TSD #3

Atmosphere – Air

December 2014

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Technical Support Document #3

AIR QUALITY & ODOUR ASSESSMENT

TAGGART
GROUP OF COMPANIES

THE MILLER GROUP

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ACRONYMS AND GLOSSARY OF TERMS

Term / Acronym	Definition
AAQC	Ambient Air Quality Criteria
CCME	Canadian Council of Ministers of the Environment
CO	Carbon monoxide
CRRRC	Capital Region Resource Recovery Centre
C&D	Construction and Demolition
EA	Environmental Assessment
ECA	Environmental Compliance Approval
EPA	*Environmental Protection Act*
ESDM	Emission Summary & Dispersion Modelling
GHG	Greenhouse gas
IC&I	Industrial, Commercial and Institutional
MOE	Ministry of the Environment
MOECC	Ministry of the Environment and Climate Change
MRF	Materials Recovery Facility
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
O. Reg.	Ontario Regulation
O_3	Ozone
PM_{10}	Particles nominally smaller than 10 µm in aerodynamic diameter
$PM_{2.5}$	Particles nominally smaller than 2.5 µm in aerodynamic diameter
POI	Point-of-Impingement
SO_2	Sulphur dioxide
SPM	Suspended particulate matter (also Total Suspended Particulate or TSP)
TOR	Terms of Reference
TSD	Technical Support Document
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds

UNITS

Unit	Definition
Am^3/hr	Actual cubic metre per hour
OU/s	Odour units per second
$\mu g/m^3$	Micrograms per cubic metre
µm	Micrometres (also microns), one-millionth of a metre

1.0 INTRODUCTION

This Technical Support Document (TSD) provides the Air Quality and Odour Assessment component in support of the Environmental Assessment (EA) for the proposed Capital Region Resource Recovery Centre (CRRRC) at the Boundary Road Site in Ottawa, Ontario. The assessment has been carried out in accordance with the approved Terms of Reference for this EA. The Site development plan is shown in Figure 1-1.

2.0 AIR QUALITY ASSESSMENT METHODS

This air quality and odour assessment characterizes and assesses the effects of the proposed CRRRC and also includes an assessment of greenhouse gas (GHG) emissions. The specific study methods used in the assessment are described in the following sections.

2.1 Study Area

The proposed CRRRC is located within the City of Ottawa, within the rural eastern part of the former Township of Cumberland. For the purposes of the air quality and odour assessment, there are two study areas, as follows:

- Site – the lands secured by Taggart Miller for the proposed Capital Region Resource Recovery Centre at the Boundary Road Site ("the Site"); and
- Site-vicinity – the lands in the vicinity of the Site.

2.2 Timeframe

The air quality and odour assessment focuses on the operations phase of the project. During the post-closure phase, the only anticipated activities are ongoing leachate collection and treatment, landfill gas (LFG) management, Site performance monitoring, and maintenance, i.e., sources of potential air emissions associated with the operations will have closed. The landfill operational activities will have ceased, a final landfill cover will be in place and the LFG management system will be operating over the whole landfill; as such, assessment of emissions from the CRRRC during operations provides a "worst case" assessment scenario.

2.3 Methodology

2.3.1 Methods for Describing the Existing Environment

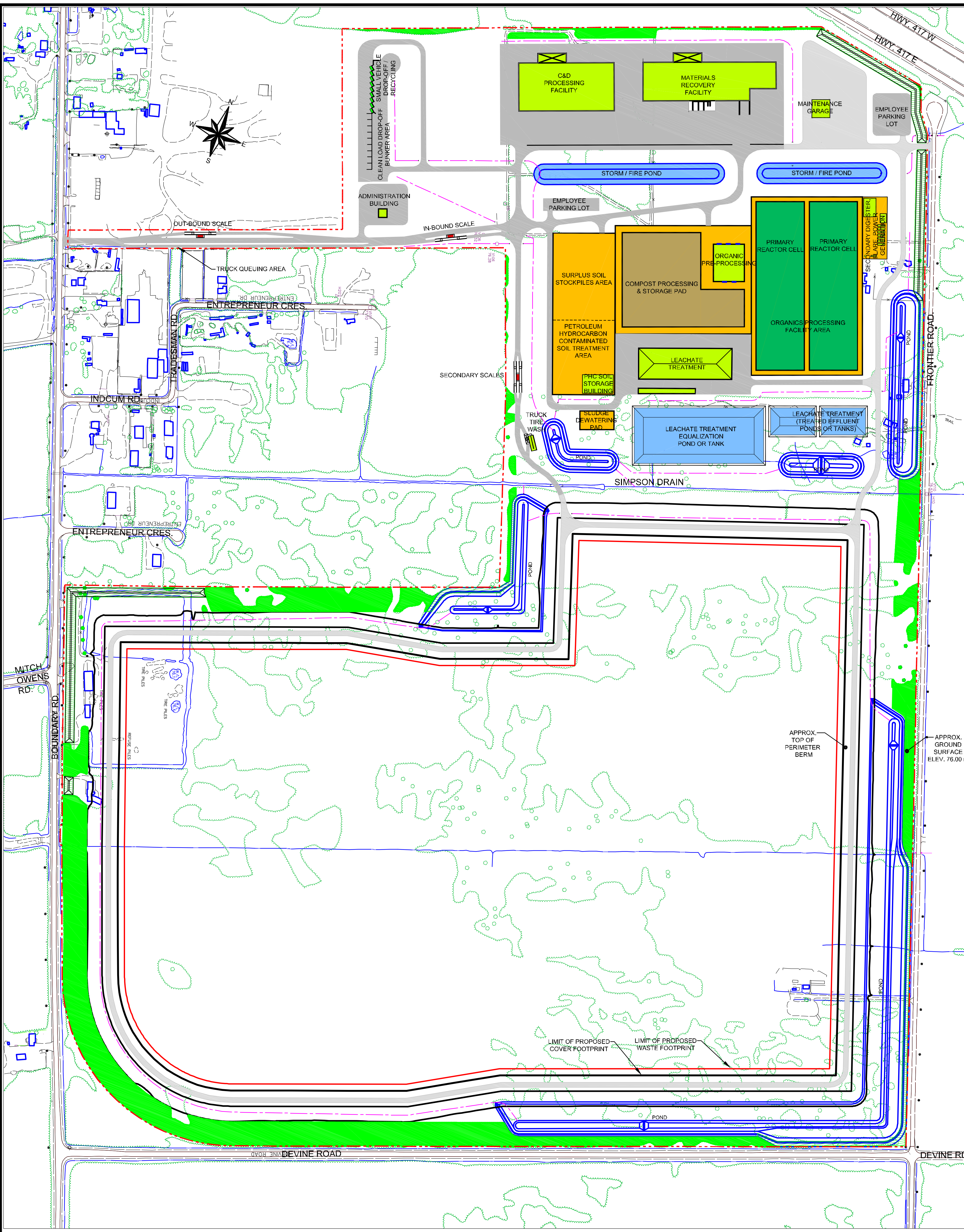
2.3.1.1 Air Quality and Odour

Existing air quality in the area has been described by considering regional concentrations, based on monitoring data. The following provides a summary of overall background air quality.

Background air quality was determined from existing MOECC monitoring stations. The closest air quality monitoring stations to the proposed undertaking are the two stations located in Ottawa: Ottawa Downtown and Ottawa Central.

For compounds relevant to the CRRRC, monitoring data for sulphur dioxide (SO_2), nitrogen dioxide (NO_2), oxides of nitrogen (NO_X), carbon monoxide (CO), and $PM_{2.5}$ are available. Ambient monitoring is not available directly for background SPM and PM_{10} concentrations but background PM_{10} and SPM can be determined from the fine particulate ($PM_{2.5}$) monitoring results. Overall, ambient levels of $PM_{2.5}$ have been found to be about 50% of the PM_{10} concentration (Health Canada, 1998). The suspended particulate matter (SPM) concentrations in Canada are typically about twice the corresponding PM_{10} concentrations (Health Canada, 1998). These ratios were used to derive the background SPM and PM_{10} from the $PM_{2.5}$ monitoring data at each station.

PLOT DATE: December 3, 2014
FILENAME: N:\Active\Spatial_IM\Miller_Paving_Ltd\CRRRC\ACAD\Phase1500_Site_Development_Concepts\Xref - Design\1211250045-1500-1-1-Air1.dwg



LEGEND

- PROPOSED FACILITY BUILDING
- OUTDOOR DIVERSION AREA
- PAVED ROAD (ASPHALT)
- GRAVEL ROAD
- PROPERTY BOUNDARY
- EXISTING VEGETATION SCREENING
- CONSTRUCTED SCREENING FEATURE
- PERIMETER BERM CONTOURS (interval 1 m)
- STORMWATER MANAGEMENT PONDS

120 0 120 240
SCALE 1:6,000 METRES

Golder Associates
Ottawa, Ontario, Canada

SCALE	AS SHOWN
DATE	7 Nov. 2013
DESIGN	M.L.F.
CAD	M.L.F.
CHECK	P.L.E.
REVIEW	P.A.S.

