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WASTE CONNECTIONS OF CANADA

Ridge Landfill Expansion: Atmospheric Impact Assessment

Appendix D3A

DRAFT

Waste Connections of Canada

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Acronyms, Abbreviations, Definitions

***AAQC,** Ontario's Ambient Air Quality Criteria.*

Act *(the**)**, refers to the Environmental Assessment Act. Also known as EAA, or the EA Act.*

***ADMGO,** Air Dispersion Modeling Guideline for Ontario.*

***CAAQS,** Canadian Ambient Air Quality Standards.*

***Discrete Receptor** - A discrete receptor is a single receptor placed in a precise location of interest. Discrete receptors include a location where human activities regularly occur at a time when those activities regularly occur.*

***EA,** Environmental Assessment.*

***ECA,** Environmental Compliance Approval is a license or permit issued by the Ministry of the Environment, Conservation and Parks for the operation of a waste management facility or site.*

***ECCC,** Environment Canada and Climate Change.*

***Haul Route,** This area refers to the right-of-way of the designated truck haul route to the landfill. Traffic to the landfill travel from Highway 401 via interchange 90, heading southeast along Communication Road (County Road 11), to Drury Line then along Erieau Road to the main site entrance of the landfill at 20262 Erieau Road.*

***IC&I,** Industrial, Commercial and Institutional waste stream.*

***MECP,** Ministry of the Environment, Conservation and Parks; formerly Ministry of Environment and Climate Change, Ministry of the Environment, and Ministry of the Environment and Energy.*

***MOVES,** Motor Vehicle Emission Simulator.*

***MTO**, Ministry of Transportation Ontario.*

***NAPS,** National Air Pollution Surveillance Program.*

***OMMAH**, Ontario Ministry of Municipal Affairs and Housing.*

***off-site**, this refers to the area that is ten (10) km outside of the Ridge Landfill site boundary.*

***on-site**, this refers to the area within the Ridge Landfill site boundary.*

PM, *Particulate Matter.*

PORs, *Points of Reception.*

PPS*, Provincial Policy Statement, 2014.*

ToR, *Terms of Reference.*

TSP, *total suspended particulate matter.*

US EPA, *United States Environmental Protection Agency.*

Waste Connections*, Waste Connections of Canada Inc.*

	Units
ha	hectare
km	kilometre
L	litre
m	metre
m^3	cubic metres
m/m	metres/minute
masl	metres above sea level

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Executive Summary

Waste Connections of Canada Inc. (Waste Connections) has undertaken an Environmental Assessment (EA) pursuant to the Environmental Assessment Act (Act) to expand its Ridge Landfill (Site) in the Municipality of Chatham-Kent. The EA does not propose to increase the maximum annual fill rate (this would remain as-is); however Waste Connections is seeking the EA to increase the life of the facility for a 20 year planning period, from 2022- 2041.

This assessment has been developed to address indicator air emissions (particulate [TSP, PM_{10}, $PM_{2.5}$], SO_2, CO, NOx, H_2S, vinyl chloride, and chloroform), odour, dust, and litter from existing operations and the development phases of the preferred alternative expansion.

Background air quality was characterized through the use of data from the closest stations of Environment Canada and Climate Change (ECCC) National Air Pollution Surveillance Program (NAPS), ECCC reference documentation, and historical site-specific monitoring at the Ridge Landfill.

The greatest potential impact to the air quality for the landfill expansion will be associated with changes to on-site operations. After reviewing the cell sequencing plans for lifecycle of the preferred alternative expansion method, three (3) development phases were identified as worst-case scenarios for this assessment. These scenarios are considered milestones in the development of the site and reflect the development of the different expansion areas.

Preferred alternative scenario 1 represents the worst-case operating condition during the vertical expansion of the Old Landfill. Preferred alternative scenario 2 represents the worst-case operating condition during the horizontal expansion of the South Landfill (expansion area "B"). Preferred alternative scenario 3 represents the worst-case operating condition during the horizontal expansion of the West Landfill (expansion area "A").

Emission rates were developed for the existing conditions and preferred alternative development scenarios using industry accepted methodologies.

The environmental effects assessment includes a combination of the background air quality for the region and the contribution of all activities at the landfill with the potential to cause residual effects on the atmospheric environment. In addition to the evaluation of environmental effects, a compliance assessment was performed to determine whether the site would be anticipated to operate in compliance with only the sources regulated under O. Reg. 419/05.

Atmospheric dispersion modelling was conducted using the MECP approved AERMOD version 16216r, MECP terrain data, and an MECP processed site-specific 5-year meteorological dataset.

The current and future predicted concentration of indicator compounds are anticipated to meet relevant *O. Reg. 419/05* regulatory compliance criteria. The assessment of all sources on-site (regulated and non-regulated for compliance) demonstrated that all sources can meet relevant air quality criteria. The odour assessment or on-site sources resulted in a low potential impact on the discrete receptors.

A haul route assessment was performed to evaluate the potential impacts of road traffic associated with the proposed expansion to the Ridge Landfill. This assessment was performed considering changes to current traffic volumes and vehicle emissions along the haul route due to both landfill operation and local traffic. 2018 traffic volumes were used to represent the baseline scenario. Projected 2041 traffic volumes were developed to represent the future case under the expansion scenario.

Emission rates were developed for the vehicle traffic using the United States Environmental Protection Agency's (US EPA) Motor Vehicle Emission Simulator (MOVES). Air quality impacts as a result of vehicle traffic on the haul route associated with the site were predicted using the US EPA CAL3QHCR dispersion model.

For all indicator compounds, despite increases in local traffic, the predicted 2041 haul route impacts were expected to be the same or lower than the predicted 2018 impacts, and below relevant criteria. This is attributable to predicted improvements in vehicle operations over time. The modelling results indicate that there is no increased impact to local air quality attributable to the haul route as a result of the proposed expansion.

An assessment on the potential nuisance impact of blowing litter was performed at the Ridge Landfill. The blowing litter uses meteorological data and the distance from the active working face to the discrete receptors surrounding the site to determine the potential of blowing litter.

The blowing litter assessment has identified some limited potential for litter to migrate off-site during high wind conditions. The site currently has practices in place to manage this occurrence.

1.0 Introduction

Waste Connections of Canada Inc. (Waste Connections) has undertaken an Environmental Assessment pursuant to the *Environmental Assessment Act* (EA Act) to expand the Ridge Landfill site in the Municipality of Chatham-Kent in accordance with the Amended Terms of Reference (ToR), approved by Ontario's Minister of the Environment, Conservation and Parks (MECP) on May 1, 2018; to continue to provide long-term disposal capacity to serve the growing population and economy of the province of Ontario.

The Ridge Landfill has been in operation since 1966 and was expanded in 1999. The landfill is located at 20262 Erieau Road near Blenheim, Ontario in the Municipality of Chatham-Kent, and is operated by Waste Connections (**FIGURE D3-1**). The site is currently approved to receive waste from the industrial, commercial and institutional (IC&I) sectors in Ontario, and residential waste from the Municipality of Chatham-Kent and the surrounding Counties of Essex, Lambton, Middlesex and Elgin.

FIGURE D3-1: LOCATION OF RIDGE LANDFILL

The Landfill site area of 262 ha, is permitted by an Environmental Compliance Approval (ECA)[1] from the MECP for waste management and environmental work purposes. The area within which

[1] MECP, Waste Environmental Compliance Approval No. A021601.

waste disposal is permitted, called the Approved Waste Disposal Area, is 131 ha or half of the Landfill site area. The current approved capacity for the Ridge Landfill is 21 million m^3. As per the current ECA for the Ridge Landfill, the annual fill rate at the Ridge Landfill is 1.3 million tonnes.

As of April 2019, it is estimated that the existing Waste Disposal Area at the Ridge Landfill site will provide waste disposal capacity until approximately 2021 at the current fill rate. The expansion would increase the lifespan of the Ridge Landfill beyond 2021 to 2041. The landfill expansion will not result in an increase in annual waste volumes disposed at the site.

1.1 Work Plans

Work plans were prepared for each impact assessment study. The atmospheric work plan was prepared in September 2018.

The work plans were circulated to interested stakeholders, key government reviewers, and Indigenous Communities and Organizations who desired to review them; and they were posted on the Future Plans page of the Ridge Landfill website for public review and comment. The input received during that review has been carefully considered and incorporated into this study, where applicable.

1.2 Role of Atmospheric Discipline in the Environmental Assessment

In this assessment of the proposed Ridge Landfill expansion, the atmospheric discipline considered the potential net effects of the proposed landfill expansion on the atmospheric characteristics of the surrounding area. The criteria used in the assessment are designed to identify and evaluate the impacts of the landfill expansion as required by the *EA Act*[2] and related code of practice[3].

The primary objective of this assessment is to address the requirements of **Section 6.1**(2)(c) and (d) of the *EA Act*, as it pertains to the atmospheric environment; specifically:

(c) a description of,

(i) the environment that will be affected or that might reasonably be expected to be affected, directly or indirectly,

[2] MECP, *Environmental Assessment Act* (EAA), R.S.O. 1990.

[3] MECP, Code of Practice: Preparing & Reviewing Environmental Assessments in Ontario, January 2014.

(ii) the effects that will be caused or that might reasonably be expected to be caused to the environment, and

(iii) the actions necessary or that may reasonably be expected to be necessary to prevent, change, mitigate or remedy the effects upon or the effects that might reasonably be expected upon the environment, by the undertaking, the alternative methods of carrying out the undertaking and the alternatives to the undertaking;

(d) an evaluation of the advantages and disadvantages to the environment of the undertaking.

1.3 Scope of the Atmospheric Assessment

The scope of the Atmospheric Impact Assessment (AIA) includes a review of background conditions and data collection in the field, followed by an examination of potential impacts for the preferred landfill alternative, atmospheric modelling, and the cumulative effects of these impacts that may be affected by the proposed expansion of the Ridge Landfill. Atmospheric modelling can provide insight into the atmospheric setting and help us understand the physical, chemical and biochemical processes occurring at the site. This complex model includes: the atmospheric conceptual framework, the geometry and structure of the site features, assumptions and limitations, processes, boundary conditions, governing equations, and a solution method.

Atmospheric modelling was performed to determine potential air quality impacts from the existing operations and the development phases of the preferred alternative expansion. Each landfill footprint was modelled as adjacent sources to appropriately capture the emission rates during worst-case operating years of the development, as per correspondence with the MECP.

1.4 Overview of Report Contents

This report describes the baseline atmospheric environment, using indicators of air emissions, odour, dust, and litter, in the area surrounding the Ridge Landfill site and potential changes to the future environment due to the proposed expansion. The report consists of the following:

- **Section 1** presents an introduction to the study, a description of the site, and the role and scope of the atmospheric assessment;
- **Section 2** describes the study methods to this assessment including: study areas, criteria and indicators, data collection and method analysis;

- **Section 3** provides a description of the existing atmospheric conditions and how they would change in the future without the proposed expansion of the Ridge Landfill;
- **Section 4** provides a description of the on-site activities impact assessment of the landfill expansion on the atmospheric environment;
- **Section 5** presents potential impacts from haul route traffic from the proposed landfill expansion on the atmospheric environment;
- **Section 6** presents potential impacts of blowing litter from the proposed landfill expansion on the atmospheric environment;
- **Section 7.0** summarizes major conclusions; and
- Appendices provide information that supports the atmospheric assessment.

2.0 Methods of Assessment

The potential for impact of the preferred alternative on the atmospheric environment was evaluated using three (3) impact study areas, namely on-site, off-site, and haul route, and through the completion of an impact assessment for the study areas described as follows:

2.1 Study Areas

The term "study area" refers to those areas for which data was collected and the impact analysis was carried out (See **FIGURE D3-2**). For the purpose of the AIA, the study areas considered are: on-site, off-site, and along the haul route. The rationale for these study areas is to remain consistent with the significant level of previous atmospheric investigation completed at the site in all three study areas.

The off-site study area extends to 10 km from the Ridge Landfill as this allows for a more comprehensive characterization of baseline conditions and assessment of potential atmospheric impacts. The proposed expansion of the landfill has the potential to increase air emissions from the site.

For the purposes of the AIA, three impact study areas are more specifically defined as follows:

- **On-site Study Area ("on-site")** – includes the property on which the current Ridge Landfill and proposed expansion is situated.

- **Off-site Study Area ("off-site")** – encompasses the area within ten (10) kilometres of the centre of site. For all indicator compounds except odour: multi-tier grid of receptors were developed in accordance with **Section 14** of *O.Reg. 419/05*. For odour, the nearest discrete receptors will be identified in all directions around the site.

- **Haul Route Study Area ("haul route")** – encompasses lands immediately adjacent to Communication Road, Drury Line and Erieau Road which are identified as the designated haul route for the site. The extents proposed are based on good practice and anticipated impacts, as discussed above.

FIGURE D3-2: ATMOSPHERIC STUDY AREA

2.2 Assessment Criteria

The atmospheric assessment is documented following the requirements of **Section 8** of *O.Reg. 232/98*. As prescribed, it includes; the suitability of the site for landfill waste disposal purposes, proposed monitoring and contingency plans.

The Atmospheric Impact Assessment Criteria are:

- Potential impacts to air quality from the landfill based on indicator compounds (particulate [TSP, PM_{10}, $PM_{2.5}$], SO_2/CO/NOx; H_2S/Vinyl Chloride/Chloroform).
- Potential impacts on air quality (based on indicator compounds [TSP, PM_{10}, $PM_{2.5}$], SO_2/CO/NOx; from haul route).

A description of the criteria, indicators, rationale and data sources are provided in **Table D3-1**.

Table D3-1: Criteria & Indicators

Criteria	Indicator	Rationale	Data Source
Potential impacts to air quality from the landfill based on indicator compounds (particulate [TSP, PM_{10}, $PM_{2.5}$], SO_2/CO/NOx; H_2S/Vinyl Chloride/Chloroform).	Comparison of predicted concentrations of air quality indicator compounds with baseline conditions at the landfill against MECP air quality criteria.	The landfill must meet criteria established by the MECP.	• MECP and Environmental Climate Change Canada (ECCC) background air quality monitoring data; • Local meteorological data; • Existing and proposed facility characteristics including working face location, waste receipt, material handling, on-site traffic, landfill gas collection, etc.; • GIS mapping/secondary sources; • US EPA AP-42 and MECP emission factors; • MECP D-4 Land Use on or Near Landfills and Dumps; and • US EPA LandGEM modelling.
Potential impacts on air quality (based on	Comparison of predicted	Landfill haul route traffic has	• Transportation assessment results;

Criteria	Indicator	Rationale	Data Source
indicator compounds [TSP, PM_{10}, $PM_{2.5}$], SO_2/CO/NOx; from haul route).	concentrations of indicator compounds from the haul route traffic sources associate with the potential changes to soil truck or background traffic levels.	potential for air quality impacts.	• US EPA emission factors; • US EPA modelling guidance; • MECP D-4 Land Use on or Near Landfills and Dumps; and • GIS mapping/Secondary sources.

2.3 Study Period

The time horizon for the Atmospheric Impact Assessment includes the existing conditions of the site as reflective of the most recent full calendar year and the operating life during the development of the expansion, assumed to be from 2021 to 2041. This time horizon for the Atmospheric Impact Assessment relates to the anticipated future conditions for the atmospheric characteristics of the surrounding area.

3.0 Existing Atmospheric Conditions

The potential for impact of the preferred alternative on the atmospheric environment was evaluated using indicator compounds that were selected and approved in the atmospheric work plan, prepared September 2018. The applicable criteria and background concentrations of the indicator compounds for the study areas are described as follows:

3.1 Indicator Compounds

The following list includes indicator compounds that are typically emitted from landfills. These compounds will have the highest potential for impacts in regards to the atmospheric environment:

- Particulate Matter (PM) **–** Including total suspended particulate matter (TSP), PM_{10} and $PM_{2.5}$;
- Nitrogen Oxides (NOx);
- Carbon Monoxide (CO);
- Sulphur Dioxide (SO_2);
- Volatile Organic Compounds (VOCs) – specifically Vinyl Chloride and Chloroform;
- Hydrogen Sulphide (H_2S); and
- Odour.

These indicator compounds are evaluated in this impact assessment from the atmospheric environment by combining background levels with predicted ground level concentrations from existing operations and the selected scenarios from the preferred alternative expansion.

3.1.1 Air Quality and Odour Criteria

The criteria for air quality in Ontario are established in *Ontario Regulation 419/05*[4] (O. Reg. 419/05) and in *Ontario's Ambient Air Quality Criteria*[5] (AAQC). *O. Reg. 419/05* provides contaminant concentration standards and guidelines to assess impacts for permitting requirements (i.e., compliance). The *AAQC*s developed by the MECP are commonly used in environmental assessments, special studies using ambient air monitoring data, assessment of general air quality in a community and annual reporting on air quality across the province.

[4] MECP. Environmental Protection Act. Ontario Regulation 419: Air Pollution – Local Air Quality. January 1, 2019.
[5] MECP. Ontario's Ambient Air Quality Criteria. April 30, 2019.

Federally, the Canadian Council of Ministers of the Environment has a set of *Canadian Ambient Air Quality Standards*[6] (*CAAQS*) that were developed to be outdoor air quality targets for air quality actions across the country.

The applicable Ontario and Canada-wide standards and criteria are provided in **Table D3-2**. The most stringent criteria, standard, or guideline for each averaging period (shown in **bold** in **Table D3-2**) will be used throughout the assessment.

Table D3-2: Ontario and Canada-Wide Standards and Criteria

Indicator Compound	Averaging Period	Criterion (µg/m³)	Regulation/Guideline
TSP	**24 hr**	**120**	**O. Reg. 419/05**
	Annual	**60**	**AAQC**
PM_{10}	**24 hr**	**50**	**AAQC**
$PM_{2.5}$	24 hr	30	AAQC
	24 hr	28	CAAQS
	24 hr	**27**	**CAAQS future(1)**
	Annual	10	CAAQS
	Annual	**8.8**	**CAAQS future(1)**
Nitrogen Oxides	**24 hr**	**200**	**O. Reg. 419/05**
	1 hr	**400**	**O. Reg. 419/05**
Hydrogen Sulphide	**24 hr**	**7**	**O. Reg. 419/05**
	10 min	**13**	**O. Reg. 419/05**
Vinyl Chloride	**24 hr**	**1**	**O. Reg. 419/05**
Chloroform	**24 hr**	**1**	**O. Reg. 419/05**
Carbon Monoxide	**0.5 hr**	**6000**	**O. Reg. 419/05**
Sulphur Dioxide	**24 hr**	**275**	**O. Reg. 419/05**
	1 hr	690	O. Reg. 419/05
	1 hr	**100**	**O. Reg. 419/05 future**
	Annual	55	O. Reg. 419/05
	Annual	**10**	**O. Reg. 419/05 future**

[6] ECCC. Canadian Ambient Air Quality Standards (CAAQS) for Fine Particulate Matter ($PM_{2.5}$) and Ozone. October 2012.

Indicator Compound	Averaging Period	Criterion (µg/m³)	Regulation/Guideline
Odour	**10 min**	**1 OU/m³**	**MECP Guideline**

Notes:

(1) CAAQS future – criteria set for the year 2020.

(2) *O.Reg. 419* future – standard effective on July 1, 2023.

3.1.2 Background Air Quality

Background air quality was quantified by compiling historic monitoring records in the region of the study areas in addition to a review of on-site air monitoring data. The Environment and Climate Change Canada (ECCC) National Air Pollution Surveillance Program (NAPS) stations were reviewed for each indicator compound. The closest monitoring station to the study areas with a three (3) year data set was selected. A summary of NAPS station IDs and data range available for each indicator compound is summarized in **Table D3-3** below.

Table D3-3: Indicator Compound NAPS Station ID

Indicator Compound	Station ID	Data Range
TSP	NA	NA
PM_{10}	NA	NA
$PM_{2.5}$	Chatham (13001)	2015-2017
Nitrogen Oxides (NO_x)	Chatham (13001)	2015-2017
Hydrogen Sulphide (H_2S)	NA	NA
Vinyl Chloride	London (060904)	2014-2016
Chloroform	London (060904)	2014-2016
Carbon Monoxide (CO)	Windsor Downtown (12008)	2015-2017
Sulphur Dioxide (SO_2)	Windsor Downtown (12008)	2015-2017
Odour	NA	NA

The background concentrations for the indicator compounds from the NAPS stations were estimated based on the 90th percentile of the data obtained for the monitoring stations.

Ambient monitoring data for hydrogen sulphide is not readily available for the study areas. The ECCC documents an overall average concentration, measured in urban area presumed to be away from major anthropogenic (originating from human activity) sources in Canada[7], which was used as the background concentration for this assessment.

The data obtained from the NAPS stations for vinyl chloride and chloroform were compared to site-specific, MECP witnessed and approved, air monitoring performed by Dillon in 2014[8]. Of the 38 samples taken during the site-specific monitoring, only three (3) samples presented detectable levels of chloroform and there were no detectable levels of hydrogen sulphide present during the monitoring study. Of the three (3) samples with detectable concentrations of chloroform, it was concluded that the values were not attributed to the landfill operations based on wind conditions or were considered anomalous. The low concentration data from the NAPS station can be considered reasonable background concentrations for the study areas, especially in the context of the historical site-specific monitoring.

To be consistent with using 3-years of background data where possible, the NAPS station $PM_{2.5}$ data was adjusted to provide calculate TSP and PM_{10} background data. As $PM_{2.5}$ is a size fraction subset of PM_{10}, and PM_{10} is a size fraction subset of TSP, the PM_{10} and TSP background concentrations can be estimated based on the $PM_{2.5}$ background concentration. $PM_{2.5}$ accounts for approximately 25% of TSP, while PM_{10} accounts for approximately 50% of TSP[9]. The PM_{10} and TSP values were calculated using the following multipliers:

$$TSP_{concentration} = 4 \times (PM2.5_{concentration})$$

$$PM10_{concentration} = 0.5 \times (TSP_{concentration})$$

ECCC ambient monitoring data for TSP and PM_{10} size fractions are not readily available for the study areas. The site-specific, MECP witnessed and approved, air monitoring performed by Dillon in 2014[10] included the sampling of TSP. The program included 24-hour samples that were taken weekly over 6-months spanning the summer and fall months (June – November). The site-specific sampled data for TSP includes contributions from site operations as well as ambient concentration. The monitoring program concluded that the 24-hour TSP results were well below the MECP criterion and that the site would not generate off-property elevated TSP levels.

[7] ECCC. Draft Screening Assessment: Hydrogen Sulfide (H_2S), Sodium Sulfide (NA(SH)) and Sodium Sulfide (Na_2S). September 2017.
[8] Dillon Consulting Ltd. Ridge Landfill 2014 Air Monitoring Report. June 2015.
[9] CEPA/FPAC Working Group on Air Quality Objectives and Guidelines, National Ambient Air Quality Objectives for Particulate Matter Part 1: Science Assessment Document, ISBN 0-662-63486-1, 1998.
[10] [10] Dillon Consulting Ltd. Ridge Landfill 2014 Air Monitoring Report. June 2015.

The site-specific monitored data (measured on-site), shows that combined facility and background levels of TSP are well below the background data that is estimated based on the methodology above (TSP estimated from $PM^{2.5}$ concentrations). The estimated TSP and PM_{10} baseline values tabulated below are therefore considered to be highly conservative estimates of baseline conditions.

As the environment surrounding the site consists of primarily agricultural land uses, it is expected that the ambient odour would be characteristic of a rural agricultural setting. There have not been any odour studies performed within the study areas and therefore no baseline value has been defined for odour.

The calculated background concentrations (ug/m^3) for each indicator compound for the study areas are summarized in **Table D3-4** below.

Table D3-4: Background Air Quality

Indicator Compound	Averaging Period	Background Concentration (µg/m^3)
TSP	24 hr	49.5*
	Annual	32.3*
PM_{10}	24 hr	24.8*
$PM_{2.5}$	24 hr	12.4
	Annual	8.1
Nitrogen Oxides	24 hr	13.9
	1 hr	34.0
Hydrogen Sulphide	24 hr	1.4
	10 min	1.4
Vinyl Chloride	24 hr	0.004
Chloroform	24 hr	0.2
Carbon Monoxide	0.5 hr	1172.6
Sulphur Dioxide	24 hr	3.2
	1 hr	16.0
	Annual	1.3
Odour	10 min	--

Note: * Anticipated to be a conservatively high estimate of baseline conditions as site-specific monitoring of TSP (site operations and background levels) measured lower levels.

4.0 On-Site Activities Impact Assessment

The daily waste acceptance rate of the landfill and number of trucks transporting waste to the site will not be increased from the existing conditions for the preferred alternative. The composition of waste is not expected to change over the landfill expansion. Therefore, the greatest potential impact to the air quality for the landfill expansion will be associated with changes to on-site operations.

On-site operations vary greatly throughout the lifecycle of a landfill. Three (3) worst-case operational scenarios were assessed to determine environmental effects and assess compliance.

After reviewing the cell sequencing plans for lifecycle of the preferred landfill expansion alternative method, three (3) development phases were identified as worst-case scenarios for this assessment. These scenarios are considered milestones in the development of the site and reflect the development of the different expansion areas (vertical expansion of Old Landfill and horizontal expansions of the South and West Landfills) as they are brought "on-line". The scenarios were chosen based on the following considerations:

- The proximity of the active working face to the property line and discrete receptors.
- The length and volume of traffic volumes for the on-site haul routes.
- The predominant wind direction.

Scenario 1 for the preferred alternative represents the worst-case operating condition during the vertical expansion of the Old Landfill. Scenario 2 for the preferred alternative represents the worst-case operating condition during the horizontal expansion of the South Landfill (expansion area "B"). Scenario 3 for the preferred alternative represents the worst-case operating condition during the horizontal expansion of the West Landfill (expansion area "A").

The three (3) scenarios are considered to present reasonable worst-case estimates of potential emissions during the development of the landfill expansion.

The Atmospheric Impact Assessment includes a combination of the background air quality for the region and the contribution of all activities at the landfill with the potential to cause residual effects on the atmospheric environment.

In addition to the evaluation of environmental effects, a compliance assessment was performed to determine whether the site would be anticipated to operate in compliance with sources regulated under *O. Reg. 419/05*. For the Ridge Landfill, this includes landfill gas emissions (fugitive and control equipment) and material handling emissions only. Emissions associated with mobile equipment are not regulated under *O. Reg. 419/05*. Background air quality is not considered in a compliance assessment under *O. Reg. 419/05*.

The operating conditions used in the calculation of the emission estimates, sources and contaminants identification for the existing conditions at the landfill, and three (3) scenarios assessed from lifecycle of the preferred alternative are described below:

4.1 Existing Conditions Source Identification

The air emissions from sources on-site for the current operations, which will hereafter be referred to as the existing conditions, was estimated from operations during the last complete calendar year (2018) at the Ridge Landfill.

The on-site operations that generate emissions of indicator compounds for the existing conditions include the following:

- The use of two (2) landfill gas flares as part of the landfill gas collection system;
- Operations associated with vehicular traffic and material transfer at the active working face (currently located within the South Landfill);
- Material transfer and vehicle operations at two (2) storage piles; soil and recycled aggregate;
- Concrete crushing operations (occurs twice a year, 5-days per event);
- Traffic activities along the paved and unpaved roads on-site; and
- Landfill gas is generated from the Old Landfill, West Landfill, and South Landfill footprints.

The sources and contaminants included in the assessment of the existing conditions at the landfill are provided in the following **Table D3-5**.

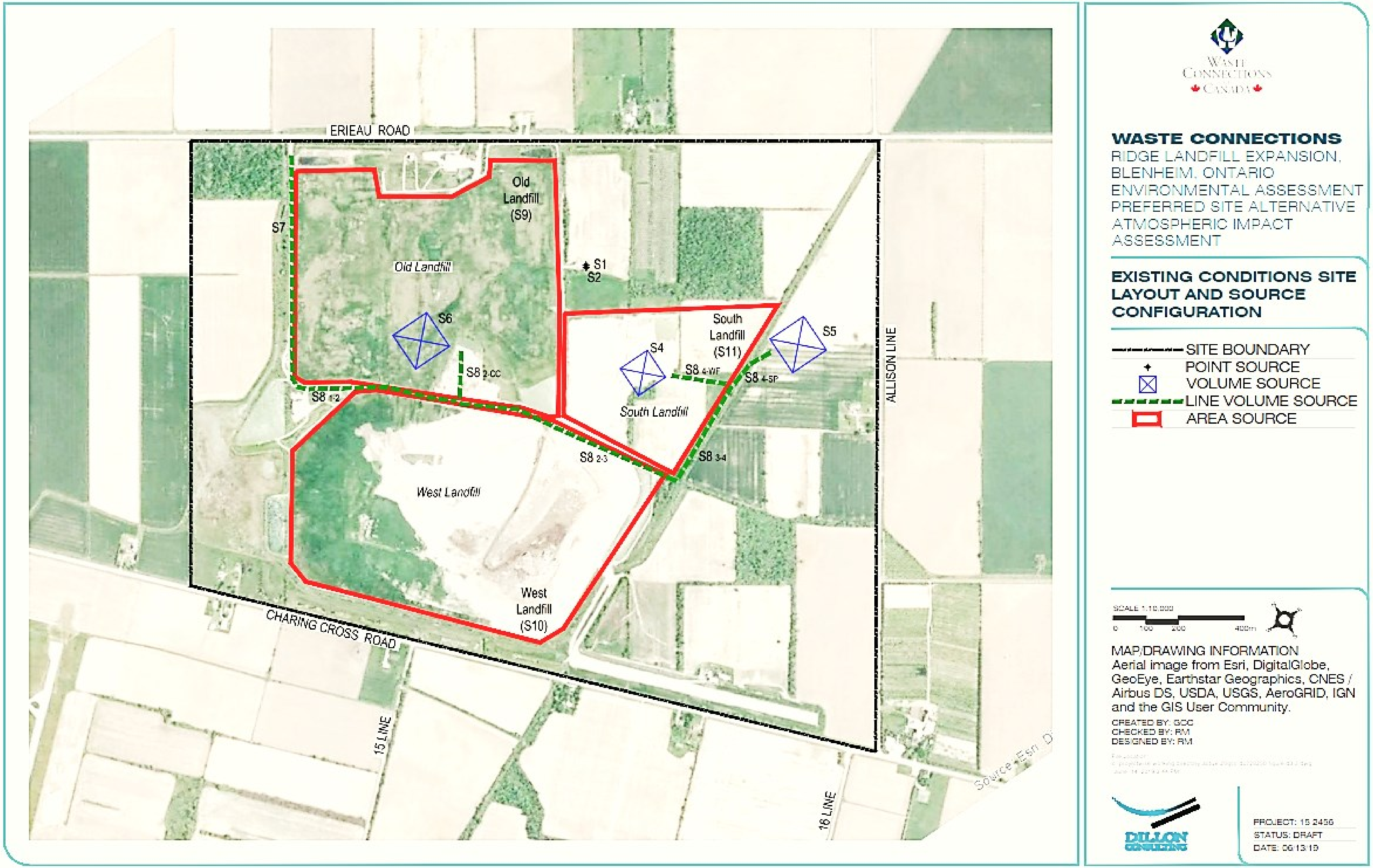
Table D3-5: Source and Contaminants Identification Table - Existing Conditions

Source Information			Contaminants
Source Identifier	Source Description	General Location	
S1	Landfill Gas Flare 1	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S2	Landfill Gas Flare 2	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S4	Active Working Face	South Landfill	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S5	Soil Storage (Pile 1)	Storage Pile	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S6	Concrete Crushing (including Storage Pile 2)	Concrete Crushing	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S7	Paved Road	Paved Road	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide

Source Information			Contaminants
Source Identifier	Source Description	General Location	
			TSP, PM_{10}, $PM_{2.5}$
S8	Unpaved Road	Unpaved Road	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S9	Old Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S10	West Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S11	South Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform

The following **FIGURE D3-3** details the site layout and source configuration for the existing conditions at the Ridge Landfill.

FIGURE D3-3: EXISTING CONDITIONS SITE LAYOUT AND SOURCE CONFIGURATION



4.2 Preferred Alternative Scenario 1 Source Identification

The air emissions from sources on-site for the preferred alternative scenario 1 were estimated from future operations during the year 2024 at the Ridge Landfill. The year 2024 was selected as the worst-case phase of development during the vertical expansion of the Old Landfill. The on-site operations that generate emissions of indicator compounds for preferred alternative scenario 1 conditions include the following:

- The use of four (4) landfill gas flares as part of the landfill gas collection system.
- Operations associated with vehicular traffic and material transfer at the active working face (to be located within the Old Landfill vertical expansion area).
- Material transfer and vehicle operations at two (2) storage piles; soil and recycled aggregate.
- Concrete crushing operations (occurs twice a year, 5-days per event).
- Wood grinding operations (occurs once a year, 5-days per event).
- Traffic activities along the paved and unpaved roads on-site.
- Landfill gas is generated from the Old Landfill (including vertical expansion), West Landfill, and South Landfill footprints.

The sources and contaminants included in the assessment of the preferred alternative scenario 1 at the landfill are provided in the following **Table D3-6**.

Table D3-6: Source and Contaminants Identification Table – Scenario 1

Source Information			Contaminants
Source Identifier	Source Description	General Location	
S1	Landfill Gas Flare 1	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S2		Flare Station	Nitrogen oxides

Source Information			Contaminants
Source Identifier	Source Description	General Location	
	Landfill Gas Flare 2		Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S3a	Landfill Gas Flare 3	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S3b	Landfill Gas Flare 4	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S4	Active Working Face	Old Landfill	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
TSPS5	Soil Storage (Pile 1)	Storage Pile	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S6	Concrete Crushing	Concrete Crushing	Nitrogen oxides
			Sulphur dioxide

Source Information			Contaminants
Source Identifier	**Source Description**	**General Location**	
	(including Storage Pile 2)		Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S7	Paved Road	Paved Road	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S8	Unpaved Road	Unpaved Road	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S9	Old Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S10	West Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S11	South Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform

The following **FIGURE D3-4** details the site layout and source configuration for the preferred alternative scenario 1 at the Ridge Landfill.

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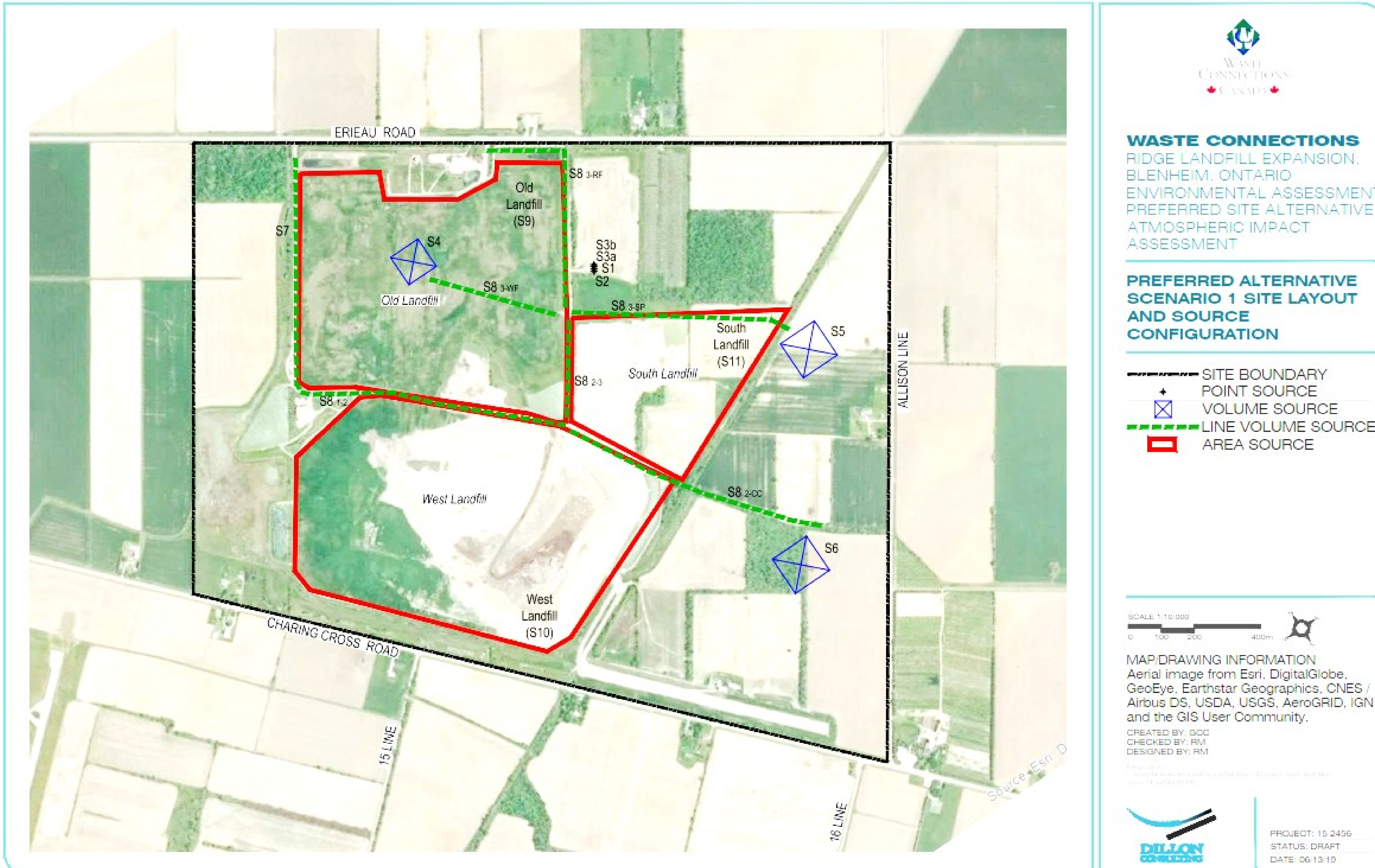
FIGURE D3-4: PREFERRED ALTERNATIVE SCENARIO 1 SITE LAYOUT AND SOURCE CONFIGURATION



4.3 Preferred Alternative Scenario 2 Source Identification

The air emissions from sources on-site for the preferred alternative scenario 2 were estimated from future operations during the year 2028 at the Ridge Landfill. The year 2028 was selected as the worst-case phase of development during the horizontal expansion of the South Landfill (expansion area “B”). The on-site operations that generate emissions of indicator compounds for preferred alternative scenario 2 conditions include the following:

- The use of five (5) landfill gas flares as part of the landfill gas collection system;
- Operations associated with vehicular traffic and material transfer at the active working face (to be located within the South Landfill expansion area “B”);
- Material transfer and vehicle operations at two (2) storage piles; soil and recycled aggregate;
- Concrete crushing operations (occurs twice a year, 5-days per event);
- Wood grinding operations (occurs once a year, 5-days per event);
- Leachate collection system (LCS) construction and cell excavation;
- Traffic activities along the paved and unpaved roads on-site; and
- Landfill gas is generated from the Old Landfill (including vertical expansion), West Landfill, South Landfill, and South Landfill horizontal expansion area “B”.

