EMISSION SUMMARY AND DISPERSION MODELLING REPORT

RICHMOND SANITARY LANDFILL SITE
Napanee, Ontario

Prepared for

WASTE MANAGEMENT OF CANADA CORPORATION
1271 Beechwood Road
Greater Napanee, Ontario
K7R 3L1

Prepared by

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Project No. 9-442 September 19, 2011

Ministry of the Environment | Ministère de l'Environnement

Ontario

EMISSION SUMMARY AND DISPERSION MODELLING REPORT CHECKLIST

Company Name: Waste Management of Canada Corporation

Company Address: 1271 Beechwood Road, RR#6
Greater Napanee, Ontario, K7R 3L1

Location of Facility: 1271 Beechwood Road, RR#6
Greater Napanee, Ontario, K7R 3L1

The attached Emission Summary and Dispersion Modeling Report was prepared in accordance with s.26 of O. Reg. 419/05 and the guidance in the MOE document "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated March 2009 and "Air Dispersion Modelling Guideline for Ontario" dated March 2009 and the minimum required information identified in the check-list on the reverse of this sheet has been submitted.

Company Contact:

Name: Reid Cleland

Title: Director of Disposal Operations

Phone Number: 519-849-5810

Signature:

Date: Aug 5, ~~2010~~ 2011

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Representing: Comcor Environmental Limited

Phone Number: 519-621-6669 ext. 246

Signature:

Date: Sept 16, 2011

 * This checklist is taken from the document titled "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated March 2009

EMISSION SUMMARY AND DISPERSION MODELLING REPORT CHECKLIST

	Required Information			
			Submitted	Explanation/Reference
	Executive Summary and Emission Summary Table			
	1.1	Overview of ESDM Report	☒ Yes	Executive Summary
	1.2	Emission Summary Table	☒ Yes	ESDM Table 4
1.0	**Introduction and Facility Description**			
	1.1	Purpose and Scope of ESDM Report (when report only represents a portion of facility)	☒ Yes	ESDM Section 1.2
	1.2	Description of Processes and NAICS code(s)	☒ Yes	ESDM Sections 1.3 & 1.4
	1.3	Description of Products and Raw Materials	☒ Yes	ESDM Section 1.3
	1.4	Process Flow Diagram	☒ Yes	ESDM Figure 4
	1.5	Operating Schedule	☒ Yes	ESDM Section 1.4
2.0	**Initial Identification of Sources and Contaminants**			
	2.1	Sources and Contaminants Identification Table	☒ Yes	ESDM Table 1
3.0	**Assessment of the Significance of Contaminants and Sources**			
	3.1	Identification of Negligible Contaminants and Sources	☒ Yes	ESDM Section 7.0
	3.2	Rationale for Assessment	☒ Yes	ESDM Section 7.0
4.0	**Operating Conditions, Emission Rate Estimating and Data Quality**			
	4.1	Description of operating conditions, for each significant contaminant that results in the maximum POI concentration for that contaminant	☒ Yes	ESDM Section 4.0
	4.2	Explanation of Method used to calculate the emission rate for each contaminant	☒ Yes	ESDM Section 4.0
	4.3	Sample calculation for each method	☒ Yes	ESDM Appendix E
	4.4	Assessment of Data Quality for each emission rate	☒ Yes	ESDM Section 4.0
5.0	**Source Summary Table and Property Plan**			
	5.1	Source Summary Table	☒ Yes	ESDM Table 2
	5.2	Site Plan (scalable)	☒ Yes	ESDM Figure 5
6.0	**Dispersion Modelling**			
	6.1	Dispersion Modelling Input Summary Table	☒ Yes	ESDM Table 3
	6.2	Land Use Zoning Designation Plan	☒ Yes	ESDM Appendix G
	6.3	Dispersion Modelling Input and Output Files	☒ Yes	ESDM Appendix H
7.0	**Emission Summary Table and Conclusions**			
	7.1	Emission Summary Table	☒ Yes	ESDM Table 4
	7.2	Assessment of Contaminants with no MOE POI Limits	☒ Yes	ESDM Section 7.1
	7.3	Conclusions	☒ Yes	ESDM Section 8.0
	Appendices (Provide supporting information or details such as…)			
	Proof of Legal Name		☒ Yes	Appendix A
	Current CofA (Air & Noise) for the Landfill Site		☒ Yes	Appendix B
	MOE Forms		☒ Yes	Appendix C
	Equipment Specifications		☒ Yes	Appendix D
	Emission factors and data quality references		☒ Yes	Appendix F
	Acoustic Assessment and Related Noise Forms		☐ Yes	Submitted with ESDM

 * This checklist is taken from the document titled "Procedure for Preparing an Emission Summary and Dispersion Modelling Report" dated March 2009

EXECUTIVE SUMMARY

Comcor Environmental Limited (Comcor) was retained by Waste Management of Canada Corporation (WMCC) to prepare this Emission Summary and Dispersion Modelling (ESDM) Report for the operation of a back-up, utility flare at the Richmond Sanitary Landfill Site (Site) in Greater Napanee, Ontario. This application is being submitted to achieve compliance of the Site's operations with the requirements of Section 9 of the Environmental Protection Act, R.S.O. 1990 as amended.

This ESDM Report has been prepared in support of an application for an amendment to Certificate of Approval (CofA) (Air & Noise) No. 8-4078-99-006 and presents the results of dispersion modelling conducted and calculates contaminant concentrations which are compared to the corresponding contaminant Point of Impingement (POI) limits.

As part of a Landfill Gas Collection System Contingency Plan developed in June 2010, WMCC proposes to install a second, backup, utility flare at the Site. The flare will be of the open, candlestick type and will only operate when the existing enclosed flaring system is shut down for repairs or maintenance.

The candlestick flare (CF) has been identified as a significant source and has been included in the dispersion modelling. Since the enclosed and candlestick flares will not operate simultaneously, the maximum emission scenario used in the dispersion model involves only the candlestick flare operating at its maximum designed flow rate.

The Site is located on land that is zoned as Waste Management Industrial. Land use surrounding the Site includes Rural, Agricultural, Community Facility, and Environmental Protection. The closest Point of Reception is a permanent residence located approximately 315 metres south of the flare, and a place of worship is located approximately 500 metres west of the flare. A detailed Acoustic Assessment, prepared by RWDI Air Inc., is included with this report and shows that the candlestick flare and associated equipment are below the MOE NPC-232 sound level limits.

The MOE approved Screen3 dispersion model was used to predict the point of impingement concentrations that were used in this assessment. In accordance with Section 20 of Ontario Regulation 419/05, a "speed-up" request to have Schedule 3 standards apply in advance of the date required by the Regulation was completed in conjunction with this application.

The Emission Summary Table, provided below and attached in the report as Table 4, summarizes the emission rates and the maximum calculated POI concentrations for each of the landfill gas constituents and combustion products. The POI concentrations were compared to Schedule 3 standards when available. The Percentage of Criteria Column in the Emission Summary Table shows that the maximum point of impingement concentration for all compounds modelled are below the POI Standards for all parameters considered.

The candlestick flare has been modelled in accordance with Ontario Regulation 419/05 and it has been determined that the maximum point of impingement concentration for all compounds modelled are below the POI Standards for all parameters considered.