FILE No. 1211250045-1500-1-1-Air1.dwg
PROJECT No. 12-1125-0045 REV.

TITLE

SITE DEVELOPMENT PLAN

ENVIRONMENT ASSESSMENT OF THE
CAPITAL REGION RESOURCE RECOVERY CENTRE

FIGURE 1-1

2.3.1.2 Greenhouse Gases

The predicted emission of GHGs from the various components of the proposed CRRRC has been calculated. Emission rates for CO_2, CH_4, and N_2O are provided in Section 2.3.3.

2.3.2 Methods for Predicting Potential Air Quality and Odour Effects

Assessing potential effects to air quality and odour resulting from the proposed CRRRC involved three steps:

1) Calculating representative emission rates;

2) Dispersion modelling to predict resulting concentrations of indicator compounds in the environment; and

3) Comparison of predicted concentrations to MOECC standards and guidelines.

These steps are described in more detail below.

<u>Step 1 – Calculating Emission Rates</u>

The method used for calculating and quantifying air emissions resulting from the proposed CRRRC involved the following steps:

- **Identifying emissions sources:** Emission sources were identified based on detailed project information provided by the CRRRC design and engineering team. The location of the sources on the Site is as shown on the proposed Site development plan (Figure 1-1).
- **Calculating emission rates:** Air emission rates were calculated using accepted methods, such as emission factors, and were based on design activity data provided by the engineering team, as well as LandGEM modelling results provided in Appendix C. Emission rates were calculated for the worst-case scenario.
- **Summarizing overall emissions:** The calculated emissions were summarized by activity type and location.

The emission estimation methods used followed accepted MOECC practices including, where applicable, guidance in the Ontario MOECC document "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" Version 3.0 (MOE, 2009b) (MOECC ESDM Procedure Document). In calculating these emissions, all potential sources at the proposed CRRRC were considered.

In addition to assessing the potential air quality effects of the proposed CRRRC, and hence the ability of the proposed facility to comply with the requirements of O. Reg. 419/05 (MOE, 2013), air quality predictions were also used for assessment by other disciplines (i.e., biology and land use & socio-economic).

Details of the specific emissions calculation methods and resulting emissions are provided in Appendix A.

<u>Step 2 – Dispersion Modelling</u>

Models were used to predict ground-level concentrations of indicator compounds. The results were then compared to the relevant regulatory standard. The AERMOD-PRIME (AERMOD) dispersion model (Version 13350) was used for the air dispersion modelling. The AERMOD dispersion modelling system was developed by the United States Environmental Protection Agency (U.S. EPA). This model has also been adopted in Ontario as the regulatory model recommended by the MOECC (MOE, 2009a).

AERMOD was selected as the dispersion model for the CRRRC for the following reasons:

- The model is well documented and accepted by the MOECC as a recommended model (MOE, 2009a);
- It permits the evaluation of various source types and compounds associated with the proposed CRRRC;
- It has a technical basis that is scientifically sound, and is in keeping with the current understanding of dispersion in the atmosphere;
- The model applies formulations that are clearly delineated and are subjected to rigorous independent scrutiny;
- The results are consistent with observations; and
- The terrain is relatively simple and can be addressed by the model.

The AERMOD modelling system consists of the AERMOD dispersion model, the AERMET meteorological pre-processor and the AERMAP terrain pre-processor. The following approved dispersion model and pre-processors were used in the assessment:

- AERMOD dispersion model (v. 13350);
- AERMAP surface pre-processor (v. 11103); and
- Building Profile Input Program (BPIP) building downwash pre-processor (v.42104).

AERMET was not used in this assessment, as a pre-processed MOECC meteorological 5-year dataset was used (MOE, 2011). The wind rose for the MOECC meteorological dataset showing the wind direction as “blowing from” is provided below.

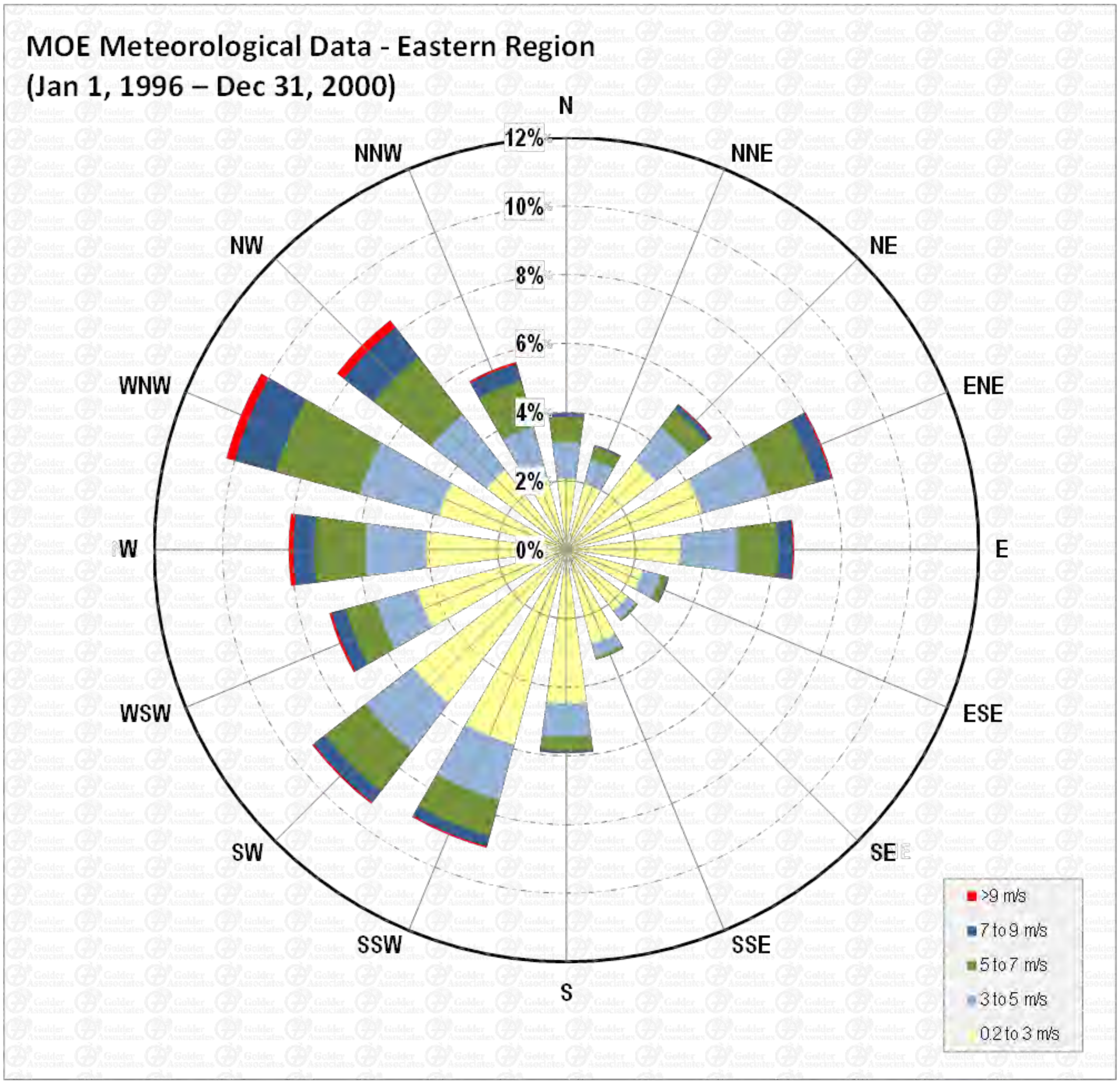


Figure 2-1: Eastern Region Wind Rose

Details regarding the dispersion meteorology and terrain inputs are provided in Appendix B.

The calculated emission rates used in the modelling were calculated taking into consideration mitigation measures inherent to the design (as explained in Section 4.5) and the modelled concentrations provide information on the residual effects (after mitigation).

Further details regarding the dispersion modelling, including receptor grids, input parameters and source parameters are provided in Appendix B.

Step 3 – Comparison to Existing Conditions and Regulatory Standards

To determine potential effects of the proposed CRRRC on air quality and odour, the predicted concentrations of indicator contaminants were compared to MOECC standards and guidelines.

The air quality and odour assessment focused on concentrations of the following compounds for which air quality criteria exist:

- Particulate matter, including suspended particulate matter (SPM), particles nominally smaller than 10 µm in diameter (PM_{10}), and particles nominally smaller than 2.5 µm in diameter ($PM_{2.5}$);
- Oxides of nitrogen (NO_X);
- Sulphur dioxide (SO_2);
- Carbon monoxide (CO);
- Hydrogen sulphide (H_2S);
- Vinyl chloride (C_2H_3Cl); and
- Odour.

