBtu/hr	MMkJ/hr	1-hr	24 hr
AHU 1-1	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 1-2	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 1-3	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 1-4	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 1-5	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 1-6	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 1-7	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 1-8	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 2-1	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 2-2	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 2-3	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 2-4	Make-up Air Unit	0.14	1.88	1.98	2.32E-02	2.32E-02
AHU 3-1	Make-up Air Unit	0.22	3.00	3.17	3.71E-02	3.71E-02
AHU 3-2	Make-up Air Unit	0.22	3.00	3.17	3.71E-02	3.71E-02
AHU 3-3	Make-up Air Unit	0.22	3.00	3.17	3.71E-02	3.71E-02
AHU 3-4	Make-up Air Unit	0.22	3.00	3.17	3.71E-02	3.71E-02
AHU 3-5	Make-up Air Unit	0.22	3.00	3.17	3.71E-02	3.71E-02
AHU 3-6	Make-up Air Unit	0.22	3.00	3.17	3.71E-02	3.71E-02
AHU 3-7	Make-up Air Unit	0.22	3.00	3.17	3.71E-02	3.71E-02
AHU 3-8	Make-up Air Unit	0.22	3.00	3.17	3.71E-02	3.71E-02
AHU 3-9	Make-up Air Unit	0.22	3.00	3.17	3.71E-02	3.71E-02
AHU 4-1	Make-up Air Unit	0.22	3.00	3.17	3.71E-02	3.71E-02
AHU 5-1	Make-up Air Unit	0.09	1.25	1.32	1.55E-02	1.55E-02
AHU 6-1	Make-up Air Unit	0.18	2.50	2.64	3.09E-02	3.09E-02
AHU 7-1	Make-up Air Unit	0.11	1.55	1.64	1.92E-02	1.92E-02
-	Boiler 1	0.47	6.5	6.86	8.05E-02	8.05E-02
-	Boiler 2	0.47	6.5	6.86	8.05E-02	8.05E-02
-	Water Heater	0.04	0.5	0.53	6.19E-03	6.19E-03
-	Water Heater (Tankless)	0.58	8	8.44	9.90E-02	9.90E-02
Total		**5.73**	**79.30**	**83.66**	**9.82E-01**	**9.82E-01**

B.6 Paint Booth

The emission rates for the Paint Booth were calculated using the equations below. The maximum emissions from the paint booth are based on 100% of VOCs being released to the atmosphere. For solids, the maximum emission is based on a 60% transfer efficiency and 97% filter efficiency. The calculation is based on a maximum rate of 2 L/day and 0.5 L/hour. It was assumed that only one product would be used at a time. The calculated emission rates are provided in Table B.10.

$$VOC\ Emission\ Rate\ \left(\frac{g}{s}\right) = Coating\ usage\ \left(\frac{L}{period}\right) \times\ wt\%\ \times Product\ density\ \left(\frac{g}{L}\right) \div \frac{s}{period}$$

$$Solids\ Emission\ Rate\ \left(\frac{g}{s}\right) = Coating\ usage\ \left(\frac{L}{period}\right) \times\ wt\%\ \times Product\ density\ \left(\frac{g}{L}\right) \times 40\%\ overspray\ \times 3\%\ emitted \div \frac{s}{period}$$

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Table B.10: Paint Booth Emission Rates

Chemical Product	Contaminant	CAS	VOC	Max Weight %	Density (g/L)	24-hr ER (g/s)	1-hr ER (g/s)
2C Acrycote Activator	Xylenes	1330-20-7	Y	30%	930	6.46E-03	3.88E-02
	Butyl acetate, n-	123-86-4	Y	30%	930	6.46E-03	3.88E-02
	Propylene glycol monomethyl ether acetate	108-65-6	N	30%	930	7.75E-05	4.65E-04
	Butanol, n-	71-36-3	Y	13%	930	2.80E-03	1.68E-02
	Ethyl benzene	100-41-4	Y	5%	930	1.08E-03	6.46E-03
	Toluene	108-88-3	Y	1%	930	2.15E-04	1.29E-03
2C Acrycote Gen3 Clear	Xylenes	1330-20-7	Y	30%	960	6.67E-03	4.00E-02
	Methyl-n-amyl ketone	110-43-0	N	13%	960	3.47E-05	2.08E-04
	Propylene glycol methyl ether	107-98-2	Y	7%	960	1.56E-03	9.33E-03
	Propylene glycol monomethyl ether acetate	108-65-6	N	7%	960	1.87E-05	1.12E-04
	Diethylene glycol monobutyl ether	112-34-5	Y	5%	960	1.11E-03	6.67E-03
	Ethyl benzene	100-41-4	Y	5%	960	1.11E-03	6.67E-03
	2-Methoxy-1-propanol	1589-47-5	Y	1%	960	2.22E-04	1.33E-03
Organic Zinc Primer	Xylenes	1330-20-7	Y	32%	960	7.11E-03	4.27E-02
	Butanol, n-	71-36-3	Y	32%	960	7.11E-03	4.27E-02
	Polyethylenepolyamine reaction products with c18-unsat. Fatty acids	68410-23-1	N	20%	960	5.33E-05	3.20E-04
	Isopropanol (Isopropyl alcohol)	67-63-0	Y	10%	960	2.22E-03	1.33E-02
	Methyl isobutyl ketone	108-10-1	Y	8%	960	1.67E-03	1.00E-02
	Ethyl benzene	100-41-4	Y	5%	960	1.11E-03	6.67E-03
	Toluene	108-88-3	Y	5%	960	1.11E-03	6.67E-03
LV-403 Solvent Blend	Acetone	67-64-1	Y	66%	820	1.25E-02	7.48E-02
	Propane	74-98-6	Y	18%	820	3.35E-03	2.01E-02
	Butane	106-97-8	Y	10%	820	1.96E-03	1.18E-02
	Ethyl-3-ethoxy propionate	763-69-9	N	6%	820	1.42E-05	8.53E-05
Euro Classic Primer Activator	Propylene glycol monomethyl ether acetate	108-65-6	N	50%	924	1.28E-04	7.70E-04
	Isopropanol (Isopropyl alcohol)	67-63-0	Y	20%	924	4.28E-03	2.57E-02
	Xylenes	1330-20-7	Y	10%	924	2.14E-03	1.28E-02
	Ethyl benzene	100-41-4	Y	5%	924	1.07E-03	6.42E-03
	Butanol, n-	71-36-3	Y	5%	924	1.07E-03	6.42E-03
	Methyl isobutyl ketone	108-10-1	Y	1%	924	2.14E-04	1.28E-03
Euro Classic Primer Gray	Butyl acetate, n-	123-86-4	Y	20%	1475	6.83E-03	4.10E-02
	Xylenes	1330-20-7	Y	20%	1475	6.83E-03	4.10E-02
	Barium sulfate	7727-43-7	N	20%	1475	8.19E-05	4.92E-04
	Titanium dioxide	13463-67-7	N	10%	1475	4.10E-05	2.46E-04
	Wollastonite	13983-17-0	N	10%	1475	4.10E-05	2.46E-04
	Ethyl benzene	100-41-4	Y	5%	1475	1.71E-03	1.02E-02
	N-Pentyl proprionate	624-54-4	N	5%	1475	2.05E-05	1.23E-04
	Silicon dioxide	7631-86-9	N	1%	1475	4.10E-06	2.46E-05
	Carbon black	1333-86-4	N	1%	1475	4.10E-06	2.46E-05
Self Etching Primer Part A	Butyl acetate, n-	123-86-4	Y	20%	1126	5.21E-03	3.13E-02
	Xylenes	1330-20-7	Y	20%	1126	5.21E-03	3.13E-02