Table 4
Emission Summary Table
Richmond Sanitary Landfill Site
Greater Napanee, Ontario

						Candlestick Flare			Contaminant Significance			
Contaminant	**Contaminant Code (CAS No.)**	**MOE POI Criteria (ug/m^3)**	**Limiting Effect**	**Regulation Schedule #/ Guideline**	**Averaging Period (hr)**	**Facility Emission Rate (g/s)**	**POI[1] Concentration (ug/m^3)**	**Percentage of Criteria**	**Dispersion[2] Factor ($\mu g/m^3$)/(g/s)**	**Emission[3] Threshold (g/s)**	**Concentration Threshold ($\mu g/m^3$)**	**Significant[4] (Y/N)**
Landfill Gas Constituents												
1,1,1-Trichloroethane	71-55-6	115000	Health	3	24	1.85E-05	1.39E-04	0.0%	879	6.54E+01		N
1,1,2,2-Tetrachloroethane[5]	79-34-5	NA			0.5	5.39E-05	1.19E-03	NA	NA	NA	3.00E-01	N
1,1-Dichloroethane (ethylidene dichloride)	75-34-3	165	Health	3	24	6.73E-05	5.04E-04	0.0%	879	9.39E-02		N
1,1-Dichloroethene (vinylidene dichloride)	75-35-4	10	Health	3	24	5.61E-06	4.20E-05	0.0%	879	5.69E-03		N
1,2-Dichloroethane (ethylene dichloride)	106-93-4	3	Health	AAQC	24	1.17E-05	8.80E-05	0.0%	879	1.71E-03		N
1,2-Dichloropropane (propylene dichloride)	78-87-5	2400	Odour	2	0.5	5.88E-06	1.30E-04	0.0%	2598	4.62E-01		N
2-Propanol	67-63-0	7300	Health	3	24	3.49E-04	2.61E-03	0.0%	879	4.15E+00		N
Acetone	67-64-1	11880	Odour	3	24	4.71E-05	3.53E-04	0.0%	879	6.76E+00		N
Acrylonitrile	107-13-1	0.6	Health	3	24	3.89E-05	2.91E-04	0.0%	879	3.41E-04		N
Bromodichloromethane[6]	75-27-4	NA			0.5	1.48E-04	3.29E-03	NA	NA	NA	3.00E-02	N
Butane	106-97-8	7600		JSL	24	3.38E-05	2.53E-04	0.0%	879	4.32E+00		N
Carbon disulfide	75-15-0	330	Odour	2	0.5	5.11E-06	1.13E-04	0.0%	2598	6.35E-02		N
Carbon Tetrachloride	56-23-5	2.4	Health	3	24	1.78E-07	1.33E-06	0.0%	879	1.37E-03		N
Carbonyl Sulfide	463-58-1	3.2		JSL	24	3.41E-06	2.55E-05	0.0%	879	1.82E-03		N
Chlorobenzene	108-90-7	3500	Health	AAQC	1	8.14E-06	1.49E-04	0.0%	2140	8.18E-01		N
Chlorodifluoromethane	75-45-6	350000	Health	AAQC	24	3.25E-05	2.44E-04	0.0%	879	1.99E+02		N
Chloroethane (ethyl chloride)	75-00-3	5600	Health	3	24	2.33E-05	1.75E-04	0.0%	879	3.19E+00		N
Chloroform	67-66-3	1	Health	3	24	1.04E-06	7.76E-06	0.0%	879	5.69E-04		N
Chloromethane	74-87-3	320	Health	3	24	1.77E-05	1.32E-04	0.0%	879	1.82E-01		N
Dichlorobenzene	95-50-1	30500	Health	AAQC	1	8.93E-06	1.63E-04	0.0%	2140	7.13E+00		N
Dichlorodifluoromethane	75-71-8	500000	Health	AAQC	24	5.49E-04	4.11E-03	0.0%	879	2.84E+02		N
Dichlorofluoromethane[5]	75-43-4	NA			0.5	7.80E-05	1.73E-03	NA	NA	NA	3.00E-01	N
Dichloromethane (methylene chloride)	75-09-2	220	Health	3	24	3.51E-04	2.63E-03	0.0%	879	1.25E-01		N
Dimethyl sulfide	75-18-3	30	Odour	2	0.5	5.62E-05	1.25E-03	0.0%	2598	5.77E-03		N
Ethane	74-84-0	4800		JSL	24	3.09E-03	2.32E-02	0.0%	879	2.73E+00		N
Ethanol	64-17-5	19000	Odour	AAQC	1	1.45E-04	2.65E-03	0.0%	2140	4.44E+00		N
Ethyl Mercaptan (ethanethiol)[5]	75-08-1	NA			0.5	1.64E-05	3.63E-04	NA	NA	NA	3.00E-01	N
Ethylbenzene	100-41-4	1000	Health	3	24	5.66E-05	4.24E-04	0.0%	879	5.69E-01		N
Ethylene dibromide	106-93-4	3	Health	AAQC	24	5.44E-08	4.07E-07	0.0%	879	1.71E-03		N
Fluorotrichloromethane	75-69-4	6000	Health	AAQC	24	3.02E-05	2.26E-04	0.0%	879	3.41E+00		N
Hexane	110-54-3	2500	Health	3	24	6.55E-05	4.91E-04	0.0%	879	1.42E+00		N
Hydrogen sulfide	7783-06-4	7	Health	3	24	5.25E-05	3.93E-04	0.0%	879	3.98E-03		N
Mercury	7439-97-6	2	Health	3	24	8.47E-07	6.35E-06	0.0%	879	1.14E-03		N
Methyl ethyl ketone	78-93-3	1000	Health	3	24	5.92E-05	4.43E-04	0.0%	879	5.69E-01		N
Methyl isobutyl ketone	108-10-1	1200	Odour	2	0.5	2.17E-05	4.80E-04	0.0%	2598	2.31E-01		N
Methyl mercaptan	74-93-1	20	Odour	2	0.5	1.39E-05	3.07E-04	0.0%	2598	3.85E-03		N
Pentane	109-66-0	4200		JSL	24	2.75E-05	2.06E-04	0.0%	879	2.39E+00		N
Perchloroethylene (tetrachloroethylene)	127-18-4	360	Health	3	24	1.79E-04	1.34E-03	0.0%	879	2.05E-01		N
Propane	74-98-6	7200		JSL	24	5.66E-05	4.24E-04	0.0%	879	4.10E+00		N
t-1,2-dichloroethene	156-60-5	105	Health	AAQC	24	7.97E-05	5.97E-04	0.0%	879	5.97E-02		N
Trichlororethylene	79-01-6	12	Health	3	24	1.07E-04	8.03E-04	0.0%	879	6.83E-03		N
Vinyl chloride	75-01-4	1	Health	3	24	1.33E-04	9.94E-04	0.1%	879	5.69E-04		N
Xylenes	1330-20-7	730	Health	3	24	1.49E-04	1.11E-03	0.0%	879	4.15E-01		N
Benzene	71-43-2	NA	CARC	AAQC	0.5	1.00E-04	2.22E-03	NA	NA	NA		Y
Toluene	108-88-3	2000	Odour	2	0.5	1.76E-03	3.90E-02	0.0%	2598	3.85E-01		N
Combustion By-products												
Carbon Monoxide	630-08-0	6000	Health	3	0.5	1.33E+00	2.94E+01	0.5%	2598	1.15E+00		Y
Nitrogen Dioxide	10102-44-0	200	Health	3	24	7.08E-01	5.30E+00	2.7%	879	1.14E-01		Y
Particulate Matter	N/A	120	Visibility	3	24	1.36E-01	1.02E+00	0.9%	879	6.83E-02		Y
Dioxin/Furan	N/A	5E-06	Health	AAQC	24	1.19E-09	8.88E-09	0.2%	879	2.84E-09		N
Sulphur Dioxide	7446-09-5	275	Hlth & Veg	3	24	4.36E-02	3.26E-01	0.1%	879	1.56E-01		N
Hydrogen Chloride	7647-01-0	20	Health	3	24	2.17E-02	1.63E-01	0.8%	879	1.14E-02		Y