The sources and contaminants included in the assessment of the preferred alternative scenario 2 at the landfill are provided in the following **Table D3-7**.

Table D3-7: Source and Contaminants Identification Table – Scenario 2

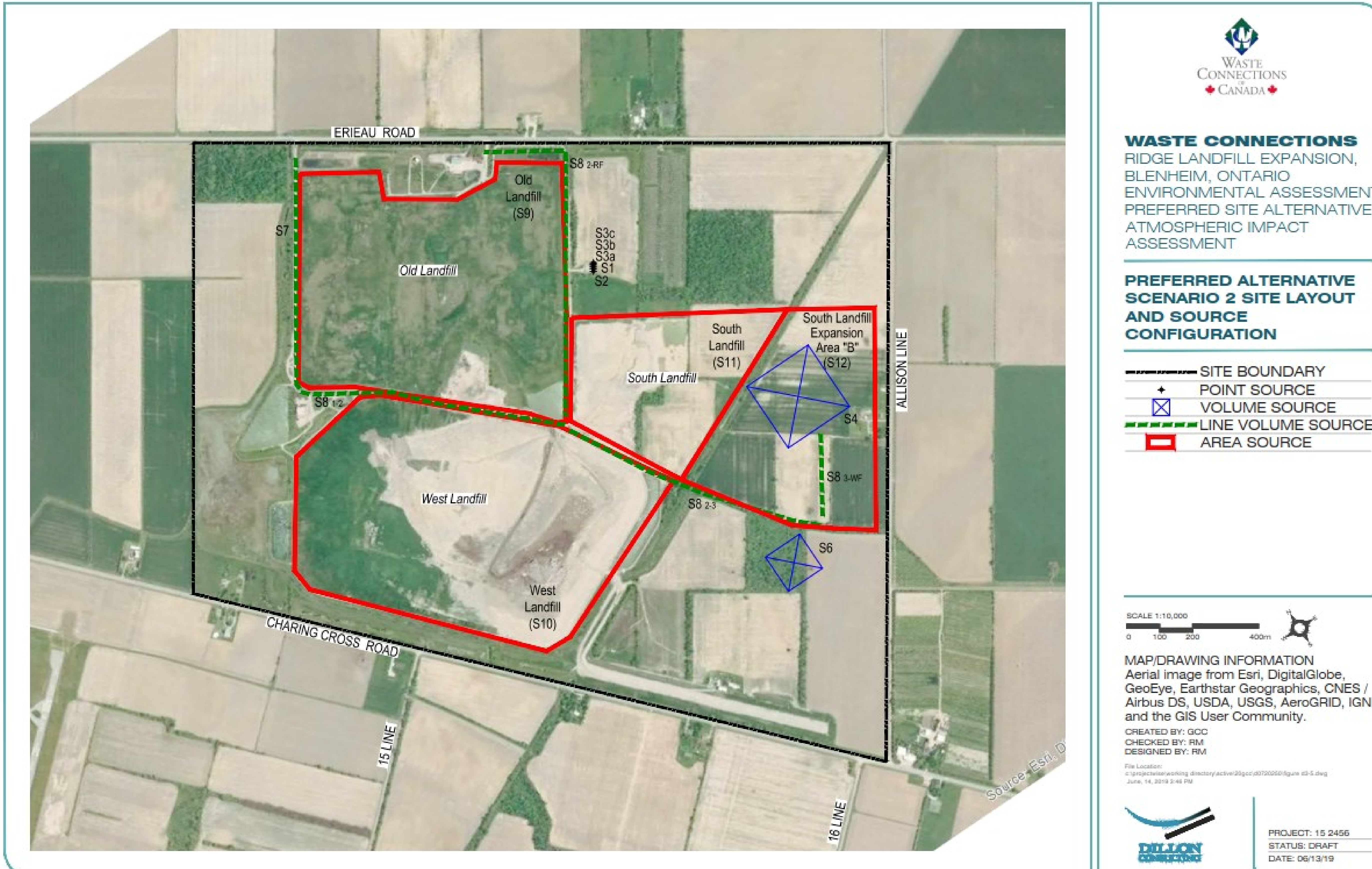
Source Information			Contaminants
Source Identifier	Source Description	General Location	
S1	Landfill Gas Flare 1	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S2	Landfill Gas Flare 2	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S3a	Landfill Gas Flare 3	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S3b	Landfill Gas Flare 4	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform

Source Information			Contaminants
Source Identifier	Source Description	General Location	
S3c	Landfill Gas Flare 5	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S4	Active Working Face (including Storage Pile 1, LCS construction, and cell excavation)	South Landfill Expansion Area "B"	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S6	Concrete Crushing (including wood grinding and Storage Pile 2)	Concrete Crushing	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S7	Paved Road	Paved Road	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S8	Unpaved Road	Unpaved Road	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S9	Old Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S10	West Landfill	Landfill Footprint	Odour
			Hydrogen sulphide

Source Information			Contaminants
Source Identifier	Source Description	General Location	
			Vinyl chloride
			Chloroform
S11	South Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S12	South Landfill Expansion "A"	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform

The following **FIGURE D3-5** details the site layout and source configuration for the preferred alternative scenario 2 at the Ridge Landfill.

FIGURE D3-5: PREFERRED ALTERNATIVE SCENARIO 2 SITE LAYOUT AND SOURCE CONFIGURATION



4.4 Preferred Alternative Scenario 3 Source Identification

The air emissions from sources on-site for the preferred alternative scenario 3 were estimated from future operations during the year 2039 at the Ridge Landfill. The year 2039 was selected as the worst-case phase of development during the horizontal expansion of the West Landfill (expansion area "A"). The on-site operations that generate emissions of indicator compounds for preferred alternative scenario 3 conditions include the following:

- The use of five (5) landfill gas flares as part of the landfill gas collection system.
- Operations associated with vehicular traffic and material transfer at the active working face (to be located within the West Landfill expansion area "A").
- Material transfer and vehicle operations at two (2) storage piles; soil and recycled aggregate.
- Concrete crushing operations (occurs twice a year, 5-days per event).
- Wood grinding operations (occurs once a year, 5-days per event).
- Leachate collection system (LCS) construction and cell excavation.
- Traffic activities along the paved and unpaved roads on-site.
- Landfill gas is generated from the Old Landfill (including vertical expansion), West Landfill, South Landfill, South Landfill horizontal expansion area "B", and West Landfill horizontal expansion area "A".

The sources and contaminants included in the assessment of the preferred alternative scenario 3 at the landfill are provided in the following **Table D3-8**.

Table D3-8: Source and Contaminants Identification Table – Scenario 3

Source Information			Contaminants
Source Identifier	Source Description	General Location	
S1	Landfill Gas Flare 1	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride

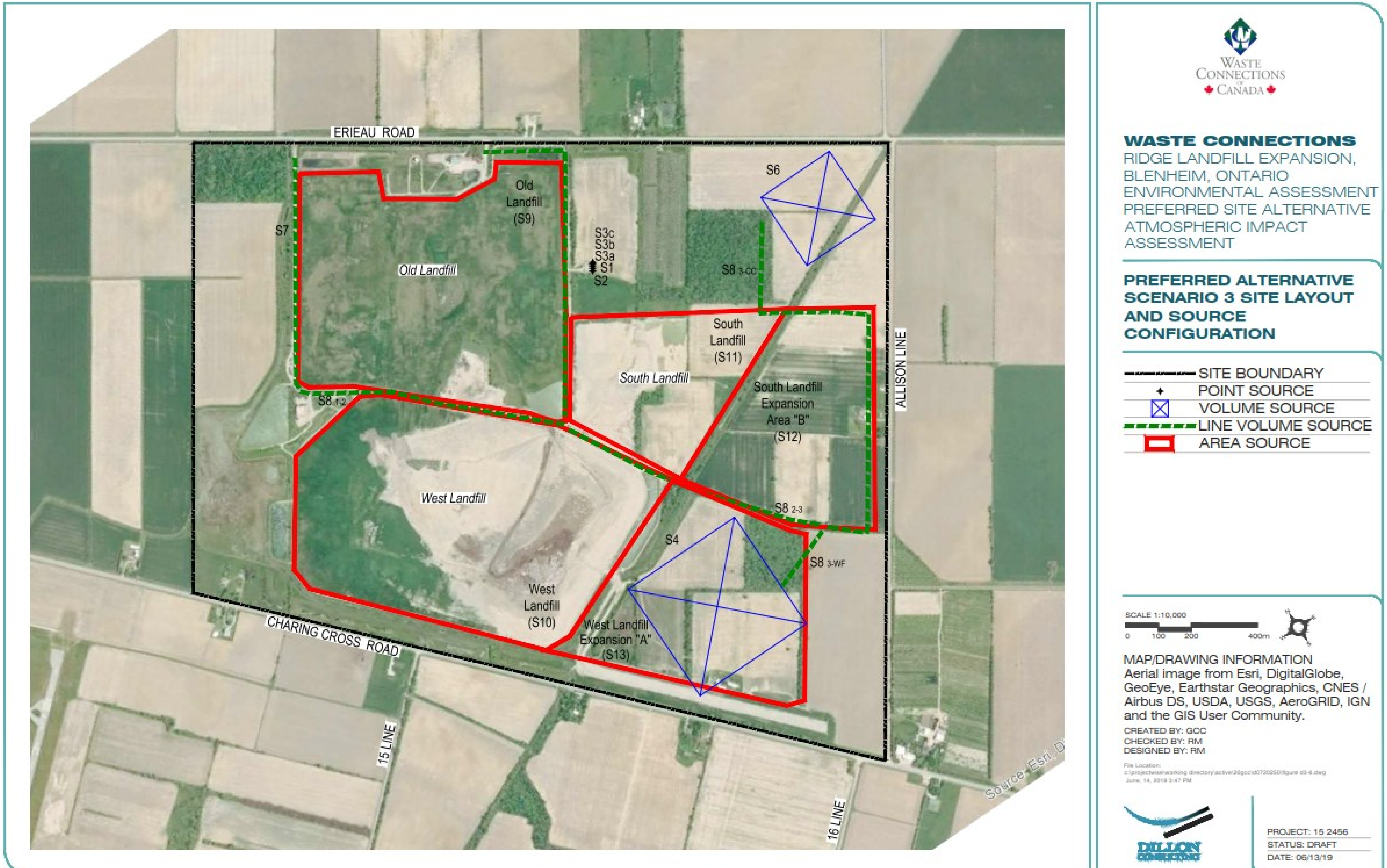
Source Information			Contaminants
Source Identifier	Source Description	General Location	
			Chloroform
S2	Landfill Gas Flare 2	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S3a	Landfill Gas Flare 3	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S3b	Landfill Gas Flare 4	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S3c	Landfill Gas Flare 5	Flare Station	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
			Hydrogen sulphide
			Vinyl chloride
			Chloroform

Source Information			Contaminants
Source Identifier	Source Description	General Location	
S4	Active Working Face (including Storage Pile 2, LCS construction, and cell excavation)	West Landfill Expansion Area "A"	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S6	Concrete Crushing (including wood grinding and Storage Pile 1)	Concrete Crushing	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S7	Paved Road	Paved Road	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S8	Unpaved Road	Unpaved Road	Nitrogen oxides
			Sulphur dioxide
			Carbon monoxide
			TSP, PM_{10}, $PM_{2.5}$
S9	Old Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S10	West Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S11	South Landfill	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform

Source Information			Contaminants
Source Identifier	Source Description	General Location	
S12	South Landfill Expansion "B"	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform
S13	West Landfill Expansion "A"	Landfill Footprint	Odour
			Hydrogen sulphide
			Vinyl chloride
			Chloroform

The following **FIGURE D3-6** details the site layout and source configuration for the preferred alternative scenario 3 at the Ridge Landfill.

FIGURE D3-6: PREFERRED ALTERNATIVE SCENARIO 3 SITE LAYOUT AND SOURCE CONFIGURATION



4.5 Source Configurations

The following provides a detailed breakdown of source configurations used as inputs to the dispersion model. Fugitive sources of emissions such as: construction activities, cell excavation, active working face operations, and concrete crushing were modelled as volume sources. Emissions associated with roadways, both paved and unpaved were modelled as line volume sources. Emissions associated with the landfill footprints were modelled as area sources. Landfill gas flare stacks were modelled as individual point sources.

The sources at the landfill that fit the physical parameters associated with a well-mixed plume provided by a volume source include areas with material transfer and non-road vehicle movement. The volume source dimensions have been estimated based on satellite imagery of existing working areas and release heights of equipment operating within the volume source. The dimensions of the volume source representing the active working face for preferred alternative scenario 3 have been increased to account for the increased initial dispersion that will be experienced due to the proximity of the berm along the southwest site boundary.

The MECP's *Air Dispersion Modeling Guideline for Ontario* (ADMGO) recommends that roadways be modelled using a line volume source which is represented by a series of separated volume sources. The MECP recognizes the limitations of this modelling approach (inability to appropriately simulate the turbulence and added dispersion that occurs in the wake of vehicular traffic) and understands the potential for the model to produce overly conservative results. The haul road[11] volume sources were defined based on the average height of a refuse truck (3.8 m) and on-site haul road width (10 m) to calculate the volume sources initial plume height and width.

Fugitive emissions from the landfill footprints are best represented by area sources which are used to model low level or ground releases from flat surfaces. In accordance with discussions with the MECP, each landfill footprint (Old Landfill, West Landfill, South Landfill, South Landfill expansion Area "B", and West Landfill expansion Area "A") were modelled as a separate area source. The release elevation of the emissions of these sources were conservatively estimated as half of the final landfill height.

Emissions from the landfill gas enclosed flare stacks were modelled as point sources.

[11] The haul road refers to the internal road network within the property boundary of the Ridge Landfill.

A summary of model source types for the existing conditions and preferred alternative scenarios are provided in **Table D3-9** to **Table D3-12**.

Table D3-9: Existing Conditions Model Source Types

Source Identifier	Source Description	Source Data					UTM Coordinate	
		Stack Gas Flow Rate	Exhaust Temperature	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof		
		[m³/s]	[°C]	[m]	[m]	[m]	X	Y
S1	Flare 1	47.1	668	2.9	11.6	-	413450.6	4684955.4
S2	Flare 2	47.1	668	2.9	11.6	-	413455.1	4684962.2
S4	Active Working Face	Modelled as a volume source					413413.1	4684590.3
S5	Storage Pile 1	Modelled as a volume source					413856.9	4684395.5
S6	Concrete Crushing (including Storage Pile 2)	Modelled as a volume source					412904.4	4685053.1
S7	Paved Road	Modelled as line volume sources					various	
$S8_{1-2}$	Unpaved Road Segment 1	Modelled as line volume sources					various	
$S8_{2-CC}$	Unpaved Road Segment 2	Modelled as line volume sources					various	
$S8_{2-3}$	Unpaved Road Segment 3	Modelled as line volume sources					various	
$S8_{3-4}$	Unpaved Road Segment 4	Modelled as line volume sources					various	

Source Identifier	Source Description	Source Data					UTM Coordinate	
		Stack Gas Flow Rate	Exhaust Temperature	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof		
		[m³/s]	[°C]	[m]	[m]	[m]	X	Y
S8$_{4\text{-WF}}$	Unpaved Road Segment 5	Modelled as line volume sources					various	
S8$_{4\text{-SP}}$	Unpaved Road Segment 6	Modelled as line volume sources					various	
S9	Old Landfill	Modelled as an area source					412877.9	4685699.9
S10	West Landfill	Modelled as an area source					413102.8	4684623.3
S11	South Landfill	Modelled as an area source					413316.9	4684875.8

Table D3-10: Preferred Alternative Scenario 1 Model Source Types

Source Identifier	Source Description	Source Data					UTM Coordinate	
		Stack Gas Flow Rate	Exhaust Temperature	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof		
		[m³/s]	[°C]	[m]	[m]	[m]	X	Y
S1	Flare 1	47.1	668	2.9	11.6	-	413454.2	4684962.9
S2	Flare 2	47.1	668	2.9	11.6	-	413450.1	4684955.8
S3a	Flare 3	47.1	668	2.9	11.6	-	413458.0	4684968.7
S3b	Flare 4	47.1	668	2.9	11.6	-	413461.2	4684973.2
S4	Active Working Face	Modelled as a volume source					412950.7	4685373.0
S5	Storage Pile 1	Modelled as a volume source					413856.9	4684395.5
S6	Concrete Crushing(including wood grinding and Storage Pile 2)	Modelled as a volume source					413471.5	4683868.1
S7	Paved Road	Modelled as line volume sources					various	
$S8_{1-2}$	Unpaved Road Segment 1	Modelled as line volume sources					various	
$S8_{2-CC}$	Unpaved Road Segment 2	Modelled as line volume sources					various	
$S8_{2-3}$	Unpaved Road Segment 3	Modelled as line volume sources					various	
$S8_{3-RF}$	Unpaved Road Segment 4	Modelled as line volume sources					various	
$S8_{3-WF}$	Unpaved Road Segment 5	Modelled as line volume sources					various	
$S8_{3-SP}$	Unpaved Road Segment 6	Modelled as line volume sources					various	
S9	Old Landfill	Modelled as an area source					412877.9	4685699.9
S10	West Landfill	Modelled as an area source					413102.8	4684623.3
S11	South Landfill	Modelled as an area source					413316.9	4684875.8

Table D3-11: Preferred Alternative Scenario 2 Model Source Types

Source Identifier	Source Description	Source Data					UTM Coordinate	
		Stack Gas Flow Rate	Exhaust Temperature	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof		
		[m³/s]	[°C]	[m]	[m]	[m]	X	Y
S1	Flare 1	47.1	668	2.9	11.6	-	413454.2	4684962.9
S2	Flare 2	47.1	668	2.9	11.6	-	413450.1	4684955.8
S3a	Flare 3	47.1	668	2.9	11.6	-	413458.0	4684968.7
S3b	Flare 4	47.1	668	2.9	11.6	-	413461.2	4684973.2
S3c	Flare 5	58.9	668	2.9	11.6	-	413464.5	4684977.4
S4	Active Working Face(including storage pile 1, LCS construction, and cell excavation)	Modelled as a volume source					413752.2	4684293.1
S6	Concrete Crushing (including wood grinding and Storage Pile 2)	Modelled as a volume source					413459.6	4683882.7
S7	Paved Road	Modelled as line volume sources					various	
$S8_{1-2}$	Unpaved Road Segment 1	Modelled as line volume sources					various	
$S8_{2-3}$	Unpaved Road Segment 2	Modelled as line volume sources					various	
$S8_{2-RF}$	Unpaved Road Segment 3	Modelled as line volume sources					various	
$S8_{3-WF}$	Unpaved Road Segment 4	Modelled as line volume sources					various	
S9	Old Landfill	Modelled as an area source					412877.9	4685699.9
S10	West Landfill	Modelled as an area source					413102.8	4684623.3
S11	South Landfill	Modelled as an area source					413316.9	4684875.8

Source Identifier	Source Description	Source Data					UTM Coordinate	
		Stack Gas Flow Rate	Exhaust Temperature	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof		
		[m^3/s]	[°C]	[m]	[m]	[m]	X	Y
S12	South Landfill Expansion	Modelled as an area source					413317.5	4684282.9

Table D3-12: Preferred Alternative Scenario 3 Model Source Types

Source Identifier	Source Description	Source Data					UTM Coordinate	
		Stack Gas Flow Rate	Exhaust Temperature	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof		
		[m³/s]	[°C]	[m]	[m]	[m]	X	Y
S1	Flare 1	47.1	668	2.9	11.6	-	413454.2	4684962.9
S2	Flare 2	47.1	668	2.9	11.6	-	413450.1	4684955.8
S3a	Flare 3	47.1	668	2.9	11.6	-	413458.0	4684968.7
S3b	Flare 4	47.1	668	2.9	11.6	-	413461.2	4684973.2
S3c	Flare 5	58.9	668	2.9	11.6	-	413464.5	4684977.4
S4	Active Working Face (including Storage Pile 2, LCS construction, and cell excavation)	Modelled as a volume source					413192.6	4683899.7
S6	Concrete Crushing(including Storage Pile 1 and wood grinding)	Modelled as a volume source					414123.8	4684729.9
S7	Paved Road	Modelled as line volume sources					various	
$S8_{1-2}$	Unpaved Road Segment 1	Modelled as line volume sources					various	
$S8_{2-3}$	Unpaved Road Segment 2	Modelled as line volume sources					various	
$S8_{2-RF}$	Unpaved Road Segment 3	Modelled as line volume sources					various	
$S8_{3-WF}$	Unpaved Road Segment 4	Modelled as line volume sources					various	
$S8_{3-CC}$	Unpaved Road Segment 5	Modelled as line volume sources					various	
S9	Old Landfill	Modelled as an area source					412877.9	4685699.9
S10	West Landfill	Modelled as an area source					413102.8	4684623.3
S11	South Landfill	Modelled as an area source					413316.9	4684875.8

Source Identifier	Source Description	Source Data					UTM Coordinate	
		Stack Gas Flow Rate	Exhaust Temperature	Stack Diameter	Stack Height Above Grade	Stack Height Above Roof		
		[m³/s]	[°C]	[m]	[m]	[m]	X	Y
S12	South Landfill Expansion	Modelled as an area source					413317.5	4684282.9
S13	West Landfill Expansion	Modelled as an area source					413295.0	4684292.7

4.6 Emission Rates

The emissions were developed for the existing conditions and preferred alternative using industry accepted methodologies.

As per consultation with the MECP, the emissions from the landfill footprints were estimated using US EPA LandGEM models for each individual landfill area and taking the landfill gas generation rate at each preferred alternative scenario year.

Emissions from the landfill gas flares were estimated based on US EPA LandGEM models, flare specifications, and US EPA emission factors[12].

The emissions for paved and unpaved roads were estimated based on US EPA emission factors[13,14] and on-site vehicle activity along the haul route[15].

The emissions from material transfers at the working face and storage piles were estimated based on average hourly transfer rates and US EPA emission factors[16].

The emissions from concrete crushing operations is based on the maximum throughput capacity of the equipment and US EPA emission factors[17].

Non-road vehicle emissions were estimated using available US EPA non-road engine emission factors[18] and the hours of operation[19].

On-road vehicle emissions were estimated using the US EPA Motor Vehicle Emission Simulator (MOVES) model. MOVES was used to estimate an emission rate per unit distance for tailpipe emissions from the typical on-road vehicles expected at the site. A summary of the major inputs for the MOVES model is provided in **Table D3-13** below.

[12] US EPA. AP-42 Chapter 2.4 "Municipal Solid Waste Landfills. Draft Section. October 2008.
[13] US EPA. AP-42 Chapter 13.2.1 "Paved Roads". Final Section. January 2011.
[14] US EPA. AP-42 Chapter 13.2.2 "Unpaved Roads". Final Section. November 2006.
[15] Golder. Technical Memorandum. "Ridge Landfill Expansion EA – Old landfill design optimization and information for visual, air and noise impact assessment of the preferred expansion alternative". January 31, 2019.
[16] US EPA. AP-42 Chapter 13.2.4 "Aggregate Handling and Storage Piles". Final Section. November 2006.
[17] US EPA. AP-42 Chapter 11.19.2 "Crushed Stone Processing and Pulverized Mineral Processing". Final Section. August 2004.
[18] US EPA. "Exhaust and Crankcase Emission Factors for Nonroad Engine Modelling – Compression-Ignition NR-009d". July 2010.
[19] Golder. Technical Memorandum. "Ridge Landfill Expansion EA – Old landfill design optimization and information for visual, air and noise impact assessment of the preferred expansion alternative". January 31, 2019.

Table D3-13: MOVES Input Parameters

Parameter	Input
Scale/Geographic Bounds	Custom County Domain
Meteorology	Temperature and relative humidity were obtained from the Environment Canada Chatham-Kent weather station for the 2018 year.
Years	2018, 2024, 2028, and 2039
Fuels	Diesel fuels and gasoline fuels. Default fuel inputs from Genesee County, Michigan were used to represent Chatham-Kent.
Source Use Types	Refuse truck and light passenger truck
Road Type	Rural unrestricted access
Contaminants	NO_x, CO, SO_2, PM_{10}, and $PM_{2.5}$. TSP cannot be directly modelled in MOVES. It was estimated that all tailpipe emissions were PM_{10} or less, therefore, the PM_{10} emissions were used for TSP.
Vehicle Age Distribution	Vehicle age was based on US EPA's default distribution[20].

A detailed calculation summary for the existing conditions are provided in **Appendix D3A - 1 –** Atmospheric Impact Assessment Report. A detailed calculation summary for the preferred alternative scenario 1, 2 and 3 are provided in **Appendices D3B-2, -3** and -**4** respectively.

4.6.1 Effects Assessment Emission Rates

The environmental effects from the existing conditions at the Ridge Landfill and preferred alternative expansion include all potential sources of atmospheric emissions on-site. The estimated emission rates attributing to the environmental effects of the existing conditions and preferred alternative are provided in **Table D3-14** to **Table D3-17** below.

[20] US EPA. Population and Activity of On-road Vehicles in MOVES2014. Draft Report. EPA-420-D-15-001. July 2015.

Table D3-14: Environmental Effects Existing Conditions Emission Rates

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S1	Flare 1	Nitrogen oxides	10102-44-0	3.46E-01	1	10%
		Nitrogen oxides	10102-44-0	3.46E-01	24	17%
		Sulphur dioxide	7446-09-05	1.40E-01	1	49%
		Sulphur dioxide	7446-09-05	1.40E-01	24	50%
		Sulphur dioxide	7446-09-05	1.40E-01	annual	50%
		Carbon monoxide	630-08-0	4.04E-01	0.5	35%
		TSP	N/A - TSP	1.30E-01	24	2%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	7%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	29%
		Hydrogen sulphide	7783-06-04	1.41E-04	10-min	0.4%
		Hydrogen sulphide	7783-06-04	1.41E-04	24	0.4%
		Vinyl chloride	75-01-4	5.23E-05	24	0.4%
		Chloroform	67-66-3	4.11E-07	24	0.4%
S2	Flare 2	Nitrogen oxides	10102-44-0	3.46E-01	1	10%
		Nitrogen oxides	10102-44-0	3.46E-01	24	17%
		Sulphur dioxide	7446-09-05	1.40E-01	1	49%
		Sulphur dioxide	7446-09-05	1.40E-01	24	50%
		Sulphur dioxide	7446-09-05	1.40E-01	annual	50%
		Carbon monoxide	630-08-0	4.04E-01	0.5	35%
		TSP	N/A - TSP	1.30E-01	24	2%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	7%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	29%
		Hydrogen sulphide	7783-06-04	1.41E-04	10-min	0.4%
		Hydrogen sulphide	7783-06-04	1.41E-04	24	0.4%
		Vinyl chloride	75-01-4	5.23E-05	24	0.4%
		Chloroform	67-66-3	4.11E-07	24	0.4%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S4	Active Working Face	Nitrogen oxides	10102-44-0	1.48E+00	1	41%
		Nitrogen oxides	10102-44-0	9.08E-01	24	44%
		Sulphur dioxide	7446-09-05	1.99E-03	1	1%
		Sulphur dioxide	7446-09-05	1.16E-03	24	0.4%
		Sulphur dioxide	7446-09-05	1.16E-03	annual	0.4%
		Carbon monoxide	630-08-0	5.50E-02	0.5	5%
		TSP	N/A - TSP	1.83E-02	24	0.3%
		PM_{10}	N/A - PM_{10}	1.32E-02	24	0.7%
		$PM_{2.5}$	N/A - $PM_{2.5}$	9.23E-03	24	2%
S5	Storage Pile 1	Nitrogen oxides	10102-44-0	1.64E-01	1	5%
		Nitrogen oxides	10102-44-0	4.54E-02	24	2%
		Sulphur dioxide	7446-09-05	2.25E-04	1	0.1%
		Sulphur dioxide	7446-09-05	6.24E-05	24	0.02%
		Sulphur dioxide	7446-09-05	6.24E-05	annual	0.02%
		Carbon monoxide	630-08-0	5.50E-03	0.5	0.5%
		TSP	N/A - TSP	1.33E-03	24	0.02%
		PM_{10}	N/A - PM_{10}	7.17E-04	24	0.04%
		$PM_{2.5}$	N/A - $PM_{2.5}$	2.50E-04	24	0.06%
S6	Concrete Crushing (including Storage Pile 2)	Nitrogen oxides	10102-44-0	8.44E-01	1	24%
		Nitrogen oxides	10102-44-0	2.75E-01	24	13%
		Sulphur dioxide	7446-09-05	1.15E-03	1	0.4%
		Sulphur dioxide	7446-09-05	3.74E-04	24	0.1%
		Sulphur dioxide	7446-09-05	3.74E-04	annual	0.1%
		Carbon monoxide	630-08-0	1.78E-01	0.5	15%
		TSP	N/A - TSP	2.53E-01	24	4%
		PM_{10}	N/A - PM_{10}	1.11E-01	24	6%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.34E-02	24	3%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S7	Paved Road	Nitrogen oxides	10102-44-0	1.15E-01	1	3%
		Nitrogen oxides	10102-44-0	4.71E-02	24	2%
		Sulphur dioxide	7446-09-05	2.25E-04	1	0.1%
		Sulphur dioxide	7446-09-05	9.14E-05	24	0.03%
		Sulphur dioxide	7446-09-05	9.14E-05	annual	0.03%
		Carbon monoxide	630-08-0	3.16E-02	0.5	3%
		TSP	N/A - TSP	8.44E-01	24	14%
		PM_{10}	N/A - PM_{10}	1.66E-01	24	9%
		$PM_{2.5}$	N/A - $PM_{2.5}$	4.12E-02	24	9%
$S8_{1-2}$	Unpaved Road Segment 1	Nitrogen oxides	10102-44-0	7.03E-02	1	2%
		Nitrogen oxides	10102-44-0	2.89E-02	24	1%
		Sulphur dioxide	7446-09-05	1.29E-04	1	0.05%
		Sulphur dioxide	7446-09-05	5.23E-05	24	0.02%
		Sulphur dioxide	7446-09-05	5.23E-05	annual	0.02%
		Carbon monoxide	630-08-0	1.93E-02	0.5	2%
		TSP	N/A - TSP	1.20E+00	24	20%
		PM_{10}	N/A - PM_{10}	3.26E-01	24	18%
		$PM_{2.5}$	N/A - $PM_{2.5}$	3.36E-02	24	7%
$S8_{2-CC}$	Unpaved Road Segment 2	Nitrogen oxides	10102-44-0	1.44E-02	1	0.4%
		Nitrogen oxides	10102-44-0	5.89E-03	24	0.3%
		Sulphur dioxide	7446-09-05	1.66E-05	1	0.01%
		Sulphur dioxide	7446-09-05	6.43E-06	24	0.002%
		Sulphur dioxide	7446-09-05	6.43E-06	annual	0.002%
		Carbon monoxide	630-08-0	3.54E-03	0.5	0.3%
		TSP	N/A - TSP	2.17E-02	24	0.4%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
		PM_{10}	N/A - PM_{10}	6.00E-03	24	0.3%
		PM2.5	N/A - PM2.5	7.60E-04	24	0.2%
$S8_{2-3}$	Unpaved Road Segment 3	Nitrogen oxides	10102-44-0	1.09E-01	1	3%
		Nitrogen oxides	10102-44-0	4.48E-02	24	2.150%
		Sulphur dioxide	7446-09-05	1.99E-04	1	0.1%
		Sulphur dioxide	7446-09-05	8.06E-05	24	0.03%
		Sulphur dioxide	7446-09-05	8.06E-05	annual	0.03%
		Carbon monoxide	630-08-0	3.00E-02	0.5	3%
		TSP	N/A - TSP	1.83E+00	24	31%
		PM_{10}	N/A - PM_{10}	4.98E-01	24	28%
		$PM_{2.5}$	N/A - $PM_{2.5}$	5.14E-02	24	11%
$S8_{3-4}$	Unpaved Road Segment 4	Nitrogen oxides	10102-44-0	5.09E-02	1	1%
		Nitrogen oxides	10102-44-0	2.09E-02	24	1%
		Sulphur dioxide	7446-09-05	9.52E-05	1	0.03%
		Sulphur dioxide	7446-09-05	3.86E-05	24	0.01%
		Sulphur dioxide	7446-09-05	3.86E-05	annual	0.01%
		Carbon monoxide	630-08-0	1.41E-02	0.5	1%
		TSP	N/A - TSP	9.07E-01	24	15%
		PM_{10}	N/A - PM_{10}	2.46E-01	24	14%
		$PM_{2.5}$	N/A - $PM_{2.5}$	2.54E-02	24	6%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
$S8_{4\text{-}WF}$	Unpaved Road Segment 5	Nitrogen oxides	10102-44-0	2.60E-02	1	1%
		Nitrogen oxides	10102-44-0	1.07E-02	24	1%
		Sulphur dioxide	7446-09-05	4.86E-05	1	0.02%
		Sulphur dioxide	7446-09-05	1.97E-05	24	0.01%
		Sulphur dioxide	7446-09-05	1.97E-05	annual	0.01%
		Carbon monoxide	630-08-0	7.19E-03	0.5	1%
		TSP	N/A - TSP	4.63E-01	24	8%
		PM_{10}	N/A - PM_{10}	1.26E-01	24	7%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-02	24	3%
$S8_{4\text{-}SP}$	Unpaved Road Segment 6	Nitrogen oxides	10102-44-0	1.52E-02	1	0.4%
		Nitrogen oxides	10102-44-0	6.22E-03	24	0.3%
		Sulphur dioxide	7446-09-05	1.79E-05	1	0.01%
		Sulphur dioxide	7446-09-05	6.96E-06	24	0.002%
		Sulphur dioxide	7446-09-05	6.96E-06	annual	0.002%
		Carbon monoxide	630-08-0	3.75E-03	0.5	0.3%
		TSP	N/A - TSP	4.99E-02	24	1%
		PM_{10}	N/A - PM_{10}	1.36E-02	24	1%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.53E-03	24	0.3%
S9	Old Landfill	Odour	N/A - Odour	6.89E+02 OU/S	10-min	10%
		Hydrogen sulphide	7783-06-04	3.52E-03	10-min	10.3%
		Hydrogen sulphide	7783-06-04	3.52E-03	24	10.3%
		Vinyl chloride	75-01-4	1.31E-03	24	10.3%
		Chloroform	67-66-3	1.03E-05	24	10.3%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S10	West Landfill	Odour	N/A - Odour	5.60E+03 OU/S	10-min	85%
		Hydrogen sulphide	7783-06-04	2.86E-02	10-min	84.1%
		Hydrogen sulphide	7783-06-04	2.86E-02	24	84.1%
		Vinyl chloride	75-01-4	1.06E-02	24	84.1%
		Chloroform	67-66-3	8.35E-05	24	84.1%
S11	South Landfill	Odour	N/A - Odour	3.19E+02 OU/S	10-min	5%
		Hydrogen sulphide	7783-06-04	1.63E-03	10-min	4.8%
		Hydrogen sulphide	7783-06-04	1.63E-03	24	4.8%
		Vinyl chloride	75-01-4	6.05E-04	24	4.8%
		Chloroform	67-66-3	4.75E-06	24	4.8%