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Chemical Product	Contaminant	CAS	VOC	Max Weight %	Density (g/L)	24-hr ER (g/s)	1-hr ER (g/s)
	Toluene	108-88-3	Y	10%	1126	2.61E-03	1.56E-02
	Isopropanol (Isopropyl alcohol)	67-63-0	Y	10%	1126	2.61E-03	1.56E-02
	Acetic acid ethenyl ester, polymer with ethenol, cyclic acetal with butanal (polyvinyl butyral)	68648-78-2	N	10%	1126	3.13E-05	1.88E-04
	Bisphenol A-Bisphenol A diglycidyl ether polymer	25036-25-3	N	10%	1126	3.13E-05	1.88E-04
	Talc - fibrous	14807-96-6	N	5%	1126	1.56E-05	9.39E-05
	Wollastonite	13983-17-0	N	5%	1126	1.56E-05	9.39E-05
	Propylene glycol monomethyl ether acetate	108-65-6	N	5%	1126	1.56E-05	9.39E-05
	Ethyl benzene	100-41-4	Y	5%	1126	1.30E-03	7.82E-03
	Titanium dioxide	13463-67-7	N	5%	1126	1.56E-05	9.39E-05
	Zinc	7440-66-6	N	5%	1126	1.56E-05	9.39E-05
	Carbon black	1333-86-4	N	1%	1126	3.13E-06	1.88E-05
	Silicon dioxide	7631-86-9	N	1%	1126	3.13E-06	1.88E-05
	Ethanol (Ethyl alcohol)	64-17-5	Y	1%	1126	2.61E-04	1.56E-03
Self Etching Primer Activator/Reducer Part B	Acetone	67-64-1	Y	50%	953	1.10E-02	6.62E-02
	p-Chlorobenzotrifluoride	98-56-6	Y	40%	953	8.82E-03	5.29E-02
	Methyl-n-amyl ketone	110-43-0	N	10%	953	2.65E-05	1.59E-04
	Butyl acetate, n-	123-86-4	Y	10%	953	2.21E-03	1.32E-02
	Phosphoric acid	7664-38-2	N	5%	953	1.32E-05	7.94E-05
Urethane Grade Reducer Medium	Butyl acetate, n-	123-86-4	Y	60%	1068	1.48E-02	8.90E-02
	Ethyl acetate	141-78-6	Y	30%	1068	7.41E-03	4.45E-02
	Toluene	108-88-3	Y	20%	1068	4.94E-03	2.97E-02
	Propylene glycol monomethyl ether acetate	108-65-6	N	10%	1068	2.97E-05	1.78E-04
Urethane Grade Reducer Fast	Ethyl acetate	141-78-6	Y	50%	895	1.04E-02	6.22E-02
	Butyl acetate, n-	123-86-4	Y	30%	895	6.22E-03	3.73E-02
	Toluene	108-88-3	Y	20%	895	4.14E-03	2.49E-02
	Propylene glycol monomethyl ether acetate	108-65-6	N	10%	895	2.49E-05	1.49E-04
WB Paint (White)	Titanium dioxide	13463-67-7	N	10%	1672	4.64E-05	2.79E-04
	Methanol (Methyl alcohol)	67-56-1	Y	5%	1672	1.94E-03	1.16E-02
	Silica - respirable (<10 µm diameter), quartz	14808-60-7	N	1%	1672	4.64E-06	2.79E-05
	Phosphorus pentoxide	1314-56-3	N	1%	1672	4.64E-06	2.79E-05
WB Paint (Yellow)	Titanium dioxide	13463-67-7	N	10%	1652	4.59E-05	2.75E-04
	Methanol (Methyl alcohol)	67-56-1	Y	5%	1652	1.91E-03	1.15E-02
	Silica - respirable (<10 µm diameter), quartz	14808-60-7	N	1%	1652	4.59E-06	2.75E-05
Paint Stripper	Methylene chloride	75-09-2	Y	85%	1181	2.32E-02	1.39E-01
	Methanol (Methyl alcohol)	67-56-1	Y	7%	1181	1.91E-03	1.15E-02
	Ethanol (Ethyl alcohol)	64-17-5	Y	7%	1181	1.91E-03	1.15E-02
	Ammonium hydroxide	1336-21-6	Y	5%	1181	1.37E-03	8.20E-03
-	Particulate Matter	SPM	N	100%	1672	4.64E-04	2.79E-03