Notes:

[1] POI concentration obtained by multiplying the facility emission rate by the unit concentration factor of 18.24 (ug/m^3)/(g/s) obtained from Screen3, and converting to the appropriate averaging time if applicable.

[2] Linear interpolation was used to calculate the rural dispersion factor at a distance of 270 metres from the source and converted to the appropriate averaging time, as per Table B-1 of the MOE's *Procedure for Preparing an ESDM Report*.

[3] Emission threshold calculated as (0.5 x MOE POI Criteria)/(Dispersion Factor), as per Section 7.1.2 of the MOE's *Procedure for Preparing and ESDM Report*.

[4] If the actual emission rate is less than the emission threshold, or if the actual concentration is less than the concentration threshold, the contaminant was considered insignificant.

[5] Contaminants not on List of MOE POI Limits and not on Table B-2B of the MOE's *Procedure for Preparing an ESDM Report* were compared to a 1/2-hr average threshold concentration of 0.3 ug/m^3.

[6] Contaminants not on List of MOE POI Limits and on Table B-2B of the MOE's *Procedure for Preparing an ESDM Report* were compared to a 1/2-hr average threshold concentration of 0.03 ug/m^3.

EMISSION SUMMARY AND DISPERSION MODELLING REPORT
RICHMOND SANITARY LANDFILL SITE

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Appendix A	Proof of Legal Name
Appendix B	Certificate of Approval (Air) No. 8-4078-99-006
Appendix C	Application for Approval (Air & Noise) Application Fees Schedule Supporting Information Worksheet Speed-up Request under O.Reg. 419/05, s.20(4)
Appendix D	Candlestick Flare Skid Specifications
Appendix E	Supporting Calculations
Appendix F	USEPA AP-42 Compilation of Emission Factors Section 2.4 – Municipal Solid Waste Landfills, November 1998
Appendix G	Zoning Maps
Appendix H	Dispersion Modelling Input and Output

1.0 INTRODUCTION AND FACILITY DESCRIPTION

This Emission Summary and Dispersion Modelling (ESDM) Report has been prepared in accordance with the Ministry of the Environment (MOE) document, *"Procedure for Preparing an Emissions Summary and Dispersion Modelling Report Version 3.0"*, dated March 2009.

In this section, an overview of the Site's operations and relevant data to support the definition of operating conditions that form the basis of air emission estimates and predictions of maximum Point of Impingement (POI) concentrations is presented.

1.1 Project Introduction

Comcor Environmental Limited (Comcor) was retained by Waste Management of Canada Corporation (WMCC) to prepare this ESDM Report for the operation of a candlestick flare at the Richmond Sanitary Landfill Site (Site) in Greater Napanee, Ontario. A copy of WMCC's Proof of Legal Name is provided in Appendix A.

The Site is located at 1271 Beechwood Road in Greater Napanee as shown in Figure 1. The legal description of the Site is part of Lots 1, 2 and 3, Concession IV. A site plan showing the current conditions at the landfill is provided as Figure 2. A copy of the landfill's Certificate of Approval (CofA) (Air & Noise) is provided in Appendix B. The CofA allows for the operation of a landfill gas control facility (Facility) consisting of one (1) enclosed flare.