These compounds are typically associated with various diversion facility and landfill operational activities. Particulate matter is typically associated with airborne dust from vehicles travelling on on-Site paved roads and unpaved roads/haul routes, as well as material loading and unloading activities. Products of combustion (NO_2, SO_2 and CO) are associated with the exhaust from on-Site vehicles as well as fuel consumption. Emissions of hydrogen sulphide and vinyl chloride can result from breakdown of waste material within the landfill.

Ozone (O_3) is a substance that will not be emitted directly from the proposed CRRRC and is a regional issue. Ozone is the result of photochemical reactions between NO_X and volatile organic compounds (VOCs), both of which could be emitted from the CRRRC. In some situations, NOx emissions can scavenge the ozone and reduce the local effect.

The MOECC has point-of-impingement (POI) guidelines and ambient air quality criteria (AAQC) for various compounds. The AAQC are commonly used in assessments of general air quality in a community, whereas the POI criteria under O.Reg. 419/05 (MOE, 2013) are used to assess emissions of an individual facility.

In addition, a working group of provincial, territorial and federal ministers has established the Canada-Wide Standards (CWS) for ambient air quality for a number of air contaminants. The CWS are intended to be adopted by the provinces, which have primary regulatory authority over air quality. The CWS are ambient objectives and have no regulatory status per se.

A summary of the applicable Ontario and Canadian objectives and criteria are listed Table 2-1.

Table 2-1: Canadian Regulatory Air Quality Objectives and Criteria

Substance	Ontario Criteria		Canada-Wide Standards[c]
	Schedule 3[a]	Ambient[b]	
SO_2 (µg/m^3)			
1-Hour	690	—	—
24-Hour	275	—	—
NO_X (µg/m^3)			
1-Hour	400[d]	—	—
24-Hour	200[d]	—	—
NO_2 (µg/m^3)			
1-Hour	—	400	—
24-Hour	—	200	—
O_3 (µg/m^3)			
1-Hour	165	—	—
8-Hour	—	—	128[e]
24-Hour	—	—	—
CO (µg/m^3)			
1-Hour	—	36,200	—
8-Hour	—	15,700	—
½ Hour	6000		
SPM (µg/m^3)			
24-Hour	120	120	—
PM_{10} (µg/m^3)			
24-Hour	—	50[g]	—
$PM_{2.5}$ (µg/m^3)			
24-Hour	—	25	30[f]
Hydrogen Sulphide (µg/m^3)			
24-Hour	7	7	—
10-Minute	13	13	—
Vinyl Chloride (µg/m^3)			
24-Hour	1	1	—
Odour (OU/m^3)			
10-Minute	1[g]	—	—

Notes:
[a] MOE (2012a)
[b] MOE (2012b)
[c] CCME (2000)
[d] The Ontario limit for NO_X is based on Nitrogen Oxides, which are defined to be the sum of nitrogen dioxide (NO_2) and nitric oxide (NO).
[e] Compliance with the Canada Wide Standard is based on the 4th highest measurement annually, averaged over three consecutive years.
[f] Compliance with the Canada Wide Standard is based on the 98th percentile of the annual monitored data averaged over three years of measurements.
[g] The Ontario Guideline is based on the 99.5th percentile on a 10-minute averaging period.
— No guideline available.
µg/m^3 = micrograms per cubic metre; OU/m^3 = odour unit per cubic metre; SO_2 = sulphur dioxide; NO_2 = nitrogen dioxide; O_3 = ozone; CO = carbon monoxide; SPM = suspended particulate matter < 0.44 µm; PM = particular matter.

2.3.2.1 Key Emissions Assumptions

The assessment employed an operating scenario that is inherently very conservative by superimposing the emissions from all the CRRRC components, which results in the maximum possible emissions from the proposed CRRRC. The assumed throughputs and details were chosen so that the emissions calculated are quite conservative and will allow any required reasonable design modifications to be made at the final design stage and remain within the conservative assumptions used in this air quality and odour assessment.

The key assumptions used in the assessment are as follows:

- The flare destruction efficiency ranges from 98-99% depending on the contaminant. This assumption is based on typical values provided in Chapter 2.4 of the US EPA AP-42. (US EPA, 2008).
- The electricity generation plant and flare, when in operation, will be operated for 24 hours a day and the LFG and biogas will be directed to either the engines or the flare with potential excess gas being flared during the ramp up of the CRRRC operations.
- A collection efficiency of 75% of the LFG and biogas was applied. This is based on typical values provided in Chapter 2.4 of the US EPA AP-42.
- All non-road vehicles will meet Tier 3 standards for non-road compression-ignition engines.
- The proposed CRRRC will employ best management practices to mitigate fugitive road dust.
- Truck traffic at the Site will be limited to 7:00 am to 7:00 pm.
- The weight of empty collection trucks is 3 or 10 tonnes depending on the type, while the weight of full collection trucks is 6 or 20 tonnes.
- The maximum flow rate of the biofilter for the petroleum hydrocarbon (PHC) impacted soil treatment area is 15,000 Am^3/hr and for the organics processing building is 72,000 Am^3/hr.
- The flow rate of the dust collector for the MRF and for the C&D facility is 15,000 acfm.

Appendix A contains the full listing of assumptions for this assessment.

2.3.3 Methods for Predicting Potential Greenhouse Gas Effects

In addition to assessing air quality and odour effects of the proposed CRRRC, the potential GHG effects were also assessed using the methodology described in the section above, with the exception of the dispersion modelling step.

The emission estimation methods used follow accepted practices for conducting environmental assessments and, where appropriate, guidance in the Ontario MOECC document "*Guideline for Greenhouse Gas Emissions Reporting*" (MOE, 2012c).

Details of the specific emission calculation methods and resulting emissions are provided in Appendix A.

The GHG portion of the air quality and odour assessment focuses on emissions of the following compounds, which are anticipated to be emitted from the proposed CRRRC:

- Carbon dioxide (CO_2);
- Methane (CH_4); and
- Nitrous oxide (N_2O).

These compounds are associated with biogas and LFG combustion from the flare, the electrical generation plant as well as from diesel combustion from tailpipe emissions, vehicle exhausts, and the proposed boilers at the leachate building. Emissions of these compounds are also the result of breakdown of waste material within the landfill and the composting area.

2.4 Compliance with Ontario Regulation 419/05

This study includes an assessment to determine if the proposed CRRRC facility meets the provincial requirements to obtain an ECA for air emissions under Section 9 of the *Environmental Protection Act* (EPA). To obtain an ECA, it must be shown that the facility can achieve compliance with O. Reg. 419/05 (MOE, 2013).

This compliance assessment was conducted by predicting air quality concentrations in accordance with O.Reg. 419/05 (MOE, 2013) and comparing the results to the relevant MOECC standards. Dispersion modelling was carried out in accordance with s.14 of O. Reg. 419/05 and Ontario guidance (MOE 2009a, 2009b) to determine whether the maximum POI concentrations meet the relevant O. Reg. 419/05 standards at or beyond the property boundary for the facility. The air quality predictions were made for potential receptors assuming they are located along the property line using a 10 m and a tiered modelling grid as per MOECC guidance specified in O.Reg. 419/05. A figure of the layout of the receptors is presented in Appendix B, Figure B4. Although as per O. Reg. 524/98-S.13 (MOE, 1998) the emissions from on-Site vehicles and fugitive emissions from on-Site roadways and storage piles are exempt from Ontario Reg. 419 ECA compliance assessment, they have conservatively been included in the O.Reg. 419/05 compliance assessment for this EA.

For odour based compounds (whole odour and H_2S), the compliance assessment was conducted by comparing the AERMOD predictions against the MOECC standards, with an allowed frequency of occurrence in excess of the 10-minute standard of no more than 0.5% at any of the nearby residences (referred to as discrete receptors) (MOE, 2008a).

In accordance with the MOECC ESDM Procedure Document (MOE, 2009b), sources that produce negligible amounts of emissions, relative to the overall emissions from the proposed CRRRC, have been excluded from the compliance assessment. Appendix A provides additional details pertaining to the activities and compounds that were considered negligible and the corresponding rationale.

3.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

Air Quality monitoring data for the years 2000 through 2011 was collected from the downtown Ottawa and Ottawa Central regional monitoring stations (MOE, 2011).

The location of each of these stations relative to the project is set out in Table 3-1.

Table 3-1: Location of Air Monitoring Stations

City	Station ID	Location	Lat/Long	Distance to Site (km)	Direction
Ottawa Downtown (Ottawa DT)	51001	Outside Site-vicinity Area	44.1502528, -77.3955	22	West-Northwest (generally upwind)
Ottawa Central (Ottawa C)	51002	Outside Site-vicinity Area	45.033333 -75.675	23	West-Northwest (generally upwind)

At each station, not all compounds have the same data availability, as the monitoring of some compounds is added to the station while others are discontinued. Table 3-2 provides a summary of the monitoring data available from each of these stations.

Table 3-2: Availability of Ambient Air Quality Data

Compound	Ottawa DT	Ottawa C
SPM	N/A	N/A
PM_{10}	N/A	N/A
$PM_{2.5}$	2003-2011	2007-2011
NO_x	2000-2011	2007-2011
NO_2	2000-2011	2007-2011
SO_2	2001, 2003-2011	2007-2009
CO	2001, 2003-2011	2007-2009

Note: "NA" indicates that data for the compound were not available at that station.