B.7 Welding

The emission rates for the Welding were calculated using the equation below. Emissions were estimated using AP-42 Section 12.19 emission factors for E70S welding wire for gas metal arc welding, or MIG welding. Emissions were conservatively estimated based on uncontrolled emission factors. The calculated emission rates are provided in Table B.11.

$$Emission\ Rate\ \left(\frac{g}{s}\right) = Welding\ wire\ usage\ \left(\frac{kg}{period}\right) \times Emission\ factor\ \left(\frac{g}{kg}\right) \div \frac{s}{period}$$

Table B.11: Welding Emission Rates

Contaminant	CAS#	Emission Factor (g/kg)	Max Consumption	Emission Rate (g/s)
Particulate Matter	SPM	5.2	1 kg/day	6.02E-05
Total Chromium	7440-47-3	0.001	1 kg/day	1.16E-08
Manganese	7439-96-5	0.318	1 kg/day	3.68E-06
Cobalt	7440-48-4	0.001	1 kg/day	1.16E-08
Nickel	7440-02-0	0.001	40 kg/year	1.27E-09

APPENDIX C

Emission Threshold Screening
(2 Pages)

C.1 Emission Threshold Screening

Section 7.1.2 of Guideline A-10 states that aggregate facility-wide emissions of a contaminant that are less than the calculated site-specific Emission Threshold may be considered negligible.

The Emission Threshold for a contaminant is calculated using the following formula:

$$\text{Emission Threshold (g/s)} = \frac{0.5 \text{ x MECP POI Limit } (\mu g/m^3)}{\text{Dispersion Factor } (\mu g/m^3 \text{ per g/s emission})}$$

Where the MECP POI Limit is the ACB List limit for the contaminant and the Dispersion Factor is the corresponding 1-hour Dispersion Factor from Table B-1 of Guideline A-10 based on the distance from Facility sources to the property line and the land use conditions around the source.

Where the MECP POI Limit had a different averaging period than the Dispersion Factor (i.e. other than 1-hour), the Dispersion Factor was converted to the MECP POI Limit's averaging period using the formula provided in Table 7-1 of Guideline A-10. Note that the Facility is considered to be in an urban area, and the corresponding Table B-1 Dispersion Factors were used. Only nitrogen oxides, carbon monoxide, and n-butyl acetate emissions were determined to be significant.