Table D3-15: Environmental Effects Preferred Alternative Scenario 1 Emission Rates

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S1	Flare 1	Nitrogen oxides	10102-44-0	3.46E-01	1	8%
		Nitrogen oxides	10102-44-0	3.46E-01	24	13%
		Sulphur dioxide	7446-09-05	1.16E-01	1	25%
		Sulphur dioxide	7446-09-05	1.16E-01	24	25%
		Sulphur dioxide	7446-09-05	1.16E-01	annual	25%
		Carbon monoxide	630-08-0	4.04E-01	0.5	21%
		TSP	N/A - TSP	1.30E-01	24	1%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	6%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	18%
		Hydrogen sulphide	7783-06-04	1.90E-04	10-min	0.4%
		Hydrogen sulphide	7783-06-04	1.90E-04	24	0.4%
		Vinyl chloride	75-01-4	7.05E-05	24	0.4%
		Chloroform	67-66-3	5.54E-07	24	0.4%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S2	Flare 2	Nitrogen oxides	10102-44-0	3.46E-01	1	8%
		Nitrogen oxides	10102-44-0	3.46E-01	24	13%
		Sulphur dioxide	7446-09-05	1.16E-01	1	25%
		Sulphur dioxide	7446-09-05	1.16E-01	24	25%
		Sulphur dioxide	7446-09-05	1.16E-01	annual	25%
		Carbon monoxide	630-08-0	4.04E-01	0.5	21%
		TSP	N/A - TSP	1.30E-01	24	1%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	6%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	18%
		Hydrogen sulphide	7783-06-04	1.90E-04	10-min	0.4%
		Hydrogen sulphide	7783-06-04	1.90E-04	24	0.4%
		Vinyl chloride	75-01-4	7.05E-05	24	0.4%
		Chloroform	67-66-3	5.54E-07	24	0.4%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S3a	Flare 3	Nitrogen oxides	10102-44-0	3.46E-01	1	8%
		Nitrogen oxides	10102-44-0	3.46E-01	24	13%
		Sulphur dioxide	7446-09-05	1.16E-01	1	25%
		Sulphur dioxide	7446-09-05	1.16E-01	24	25%
		Sulphur dioxide	7446-09-05	1.16E-01	annual	25%
		Carbon monoxide	630-08-0	4.04E-01	0.5	21%
		TSP	N/A - TSP	1.30E-01	24	1%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	6%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	18%
		Hydrogen sulphide	7783-06-04	1.90E-04	10-min	0.4%
		Hydrogen sulphide	7783-06-04	1.90E-04	24	0.4%
		Vinyl chloride	75-01-4	7.05E-05	24	0.4%
		Chloroform	67-66-3	5.54E-07	24	0.4%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S3b	Flare 4	Nitrogen oxides	10102-44-0	3.46E-01	1	8%
		Nitrogen oxides	10102-44-0	3.46E-01	24	13%
		Sulphur dioxide	7446-09-05	1.16E-01	1	25%
		Sulphur dioxide	7446-09-05	1.16E-01	24	25%
		Sulphur dioxide	7446-09-05	1.16E-01	annual	25%
		Carbon monoxide	630-08-0	4.04E-01	0.5	21%
		TSP	N/A - TSP	1.30E-01	24	1%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	6%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	18%
		Hydrogen sulphide	7783-06-04	1.90E-04	10-min	0.4%
		Hydrogen sulphide	7783-06-04	1.90E-04	24	0.4%
		Vinyl chloride	75-01-4	7.05E-05	24	0.4%
		Chloroform	67-66-3	5.54E-07	24	0.4%

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Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S4	Active Working Face	Nitrogen oxides	10102-44-0	1.48E+00	1	35%
		Nitrogen oxides	10102-44-0	9.08E-01	24	33%
		Sulphur dioxide	7446-09-05	1.99E-03	1	0.4%
		Sulphur dioxide	7446-09-05	1.16E-03	24	0.2%
		Sulphur dioxide	7446-09-05	1.16E-03	annual	0.2%
		Carbon monoxide	630-08-0	5.50E-02	0.5	3%
		TSP(1)	N/A - TSP	4.40E-02	24	0.3%
		PM_{10}	N/A - PM_{10}	1.32E-02	24	0.6%
		$PM_{2.5}$	N/A - $PM_{2.5}$	9.23E-03	24	1%
S5	Storage Pile 1	Nitrogen oxides	10102-44-0	1.64E-01	1	4%
		Nitrogen oxides	10102-44-0	4.54E-02	24	2%
		Sulphur dioxide	7446-09-05	2.25E-04	1	0.05%
		Sulphur dioxide	7446-09-05	6.24E-05	24	0.01%
		Sulphur dioxide	7446-09-05	6.24E-05	annual	0.01%
		Carbon monoxide	630-08-0	5.50E-03	0.5	0.3%
		TSP	N/A - TSP	3.19E-03	24	0.02%
		PM_{10}	N/A - PM_{10}	7.17E-04	24	0.04%
		$PM_{2.5}$	N/A - $PM_{2.5}$	2.50E-04	24	0.04%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S6	Concrete Crushing(including wood grinding and Storage Pile 2)(2)	Nitrogen oxides	10102-44-0	8.44E-01	1	20%
		Nitrogen oxides	10102-44-0	2.75E-01	24	10%
		Sulphur dioxide	7446-09-05	1.15E-03	1	0.2%
		Sulphur dioxide	7446-09-05	3.74E-04	24	0.1%
		Sulphur dioxide	7446-09-05	3.74E-04	annual	0.1%
		Carbon monoxide	630-08-0	1.78E-01	0.5	9%
		TSP(1)	N/A - TSP	6.08E-01	24	4%
		PM_{10}	N/A - PM_{10}	1.11E-01	24	5%
		PM2.5	N/A - PM2.5	1.34E-02	24	2%
S7	Paved Road	Nitrogen oxides	10102-44-0	6.54E-02	1	2%
		Nitrogen oxides	10102-44-0	2.69E-02	24	1%
		Sulphur dioxide	7446-09-05	1.67E-04	1	0.04%
		Sulphur dioxide	7446-09-05	6.82E-05	24	0.01%
		Sulphur dioxide	7446-09-05	6.82E-05	annual	0.01%
		Carbon monoxide	630-08-0	1.88E-02	0.5	1%
		TSP(1)	N/A - TSP	2.12E+00	24	15%
		PM_{10}	N/A - PM_{10}	1.72E-01	24	8%
		$PM_{2.5}$	N/A - $PM_{2.5}$	4.20E-02	24	6%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
$S8_{1-2}$	Unpaved Road Segment 1	Nitrogen oxides	10102-44-0	6.85E-02	1	2%
		Nitrogen oxides	10102-44-0	2.81E-02	24	1%
		Sulphur dioxide	7446-09-05	1.72E-04	1	0.04%
		Sulphur dioxide	7446-09-05	7.01E-05	24	0.01%
		Sulphur dioxide	7446-09-05	7.01E-05	annual	0.01%
		Carbon monoxide	630-08-0	1.78E-02	0.5	1%
		TSP(1)	N/A - TSP	5.11E+00	24	36%
		PM_{10}	N/A - PM_{10}	5.77E-01	24	28%
		$PM_{2.5}$	N/A - $PM_{2.5}$	5.86E-02	24	8%
$S8_{2-CC}$	Unpaved Road Segment 2	Nitrogen oxides	10102-44-0	5.14E-02	1	1%
		Nitrogen oxides	10102-44-0	2.10E-02	24	0.8%
		Sulphur dioxide	7446-09-05	6.01E-05	1	0.01%
		Sulphur dioxide	7446-09-05	2.34E-05	24	0.005%
		Sulphur dioxide	7446-09-05	2.34E-05	annual	0.005%
		Carbon monoxide	630-08-0	1.26E-02	0.5	0.6%
		TSP(1)	N/A - TSP	3.04E-01	24	2.1%
		PM_{10}	N/A - PM_{10}	3.47E-02	24	1.7%
		$PM_{2.5}$	N/A - $PM_{2.5}$	4.04E-03	24	0.6%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
$S8_{2-3}$	Unpaved Road Segment 3	Nitrogen oxides	10102-44-0	2.55E-02	1	1%
		Nitrogen oxides	10102-44-0	1.05E-02	24	0.4%
		Sulphur dioxide	7446-09-05	6.35E-05	1	0.01%
		Sulphur dioxide	7446-09-05	2.59E-05	24	0.01%
		Sulphur dioxide	7446-09-05	2.59E-05	annual	0.01%
		Carbon monoxide	630-08-0	6.63E-03	0.5	0.3%
		TSP(1)	N/A - TSP	1.88E+00	24	13%
		PM_{10}	N/A - PM_{10}	2.12E-01	24	10%
		$PM_{2.5}$	N/A - $PM_{2.5}$	2.15E-02	24	3%
$S8_{3-RF}$	Unpaved Road Segment 4	Nitrogen oxides	10102-44-0	4.51E-02	1	1%
		Nitrogen oxides	10102-44-0	1.84E-02	24	1%
		Sulphur dioxide	7446-09-05	5.49E-05	1	0.01%
		Sulphur dioxide	7446-09-05	2.14E-05	24	0.005%
		Sulphur dioxide	7446-09-05	2.14E-05	annual	0.005%
		Carbon monoxide	630-08-0	1.11E-02	0.5	1%
		TSP(1)	N/A - TSP	3.71E-01	24	3%
		PM_{10}	N/A - PM_{10}	4.22E-02	24	2%
		$PM_{2.5}$	N/A - $PM_{2.5}$	4.72E-03	24	1%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
$S8_{3-WF}$	Unpaved Road Segment 5	Nitrogen oxides	10102-44-0	3.55E-02	1	1%
		Nitrogen oxides	10102-44-0	1.46E-02	24	1%
		Sulphur dioxide	7446-09-05	9.16E-05	1	0.02%
		Sulphur dioxide	7446-09-05	3.74E-05	24	0.01%
		Sulphur dioxide	7446-09-05	3.74E-05	annual	0.01%
		Carbon monoxide	630-08-0	9.25E-03	0.5	0%
		TSP(1)	N/A - TSP	2.65E+00	24	19%
		PM_{10}	N/A - PM_{10}	2.99E-01	24	15%
		$PM_{2.5}$	N/A - $PM_{2.5}$	3.04E-02	24	4%
$S8_{3-SP}$	Unpaved Road Segment 6	Nitrogen oxides	10102-44-0	4.23E-02	1	1%
		Nitrogen oxides	10102-44-0	1.73E-02	24	0.6%
		Sulphur dioxide	7446-09-05	5.15E-05	1	0.01%
		Sulphur dioxide	7446-09-05	2.01E-05	24	0.004%
		Sulphur dioxide	7446-09-05	2.01E-05	annual	0.004%
		Carbon monoxide	630-08-0	1.04E-02	0.5	1%
		TSP(1)	N/A - TSP	5.46E-01	24	4%
		PM_{10}	N/A - PM_{10}	6.19E-02	24	3%
		$PM_{2.5}$	N/A - $PM_{2.5}$	6.66E-03	24	1%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S9	Old Landfill	Odour	N/A - Odour	1.86E+03 OU/s	10-min	21%
		Hydrogen sulphide	7783-06-04	9.48E-03	10-min	20.7%
		Hydrogen sulphide	7783-06-04	9.48E-03	24	20.7%
		Vinyl chloride	75-01-4	3.53E-03	24	20.7%
		Chloroform	67-66-3	2.77E-05	24	20.7%
S10	West Landfill	Odour	N/A - Odour	4.41E+03 OU/s	10-min	50%
		Hydrogen sulphide	7783-06-04	2.25E-02	10-min	49.0%
		Hydrogen sulphide	7783-06-04	2.25E-02	24	49.0%
		Vinyl chloride	75-01-4	8.37E-03	24	49.0%
		Chloroform	67-66-3	6.57E-05	24	49.0%
S11	South Landfill	Odour	N/A - Odour	2.57E+03 OU/s	10-min	29%
		Hydrogen sulphide	7783-06-04	1.31E-02	10-min	28.6%
		Hydrogen sulphide	7783-06-04	1.31E-02	24	28.6%
		Vinyl chloride	75-01-4	4.88E-03	24	28.6%
		Chloroform	67-66-3	3.83E-05	24	28.6%

Notes:

(1) TSP emissions have been converted to a 24 hour emission rate and have been modelled using a variable emission rate for 7:00 a.m. to 5:00 p.m. (Monday – Friday) and 7:00 a.m. to 12:00 p.m. (Saturday) site operations.

(2) As the impacts from concrete crushing and wood grinding would not occur simultaneously and concrete crushing has the higher emission rate, the emission rate for operations associated with concrete crushing was used.

Table D3-16: Environmental Effects Preferred Alternative Scenario 2 Emission Rates

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S1	Flare 1	Nitrogen oxides	10102-44-0	3.46E-01	1	7%
		Nitrogen oxides	10102-44-0	3.46E-01	24	11%
		Sulphur dioxide	7446-09-05	1.07E-01	1	19%
		Sulphur dioxide	7446-09-05	1.07E-01	24	19%
		Sulphur dioxide	7446-09-05	1.07E-01	annual	19%
		Carbon monoxide	630-08-0	4.04E-01	0.5	16%
		TSP	N/A - TSP	1.30E-01	24	1.6%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	5%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	14%
		Hydrogen sulphide	7783-06-04	3.19E-04	10-min	0.6%
		Hydrogen sulphide	7783-06-04	3.19E-04	24	0.6%
		Vinyl chloride	75-01-4	1.19E-04	24	0.6%
		Chloroform	67-66-3	9.32E-07	24	0.6%
S2	Flare 2	Nitrogen oxides	10102-44-0	3.46E-01	1	7%
		Nitrogen oxides	10102-44-0	3.46E-01	24	11%
		Sulphur dioxide	7446-09-05	1.07E-01	1	19%
		Sulphur dioxide	7446-09-05	1.07E-01	24	19%
		Sulphur dioxide	7446-09-05	1.07E-01	annual	19%
		Carbon monoxide	630-08-0	4.04E-01	0.5	16%
		TSP	N/A - TSP	1.30E-01	24	2%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	5%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	14%
		Hydrogen sulphide	7783-06-04	3.19E-04	10-min	0.6%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
		Hydrogen sulphide	7783-06-04	3.19E-04	24	0.6%
		Vinyl chloride	75-01-4	1.19E-04	24	0.6%
		Chloroform	67-66-3	9.32E-07	24	0.6%
S3a	Flare 3	Nitrogen oxides	10102-44-0	3.46E-01	1	7%
		Nitrogen oxides	10102-44-0	3.46E-01	24	11%
		Sulphur dioxide	7446-09-05	1.07E-01	1	19%
		Sulphur dioxide	7446-09-05	1.07E-01	24	19%
		Sulphur dioxide	7446-09-05	1.07E-01	annual	19%
		Carbon monoxide	630-08-0	4.04E-01	0.5	16%
		TSP	N/A - TSP	1.30E-01	24	1.6%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	5%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	14%
		Hydrogen sulphide	7783-06-04	3.19E-04	10-min	0.6%
		Hydrogen sulphide	7783-06-04	3.19E-04	24	0.6%
		Vinyl chloride	75-01-4	1.19E-04	24	0.6%
		Chloroform	67-66-3	9.32E-07	24	0.6%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S3b	Flare 4	Nitrogen oxides	10102-44-0	3.46E-01	1	7%
		Nitrogen oxides	10102-44-0	3.46E-01	24	11%
		Sulphur dioxide	7446-09-05	1.07E-01	1	19%
		Sulphur dioxide	7446-09-05	1.07E-01	24	19%
		Sulphur dioxide	7446-09-05	1.07E-01	annual	19%
		Carbon monoxide	630-08-0	4.04E-01	0.5	16%
		TSP	N/A - TSP	1.30E-01	24	1.6%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	5%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	14%
		Hydrogen sulphide	7783-06-04	3.19E-04	10-min	0.6%
		Hydrogen sulphide	7783-06-04	3.19E-04	24	0.6%
		Vinyl chloride	75-01-4	1.19E-04	24	0.6%
		Chloroform	67-66-3	9.32E-07	24	0.6%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S3c	Flare 5	Nitrogen oxides	10102-44-0	4.36E-01	1	9%
		Nitrogen oxides	10102-44-0	4.36E-01	24	14%
		Sulphur dioxide	7446-09-05	1.35E-01	1	24%
		Sulphur dioxide	7446-09-05	1.35E-01	24	24%
		Sulphur dioxide	7446-09-05	1.35E-01	annual	24%
		Carbon monoxide	630-08-0	5.10E-01	0.5	21%
		TSP	N/A - TSP	1.65E-01	24	2.0%
		PM_{10}	N/A - PM_{10}	1.65E-01	24	6%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.65E-01	24	18%
		Hydrogen sulphide	7783-06-04	4.03E-04	10-min	0.7%
		Hydrogen sulphide	7783-06-04	4.03E-04	24	0.7%
		Vinyl chloride	75-01-4	1.50E-04	24	0.7%
		Chloroform	67-66-3	1.18E-06	24	0.7%
S4	Active Working Face(including storage pile 1, LCS construction, and cell excavation)	Nitrogen oxides	10102-44-0	1.83E+00	1	38%
		Nitrogen oxides	10102-44-0	8.51E-01	24	28%
		Sulphur dioxide	7446-09-05	2.49E-03	1	0.4%
		Sulphur dioxide	7446-09-05	1.08E-03	24	0.2%
		Sulphur dioxide	7446-09-05	1.08E-03	annual	0.2%
		Carbon monoxide	630-08-0	6.70E-02	0.5	3%
		TSP	N/A - TSP	1.93E-02	24	0.2%
		PM_{10}	N/A - PM_{10}	1.35E-02	24	0.5%
		$PM_{2.5}$	N/A - $PM_{2.5}$	9.10E-03	24	1%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S6	Concrete Crushing (including wood grinding and storage pile 2)(1)	Nitrogen oxides	10102-44-0	8.44E-01	1	18%
		Nitrogen oxides	10102-44-0	2.75E-01	24	9%
		Sulphur dioxide	7446-09-05	1.15E-03	1	0.2%
		Sulphur dioxide	7446-09-05	3.74E-04	24	0.1%
		Sulphur dioxide	7446-09-05	3.74E-04	annual	0.1%
		Carbon monoxide	630-08-0	1.78E-01	0.5	7%
		TSP	N/A - TSP	2.53E-01	24	3%
		PM_{10}	N/A - PM_{10}	1.11E-01	24	4%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.34E-02	24	1%
S7	Paved Road	Nitrogen oxides	10102-44-0	6.82E-02	1	1%
		Nitrogen oxides	10102-44-0	2.79E-02	24	1%
		Sulphur dioxide	7446-09-05	1.83E-04	1	0.03%
		Sulphur dioxide	7446-09-05	7.42E-05	24	0.01%
		Sulphur dioxide	7446-09-05	7.42E-05	annual	0.01%
		Carbon monoxide	630-08-0	1.85E-02	0.5	1%
		TSP	N/A - TSP	1.08E+00	24	13%
		PM_{10}	N/A - PM_{10}	2.10E-01	24	8%
		$PM_{2.5}$	N/A - $PM_{2.5}$	5.12E-02	24	5%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
$S8_{1-2}$	Unpaved Road Segment 1	Nitrogen oxides	10102-44-0	7.14E-02	1	1%
		Nitrogen oxides	10102-44-0	2.93E-02	24	1%
		Sulphur dioxide	7446-09-05	1.88E-04	1	0.03%
		Sulphur dioxide	7446-09-05	7.65E-05	24	0.01%
		Sulphur dioxide	7446-09-05	7.65E-05	annual	0.01%
		Carbon monoxide	630-08-0	1.80E-02	0.5	1%
		TSP	N/A - TSP	2.60E+00	24	31%
		PM_{10}	N/A - PM_{10}	7.06E-01	24	26%
		$PM_{2.5}$	N/A - $PM_{2.5}$	7.15E-02	24	8%
$S8_{2-3}$	Unpaved Road Segment 2	Nitrogen oxides	10102-44-0	6.43E-02	1	1%
		Nitrogen oxides	10102-44-0	2.62E-02	24	1%
		Sulphur dioxide	7446-09-05	9.44E-05	1	0.02%
		Sulphur dioxide	7446-09-05	3.73E-05	24	0.01%
		Sulphur dioxide	7446-09-05	3.73E-05	annual	0.01%
		Carbon monoxide	630-08-0	1.58E-02	0.5	1%
		TSP	N/A - TSP	2.75E+00	24	33%
		PM_{10}	N/A - PM_{10}	7.43E-01	24	27%
		PM2.5	N/A - PM2.5	7.51E-02	24	8%

Source Identifier	Source Description	Emissions Data: Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
$S8_{2\text{-RF}}$	Unpaved Road Segment 3	Nitrogen oxides	10102-44-0	8.03E-02	1	2%
		Nitrogen oxides	10102-44-0	3.28E-02	24	1%
		Sulphur dioxide	7446-09-05	9.72E-05	1	0.02%
		Sulphur dioxide	7446-09-05	3.79E-05	24	0.007%
		Sulphur dioxide	7446-09-05	3.79E-05	annual	0.007%
		Carbon monoxide	630-08-0	1.96E-02	0.5	1%
		TSP	N/A - TSP	2.30E-01	24	3%
		PM_{10}	N/A - PM_{10}	6.28E-02	24	2%
		$PM_{2.5}$	N/A - $PM_{2.5}$	7.17E-03	24	1%
$S8_{3\text{-WF}}$	Unpaved Road Segment 4	Nitrogen oxides	10102-44-0	2.30E-02	1	0%
		Nitrogen oxides	10102-44-0	9.44E-03	24	0%
		Sulphur dioxide	7446-09-05	6.28E-05	1	0.01%
		Sulphur dioxide	7446-09-05	2.56E-05	24	0.00%
		Sulphur dioxide	7446-09-05	2.56E-05	annual	0.00%
		Carbon monoxide	630-08-0	5.83E-03	0.5	0%
		TSP	N/A - TSP	6.93E-01	24	8%
		PM_{10}	N/A - PM_{10}	1.88E-01	24	7%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.91E-02	24	2%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S9	Old Landfill	Odour	N/A - Odour	4.11E+03 OU/s	10-min	38%
		Hydrogen sulphide	7783-06-04	2.10E-02	10-min	37.19%
		Hydrogen sulphide	7783-06-04	2.10E-02	24	37.19%
		Vinyl chloride	75-01-4	7.81E-03	24	37.19%
		Chloroform	67-66-3	6.13E-05	24	37.19%
S10	West Landfill	Odour	N/A - Odour	3.76E+03 OU/s	10-min	35%
		Hydrogen sulphide	7783-06-04	1.92E-02	10-min	34.0%
		Hydrogen sulphide	7783-06-04	1.92E-02	24	34.0%
		Vinyl chloride	75-01-4	7.13E-03	24	34.0%
		Chloroform	67-66-3	5.60E-05	24	34.0%
S11	South Landfill	Odour	N/A - Odour	2.19E+03 OU/s	10-min	20%
		Hydrogen sulphide	7783-06-04	1.12E-02	10-min	19.8%
		Hydrogen sulphide	7783-06-04	1.12E-02	24	19.8%
		Vinyl chloride	75-01-4	4.16E-03	24	19.8%
		Chloroform	67-66-3	3.27E-05	24	19.8%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S12	South Landfill Expansion	Odour	N/A - Odour	6.67E+02 OU/s	10-min	6%
		Hydrogen sulphide	7783-06-04	3.41E-03	10-min	6.0%
		Hydrogen sulphide	7783-06-04	3.41E-03	24	6.0%
		Vinyl chloride	75-01-4	1.27E-03	24	6.0%
		Chloroform	67-66-3	9.94E-06	24	6.0%

Notes:

(1) As the impacts from concrete crushing and wood grinding would not occur simultaneously and concrete crushing has the higher emission rate, the emission rate for operations associated with concrete crushing was used.

Table D3-17: Environmental Effects Preferred Alternative Scenario 3 Emission Rates

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S1	Flare 1	Nitrogen oxides	10102-44-0	3.46E-01	1	8%
		Nitrogen oxides	10102-44-0	3.46E-01	24	11%
		Sulphur dioxide	7446-09-05	1.25E-01	1	19%
		Sulphur dioxide	7446-09-05	1.25E-01	24	19%
		Sulphur dioxide	7446-09-05	1.25E-01	annual	19%
		Carbon monoxide	630-08-0	4.04E-01	0.5	17%
		TSP	N/A - TSP	1.30E-01	24	2%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	5%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	14%
		Hydrogen sulphide	7783-06-04	2.06E-04	10-min	0.32%
		Hydrogen sulphide	7783-06-04	2.06E-04	24	0.32%
		Vinyl chloride	75-01-4	7.64E-05	24	0.32%
		Chloroform	67-66-3	6.00E-07	24	0.32%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S2	Flare 2	Nitrogen oxides	10102-44-0	3.46E-01	1	8%
		Nitrogen oxides	10102-44-0	3.46E-01	24	11%
		Sulphur dioxide	7446-09-05	1.25E-01	1	19%
		Sulphur dioxide	7446-09-05	1.25E-01	24	19%
		Sulphur dioxide	7446-09-05	1.25E-01	annual	19%
		Carbon monoxide	630-08-0	4.04E-01	0.5	17%
		TSP	N/A - TSP	1.30E-01	24	2%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	5%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	14%
		Hydrogen sulphide	7783-06-04	2.06E-04	10-min	0.3%
		Hydrogen sulphide	7783-06-04	2.06E-04	24	0.3%
		Vinyl chloride	75-01-4	7.64E-05	24	0.3%
		Chloroform	67-66-3	6.00E-07	24	0.3%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S3a	Flare 3	Nitrogen oxides	10102-44-0	3.46E-01	1	8%
		Nitrogen oxides	10102-44-0	3.46E-01	24	11%
		Sulphur dioxide	7446-09-05	1.25E-01	1	19%
		Sulphur dioxide	7446-09-05	1.25E-01	24	19%
		Sulphur dioxide	7446-09-05	1.25E-01	annual	19%
		Carbon monoxide	630-08-0	4.04E-01	0.5	17%
		TSP	N/A - TSP	1.30E-01	24	2%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	5%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	14%
		Hydrogen sulphide	7783-06-04	2.06E-04	10-min	0.3%
		Hydrogen sulphide	7783-06-04	2.06E-04	24	0.3%
		Vinyl chloride	75-01-4	7.64E-05	24	0.3%
		Chloroform	67-66-3	6.00E-07	24	0.3%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S3b	Flare 4	Nitrogen oxides	10102-44-0	3.46E-01	1	8%
		Nitrogen oxides	10102-44-0	3.46E-01	24	11%
		Sulphur dioxide	7446-09-05	1.25E-01	1	19%
		Sulphur dioxide	7446-09-05	1.25E-01	24	19%
		Sulphur dioxide	7446-09-05	1.25E-01	annual	19%
		Carbon monoxide	630-08-0	4.04E-01	0.5	17%
		TSP	N/A - TSP	1.30E-01	24	2%
		PM_{10}	N/A - PM_{10}	1.30E-01	24	5%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.30E-01	24	14%
		Hydrogen sulphide	7783-06-04	2.06E-04	10-min	0.3%
		Hydrogen sulphide	7783-06-04	2.06E-04	24	0.3%
		Vinyl chloride	75-01-4	7.64E-05	24	0.3%
		Chloroform	67-66-3	6.00E-07	24	0.3%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S3c	Flare 5	Nitrogen oxides	10102-44-0	4.36E-01	1	10%
		Nitrogen oxides	10102-44-0	4.36E-01	24	14%
		Sulphur dioxide	7446-09-05	1.58E-01	1	24%
		Sulphur dioxide	7446-09-05	1.58E-01	24	24%
		Sulphur dioxide	7446-09-05	1.58E-01	annual	24%
		Carbon monoxide	630-08-0	5.10E-01	0.5	21%
		TSP	N/A - TSP	1.65E-01	24	2%
		PM_{10}	N/A - PM_{10}	1.65E-01	24	6%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.65E-01	24	18%
		Hydrogen sulphide	7783-06-04	2.59E-04	10-min	0.4%
		Hydrogen sulphide	7783-06-04	2.59E-04	24	0.4%
		Vinyl chloride	75-01-4	9.65E-05	24	0.4%
		Chloroform	67-66-3	7.57E-07	24	0.4%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S4	Active Working Face (including Storage Pile 2, LCS construction, and cell excavation)	Nitrogen oxides	10102-44-0	1.45E+00	1	32%
		Nitrogen oxides	10102-44-0	7.67E-01	24	25%
		Sulphur dioxide	7446-09-05	1.96E-03	1	0.3%
		Sulphur dioxide	7446-09-05	9.67E-04	24	0.1%
		Sulphur dioxide	7446-09-05	9.67E-04	annual	0.1%
		Carbon monoxide	630-08-0	5.42E-02	0.5	2%
		TSP	N/A - TSP	1.79E-02	24	0.2%
		PM_{10}	N/A - PM_{10}	1.27E-02	24	0.5%
		$PM_{2.5}$	N/A - $PM_{2.5}$	8.72E-03	24	1%
S6	Concrete Crushing (including Storage Pile 1 and wood grinding)(1)	Nitrogen oxides	10102-44-0	1.01E+00	1	22%
		Nitrogen oxides	10102-44-0	3.20E-01	24	11%
		Sulphur dioxide	7446-09-05	1.38E-03	1	0.2%
		Sulphur dioxide	7446-09-05	5.99E-04	24	0.1%
		Sulphur dioxide	7446-09-05	5.99E-04	annual	0.1%
		Carbon monoxide	630-08-0	1.83E-01	0.5	8%
		TSP	N/A - TSP	2.53E-01	24	3%
		PM_{10}	N/A - PM_{10}	1.12E-01	24	4%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.36E-02	24	1%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S7	Paved Road	Nitrogen oxides	10102-44-0	4.77E-02	1	1%
		Nitrogen oxides	10102-44-0	1.95E-02	24	1%
		Sulphur dioxide	7446-09-05	1.62E-04	1	0.0%
		Sulphur dioxide	7446-09-05	6.61E-05	24	0.01%
		Sulphur dioxide	7446-09-05	6.61E-05	annual	0.01%
		Carbon monoxide	630-08-0	1.25E-02	0.5	1%
		TSP	N/A - TSP	1.08E+00	24	13%
		PM_{10}	N/A - PM_{10}	2.10E-01	24	8%
		$PM_{2.5}$	N/A - $PM_{2.5}$	5.09E-02	24	5%
$S8_{1-2}$	Unpaved Road Segment 1	Nitrogen oxides	10102-44-0	5.00E-02	1	1%
		Nitrogen oxides	10102-44-0	2.05E-02	24	1%
		Sulphur dioxide	7446-09-05	1.67E-04	1	0.03%
		Sulphur dioxide	7446-09-05	6.83E-05	24	0.01%
		Sulphur dioxide	7446-09-05	6.83E-05	annual	0.01%
		Carbon monoxide	630-08-0	1.25E-02	0.5	1%
		TSP	N/A - TSP	2.60E+00	24	32%
		PM_{10}	N/A - PM_{10}	7.05E-01	24	26%
		$PM_{2.5}$	N/A - $PM_{2.5}$	7.11E-02	24	8%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
$S8_{2-3}$	Unpaved Road Segment 2	Nitrogen oxides	10102-44-0	5.27E-02	1	1%
		Nitrogen oxides	10102-44-0	2.16E-02	24	0.712%
		Sulphur dioxide	7446-09-05	1.74E-04	1	0.0%
		Sulphur dioxide	7446-09-05	7.09E-05	24	0.01%
		Sulphur dioxide	7446-09-05	7.09E-05	annual	0.01%
		Carbon monoxide	630-08-0	1.31E-02	0.5	1%
		TSP	N/A - TSP	2.15E+00	24	26%
		PM_{10}	N/A - PM_{10}	5.82E-01	24	22%
		$PM_{2.5}$	N/A - $PM_{2.5}$	5.88E-02	24	6%
$S8_{2-RF}$	Unpaved Road Segment 3	Nitrogen oxides	10102-44-0	5.84E-02	1	1%
		Nitrogen oxides	10102-44-0	2.38E-02	24	1%
		Sulphur dioxide	7446-09-05	7.29E-05	1	0.01%
		Sulphur dioxide	7446-09-05	2.85E-05	24	0.004%
		Sulphur dioxide	7446-09-05	2.85E-05	annual	0.004%
		Carbon monoxide	630-08-0	1.43E-02	0.5	1%
		TSP	N/A - TSP	2.29E-01	24	3%
		PM_{10}	N/A - PM_{10}	6.25E-02	24	2%
		$PM_{2.5}$	N/A - $PM_{2.5}$	6.89E-03	24	1%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
$S8_{3\text{-}WF}$	Unpaved Road Segment 4	Nitrogen oxides	10102-44-0	1.32E-02	1	0.3%
		Nitrogen oxides	10102-44-0	5.40E-03	24	0.2%
		Sulphur dioxide	7446-09-05	4.59E-05	1	0.01%
		Sulphur dioxide	7446-09-05	1.87E-05	24	0.003%
		Sulphur dioxide	7446-09-05	1.87E-05	annual	0.003%
		Carbon monoxide	630-08-0	3.30E-03	0.5	0.1%
		TSP	N/A - TSP	5.67E-01	24	7%
		PM_{10}	N/A - PM_{10}	1.54E-01	24	6%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.55E-02	24	2%
$S8_{3\text{-}CC}$	Unpaved Road Segment 5	Nitrogen oxides	10102-44-0	7.71E-02	1	2%
		Nitrogen oxides	10102-44-0	3.15E-02	24	1.0%
		Sulphur dioxide	7446-09-05	9.62E-05	1	0.01%
		Sulphur dioxide	7446-09-05	3.76E-05	24	0.006%
		Sulphur dioxide	7446-09-05	3.76E-05	annual	0.006%
		Carbon monoxide	630-08-0	1.89E-02	0.5	1%
		TSP	N/A - TSP	5.62E-01	24	7%
		PM_{10}	N/A - PM_{10}	1.52E-01	24	6%
		$PM_{2.5}$	N/A - $PM_{2.5}$	1.61E-02	24	2%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S9	Old Landfill	Odour	N/A - Odour	2.65E+03 OU/s	10-min	21%
		Hydrogen sulphide	7783-06-04	1.35E-02	10-min	20.8%
		Hydrogen sulphide	7783-06-04	1.35E-02	24	20.8%
		Vinyl chloride	75-01-4	5.03E-03	24	20.8%
		Chloroform	67-66-3	3.95E-05	24	20.8%
S10	West Landfill	Odour	N/A - Odour	2.42E+03 OU/s	10-min	19%
		Hydrogen sulphide	7783-06-04	1.23E-02	10-min	19.0%
		Hydrogen sulphide	7783-06-04	1.23E-02	24	19.0%
		Vinyl chloride	75-01-4	4.59E-03	24	19.0%
		Chloroform	67-66-3	3.60E-05	24	19.0%
S11	South Landfill	Odour	N/A - Odour	1.41E+03 OU/s	10-min	11%
		Hydrogen sulphide	7783-06-04	7.21E-03	10-min	11.1%
		Hydrogen sulphide	7783-06-04	7.21E-03	24	11.1%
		Vinyl chloride	75-01-4	2.68E-03	24	11.1%
		Chloroform	67-66-3	2.10E-05	24	11.1%

Source Identifier	Source Description	Emissions Data				
		Contaminant	CAS No.	Max Emission Rate [g/s]	Averaging Period [hours]	Percent of Overall Emission
S12	South Landfill Expansion	Odour	N/A - Odour	2.43E+03 OU/s	10-min	19%
		Hydrogen sulphide	7783-06-04	1.24E-02	10-min	19.0%
		Hydrogen sulphide	7783-06-04	1.24E-02	24	19.0%
		Vinyl chloride	75-01-4	4.61E-03	24	19.0%
		Chloroform	67-66-3	3.62E-05	24	19.0%
S13	West Landfill Expansion	Odour	N/A - Odour	3.63E+03 OU/s	10-min	29%
		Hydrogen sulphide	7783-06-04	1.85E-02	10-min	28.5%
		Hydrogen sulphide	7783-06-04	1.85E-02	24	28.5%
		Vinyl chloride	75-01-4	6.89E-03	24	28.5%
		Chloroform	67-66-3	5.41E-05	24	28.5%

Notes:

(1) As the impacts from concrete crushing and wood grinding would not occur simultaneously and concrete crushing has the higher emission rate, the emission rate for operations associated with concrete crushing was used.