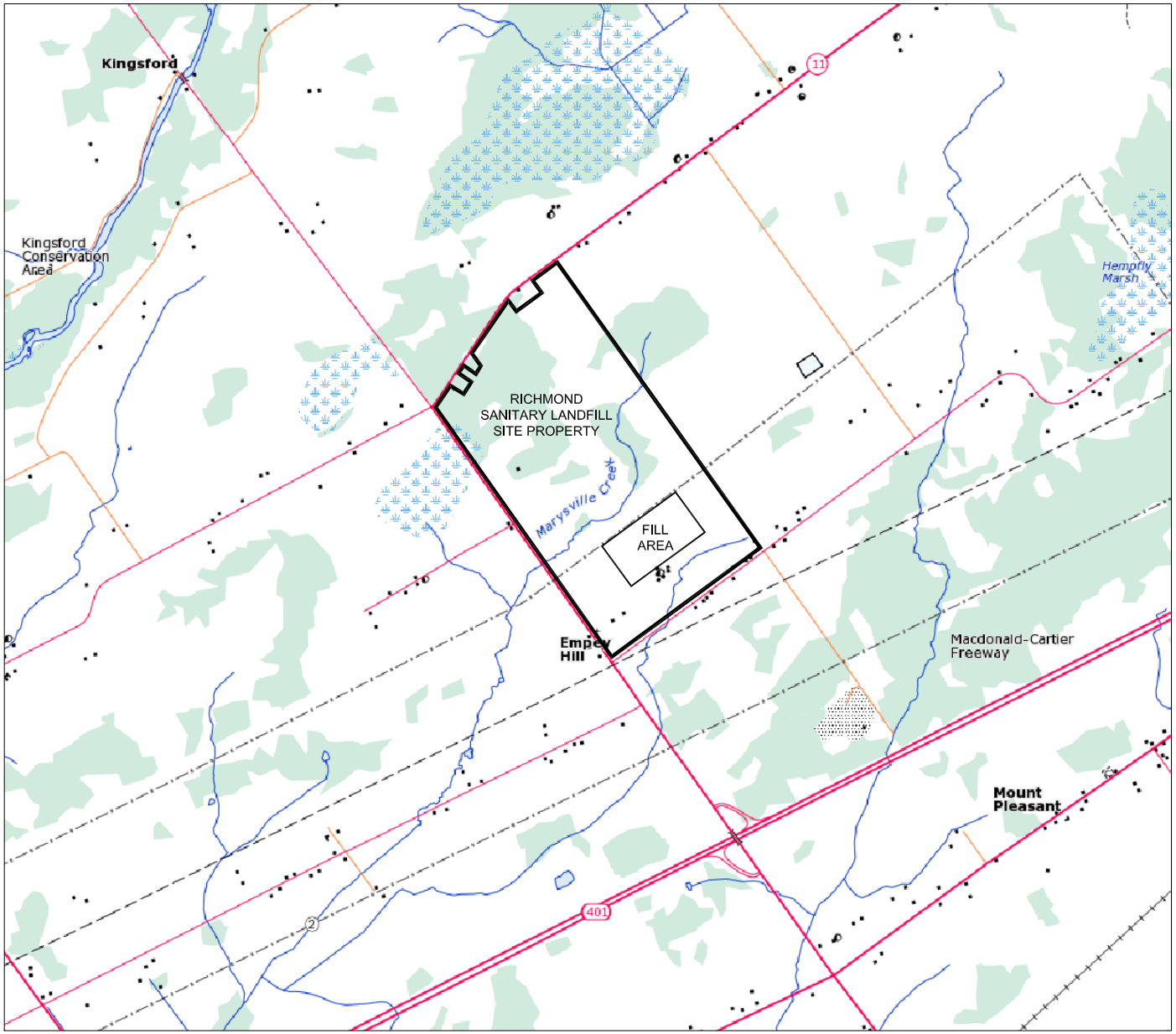
1.2 Purpose and Scope of ESDM Report

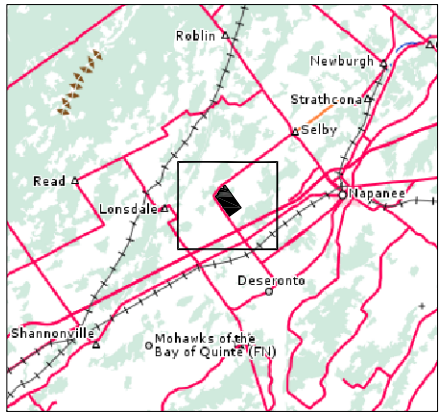
In June 2010, WMCC developed a Landfill Gas Collection System Contingency Plan for the Site. The Plan proposes to install a second, backup, utility flare at the Facility. The backup flare will be of the open, candlestick type and will only operate when the existing enclosed flaring system is shut down for repairs or maintenance.

This ESDM Report has been prepared in support of an application for an amendment to the Site's current CofA to allow for the operation of the candlestick flare. Appendix C contains a copy of the following application related documentation:

- Application for Certificate of Approval (Air & Noise)
- Application Fees Schedule
- Supporting Information Worksheet
- Speed-up Request under O.Reg. 419/05, s. 20 (4)

Ontario Regulation 419/05 is the primary regulatory tool for creating standards for contaminants that are protective of local air quality and which emitters in Ontario must meet. This regulation sets emission limits at a certain distance from the property, referred to as the Point of Impingement (POI).





KEY PLAN
N.T.S.

Scale: 1:40,000
0 500 1000 2000 metres

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RICHMOND SANITARY LANDFILL
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Figure 1
SITE LOCATION PLAN

Scale: 1:3,000

0 50 100 150 metres

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RICHMOND SANITARY LANDFILL
GREATER NAPEAN, ONTARIO

Figure 2

SITE PLAN

This ESDM Report presents the results of dispersion modelling conducted and calculates ground level contaminant concentrations which are compared to the corresponding contaminant POI limits. The POI limits are taken from the MOE document titled *Summary of Standards and Guidelines to Support Ontario Regulation 419: Air Pollution – Local Air Quality, February 2008*.

1.3 Process Description

The candlestick flare will be placed adjacent to the existing enclosed flare as shown in Figure 3. The flare will be factory installed on a 2.4 metre by 6.1 metre structural steel skid complete with the following accessories:

- 30 HP multistage centrifugal blower
- Varec flame trap assembly
- Propane pilot assembly with automatic igniter system
- Thermocouple, UV flame scanner, and flow meter
- Condensate knock out pot
- Variable frequency drive and control panel

A process flow diagram for the candlestick flare is shown in Figure 4. Complete specifications for the candlestick flare system are provided in Appendix D.

The candlestick flare will be designed to handle a maximum landfill gas flow rate of 0.354 m^3/s (750 cfm), at a minimum exhaust temperature of 760 °C (1,400 °F). The flare will have a stack height of 6.7 m (22 ft), and an exhaust tip diameter of 0.15 m (6 in).

1.4 Operating Schedule/NAICS Codes

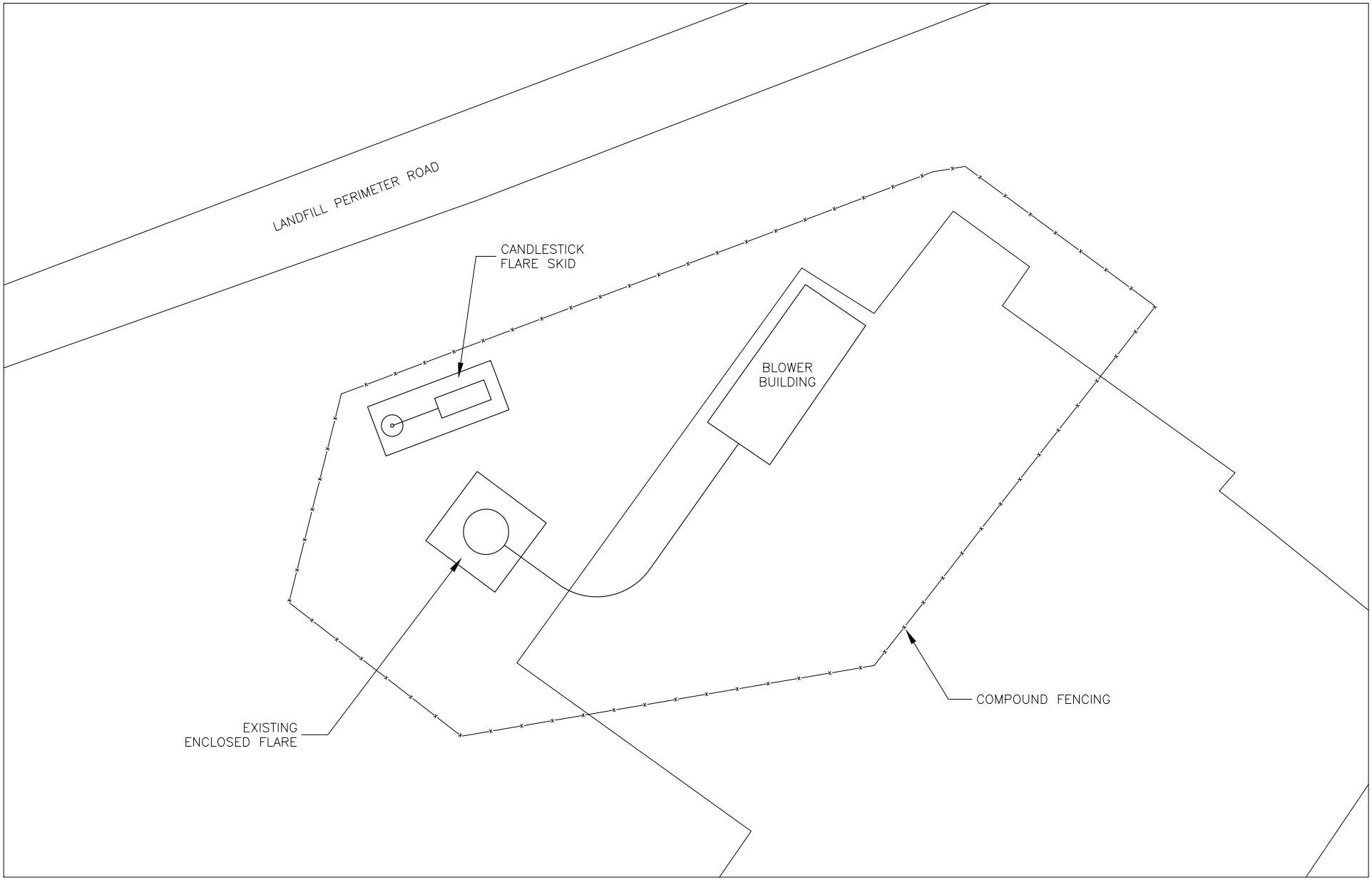
The candlestick flare will operate intermittently when the existing enclosed flare system is shut down for repairs or maintenance.