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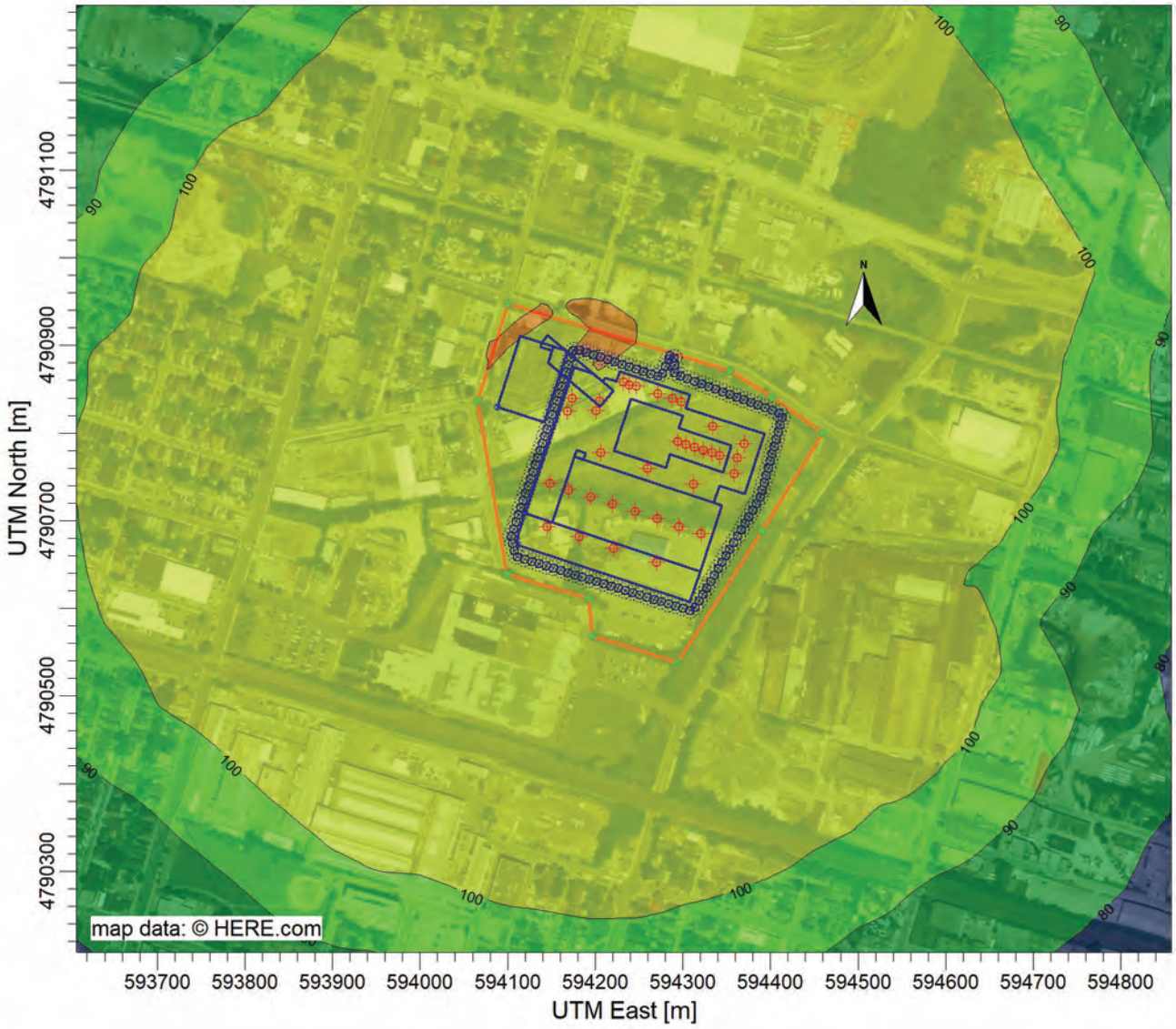
Contaminant	CAS #	Facility Total Emission Rate (g/s)	Distance to Property Line (m)	Table B-1 Dispersion Factor (1-hour) ($\mu g/m^3$ per g/s)	Averaging Period Converted Dispersion Factor ($\mu g/m^3$ per g/s)	MECP POI Limit ($\mu g/m^3$)	MECP POI Limit Averaging Period (hrs)	MECP POI Limit Limiting Effect	MECP POI Limit Reference	Calculated Emission Threshold (g/s)	% of Emission Threshold (%)	Negligible?
Ethyl benzene	100-41-4	1.71E-03	<20	8700	14360.139	1900	0.167	Odour	B1	0.066	2.59%	Yes
Ethyl benzene	100-41-4	1.71E-03	<20	8700	3573.2229	1000	24	Health	B1	0.140	1.22%	Yes
Nitrogen oxides	10102-44-0	1.80E+00	<20	8700	3573.2229	200	24	Health	B1	0.028	6436.47%	No
Nitrogen oxides	10102-44-0	1.80E+00	<20	8700	3573.2229	400	1	Health	B1	0.023	7835.68%	No
Butane	106-97-8	1.96E-03	<20	8700	3573.2229	3600	24	Health	B2	0.504	0.39%	Yes
Propylene glycol methyl ether	107-98-2	9.33E-03	<20	8700	14368.175	121,000	0.17	Odour	B1	4.211	0.22%	Yes
Methyl isobutyl ketone	108-10-1	1.67E-03	<20	8700	3573.2229	1200	24	Odour	B1	0.168	0.99%	Yes
Propylene glycol monomethyl ether acetate	108-65-6	1.28E-04	<20	8700	3573.2229	5000	24	Odour	B1	0.700	0.02%	Yes
Toluene	108-88-3	4.97E-03	<20	8700	3573.2229	2000	24	Odour	B1	0.280	1.78%	Yes
Methyl-n-amyl ketone	110-43-0	3.47E-05	<20	8700	3573.2229	4600	24	Health	B1	0.644	0.01%	Yes
Diethylene glycol monobutyl ether	112-34-5	1.11E-03	<20	8700	3573.2229	65	24	Health	B1	0.009	12.22%	Yes
Butyl acetate, n-	123-86-4	8.90E-02	<20	8700	8700	15000	1	Health	B1	0.862	10.32%	Yes
Butyl acetate, n-	123-86-4	8.90E-02	<20	8700	14368.175	1000	0.17	Odour	B1	0.035	255.67%	No
Phosphorus pentoxide	1314-56-3	4.64E-06	<20	8700	3573.2229	1	24	Health	B2	0.000	3.32%	Yes
Xylenes	1330-20-7	4.28E-02	<20	8700	14368.175	3000	0.17	Odour	B1	0.104	41.03%	Yes
Xylenes	1330-20-7	7.13E-03	<20	8700	3573.2229	730	24	Standard	B1	0.102	6.98%	Yes
Carbon black	1333-86-4	4.10E-06	<20	8700	3573.2229	10	24	Soiling	B1	0.001	0.29%	Yes
Ammonium hydroxide	1336-21-6	1.37E-03	<20	8700	3573.2229	500	24	Health	B2	0.070	1.95%	Yes
Titanium dioxide	13463-67-7	4.64E-05	<20	8700	3573.2229	34	24	Health	B1	0.005	0.98%	Yes
Wollastonite	13983-17-0	4.10E-05	<20	8700	3573.2229	15	24	Health & Particulate	B2	0.002	1.95%	Yes
Ethyl acetate	141-78-6	6.22E-02	<20	8700	8700	19000	1	Odour	B1	1.092	5.69%	Yes
Talc - fibrous	14807-96-6	1.56E-05	<20	8700	3573.2229	2	24	Health	B1	0.000	5.59%	Yes
Silica - respirable (<10 µm diameter), quartz	14808-60-7	4.64E-06	<20	8700	3573.2229	5	24	Health	B1	0.001	0.66%	Yes
2-Methoxy-1-propanol	1589-47-5	2.22E-04	<20	8700	3573.2229	95	24	Health	B2	0.013	1.67%	Yes