Table D3-18: Dispersion Modelling Input Summary Table

Relevant Section of the Regulation O. Reg. 419/05	Section Title	Description of How the Approved Dispersion Model was Used
Section 8	Negligible sources of contaminant	Only significant sources and contaminants have been assessed.
Section 9	Same structure contamination	Not applicable. Ridge Landfill is the only occupant of the Site and there are no discrete receptors (e.g., child-care facility) at the Site.
Section 10	Operating conditions	All equipment was assumed to be operating at their maximum production rates at the same time.
Section 11	Source of contaminant emission rates	The emission rate for each significant contaminant emitted from a significant source was estimated, the methodology for the calculation is documented in **Appendices D3-A** to **D3-D**.
Section 12	Combined effect of assumptions for operating conditions and emission rates	The operating conditions were estimated in accordance with s.10(11)1 and s.11(11)1 of *O. Reg. 419/05* and area emitted.
Section 13	Meteorological data	Meteorological data provided by the MECP located within the facility geographic region was used in the AERMOD dispersion model. For odour and discrete receptor analysis, site-specific meteorological data was provided from the MECP for the ECCC Ridge Town monitoring station.
Section 14	Area of modelling coverage	In accordance with *O. Reg.419/05*, the model includes contaminant concentrations to a distance of 5 km from the Facility which is anticipated to capture the highest potential impact from all on-site operations. (see **Section 4.7.3.2**-all impacts at or near the property line).
Section 15	Stack height for certain new sources of contaminants	Documented in accordance with MECP Guidance as provided in **Section 4.6** for each scenario.
Section 16	Terrain data	MECP available terrain data for the area located within the facility geographic region was used in the AERMOD dispersion model.

Relevant Section of the Regulation O. Reg. 419/05	Section Title	Description of How the Approved Dispersion Model was Used
Section 17	Averaging periods	The averaging periods as summarized in **Section 4.6** for each scenario are used.

4.6.2 Compliance Assessment Emission Rates

The compliance assessment includes the estimated emissions from all project works and activities that are located on-site subject to *O. Reg. 419/05*.

The emission rates for indicator compounds associated with landfill gas generation (footprint and landfill gas flare) and the emissions of TSP associated with material handling (storage piles, active working face, concrete crushing) are the same for the environmental effects assessment as shown in the previous section for the compliance assessment.

As the compliance assessment only includes sources subject to *O. Reg. 419*, the following sources were not included in the modeling:

- emissions from paved and unpaved roads;
- on-road vehicle emissions; and
- non-road vehicle emissions.

4.7 Dispersion Modelling

This section provides a description of how the dispersion modelling was conducted at the facility to calculate the maximum concentration at a point-of-impingement (POI).

The dispersion modelling was conducted in accordance with MECP Guidelines (the ADMGO)[21]. A general description of the input data used in the dispersion model is provided below and summarized in **Table D3A-5**.Error! Reference source not found.

As the site emits odours, the modelled impact of emissions was assessed at discrete receptor locations for a 10-minute averaging period. The US EPA's AERMOD air dispersion model was used to determine POI concentrations.

The AERMOD modelling system has been identified by the MECP as one of the approved dispersion models under *O.Reg. 419/05*. The use of a more refined model, such as AERMOD, is necessary when assessing air quality against Schedule 3 Standards. The AERMOD modelling system is made up of the AERMOD dispersion model, the AERMET meteorological pre-processor and the AERMAP terrain pre-processor. AERMOD version 16216r was used for this application.

[21] MECP. *Air Dispersion Modelling Guideline for Ontario* (ADMGO). February 2017.

The emission rates used in the dispersion model meet the requirements of s.11(1)1 of O. Reg. 419/05, which requires that the emission rate used in the dispersion model is at least as high as the maximum emission rate that the source of contaminant is reasonably capable of for the relevant contaminant. These emission rates are described in **Section 4.6**.

4.7.1 Metrological Data Sources

Sub-paragraph 10 of s.26(1) of *O. Reg. 419/05* requires a description of the local land use conditions if meteorological data described in paragraph 2 of s.13(1) of O. Reg. 419/05 was used. The dispersion model required a frequency assessment at discrete receptors and therefore pre-processed local meteorological data from the Ridgetown monitoring station was provided by the Air Modelling and Emissions Unit of the MECP.

4.7.2 Terrain

Terrain data was incorporated into the model using MECP provided digital elevation data (MECP, 2015). The following DEM Tiles were used in the dispersion model for UTM Zone 17:

- 0683_3
- 0683_4
- 0684_3
- 0684_4
- 0685_3
- 0685_4

4.7.3 Receptors

4.7.3.1 Environmental Effects Discrete Receptors

Receptors were chosen to determine the impact of environmental effects from a grid of discrete receptors identified using satellite imagery. The discrete receptors for the study area were residences and businesses located in the vicinity of the landfill. **FIGURE D3-7** presents the discrete receptors for the study area.

4.7.3.2 Compliance Assessment MECP Receptor Grid

Receptors were chosen based on recommendations provided in **Section 7.1** of the ADMGO, which is in accordance with s.14 of *O. Reg. 419/05*. As the areas of highest impact from site operations are anticipated close to or at the property line, a 5 km multi-tier grid was decided to be appropriate for the modelling that was conducted. Although the off-site study area extends 10 km to the centre of the site, the results of the assessment confirmed that the highest area of impact were localized near the site, and therefore confirmed the appropriateness of a 5 km receptor grid. Specifically, a nested receptor grid, centered around the buildings at the site, were placed as follows:

a) 20 m spacing, within an area of 200 m by 200 m;
b) 50 m spacing, within an area surrounding the area described in (a) with a boundary at 500 m by 500 m outside of the boundary described in (a);
c) 100 m spacing, within an area surrounding the area described in (b) with a boundary at 1,000 m by 1,000 m outside of the boundary described in (a);
d) 200 m spacing, within an area surrounding the area described in (c) with a boundary at 2,000 m by 2,000 m outside of the boundary described in (a); and
e) 500 m spacing, within an area surrounding the area described in (d) with a boundary at 5,000 m by 5,000 m outside of the boundary described in (a).

In addition to using the nested receptor grid, receptors were also placed every 10 m along the property line.

The highest predicted impacts occur at or near the property line and therefore the 5,000 m coverage provided within the model captures the worst-case impacts.

There is no child care facility, health care facility, senior's residence, or long-term care facility located at the site. Therefore, same-structure contamination was not assessed.

FIGURE D3-8 presents the discrete receptors for the study area.

FIGURE D3-7: ENVIRONMENTAL EFFECTS DISCRETE RECEPTORS

FIGURE D3-8: COMPLIANCE ASSESSMENT MECP RECEPTOR GRID

4.7.4 Building Downwash

Building wake effects were considered in this assessment using the USEPA's Building Profile Input Program (BPIP-PRIME), another pre-processor to AERMOD. The inputs into this pre-processor include the coordinates and heights of the buildings and stacks. The output data from BPIP is used in the AERMOD building wake effect calculations.

4.7.5 Deposition

AERMOD has the capability to account for wet and dry deposition of substances that would reduce ground level concentrations at POIs. However, the deposition algorithm has not been implemented as only regulatory defaults have been used.

4.7.6 Averaging Time and Conversions

The shortest time scale that AERMOD predicts is a 1-hr average value. 10-minute odour concentrations were determined by using a "x1.65" scaling factor applied to the modelled 1-hour concentrations. The x1.65 scaling factor was implemented directly within the AERMOD modelling system. The x1.65 scaling factor represents the MECP recommended conversion factors as per the MECP's ESDM procedure document[22].

4.7.7 Dispersion Modelling Options

The regulatory default options for AERMOD were used for this assessment. Some of the options used are summarized below in **Table D3-19**.

Table D3-19: Dispersion Modelling Options

Modelling Parameter	Description	Used in the Assessment?
DFAULT	Specifies the regulatory default options will be used	Yes
CONC	Specifies that concentration values will be calculated	Yes
NODRYDPLT	Specifies that no dry deposition will be calculated	Dry deposition was not considered.

[22] MECP. Procedure for Preparing an Emission Summary and Dispersion Modelling Report. March 2018.

Modelling Parameter	Description	Used in the Assessment?
NOWETDPLT	Specifies that no wet deposition will be calculated	Wet deposition was not considered.
FLAT	Specifies that the non-default option of assuming flat terrain will be used	No – elevated terrain used
NOSTD	Specifies that the non-default option of no-stack tip downwash will be used	No
AVERTIME	Averaging periods used	1-hour, 24-hour, and annual
URBANOPT	Specifies that the urban dispersion coefficients will be used	No
URBANROUGHNESS	Specifies the urban roughness (m) if URBANOPT is used	Default
FLAGPOLE	Specifies that receptor heights above local ground level are allowed on the receptors	Yes

4.8 Predicted Air Quality

Predicted concentrations for each indicator compound were generated based on the emission rates provided in **Section 4.6** and the modeling that was conducted.

4.8.1 Environmental Effects Predicted Air Quality

The predicted air quality for the existing conditions and the preferred alternative expansion scenarios are summarized in **Table D3-20** to **Table D3-23** below. The predicted POI concentrations from the dispersion model have been added to the background concentrations to determine the cumulative air quality.

The cumulative air quality for each indicator compound was compared against the most stringent applicable air quality criteria. The predicted concentrations are below their respective criteria for each indicator compound for the existing conditions and each scenario of the preferred alternative with the exception of TSP and PM_{10} for the 24-hr averaging period.

The cumulative air quality predictions for TSP (24-hr average) were modeled to be 121% of the applicable criteria for the existing conditions and ranged from 133 – 138% of the applicable criteria for the preferred alternative scenarios.

The cumulative air quality predictions for PM_{10} (24-hr average) were modeled as 103% of the applicable criteria for the existing conditions and ranged from 108 – 125% of the applicable criteria for the preferred alternative scenarios.

The background air quality for TSP (24-hr average) was estimated at 49.5 µg/m^3, which is 41% of the applicable criteria. The background air quality of PM_{10} (24-hr average) was estimated as 24.8 µg/m^3, which is 50% of the applicable criteria.

The predicted elevated levels of TSP for the effects assessment are not considered to be significant because of two main factors; deposition and demonstrated operations below relevant criteria through monitoring. These are described below:

Deposition

The predicted TSP and PM_{10} values from the model do not consider the effects of dry and wet particle deposition that can lead to rapid concentration depletion in fugitive emission plumes. As there is significant distance from the sources to the receptors, a concentration reduction would be expected.

Demonstrated Operations Below Relevant Criteria Through Monitoring

As discussed in **Section 3.1.2**, site-specific air monitoring was performed by Dillon in 2014 which included 24-hour TSP sampling performed weekly over a 6-month period. The monitoring was conducted on-site and therefore captured background concentrations as well as on-site operations.

The results of the sampling showed a 90th percentile TSP (24-hr average) ambient concentration to be 41.4 µg/m^3 which is 35% of the applicable criteria.

As PM10 was not sampled during the 2014 monitoring, a representative PM_{10} value was calculated based on 50% of the TSP being of the PM_{10} size fraction[23]. The results of the sampling showed a 90th percentilePM_{10} (24-hr average) ambient concentration to be 20.7 µg/m^3 which is 17% of the applicable criteria.

[23] CEPA/FPAC Working Group on Air Quality Objectives and Guidelines, National Ambient Air Quality Objectives for Particulate Matter Part 1: Science Assessment Document, ISBN 0-662-63486-1, 1998.

As noted above, the 2014 site-specific monitoring of TSP captured site impacts as well as ambient air quality in the study area of the landfill and concludes that the TSP results were well below the MECP criterion and that the site would not generate off-site elevated TSP levels.

Table D3-24 provides a comparison of the monitored TSP and PM_{10} concentrations and the modelled concentrations (including background concentrations). The modelled increase in concentrations of TSP from the existing conditions to the preferred alternative scenarios range from 9% – 12%. The modelled increase in concentrations of PM_{10} from the existing conditions to the preferred alternative scenarios range from 5% – 18%.

Applying the percent increase in modelled concentrations of TSP and PM_{10} to the monitored TSP and PM_{10} data would result in TSP and PM_{10} levels that are below the relevant criteria.

Further, the most significant source for TSP and PM_{10} emissions that contribute to the maximum POI is the fugitive dust generated from the paved and unpaved roads on-site. These emissions are managed and mitigated by the Ridge Landfill's fugitive dust and best management practices where Waste Connections actively uses a sweeper and water as a dust suppressant to reduce the amount of particulate emissions associated with this operation.

The 2014 site-specific ambient monitoring shows that the site operations are currently well below TSP and PM_{10} criteria and that increases in ambient concentration due to the expansion scenarios of the preferred alternative would not be significant.

Table D3-20: Preferred Alternative Existing Conditions Resulting Cumulative Air Quality

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Averaging Periods [hrs]	Maximum POI Concentration [ug/m³][(1)]	Background Concentration [ug/m³]	Resulting Ambient Air Quality [ug/m³]	Most Stringent POI Criteria [ug/m³]	Percent of Criteria [%]
Nitrogen oxides	10102-44-0	3.58E+00	1	337.8	34.0	371.8	400	93%
Nitrogen oxides	10102-44-0	2.08E+00	24	40.7	13.9	54.6	200	27%
Sulphur dioxide	7446-09-05	2.82E-01	1	2.2	16.0	18.2	100	18%
Sulphur dioxide	7446-09-05	2.84E-01	24	0.8	3.2	4.0	275	1%
Sulphur dioxide	7446-09-05	2.82E-01	Annual	0.1	1.3	1.4	10	14%
Carbon monoxide	630-08-0	1.16E+00	0.5	39.3	1,172.6	1,211.9	6,000	20%
TSP	N/A - TSP	5.85E+00	24	95.6	49.5	145.1	120	121%[2]
TSP	N/A - TSP	5.85E+00	Annual	13.8	32.3	46.1	60	77%
PM_{10}	N/A - PM_{10}	1.77E+00	24	26.5	24.8	51.3	50	103%
$PM_{2.5}$	N/A - $PM_{2.5}$	4.51E-01	24	3.1	12.4	15.5	27.0	57%
$PM_{2.5}$	N/A - $PM_{2.5}$	4.51E-01	Annual	0.5	8.1	8.6	8.8	98%
Hydrogen sulphide	7783-06-04	3.40E-02	10-min	1.7	1.4	3.1	13	24%
Hydrogen sulphide	7783-06-04	3.40E-02	24	0.4	1.4	1.8	7	26%
Vinyl chloride	75-01-4	1.27E-02	24	0.1	0.004	0.1	1	15%
Chloroform	67-66-3	9.93E-05	24	0.001	0.2	0.2	1	20%
Odour	N/A - Odour	6.61E+03 OU/s	10-min	0.33	--	0.33 OU	1	33%

Table Notes:

(1) All modelled maximum POI concentrations are taken from the worst-case discrete receptor.

(2) As noted in **Section 4.8.1**, this is a modeled concentration. Site specific, MECP approved and witnessed, monitoring that was conducted shows particulate levels well below relevant criteria.

Table D3-21: Preferred Alternative Scenario 1 Resulting Cumulative Air Quality

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Averaging Periods [hrs]	Maximum POI Concentration [ug/m³][(1)]	Background Concentration [ug/m³]	Resulting Ambient Air Quality [ug/m³]	Most Stringent POI Criteria [ug/m³]	Percent of Criteria [%]
Nitrogen oxides	10102-44-0	4.20E+00	1	263.9	34.0	297.9	400	74%
Nitrogen oxides	10102-44-0	2.75E+00	24	29.9	13.9	43.8	200	22%
Sulphur dioxide	7446-09-05	4.70E-01	1	3.5	16.0	19.5	100	20%
Sulphur dioxide	7446-09-05	4.67E-01	24	1.3	3.2	4.5	275	2%
Sulphur dioxide	7446-09-05	4.67E-01	Annual	0.1	1.3	1.4	10	14%
Carbon monoxide	630-08-0	1.94E+00	0.5	61.1	1,172.6	1,233.7	6,000	21%
TSP	N/A - TSP	1.41E+01[(2)]	24	114.7	49.5	164.2	120	137%[3]
TSP	N/A - TSP	1.41E+01[(2)]	Annual	5.9	32.3	38.2	60	64%
PM_{10}	N/A - PM_{10}	2.05E+00	24	37.6	24.8	62.4	50	125%[3]
$PM_{2.5}$	N/A - $PM_{2.5}$	7.13E-01	24	4.4	12.4	16.8	27.0	62%
$PM_{2.5}$	N/A - $PM_{2.5}$	7.13E-01	Annual	0.6	8.1	8.7	8.8	99%
Hydrogen sulphide	7783-06-04	4.59E-02	10-min	2.0	1.4	3.4	13	26%
Hydrogen sulphide	7783-06-04	4.59E-02	24	0.4	1.4	1.8	7	25%
Vinyl chloride	75-01-4	1.71E-02	24	0.1	0.004	0.1	1	14%
Chloroform	67-66-3	1.34E-04	24	0.001	0.2	0.2	1	20%
Odour	N/A - Odour	8.84E+03 OU/s	10-min	0.40	--	0.40 OU	1	40%

Table Notes:

(1) All modelled maximum POI concentrations are taken from the worst-case discrete receptor.

(2) TSP emissions reflective of a 1-hr emission rate. The air dispersion model has been refined for this Scenario to include to a variable emission rate using the 1-hr emission rate during site operations (7:00 a.m. to 5:00 p.m. Monday to Saturday).

(3) As noted in Section 4.8.1, this is a modeled concentration. Site specific, MECP approved and witnessed, monitoring that was conducted shows particulate levels well below relevant criteria.

Table D3-22: Preferred Alternative Scenario 2 Resulting Cumulative Air Quality

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Averaging Periods [hrs]	Maximum POI Concentration [ug/m^3](1)	Background Concentration [ug/m^3]	Resulting Ambient Air Quality [ug/m^3]	Most Stringent POI Criteria [ug/m^3]	Percent of Criteria [%]
Nitrogen oxides	10102-44-0	4.81E+00	1	283.5	34.0	317.5	400	79%
Nitrogen oxides	10102-44-0	3.07E+00	24	23.8	13.9	37.7	200	19%
Sulphur dioxide	7446-09-05	5.69E-01	1	4.1	16.0	20.1	100	20%
Sulphur dioxide	7446-09-05	5.66E-01	24	1.6	3.2	4.8	275	2%
Sulphur dioxide	7446-09-05	5.66E-01	Annual	0.1	1.3	1.4	10	14%
Carbon monoxide	630-08-0	2.45E+00	0.5	60.8	1,172.6	1,233.4	6,000	21%
TSP	N/A - TSP	8.32E+00	24	115.8	49.5	165.3	120	138%2
TSP	N/A - TSP	8.32E+00	Annual	17.2	32.3	49.5	60	82%
PM_{10}	N/A - PM_{10}	2.72E+00	24	31.3	24.8	56.1	50	112%2
$PM_{2.5}$	N/A - $PM_{2.5}$	9.33E-01	24	3.6	12.4	16.0	27.0	59%
$PM_{2.5}$	N/A - $PM_{2.5}$	9.33E-01	Annual	0.7	8.1	8.8	8.8	99.5%
Hydrogen sulphide	7783-06-04	5.64E-02	10-min	2.0	1.4	3.4	13	26%
Hydrogen sulphide	7783-06-04	5.64E-02	24	0.4	1.4	1.8	7	26%
Vinyl chloride	75-01-4	2.10E-02	24	0.2	0.004	0.2	1	16%
Chloroform	67-66-3	1.65E-04	24	0.001	0.2	0.2	1	20%
Odour	N/A - Odour	1.07E+04 OU/s	10-min	0.40	--	0.40 OU	1 OU	40%

Table Notes:

(1) All modelled maximum POI concentrations are taken from the worst-case discrete receptor.

(2) As noted in Section 4.8.1, this is a modeled concentration. Site specific, MECP approved and witnessed, monitoring that was conducted shows particulate levels well below relevant criteria.

Table D3-23: Preferred Alternative Scenario 3 Resulting Cumulative Air Quality

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Averaging Periods [hrs]	Maximum POI Concentration [ug/m³](1)	Background Concentration [ug/m³]	Resulting Ambient Air Quality [ug/m³]	Most Stringent POI Criteria [ug/m³]	Percent of Criteria [%]
Nitrogen oxides	10102-44-0	4.58E+00	1	331.6	34.0	365.6	400	91%
Nitrogen oxides	10102-44-0	3.03E+00	24	53.0	13.9	66.9	200	33%
Sulphur dioxide	7446-09-05	6.64E-01	1	4.8	16.0	20.8	100	21%
Sulphur dioxide	7446-09-05	6.62E-01	24	1.8	3.2	5.0	275	2%
Sulphur dioxide	7446-09-05	6.62E-01	Annual	0.1	1.3	1.4	10	14%
Carbon monoxide	630-08-0	2.44E+00	0.5	49.4	1,172.6	1,222.0	6,000	20%
TSP	N/A - TSP	8.15E+00	24	110.2	49.5	159.7	120	133%[2]
TSP	N/A - TSP	8.15E+00	Annual	17.2	32.3	49.5	60	82%
PM_{10}	N/A - PM_{10}	2.68E+00	24	29.4	24.8	54.2	50	108%[2]
$PM_{2.5}$	N/A - $PM_{2.5}$	9.28E-01	24	3.3	12.4	15.7	27.0	58%
$PM_{2.5}$	N/A - $PM_{2.5}$	9.28E-01	Annual	0.7	8.1	8.8	8.8	99.6%
Hydrogen sulphide	7783-06-04	6.51E-02	10-min	2.5	1.4	3.9	13	30%
Hydrogen sulphide	7783-06-04	6.51E-02	24	0.5	1.4	1.9	7	27%
Vinyl chloride	75-01-4	2.42E-02	24	0.2	0.004	0.2	1	18%
Chloroform	67-66-3	1.90E-04	24	0.001	0.2	0.2	1	20%
Odour	N/A - Odour	1.25E+04 OU/s	10-min	0.49	--	0.49 OU	1 OU	49%

Table Notes:

(1) All modelled maximum POI concentrations are taken from the worst-case discrete receptor.

(2) As noted in Section 4.8.1, this is a modeled concentration. Site specific, MECP approved and witnessed, monitoring that was conducted shows particulate levels well below relevant criteria.

Table D3-24: Cumulative TSP and PM10 24-hr Average Monitored and Modelled Comparison

Contaminant Name	CAS No.	2014 Monitored [ug/m3](1)	Existing Conditions (NAPS baseline + Modeled operations) [ug/m³]	Scenario 1 (NAPS baseline + Modeled operations) [ug/m³]	Scenario 2 (NAPS baseline + Modeled operations) [ug/m³]	Scenario 3 (NAPS baseline + Modeled operations) [ug/m³]
TSP	N/A - TSP	41.4	145.1	164.2	165.3	159.7
PM_{10}	N/A - PM_{10}	20.7(2)	51.3	62.4	56.1	54.2

Table Notes:

(1) TSP concentration is based on the 90th percentile of the sampled data during the monitoring period[24].

(2) PM_{10} was not sampled during the monitoring period, therefore, it was calculated based on an estimation of 50% of TSP being in the PM_{10} size fraction[25].

4.8.2 Environmental Effects Predicted Cumulative Air Quality Comparison

The predicted cumulative air quality for the existing conditions and the preferred alternative expansion scenarios are summarized in **Table D3-25** below.

The resulting concentrations for most indicator compounds show that there will be an increase relative to the existing conditions for the future operating scenarios.

The increase in cumulative concentrations of landfill gas associated indicator compounds is attributed to increased total waste receipt at the landfill over the expansion period.

The variation in emissions associated with vehicular activity are attributed to the change in location of high vehicular activity and on-site haul routes during the construction of the expansion area landfill cells.

There is considerable variation in the predicted cumulative concentrations of nitrogen oxides. The variation of nitrogen oxides is attributed to the change in location of the active working face (and applicable emission sources) from the existing conditions throughout the development scenarios of the preferred alternative.

24 Dillon Consulting Ltd. Ridge Landfill 2014 Air Monitoring Report. June 2015.

25 CEPA/FPAC Working Group on Air Quality Objectives and Guidelines, National Ambient Air Quality Objectives for Particulate Matter Part 1: Science Assessment Document, ISBN 0-662-63486-1, 1998.

The emissions and resulting ambient concentrations will incorporate mitigative measures outlined in **Section 4.7.2** to be included in the Design and Operations Report[26] for the landfill expansion, see **Appendix D6** – Design and Operations Report.

Table D3-25: Comparison of the Predicted Cumulative Air Quality

Contaminant Name	CAS No.	Averaging Periods [hrs]	Scenario 1 Percent Change from Existing Conditions [%]	Scenario 2 Percent Change from Existing Conditions [%]	Scenario 3 Percent Change from Existing Conditions [%]
Nitrogen oxides	10102-44-0	1	-25%	-17%	-2%
Nitrogen oxides	10102-44-0	24	-25%	-45%	18%
Sulphur dioxide	7446-09-05	1	7%	10%	13%
Sulphur dioxide	7446-09-05	24	12%	16%	21%
Sulphur dioxide	7446-09-05	Annual	2%	3%	4%
Carbon monoxide	630-08-0	0.5	2%	2%	1%
TSP	N/A - TSP	24	12%	12%	9%
TSP	N/A - TSP	Annual	-21%	7%	7%
PM_{10}	N/A - PM_{10}	24	18%	8%	5%
$PM_{2.5}$	N/A - $PM_{2.5}$	24	8%	3%	2%
$PM_{2.5}$	N/A - $PM_{2.5}$	Annual	2%	2%	2%
Hydrogen sulphide	7783-06-04	10-min	10%	10%	21%
Hydrogen sulphide	7783-06-04	24	-1%	1%	4%
Vinyl chloride	75-01-4	24	-3%	5%	17%
Chloroform	67-66-3	24	-0.02%	0.03%	0.1%
Odour	N/A - Odour	10-min	18%	17%	33%

[26] Golder Associates Limited. Appendix D6 – Ridge Landfill Expansion: Design and Operations Report Draft. July 2019.

4.8.3 Compliance Assessment Emission Summary

The predicted concentrations for each indicator compound of all potential sources that are subject to *O. Reg. 419/05* for assessment of compliance are provided in **Table D3-26** to **D3-29** below.

The concentrations for each indicator compound were compared against the applicable criteria. The predicted concentrations are below their respective criteria for each indicator compound. This Atmospheric Impact Assessment demonstrates that the site currently operates in compliance with *O. Reg. 419/05*, and is predicted to continue to comply with *O. Reg. 419/05* through the development of the preferred alternative.

Table D3-26: Compliance Assessment Existing Conditions Emission Summary Table

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Maximum POI Concentration [ug/m³]	Averaging Periods [hrs]	MECP POI Limit [ug/m³](1)	Percentage of MECP POI Limit [%]
Nitrogen oxides	10102-44-0	6.92E-01	7.22E+00	1	400	1.8%
Nitrogen oxides	10102-44-0	6.92E-01	3.04E+00	24	200	1.5%
Sulphur dioxide	7446-09-05	2.80E-01	2.92E+00	1	690	<1%
Sulphur dioxide	7446-09-05	2.80E-01	1.23E+00	24	275	<1%
Sulphur dioxide	7446-09-05	2.80E-01	2.92E+00	1	100 (2)	2.9%
Sulphur dioxide	7446-09-05	2.80E-01	6.49E-02	Annual	10 (2)	<1%
Carbon monoxide	630-08-0	8.08E-01	1.01E+01	0.5	6,000	<1%
TSP	N/A - TSP	5.15E-01	1.53E+01	24	120	12.8%
Hydrogen sulphide	7783-06-04	3.40E-02	1.88E+00	10-min	13	14.5%
Hydrogen sulphide	7783-06-04	3.40E-02	4.23E-01	24	7	6.0%
Vinyl chloride	75-01-4	1.27E-02	1.57E-01	24	1	15.7%
Chloroform	67-66-3	9.93E-05	1.24E-03	24	1	<1%
Odour	N/A - Odour	6.61E+03 OU/s	3.69E-01 OU	10-min	1 OU/m3	36.9%

Table Notes:

(1) Criteria listed in the MECP Air Contaminants Benchmarks (ACB) List: Standards, Guidelines, and Screening Levels for Assessing POI Concentrations of Air Contaminants, Version 2.0, dated April 2018.

(2) MECP proposed POI Limit, effective on July 1, 2023.

Table D3-27: Compliance Assessment Scenario 1 Emission Summary Table

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Maximum POI Concentration [ug/m^3]	Averaging Periods [hrs]	MECP POI Limit [ug/m^3][(1)]	Percentage of MECP POI Limit [%]
Nitrogen oxides	10102-44-0	1.38E+00	1.45E+01	1	400	3.6%
Nitrogen oxides	10102-44-0	1.38E+00	6.18E+00	24	200	3.1%
Sulphur dioxide	7446-09-05	4.66E-01	4.89E+00	1	690	<1%
Sulphur dioxide	7446-09-05	4.66E-01	2.08E+00	24	275	<1%
Sulphur dioxide	7446-09-05	4.66E-01	4.89E+00	1	100 (2)	4.9%
Sulphur dioxide	7446-09-05	4.66E-01	1.02E-01	Annual	10 (2)	1.0%
Carbon monoxide	630-08-0	1.62E+00	2.04E+01	0.5	6,000	<1%
TSP	N/A - TSP	7.76E-01	4.09E+01	24	120	34.1%
Hydrogen sulphide	7783-06-04	7.76E-01	3.99E+00	10-min	13	6.7%
Hydrogen sulphide	7783-06-04	4.59E-02	2.37E+00	24	7	18.2%
Vinyl chloride	75-01-4	4.59E-02	4.36E-01	24	1	6.2%
Chloroform	67-66-3	1.71E-02	1.62E-01	24	1	16.2%
Odour	N/A - Odour	8.84E+03 OU/s	4.65E-01 OU	10-min	1 OU/m3	46.5%

Table Notes:

(1) Criteria listed in the MECP Air Contaminants Benchmarks (ACB) List: Standards, Guidelines, and Screening Levels for Assessing POI Concentrations of Air Contaminants, Version 2.0, dated April 2018.

(2) MECP proposed POI Limit, effective on July 1, 2023.

Table D3-28: Compliance Assessment Scenario 2 Emission Summary Table

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Maximum POI Concentration [ug/m^3]	Averaging Periods [hrs]	MECP POI Limit [ug/m^3][(1)]	Percentage of MECP POI Limit [%]
Nitrogen oxides	10102-44-0	1.82E+00	1.77E+01	1	400	4.4%
Nitrogen oxides	10102-44-0	1.82E+00	7.68E+00	24	200	3.8%
Sulphur dioxide	7446-09-05	5.65E-01	5.49E+00	1	690	<1%
Sulphur dioxide	7446-09-05	5.65E-01	2.38E+00	24	275	<1%
Sulphur dioxide	7446-09-05	5.65E-01	5.49E+00	1	100 (2)	5.5%
Sulphur dioxide	7446-09-05	5.65E-01	1.32E-01	Annual	10 (2)	1.3%
Carbon monoxide	630-08-0	2.13E+00	2.48E+01	0.5	6,000	<1%
TSP	N/A - TSP	9.41E-01	3.81E+01	24	120	31.7%
Hydrogen sulphide	7783-06-04	9.41E-01	3.65E+00	10-min	13	6.1%
Hydrogen sulphide	7783-06-04	5.64E-02	2.25E+00	24	7	17.3%
Vinyl chloride	75-01-4	5.64E-02	4.61E-01	24	1	6.6%
Chloroform	67-66-3	2.10E-02	1.71E-01	24	1	17.1%
Odour	N/A - Odour	1.07E+04 OU/s	4.41E-01 OU	10-min	1 OU/m3	44.1%

Table Notes:

(1) Criteria listed in the MECP Air Contaminants Benchmarks (ACB) List: Standards, Guidelines, and Screening Levels for Assessing POI Concentrations of Air Contaminants, Version 2.0, dated April 2018.

(2) MECP proposed POI Limit, effective on July 1, 2023.

Table D3-29: Compliance Assessment Scenario 3 Emission Summary Table

Contaminant Name	CAS No.	Total Facility Emission Rate [g/s]	Maximum POI Concentration [ug/m^3]	Averaging Periods [hrs]	MECP POI Limit [ug/m^3](1)	Percentage of MECP POI Limit [%]
Nitrogen oxides	10102-44-0	1.82E+00	1.77E+01	1	400	4.4%
Nitrogen oxides	10102-44-0	1.82E+00	7.68E+00	24	200	3.8%
Sulphur dioxide	7446-09-05	6.60E-01	6.42E+00	1	690	<1%
Sulphur dioxide	7446-09-05	6.60E-01	2.79E+00	24	275	1.0%
Sulphur dioxide	7446-09-05	6.60E-01	6.42E+00	1	100 (2)	6.4%
Sulphur dioxide	7446-09-05	6.60E-01	1.54E-01	Annual	10 (2)	1.5%
Carbon monoxide	630-08-0	2.13E+00	2.48E+01	0.5	6,000	<1%
TSP	N/A - TSP	9.39E-01	4.52E+01	24	120	37.7%
Hydrogen sulphide	7783-06-04	9.39E-01	8.25E+00	10-min	13	13.8%
Hydrogen sulphide	7783-06-04	6.51E-02	2.55E+00	24	7	19.6%
Vinyl chloride	75-01-4	6.51E-02	5.46E-01	24	1	7.8%
Chloroform	67-66-3	2.42E-02	2.03E-01	24	1	20.3%
Odour	N/A - Odour	1.25E+04 OU/s	4.99E-01 OU	10-min	1 OU/m3	49.9%

Table Notes:

(1) Criteria listed in the MECP Air Contaminants Benchmarks (ACB) List: Standards, Guidelines, and Screening Levels for Assessing POI Concentrations of Air Contaminants, Version 2.0, dated April 2018.

(2) MECP proposed POI Limit, effective on July 1, 2023.

4.8.4 Compliance Assessment Comparison

The predicted concentrations for the compliance assessment of the existing conditions and the development scenarios are summarized in **Table D3-30** below. The table presents the comparison of predicted concentrations for each indicator compound during the scenarios of the preferred alternative expansion.

Overall, the predicted atmospheric concentrations for all indicator compounds increase from the existing conditions to the development scenarios of the preferred alternative. The variability in predicted concentrations of combustion products during the different development scenarios of the preferred alternative expansion is attributed to the increase in the number of landfill gas flares.

The increase in landfill gas associated indicator compounds is attributed to increased total waste receipt at the landfill over the expansion period. The landfill gas generation rates provide a larger contribution to the emissions profile for sulphur dioxide as the emission estimates and predicted concentrations are directly correlated to the total landfill gas generation.

As the same amount of material is being handled throughout the different expansion scenarios of the preferred alternative, the variability in TSP predicted concentrations is due to the varying locations of activity during the expansion scenarios.

Table D3-30: Comparison of Predicted Compliance Air Quality Concentrations

Contaminant Name	CAS No.	Averaging Periods [hrs]	Scenario 1 Percent Change from Existing Conditions [%]	Scenario 2 Percent Change from Existing Conditions [%]	Scenario 3 Percent Change from Existing Conditions [%]
Nitrogen oxides	10102-44-0	1	101%	145%	145%
Nitrogen oxides	10102-44-0	24	103%	152%	152%
Sulphur dioxide	7446-09-05	1	68%	88%	120%
Sulphur dioxide	7446-09-05	24	69%	94%	126%
Sulphur dioxide	7446-09-05	Annual	57%	103%	137%
Carbon monoxide	630-08-0	0.5	101%	145%	145%
TSP	N/A - TSP	24	167%	149%	195%
TSP	N/A - TSP	Annual	165%	142%	446%
Hydrogen sulphide	7783-06-04	10-min	26%	20%	35%
Hydrogen sulphide	7783-06-04	24	3%	9%	29%
Vinyl chloride	75-01-4	24	3%	9%	29%
Chloroform	67-66-3	24	3%	9%	29%
Odour	N/A - Odour	10-min	26%	19%	35%

Table Notes:

(1) Criteria listed in the MECP Air Contaminants Benchmarks (ACB) List: Standards, Guidelines, and Screening Levels for Assessing POI Concentrations of Air Contaminants, Version 2.0, dated April 2018.

(2) MECP proposed POI Limit, effective on July 1, 2023.

4.9 Mitigative Measures

The Design and Operations Report[27] of the Ridge Landfill considers certain mitigative measures that are integral in managing air emissions associated with on-site activities. The mitigative measures are considered to be typical of normal landfill operations and consistent with industry best practices.