The historic monitoring data for the two stations evaluated indicate that the compound levels in the area are typical when compared to other locations in Southeastern Ontario. All measured values were below their respective AAQC values. The existing values considered to be representative of background air quality are outlined in Table 3-3. Generally, the 90^{th} percentile of measured concentration is considered representative of local background air quality.

Table 3-3: Background Air Quality Concentrations (90th Percentile)

Compound	Averaging Period	Ottawa DT (µg/m³)	Ottawa C (µg/m³)
$PM_{2.5}$	24-hour	12.26	9.92
NO_X	1-hour	62.07	37.62
	24-hour	57.12	35.17
	Annual	28.76	16.92
NO_2	1-hour	45.14	31.98
	24-hour	38.83	26.01
	Annual	20.45	13.30
SO_2	1-hour	7.86	5.24
	24-hour	7.64	6.02
	Annual	2.94	2.52
CO	1-hour	722.65	389.38
	8-hour	827.44	449.51

Note: µg/m^3 = micrograms per cubic metre

These stations are considered generally indicative of background air quality levels for the Site.

4.0 ASSESSMENT OF AIR QUALITY AND ODOUR EFFECTS

The assessment of effects predicts and describes the likely environmental effects, mitigation measures, and the residual effects on existing air quality and odour that could reasonably be expected as a result of the CRRRC.

4.1 Identification of Emission Sources

Emissions during the operations phase of the project will be greater than the emissions and associated effects during either the construction or post-operation phase; as such, the emissions and associated effects during the operation of the facility represent the bounding case, the effects of which are assumed to apply throughout the life of the CRRRC. Table 4-1 outlines the activities (i.e., sources of emissions) that have been assessed as part of the air quality assessment.

4.2 Air & Odour Emissions

Table 4-2 summarizes the assumed emission rates in grams per second (g/s) for each activity at the facility.

Table 4-1: Summary of Sources Assessed as Part of the Air Quality & Odour Assessment

Source Information		Significant (Yes or No)?	Modelled (Yes or No)?	Rationale
General Location	**Source**			
Flare and/or Electrical Generation Plant	Enclosed LFG and biogas flare and/or engines	Yes	Yes	—
Construction and Demolition Facility	Dust collector	Yes	Yes	—
Material Recovery Facility	Dust collector	Yes	Yes	—
Organics Processing Facility	Biofilter	Yes	Yes	—
	Organics processing operations (material handling)	Yes	Yes	—
	Organics processing operations (tailpipe emissions)	Yes	Yes	—
Composting	Composting, curing, and post processing (material handling)	Yes	Yes	—
	Composting, curing, and post processing (tailpipe emissions)	Yes	Yes	—
PHC Impacted Soil Treatment Area	Biofilter	Yes	Yes	—
	PHC soil treatment operations (material handling)	Yes	Yes	—
	PHC soil treatment operations (tailpipe emissions)	Yes	Yes	—
Landfill	Landfill Cap	Yes	Yes	—
	Landfill operations (material handling)	Yes	Yes	—
	Landfill operations (tailpipe exhaust emissions)	Yes	Yes	—
Leachate Pre-Treatment	Leachate pre-treatment	Yes	Yes	—
	Leachate ponds	Yes	Yes	—
Paved Roads	Vehicle exhaust and fugitive road dust	Yes	Yes	—
Unpaved Roads	Vehicle exhaust and fugitive road dust	Yes	Yes	—
Emergency Generator	Diesel emergency power generator used to provide electricity during power outages.	Yes	No	The emergency power equipment only operates periodically (rather than continuously) and therefore produces emissions that are negligible relative to the overall emissions from the CRRRC. Additionally, the emergency power generator will not be operating at the same time as any other equipment and therefore is not a part of the worst-case scenario.
Support Activities	Operational support activities, such as maintenance activities (including welding, compressor, diesel fire pump, lights)	No	No	These activities are considered to be negligible in comparison to the other activities occurring on- Site.
	Stationary fuel combustion for comfort heating	Yes	Yes	Emissions from these sources occur seasonally (i.e., do not occur at all times during a year) and are very small compared to mobile combustion sources. For this assessment, only nitrogen oxide emissions were modelled.

Table 4-2: Summary of Worst Case Assumed Emissions during Operation of the CRRRC

Facility	Activity	Contaminant (g/s)								
		SPM	PM_{10}	$PM_{2.5}$	NO_x/NO_2 (1)	SO_2	CO	H_2S	C_2H_3Cl	Odour (OU/s)
Flare and/or Electrical Generation Plant	Enclosed LFG flare and/or LFG and biogas to energy engines	0.1309	0.1309	0.1309	0.4404	0.1018	4.6546	0.0031	0.0002	—
Construction and Demolition Facility	Dust collector	0.0708	0.0708	0.0708	—	—	—	—	—	—
Materials Recovery Facility	Dust collector	0.0708	0.0708	0.0708	—	—	—	—	—	—
Organics Processing Facility	Biofilter	—	—	—	—	—	—	—	—	10,000
	Organics processing operations (material handling)	0.0043	0.0021	0.0003	—	—	—	—	—	—
	Organics processing operations (tailpipe emissions)	0.0278	0.0278	0.0278	0.4472	0.00001	0.4777	—	—	—
Composting	Composting, curing, and post processing (material handling)	0.0046	0.0022	0.0003	—	—	—	—	—	309
	Composting, curing, and post processing (tailpipe emissions)	0.0559	0.0584	0.0584	1.1572	0.00002	0.9882	—	—	—

Facility	Activity	Contaminant (g/s)								
		SPM	PM_{10}	$PM_{2.5}$	NO_x/ NO_2 (1)	SO_2	CO	H_2S	C_2H_3Cl	Odour (OU/s)
PHC Impacted Soil Treatment	Biofilter	—	—	—	—	—	—	—	—	2,083
	PHC impacted soil treatment operations (material handling)	0.0104	0.0049	0.0007	—	—	—	—	—	—
	PHC impacted soil treatment operations (tailpipe emissions)	0.0025	0.0025	0.0025	0.0433	0.000001	0.0429	—	—	—
Landfill	Landfill cap	—	—	—	—	—	—	0.0047	0.0004	1,046
	Landfill operations (material handling)	0.0161	0.0076	0.0012	—	—	—	—	—	1,347
	Landfill operations (tailpipe emissions)	0.0618	0.0618	0.0618	1.0799	0.00002	1.0717	—	—	—
Leachate Pre-treatment	Leachate pre-treatment	—	—	—	—	—	—	—	—	6,944
	Leachate equalization pond	—	—	—	—	—	—	—	—	0.9250
	Leachate effluent ponds	—	—	—	—	—	—	—	—	0.9250
Paved Roads	Fugitive road dust	0.6332	0.1215	0.0294	—	—	—	—	—	—
	Vehicle exhaust	0.0013	0.0013	0.0011	0.0315	0.0001	0.0073	—	—	—

Facility	Activity	Contaminant (g/s)								
		SPM	PM_{10}	$PM_{2.5}$	NO_x/ NO_2 [1]	SO_2	CO	H_2S	C_2H_3Cl	Odour (OU/s)
Unpaved Roads	Fugitive road dust	0.2880	0.0778	0.0078	—	—	—	—	—	—
	Vehicle exhaust	0.0001	0.0001	0.0001	0.0025	0.0000	0.0006	—	—	—
Emergency Generator[2]	Diesel emergency power generator	0.0004	0.0004	0.0004	0.1446	0.0708	0.0152	—	—	—
Support Activities	Operational support activities, such as maintenance activities (including welding, compressor, diesel fire pump, lights)	These activities are considered to be negligible in comparison to the other activities occurring on-Site.								
	Stationary Fuel Combustion	— [3]	— [3]	— [3]	0.0387	— [3]	— [3]	—	—	—

Notes:

[1] NOx emissions were assumed to be all NO_2

[2] The emergency power generator was evaluated separately as it is used to provide electricity during power outages when other equipment is not in operation.

[3] Other than NOx, compounds from this activity are considered to be negligible in comparison to the other activities occurring on-Site

— Compound not emitted from that source

SPM = Suspended particulate matter

PM_{10} = Particles nominally smaller than 10 µm in diameter

$PM_{2.5}$ = Particles nominally smaller than 2.5 µm in diameter

SO_2 = Sulphur dioxide

CO = Carbon monoxide

H_2S = Hydrogen sulphide

C_2H_3Cl = Vinyl chloride

4.3 Modeling Results

Concentrations resulting from operation of the proposed facility for the air quality indicators were predicted with the aid of the AERMOD dispersion model (see Section 2.3.1.2). The resulting maximum off-property concentrations at the Discrete Receptors (see Figure B4 of Appendix B) in the Site-Vicinity study area are presented in Table 4-3 along with cumulative effects of the predicted maximum off-property concentrations together with Ottawa existing conditions. It is noted that regulatory criteria are not provided in Table 4-3 because they do not directly compare to cumulative effects.