Bisphenol A-Bisphenol A diglycidyl ether polymer	25036-25-3	3.13E-05	<20	8700	3573.2229	120	24	Health & Particulate	B2	0.017	0.19%	Yes
Formaldehyde	50-00-0	5.78E-04	<20	8700	3573.2229	65	24	Health	B1	0.009	6.35%	Yes
N-Pentyl proprionate	624-54-4	2.05E-05	<20	8700	3573.2229	320	24	Health	B2	0.045	0.05%	Yes
Carbon monoxide	630-08-0	6.61E-01	<20	8700	10563.495	6000	0.5	Health	B1	0.284	232.91%	No
Ethanol (Ethyl alcohol)	64-17-5	1.15E-02	<20	8700	8700	19000	1	Odour	B1	1.092	1.05%	Yes
Methanol (Methyl alcohol)	67-56-1	1.94E-03	<20	8700	3573.2229	4000	24	Health	B1	0.560	0.35%	Yes
Isopropanol (Isopropyl alcohol)	67-63-0	4.28E-03	<20	8700	3573.2229	7300	24	Health	B1	1.021	0.42%	Yes
Acetone	67-64-1	1.25E-02	<20	8700	3573.2229	11880	24	Health	B1	1.662	0.75%	Yes
Polyethylenepolyamine reaction products with c18-unsat. Fatty acids	68410-23-1	5.33E-05	<20	8700	3573.2229	0.5	24	Health	B2	0.000	76.23%	Yes
Acetic acid ethenyl ester, polymer with ethenol, cyclic acetal with butanal (polyvinyl butyral)	68648-78-2	3.13E-05	<20	8700	3573.2229	15	24	Health & Particulate	B2	0.002	1.49%	Yes
Butanol, n-	71-36-3	4.27E-02	<20	8700	14368.175	2100	0.17	Odour	B1	0.073	58.38%	Yes
Butanol, n-	71-36-3	7.11E-03	<20	8700	3573.2229	920	24	Health	B1	0.129	5.52%	Yes
Benzene	71-43-2	9.01E-06	<20	8700	684.88571	0.45	8760	Health	B1	0.000	2.74%	Yes
Manganese and Manganese Compounds	7439-96-5	3.68E-06	<20	8700	3573.2229	0.4	24	Health	B1	0.000	6.58%	Yes
Nickel and Nickel Compounds	7440-02-0	1.27E-09	<20	8700	684.88571	0.04	8760	Health	B1	0.000	0.00%	Yes
Chromium Compounds (metallic, divalent and trivalent forms)	7440-47-3	1.16E-08	<20	8700	3573.2229	0.5	24	Health	B1	0.000	0.02%	Yes
Cobalt	7440-48-4	1.16E-08	<20	8700	3573.2229	0.1	24	Health	B1	0.000	0.08%	Yes
Zinc	7440-66-6	1.56E-05	<20	8700	3573.2229	120	24	Particulate	B1	0.017	0.09%	Yes
Propane	74-98-6	3.35E-03	<20	8700	3573.2229	215000	24	Health	B2	30.085	0.01%	Yes
Acetaldehyde	75-07-0	4.91E-04	<20	8700	3573.2229	500	24	Health	B1	0.070	0.70%	Yes
Acetaldehyde	75-07-0	3.55E-03	<20	8700	10563.495	500	0.5	Health	B1	0.024	14.98%	Yes
Methylene chloride	75-09-2	2.32E-02	<20	8700	3573.2229	220	24	Health	B1	0.031	75.50%	Yes
Silicon dioxide	7631-86-9	4.10E-06	<20	8700	3573.2229	5	24	Health	B2	0.001	0.59%	Yes
Ethyl-3-ethoxy propionate	763-69-9	8.53E-05	<20	8700	14368.175	200	0.17	Odour	B1	0.007	1.23%	Yes
Phosphoric acid	7664-38-2	1.32E-05	<20	8700	3573.2229	7	24	Health	B1	0.001	1.35%	Yes
Barium sulfate	7727-43-7	8.19E-05	<20	8700	3573.2229	25	24	Health	B2	0.003	2.34%	Yes
p-Chlorobenzotrifluoride	98-56-6	8.82E-03	<20	8700	3573.2229	350	24	Health	B2	0.049	18.02%	Yes
Suspended particulate matter (< 44 µm diameter)	SPM	2.87E-03	<20	8700	3573.2229	120	24	Visibility	B1	0.017	17.07%	Yes