Table D3-31 provides a summary of mitigative measures considered in the air quality assessment.

Table D3-31: Summary of Mitigative Measures

Indicator	Mitigation Specifics	Works and Activities Affected	Net Effects	Incorporation into Assessment
TSP PM_{10} $PM_{2.5}$	Road cleaning (paved roads) and dust suppressant (watering of unpaved roads) on a regular basis	On-site vehicle movements and roadways	Reduced particulate emissions	Reduction included in emission predictions
Odour	Daily cover material applied at the end of each operating day		Control of odour emissions	No reduction included in emission predictions
Odour Hydrogen sulphide Vinyl chloride Chloroform	Expansion of landfill gas collection system	Landfill footprints	Reduced odour and landfill gas compound emissions	Landfill gas collection and new landfill gas flare included in emission predictions

[27] Golder Associates Limited. Appendix D6 – Ridge Landfill Expansion: Design and Operations Report Draft. July 2019.

4.10 Results

The results of the air quality assessment of the site operations can be summarized as follows:

- The current and future predicted concentrations of indicator compounds are anticipated to meet relevant O. Reg. 419/05 regulatory compliance criteria;
- The odour assessment resulted in a low potential impact on the discrete receptors.
- The modeling of current and future effects for all sources on-site yielded indicator compound concentrations that are below relevant criteria, with the exception of TSP and PM_{10}. However site-specific, MECP witnessed and reviewed monitoring of the current operations (on-site activities and background concentrations) showed that the current cumulative concentrations of indicator compounds are well below relevant criteria. When the modeled incremental change in concentrations (existing to future scenarios) is applied to the monitored concentrations, the site is anticipated to be below relevant criteria for TSP and PM_{10} for all development scenarios.

5.0 Haul Route Impact Assessment

The haul route assessment was performed to evaluate the potential impacts of road traffic associated with the proposed expansion to the Ridge Landfill. This assessment was performed considering changes to current traffic volumes and vehicle emissions along the haul route due to both landfill operation and local traffic. 2018 traffic volumes were used to represent the baseline scenario. Projected 2041 traffic volumes were developed to represent the future case under the expansion scenario. Projected 2021 traffic volumes were developed to represent the no expansion scenario. Traffic and vehicle data used in the haul route assessment is based on the Transportation Impact Assessment completed for this EA[28].

5.1 Scope of Assessment

Baseline and future scenarios were evaluated using air dispersion modelling to predict contaminant concentrations at receptors near to the roadway. Model results were combined with background concentrations to assess the potential for air quality impacts resulting from the haul route.

5.1.1 Study Area and Receptor Locations

For the purposes of this assessment, the Haul Route Study Area ("haul route") has been defined as the lands immediately adjacent to Communication Road, Drury Line and Erieau Road which are identified as the designated haul route for the site. The haul route is shown in **FIGURE D3-9.**

Concentrations of selected indicator compounds were modelled at Points of Reception (PORs) surrounding the haul route. Indicator compound concentrations typically decrease with distance from the roadway, therefore the closest PORs are expected to experience the highest concentrations. For consistency, the receptor locations chosen for the on-site air quality assessment were used where applicable. Receptor locations assessed are shown on **FIGURE D3-9.**

[28] Dillon Consulting Limited, Appendix D11 – Transportation Impact Assessment, July 2019.

5.1.2 Haul Route Traffic Data

Existing classified turning movement traffic volumes were surveyed by Pyramid Traffic Inc. on Thursday, March 9, 2017 for an 11-hour period from 7:00 a.m. to 6:00 p.m. at the following intersections/ramps (study area network):

- Erieau Road / Ridge Landfill Driveway;
- Erieau Road / Drury Line;
- Communication Road (RR 11) / Drury Line;
- Communication Road (Highway 40) / 401 EB ramps; and,
- Communication Road (Highway 40) / 401 WB ramps.

The turning movement and traffic count data was used to develop a traffic model for the haul route study area. For the study area a.m. and p.m. peak hourly traffic volumes are shown in **FIGURE D3-10**. Annual traffic growth from the measured year (2017) was accounted for in the Transportation Impact Assessment (**Appendix D11 –** Transportation Impact Assessment) by applying a region-specific 0.4% annual growth rate. The traffic study provided a breakdown of light-duty and heavy-duty vehicles as well as the portion of traffic which is attributable to the site.

FIGURE D3-9: HAUL ROUTE LOCATION

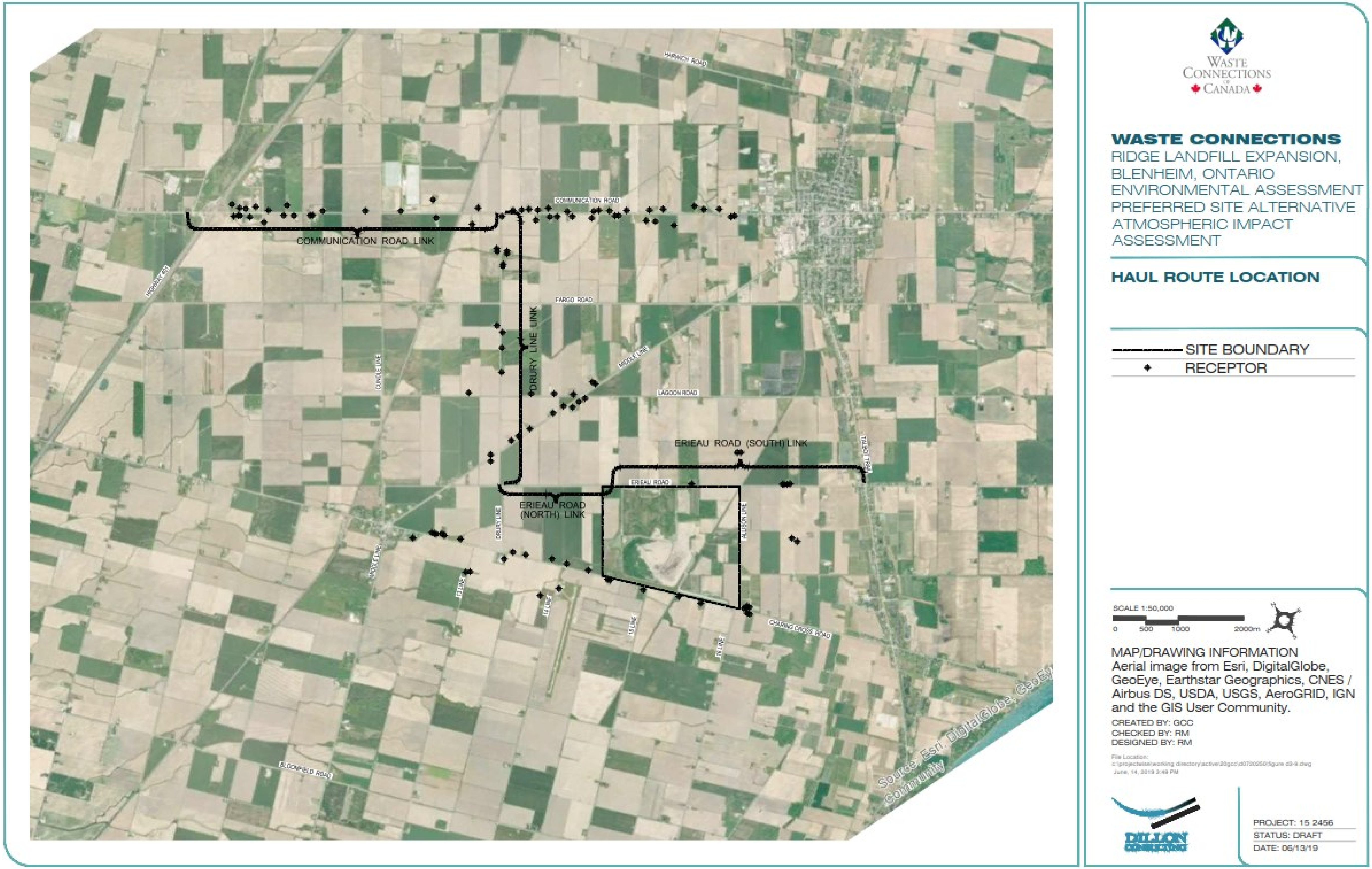
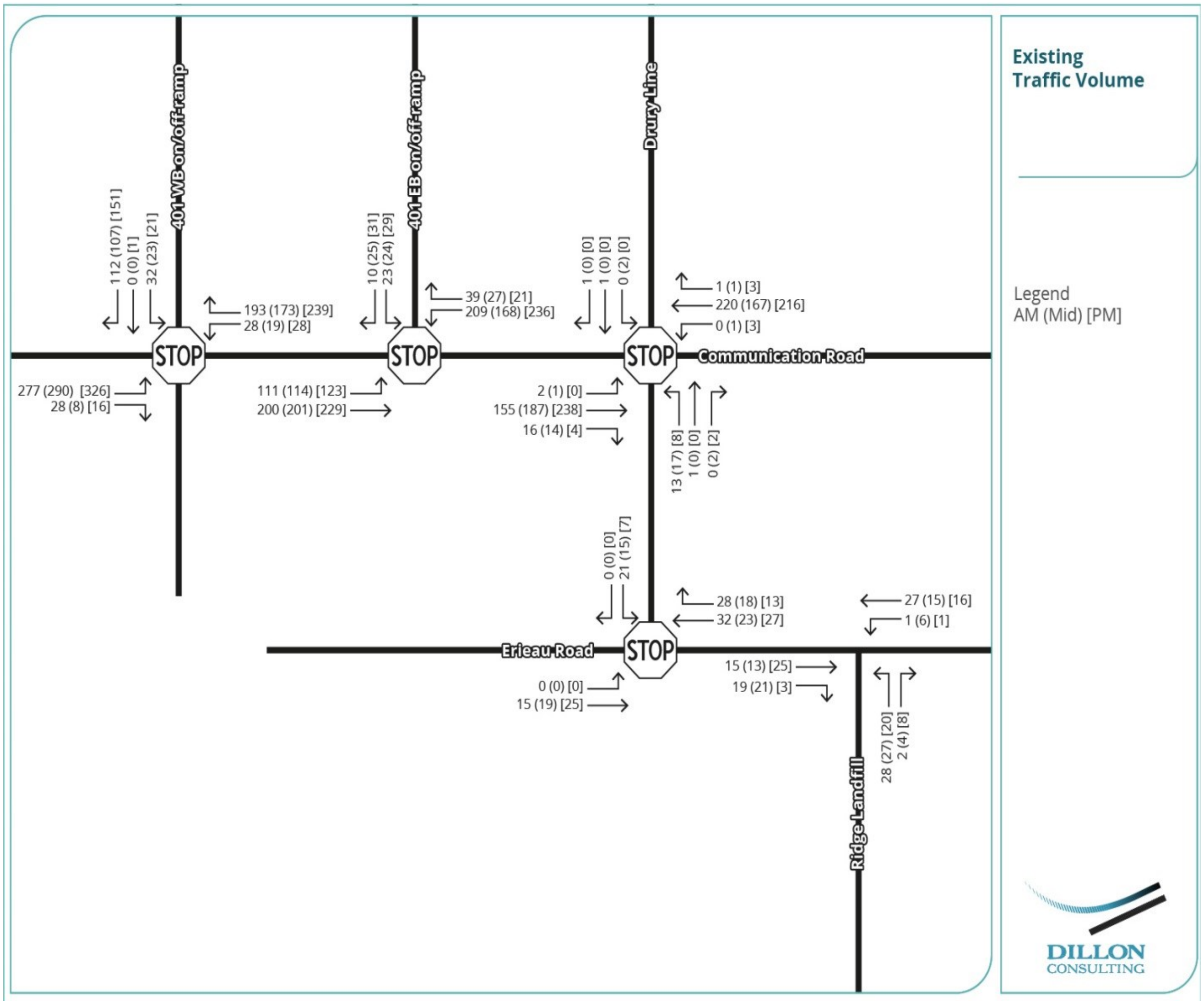


FIGURE D3-10: 2018 PEAK HOURLY TRAFFIC VOLUMES



5.1.3 Scenarios Assessed

Three (3) scenarios were modelled to evaluate the potential impacts as a result of vehicle traffic on the haul route.

2018 "Baseline Scenario"

The Baseline Scenario was assessed to evaluate the predicted impacts of the haul route based on current operations at the landfill. 2017 traffic volumes were scaled to represent 2018 in the Transportation Impact Assessment.

2021 "Closure Scenario"

The Closure Scenario was assessed to provide comparison to baseline impacts of the haul route post-closure of the landfill (i.e., with no landfill traffic on the haul route). 2017 traffic volumes were scaled to represent 2021 in the Transportation Impact Assessment.

2041 "Expansion Scenario"

The Expansion Scenario was assessed to evaluate the predicted impacts of haul route vehicle traffic based on operations at the landfill in the final year of operation. The proposed expansion of the Ridge Landfill will not increase the daily intake at the landfill, therefore the haul route traffic associated with the landfill is not expected to increase. Local traffic volumes are predicted to increase following the regional growth rate.

5.2 Air Quality Assessment Methodology

Air quality impacts as a result of vehicle traffic on the haul route associated with the proposed expansion of the Ridge Landfill were predicted using air dispersion modelling. This assessment includes both vehicles associated with the landfill as well as local traffic in order to quantify the total potential impacts of vehicles along the haul route. Tailpipe emissions were assessed along with brake wear, tire wear, and the re-suspension of road dust due to vehicles travelling along the haul route.

Where applicable, this assessment followed the methodology outlined in the Ministry of Transportation of Ontario's (MTO) *Environmental Guide for Assessing and Mitigating the Air Quality Impacts and Greenhouse Gas Emissions of Provincial Transportation Projects.*

The indicator compounds assessed, listed below, were chosen based on consultation with the MECP:

- Carbon Monoxide (CO);
- Nitrogen Oxides (NO_x);
- Sulphur Dioxide (SO_2);
- Respirable Particulate Matter ($PM_{2.5}$);
- Inhalable Particulate Matter (PM_{10}); and
- Total Suspended Particulate Matter (TSP).

5.2.1 Motor Vehicle Emission Rates

Motor vehicle emission rates were developed using the United States Environmental Protection Agency's (US EPA) Motor Vehicle Emission Simulator (MOVES) which predicts vehicle emissions based on extensive testing performed by the agency. The MOVES program accounts for local meteorology, fuel formulation, improving emissions technology, vehicle speed, vehicle driving cycles, vehicle fleet age, road type, and other factors in order to estimate emissions.

TableD3-32 through **TableD3-35** provide the emission rates for the 2018 and 2041 scenarios in grams per vehicle mile travelled (g/VMT). 2018 emission rates were used in the 2021 Closure Scenario modelling. Passenger trucks were used to represent the local and site-related passenger traffic. Refuse trucks were used to represent local and site-related heavy-duty traffic. Note that MOVES does not directly predict emissions for TSP, however, a US EPA study found that 97% of tailpipe particulate emissions are PM_{10} or smaller[29]. Tailpipe, brake wear, and tire wear PM_{10} emissions were used to represent TSP.

TableD3-32: 2018 Passenger Truck Emissions (g/VMT)

Compound	60kmhr	90kmhr
NOx	2.23E-01	2.43E-01
SO_2	2.79E+00	2.60E+00
CO	2.07E+00	1.86E+00
PM_{10} Tailpipe	4.24E-03	4.11E-03
PM_{10} Brake wear	3.26E-02	8.06E-03
PM_{10} Tire wear	1.03E-02	7.67E-03
$PM_{2.5}$ Tailpipe	3.75E-03	3.63E-03
$PM_{2.5}$ Brake wear	4.07E-03	1.01E-03
$PM_{2.5}$ Tire wear	1.55E-03	1.15E-03

[29] US EPA, *Exhaust Emission Rates for Light-Duty On-Road Vehicles in MOVES2014*, October 2015

Table D3-33: 2018 Haul Truck Emissions (g/VMT)

Compound	60kmhr	90kmhr
NOx	4.23E+00	3.78E+00
SO_2	1.46E+01	1.31E+01
CO	1.19E+00	9.89E-01
PM_{10} Tailpipe	2.39E-01	1.76E-01
PM_{10} Brake wear	1.97E-01	6.77E-02
PM_{10} Tire wear	3.71E-02	2.97E-02
$PM_{2.5}$ Tailpipe	2.20E-01	1.62E-01
$PM_{2.5}$ Brake wear	2.47E-02	8.47E-03
$PM_{2.5}$ Tire wear	5.57E-03	4.46E-03

Table D3-34: 2041 Passenger Truck Emissions (g/VMT)

Compound	60kmhr	90kmhr
NOx	1.37E-02	1.92E-02
SO_2	1.62E+00	1.51E+00
CO	4.54E-01	4.44E-01
PM_{10} Tailpipe	1.55E-03	1.48E-03
PM_{10} Brake wear	3.26E-02	8.06E-03
PM_{10} Tire wear	1.03E-02	7.67E-03
$PM_{2.5}$ Tailpipe	1.37E-03	1.31E-03
$PM_{2.5}$ Brake wear	4.07E-03	1.01E-03
$PM_{2.5}$ Tire wear	1.55E-03	1.15E-03

TableD3-35: 2041 Haul Truck Emissions (g/VMT)

Compound	60kmhr	90kmhr
NOx	7.07E-01	5.68E-01
SO_2	1.33E+01	1.12E+01
CO	1.92E-01	1.53E-01
PM_{10} Tailpipe	1.85E-02	1.16E-02
PM_{10} Brake wear	1.99E-01	3.64E-02
PM_{10} Tire wear	3.76E-02	2.79E-02
$PM_{2.5}$ Tailpipe	1.70E-02	1.06E-02
$PM_{2.5}$ Brake wear	2.49E-02	4.55E-03
$PM_{2.5}$ Tire wear	5.64E-03	4.19E-03

Road dust refers to silt which is physically suspended as a result of vehicles travelling on the road. Road dust was estimated using emission factors from the US EPA's AP-42 database (Chapter 13.2.1). The following calculation shows the methodology which was used to determine the emission rates shown in **Table D3-36**.

$$E = k(sL)^{0.91} * (W)^{1.02}$$

Where:

E = particulate emission factor (g/VMT)

k = particle size multiplier [$PM_{2.5}$ = 0.25 g/VMT, PM_{10}= 1g/VMT, TSP = 5.24 g/VMT]

sL = silt loading (g/m^2), [0.2 if AADT < 5000, 0.06 if AADT> 5000]

W = vehicle weight (tons)

$$E_{light\ duty, PM2.5, AADT<5000} = 0.25(0.2)^{0.91} * (2.5)^{1.02}$$

$$E_{light\ duty, PM2.5, AADT<5000} = 1.47E - 01\ g/VMT$$

Table D3-36: Road Dust Emission Rates (g/VMT)

Vehicle Type	Weight (tons)	AADT	TSP	PM10	PM2.5
Light Duty	2.5	500-5000	3.08E+00	5.89E-01	1.47E-01
Light Duty	2.5	5000+	1.03E+00	1.97E-01	4.92E-02
Heavy Duty	40	500-5000	5.22E+01	9.95E+00	2.49E+00
Heavy Duty	40	5000+	1.74E+01	3.33E+00	8.32E-01

5.2.2 Dispersion Modelling

The US EPA's CAL3QHCR dispersion model was used to predict indicator compound concentrations at the POR's using. CAL3QHCR uses traffic volumes, vehicles emissions rates, chemical properties, and local meteorological data to predict the dispersion of roadway emissions.

The MECP publishes 5-year meteorological datasets for air quality assessments in Ontario that are intended to conservatively represent regions within the province. This data is provided in a raw format which can be processed to work with CAL3QHCR. Five-years of surface meteorological data from the MECP's London station was used to represent the study area. The US EPA's RAMMET meteorological pre-processor was used to estimate mixing height data based on the MECP surface data. Modelling was individually performed for five years (1996-2000, based on the MECP meteorological dataset) to determine the worst-case year, using 1-hour NO_x concentrations as an indicator of worst-case year. For all indicator compounds, the worst case year (2041) was used to assess the roadway impacts.

The haul route was modelled as a flat domain (i.e., no terrain elevation was used). Receptors were set at 1.8 m above grade to represent a typical human receptor. The study area was modelled with a surface roughness length of 7.25 cm to represent the rural nature of the site. 7.25 cm is the average of the seasonal surface roughness values provided by the MTO guide for the "pasture/hay" land type.

CAL3QHCR can account for idling vehicles through the use of queue links, which represent vehicles at traffic signals such as lights or stop signs. Due to the low overall traffic volumes in the study domain, queue links were not used; CAL3QHCR requires that at minimum one vehicle be idling at a traffic signal at all times, which is not representative of the study area.

Particulate matter settling and deposition velocities were selected to match MTO guidance. $PM_{2.5}$ was modelled with a settling velocity of 0.02 cm/s and a deposition velocity of 0.1 cm/s. PM_{10} and TSP were modelled with a settling velocity of 0.3 cm/s and a deposition velocity of 0.5 cm/s. The remaining indicator compounds are not subject to settling or deposition in the model.

5.2.3 Traffic Volumes

The years 2018, 2021, and 2041 traffic volumes were used in the model. The 2018 and 2041 had the same site-related traffic volumes, and the 2041 expansion scenario included growth in local traffic volumes. The 2021 scenario did not have site-related traffic volumes, but did include growth in local traffic volumes. Light-duty and heavy-duty vehicular traffic volumes were included in the mode, along with the corresponding emission rates - developed using MOVES - for the two (2) vehicle classes.

Traffic volumes were provided as a.m., midday, and p.m. peaks. Peak volumes were used to develop hourly traffic volumes based on the US EPAs published daily traffic volumes for weekday rural conditions. **Table D3-37** shows the hourly breakdown of traffic volumes for urban and rural settings. The weekday profile was selected for this assessment as it has the highest single-hour vehicle percentage (7.7%) which would be expected to represent a worst-case hour for traffic volumes.

Table D3-37: MOVES Hourly Traffic Distributions[30]

hourID	Description	Urban		Rural	
		Weekday	Weekend	Weekday	Weekend
1	Hour beginning at 12:00 midnight	0.0098621	0.0214739	0.0107741	0.0164213
2	Hour beginning at 1:00 AM	0.00627248	0.0144428	0.0076437	0.0111921
3	Hour beginning at 2:00 AM	0.00505767	0.0109684	0.0065464	0.0085415
4	Hour beginning at 3:00 AM	0.00466686	0.0074945	0.0066348	0.00679328
5	Hour beginning at 4:00 AM	0.00699469	0.0068385	0.0095399	0.00721894
6	Hour beginning at 5:00 AM	0.018494	0.0103588	0.0200551	0.0107619
7	Hour beginning at 6:00 AM	0.0459565	0.0184303	0.0410295	0.01768008
8	Hour beginning at 7:00 AM	0.0696444	0.0268117	0.0579722	0.0268751
9	Hour beginning at 8:00 AM	0.0608279	0.0363852	0.0534711	0.0386587
10	Hour beginning at 9:00 AM	0.0502862	0.0475407	0.0525478	0.0522389
11	Hour beginning at 10:00 AM	0.0499351	0.0574664	0.0550607	0.0631739
12	Hour beginning at 11:00 AM	0.0543654	0.0650786	0.0576741	0.0699435
13	Hour beginning at 12:00 Noon	0.0576462	0.0713228	0.0591429	0.0729332
14	Hour beginning at 1:00 PM	0.0580319	0.0714917	0.0608019	0.0731218
15	Hour beginning at 2:00 PM	0.0622554	0.0717226	0.0652985	0.0736159
16	Hour beginning at 3:00 PM	0.0710049	0.0720061	0.0726082	0.0744608
17	Hour beginning at 4:00 PM	0.0769725	0.0711487	0.0773817	0.0742165
18	Hour beginning at 5:00 PM	0.077432	0.0678874	0.0754816	0.0700091
19	Hour beginning at 6:00 PM	0.059783	0.0617718	0.0587059	0.0614038
20	Hour beginning at 7:00 PM	0.0443923	0.0516882	0.0439864	0.0505043
21	Hour beginning at 8:00 PM	0.0354458	0.0428658	0.0357309	0.0412072
22	Hour beginning at 9:00 PM	0.031824	0.0380302	0.0307428	0.0336373
23	Hour beginning at 10:00 PM	0.0249419	0.0322072	0.0238521	0.0262243
24	Hour beginning at 11:00 PM	0.0179068	0.0245677	0.0173177	0.0191666
	Sum of All Fractions	**1.000**	**1.000**	**1.000**	**1.000**

Each road segment in the study area was modelled with hourly traffic volumes, based on the US EPA distribution. The modelled a.m. and p.m. peak traffic volumes are shown in **Table D3-38** along with heavy duty vehicle percentage and the percentage of traffic attributable to the site.

[30] US EPA, *"Population and Activity of On-Road Vehicles in MOVES2014"*, July 2015, Table 12-5.

Table D3-38: Peak Hour Traffic Volumes and Heavy Duty Vehicle Percentage

Road Segment	a.m. Peak	p.m. Peak	Heavy Duty Vehicle %	Site Traffic %
2018 Peak Hour Traffic Volumes				
Erieau (Site access to Drury)	91	66	47%	47%
Erieau (East from site)	47	52	27%	17%
Drury	51	28	77%	94%
Communication Road	409	468	21%	8%
2021 Peak Hour Traffic Volumes				
Road Segment	a.m. Peak	p.m. Peak	Heavy Duty Vehicle %	Site Traffic %
Erieau (Site access to Drury)	46	45	21%	0%
Erieau (East from site)	45	45	21%	0%
Drury	4	5	44%	0%
Communication Road	367	451	16%	0%
2041 Peak Hour Traffic Volumes				
Road Segment	a.m. Peak	p.m. Peak	Heavy Duty Vehicle %	Site Traffic %
Erieau (Site access to Drury)	95	69	45%	45%
Erieau (East from site)	52	56	26%	16%
Drury	51	28	77%	94%
Communication Road	444	510	21%	8%

5.2.4 Background Concentrations

The results of the dispersion modelling assessment were compared to the relevant regulatory criteria as provided for the on-site assessment. 90th percentile background concentrations were added to the modelling results to provide a reasonably conservative assessment of predicted cumulative impacts surrounding the haul route.

5.3 Results

Air dispersion modelling results are presented in **Table D3-39** through **Table D3-44**. Where the model does not predict indicator compound concentrations for the relevant averaging period (e.g., 24-hour SO_2 concentrations), the predicted 1-hour concentrations were conservatively chosen to represent that averaging period. The following conclusions can be drawn from the dispersion modelling results:

- Excluding background concentrations, the maximum contribution from the haul route (site and local traffic) is 22% of the 24-hour TSP criteria in the 2018 and 2041 scenarios.
- Considering the proposed landfill expansion and background concentrations together, the maximum predicted result is 96% of the proposed annual $PM_{2.5}$ criteria. Of the 96%, 91% is attributable to background concentrations, and 5% is attributable to the haul route traffic.
- For all indicator compounds, despite increases in local traffic, the predicted 2041 concentrations were expected to be the same or lower than the predicted 2018 concentrations when compared to the relevant criteria. This is attributable to predicted improvements in vehicle operation in the MOVES model.
- The 2021 Closure Scenario showed improvements from the 2018 scenario due to the removal of the landfill-associated vehicles.
- The modelling results indicate that there is no increased impact to local air quality from current levels, attributable to the haul route as a result of the proposed landfill expansion.

Table D3-39: Predicted NO_x Concentrations + 90th Percentile Background Concentrations

NO_x Concentrations	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$)	Criteria ($\mu g/m^3$)	Percent of Criteria
2018 Project	1-hour	3.63E+01	400	9%
	24-hour[1]	3.63E+01	200	18%
2018 Project + Background	1-hour	1.00E+02	400	25%
	24-hour[1]	1.00E+02	200	50%
2021 Closure	1-hour	2.41E+01	400	6%
	24-hour[1]	2.41E+01	200	12%
2021 Project + Background	1-hour	8.80E+01	400	22%
	24-hour[1]	8.80E+01	200	44%
2041 Project	1-hour	5.27E+00	400	1%
	24-hour[1]	5.27E+00	200	3%
2041 Project + Background	1-hour	6.92E+01	400	17%
	24-hour[1]	6.92E+01	200	35%

[1]CAL3QHCR does not predict 24-hour concentrations for NO_x. 1-hour predicted concentrations were conservatively chosen to select 24-hour results.

Table D3-40: Predicted CO Concentrations + 90th Percentile Background Concentrations

CO Concentrations	Averaging Period	Maximum Predicted Concentration (µg/m³)	Criteria (µg/m³)	Percent of Criteria
2018 Project	1/2-hour[1]	6.53E+01	36,200	0%
	1-hour	5.38E+01	15,700	0%
	8-hour	1.14E+01	6,000	0%
2018 Project + Background	1/2-hour[1]	1.24E+03	36,200	3%
	1-hour	1.02E+03	15,700	6%
	8-hour	4.38E+02	6,000	7%
2021 Closure	1/2-hour[1]	6.02E+01	36,200	0%
	1-hour	4.96E+01	15,700	0%
	8-hour	1.14E+01	6,000	0%
2021 Closure + Background	1/2-hour	1.23E+03	36,200	3%
	1-hour	1.01E+03	15,700	6%
	8-hour	4.38E+02	6,000	7%
2041 Project	1/2-hour[1]	1.61E+01	36,200	0%
	1-hour	1.33E+01	15,700	0%
	8-hour	0.00E+00	6,000	0%
2041 Project + Background	1/2-hour[1]	1.19E+03	36,200	3%
	1-hour	9.78E+02	15,700	6%
	8-hour	4.26E+02	6,000	7%

[1] CAL3QHCR does not predict ½-hour concentrations. 1-hour results were converted to ½-hour concentrations following MECP guidance.

Table D3-41: Predicted SO_2 Concentrations + 90th Percentile Background Concentrations

SO_2 Concentrations	Averaging Period	Maximum Predicted Concentration (µg/m^3)	Criteria (µg/m^3)	Percent of Criteria
2018 Project	1-hour	1.69E-01	100	0%
	24-hour[1]	1.69E-01	275	0%
	Annual[2]	1.69E-01	55	0%
2018 Project + Background	1-hour	4.07E+01	100	41%
	24-hour[1]	8.56E+00	275	3%
	Annual[2]	3.65E+00	55	7%
2021 Closure	1-hour	1.26E-01	100	0%
	24-hour[1]	1.26E-01	275	0%
	Annual[2]	1.26E-01	55	0%
2021 Closure + Background	1-hour	4.07E+01	100	41%
	24-hour[1]	8.52E+00	275	3%
	Annual[2]	3.61E+00	55	7%
2041 Project	1-hour	1.36E-01	100	0%
	24-hour[1]	1.36E-01	275	0%
	Annual[2]	1.36E-01	55	0%
2041 Project + Background	1-hour	4.07E+01	100	41%
	24-hour[1]	8.53E+00	275	3%
	Annual[2]	3.62E+00	55	7%

[1] CAL3QHCR does not predict 24-hour concentrations for SO_2. 1-hour predicted concentrations were conservatively chosen to select 24-hour results.

[2] CAL3QHCR does not predict annual concentrations for SO_2. 1-hour predicted concentrations were conservatively chosen to select annual results.

Table D3-42: Predicted $PM_{2.5}$ Concentrations + 90th Percentile Background Concentrations

$PM_{2.5}$ Concentrations	Averaging Period	Maximum Predicted Concentration (µg/m³)	Criteria (µg/m³)	Percent of Criteria
2018 Project	24-hour	1.45E+00	27	5%
	Annual	3.88E-01	8.8	4%
2018 Project + Background	24-hour	1.38E+01	27	51%
	Annual	8.47E+00	8.8	96%
2021 Closure	24-hour	8.49E-01	27	3%
	Annual	2.51E-01	8.8	3%
2021 Closure + Background	24-hour	1.32E+01	27	49%
	Annual	8.33E+00	8.8	95%
2041 Project	24-hour	1.34E+00	27	5%
	Annual	3.60E-01	8.8	4%
2041 Project + Background	24-hour	1.37E+01	27	51%
	Annual	8.44E+00	8.8	96%

Table D3-43: Predicted PM_{10} Concentrations + 90th Percentile Background Concentrations

PM_{10} Concentrations	Averaging Period	Maximum Predicted Concentration (µg/m³)	Criteria (µg/m³)	Percent of Criteria
2018 Project	24-hour	5.22E+00	50	10%
2018 Project + Baseline	24-hour	3.00E+01	50	60%
2021 Closure	24-hour	2.99E+00	50	6%
2021 Closure + Baseline	24-hour	2.77E+01	50	55%
2041 Project	24-hour	5.22E+00	50	10%
2041 Project + Baseline	24-hour	2.14E+01	50	43%

Table D3-44: Predicted TSP Concentrations + 90th Percentile Background Concentrations

TSP Concentrations	Averaging Period	Maximum Predicted Concentration (µg/m³)	Criteria (µg/m³)	Percent of Criteria
2018 Project	24-hour	2.60E+01	120	22%
	Annual	7.32E+00	60	12%
2018 Project + Background	24-hour	7.55E+01	120	63%
	Annual	3.96E+01	60	66%
2021 Closure	24-hour	1.47E+01	120	12%
	Annual	4.38E+00	60	7%
2021 Closure + Background	24-hour	6.42E+01	120	53%
	Annual	3.67E+01	60	61%
2041 Project	24-hour	2.67E+01	120	22%
	Annual	7.30E+00	60	12%
2041 Project + Background	24-hour	7.62E+01	120	63%
	Annual	3.96E+01	60	66%

6.0 Blowing Litter Impact Assessment

In the operation of a landfill site, it is important to minimize nuisance impacts on the surrounding area. A potential nuisance created by a landfill is blowing litter, which may be transported off-site under windy conditions. Although it is not feasible to completely eliminate blowing litter events, these events can be reduced with proper control practices.

Under current operating practices at the Ridge Landfill site, control of blowing litter has been relatively successful. The three (3) future design operating scenarios (considered under the preferred alternative) entail various locations of the active working face of the landfill. In addition to existing conditions, these scenarios have also been assessed in order to determine if the proposed changes have the potential to increase the impact of blowing litter on the surrounding businesses and residences as the working face of the landfill shifts to a different location (depending on the scenario).

The assessment of blowing litter impacts is considered to represent a worst-case analysis since blowing litter control measures were assumed not to be in place. As Waste Connections does maintain extensive control measures, the actual impacts are expected to be less than estimated in this report. As part of the site assessment for the proposed expansion to the Ridge Landfill, this study evaluated the potential for blowing litter and assessed its potential off-site impact. Recommended measures for blowing litter control have also been provided.

6.1 Study Area

The area of interest with respect to blowing litter includes residences and businesses in close proximity to the landfill and the surrounding agricultural lands as the level of potential impact will be directly related to the distance between the landfill and the receptors. Only receptors located outside the property boundary were included in the assessment. Receptors were identified using satellite imagery. Receptors along the haul routes were not considered, since all trucks transporting waste to the site will be covered.

The location of the receptors used in the blowing litter assessment are provided in **FIGURE D3-11**.

6.2 Assessment Criteria

To date, there are no definitive industry standards regarding acceptable levels of blowing litter and no regulatory standards exist. To establish assessment criteria for the impact of blowing litter from a landfill site involves considerable uncertainty. Since there are no formal records kept of the amount and distribution of blowing litter, it is not possible to make an assessment based on any quantitative measures. As well, conditions on-site that may lead to a blowing litter event, such as the length of time that litter is exposed, are constantly changing and difficult to measure. For these reasons, determining the impact of blowing litter was limited to two measurable variables[31]:

- Frequency of wind speeds that exceeded the threshold for transporting litter; and
- Proximity of the receptor to the working face of the landfill where litter is exposed and has the potential for transport.

The threshold wind speed criteria for blowing litter events were established by RWDI through a garbage erosion test conducted in the wind tunnel for a previous landfill expansion study[32]. In that study, significant threshold wind speeds for blowing litter events were determined and categorized by the mass per unit area. The analysis for the present study was completed using the same blowing litter threshold wind speed criteria previously established for the site. These criteria are summarized in **Table D3-45** below.