The North American Industrial Classification system (NAICS) code that best describes the primary operations of the Richmond Sanitary Landfill Site is 562210 (Waste Treatment and Disposal).

2.0 INITIAL IDENTIFICATION OF SOURCES AND CONTAMINANTS

In accordance with the MOE Procedure, this section of the ESDM Report provides an initial listing of the individual sources and contaminants. Since the candlestick flare will only operate when the existing enclosed flare is shut down for repairs or maintenance, the candlestick flare is the only significant source considered in the ESDM.

Potential contaminant emissions that could be emitted from the candlestick flare include uncontrolled landfill gas constituents and combustion by-products. Table 1 summarizes the significant sources and potential contaminants emitted by the Facility.



Scale: 1:250

0 4 8 12 metres

N

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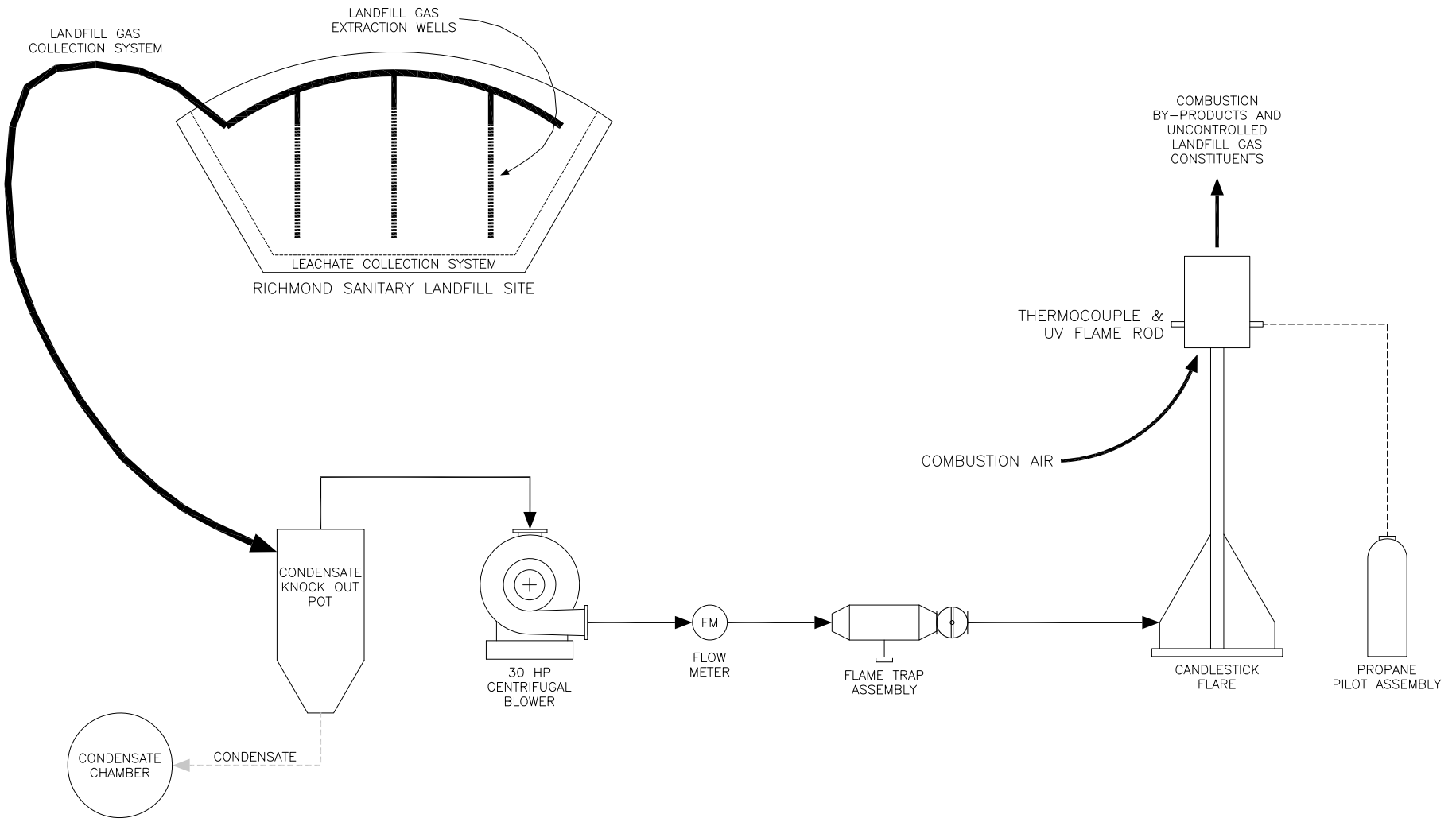
RICHMOND SANITARY LANDFILL
GREATER NAPEAN, ONTARIO

Figure 3

FACILITY
LAYOUT PLAN



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RICHMOND SANITARY LANDFILL
GREATER NAPEAN, ONTARIO

Figure 4

PROCESS FLOW
DIAGRAM

3.0 ASSESSMENT OF SIGNIFICANCE OF CONTAMINANTS AND SOURCES

In accordance with the MOE Procedure, this section assesses the significance of the contaminant sources identified in the previous section. The intention is to provide a detailed analysis of emission and POI concentrations from the significant contaminants and sources.

3.1 Assessment of Source Significance

As indicated in Table 1, the candlestick flare (CF) has been identified as a significant source and has been included in the dispersion modelling. For the purposes of this assessment, no sources at the Facility have been deemed insignificant.

3.2 Assessment of Contaminant Significance

An assessment of the significance of each contaminant was undertaken in accordance with Section 7.0 of the MOE document, *"Procedure for Preparing an Emissions Summary and Dispersion Modelling Report Version 3.0"*. The assessment is discussed in further detail in Section 7.0 of this report.

4.0 OPERATING CONDITIONS, EMISSIONS ESTIMATING AND DATA QUALITY

This Section documents the operating conditions and the development of emission rate estimates for the significant air contaminants discharged from the candlestick flare.