APPENDIX D

Contour Plots
(5 Pages)

PROJECT TITLE:

IBI Group, Hamilton Maintenance Storage Facility
Nitrogen Oxides - 1 hour Contour Plot



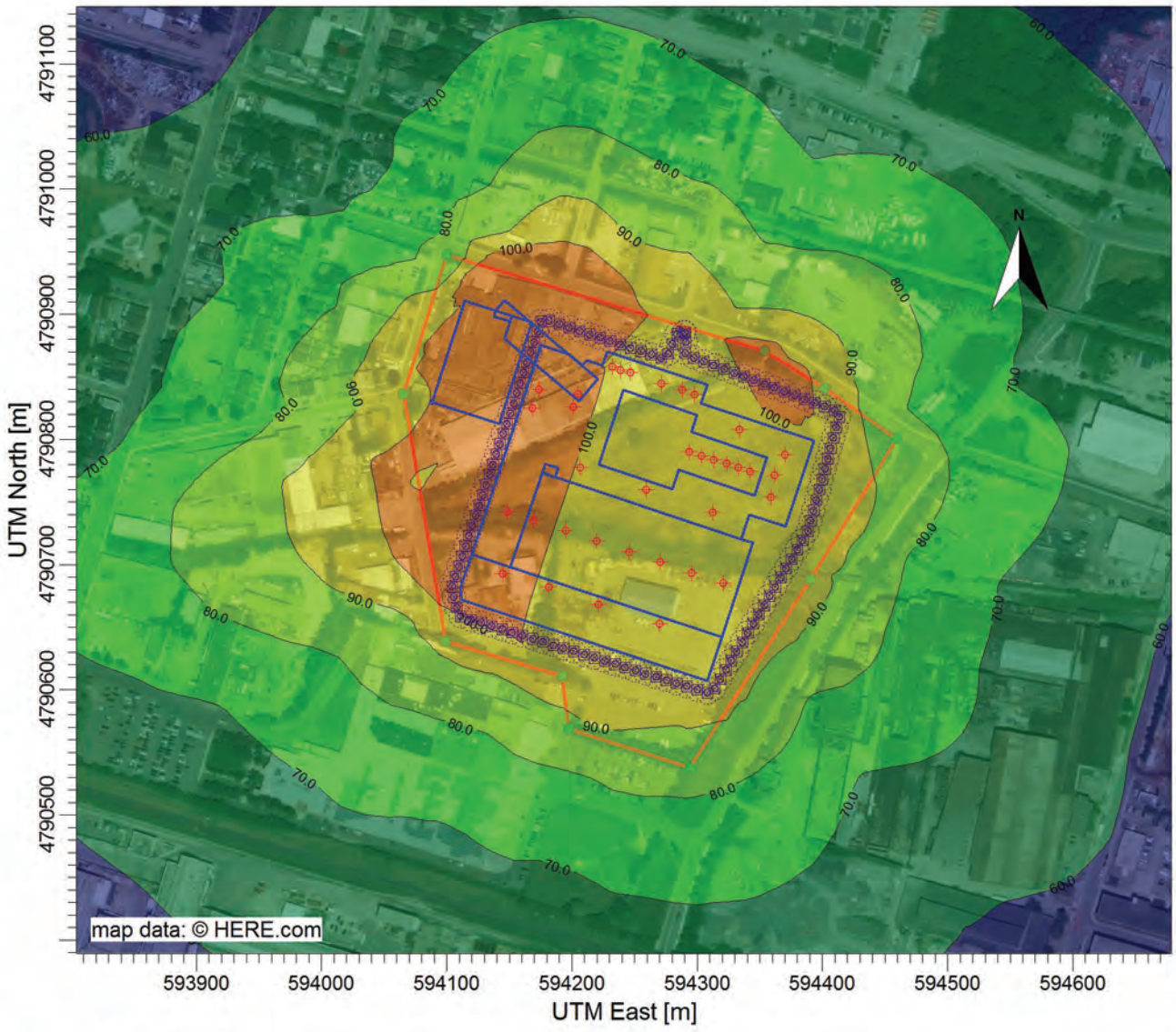
PLOT FILE OF HIGH 1ST HIGH 1-HR VALUES FOR SOURCE GROUP: ALL ug/m^3

Max: 221 [ug/m^3] at (594218.73, 4790926.20)

COMMENTS:	SOURCES: **61**	COMPANY NAME: **ORTECH Consulting Inc.**	
	RECEPTORS: **2922**	MODELER: **Giulia Celli**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:7,862 0 0.2 km	
	MAX: **221 ug/m^3**	DATE: **2019-07-16**	PROJECT NO.:

PROJECT TITLE:

IBI Group, Hamilton Maintenance Storage Facility
Nitrogen Oxides - 24 hour Contour Plot



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

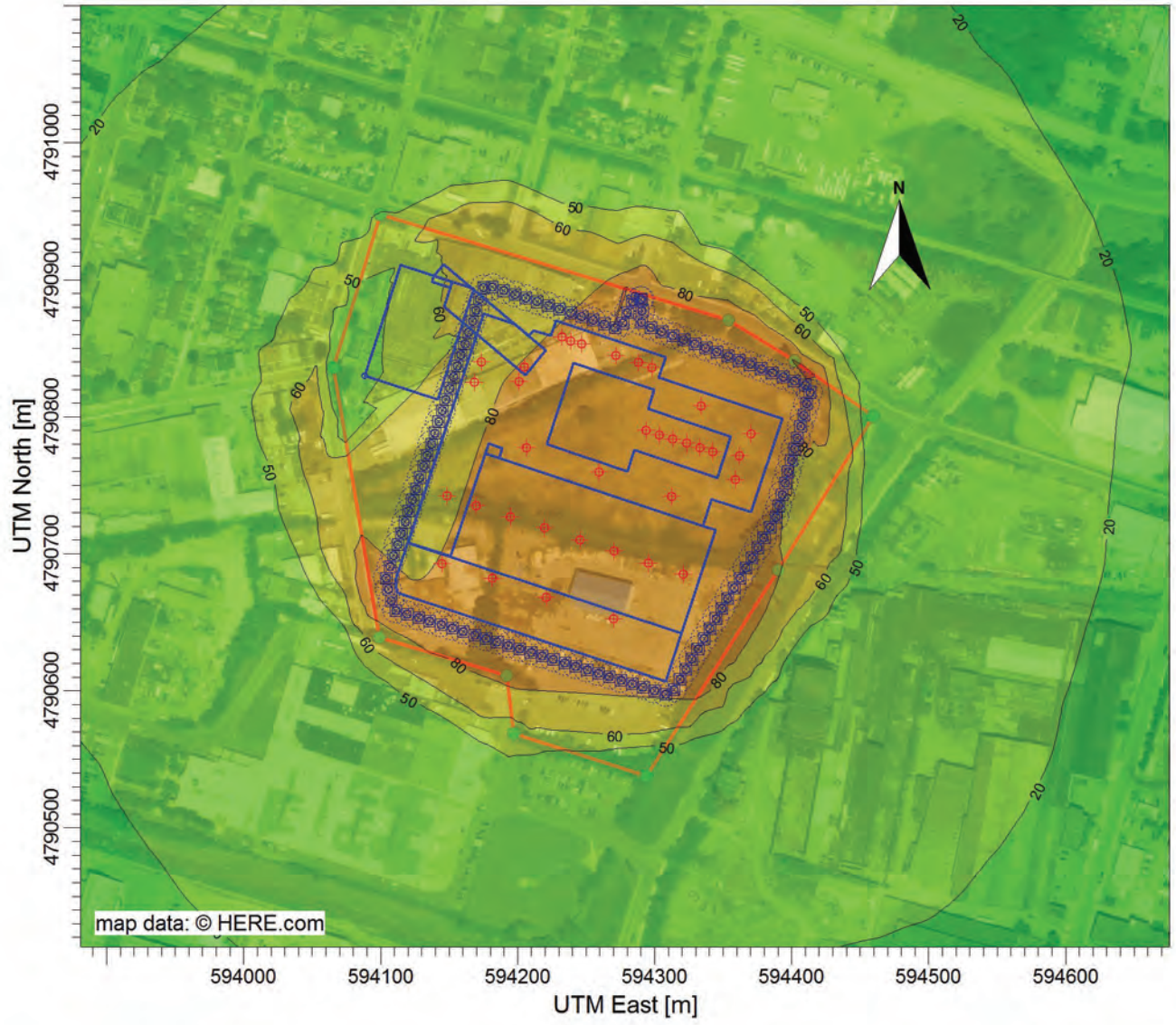
Max: 112.5 [ug/m^3] at (594193.95, 4790919.08)