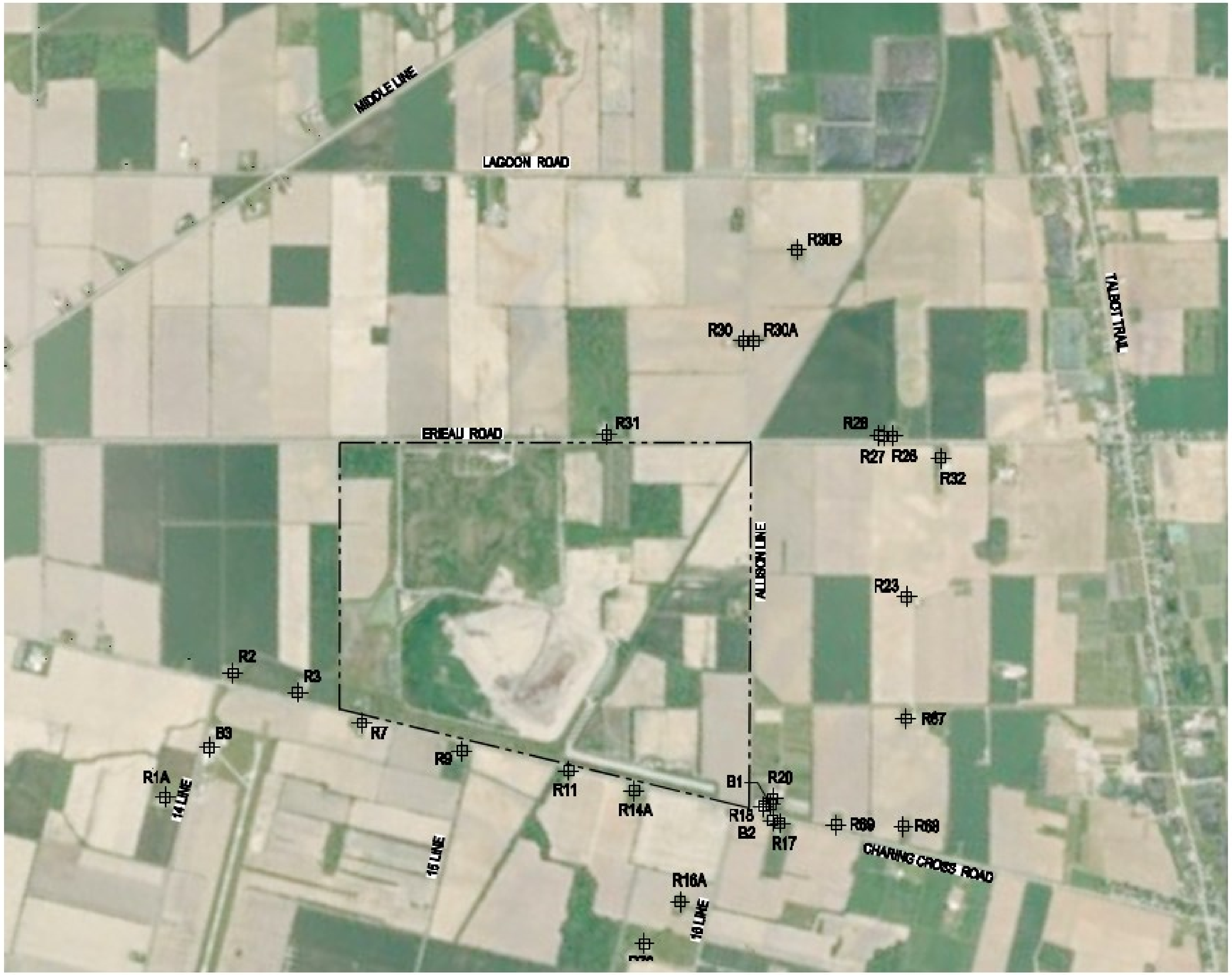
Table D3-45: Blowing Litter Threshold Wind Speed Criteria

Blowing Litter Type	Wind Speed(1) (km/h)	Litter Type Description
None	0 – 22	Not applicable
Light	22 – 33	Newsprint, tissue, paper towel, light bond paper
Moderate	33 – 47	All of the above plus plastic bags, small boxes, small cardboard tubes, paper bags, plastic sheets
Heavy	47+	All of the above plus large quantities of heavy bond paper

Table Note:
(1) Wind speeds measured at 2 m above the ground

[31] RWDI. BFI Ridge Landfill Expansion EA Impact Assessment. "Appendix M – Landfill Atmospheric Studies". 1996.
[32] RWDI. Britannia Landfill Expansion Study. Volume 2: Supporting Reports – Noise, Dust and Blowing Litter. May 1992.

FIGURE D3-11: BLOWING LITTER RECEPTOR LOCATIONS



WASTE CONNECTIONS OF CANADA

WASTE CONNECTIONS
RIDGE LANDFILL EXPANSION, BLENHEIM, ONTARIO
ENVIRONMENTAL ASSESSMENT
PREFERRED SITE ALTERNATIVE
ATMOSPHERIC IMPACT ASSESSMENT

BLOWING LITTER DISCRETE RECEPTORS

SITE BOUNDARY
RECEPTOR

SCALE 1:20,000
0 200 400 800m

MAP/DRAWING INFORMATION
Aerial image from Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES / Airbus DS, USDA, USGS, AeroGRID, IGN and the GIS User Community.

CREATED BY: GCC, EVS
CHECKED BY: RM
DESIGNED BY: RM

DILLON CONSULTING

PROJECT: 15 2456
STATUS: DRAFT
DATE: 07/10/19

In order to facilitate the analysis and interpretation of results, the threshold wind speed criteria were also converted to m/s and are summarized in **Table D3-46** below.

Table D3-46: Blowing Litter Threshold Wind Speed Criteria Expressed in m/s

Blowing Litter Type	Wind Speed[(1)] (m/s)
None	0 – 6.1
Light	6.1 – 9.2
Moderate	9.2 – 13.1
Heavy	13.1+

Note:
(1) Wind speeds measured at 2 m above the ground

The criteria for impact zones for blowing litter were defined based on experience from other sites[33]. The impact zones are based on the distance from the receptor to the working face and are summarized in **Table D3-47** below. The "low" impact zone boundary of greater than 500 m defines the distance beyond the working face that litter will travel. The "medium" impact zone is the area within 200 m to 500 m from the working face, and the "high" impact zone is defined as being within 200 m of the working face[34].

Table D3-47: Blowing Litter Impact Zone Criteria

Impact of Blowing Litter	Distance from Working Face to Receptor (m)
Low	> 500
Medium	200 – 500
High	< 200

6.3 Data Collection

Meteorological data from the Chatham-Kent region was used was used to evaluate the potential frequency of blowing litter events. The data was collected from the ECCC's Ridgetown monitoring station and was provided by the Air Modelling and Emissions Unit of the MECP. The 5-year (2014-2018) site-specific meteorological dataset was used in the analysis/modelling assessment and is considered to be a reasonable reflection of meteorological conditions and representative for the region.

[33] Interim Waste Authority Ltd. Durham Landfill Site Search. Detailed Assessment of the Proposed Site EE11. "Appendix M Air Quality. October 1994.
[34] RWDI. BFI Ridge Landfill Expansion EA Impact Assessment. "Appendix M – Landfill Atmospheric Studies". 1996.

6.4 Assumptions

As described in the previous study for the site, in order to estimate the potential frequencies for blowing litter events, all conditions necessary for a blowing litter event must be considered. For a blowing litter event to occur, three conditions must arise concurrently:

- litter must be available for transport by wind;
- wind speeds must be high enough to mobilize litter; and
- litter control measures are either not functioning or not effective.

Determining the availability of litter for transport involves considerable uncertainty, as the time from when the garbage trucks unload to the time the waste is covered can vary significantly. However, it is standard practice at the existing Ridge Landfill site for the working face to be completely covered at the end of the working day. As a worst-case scenario it has been assumed that litter is always available for transport. This is an overly conservative assumption. In reality, exposed litter would be available for transport only during hours when the landfill is operating (currently, 7 a.m. to 5 p.m., Monday to Friday, and 7 a.m. to 5 p.m. on Saturday) and not available when it is not operating.

The level of success of litter control measures is also difficult to predict. Although the working face is continuously compacted, which limits blowing litter, litter may still be mobilized, particularly during the time when waste is being unloaded and has yet to be compacted. The localized wind currents can fluctuate rapidly in direction and speed, which may carry litter beyond litter control fencing that were properly placed based on forecast wind directions. Even with the control measures of compaction and litter control fences in place, it is impractical to prevent all occurrences of blowing litter and difficult to quantify the effectiveness of controls, although the control measures would significantly reduce the frequency of occurrence of blowing litter events. For this reason, it was assumed, as a worst-case scenario, no litter control measures were in place.

The final condition required for a blowing litter event to occur is wind speed must be high enough to mobilize litter. This condition may be measured by evaluating the frequency of the threshold wind speeds defined in **Table D3-46**.

6.5 Methods of Analysis

A meteorological analysis in order to determine the wind conditions at the Ridge landfill site was conducted using the hourly site-specific meteorological dataset. It was conservatively assumed that litter is available for transport at all times, realistically, litter would be transported only during normal operating hours. The wind speed data was adjusted to account for the boundary effects of the ground and the shape of the terrain.

Since the wind speed data was collected at an anemometer height of 10 m, it must be adjusted to a height of 2 m to be comparable to the conditions used for the four (4) categories of blowing litter events. The mean wind speed profile in the lowest 600 m of the atmosphere is represented by the power-law expression:

$$U = U_a \left(\frac{Z}{Z_a}\right)^a$$

where,
U = mean wind speed;
U_α = mean wind speed at anemometer height (from weather data);
Z = height above ground (2 m for the analysis herein);
Z_α = anemometer height (10 m); and
α = constant that depends on the roughness of the surrounding terrain.

All of the hourly wind speeds were adjusted using this equation, assuming α = 0.14 for open country with vegetation as used in the previous Ridge Landfill blowing litter assessment[35].

At the landfill site, the average wind speed at the top of the landfill mound will be considerably higher than the wind on flat terrain due to the acceleration of the wind as it is forced up over the covered waste mounds. Over time, the acceleration due to wind flow over the south and west landfills will increase as the landfill mound approaches the maximum vertical lift. To compensate for this difference in wind speed, the wind speed data was adjusted further using an exposure factor calculated according to the National Building Code of Canada[36], which takes into account the acceleration of winds over hills. In adjusting the wind speed for the cross-sectional shape of the landfill, the worst-case scenario was considered, where the working face would be located at the crest of the landfill. At this location, the wind speed magnification would be at a maximum. The exposure factors calculated in the previous study[37] ranged from 1.18 – 1.39, with the maximum value (1.39) representing worst-case conditions. This factor for worst-case conditions was also used in the current analysis and was applied to all wind speeds from all directions. It increased the wind speeds by approximately 39%.

[35] RWDI. BFI Ridge Landfill Expansion EA Impact Assessment. "Appendix M – Landfill Atmospheric Studies". 1996
[36] Associate Committee on the National Building Code. "National Building Code of Canada 1990. National Research Council of Canada . Ottawa. January 1991.
[37] RWDI. BFI Ridge Landfill Expansion EA Impact Assessment. "Appendix M – Landfill Atmospheric Studies". 1996

Using the adjusted wind speed data, a frequency analysis of the threshold wind speeds was conducted. The results of the meteorological analysis are presented in the form of a windrose plots and also a frequency distribution graph in **FIGURE D3-12** to **FIGURE D3-14**.

6.6 Analysis: Distance to Receptors

The distance of receptors from the working face of the landfill is required to determine the potential of blowing litter for each discrete receptor location based on the impact zone criteria specified in **Table D3-47**. The distance between the working face and each receptor will vary depending on the section of the landfill being filled. Four different cases were assessed, each one involving a different location of the working face. Specifically, the modelled scenarios are:

- Existing conditions (active working face)
- Preferred Alterative Scenario 1 (working face at the old landfill)
- Preferred Alternative Scenario 2 (working face at the south landfill)
- Preferred Alternative Scenario 3 (working face at the west landfill)

The location of each receptor is shown in **FIGURE D3-11** for each receptor and scenario, the impacts of blowing litter are summarized in **Table D3-48** to **Table D3-51.**

It should be noted that impacts are based on the proximity to the landfill site and reflect the potential for an off-site litter impact with no mitigation measures in place. Actual litter events are expected to be infrequent.

Table D3-48: Potential for Blowing Litter Events – Existing conditions

Receptor	Distance from Working Face (m)	Impact of Blowing Litter
R1A	>500	Low
R2	>500	Low
R3	>500	Low
R7	>500	Low
R9	>500	Low
R11	>500	Low
R14A	>500	Low
R16A	>500	Low
R17	>500	Low
R18	>500	Low
R20	>500	Low
R23	>500	Low
R26	>500	Low
R27	>500	Low
R28	>500	Low
R30	>500	Low
R30A	>500	Low
R30B	>500	Low
R31	>500	Low
R32	>500	Low
R67	>500	Low
R68	>500	Low
R69	>500	Low
R70	>500	Low
B1	>500	Low
B2	>500	Low
B3	>500	Low

Table D3-49: Potential for Blowing Litter Events – Scenario 1

Receptor	Distance from Working Face (m)	Impact of Blowing Litter
R1A	>500	Low
R2	>500	Low
R3	>500	Low
R7	>500	Low
R9	>500	Low
R11	>500	Low
R14A	>500	Low
R16A	>500	Low
R17	>500	Low
R18	>500	Low
R20	>500	Low
R23	>500	Low
R26	>500	Low
R27	>500	Low
R28	>500	Low
R30	>500	Low
R30A	>500	Low
R30B	>500	Low
R31	>500	Low
R32	>500	Low
R67	>500	Low
R68	>500	Low
R69	>500	Low
R70	>500	Low
B1	>500	Low
B2	>500	Low
B3	>500	Low

Table D3-50: Potential for Blowing Litter Events – Scenario 2

Receptor	Distance from Working Face (m)	Impact of Blowing Litter
R1A	>500	Low
R2	>500	Low
R3	>500	Low
R7	>500	Low
R9	>500	Low
R11	>500	Low
R14A	>500	Low
R16A	>500	Low
R17	>500	Low
R18	>500	Low
R20	>500	Low
R23	>500	Low
R26	>500	Low
R27	>500	Low
R28	>500	Low
R30	>500	Low
R30A	>500	Low
R30B	>500	Low
R31	>500	Low
R32	>500	Low
R67	>500	Low
R68	>500	Low
R69	>500	Low
R70	>500	Low
B1	>500	Low
B2	>500	Low
B3	>500	Low

Table D3-51: Potential for Blowing Litter Events – Scenario 3

Receptor	Distance from Working Face (m)	Impact of Blowing Litter
R1A	>500	Low
R2	>500	Low
R3	>500	Low
R7	>500	Low
R9	>500	Low
R11	200-500	Medium
R14A	200-500	Medium
R16A	>500	Low
R17	>500	Low
R18	>500	Low
R20	>500	Low
R23	>500	Low
R26	>500	Low
R27	>500	Low
R28	>500	Low
R30	>500	Low
R30A	>500	Low
R30B	>500	Low
R31	>500	Low
R32	>500	Low
R67	>500	Low
R68	>500	Low
R69	>500	Low
R70	>500	Low
B1	>500	Low
B2	>500	Low
B3	>500	Low

As detailed in the existing conditions (**Table D3-48**), scenario 1 (**Table D3-49**), and scenario 2 (**Table D3-50**) all discrete receptors are located at the low impact zone of blowing litter impacts and are not expected to be affected significantly. As detailed in scenario 3 (**Table D3-51**), select receptors are located in the medium impact zone and are more likely to be affected by blowing litter events compared to other receptors. Specifically, under Scenario 3, receptors R11 and R14A would be closer to the proposed landfill expansion (West Landfill Area) and, as such, have a higher potential of being exposed to blowing litter. Overall, there are no receptors found in the "high" impact zone in any of the cases analyzed.

6.7 Analysis: Frequency of Wind Events Causing Blowing Litter

A frequency analysis of the threshold wind speeds defined for light, moderate and heavy blowing litter events was conducted using 5-years of hourly wind data (2014-2018 data). The results are summarized in the windroses (**FIGURE D3-12** and **FIGURE D3-13**) and graph (**FIGURE D3-14**) below.

FIGURE D3-12: WINDROSE FOR ALL WIND SPEEDS (SPEEDS ADJUSTED TO 2 M ABOVE GROUND PLUS EXPOSURE FACTOR APPLIED)

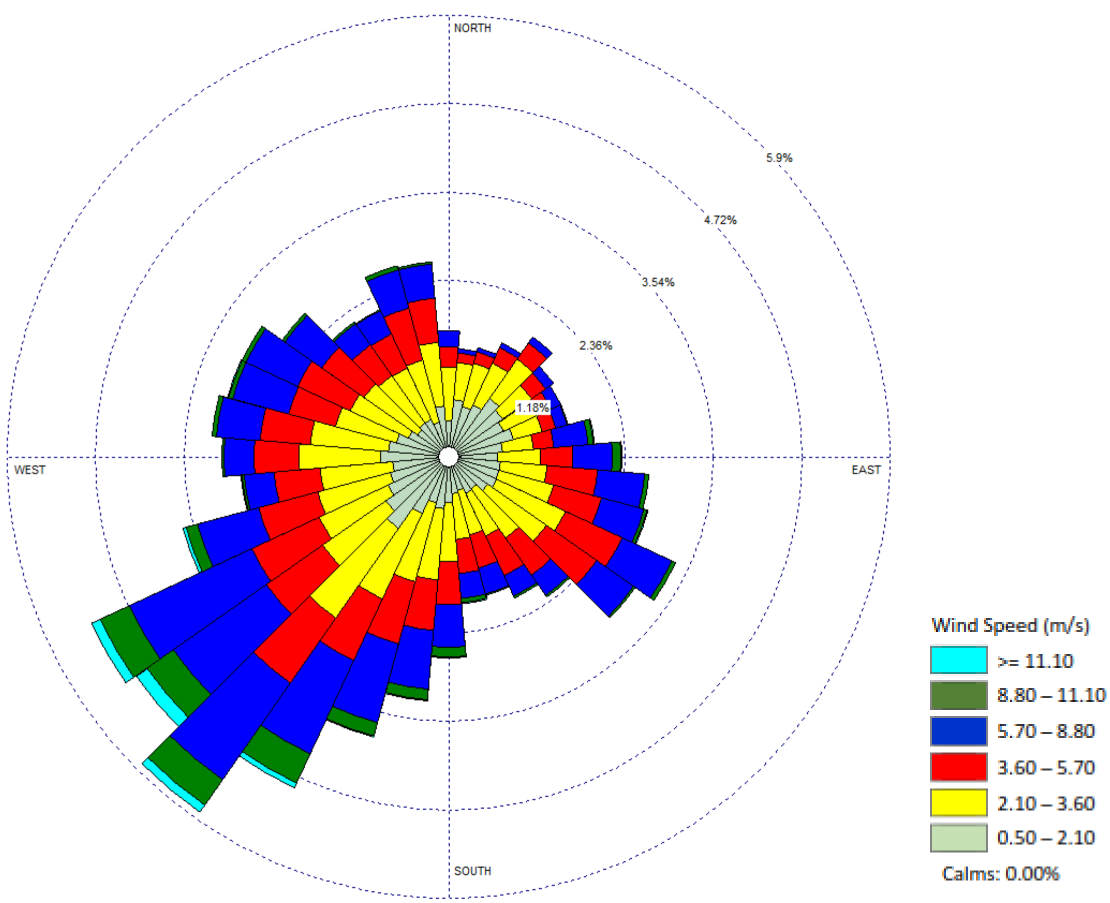
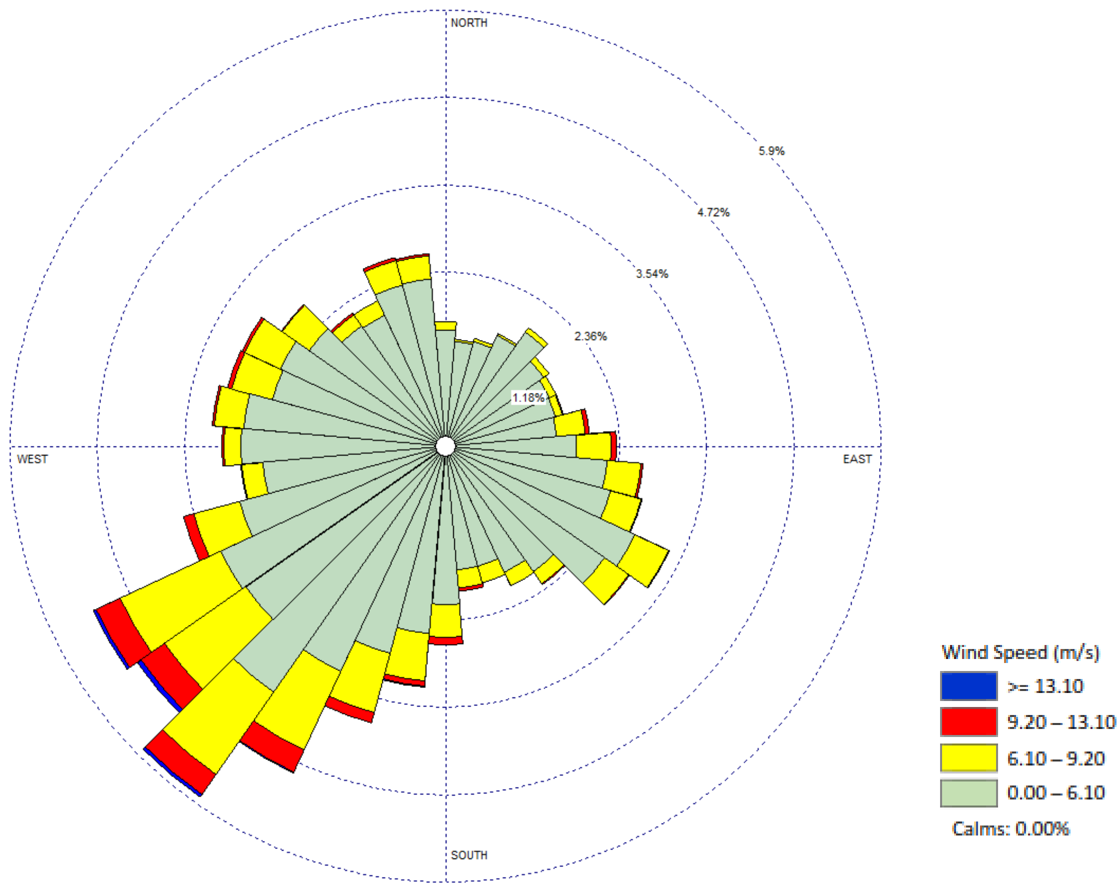
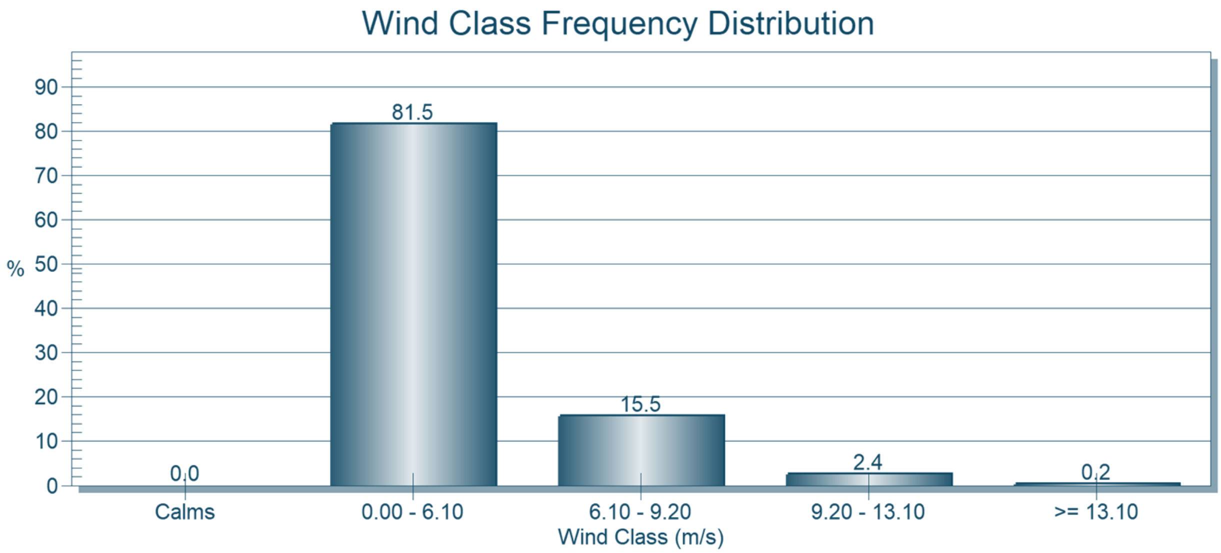


FIGURE D3-13: WINDROSE FOR ADJUSTED WIND SPEEDS AND SPECIFIED WIND CLASSES (THRESHOLD CATEGORIES)



As detailed in **FIGURE D3-12** and **FIGURE D3-13**, the predominant wind direction for moderate blowing litter events (red area) is from the southwest, with minor easterly and westerly components. Wind speeds capable of causing heavy blowing litter events (blue area) are very rare; such speeds are only observed as a very small component of winds blowing from the southwest. Light blowing wind events (yellow area) have the broadest range of wind directions, with the predominant direction also being the southwest.

FIGURE D3-14: WIND CLASS FREQUENCY DISTRIBUTION GRAPH



As detailed in **FIGURE D3-14**, the vast majority of wind speed data (81.5 %) do not have the potential of causing blowing litter impacts. A small component of wind speeds (15.5 %) correspond to light blowing litter events. Winds causing moderate and heavy blowing litter events are very infrequent.

6.7.1 Impact on Receptors

As winds were observed to be blowing from the southwest primarily, it was concluded that the winds will have the greatest potential to carry litter towards the receptor sites to the northeast of the landfill.

The impact to any off-site receptors is not expected to be substantial since the active landfill area will be separated from those receptors by the existing landfill (that will act as a buffer zone) and most litter that escapes the blowing litter controls around the working face will likely remain on-site[38].

The distance between the receptors and the working face tends to govern the potential impact of blowing litter more than the predominant wind direction. The level of impact assigned to the receptors is weighted more heavily on distance. The potential impact for each receptor (depending on the location of the active face of the landfill) has been summarized in **Table D3-48** to **Table D3-51**. Overall, there were no receptors found in the

[38] RWDI. BFI Ridge Landfill Expansion EA Impact Assessment. "Appendix M – Landfill Atmospheric Studies". 1996

high impact zone of blowing litter. Under the existing conditions, Scenario 1, and Scenario 2, all receptors are characterized as "low" impact. Under Scenario 3, only two receptors are identified as "medium" impact and all remaining receptors are characterized as low impact.

For the purposes of conducting this assessment, no control measures were assumed to be in place. In reality, control measures will be in place and are expected to limit off-site blowing litter events.

6.8 Proposed Mitigation Measures

In order to minimize blowing litter impacts, the following control measures are proposed. These are based on proven litter control practices and are detailed in the Development and Operation Report for the previous Ridge Landfill expansion.

The impact assessment was based on a worst-case, semi-quantitative approach.

The effectiveness of the control measures is expected to decrease the frequency and severity of off-site blowing litter events, but the level of control is difficult to determine[39].

- Regular monitoring of wind conditions through weather forecasts or a weather station installed on-site is necessary to provide information on wind speeds and direction and early warning of approaching strong winds. The weather station provides useful information for blowing litter events and the investigation of dust and odour events;
- As an alternative, a well shielded working face should be established for use on days with strong winds;
- The use of the portable catchment fence downwind from the working face should be included in site operations. It should be as close to the working face as possible (preferably within 6 or 7 fence heights); for maximum effect, this fence should be moved on a daily basis to remain downwind of the working face;
- In addition to the portable fencing, a permanent litter control fence should be installed at key downwind locations on of the property;
- All portable and perimeter fences should be routinely inspected and maintained in good repair, as well as being cleaned on a regular basis to allow winds to penetrate and litter to be trapped;

[39] RWDI. BFI Ridge Landfill Expansion EA Impact Assessment. "Appendix M – Landfill Atmospheric Studies". 1996.

- The working face should be kept to a practical minimum width to reduce litter generation. Also, all waste should be compacted immediately after unloading, and all light weight waste should be covered as soon as possible; and
- During higher wind speeds, the compaction equipment should be monitored for their ability to compact waste immediately after unloading to immobilize litter. If delays are significant enough to allow considerable amounts of litter to be mobilized, additional equipment should be considered.

6.9 Results

The blowing litter assessment has identified some limited potential for litter to migrate off-site during high wind conditions. The site currently has practices in place to manage this occurrence, and best practices have been documented in the previous section.

Current practices of monitoring and control should be maintained, including off-site inspections in the surrounding area and along the haul route and keeping waste trucks covered on-site and along the haul route.

7.0 Conclusions

The Atmospheric Impact Assessment included the analysis of air quality impacts of on-site operations, air quality impacts of the haul route and the potential for nuisance impacts from blowing litter. The following are the results of these assessments:

- The current and future predicted concentrations of indicator compounds are anticipated to meet relevant *O.Reg. 419/05* regulatory compliance guidelines;
- Assessment of all sources on-site (regulated and non-regulated for compliance) demonstrated that all sources can meet relevant air quality guidelines;
- The odour assessment or on-site sources resulted in a low potential impact on the discrete receptors;
- For all indicator compounds, despite increases in local traffic, the predicted 2041 haul route impacts were expected to be the same or lower than the predicted 2018 impacts, and below relevant criteria. This is attributable to predicted improvements in vehicle/ equipment operations over time;
- The modelling results indicate that there is no increased impact to local air quality attributable to the haul route as a result of the proposed landfill expansion. The landfill closure scenario with no expansion showed an improvement from the existing conditions due to the removal of the landfill-associated vehicles; and,
- The blowing litter assessment has identified some limited potential for litter to migrate offsite during high wind conditions. The site currently has practices in place to manage this occurrence. All receptors are low except for the two (2) noted as medium under one specific operating scenario for a limited period of time.

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This Atmospheric Impact Assessment Report has been prepared based in part on information provided by Waste Connections of Canada Inc. (Waste Connections). This report is intended to provide a reasonable review of available information within an agreed work scope, schedule, and budget. This report was prepared by Dillon Consulting Limited (Dillon) for the sole benefit of Waste Connections. The material in the report reflects Dillon's judgment in light of the information available to Dillon at the time of this report preparation. Any use which a third party makes of this report, or any reliance on or decisions made based on it, are the responsibilities of such third parties. Dillon accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report

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Appendix D3A-1

Existing Conditions Calculation Summary

Table 1-1
LandGEM Results - Existing Conditions

Old Landfill - Operating Year 2018 (Closure 1999)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)[(1)]
Total landfill gas	1.39E+07	1.09E+07	2.79E+06
Methane	3.99E+06	4.02E+02	7.98E+05
Carbon disulfide - HAP/VOC	2.00E+01	4.24E-04	3.99E+00
Carbon monoxide	1.77E+03	1.02E-01	3.55E+02
Carbonyl sulfide - HAP/VOC	1.33E+01	3.58E-04	2.66E+00
Chloroform - HAP/VOC	1.62E+00	2.19E-05	3.24E-01
Dimethyl sulfide (methyl sulfide) - VOC	2.19E+02	5.70E-03	4.38E+01
Ethyl mercaptan (ethanethiol) - VOC	6.46E+01	1.68E-03	1.29E+01
Hydrogen sulfide	5.55E+02	2.63E-02	1.11E+02
Methyl mercaptan - VOC	5.44E+01	1.83E-03	1.09E+01
Vinyl chloride - HAP/VOC	2.06E+02	5.33E-03	4.12E+01

West Landfill - Operating Year 2018 (Closure 2017)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)[(1)]
Total landfill gas	1.13E+08	8.84E+07	2.27E+07
Methane	3.26E+07	4.89E+07	6.52E+06
Carbon disulfide - HAP/VOC	1.62E+02	5.13E+01	3.25E+01
Carbon monoxide	1.44E+04	1.24E+04	2.88E+03
Carbonyl sulfide - HAP/VOC	1.08E+02	4.33E+01	2.16E+01
Chloroform - HAP/VOC	1.32E+01	2.65E+00	2.63E+00
Dimethyl sulfide (methyl sulfide) - VOC	1.78E+03	6.89E+02	3.56E+02
Ethyl mercaptan (ethanethiol) - VOC	5.25E+02	2.03E+02	1.05E+02
Hydrogen sulfide	4.51E+03	3.18E+03	9.02E+02
Methyl mercaptan - VOC	4.42E+02	2.21E+02	8.84E+01
Vinyl chloride - HAP/VOC	1.68E+03	6.45E+02	3.35E+02

South Landfill - Operating Year 2018 (Closure 2021)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)[(1)]
Total landfill gas	6.45E+06	5.03E+06	1.29E+06
Methane	1.85E+06	2.78E+06	3.71E+05
Carbon disulfide - HAP/VOC	9.23E+00	2.91E+00	1.85E+00
Carbon monoxide	8.20E+02	7.04E+02	1.64E+02
Carbonyl sulfide - HAP/VOC	6.15E+00	2.46E+00	1.23E+00
Chloroform - HAP/VOC	7.49E-01	1.51E-01	1.50E-01
Dimethyl sulfide (methyl sulfide) - VOC	1.01E+02	3.92E+01	2.03E+01
Ethyl mercaptan (ethanethiol) - VOC	2.99E+01	1.16E+01	5.97E+00
Hydrogen sulfide	2.56E+02	1.81E+02	5.13E+01
Methyl mercaptan - VOC	2.51E+01	1.26E+01	5.03E+00
Vinyl chloride - HAP/VOC	9.54E+01	3.67E+01	1.91E+01

Existing Conditions Landfill Gas Flare Flow Rate (m^3/year)(1)	Estimated Landfill Gas Collection Efficiency (%)(2)	Methane Concentration in Landfill Gas(3) (%)	Methane Gas Produced from LandGEM (m^3/year)	Methane Gas Flare Flow Rate (m^3/year)
83,413,974	80.0%	55.3%	51,650,328	46,127,928

Sulphur Compounds	Molecular Weight	Volume (m^3/year)	Concentration (ppm)	Concentration of Sulphur Compounds (ppm)
Carbonyl Sulphide	60.07	4.58E+01	0.44	4.39E-01
Carbon Disulphide	76.14	5.42E+01	0.52	1.04E+00
Dimethyl Sulphide	62.13	7.29E+02	6.99	6.99E+00
Ethyl Mercaptan	62.13	2.15E+02	2.06	2.06E+00
Hydrogen Sulphide	34.08	3.36E+03	32.25	3.22E+01
Methyl Mercaptan	48.11	2.34E+02	2.24	2.24E+00
	Total	4.64E+03	Total	4.50E+01

Notes:

(1) The 2018 emission inventory year of each landfill footprint was taken to provide an analysis of landfill gas generation emissions for the existing conditions.

(2) Landfill gas collection efficiency and methane concentration taken from Technical Memorandum "Ridge Landfill Expansion EA - Old landfill design optimization and information for visual, air and noise impact assessment of the preferred landfill expansion alternative" by Golder dated January 31, 2019.

(3) Landfill gas methane concentration taken from "Ontario Regulation 127, NPRI and Greenhouse Gas Emissions Reporting Year - 2017" by RWDI dated May 28, 2018.

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Table 1-2
Flare Emission Estimates - Existing Conditions

Source	Source ID	Contaminant	CAS No.	Molecular Weight	Emission Factor ($kg/10^6 dscm_{CH4}$)[1]	Total Emission Rate (g/s)
Flare 1	S1	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- [2]	1.40E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	7783-06-04	34.08	--[3][4]	1.41E-04
		Vinyl chloride	75-01-4	62.50	--[3][4]	5.23E-05
		Chloroform	67-66-3	119.39	--[3][4]	4.11E-07
Flare 2		Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- [2]	1.40E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	7783-06-04	34.08	--[3][4]	1.41E-04
		Vinyl chloride	75-01-4	62.50	--[3][4]	5.23E-05
		Chloroform	67-66-3	119.39	--[3][4]	4.11E-07

Notes:

(1) Emission factors obtained from US EPA AP-42 Chapter 2.4 Table 2.4-4 "Emission Factors for Secondary Compounds Existing Control Devices" for a flare.
(2) Emission estimates obtained from US EPA AP-42 Chapter 2.4 equations 3, 4, 7, and 8.

(3) Emission estimates obtained from landfill gas collection efficiency, flare efficiency, and LandGEM generated emissions. The total emission rates for these estimates are split across both flares.
(4) Flare parameters:

Landfill Gas Flare 1 Flow[5]	1.0	m^3/s
Landfill Gas Flare 2 Flow[5]	1.0	m^3/s
Methane Content[6]	55.3	%
Carbon Dioxide Content [6]	40.2	%
Destruction Efficiency[7]	98	%

(5) Taken from Technical Memorandum "Ridge Landfill Expansion EA - Old landfill design optimization and information for visual, air and noise impact assessment of the preferred landfill expansion alternative" by Golder dated January 31, 2019.
(6) Landfill gas methane concentration taken from "Ontario Regulation 127, NPRI and Greenhouse Gas Emissions Reporting Year - 2017" by RWDI dated May 28, 2018.

(7) Manufacturer guarantee.