The approximate operating conditions and design details of the candlestick flare are as follows:

Operating Temperature:	Minimum of 760 °C (1,400 °F)
Fuel Flow Rate:	Up to 0.354 m^3/s (750 cfm) of landfill gas
Gas Composition:	Typically 45% combustible gas by volume but may range between 35 and 50%. Maximum emission scenario based on 50% methane.
Stack Diameter:	Cowling Diameter of 1 m (3.3 ft) Exhaust tip diameter of 0.15 m (6 in)
Stack Height:	6.7 m (22 ft)
Exit Velocity:	16.43 m/s

Since the candlestick flare will only operate when the existing enclosed flare is shut down for repairs or maintenance, the maximum emission scenario involves only the candlestick

Table 1
Source Identification Table
Richmond Sanitary Landfill Site
Greater Napanee, Ontario

Source Information			Expected Contaminants	Included in Modelling?
Source ID	**Source Description**	**General Location**	**Contaminants**	**Significant (Yes or No?)**
CF	Open Candlestick Flare	Within Existing Flare Compound	Uncontrolled landfill gas constituents and combustion by-products as per USEPA AP-42 Section 2.4 Municipal Solid Waste Landfills	Yes

flare operating at its maximum designed flow rate of 0.354 m^3/s (750 cfm) at 50% methane by volume and 760 °C. A Source Summary Table for the candlestick flare is provided as Table 2. Emission calculations for the flare are attached in Appendix E.

The default concentrations of typical landfill gas constituents and combustion by-products were taken from Section 2.4 of the United States Environmental Protection Agency's (USEPA) Compilation of Emission Factors, revised November 1998 (copy attached in Appendix F). The Emission Factor Rating relates to the quality of the Default Concentration data. The Control Efficiency and Rating relate to the efficiency of a candlestick flare to remove particular compounds from the landfill gas. The Final Data Quality is taken to be the lowest of the Emissions Factor Rating and the Control Efficiency Rating, if applicable. The emission rates for sulphur dioxide and hydrogen chloride are derived from engineering calculations, which are attached in Appendix E.

5.0 SOURCE SUMMARY TABLE AND SITE PLAN

As indicated above, a Source Summary Table for the candlestick flare is provided as Table 2. The Table summarizes all emission data for the flare and serves as the basis for inputs to the dispersion model. The information provided in Table 2 meets the "Contents of ESDM Report" requirements as defined for source summary tables identified in Subsection 26 (1) of O.Reg.419/05.

As required by the MOE Procedure, a scaled area location plan is provided as Figure 5. The plan is drawn using the Universal Transverse Mercator (Zone 18) coordinate system. The coordinates of the Landfill Site property boundary, off-site receptors and the candlestick flare are shown on the plan.

The Site is located on land that is zoned as Waste Management Industrial. Land use surrounding the candlestick flare within a 1000 metre radius includes Rural, Agricultural, Community Facility, and Environmental Protection. The flare is approximately 270 metres away from the southern property line. The closest Point of Reception is a permanent residence located approximately 315 metres south of the flare, and a place of worship is located approximately 500 metres west of the flare.

Zoning maps for the Site and surrounding area are provided in Appendix G. Based on the MOE's Noise Screening Process, a detailed Acoustic Assessment is required for the candlestick flare. The Acoustic Assessment prepared by RWDI Air Inc. and submitted with this report, shows that the candlestick flare and associated equipment is within the sound level limits for stationary sources in Class 3 (rural) areas as prescribed by MOE NPC-232.

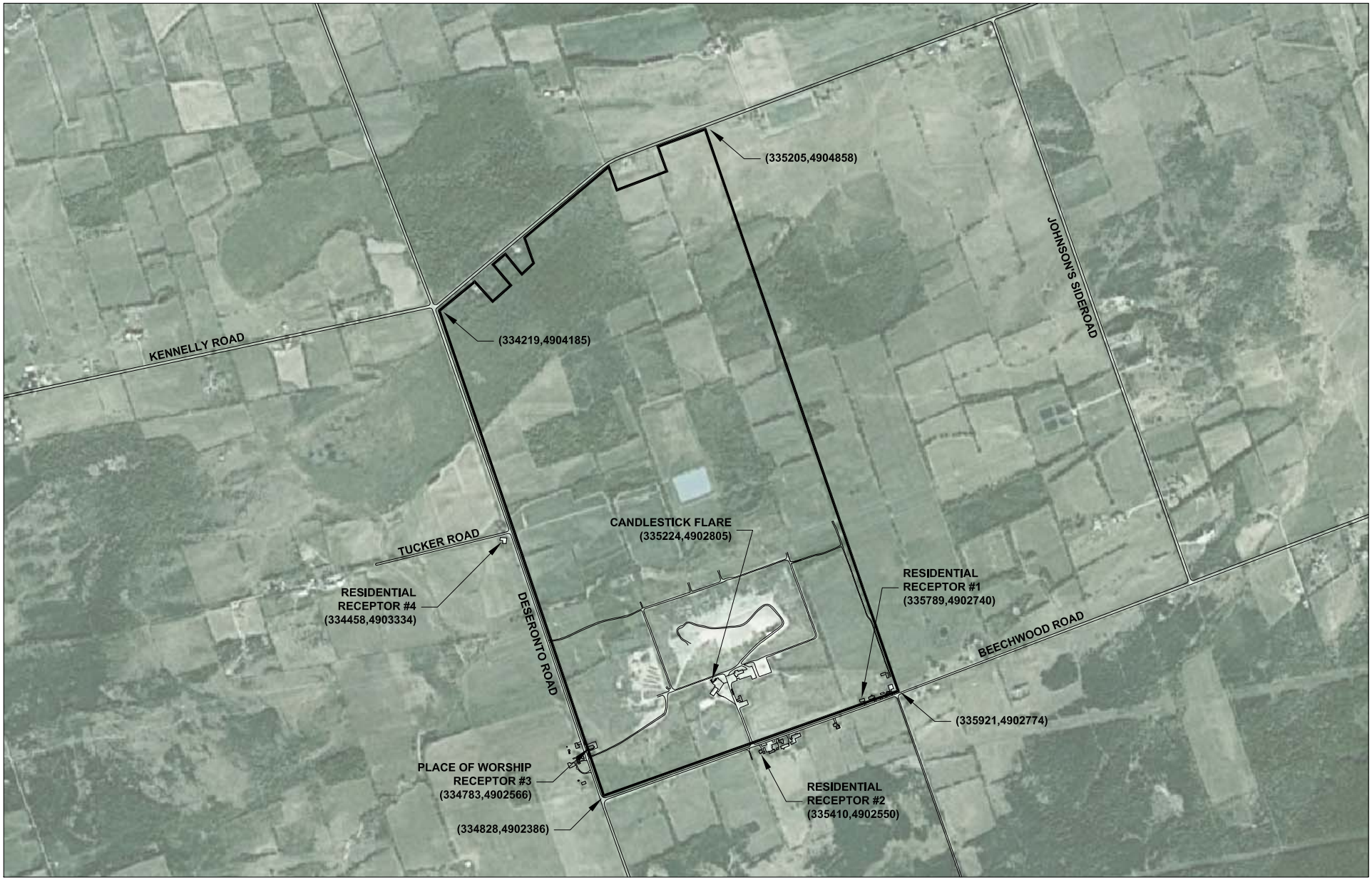
6.0 DISPERSION MODELLING

The MOE approved Screen3 air dispersion model was used to predict the point of impingement concentrations that were used in this assessment. All modelling was completed in accordance with the MOE document "*Air Dispersion Modelling Guideline*

Table 2
Source Summary Table
Richmond Sanitary Landfill Site
Greater Napanee, Ontario