Table 4-3: Concentrations at Discrete Receptors for the Proposed CRRRC Facility

Indicator	Averaging Period	Existing Conditions Ottawa (μg/m³)(1)	Maximum Predicted Concentration at Discrete Receptors (μg/m³)(2)	Cumulative effect (μg/m³)
SPM (24-hr)	24-hour	49.04	14.03	63.07
PM_{10} (24-hr)	24-hour	24.52	3.76	28.28
$PM_{2.5}$ (24-hr)	24-hour	12.26	2.26	14.52
NO_X (1-hr)	1-hour	62.07	13.72	75.79
NO_X (24-hr)	24-hour	57.12	2.38	59.50
NO_2 (1-hr) (3)	1-hour	45.14	13.72	58.86
NO_2 (24-hr)(3)	24-hour	38.83	2.38	41.21
SO_2 (1-hr)	1-hour	7.86	1.92	9.78
SO_2 (24-hr)	24-hour	7.64	0.54	8.18
CO (1/2-hr)	½-hour	867.18	106.59	973.77
CO (1-hr)	1-hour	722.65	87.78	810.43
CO (8-hr)	8-hour	827.44	43.99	871.43
H_2S (24-hr)	24-hour	—	0.016	0.0161
H_2S (10-min)	10-min	—	0.10	0.100
C_2H_3Cl (24-hr)	24-hour	—	0.0013	0.00131
Odour (10-min)(4)	10-min	—	0.58	0.5775

Notes:

(1) The 90th percentile predicted existing concentrations; values for SPM and PM_{10} are calculated from the $PM_{2.5}$ as described in Section 2.3.1.1

(2) Represents the maximum predicted concentrations at discrete receptors within the Site- vicinity.

(3) A conservative concentration conversion value of 100% of NO_x was applied to NO_2.

(4) The 99.5th percentile predicted concentration at discrete receptors.

"—" indicates that there is no data available for existing conditions.

4.4 Compliance with Ontario Regulation 419/05

Compliance with O. Reg. 419/05 (MOE, 2013) is based on achieving the appropriate standards in the natural environment at a POI located at or beyond the property boundary. Table 4-4 lists the maximum predicted POI concentrations against the relevant O. Reg. 419/05 standards. As noted therein, all of the maximum POI concentrations meet the relevant standards.

The CRRRC regulated sources would include LFG, combustion processes and materials handling emissions. As noted above, the mobile equipment does not need to be considered for permitting under O.Reg. 419/05 (MOE, 2013) when a best management practice is in place. However, for the purpose of this assessment, outdoor mobile equipment was conservatively included in the assessment of compliance with O. Reg. 419/05.

Table 4-4 presents the maximum concentrations of the indicators at the proposed CRRRC point-of-impingement. The assessment indicates that the proposed facility will be in compliance with O. Reg. 419/05 (MOE, 2013), even with mobile equipment and fugitive emissions from roadways and storage piles considered.

Table 4-4: Predicted Compliance Air Quality Concentrations at POI

Indicator	Averaging Period	Air Quality Criteria (µg/m³)	Maximum Concentration at POI (µg/m³) (1)	Percentage of Limit (%)
SPM (24-hr)	24-hour	120	98.23	82%
PM_{10} (24-hr)	24-hour	50	23.30	47%
$PM_{2.5}$ (24-hr)	24-hour	25	20.16	81%
NO_X (1-hr)	1-hour	400	68.90	17%
NO_X (24-hr)	24-hour	200	37.15	19%
NO_2 (1-hr)(2)	1-hour	400	68.90	17%
NO_2 (24-hr)(2)	24-hour	200	37.15	19%
SO_2 (1-hr)	1-hour	690	15.91	2%
SO_2 (24-hr)	24-hour	275	8.54	3%
CO (1/2-hr)	½-hour	6000	860.01	14%
H_2S (24-hr)	24-hour	7	0.26	4%
H_2S (10-min)	10-min	13	0.79	6%
C_2H_3Cl (24-hr)	24-hour	1	0.021	2%
Odour (10-min) (3)	10-min	1(3)	0.58	58%

Notes:

(1) Represents the maximum predicted concentrations at POI locations within the Site-vicinity.

(2) A conservative concentration conversion value of 100% of NO_x was applied to NO_2.

(3) The 99.5th percentile predicted concentration at discrete receptors.

4.5 Mitigation Measures

In determining the predicted air emissions associated with the CRRRC works and activities, consideration was given to those mitigation measures that were considered to be integral to the design and implementation of the works and activities. These mitigation measures, which are considered to be typical and consistent with best practices, were assumed for the purposes of the emission estimates presented in Section 4.2, and therefore were incorporated in the effects predictions presented in Section 4.3. The in-design mitigation measures that were included in the air quality and odour assessment are summarized in Table 4-5.

Table 4-5: Summary of In-Design Mitigation Incorporated in the Air Quality and Odour Assessment

Mitigation Measure	Mitigation Specifics	Works and Activities Affected	Compound Affected by Mitigation Measure	Project Phase where Mitigation is being Considered
Dust suppressant on paved and unpaved roadways	Application of dust suppressant on unpaved roads on a routine basis	▪ Vehicle movements related to Base, Construction, Waste Excavation, Waste Placement	▪ SPM ▪ PM_{10} ▪ $PM_{2.5}$	▪ Construction ▪ Operation
Paved road entrance	Sweep the roads to avoid track out, and use of a truck tire wash station for vehicles leaving the landfill	▪ Vehicle movements	▪ SPM ▪ PM_{10} ▪ $PM_{2.5}$	▪ Construction ▪ Operation
Maintenance of on-Site vehicles and equipment	On-Site vehicles and equipment engines will meet Tier 3 emission standards and be maintained in good working order	▪ On-Site Vehicles	▪ NO_2 ▪ CO ▪ SO_2 ▪ SPM ▪ PM_{10} ▪ $PM_{2.5}$	▪ Construction ▪ Operation
Minimize idling of vehicles on-Site	Minimize idling of vehicles on-Site	▪ On-Site vehicles	▪ NO_2 ▪ CO ▪ SO_2 ▪ SPM ▪ PM_{10} ▪ $PM_{2.5}$	▪ Construction ▪ Operation
Minimize working face/daily cover	Site is restricted to approx.1500 m^2 working face, daily cover is required	▪ Landfill	▪ H_2S ▪ C_2H_3Cl ▪ Odour	▪ Operation
Use of dust collectors, where applicable	—	▪ C&D Processing ▪ MRF	▪ SPM ▪ PM_{10} ▪ $PM_{2.5}$	▪ Operation
Use of biofilters or other odour control (misting system, aeration, scrubber, chemical addition, cover), where indicated or if required	—	▪ Organics Processing ▪ PHC Impacted Soil Treatment ▪ Leachate Treatment Building ▪ Leachate holding pond and treated effluent ponds	▪ H_2S ▪ C_2H_3Cl ▪ Odour	▪ Operation ▪ Post-closure (leachate treatment only)
Capping of Landfill	Landfill will be capped	▪ Landfill	▪ H_2S ▪ C_2H_3Cl ▪ Odour	▪ Post-closure

5.0 ASSESSMENT OF GREENHOUSE GAS EFFECTS

In its comments on the TOR, the City of Ottawa requested an inventory of potential GHG emissions from the CRRRC to assist its efforts in creating an up to date City inventory.

Table 5-1 summarizes the predicted GHG emission rates in tonnes per year for each activity at the proposed CRRRC for the maximum operating scenario. The sample calculations for these values are provided in Appendix A. The C&D, MRF, organics processing facility, and the PHC impacted soil treatment building may be heated using recovered heat from the flare or electrical generation plant, therefore GHG emissions from these facilities are already included in the flare or electrical generation plant GHG emissions.

Table 5-2 presents the estimated GHG emissions by emission type.