48.1 50.0 60.0 70.0 80.0 90.0 100.0 112.5

COMMENTS:	SOURCES: **61**	COMPANY NAME: **ORTECH Consulting Inc.**	
	RECEPTORS: **2542**	MODELER: **Giulia Celli**	ORTECH
	OUTPUT TYPE: **Concentration**	SCALE: 1:5,500 (0 — 0.2 km)	
	MAX: **112.5 ug/m^3**	DATE: **05/07/2019**	PROJECT NO.: **92127**

PROJECT TITLE:

IBI Group, Hamilton Maintenance Storage Facility
Carbon Monoxide - 1 hour Contour Plot



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

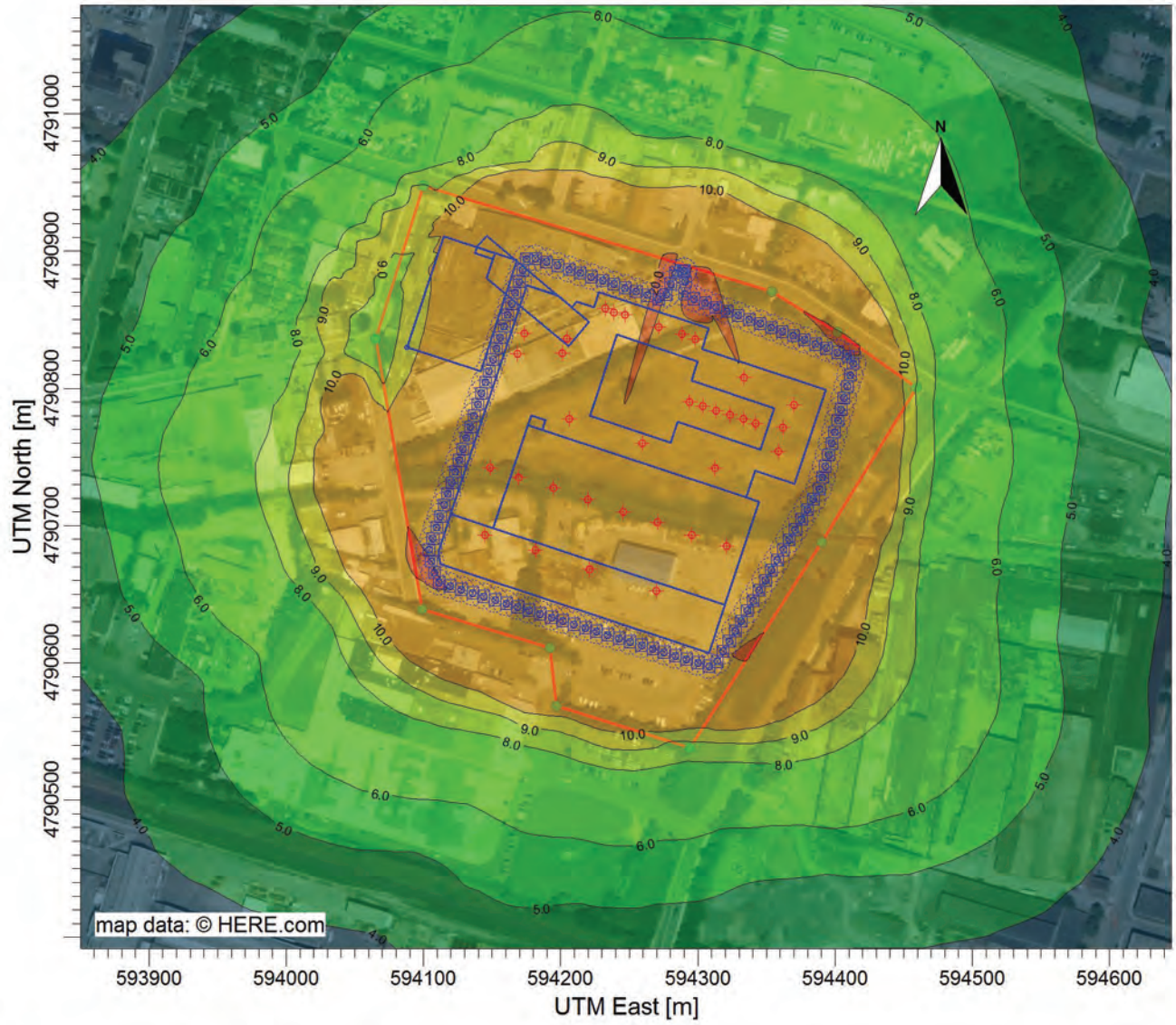
Max: 103 [ug/m^3] at (594409.04, 4790835.80)

3 5 7 9 10 20 50 60 80 100 103

COMMENTS:	SOURCES: **61**	COMPANY NAME: **ORTECH Consulting Inc.**	
	RECEPTORS: **2542**	MODELER: **Giulia Celli**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:5,000 (0 — 0.1 km)	
	MAX: **103 ug/m^3**	DATE: **05/07/2019**	PROJECT NO.: **92127**