Table 1-3
Estimated Landfill Footprint Emissions - Existing Conditions
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Landfill	LandGEM Contaminant	Source ID	Fugitive Emissions (kg/year)	Fugitive Emissions (m^3/hr)	Odour Concentration (OU/m^3)(1)	Contaminant	CAS No.	Total Emission Rate (OU/s or g/s)
Old Landfill	Total Landfill Gas	S9	--	248	10,000	Odour	N/A - Odour	6.89E+02
	Hydrogen Sulphide		111	--		Hydrogen Sulphide	7783-06-04	3.52E-03
	Vinyl Chloride		41	--		Vinyl Chloride	75-01-4	1.31E-03
	Chloroform		0.3	--		Chloroform	67-66-3	1.03E-05
West Landfill	Total Landfill Gas	S10	--	2,018	10,000	Odour	N/A - Odour	5.60E+03
	Hydrogen Sulphide		902	--		Hydrogen Sulphide	7783-06-04	2.86E-02
	Vinyl Chloride		335	--		Vinyl Chloride	75-01-4	1.06E-02
	Chloroform		2.6	--		Chloroform	67-66-3	8.35E-05
South Landfill	Total Landfill Gas	S11	--	115	10,000	Odour	N/A - Odour	3.19E+02
	Hydrogen Sulphide		51	--		Hydrogen Sulphide	7783-06-04	1.63E-03
	Vinyl Chloride		19	--		Vinyl Chloride	75-01-4	6.05E-04
	Chloroform		0.1	--		Chloroform	67-66-3	4.75E-06

Notes:
(1) Screening level taken from Interim Guide to Estimate and Assess Landfill Air Impacts (MECP, 1992).

Table 1-4
Vehicle Activity - Existing Conditions

Road Segment	Activity	Description	Movements per Hour (inbound/outbound)	Percentage Equipment Operating in a Given Hour	Non-Road Vehicle Daily Operating Time per Equipment (hour)
Paved Road Segment 0-1	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Public Waste Drop off	Light Vehicles	6	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 1-2	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 2-CC	Concrete Crushing	Tri-Axle Truck	1	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	Cat 430 Backhoe	2	0.50	6
Unpaved Road Segment 2-3	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
				--	
Unpaved Road Segment 3-4	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Hauling Soil	Tri-Axle Truck	4	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
				--	
Unpaved Road Segment 4-WF	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Hauling Soil	Tri-Axle Truck	4	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
				--	
Unpaved Road Segment 4-SP1	Hauling Soil	Tri-Axle Truck	4	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Working Face (WF)	Lift Waste Trailer to unload Waste	Landfill tipper	1	0.17	10
	Push and Spread Waste	CAT D8T Dozer	3	0.75	10
	Compact Waste	CAT 836K Landfill compactor	3	0.75	10
Storage Pile (SP1)	Soil excavation	CAT 345 Hydraulic Excavator	1	0.75	5
Concrete Crushing (CC)	Feed the crusher	Cat 336 Hydraulic Excavator	1	1.00	6
	Push the material	Cat D8T Dozer	1	1.00	6
	Create stockpiles	Conveyor/Stacker	1	1.00	10
	Crusher	Crusher	1	1.00	10

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Table 1-5
Paved Roads - Existing Conditions

Source	Source ID	Distance Travelled (m)	Vehicle Type	Vehicle Numbers (#/hour)(1)	Truck Weight (tons)	Contaminant	CAS No.	Emission Factor (g/VKT)(2)(3)(4)	Total 24-hr Emission Rate (g/s)(5)(6)
Paved Road	S7	735	Tri-Axle Truck	41	40	TSP	N/A - TSP	6.72E+02	8.39E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.29E+02	1.61E-01
			Light Vehicles	6	2.5	PM2.5	N/A - PM2.5	3.12E+01	3.90E-02

Notes:

(1) Water wagon vehicle numbers have been removed from dust generation vehicle numbers due to water flushing.
(2) Emission factors obtained from US EPA AP-42 Chapter 13.2.1 "Paved Roads" equation (2).
(3) Emission factor parameters:

Road surface silt loading (sL)	7.4	g/m^2 (taken from US EPA AP-42 Chapter 13.2.1. Table 13.2.1-3 for municipal solid waste landfill).
Mean Vehicle Weight (W)	35	tons
Precipitation days (P)	137	days (at least 0.2 mm [0.01 in] of precipitation per year taken from the Environment Canada Climate Nortmals - Chatham WPCP, 1981 to 2010
Averaging period	365	days

(4) Particle size multipliers (k) from US EPA AP-42 Table 13.2.1-1:

< 30 um	3.23	g/VKT
< 10 um	0.62	g/VKT
< 2.5 um	0.15	g/VKT

(5) A 70% reduction has been applied to the total emission rate due to dust mitigation techniques.
(6) Based on 10 hours of operation per day.

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Table 1-6
Unpaved Roads - Existing Conditions

Source	Source ID	Distance Travelled (m)	Vehicle Type	Vehicle Numbers (#/hour)	Truck Weight (tons)	Contaminant	CAS No.	Emission Factor (lb/VMT)$^{(1)(2)(3)}$	Total 24-hr Emission Rate (g/s)$^{(4)(5)}$
Unpaved Segment 1	$S8_{1-2}$	454	Tri-Axle Truck	41	40	TSP	N/A - TSP	6.26E+00	1.20E+00
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	3.23E-01
			Mean Vehicle Weight (W)		39.1	PM2.5	N/A - PM2.5	1.69E-01	3.23E-02
Unpaved Segment 2	$S8_{2-CC}$	139	Tri-Axle Truck	1	40	TSP	N/A - TSP	5.27E+00	2.15E-02
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.42E+00	5.82E-03
			Mean Vehicle Weight (W)		26.7	PM2.5	N/A - PM2.5	1.42E-01	5.82E-04
Unpaved Segment 3	$S8_{2-3}$	711	Tri-Axle Truck	40	40	TSP	N/A - TSP	6.26E+00	1.83E+00
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	4.94E-01
			Mean Vehicle Weight (W)		39.0	PM2.5	N/A - PM2.5	1.69E-01	4.94E-02
Unpaved Segment 4	$S8_{3-4}$	321	Tri-Axle Truck	44	40	TSP	N/A - TSP	6.26E+00	9.05E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	2.44E-01
			Mean Vehicle Weight (W)		39.1	PM2.5	N/A - PM2.5	1.69E-01	2.44E-02
Unpaved Segment 5	$S8_{4-WF}$	164	Tri-Axle Truck	44	40	TSP	N/A - TSP	6.26E+00	4.62E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	1.25E-01
			Mean Vehicle Weight (W)		39.1	PM2.5	N/A - PM2.5	1.69E-01	1.25E-02
Unpaved Segment 6	$S8_{4-SP}$	145	Tri-Axle Truck	4	40	TSP	N/A - TSP	5.83E+00	4.97E-02
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.57E+00	1.34E-02
			Mean Vehicle Weight (W)		33.3	PM2.5	N/A - PM2.5	1.57E-01	1.34E-03

Notes:

(1) Emission factors obtained from US EPA AP-42 Chapter 13.2.2 "Unpaved Roads" equations (1a) and (2).
(2) Emission factor parameters:

Road surface silt loading (sL)	6.4	% (taken from US EPA AP-42 Chapter 13.2.2. Table 13.2.2-1 for municipal solid waste landfill - disposal routes).
Precipitation days (P)	137	days (at least 0.2 mm [0.01 in] of precipitation per year taken from the Environment Canada Climate Nortmals - Chatham WPCP, 1981 to 2010
Averaging period	365	days

(3) Constants for equation (1a) from US EPA AP-42 Table 13.2.2-2:

Particle Size	Particle multiplier (k)		Constant (a)	Constant (b)
< 30 um	4.9	lb/VMT	0.7	0.45
< 10 um	1.5	lb/VMT	0.9	0.45
< 2.5 um	0.15	lb/VMT	0.9	0.45

(4) A 70% reduction has been applied to the total emission rate due to dust mitigation techniques.
(5) Based on 10 hours of operation per day.

Table 1-7
Non-Road Vehicles Emission Factors - Existing Conditions

Vehicle Type	Power Rating (hp)	Tier	Contaminant	CAS No.	Emission Factor[1] (g/hp-hr)
CAT 430 Backhoe	94	2	Nitrogen oxides	10102-44-0	4.7
			Sulphur dioxide	7446-09-05	0.0038
			Carbon monoxide	630-08-0	2.3655
			Particulate matter[4]	N/A - TSP	0.24
CAT 735 Water Wagon	434	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT D8T Dozer	354	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 836K Landfill compactor	562	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 336 Hydraulic Excavator	314	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 345 Hydraulic Excavator[2]	314	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
John Deere 644K Front End Loader	232	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.075
			Particulate matter	N/A - TSP	0.0092
Landfill tipper	173 (3)	1 (3)	Nitrogen oxides	10102-44-0	5.7
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.87
			Particulate matter[4]	N/A - TSP	0.28
Conveyor/Stacker	90	3	Nitrogen oxides	10102-44-0	3.0
			Sulphur dioxide	7446-09-05	0.0038
			Carbon monoxide	630-08-0	2.4
			Particulate matter[4]	N/A - TSP	0.2
Crusher	440	3	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.8
			Particulate matter[4]	N/A - TSP	0.2

Notes

(1) Emission factors taken from the US EPA document "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition NR-009d", July, 2010.
(2) Estimated to be similar to the CAT 336 hydraulic Excavator.
(3) Estimated due to lack of available information.
(4) Emission factors are not available for PM10 and PM2.5, it was conservatively estimated that all TSP emitted from these sources are in the PM2.5 size fraction.

Table 1-8
Non-Road Vehicles - Existing Conditions

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate(1)(2) (g/s)	Total 24-hr Emission Rate(1)(2) (g/s)
Paved Road	S7	735	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	3.37E-02	1.69E-02
								Sulphur dioxide	7446-09-05	2.74E-05	1.37E-05
								Carbon monoxide	630-08-0	1.70E-02	8.49E-03
								Particulate matter	N/A - TSP	--	8.61E-04
								PM10	N/A - PM10	--	8.61E-04
								PM2.5	N/A - PM2.5	--	8.61E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	4.15E-02	1.38E-02
								Sulphur dioxide	7446-09-05	5.70E-05	1.90E-05
								Carbon monoxide	630-08-0	1.39E-03	4.64E-04
								Particulate matter	N/A - TSP	--	5.09E-05
								PM10	N/A - PM10	--	5.09E-05
								PM2.5	N/A - PM2.5	--	5.09E-05
Unpaved Segment 1	$S8_{1-2}$	454	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	2.09E-02	1.04E-02
								Sulphur dioxide	7446-09-05	1.69E-05	8.46E-06
								Carbon monoxide	630-08-0	1.05E-02	5.25E-03
								Particulate matter	N/A - TSP	--	5.33E-04
								PM10	N/A - PM10	--	5.33E-04
								PM2.5	N/A - PM2.5	--	5.33E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	2.57E-02	8.55E-03
								Sulphur dioxide	7446-09-05	3.52E-05	1.17E-05
								Carbon monoxide	630-08-0	8.62E-04	2.87E-04
								Particulate matter	N/A - TSP	--	3.15E-05
								PM10	N/A - PM10	--	3.15E-05
								PM2.5	N/A - PM2.5	--	3.15E-05
Unpaved Segment 2	$S8_{2-CC}$	139	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	6.39E-03	3.20E-03
								Sulphur dioxide	7446-09-05	5.19E-06	2.59E-06
								Carbon monoxide	630-08-0	3.22E-03	1.61E-03
								Particulate matter	N/A - TSP	--	1.63E-04
								PM10	N/A - PM10	--	1.63E-04
								PM2.5	N/A - PM2.5	--	1.63E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	7.86E-03	2.62E-03
								Sulphur dioxide	7446-09-05	1.08E-05	3.60E-06
								Carbon monoxide	630-08-0	2.64E-04	8.80E-05
								Particulate matter	N/A - TSP	--	9.64E-06
								PM10	N/A - PM10	--	9.64E-06
								PM2.5	N/A - PM2.5	--	9.64E-06
Unpaved Segment 3	$S8_{2-3}$	711	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	3.26E-02	1.63E-02
								Sulphur dioxide	7446-09-05	2.65E-05	1.32E-05
								Carbon monoxide	630-08-0	1.64E-02	8.22E-03
								Particulate matter	N/A - TSP	--	8.34E-04
								PM10	N/A - PM10	--	8.34E-04
								PM2.5	N/A - PM2.5	--	8.34E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	4.01E-02	1.34E-02
								Sulphur dioxide	7446-09-05	5.52E-05	1.84E-05
								Carbon monoxide	630-08-0	1.35E-03	4.50E-04
								Particulate matter	N/A - TSP	--	4.92E-05
								PM10	N/A - PM10	--	4.92E-05
								PM2.5	N/A - PM2.5	--	4.92E-05

Table 1-8
Non-Road Vehicles - Existing Conditions

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate(1)(2) (g/s)	Total 24-hr Emission Rate(1)(2) (g/s)
Unpaved Segment 4	$S8_{3-4}$	321	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	1.47E-02	7.37E-03
								Sulphur dioxide	7446-09-05	1.20E-05	5.98E-06
								Carbon monoxide	630-08-0	7.42E-03	3.71E-03
								Particulate matter	N/A - TSP	--	3.76E-04
								PM10	N/A - PM10	--	3.76E-04
								PM2.5	N/A - PM2.5	--	3.76E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	1.81E-02	6.04E-03
								Sulphur dioxide	7446-09-05	2.49E-05	8.30E-06
								Carbon monoxide	630-08-0	6.09E-04	2.03E-04
								Particulate matter	N/A - TSP	--	2.22E-05
								PM10	N/A - PM10	--	2.22E-05
								PM2.5	N/A - PM2.5	--	2.22E-05
Unpaved Segment 5	$S8_{4-WF}$	164	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	7.53E-03	3.76E-03
								Sulphur dioxide	7446-09-05	6.11E-06	3.05E-06
								Carbon monoxide	630-08-0	3.79E-03	1.89E-03
								Particulate matter	N/A - TSP	--	1.92E-04
								PM10	N/A - PM10	--	1.92E-04
								PM2.5	N/A - PM2.5	--	1.92E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	9.26E-03	3.09E-03
								Sulphur dioxide	7446-09-05	1.27E-05	4.24E-06
								Carbon monoxide	630-08-0	3.11E-04	1.04E-04
								Particulate matter	N/A - TSP	--	1.14E-05
								PM10	N/A - PM10	--	1.14E-05
								PM2.5	N/A - PM2.5	--	1.14E-05
Unpaved Segment 6	$S8_{4-SP}$	145	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	6.67E-03	3.33E-03
								Sulphur dioxide	7446-09-05	5.41E-06	2.70E-06
								Carbon monoxide	630-08-0	3.35E-03	1.68E-03
								Particulate matter	N/A - TSP	--	1.70E-04
								PM10	N/A - PM10	--	1.70E-04
								PM2.5	N/A - PM2.5	--	1.70E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	8.20E-03	2.73E-03
								Sulphur dioxide	7446-09-05	1.13E-05	3.75E-06
								Carbon monoxide	630-08-0	2.75E-04	9.18E-05
								Particulate matter	N/A - TSP	--	1.01E-05
								PM10	N/A - PM10	--	1.01E-05
								PM2.5	N/A - PM2.5	--	1.01E-05
Working Face	S4	--	Landfill tipper	Lift Waste Trailer to unload Waste	1	0.17	10	Nitrogen oxides	10102-44-0	4.53E-02	1.13E-01
								Sulphur dioxide	7446-09-05	2.75E-05	6.87E-05
								Carbon monoxide	630-08-0	6.94E-03	1.74E-02
								Particulate matter	N/A - TSP	--	5.60E-03
								PM10	N/A - PM10	--	5.60E-03
								PM2.5	N/A - PM2.5	--	5.60E-03
			CAT D8T Dozer	Push and Spread Waste	3	0.75	10	Nitrogen oxides	10102-44-0	5.53E-01	3.07E-01
								Sulphur dioxide	7446-09-05	7.60E-04	4.22E-04
								Carbon monoxide	630-08-0	1.86E-02	1.03E-02
								Particulate matter	N/A - TSP	--	1.13E-03
								PM10	N/A - PM10	--	1.13E-03
								PM2.5	N/A - PM2.5	--	1.13E-03
			CAT 836K Landfill compactor	Compact Waste	3	0.75	10	Nitrogen oxides	10102-44-0	8.78E-01	4.88E-01
								Sulphur dioxide	7446-09-05	1.21E-03	6.70E-04
								Carbon monoxide	630-08-0	2.95E-02	1.64E-02
								Particulate matter	N/A - TSP	--	1.80E-03
								PM10	N/A - PM10	--	1.80E-03
								PM2.5	N/A - PM2.5	--	1.80E-03

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Table 1-8
Non-Road Vehicles - Existing Conditions

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate(1)(2) (g/s)	Total 24-hr Emission Rate(1)(2) (g/s)
Storage Pile 1	S5	--	CAT 345 Hydraulic Excavator	Soil excavation	1	0.75	5	Nitrogen oxides	10102-44-0	1.64E-01	4.54E-02
								Sulphur dioxide	7446-09-05	2.25E-04	6.24E-05
								Carbon monoxide	630-08-0	5.50E-03	1.53E-03
								Particulate matter	N/A - TSP	--	1.67E-04
								PM10	N/A - PM10	--	1.67E-04
								PM2.5	N/A - PM2.5	--	1.67E-04
Concrete Crushing	S6	--	Cat 336 Hydraulic Excavator	Feed the crusher	1	1.00	6	Nitrogen oxides	10102-44-0	2.18E-01	5.45E-02
								Sulphur dioxide	7446-09-05	3.00E-04	7.49E-05
								Carbon monoxide	630-08-0	7.33E-03	1.83E-03
								Particulate matter	N/A - TSP	--	2.01E-04
								PM10	N/A - PM10	--	2.01E-04
								PM2.5	N/A - PM2.5	--	2.01E-04
			Cat D8T Dozer	Push the material	1	1.00	6	Nitrogen oxides	10102-44-0	2.46E-01	6.15E-02
								Sulphur dioxide	7446-09-05	3.38E-04	8.44E-05
								Carbon monoxide	630-08-0	8.26E-03	2.07E-03
								Particulate matter	N/A - TSP	--	2.26E-04
								PM10	N/A - PM10	--	2.26E-04
								PM2.5	N/A - PM2.5	--	2.26E-04
			Conveyor/Stacker	Create stockpiles	1	1.00	10	Nitrogen oxides	10102-44-0	7.50E-02	3.13E-02
								Sulphur dioxide	7446-09-05	9.55E-05	3.98E-05
								Carbon monoxide	630-08-0	5.91E-02	2.46E-02
								Particulate matter	N/A - TSP	--	2.08E-03
								PM10	N/A - PM10	--	2.08E-03
								PM2.5	N/A - PM2.5	--	2.08E-03
			Crushing	Crushing	1	1.00	10	Nitrogen oxides	10102-44-0	3.06E-01	1.27E-01
								Sulphur dioxide	7446-09-05	4.20E-04	1.75E-04
								Carbon monoxide	630-08-0	1.03E-01	4.29E-02
								Particulate matter	N/A - TSP	--	7.64E-03
								PM10	N/A - PM10	--	7.64E-03
								PM2.5	N/A - PM2.5	--	7.64E-03

Notes

(1) Emission factors taken from the US EPA document "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition NR-009d", July, 2010.
(2) Emissions from the site maintenance vehicle (CAT 430 Backhoe) have been distributed based on the segment lengths.

Table 1-9a
Onroad Vehicles - Existing Conditions

Source	Source ID	Vehicle Type	Segment Length (m)	Number of Trips per hour (Inbound and Outbound)	Hourly Vehicle Distance Travelled (VKT)	Daily Vehicle Distance Travelled (VKT)(1)	Contaminant	CAS No.	Emission Factor(2) (g/VKT)	Total 1-hr Emission Rate (g/s)	Total 24-hr Emission Rate (g/s)
Paved Road	S7	Refuse Truck	735	41	30	301	Nitrogen oxides	10102-44-0	4.59E+00	3.84E-02	1.60E-02
							Sulphur dioxide	7446-09-05	1.49E-02	1.24E-04	5.18E-05
							Carbon monoxide	630-08-0	1.54E+00	1.29E-02	5.38E-03
							Particulate matter(3)	N/A - TSP	9.53E-01	--	3.32E-03
							PM10	N/A - PM10	9.53E-01	--	3.32E-03
							PM2.5	N/A - PM2.5	3.56E-01	--	1.24E-03
		Light Vehicles	735	6	4	44	Nitrogen oxides	10102-44-0	8.49E-01	1.04E-03	4.33E-04
							Sulphur dioxide	7446-09-05	1.36E-02	1.67E-05	6.94E-06
							Carbon monoxide	630-08-0	2.41E-01	2.95E-04	1.23E-04
							Particulate matter(3)	N/A - TSP	6.84E-01	--	3.49E-04
							PM10	N/A - PM10	6.84E-01	--	3.49E-04
							PM2.5	N/A - PM2.5	1.03E-01	--	5.23E-05
Unpaved Segment 1	$S8_{1-2}$	Refuse Truck	454	41	19	186	Nitrogen oxides	10102-44-0	4.59E+00	2.38E-02	9.90E-03
							Sulphur dioxide	7446-09-05	1.49E-02	7.69E-05	3.21E-05
							Carbon monoxide	630-08-0	1.54E+00	7.99E-03	3.33E-03
							Particulate matter(3)	N/A - TSP	9.53E-01	--	2.05E-03
							PM10	N/A - PM10	9.53E-01	--	2.05E-03
							PM2.5	N/A - PM2.5	3.56E-01	--	7.67E-04
Unpaved Segment 2	$S8_{2-CC}$	Refuse Truck	139	1	0.1	1	Nitrogen oxides	10102-44-0	4.59E+00	1.78E-04	7.40E-05
							Sulphur dioxide	7446-09-05	1.49E-02	5.75E-07	2.39E-07
							Carbon monoxide	630-08-0	1.54E+00	5.97E-05	2.49E-05
							Particulate matter(3)	N/A - TSP	9.53E-01	--	1.54E-05
							PM10	N/A - PM10	9.53E-01	--	1.54E-05
							PM2.5	N/A - PM2.5	3.56E-01	--	5.73E-06
Unpaved Segment 3	$S8_{2-3}$	Refuse Truck	711	40	28	284	Nitrogen oxides	10102-44-0	4.59E+00	3.63E-02	1.51E-02
							Sulphur dioxide	7446-09-05	1.49E-02	1.17E-04	4.89E-05
							Carbon monoxide	630-08-0	1.54E+00	1.22E-02	5.08E-03
							Particulate matter(3)	N/A - TSP	9.53E-01	--	3.14E-03
							PM10	N/A - PM10	9.53E-01	--	3.14E-03
							PM2.5	N/A - PM2.5	3.56E-01	--	1.17E-03
Unpaved Segment 4	$S8_{3-4}$	Refuse Truck	321	44	14	141	Nitrogen oxides	10102-44-0	4.59E+00	1.80E-02	7.50E-03
							Sulphur dioxide	7446-09-05	1.49E-02	5.83E-05	2.43E-05
							Carbon monoxide	630-08-0	1.54E+00	6.05E-03	2.52E-03
							Particulate matter(3)	N/A - TSP	9.53E-01	--	1.56E-03
							PM10	N/A - PM10	9.53E-01	--	1.56E-03
							PM2.5	N/A - PM2.5	3.56E-01	--	5.82E-04
Unpaved Segment 5	$S8_{4-WF}$	Refuse Truck	164	44	7	72	Nitrogen oxides	10102-44-0	4.59E+00	9.20E-03	3.83E-03
							Sulphur dioxide	7446-09-05	1.49E-02	2.98E-05	1.24E-05
							Carbon monoxide	630-08-0	1.54E+00	3.09E-03	1.29E-03
							Particulate matter(3)	N/A - TSP	9.53E-01	--	7.96E-04
							PM10	N/A - PM10	9.53E-01	--	7.96E-04
							PM2.5	N/A - PM2.5	3.56E-01	--	2.97E-04

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Table 1-9a
Onroad Vehicles - Existing Conditions

Source	Source ID	Vehicle Type	Segment Length (m)	Number of Trips per hour (Inbound and Outbound)	Hourly Vehicle Distance Travelled (VKT)	Daily Vehicle Distance Travelled (VKT)(1)	Contaminant	CAS No.	Emission Factor(2) (g/VKT)	Total 1-hr Emission Rate (g/s)	Total 24-hr Emission Rate (g/s)
Unpaved Segment 6	$S8_{4-SP}$	Refuse Truck	145	2	0.3	3	Nitrogen oxides	10102-44-0	4.59E+00	3.70E-04	1.54E-04
							Sulphur dioxide	7446-09-05	1.49E-02	1.20E-06	5.00E-07
							Carbon monoxide	630-08-0	1.54E+00	1.24E-04	5.19E-05
							Particulate matter(3)	N/A - TSP	9.53E-01	--	3.20E-05
							PM10	N/A - PM10	9.53E-01	--	3.20E-05
							PM2.5	N/A - PM2.5	3.56E-01	--	1.20E-05

Notes

(1) Based on the site operating 10 hrs/day.
(2) Emission factors generated from US EPA MOVES.
(3) It was estimated that all total particulate matter emitted from this source was in the PM10 size fraction or smaller.

Table 1-9b
Onroad Vehicles - Existing Conditions

	MOVES Emission Factors	
	Refuse Trucks	Light Trucks
Compound	(g/VMT)	(g/VMT)
Nox	7.39E+00	1.37E+00
SO2	2.39E-02	2.19E-02
CO	2.48E+00	3.88E-01
PM10 total	4.77E-01	3.29E-02
PM10 Brakewear	1.00E+00	1.01E+00
PM10 Tirewear	5.39E-02	5.46E-02
PM2.5 total	4.39E-01	3.03E-02
PM 2.5 brakewear	1.25E-01	1.27E-01
PM2.5 tirewear	8.09E-03	8.19E-03
Carbon dioxide	2.77E+03	2.63E+03
Methane	5.22E-02	8.12E-02
Nitrous oxide	8.27E-03	8.28E-03

Table 1-10
Material Transfer

Source	Source ID	Hourly Tranfer (tonnes/hour)	Contaminant	CAS No.	Emission Factor (kg_{PM}/tonne)(2)(3)(4)	Total Emission Rate (24-hr average)(5) (g/s)
Active Working Face	S4	610	TSP	N/A - TSP	1.39E-04	9.81E-03
			PM10	N/A - PM10	6.58E-05	4.64E-03
			PM2.5	N/A - PM2.5	9.96E-06	7.03E-04
Storage Pile 1	S5	72	TSP	N/A - TSP	1.39E-04	1.16E-03
			PM10	N/A - PM10	6.58E-05	5.50E-04
			PM2.5	N/A - PM2.5	9.96E-06	8.33E-05
Storage Pile 2	S6	7	TSP	N/A - TSP	1.39E-04	1.17E-04
			PM10	N/A - PM10	6.58E-05	5.51E-05
			PM2.5	N/A - PM2.5	9.96E-06	8.35E-06

Notes:

(1) Material handled taken from Ride Landfill's 2017 NPRI Report. It was estimated that the sand, clay, cover, and misc. fill was split between the active working face and aggregate storage pile.
(2) Emission factors obtained from US EPA AP-42 Chapter 13.2.4 "Aggregate Handling and Storage Piles" equation 13.2.4. (1).
(3) Material parameters:

Mean wind speed (U)	3.4	m/s (taken from the MECP pre-processed 2018 hourly weather data from the ECCC's RidgeTown Station)
Moisture content (M)	14	% (taken from Table 13.2.4-1 for clay/dirt mix at municipal solid waste landfills)

(4) Particle size multipliers (k):

< 30 um	0.74
< 10 um	0.35
< 2.5 um	0.053

(5) Based on the site operations of 264 days/year, 10 hours/day.

Table 1-11
Material Crushing

Source	Source ID	Source Description	Hourly Material Tranfer(1) (tonnes/hour)	Contaminant	CAS No.	Emission Factor (kg_{PM}/tonne)(2)(3)	Total Emission Rate (24-hr average)(4) (g/s)
Concrete Crushing	S6	Crushing	500	TSP	N/A - TSP	2.70E-03	1.56E-01
				PM10	N/A - PM10	1.20E-03	6.94E-02
				PM2.5	N/A - PM2.5	5.00E-05 (5)	2.89E-03
Concrete Crushing	S6	Conveyor/Stacker	500	TSP	N/A - TSP	1.50E-03	8.68E-02
				PM10	N/A - PM10	5.50E-04	3.18E-02
				PM2.5	N/A - PM2.5	6.50E-06 (5)	3.76E-04

Notes:

(1) Taken from general equipment specifications production capacity.
(2) Emissions from the crusher are based on the US EPA AP-42 Chapter 11.19.2-1 Crushed Stone Processing and Pulverized Mineral Processing emission factor for uncontrolled tertiary crushing.
(3) Emissions from the conveyor/stacker are based on the US EPA AP-42 Chapter 11.19.2-1 Crushed Stone Processing and Pulverized Mineral Processing emission factor for uncontrolled conveyor transfer point emissions.
(4) Based on the site operations of 264 days/year, 10 hours/day.
(5) Due to lack of data for PM2.5 emission factors for uncontrolled emissions, the controlled emission factor was used for completeness.

Appendix D3A-2

Preferred Alternative Scenario 1 Calculation Summary

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Table 2-1
LandGEM Results - Scenario 1

Old Landfill - Operating Year 2024 (Closure 2027)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(2)
Total landfill gas	3.76E+07	2.93E+07	7.51E+06
Methane	1.07E+07	1.61E+07	2.15E+06
Carbon disulfide - HAP/VOC	5.38E+01	1.70E+01	1.08E+01
Carbon monoxide	4.78E+03	4.10E+03	9.56E+02
Carbonyl sulfide - HAP/VOC	3.59E+01	1.44E+01	7.17E+00
Chloroform - HAP/VOC	4.36E+00	8.79E-01	8.73E-01
Dimethyl sulfide (methyl sulfide) - VOC	5.91E+02	2.29E+02	1.18E+02
Ethyl mercaptan (ethanethiol) - VOC	1.74E+02	6.74E+01	3.48E+01
Hydrogen sulfide	1.49E+03	1.05E+03	2.99E+02
Methyl mercaptan - VOC	1.47E+02	7.32E+01	2.93E+01
Vinyl chloride - HAP/VOC	5.56E+02	2.14E+02	1.11E+02

West Landfill - Operating Year 2024 (Closure 2017)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(1)
Total landfill gas	8.93E+07	6.95E+07	1.79E+07
Methane	2.56E+07	3.84E+07	5.13E+06
Carbon disulfide - HAP/VOC	1.28E+02	4.03E+01	2.55E+01
Carbon monoxide	1.13E+04	9.73E+03	2.27E+03
Carbonyl sulfide - HAP/VOC	8.51E+01	3.41E+01	1.70E+01
Chloroform - HAP/VOC	1.04E+01	2.09E+00	2.07E+00
Dimethyl sulfide (methyl sulfide) - VOC	1.40E+03	5.42E+02	2.80E+02
Ethyl mercaptan (ethanethiol) - VOC	4.13E+02	1.60E+02	8.26E+01
Hydrogen sulfide	3.55E+03	2.50E+03	7.09E+02
Methyl mercaptan - VOC	3.48E+02	1.74E+02	6.96E+01
Vinyl chloride - HAP/VOC	1.32E+03	5.07E+02	2.64E+02

South Landfill - Operating Year 2024 (Closure 2021)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(1)
Total landfill gas	5.21E+07	4.06E+07	1.04E+07
Methane	1.50E+07	2.24E+07	2.99E+06
Carbon disulfide - HAP/VOC	7.45E+01	2.35E+01	1.49E+01
Carbon monoxide	6.62E+03	5.68E+03	1.32E+03
Carbonyl sulfide - HAP/VOC	4.97E+01	1.99E+01	9.94E+00
Chloroform - HAP/VOC	6.05E+00	1.22E+00	1.21E+00
Dimethyl sulfide (methyl sulfide) - VOC	8.18E+02	3.17E+02	1.64E+02
Ethyl mercaptan (ethanethiol) - VOC	2.41E+02	9.33E+01	4.82E+01
Hydrogen sulfide	2.07E+03	1.46E+03	4.14E+02
Methyl mercaptan - VOC	2.03E+02	1.01E+02	4.06E+01
Vinyl chloride - HAP/VOC	7.70E+02	2.96E+02	1.54E+02

Scenario 1 Landfill Gas Flare Flow Rate (m^3/year)(1)	Estimated Landfill Gas Collection Efficiency (%)(2)	Methane Concentration in Landfill Gas(3) (%)	Methane Gas Produced from LandGEM (m^3/year)	Methane Gas Flare Flow Rate (m^3/year)
111,519,907	80.0%	55.3%	77,000,246	61,670,509

Sulphur Compounds	Molecular Weight	Volume (m^3/year)	Concentration (ppm)	Concentration of Sulphur Compounds (ppm)
Carbonyl Sulphide	60.07	6.83E+01	0.49	4.90E-01
Carbon Disulphide	76.14	8.09E+01	0.58	1.16E+00
Dimethyl Sulphide	62.13	1.09E+03	7.80	7.80E+00
Ethyl Mercaptan	62.13	3.21E+02	2.30	2.30E+00
Hydrogen Sulphide	34.08	5.02E+03	36.00	3.60E+01
Methyl Mercaptan	48.11	3.48E+02	2.50	2.50E+00
	Total	6.92E+03	Total	5.03E+01

Notes:

(1) The 2024 emission inventory year of each landfill footprint was taken to provide an analysis of landfill gas generation emissions for scenario 1.

(2) Landfill gas collection efficiency taken from Technical Memorandum "Ridge Landfill Expansion EA - Old landfill design optimization and information for visual, air and noise impact assessment of the preferred landfill expansion alternative" by Golder dated January 31, 2019.

(3) Landfill gas methane concentration taken from "Ontario Regulation 127, NPRI and Greenhouse Gas Emissions Reporting Year - 2017" by RWDI dated May 28, 2018.

Table 2-2
Flare Emission Estimates - Scenario 1

Source	Source ID	Contaminant	CAS No.	Molecular Weight	Emission Factor ($kg/10^6 dscm_{CH4}$)(1)	Total Emission Rate (g/s)
Flare 1	S1	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- (2)	1.16E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	7783-06-04	34.08	--(3)(4)	1.90E-04
		Vinyl chloride	75-01-4	62.50	--(3)(4)	7.05E-05
		Chloroform	67-66-3	119.39	--(3)(4)	5.54E-07
Flare 2	S2	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- (2)	1.16E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	7783-06-04	34.08	--(3)(4)	1.90E-04
		Vinyl chloride	75-01-4	62.50	--(3)(4)	7.05E-05
		Chloroform	67-66-3	119.39	--(3)(4)	5.54E-07
Flare 3	S3a	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- (2)	1.16E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	2148878	34.08	--(3)(4)	1.90E-04
		Vinyl chloride	75-01-4	62.50	--(3)(4)	7.05E-05
		Chloroform	67-66-3	119.39	--(3)(4)	5.54E-07
Flare 4	S3b	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- (2)	1.16E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	2148878	34.08	--(3)(4)	1.90E-04
		Vinyl chloride	75-01-4	62.50	--(3)(4)	7.05E-05
		Chloroform	67-66-3	119.39	--(3)(4)	5.54E-07

Notes:

(1) Emission factors obtained from US EPA AP-42 Chapter 2.4 Table 2.4-4 "Emission Factors for Secondary Compounds Existing Control Devices" for a flare.
(2) Emission estimates obtained from US EPA AP-42 Chapter 2.4 equations 3, 4, 7, and 8.

(3) Emission estimates obtained from landfill gas collection efficiency, flare efficiency, and LandGEM generated emissions. The total emission rates for these estimates are split across all flares.
(4) Flare parameters:

Landfill Gas Flare 1 Flow(5)	1.0	m^3/s
Landfill Gas Flare 2 Flow(5)	1.0	m^3/s
Landfill Gas Flare 3 Flow(8)	1.0	m^3/s
Landfill Gas Flare 4 Flow(8)	1.0	m^3/s
Methane Content(6)	55.3	%
Destruction Efficiency(7)	98	%

(5) Taken from Technical Memorandum "Ridge Landfill Expansion EA - Old landfill design optimization and information for visual, air and noise impact assessment of the preferred landfill expansion alternative" by Golder dated January 31, 2019.
(6) Landfill gas methane concentration taken from "Ontario Regulation 127, NPRI and Greenhouse Gas Emissions Reporting Year - 2017" by RWDI dated May 28, 2018.
(7) Manufacturer guarantee.
(8) Estimated.