Table 5-1: Summary of GHG Annual Emission Rates during Operation of the CRRRC

Facility	Contaminant (tonnes)		
	CO_2	CH_4	N_2O
Electrical Generation Plant and/or Flare	34,002	0.62	0.06
Construction and Demolition Facility	*GHG already accounted for in the stationary fuel combustion*		
Material Recovery Facility	*GHG already accounted for in the stationary fuel combustion*		
Organics Processing Facility	*GHG already accounted for in the stationary fuel combustion*		
Composting/Curing Pad Activities	18,480	200	15.0
PHC Impacted Soil Treatment Building	*GHG already accounted for in the stationary fuel combustion*		
Leachate Pre-Treatment Facility	*GHG already accounted for in the stationary fuel combustion*		
Landfill	2,983	1,082	—
Stationary Fuel Combustion(1)	1,627	0.08	0.24
Mobile Equipment	12,414	0.70	5.13
Tailpipe (Hauling Trucks)(2)	227	—	—

Notes:
(1) Stationary fuel combustion includes heating of the CRRRC buildings.
(2) Tailpipe emissions include the hauling and leachate trucks.
CO_2 = Carbon dioxide
CH_4 = Methane
N_2O = Nitrous oxide

Table 5-2: GHG Emission Estimates by Emission Type

Emission Type	GHG	Emissions [tonnes]	Emissions [tonnes CO_2e]
Stationary and Process Emissions	Carbon dioxide	57,092	57,092
	Methane	1,283	26,945
	Nitrous oxide	15	4,745
		Total	**88,782**
All Sources (including Mobile Combustion Emissions)	Carbon dioxide	69,733	69,733
	Methane	1,284	26,960
	Nitrous oxide	20	6,335
		Total	**103,028**

5.1 Comparative Life Cycle Assessment

A comparative life cycle assessment of the proposed CRRRC project was carried out. It compares the diversion from landfill of a portion of the incoming waste to landfilling all of the waste. The model used for the assessment was the Greenhouse Gases (GHG) Calculator created by Environment Canada (Government of Canada, 2013), and its supporting technical document prepared by ICF Consulting (ICF, 2005). The calculation uses as its reference point, or Functional Unit, 100,000 tonnes of waste received; the output, or Environmental Intervention, is CO2eq. The result is a comparison of net GHG emissions of the proposed CRRRC (using the target diversion ranges in Table 9.1-1 of Volume I) compared to simply landfilling all the waste.

For the present analysis, landfilling of all the IC&I waste received was compared to two levels of diversion: the low and high ends of the target range in Table 9.1-1 of Volume I. The diversion rates used for the following materials: newsprint, mixed paper, cardboard, aluminium, ferrous metals, glass, HDPE, PET and mixed plastics, were 11% (lower end) and 26% (higher end). The diversion rates used for organic waste, to be composted or digested, were 60% (lower end) and 80% (higher end). Excluded were most of the C&D waste and all of the soils (the model does not make provision for their inclusion, presumably because they have little GHG impact).

The estimates of the composition of IC&I and C&D waste were obtained from a report written by Genivar/Kelleher Environmental for the City of Ottawa in 2007 (City of Ottawa, 2007). The model was set up on the assumption that the landfill component of the CRRRC has a gas recovery rate of 75% and the recovered gas is flared. The system boundaries were chosen to include only on-Site activities; the impact of transportation, for example, was assumed to be the same for all diversion rates.

The results were as follows; at the lower diversion rates for all materials the aggregate GHG reduction (compared to landfill alone) was found to be 29,000 tonnes CO2eq. per 100,000 tonnes of waste received and, at the higher diversion rates, 66,000 tonnes CO2eq. per 100,000 tonnes of waste received. Based on the assumed receipt of a maximum of 450,000 tonnes of all waste/soils at the CRRRC in a given year, once operating at capacity, this equates to an annual GHG emission reduction of between 113,000 tonnes and 257,000 tonnes CO2eq, compared to straight landfilling of these same wastes. If the composition of the incoming waste differs from that shown in Table 9.1-1 of this EA, the reduction in GHG emissions could be higher or lower. Because of various assumptions built into the model, these figures are inherently conservative.

It is quite clear from the analysis that the diversion of IC&I waste as proposed in in relation to the CRRRC has a significant and positive impact on GHG reduction.

6.0 AIR QUALITY MONITORING AND FOLLOW-UP

The conceptual air quality monitoring activities for the CRRRC are described below. It is recognized that monitoring will likely be a condition of environmental approvals and/or permits, and the final details will be confirmed in the ECA(s) for the Project. The follow-up program provided in the following sub-sections contains sufficient detail to allow independent judgment to:

- Verify effects predictions, and compare actual with predicted effects;
- Confirm effectiveness of mitigation measures, and in doing so determine if alternate mitigation strategies are required;
- Provide information for use in adaptive management to address potential unforeseen effects; and
- Demonstrate compliance with regulatory requirements.

6.1 Monitoring

A preliminary follow-up plan is provided below. The follow-up program is designed to be appropriate to the scale of the CRRRC and the potential effects identified through the EA process.

6.1.1 Initial Scope of the Follow-up Program

Table 6-1 summarizes the conceptual follow-up monitoring programs for the air quality and odour components. The recommendations identify the general timeframe for follow-up and monitoring.

Table 6-1: Proposed Follow-up Monitoring for the Atmospheric Environment

Component	Project Phase	Program Objective	Suggested Frequency and Location of Monitoring
Air Quality (including odour)	Construction and Operations Phase	▪ Prepare a best management practice (BMP) plan for fugitive dust emissions (see Section 6.1.2 for more details). ▪ To verify that the SPM, PM_{10} and $PM_{2.5}$ emission rates used in the assessment were reasonable, but conservative. ▪ To verify the predicted concentrations of SPM, PM_{10} and $PM_{2.5}$. ▪ To verify that the mitigation measures considered integral to the CRRRC are being incorporated as planned, and are effective.	▪ One time only sampling of unpaved and paved road silt loadings to confirm emission estimates. ▪ Property line dust monitoring after operational start up during the summer season (June to September) for two summer seasons. The monitoring program will consist of: – A minimum of two monitoring stations (one located upwind, and one located downwind of the facility). – Sampling to occur as per the National Air Pollution Surveillance Program (NAPs) schedule. – Sampling to be performed following the guidance of the *Operations Manual for Air Quality Monitoring in Ontario* (Operations Manual) (March 2008) by the Ontario Ministry of the Environment (MOE) Operations Division Technical Support Section (PIBS 6687e) (MOE, 2008b). ▪ If off-property adverse dust impacts are recorded, the need for more intensive short-term and long-term monitoring will be assessed. ▪ See Section 6.1.2 for details on monitoring of fugitive dust sources.
		▪ Prepare a best management practice plan for odour, including a procedure for responding to and addressing odour complaints. ▪ To verify that the mitigation measures considered integral to the CRRRC are being incorporated as planned, and are effective.	▪ Ongoing throughout the life of the CRRRC.

6.1.2 Monitoring of Fugitive Dust Sources

Through the best management practice plan, preventive and mitigation measures will be implemented to reduce the potential for dust generation. In order to track the success of these measures, documentation of the following aspects of Site operation will be maintained:

- Application of aggregate to unpaved roads – a record will be kept of the date of each application of aggregate to unpaved roads.
- Road watering or application of dust suppressants – a weekly summary will be maintained of road watering or dust suppressant application. This will help, in the event of off-property impacts, to determine if increased road watering is a feasible mitigation measure.
- Site inspection – during periods of high dust susceptibility, regular inspections will be carried out to monitor compliance with posted speed limits, track out of dust onto public roadways, the efficacy of dust mitigation activities and any potential concerns with regards to fugitive dust.
- Truck traffic – a record will be kept of the number of trucks coming on-Site each day based on the daily waste receipt recording.
- Truck weights – a record will be kept of the weight of trucks coming on-Site each day and the weight upon leaving based on record keeping within the scale house.

7.0 SUMMARY AND CONCLUSIONS

This report evaluated the potential effects of the proposed CRRRC on air quality and odour. The conclusions of the assessment are highlighted below. Emissions estimates and dispersion modelling were carried out to predict concentrations from all emission sources of the indicator compounds. Anticipated measurable air emissions were identified and evaluated to determine effects. The residual effects were evaluated and it is concluded that they do not result in adverse effects to air quality or odour, as they are all below the relevant MOECC standard.

Follow-up monitoring is recommended in accordance with Section 6.0, and subject to the ECA for the CRRRC, to:

- Verify the predicted concentrations for air quality indicator compounds; and
- Verify that the mitigation measures considered integral to the CRRRC are being incorporated as planned, and are effective.

Specifically, periodic sampling for road silt loadings, as well as an annual fugitive dust monitoring program are proposed. In addition, a procedure for responding to and addressing odour complaints should be established.

An assessment to demonstrate that the CRRRC can achieve compliance with O. Reg. 419/05 (MOE, 2013) was also completed. Air modelling guidance for the province of Ontario was followed where appropriate. This assessment demonstrates that the CRRRC can operate in compliance with s. 20 of O. Reg. 419/05.

REFERENCES

Canadian Council of Ministers of the Environment (CCME). (2000). *Canada-Wide Standards for Particulate Matter (PM) and Ozone*. Canadian Council of Ministers of the Environment. Quebec City, Quebec. Environment Canada. 2010. *National Ambient Air Quality Objectives.*

City of Ottawa. (2007*). IC&I and C&D Management Options Report, IC&I 3Rs Strategy Project.*

Environment Canada. (2013). *Facility Greenhouse Gas Emissions Reporting Program.* Cat. No. En81-6/1-2011E-PDF.

Golder Associates Ltd. (2013). *Proposed Terms of Reference for Environmental Assessment of the Proposed Capital Region Resource Recovery Centre* (January 2013)

Government of Canada. (2013). *Greenhouse Gases (GHG) Calculator for Waste Management*.

Health Canada. (1998). *National Ambient Air Quality Objectives for Particulate Matter – Executive Summary.* Part 1: Science Assessment Document.

ICF. (2005). *Determination of the Impact of Waste Management Activities on Greenhouse Gas Emissions:2005 Update Final Report* . Contract No. K2216-04-0006, Ottawa, Environment Canada.