Identifier	Description	Source Data					Emission Data										
		Flow		Flare Tip Diameter (m)	Height Above Grade (m)	Height above roof (m)	Contaminant	Contaminant Code (CAS No.)	Default[1] Concentration (ppmv, unless noted otherwise)	Default Concentration ($\mu g/m^3$)	Emission[1] Factor Rating	Control[2] Efficiency (%)	Control[2] Efficiency Rating	Facility Emission Rate (g/s)	Final[3] Data Quality	Estimation Technique	Percentage of Overall Emission
CF	Open Candlestick Landfill Gas Flare	0.354 50% 0.177 760	m^3/s LFG CH_4 by vol. m^3/s CH_4 °C	0.15	6.7	NA	Landfill Gas Constituents										
							1,1,1-Trichloroethane	71-55-6	0.48	2.62E+03	USEPA "B"	98.0	USEPA "B"	1.85E-05	USEPA "B"	EF	100%
							1,1,2,2-Tetrachloroethane	79-34-5	1.11	7.62E+03	USEPA "C"	98.0	USEPA "C"	5.39E-05	USEPA "C"	EF	100%
							1,1-Dichloroethane (ethylidene dichloride)	75-34-3	2.35	9.51E+03	USEPA "B"	98.0	USEPA "C"	6.73E-05	USEPA "C"	EF	100%
							1,1-Dichloroethene (vinylidene dichloride)	75-35-4	0.2	7.92E+02	USEPA "B"	98.0	USEPA "C"	5.61E-06	USEPA "C"	EF	100%
							1,2-Dichloroethane (ethylene dichloride)	106-93-4	0.41	1.66E+03	USEPA "B"	98.0	USEPA "C"	1.17E-05	USEPA "C"	EF	100%
							1,2-Dichloropropane (propylene dichloride)	78-87-5	0.18	8.31E+02	USEPA "D"	98.0	USEPA "C"	5.88E-06	USEPA "D"	EF	100%
							2-Propanol	67-63-0	50.1	1.23E+05	USEPA "E"	99.2	USEPA "B"	3.49E-04	USEPA "E"	EF	100%
							Acetone	67-64-1	7.01	1.66E+04	USEPA "B"	99.2	USEPA "B"	4.71E-05	USEPA "B"	EF	100%
							Acrylonitrile	107-13-1	6.33	1.37E+04	USEPA "D"	99.2	USEPA "B"	3.89E-05	USEPA "D"	EF	100%
							Bromodichloromethane	75-27-4	3.13	2.10E+04	USEPA "C"	98.0	USEPA "C"	1.48E-04	USEPA "C"	EF	100%
							Butane	106-97-8	5.03	1.19E+04	USEPA "C"	99.2	USEPA "B"	3.38E-05	USEPA "C"	EF	100%
							Carbon disulfide	75-15-0	0.58	1.80E+03	USEPA "C"	99.2	USEPA "B"	5.11E-06	USEPA "C"	EF	100%
							Carbon Tetrachloride	56-23-5	0.004	2.52E+01	USEPA "B"	98.0	USEPA "B"	1.78E-07	USEPA "B"	EF	100%
							Carbonyl sulfide	463-58-1	0.49	1.20E+03	USEPA "D"	99.2	USEPA "B"	3.41E-06	USEPA "D"	EF	100%
							Chlorobenzene	108-90-7	0.25	1.15E+03	USEPA "C"	98.0	USEPA "C"	8.14E-06	USEPA "C"	EF	100%
							Chlorodifluoromethane	75-45-6	1.3	4.59E+03	USEPA "C"	98.0	USEPA "B"	3.25E-05	USEPA "C"	EF	100%
							Chloroethane (ethyl chloride)	75-00-3	1.25	3.30E+03	USEPA "B"	98.0	USEPA "C"	2.33E-05	USEPA "C"	EF	100%
							Chloroform	67-66-3	0.03	1.46E+02	USEPA "B"	98.0	USEPA "B"	1.04E-06	USEPA "B"	EF	100%
							Chloromethane	74-87-3	1.21	2.50E+03	USEPA "B"	98.0	USEPA "C"	1.77E-05	USEPA "C"	EF	100%
							Dichlorobenzene	95-50-1	0.21	1.26E+03	USEPA "E"	98.0	USEPA "B"	8.93E-06	USEPA "E"	EF	100%
							Dichlorodifluoromethane	75-71-8	15.7	7.76E+04	USEPA "A"	98.0	USEPA "B"	5.49E-04	USEPA "B"	EF	100%
							Dichlorofluoromethane	75-43-4	2.62	1.10E+04	USEPA "D"	98.0	USEPA "C"	7.80E-05	USEPA "D"	EF	100%
							Dichloromethane (methylene chloride)	75-09-2	14.3	4.96E+04	USEPA "A"	98.0	USEPA "C"	3.51E-04	USEPA "C"	EF	100%
							Dimethyl sulfide	75-18-3	7.82	1.99E+04	USEPA "C"	99.2	USEPA "B"	5.62E-05	USEPA "C"	EF	100%
							Ethane	74-84-0	889	1.09E+06	USEPA "C"	99.2	USEPA "B"	3.09E-03	USEPA "C"	EF	100%
							Ethanol	64-17-5	27.2	5.12E+04	USEPA "E"	99.2	USEPA "B"	1.45E-04	USEPA "E"	EF	100%
							Ethyl Mercaptan (ethanethiol)	75-08-1	2.28	5.79E+03	USEPA "D"	99.2	USEPA "B"	1.64E-05	USEPA "D"	EF	100%
							Ethylbenzene	100-41-4	4.61	2.00E+04	USEPA "B"	99.2	USEPA "B"	5.66E-05	USEPA "B"	EF	100%
							Ethylene dibromide	106-93-4	0.001	7.68E+00	USEPA "E"	98.0	USEPA "B"	5.44E-08	USEPA "E"	EF	100%
							Fluorotrichloromethane	75-69-4	0.76	4.27E+03	USEPA "B"	98.0	USEPA "C"	3.02E-05	USEPA "C"	EF	100%
							Hexane	110-54-3	6.57	2.31E+04	USEPA "B"	99.2	USEPA "B"	6.55E-05	USEPA "B"	EF	100%
							Hydrogen sulfide	7783-06-4	35.5	4.95E+04	USEPA "B"	99.7	USEPA "B"	5.25E-05	USEPA "B"	EF	100%
							Mercury	7439-97-6	0.000292	2.39E+00	USEPA "E"	0	cons.	8.47E-07	USEPA "E"	EF	100%
							Methyl ethyl ketone	78-93-3	7.09	2.09E+04	USEPA "A"	99.2	USEPA "B"	5.92E-05	USEPA "B"	EF	100%
							Methyl isobutyl ketone	108-10-1	1.87	7.66E+03	USEPA "B"	99.2	USEPA "B"	2.17E-05	USEPA "B"	EF	100%
							Methyl mercaptan	74-93-1	2.49	4.90E+03	USEPA "C"	99.2	USEPA "B"	1.39E-05	USEPA "C"	EF	100%
							Pentane	109-66-0	3.29	9.70E+03	USEPA "C"	99.2	USEPA "B"	2.75E-05	USEPA "C"	EF	100%
							Perchloroethylene (tetrachloroethylene)	127-18-4	3.73	2.53E+04	USEPA "B"	98.0	USEPA "B"	1.79E-04	USEPA "B"	EF	100%
							Propane	74-98-6	11.1	2.00E+04	USEPA "B"	99.2	USEPA "B"	5.66E-05	USEPA "B"	EF	100%
							t-1,2-dichloroethene	156-60-5	2.84	1.13E+04	USEPA "B"	98.0	USEPA "B"	7.97E-05	USEPA "B"	EF	100%
							Trichlororethylene	79-01-6	2.82	1.51E+04	USEPA "B"	98.0	USEPA "B"	1.07E-04	USEPA "B"	EF	100%
							Vinyl chloride	75-01-4	7.34	1.88E+04	USEPA "B"	98.0	USEPA "B"	1.33E-04	USEPA "B"	EF	100%
							Xylenes	1330-20-7	12.1	5.25E+04	USEPA "B"	99.2	USEPA "B"	1.49E-04	USEPA "B"	EF	100%
							Benzene	71-43-2	11.1	3.54E+04	USEPA "D"	99.2	USEPA "B"	1.00E-04	USEPA "D"	EF	100%
							Toluene	108-88-3	165	6.21E+05	USEPA "D"	99.2	USEPA "B"	1.76E-03	USEPA "D"	EF	100%
							Combustion By-products										
							Carbon Monoxide[4]	630-08-0	7500	kg/10^6 m^3 CH_4	USEPA "C"			1.33E+00	USEPA "C"	EF	100%
							Nitrogen Dioxide[4]	10102-44-0	4000	kg/10^6 m^3 CH_4	USEPA "D"			7.08E-01	USEPA "D"	EF	100%
							Particulate Matter[4]	N/A	770	kg/10^6 m^3 CH_4	USEPA "E"			1.36E-01	USEPA "E"	EF	100%
							Dioxin/Furan[5]	N/A	6.70E-06	kg/10^6 m^3 CH_4	USEPA "E"			1.19E-09		EF	100%
							Sulphur Dioxide	7446-09-5	see attached calculations					4.36E-02		MB	100%
							Hydrogen Chloride	7647-01-0	see attached calculations					2.17E-02		MB	100%