PROJECT TITLE:

IBI Group, Hamilton Maintenance Storage Facility
Carbon Monoxide - 8 hour Contour Plot



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

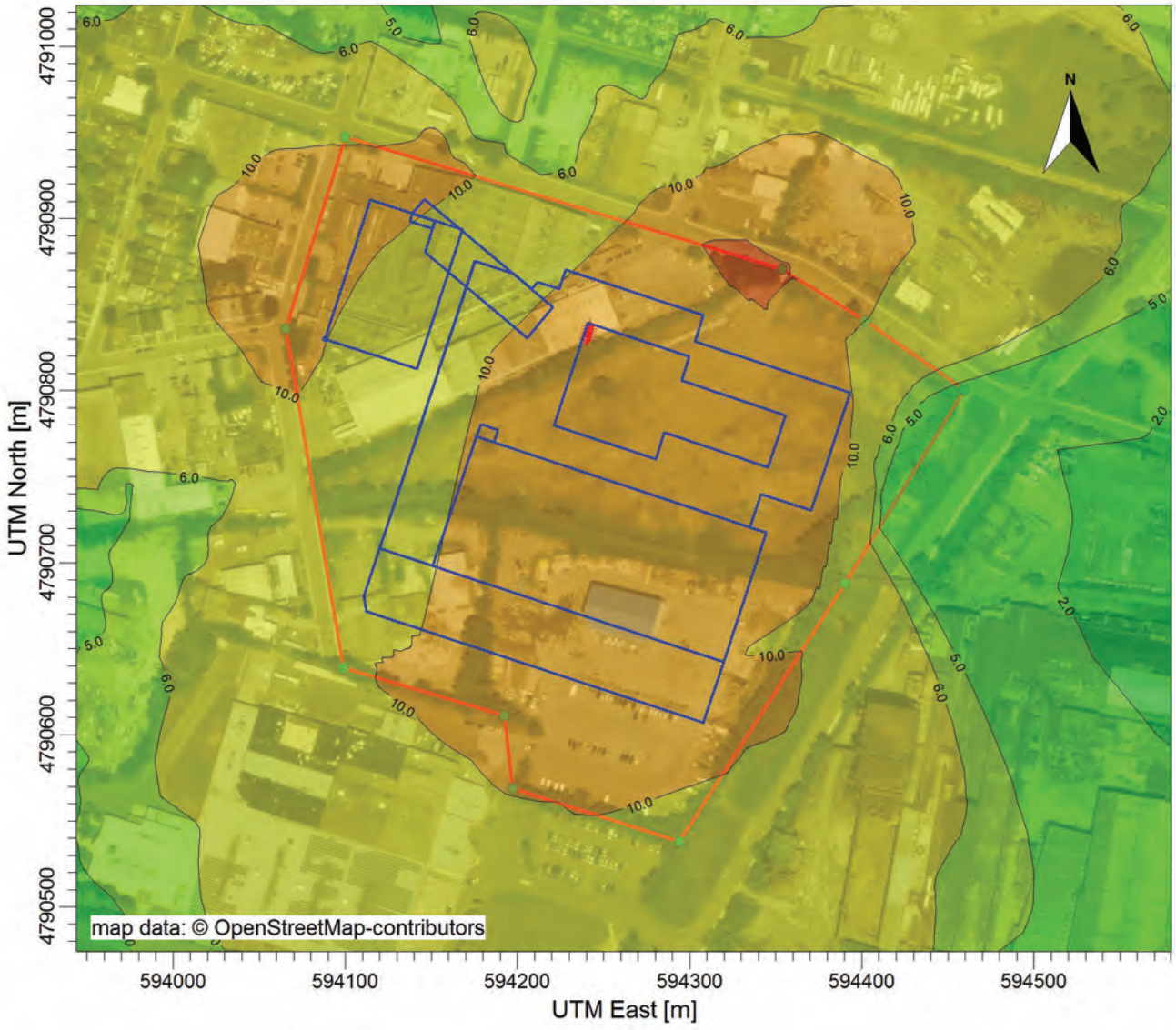
Max: 22.7 [ug/m^3] at (594278.55, 4790893.44)

1.1 3.0 4.0 5.0 6.0 8.0 9.0 10.0 20.0 22.7

COMMENTS:	SOURCES: **61**	COMPANY NAME: **ORTECH Consulting Inc.**	
	RECEPTORS: **2542**	MODELER: **Giulia Celli**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:5,000 (0 — 0.1 km)	
	MAX: **22.7 ug/m^3**	DATE: **05/07/2019**	PROJECT NO.: **92127**

PROJECT TITLE:

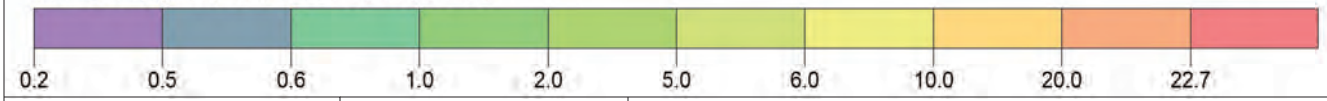
IBI Group, Hamilton Maintenance Storage Facility
n-Butyl Acetate Contour Plot



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

ug/m^3

Max: 22.7 [ug/m^3] at (594344.36, 4790873.50)



COMMENTS:	SOURCES: **6**	COMPANY NAME: **ORTECH Consulting Inc.**	
	RECEPTORS: **2542**	MODELER: **Giulia Celli**	
	OUTPUT TYPE: **Concentration**	SCALE: 1:4,000 (0 — 0.1 km)	
	MAX: **22.7 ug/m^3**	DATE: **05/07/2019**	PROJECT NO.: **92127**