Ministry of the Environment (MOE). (1990). *Ontario Environmental Protection Act*, R.S.O. 1990, c. E.19. Ministry of the Environment. Toronto, ON.

Ministry of the Environment (MOE). (1998). *Ontario Regulation 524/98: Environmental Compliance Approval – Exemptions from Section 9 of the Act. Environmental Protection Ac*t.

Ministry of the Environment (MOE). (2008a). *Methodology for Modelling Assessments of Contaminants with 10-Minute Average Standards and Guidelines under O. Reg 419/05.* Technical Bulletin. Standards Development Branch.

Ministry of the Environment (MOE). (2008b). *Operations Manual for Air Quality Monitoring.* Operations Division Technical Support Section. PIBS#: 6687e.

Ministry of the Environment (MOE). (2009a). *Air Dispersion Modelling Guideline for Ontario: Version 2*.0. PIBS#: 5165e02.

Ministry of the Environment (MOE). (2009b). *Procedure for Preparing an Emission Summary and Dispersion Modelling Report, Version 3.0*. PIBS#: 3614e03.

Ministry of the Environment (MOE). (2009c). *Ontario Regulation 452/09: Greenhouse Gas Emissions Reporting. Environmental Protection Act*.

Ministry of the Environment (MOE). (2011). *Ontario Regional Meteorological Data – Eastern Region: Ottawa, Peterborough, Belleville (1996 – 2000).* Ministry of the Environment Regional Meteorological Datasets.

Ministry of the Environment (MOE). (2012a). *Summary of Standards and Guidelines to Support Ontario Regulation 419: Air Pollution — Local Air Quality*. PIBS#: 6569e01 April 2012.

Ministry of the Environment (MOE). (2012b). *Ontario's Ambient Air Quality Criteria*. PIBS#: 6570e01 April 2012.

Ministry of the Environment (MOE). (2012c). *Guideline for Greenhouse Gas Emissions Reporting.* PIBS#: 8024e.

Ministry of the Environment (MOE). (2013). *Ontario Regulation 419/05: Air Pollution – Local Air Quality. Environmental Protection Act*.

U.S. Environmental Protection Agency (US EPA). (2008). C*ompilation of Air Pollutant Emission Factors.* Volume 1: Stationary Point and Area Sources. Chapter 2.4: *Municipal Solid Waste Landfills*. Document AP-42. U.S. EPA, Office of Air Quality Planning and Standards. Research Triangle Park, North Carolina. U.S.

U.S. Environmental Protection Agency (US EPA). (2013). *Preferred/ Recommended Models*. Technology Transfer Network: Support Center for Regulatory Atmospheric Modeling.

APPENDIX A

Emission Estimates

December 2014

Technical Support Document #3

APPENDIX A – EMISSION ESTIMATES

TAGGART
GROUP OF COMPANIES

THE MILLER GROUP

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TABLES

ATTACHMENTS

ACRONYMS AND GLOSSARY OF TERMS

Acronym	Definition
C&D	Construction and Demolition
CO	Carbon monoxide
CRRRC	Capital Region Resource Recovery Centre
EA	Environmental Assessment
EPA	Environmental Protection Agency
ER	Emission rate
ESDM	Emissions Summary and Dispersion Modelling
FR	Flow Rate
GHG	Greenhouse Gas
HC	Hydrocarbon
IPCC	International Panel on Climate Change
LFG	Landfill gas
MOE	Ontario Ministry of the Environment
MOECC	Ontario Ministry of the Environment and Climate Change
MRF	Materials Recovery Facility
MSW	Municipal Solid Waste
NO	Nitrogen oxide
NO_2	Nitrogen dioxide
NO_X	Oxides of nitrogen
O. Reg.	Ontario Regulation
O_3	Ozone
PM_{10}	Particles nominally smaller than 10 µm in aerodynamic diameter
$PM_{2.5}$	Particles nominally smaller than 2.5 µm in aerodynamic diameter
POI	Point-of-Impingement
S	Sulphur
SO_2	Sulphur dioxide
SPM	Suspended particulate matter (also Total Suspended Particulate or TSP)
TSD	Technical Supporting Document
US EPA	United States Environmental Protection Agency
VKT	Vehicle kilometres travelled
VMT	Vehicle mile travelled

UNITS

Unit	Definition
acfm	Actual cubic feet per minute
g/s	Grams per second
g/m^3	Grams per cubic metres
kg/mg	Kilograms per milligrams
km	Kilometres
kPa	Kilopascals
m	Metres
m/s	Metres per second
m^3/s	Cubic metres per second
m^3/yr	Cubic metres per year
mg/m^3	Milligrams per cubic metre
mt/hr	Metric tonne per hour
OU	Odour Units
OU/m^3	Odour Units per cubic metre
OU/s	Odour Units per second
ppb	Parts per billion
ppm	Parts per million
$\mu g/m^3$	Micrograms per cubic metre
µm	Micrometres (also microns), one-millionth of a metre
VKT/hr	Vehicle kilometres travelled per hour

1.0 INTRODUCTION

This Appendix is part of the Air Quality and Odour Assessment Technical Supporting Document #3 (TSD) for the proposed Capital Region Resource Recovery Centre (CRRRC) at the Boundary Road Site to be located in Ottawa.

1.1 Purpose

This Appendix documents the methods, input parameters and assumptions that were used to estimate the air emission rates for activities at the proposed CRRRC.

The emission rates calculated were used as inputs for dispersion modelling that provided estimates of maximum ground-level indicator contaminant concentrations resulting from the CRRRC. The emission estimation methods described within this Appendix follow generally accepted practices for conducting EAs and, where appropriate, guidance in the Ontario Ministry of the Environment and Climate Change (MOECC) document *"Procedure for Preparing an Emission Summary and Dispersion Modelling Report"* Version 3.0 (March 2009) (ESDM Procedure Document).

2.0 ASSESSMENT OF COMPOUNDS AND ACTIVITIES

Emissions were assessed for activities described in the approved *Terms of Reference for Environmental Assessment of the Proposed CRRRC* (Golder, 2013), based on process descriptions and equipment/vehicle specifications provided by the Taggart Miller design team. Scientifically accepted and well documented emission factors, most notably AP 42 (U.S. EPA 1995) were also used.

Compounds that will be discharged from the CRRRC in negligible amounts and/or activities that discharge a compound in a negligible amount were excluded from further analysis. The rationale for these exclusions is provided in Section 2.1. Table A 2-1 provides a summary of the activities for which emissions were calculated in the air quality assessment, as well as a summary of the compounds expected to be released.

Table A 2-1: Activities and Indicator Compounds Released/Expected to be Released at the Proposed CRRRC

Facility	Activity	Contaminant								
		SPM	PM_{10}	$PM_{2.5}$	NO_x/NO_2	SO_2	CO	H_2S	C_2H_3Cl	Odour
Flare and/or Electrical Generation Plant	Enclosed LFG and biogas flare and/or engines	X	X	X	X	X	X	X	X	
Construction and Demolition Facility	Dust collector	X	X	X						
Materials Recovery Facility	Dust collector	X	X	X						
Organics Processing Facility	Biofilter									X
	Organics processing operations (material handling)	X	X	X						
	Organics processing operations (tailpipe emissions)	X	X	X	X	X	X			
Composting	Composting, curing, and post processing (material handling)	X	X	X						X
	Composting, curing, and post processing (tailpipe emissions)	X	X	X	X	X	X			
PHC Impacted Soil Treatment Area	Biofilter									X
	PHC soil treatment operations (material handling)	X	X	X	X	X	X			
	PHC soil treatment operations (tailpipe emissions)									
Landfill	Landfill cap							X	X	X
	Landfill operations (material handling)	X	X	X						X
	Landfill operations (tailpipe emissions)	X	X	X	X	X	X			
Leachate Pre-Treatment	Leachate pre-treatment									X
	Leachate holding ponds									X
Paved Roads	Fugitive road dust	X	X	X						
	Vehicle exhaust	X	X	X	X	X	X			
Unpaved Roads	Fugitive road dust	X	X	X						
	Vehicle exhaust	X	X	X	X	X	X			
Emergency Generator [1]	Diesel emergency power generator	X	X	X	X	X	X			
Support Activities	Operational support activities, such as maintenance activities (including welding, compressor, diesel fire pump, lights)	These activities are considered to be negligible in comparison to the other activities occurring on Site.								
	Stationary fuel combustion	—[2]	—[2]	—[2]	X	—[2]	—[2]	—	—	—

Notes:
[1] The emergency power generator was evaluated separately as it used to provide electricity during a power outage when other equipment is not in operation.
[2] Compounds from this activity were considered to be negligible in comparison to the other activities occurring on-Site.
SPM = Suspended particulate matter
PM_{10} = Particles nominally smaller than 10 µm in diameter
$PM_{2.5}$ = Particles nominally smaller than 2.5 µm in diameter
SO_2 = Sulphur dioxide
CO = Carbon monoxide
H_2S = Hydrogen sulphide
C_2H_3Cl = Vinyl chloride

2.1 Activities Not Included in Assessment

There are many activities associated with the facilities that produce emissions; however, not all activities produce emissions for any or all compounds that are relevant to the overall emissions assessment. All activities that potentially produce emissions were evaluated to determine their relevance, however only activities that were considered to be relevant were included in the assessment.