Notes:
[1] Default Concentrations and Emission Factor Ratings taken from USEPA AP-42 Table 2.4-2 (Nov 1998)
[2] Control Efficiencies for Landfill Gas Constituents taken from USEPA AP-42 Table 2.4-3 (Nov 1998)
[3] Final Data Quality is the lower of the Emission Factor Rating and the Control Efficiency Rating
[4] Emission Data taken from USEPA AP-42 Table 2.4-4 (Nov 1998)
[5] Emission Data taken from USEPA AP-42 Table 2.4-4 (Oct 2008)



Scale: 1:20,000

0 250 500 1000 metres

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WASTE MANAGEMENT
RICHMOND SANITARY LANDFILL
GREATER NAPEAN, ONTARIO

Figure 5

SCALED AREA
LOCATION PLAN

for Ontario, Version 2.0" (ADMGO). Screen3 is a single source Gaussian plume model, and is a screening version of the ISC3 model.

Meteorological and Land Use Data

Full meteorology including all stability classes and wind speeds were used along with a default anemometer height of 10.0 m.

Terrain Data

Simple terrain was used in the dispersion model.

Source Data

As described in the Source Summary Table, the modelling consists of one (1) open candlestick landfill gas flare. In accordance with Section 4.5 of the ADMGO, the candlestick flare was modelled as a point source.

Due to the number of constituents present in landfill gas, it was felt that modelling each contaminant separately with its unique emission rate would be too tedious. Instead, a 1.0 g/s unit emission rate was used in the dispersion model and resulted in a maximum unit concentration factor of 18.24 ($\mu g/m^3$)/(g/s), occurring 300 m from the flare.

Building Downwash

The height of the existing blower building is approximately 2.5 m. Since the height of the candlestick flare (6.7 m) is greater than 2.5 times the height of the blower building (2.5 x 2.5 m = 6.25 m), building downwash does not need to be considered.

Averaging Time and Conversions

Modelling was completed using a one hour averaging period. Schedule 3 standards were used when available. When Schedule 3 standards were not available, Schedule 2 standards were used. One hour averaging periods were converted to half hour or twenty-four hour using the method described in O.Reg. 419/05 when appropriate. When neither Schedule 3 nor 2 standards were available, Ambient Air Quality Criteria (AAQC) or Jurisdictional Screening Limits (JSL) were used. When a contaminant had no limit, the POI was based on a half hour averaging period. One hour averaging periods were converted to half hour or twenty-four hour using the method described in the ADMGO and shown below:

$$\text{POI}(\tfrac{1}{2} \text{ or } 24 \text{ hour}) = \text{POI}(1 \text{ hour}) \times (t_1 \div t_0)^n$$

Where: t_1 = dispersion model averaging period (1 hour)
t_0 = desired averaging period (½ or 24 hour)
n = 0.28

Receptors

A discrete distance receptor array between 1 m and 1500 m and a receptor height of 0 m representing ground level concentrations was used in the dispersion model.

Table 3 provides a summary of the dispersion model input parameters and has been prepared in accordance with the MOE Procedure. The dispersion modelling results along with an electronic copy of the input and output data are provided in Appendix H.

7.0 EMISSION SUMMARY TABLE AND CONCLUSIONS

The Emission Summary Table, attached as Table 4, summarizes the emission rates and the maximum calculated POI concentrations for each of the landfill gas constituents and combustion by-products at the maximum ground level concentration. The POI concentrations were compared to the appropriate standard. The Percentage of Criteria Column of Table 4 shows that the maximum point of impingement concentration for all compounds modelled are below the POI Standards for all parameters considered.

An assessment of the significance of each contaminant was undertaken in accordance with Section 7.0 of the MOE document, *"Procedure for Preparing an Emissions Summary and Dispersion Modelling Report Version 3.0"* (Procedure). Linear interpolation was used with values in Table B-1 of the Procedure to calculate a 1 hour rural dispersion factor of 2140 ($\mu g/m^3$)/(g/s) at a distance of 270 metres from the source. The rural dispersion factor was converted to the appropriate averaging time using the calculation described in Section 6.0 of this report. Contaminants with a POI limit were compared to an emission threshold calculated as per Section 7.1.2 of the Procedure. Contaminants with no POI limit were compared to a concentration threshold as per Table B-2A of the Procedure.

The results of the assessment are shown in Table 4. With the exception of benzene, which is on the list of MOE POI limits but has no limit, all of the landfill gas constituents have been considered insignificant. Sulphur dioxide and dioxin/furans were the only combustion by-products considered insignificant. Supporting calculations for the determination of contaminant significance are provided in Appendix E.

7.1 Assessment of Contaminants with no POI Limits

The Emission Summary Table indicates that there are a number of contaminants that will be emitted from the candlestick flare that do not have MOE POI Limits. However, after assessing the significance of each contaminant, it was determined that all of the unlisted contaminants are released in negligible amounts. Therefore, a maximum ground level concentration acceptability request has not been submitted as part of this ESDM.