The following rationale describes why certain activities and/or emissions of certain compounds can be excluded from the assessment, as per the MOECC document *"Procedure for Preparing an Emission Summary and Dispersion Modelling Report"* Version 3.0 (March, 2009) (ESDM Procedure Document):

- The emission rates of certain compounds are very small relative to the overall emissions at the proposed CRRRC;
- The emissions of certain sources are known to not be relevant due to the type of operations in the assessment; and
- The location of the source relative to the rest of the sources on-Site (i.e., the source is located far away from any potential receptors).

Table A 2-2 lists the activities that were not assessed and the accompanying rationale.

Table A 2-2: Emissions Not Included in the Assessment

Activity/Compound	Rationale for Excluding from the Assessment
Emergency power equipment	The emergency power equipment only operates periodically for testing (rather than continuously) and therefore produces emissions that are negligible relative to the overall emissions from the Project. Additionally, the emergency power generator will only be used to supply electricity during power outage when other equipment is not operation and therefore is not included in the representative scenario.
Operational support activities, such as maintenance activities	Emissions from these sources are small and do not occur at all times compared to the process sources that are occurring regularly or continuously.

3.0 ASSUMPTIONS

Attachment 1 documents the assumptions made as part of the estimation of emission rates.

4.0 CALCULATIONS

The following sample calculations for selected sources demonstrate how the emission estimates were developed. The results are all in units of grams per seconds (g/s), which are required for the dispersion models. The dispersion model assumes the emission rate is constant over an hourly period, which is the smallest time-step within the models used for predictions.

4.1 Indicator Compounds – Emission Calculations

4.1.1 Non-Road Vehicles – Exhaust Emissions

Crank case emission factors and load factors for non-road Engine Modelling (Compression Ignition) – U.S. EPA 009d (July, 2010) were used to calculate the exhaust (tailpipe) emissions from on-Site vehicles. It was assumed that all on-Site vehicles comply with Tier 3 emission standards.

The following predictive emissions equation was used to determine the combustion emission rates for on-Site vehicles:

$$\mathrm{ER} = \mathrm{EF} \times \text{engine horsepower rating} \times \text{load factor} \times \frac{1\ \mathrm{hr}}{3{,}600\ \mathrm{s}}$$

Where:
ER = emission rate (g/s), and
EF = emission factor (g/hp-hr).

The following is a sample calculation for the NO_x emissions for the Caterpillar 430 backhoe to be located at the landfill:

$$\mathrm{ER} = \frac{2.62\ \mathrm{g}}{\mathrm{hp} - \mathrm{hr}} \times 500\ \mathrm{hp} \times 0.21 \times \frac{1\ \mathrm{hr}}{3{,}600\ \mathrm{s}}$$

$$\mathrm{ER} = 0.0764\ \mathrm{g/s}$$

The emission rates for non-road vehicles were calculated for each of the areas of the Site where non-road vehicles are anticipated to be present (the landfill, composting pad area, petroleum hydrocarbon impacted soil treatment area, and the organics treatment area) by summing the emission rates from each of the vehicles at the respective areas. The emissions rates for suspended particulate matter (SPM), PM_{10} and $PM_{2.5}$, SO_2, and CO were calculated using the same equation. These emissions were calculated based on 20 pieces of diesel powered mobile equipment (such as loaders, excavators, graders, etc.) operating at the same time, all located at the landfill, the composting area, the PHC impacted soil treatment area, and/or the organics processing facility. The emissions for the emergency power generator were calculated using the same approach.

4.1.2 On-Road Vehicles – Exhaust Emissions

Emission factors for the on-Site vehicle exhaust for on-road vehicles were obtained using the U.S. EPA MOBILE6 emission model.

The emission factors developed for the fleet trucks are provided in Table A 4-1.

Table A 4-1: Emission Factors for Fleet Trucks Calculated Using MOBILE6

Compound	Emission Factor (g/VKT)[1]
SPM	1.02E-01
PM_{10}	1.02E-01
$PM_{2.5}$	8.49E-02
NO_X	2.43E+00
SO_2	6.80E-03
CO	5.60E-01

Notes:
(1) VKT =vehicle kilometres travelled

The following equation was used to determine the vehicle kilometres travelled per hour (VKT/hr):

$$\frac{VKT}{hr} = \frac{\#\,of\,Trucks}{Hour}\ X\ Road\ Length\ Travelled\ (km)$$

The following is a sample calculation for VKT/hr on one segment (P1) of the paved roads:

$$\frac{VKT}{hr} = \frac{45\,Trucks}{Hour}\ X\ \ 0.7\ km$$

VKT/hr = 31.6

Each of the road segments P1 to P11 was calculated using the equation above. The road segments are presented in Appendix B, Figure B.6 – Road Segment Plan. The value of 46.7 VKT/hr represents total vehicle kilometres travelled per hour on all paved road segments. This value is used in the sample calculation for NO_x below.

The following predictive emissions equation was used to determine the tailpipe emission rates for on-Site vehicles travelling on paved roads:

$$\mathrm{ER} = \mathrm{EF}\ \times \text{vehicle kilometres travelled per hour}\ \ \times \frac{1\ \mathrm{hr}}{3{,}600\ \mathrm{s}}$$

Where:
ER = emission rate (g/s),
EF = emission factor (g/VKT), and
VKT = 46.7 VKT (calculated VKT for all paved road segments.)

The following is a sample calculation for NO_x emissions for on-Site vehicles tailpipe emissions on paved road segments.

$$E\mathrm{R} = \frac{2.43\ \mathrm{g}}{\mathrm{VKT}} \times \frac{46.7\ \mathrm{VKT}}{\mathrm{hr}} \times \frac{1\ \mathrm{hr}}{3{,}600\ \mathrm{s}}$$

$$\mathrm{ER} = 0.0315\ \mathrm{g/s}$$

Additionally, SPM, PM_{10} and $PM_{2.5}$, SO_2, and CO were calculated using the same equation. The emission rates for unpaved road segments were calculated using the same emissions factor and the same approach to determine the vehicle kilometres travelled as shown in Section 4.1.3 and 4.1.4.

4.1.3 Vehicles – Unpaved Road Dust

The predictive equation in U.S. EPA AP-42 Chapter 13.2.2 – Unpaved Roads (November 2006) was used to calculate the fugitive dust emissions from paved roadways. The equation accounts for the application of dust suppressant control efficiency. The equation is as follows:

$$\mathrm{EF} = \left(\mathrm{k}\left(\frac{\mathrm{s}}{12}\right)^{\mathrm{a}} \times \left(\frac{\mathrm{W}}{3}\right)^{\mathrm{b}} \times 281.9\right)(1 - \text{control efficiency})$$

Where:
EF = particulate emission factor (g/VKT),
k = empirical constant for particle size range (pounds (lbs) per vehicle mile travelled (VMT)) (see Table A 4-2),
s = road surface silt content (%) assumed to be 6.4% (as per US EPA AP-42 Section 13.2.2 for MSW landfills),
W = average weight (tons) of the vehicles traveling the road,
a = empirical constant for particle size range (dimensionless) (see Table A 4-2),
b = empirical constant for particle size range (dimensionless) (see Table A 4-2),
281.9 = conversion from pounds per vehicle miles travelled to grams per vehicle kilometres travelled, and
control efficiency = reduction of fugitive dust emissions due to dust suppressant use.

Table A 4-2: Particle Size Assumptions for Unpaved Road Dust

Size Range	k (lb/VMT)	a	b
$PM_{2.5}$	0.15	0.9	0.45
PM_{10}	1.5	0.9	0.45
SPM	4.9	0.7	0.45

The following is a sample calculation for SPM for the emission factor for vehicles that will travel along the north side of the landfill. It was estimated that the fleet vehicles will have an average weight of 15.43 tons. A control efficiency of 85% was selected to represent the use of dust suppressants.

$$\mathrm{EF} = \left(4.9\left(\frac{6.4}{12}\right)^{0.7} \times \left(\frac{15.43}{3}\right)^{0.45} \times 281.9\right)(1 - 85\%)$$

$$\mathrm{EF} = 278.8\ \mathrm{g/VKT}$$

The following is a sample calculation for the SPM emission rate for vehicles travelling along the same unpaved road segment:

$$\mathrm{ER} = \frac{278.8\ \mathrm{g}}{\mathrm{VKT}} \times \frac{3.72\ \mathrm{VKT}}{\mathrm{hr}} \times \frac{1\ \mathrm{hr}}{3600\ \mathrm{s}}$$

$$\mathrm{ER} = 0.288\ \mathrm{g/s}$$

The emission rates of PM_{10} and $PM_{2.5}$ were calculated as presented above.