Table 2-3
Estimated Landfill Footprint Emissions - Scenario 1

Landfill	LandGEM Contaminant	Source ID	Fugitive Emissions (kg/year)	Fugitive Emissions (m^3/hr)	Odour Concentration (OU/m^3)(1)	Contaminant	CAS No.	Total Emission Rate (OU/s or g/s)
Old Landfill	Total Landfill Gas	S9	--	669	10,000	Odour	N/A - Odour	1.86E+03
	Hydrogen Sulphide		299	--		Hydrogen Sulphide	7783-06-04	9.48E-03
	Vinyl Chloride		111	--		Vinyl Chloride	75-01-4	3.53E-03
	Chloroform		0.9	--		Chloroform	67-66-3	2.77E-05
West Landfill	Total Landfill Gas	S10	--	1,587	10,000	Odour	N/A - Odour	4.41E+03
	Hydrogen Sulphide		709	--		Hydrogen Sulphide	7783-06-04	2.25E-02
	Vinyl Chloride		264	--		Vinyl Chloride	75-01-4	8.37E-03
	Chloroform		2.1	--		Chloroform	67-66-3	6.57E-05
South Landfill	Total Landfill Gas	S11	--	927	10,000	Odour	N/A - Odour	2.57E+03
	Hydrogen Sulphide		414	--		Hydrogen Sulphide	7783-06-04	1.31E-02
	Vinyl Chloride		154	--		Vinyl Chloride	75-01-4	4.88E-03
	Chloroform		1.2	--		Chloroform	67-66-3	3.83E-05

Notes:
(1) Screening level taken from Interim Guide to Estimate and Assess Landfill Air Impacts (MECP, 1992).

Table 2-4
Vehicle Activity - Scenario 1

Road Segment	Activity	Description	Movements per Hour (inbound/outbound)	Percentage Equipment Operating in a Given Hour	Non-Road Vehicle Daily Operating Time per Equipment (hour)
Paved Road Segment 0-1	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	Public Waste Drop off	Light Vehicles	6	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.5	4
	Site Maintenance	CAT 430 Backhoe	2	0.5	6
Unpaved Road Segment 1-2	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.5	4
	Site Maintenance	CAT 430 Backhoe	2	0.5	6
Unpaved Road Segment 2-CC	Concrete Crushing	Tri-Axle Truck	1	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.5	4
	Site Maintenance	Cat 430 Backhoe	2	0.5	6
				--	
Unpaved Road Segment 2-3	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.5	4
	Site Maintenance	CAT 430 Backhoe	2	0.5	6
Unpaved Road Segment 3-RF	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.5	4
	Site Maintenance	CAT 430 Backhoe	2	0.5	6
Unpaved Road Segment 3-WF	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Hauling Soil	Tri-Axle Truck	4	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.5	4
	Site Maintenance	CAT 430 Backhoe	2	0.5	6
Unpaved Road Segment 3-SP1	Hauling Soil	Tri-Axle Truck	4	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.5	4
	Site Maintenance	CAT 430 Backhoe	2	0.5	6
Working Face (WF)	Lift Waste Trailer to unload Waste	Landfill tipper	1	0.2	10
	Push and Spread Waste	CAT D8T Dozer	3	0.75	10
	Compact Waste	CAT 836K Landfill compactor	3	0.75	10
Storage Pile (SP1)	Soil excavation	CAT 345 Hydraulic Excavator	1	0.75	5
Concrete Crushing (CC) (including wood grinding)	Feed the crusher	Cat 336 Hydraulic Excavator	1	1.0	6
	Push the material	Cat D8T Dozer	1	1.0	6
	Create stockpiles	Conveyor/Stacker	1	1.0	10
	Crusher	Crusher	1	1.0	10
	Wood Grinder	Wood Grinder	1	1.0	6
	Moving material	John Deere 644K Front End Loader	1	1.0	10

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Table 2-5
Paved Roads - Scenario 1

Source	Source ID	Distance Travelled (m)	Vehicle Type	Vehicle Numbers (#/hour)(1)	Truck Weight (tons)	Contaminant	CAS No.	Emission Factor (g/VKT)(2)(3)(4)	Total 24-hr Emission Rate (g/s)(5)(6)
Paved Road	S7	735	Tri-Axle Truck	43	40	TSP	N/A - TSP	6.76E+02	8.79E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.30E+02	1.69E-01
			Light Vehicles	6	2.5	PM2.5	N/A - PM2.5	3.14E+01	4.08E-02

Notes:

(1) Water wagon vehicle numbers have been removed from dust generation vehicle numbers due to water flushing.
(2) Emission factors obtained from US EPA AP-42 Chapter 13.2.1 "Paved Roads" equation (2).
(3) Emission factor parameters:

Road surface silt loading (sL)	7.4	g/m^2 (taken from US EPA AP-42 Chapter 13.2.1. Table 13.2.1-3 for municipal solid waste landfill).
Mean Vehicle Weight (W)	35	tons
Precipitation days (P)	137	days (at least 0.2 mm [0.01 in] of precipitation per year taken from the Environment Canada Climate Nortmals - Chatham WPCP, 1981 to 2010
Averaging period	365	days

(4) Particle size multipliers (k) from US EPA AP-42 Table 13.2.1-1:

< 30 um	3.23	g/VKT
< 10 um	0.62	g/VKT
< 2.5 um	0.15	g/VKT

(5) A 70% reduction has been applied to the total emission rate due to dust mitigation techniques.
(6) Based on 10 hours of operation per day.

Table 2-6
Unpaved Roads - Scenario 1

Source	Source ID	Distance Travelled (m)	Vehicle Type	Vehicle Numbers (#/hour)	Truck Weight (tons)	Contaminant	CAS No.	Emission Factor (lb/VMT)(1)(2)(3)	Total 24-hr Emission Rate (g/s)(4)(5)
Unpaved Segment 1	$S8_{1-2}$	770	Tri-Axle Truck	43	40	TSP	N/A - TSP	6.26E+00	2.12E+00
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	5.74E-01
			Mean Vehicle Weight (W)		39.1	PM2.5	N/A - PM2.5	1.69E-01	5.74E-02
Unpaved Segment 2	$S8_{2\text{-}CC}$	814	Tri-Axle Truck	1	40	TSP	N/A - TSP	5.27E+00	1.26E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.42E+00	3.40E-02
			Mean Vehicle Weight (W)		26.7	PM2.5	N/A - PM2.5	1.42E-01	3.40E-03
Unpaved Segment 3	$S8_{2-3}$	289	Tri-Axle Truck	42	40	TSP	N/A - TSP	6.26E+00	7.80E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	2.11E-01
			Mean Vehicle Weight (W)		39.1	PM2.5	N/A - PM2.5	1.69E-01	2.11E-02
Unpaved Segment 4	$S8_{3\text{-}RF}$	707	Tri-Axle Truck	2	40	TSP	N/A - TSP	5.56E+00	1.54E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.50E+00	4.15E-02
			Mean Vehicle Weight (W)		30.0	PM2.5	N/A - PM2.5	1.50E-01	4.15E-03
Unpaved Segment 5	$S8_{3\text{-}WF}$	391	Tri-Axle Truck	44	40	TSP	N/A - TSP	6.26E+00	1.10E+00
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	2.97E-01
			Mean Vehicle Weight (W)		39.1	PM2.5	N/A - PM2.5	1.69E-01	2.97E-02
Unpaved Segment 6	$S8_{3\text{-}SP}$	663	Tri-Axle Truck	4	40	TSP	N/A - TSP	5.83E+00	2.27E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.57E+00	6.13E-02
			Mean Vehicle Weight (W)		33.3	PM2.5	N/A - PM2.5	1.57E-01	6.13E-03

Notes:

(1) Emission factors obtained from US EPA AP-42 Chapter 13.2.2 "Unpaved Roads" equations (1a) and (2).
(2) Emission factor parameters:

Road surface silt loading (sL)	6.4	g/m^2 (taken from US EPA AP-42 Chapter 13.2.2. Table 13.2.2-1 for municipal solid waste landfill - disposal routes).
Precipitation days (P)	137	days (at least 0.2 mm [0.01 in] of precipitation per year taken from the Environment Canada Climate Nortmals - Chatham WPCP, 1981 to 2010
Averaging period	365	days

(3) Constants for equation (1a) from US EPA AP-42 Table 13.2.2-2:

Particle Size	Particle multiplier (k)		Constant (a)	Constant (b)
< 30 um	4.9	lb/VMT	0.7	0.45
< 10 um	1.5	lb/VMT	0.9	0.45
< 2.5 um	0.15	lb/VMT	0.9	0.45

(4) A 70% reduction has been applied to the total emission rate due to dust mitigation techniques.
(5) Based on 10 hours of operation per day.

Table 2-7
Non-Road Vehicles Emission Factors - Scenario 1

Vehicle Type	Power Rating (hp)	Tier	Contaminant	CAS No.	Emission Factor[1] (g/hp-hr)
CAT 430 Backhoe	94	2	Nitrogen oxides	10102-44-0	4.7
			Sulphur dioxide	7446-09-05	0.0038
			Carbon monoxide	630-08-0	2.3655
			Particulate matter[4]	N/A - TSP	0.24
CAT 735 Water Wagon	434	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT D8T Dozer	354	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 836K Landfill compactor	562	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 336 Hydraulic Excavator	314	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 345 Hydraulic Excavator[2]	314	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
John Deere 644K Front End Loader	232	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.075
			Particulate matter	N/A - TSP	0.0092
Landfill tipper	173 (3)	1 (3)	Nitrogen oxides	10102-44-0	5.7
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.87
			Particulate matter[4]	N/A - TSP	0.28
Conveyor/Stacker	90	3	Nitrogen oxides	10102-44-0	3.0
			Sulphur dioxide	7446-09-05	0.0038
			Carbon monoxide	630-08-0	2.4
			Particulate matter[4]	N/A - TSP	0.2
Crusher	440	3	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.8
			Particulate matter[4]	N/A - TSP	0.2
Wood Grinder	580	3 (3)	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.8
			Particulate matter[4]	N/A - TSP	0.2

Notes

(1) Emission factors taken from the US EPA document "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition NR-009d", July, 2010.
(2) Estimated to be similar to the CAT 336 ydraulic Excavator.
(3) Estimated due to lack of available information.
(4) Emission factors are not available for PM10 and PM2.5, it was conservatively estimated that all TSP emitted from these sources are in the PM2.5 size fraction.

Table 2-8
Non-Road Vehicles - Scenario 1

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate(1)(2) (g/s)	Total 24-hr Emission Rate(1)(2) (g/s)
Paved Road	S7	735	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	2.06E-02	1.03E-02
								Sulphur dioxide	7446-09-05	1.67E-05	8.36E-06
								Carbon monoxide	630-08-0	1.04E-02	5.19E-03
								Particulate matter	N/A - TSP	--	5.26E-04
								PM10	N/A - PM10	--	5.26E-04
								PM2.5	N/A - PM2.5	--	5.26E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	2.53E-02	8.45E-03
								Sulphur dioxide	7446-09-05	3.48E-05	1.16E-05
								Carbon monoxide	630-08-0	8.51E-04	2.84E-04
								Particulate matter	N/A - TSP	--	3.11E-05
								PM10	N/A - PM10	--	3.11E-05
								PM2.5	N/A - PM2.5	--	3.11E-05
Unpaved Segment 1	$S8_{1-2}$	770	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	2.16E-02	1.08E-02
								Sulphur dioxide	7446-09-05	1.75E-05	8.77E-06
								Carbon monoxide	630-08-0	1.09E-02	5.44E-03
								Particulate matter	N/A - TSP	--	5.52E-04
								PM10	N/A - PM10	--	5.52E-04
								PM2.5	N/A - PM2.5	--	5.52E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	2.66E-02	8.86E-03
								Sulphur dioxide	7446-09-05	3.65E-05	1.22E-05
								Carbon monoxide	630-08-0	8.93E-04	2.98E-04
								Particulate matter	N/A - TSP	--	3.26E-05
								PM10	N/A - PM10	--	3.26E-05
								PM2.5	N/A - PM2.5	--	3.26E-05
Unpaved Segment 2	$S8_{2-CC}$	814	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	2.28E-02	1.14E-02
								Sulphur dioxide	7446-09-05	1.85E-05	9.26E-06
								Carbon monoxide	630-08-0	1.15E-02	5.75E-03
								Particulate matter	N/A - TSP	--	5.83E-04
								PM10	N/A - PM10	--	5.83E-04
								PM2.5	N/A - PM2.5	--	5.83E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	2.81E-02	9.36E-03
								Sulphur dioxide	7446-09-05	3.86E-05	1.29E-05
								Carbon monoxide	630-08-0	9.43E-04	3.14E-04
								Particulate matter	N/A - TSP	--	3.44E-05
								PM10	N/A - PM10	--	3.44E-05
								PM2.5	N/A - PM2.5	--	3.44E-05
Unpaved Segment 3	$S8_{2-3}$	289	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	8.12E-03	4.06E-03
								Sulphur dioxide	7446-09-05	6.59E-06	3.29E-06
								Carbon monoxide	630-08-0	4.09E-03	2.04E-03
								Particulate matter	N/A - TSP	--	2.07E-04
								PM10	N/A - PM10	--	2.07E-04
								PM2.5	N/A - PM2.5	--	2.07E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	9.98E-03	3.33E-03
								Sulphur dioxide	7446-09-05	1.37E-05	4.57E-06
								Carbon monoxide	630-08-0	3.35E-04	1.12E-04
								Particulate matter	N/A - TSP	--	1.22E-05
								PM10	N/A - PM10	--	1.22E-05
								PM2.5	N/A - PM2.5	--	1.22E-05
Unpaved Segment 4	$S8_{3-RF}$	707	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	1.98E-02	9.92E-03
								Sulphur dioxide	7446-09-05	1.61E-05	8.05E-06
								Carbon monoxide	630-08-0	9.98E-03	4.99E-03
								Particulate matter	N/A - TSP	--	5.06E-04
								PM10	N/A - PM10	--	5.06E-04
								PM2.5	N/A - PM2.5	--	5.06E-04

Table 2-8
Non-Road Vehicles - Scenario 1

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate(1)(2) (g/s)	Total 24-hr Emission Rate(1)(2) (g/s)
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	2.44E-02	8.13E-03
								Sulphur dioxide	7446-09-05	3.35E-05	1.12E-05
								Carbon monoxide	630-08-0	8.20E-04	2.73E-04
								Particulate matter	N/A - TSP	--	2.99E-05
								PM10	N/A - PM10	--	2.99E-05
								PM2.5	N/A - PM2.5	--	2.99E-05
Unpaved Segment 5	$S8_{3\text{-WF}}$	391	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	1.10E-02	5.48E-03
								Sulphur dioxide	7446-09-05	8.89E-06	4.45E-06
								Carbon monoxide	630-08-0	5.52E-03	2.76E-03
								Particulate matter	N/A - TSP	--	2.80E-04
								PM10	N/A - PM10	--	2.80E-04
								PM2.5	N/A - PM2.5	--	2.80E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	1.35E-02	4.49E-03
								Sulphur dioxide	7446-09-05	1.85E-05	6.17E-06
								Carbon monoxide	630-08-0	4.53E-04	1.51E-04
								Particulate matter	N/A - TSP	--	1.65E-05
								PM10	N/A - PM10	--	1.65E-05
								PM2.5	N/A - PM2.5	--	1.65E-05
Unpaved Segment 6	$S8_{3\text{-SP}}$	663	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	1.86E-02	9.30E-03
								Sulphur dioxide	7446-09-05	1.51E-05	7.55E-06
								Carbon monoxide	630-08-0	9.36E-03	4.68E-03
								Particulate matter	N/A - TSP	--	4.75E-04
								PM10	N/A - PM10	--	4.75E-04
								PM2.5	N/A - PM2.5	--	4.75E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	2.29E-02	7.62E-03
								Sulphur dioxide	7446-09-05	3.14E-05	1.05E-05
								Carbon monoxide	630-08-0	7.68E-04	2.56E-04
								Particulate matter	N/A - TSP	--	2.81E-05
								PM10	N/A - PM10	--	2.81E-05
								PM2.5	N/A - PM2.5	--	2.81E-05
Working Face	S4	--	Landfill tipper	Lift Waste Trailer to unload Waste	1	0.17	10	Nitrogen oxides	10102-44-0	4.53E-02	1.13E-01
								Sulphur dioxide	7446-09-05	2.75E-05	6.87E-05
								Carbon monoxide	630-08-0	6.94E-03	1.74E-02
								Particulate matter	N/A - TSP	--	5.60E-03
								PM10	N/A - PM10	--	5.60E-03
								PM2.5	N/A - PM2.5	--	5.60E-03
			CAT D8T Dozer	Push and Spread Waste	3	0.75	10	Nitrogen oxides	10102-44-0	5.53E-01	3.07E-01
								Sulphur dioxide	7446-09-05	7.60E-04	4.22E-04
								Carbon monoxide	630-08-0	1.86E-02	1.03E-02
								Particulate matter	N/A - TSP	--	1.13E-03
								PM10	N/A - PM10	--	1.13E-03
								PM2.5	N/A - PM2.5	--	1.13E-03
			CAT 836K Landfill compactor	Compact Waste	3	0.75	10	Nitrogen oxides	10102-44-0	8.78E-01	4.88E-01
								Sulphur dioxide	7446-09-05	1.21E-03	6.70E-04
								Carbon monoxide	630-08-0	2.95E-02	1.64E-02
								Particulate matter	N/A - TSP	--	1.80E-03
								PM10	N/A - PM10	--	1.80E-03
								PM2.5	N/A - PM2.5	--	1.80E-03
Storage Pile	S5	--	CAT 345 Hydraulic Excavator	Soil excavation	1	0.75	5	Nitrogen oxides	10102-44-0	1.64E-01	4.54E-02
								Sulphur dioxide	7446-09-05	2.25E-04	6.24E-05
								Carbon monoxide	630-08-0	5.50E-03	1.53E-03
								Particulate matter	N/A - TSP	--	1.67E-04
								PM10	N/A - PM10	--	1.67E-04
								PM2.5	N/A - PM2.5	--	1.67E-04

Table 2-8
Non-Road Vehicles - Scenario 1

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate(1)(2) (g/s)	Total 24-hr Emission Rate(1)(2) (g/s)
Concrete Crushing	S6	--	Cat 336 Hydraulic Excavator	Feed the crusher	1	1.00	6	Nitrogen oxides	10102-44-0	2.18E-01	5.45E-02
Wood Grinding								Sulphur dioxide	7446-09-05	3.00E-04	7.49E-05
								Carbon monoxide	630-08-0	7.33E-03	1.83E-03
								Particulate matter	N/A - TSP	--	2.01E-04
								PM10	N/A - PM10	--	2.01E-04
								PM2.5	N/A - PM2.5	--	2.01E-04
			Cat D8T Dozer	Push the material	1	1.00	6	Nitrogen oxides	10102-44-0	2.46E-01	6.15E-02
								Sulphur dioxide	7446-09-05	3.38E-04	8.44E-05
								Carbon monoxide	630-08-0	8.26E-03	2.07E-03
								Particulate matter	N/A - TSP	--	2.26E-04
								PM10	N/A - PM10	--	2.26E-04
								PM2.5	N/A - PM2.5	--	2.26E-04
			Conveyor/Stacker	Create stockpiles	1	1.00	10	Nitrogen oxides	10102-44-0	7.50E-02	3.13E-02
								Sulphur dioxide	7446-09-05	9.55E-05	3.98E-05
								Carbon monoxide	630-08-0	5.91E-02	2.46E-02
								Particulate matter	N/A - TSP	--	2.08E-03
								PM10	N/A - PM10	--	2.08E-03
								PM2.5	N/A - PM2.5	--	2.08E-03
			Crushing	Crushing	1	1.00	10	Nitrogen oxides	10102-44-0	3.06E-01	1.27E-01
								Sulphur dioxide	7446-09-05	4.20E-04	1.75E-04
								Carbon monoxide	630-08-0	1.03E-01	4.29E-02
								Particulate matter	N/A - TSP	--	7.64E-03
								PM10	N/A - PM10	--	7.64E-03
								PM2.5	N/A - PM2.5	--	7.64E-03
			Wood Grinder	Wood Grinder	1	1.00	6	Nitrogen oxides	10102-44-0	4.03E-01	1.01E-01
								Sulphur dioxide	7446-09-05	5.53E-04	1.38E-04
								Carbon monoxide	630-08-0	1.36E-01	3.39E-02
								Particulate matter	N/A - TSP	--	6.04E-03
								PM10	N/A - PM10	--	6.04E-03
								PM2.5	N/A - PM2.5	--	6.04E-03
			John Deere 644K Front End Loader	Moving material	1	1.00	10	Nitrogen oxides	10102-44-0	1.61E-01	6.71E-02
								Sulphur dioxide	7446-09-05	2.21E-04	9.22E-05
								Carbon monoxide	630-08-0	4.83E-03	2.01E-03
								Particulate matter	N/A - TSP	--	2.47E-04
								PM10	N/A - PM10	--	2.47E-04
								PM2.5	N/A - PM2.5	--	2.47E-04

Notes

(1) Emission factors taken from the US EPA document "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition NR-009d", July, 2010.
(2) Emissions from the site maintenance vehicle (CAT 430 Backhoe) have been distributed based on the segment lengths.

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Table 2-9a
Onroad Vehicles - Scenario 1

Source	Source ID	Vehicle Type	Segment Length (m)	Number of Trips per hour (Inbound and Outbound)	Hourly Vehicle Distance Travelled (VKT)	Daily Vehicle Distance Travelled (VKT)[1]	Contaminant	CAS No.	Emission Factor[2] (g/VKT)	Total 1-hr Emission Rate (g/s)	Total 24-hr Emission Rate (g/s)
Paved Road	S7	Refuse Truck	735	41	30	301	Nitrogen oxides	10102-44-0	2.32E+00	1.94E-02	8.08E-03
							Sulphur dioxide	7446-09-05	1.34E-02	1.12E-04	4.69E-05
							Carbon monoxide	630-08-0	6.87E-01	5.75E-03	2.39E-03
							Particulate matter[3]	N/A - TSP	7.32E-01	--	2.55E-03
							PM10	N/A - PM10	7.32E-01	--	2.55E-03
							PM2.5	N/A - PM2.5	1.80E-01	--	6.27E-04
		Light Vehicles	735	6	4	44	Nitrogen oxides	10102-44-0	6.40E-02	7.84E-05	3.27E-05
							Sulphur dioxide	7446-09-05	2.71E-03	3.31E-06	1.38E-06
							Carbon monoxide	630-08-0	1.49E+00	1.82E-03	7.60E-04
							Particulate matter[3]	N/A - TSP	7.03E-02	--	3.59E-05
							PM10	N/A - PM10	7.03E-02	--	3.59E-05
							PM2.5	N/A - PM2.5	1.13E-02	--	5.74E-06
Unpaved Segment 1	$S8_{1-2}$	Refuse Truck	770	41	32	316	Nitrogen oxides	10102-44-0	2.32E+00	2.03E-02	8.47E-03
							Sulphur dioxide	7446-09-05	1.34E-02	1.18E-04	4.91E-05
							Carbon monoxide	630-08-0	6.87E-01	6.03E-03	2.51E-03
							Particulate matter[3]	N/A - TSP	7.32E-01	--	2.68E-03
							PM10	N/A - PM10	7.32E-01	--	2.68E-03
							PM2.5	N/A - PM2.5	1.80E-01	--	6.58E-04
Unpaved Segment 2	$S8_{2-CC}$	Refuse Truck	814	1	0.8	8	Nitrogen oxides	10102-44-0	2.32E+00	5.24E-04	2.18E-04
							Sulphur dioxide	7446-09-05	1.34E-02	3.04E-06	1.27E-06
							Carbon monoxide	630-08-0	6.87E-01	1.55E-04	6.47E-05
							Particulate matter[3]	N/A - TSP	7.32E-01	--	6.90E-05
							PM10	N/A - PM10	7.32E-01	--	6.90E-05
							PM2.5	N/A - PM2.5	1.80E-01	--	1.69E-05
Unpaved Segment 3	$S8_{2-3}$	Refuse Truck	289	40	12	116	Nitrogen oxides	10102-44-0	2.32E+00	7.45E-03	3.10E-03
							Sulphur dioxide	7446-09-05	1.34E-02	4.32E-05	1.80E-05
							Carbon monoxide	630-08-0	6.87E-01	2.21E-03	9.20E-04
							Particulate matter[3]	N/A - TSP	7.32E-01	--	9.81E-04
							PM10	N/A - PM10	7.32E-01	--	9.81E-04
							PM2.5	N/A - PM2.5	1.80E-01	--	2.41E-04
Unpaved Segment 4	$S8_{3-RF}$	Refuse Truck	707	2	1	14	Nitrogen oxides	10102-44-0	2.32E+00	9.10E-04	3.79E-04
							Sulphur dioxide	7446-09-05	1.34E-02	5.28E-06	2.20E-06
							Carbon monoxide	630-08-0	6.87E-01	2.70E-04	1.12E-04
							Particulate matter[3]	N/A - TSP	7.32E-01	--	1.20E-04
							PM10	N/A - PM10	7.32E-01	--	1.20E-04
							PM2.5	N/A - PM2.5	1.80E-01	--	2.95E-05
Unpaved Segment 5	$S8_{3-WF}$	Refuse Truck	391	44	17	172	Nitrogen oxides	10102-44-0	2.32E+00	1.11E-02	4.61E-03
							Sulphur dioxide	7446-09-05	1.34E-02	6.42E-05	2.68E-05
							Carbon monoxide	630-08-0	6.87E-01	3.28E-03	1.37E-03
							Particulate matter[3]	N/A - TSP	7.32E-01	--	1.46E-03
							PM10	N/A - PM10	7.32E-01	--	1.46E-03
							PM2.5	N/A - PM2.5	1.80E-01	--	3.58E-04
Unpaved Segment 6	$S8_{3-SP}$	Refuse Truck	663	2	1.3	13	Nitrogen oxides	10102-44-0	2.32E+00	8.53E-04	3.56E-04
							Sulphur dioxide	7446-09-05	1.34E-02	4.95E-06	2.06E-06
							Carbon monoxide	630-08-0	6.87E-01	2.53E-04	1.05E-04
							Particulate matter[3]	N/A - TSP	7.32E-01	--	1.12E-04
							PM10	N/A - PM10	7.32E-01	--	1.12E-04
							PM2.5	N/A - PM2.5	1.80E-01	--	2.76E-05

Notes

(1) Based on the site operating 10 hrs/day.
(2) Emission factors generated from US EPA MOVES.
(3) It was estimated that all total particulate matter emitted from this source was in the PM10 size fraction or smaller.

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Table 2-9b
Onroad Vehicles - Scenario 1

	MOVES Emission Factors	
	Refuse Trucks	Light Trucks
Compound	(g/VMT)	(g/VMT)
Nox	3.73E+00	1.03E-01
SO2	2.16E-02	4.36E-03
CO	1.11E+00	2.40E+00
PM10 total	1.77E-01	4.77E-03
PM10 Brakewear	9.49E-01	9.48E-02
PM10 Tirewear	5.11E-02	1.36E-02
PM2.5 total	1.63E-01	4.22E-03
PM 2.5 brakewear	1.19E-01	1.19E-02
PM2.5 tirewear	7.67E-03	2.04E-03
Carbon dioxide	2.56E+03	6.33E+02
Methane	7.22E-02	2.27E-03
Nitrous oxide	7.78E-03	6.47E-03

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Table 2-10
Material Transfer - Scenario 1

Source	Source ID	Hourly Tranfer (tonnes/hour)	Contaminant	CAS No.	Emission Factor (kg_{PM}/tonne)$^{(2)(3)(4)}$	Total Emission Rate (24-hr average)$^{(5)}$ (g/s)
Active Working Face	S4	610	TSP	N/A - TSP	1.39E-04	9.81E-03
			PM10	N/A - PM10	6.58E-05	4.64E-03
			PM2.5	N/A - PM2.5	9.96E-06	7.03E-04
Storage Pile 1	S5	72	TSP	N/A - TSP	1.39E-04	1.16E-03
			PM10	N/A - PM10	6.58E-05	5.50E-04
			PM2.5	N/A - PM2.5	9.96E-06	8.33E-05
Storage Pile 2	S6	7	TSP	N/A - TSP	1.39E-04	1.17E-04
			PM10	N/A - PM10	6.58E-05	5.51E-05
			PM2.5	N/A - PM2.5	9.96E-06	8.35E-06

Notes:

(1) Material handled taken from Ride Landfill's 2017 NPRI Report. It was estimated that the sand, clay, cover, and misc. fill was split between the active working face and aggregate storage pile.
(2) Emission factors obtained from US EPA AP-42 Chapter 13.2.4 "Aggregate Handling and Storage Piles" equation 13.2.4. (1).
(3) Material parameters:

Mean wind speed (U)	3.4	m/s (taken from the MECP pre-processed 2018 hourly weather data from the ECCC's RidgeTown Station)
Moisture content (M)	14	% (taken from Table 13.2.4-1 for clay/dirt mix at municipal solid waste landfills)

(4) Particle size multipliers (k):

< 30 um	0.74
< 10 um	0.35
< 2.5 um	0.053

(5) Based on the site operations of 264 days/year, 10 hours/day.

Table 2-11
Material Crushing - Scenario 1

Source	Source ID	Source Description	Hourly Material Tranfer[1] (tonnes/hour)	Contaminant	CAS No.	Emission Factor (kg_{PM}/tonne)[2][3]	Total Emission Rate (24-hr average)[4] (g/s)
Concrete Crushing	S6	Crushing	500	TSP	N/A - TSP	2.70E-03	1.56E-01
				PM10	N/A - PM10	1.20E-03	6.94E-02
				PM2.5	N/A - PM2.5	5.00E-05 (5)	2.89E-03
Concrete Crushing	S6	Conveyor/Stacker	500	TSP	N/A - TSP	1.50E-03	8.68E-02
				PM10	N/A - PM10	5.50E-04	3.18E-02
				PM2.5	N/A - PM2.5	6.50E-06 (5)	3.76E-04

Notes:

(1) Taken from general equipment specifications production capacity.
(2) Emissions from the crusher are based on the US EPA AP-42 Chapter 11.19.2-1 Crushed Stone Processing and Pulverized Mineral Processing emission factor for uncontrolled tertiary crushing.
(3) Emissions from the conveyor/stacker are based on the US EPA AP-42 Chapter 11.19.2-1 Crushed Stone Processing and Pulverized Mineral Processing emission factor for uncontrolled conveyor transfer point emissions.
(4) Based on the site operations of 264 days/year, 10 hours/day.
(5) Due to lack of data for PM2.5 emission factors for uncontrolled emissions, the controlled emission factor was used for completeness.

Appendix D3A-3

Preferred Alternative Scenario 2 Calculation Summary

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Table 3-1
LandGEM Results - Scenario 2

Old Landfill - Operating Year 2028 (Closure 2027)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(2)
Total landfill gas	8.32E+07	6.49E+07	1.66E+07
Methane	2.38E+07	3.57E+07	4.76E+06
Carbon disulfide - HAP/VOC	1.19E+02	3.76E+01	2.38E+01
Carbon monoxide	1.06E+04	9.08E+03	2.12E+03
Carbonyl sulfide - HAP/VOC	7.94E+01	3.18E+01	1.59E+01
Chloroform - HAP/VOC	9.66E+00	1.95E+00	1.93E+00
Dimethyl sulfide (methyl sulfide) - VOC	1.31E+03	5.06E+02	2.61E+02
Ethyl mercaptan (ethanethiol) - VOC	3.86E+02	1.49E+02	7.71E+01
Hydrogen sulfide	3.31E+03	2.34E+03	6.62E+02
Methyl mercaptan - VOC	3.24E+02	1.62E+02	6.49E+01
Vinyl chloride - HAP/VOC	1.23E+03	4.74E+02	2.46E+02

West Landfill - Operating Year 2028 (Closure 2017)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(1)
Total landfill gas	7.61E+07	5.92E+07	1.52E+07
Methane	2.19E+07	3.28E+07	4.37E+06
Carbon disulfide - HAP/VOC	1.09E+02	3.44E+01	2.18E+01
Carbon monoxide	9.66E+03	8.29E+03	1.93E+03
Carbonyl sulfide - HAP/VOC	7.25E+01	2.90E+01	1.45E+01
Chloroform - HAP/VOC	8.82E+00	1.78E+00	1.76E+00
Dimethyl sulfide (methyl sulfide) - VOC	1.19E+03	4.62E+02	2.39E+02
Ethyl mercaptan (ethanethiol) - VOC	3.52E+02	1.36E+02	7.04E+01
Hydrogen sulfide	3.02E+03	2.13E+03	6.05E+02
Methyl mercaptan - VOC	2.96E+02	1.48E+02	5.93E+01
Vinyl chloride - HAP/VOC	1.12E+03	4.32E+02	2.25E+02

South Landfill - Operating Year 2028 (Closure 2021)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(1)
Total landfill gas	4.44E+07	3.46E+07	8.88E+06
Methane	1.28E+07	1.91E+07	2.55E+06
Carbon disulfide - HAP/VOC	6.35E+01	2.01E+01	1.27E+01
Carbon monoxide	5.64E+03	4.84E+03	1.13E+03
Carbonyl sulfide - HAP/VOC	4.23E+01	1.69E+01	8.47E+00
Chloroform - HAP/VOC	5.15E+00	1.04E+00	1.03E+00
Dimethyl sulfide (methyl sulfide) - VOC	6.97E+02	2.70E+02	1.39E+02
Ethyl mercaptan (ethanethiol) - VOC	2.06E+02	7.95E+01	4.11E+01
Hydrogen sulfide	1.76E+03	1.25E+03	3.53E+02
Methyl mercaptan - VOC	1.73E+02	8.65E+01	3.46E+01
Vinyl chloride - HAP/VOC	6.56E+02	2.52E+02	1.31E+02

South Landfill Expansion - Operating Year 2029(1) (Closure 2032)

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Table 3-1
LandGEM Results - Scenario 2

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(2)
Total landfill gas	1.35E+07	1.05E+07	2.70E+06
Methane	3.88E+06	5.82E+06	7.77E+05
Carbon disulfide - HAP/VOC	1.93E+01	6.10E+00	3.87E+00
Carbon monoxide	1.72E+03	1.47E+03	3.43E+02
Carbonyl sulfide - HAP/VOC	1.29E+01	5.16E+00	2.58E+00
Chloroform - HAP/VOC	1.57E+00	3.16E-01	3.14E-01
Dimethyl sulfide (methyl sulfide) - VOC	2.12E+02	8.21E+01	4.24E+01
Ethyl mercaptan (ethanethiol) - VOC	6.25E+01	2.42E+01	1.25E+01
Hydrogen sulfide	5.37E+02	3.79E+02	1.07E+02
Methyl mercaptan - VOC	5.26E+01	2.63E+01	1.05E+01
Vinyl chloride - HAP/VOC	2.00E+02	7.68E+01	3.99E+01

Scenario 2 Landfill Gas Flare Flow Rate (m^3/year)(2)	Estimated Landfill Gas Collection Efficiency (%)(3)	Methane Concentration in Landfill Gas(4) (%)	Methane Gas Produced from LandGEM (m^3/year)	Methane Gas Flare Flow Rate (m^3/year)
135,370,123	80.0%	55.3%	93,380,002	74,859,678

Sulphur Compounds	Molecular Weight	Volume (m^3/year)	Concentration (ppm)	Concentration of Sulphur Compounds (ppm)
Carbonyl Sulphide	60.07	8.29E+01	0.49	4.90E-01
Carbon Disulphide	76.14	9.81E+01	0.58	1.16E+00
Dimethyl Sulphide	62.13	1.32E+03	7.80	7.80E+00
Ethyl Mercaptan	62.13	3.89E+02	2.30	2.30E+00
Hydrogen Sulphide	34.08	6.09E+03	36.00	3.60E+01
Methyl Mercaptan	48.11	4.23E+02	2.50	2.50E+00
	Total	8.40E+03	Total	5.03E+01

Notes:

(1) The South Landfill expansion will begin filling operations in 2028, therefore LandGem results from 2029 have been used in the Scenario 2 assessment as a conservative estimate of landfill gas generation.
(2) The 2028 emission inventory year of each landfill footprint was taken to provide an analysis of landfill gas generation emissions for scenario 2.
(3) Landfill gas collection efficiency taken from Technical Memorandum "Ridge Landfill Expansion EA - Old landfill design optimization and information for visual, air and noise impact assessment of the preferred landfill expansion alternative" by Golder dated January 31, 2019.

(4) Landfill gas methane concentration taken from "Ontario Regulation 127, NPRI and Greenhouse Gas Emissions Reporting Year - 2017" by RWDI dated May 28, 2018.

Table 3-2
Flare Emission Estimates - Scenario 2

Source	Source ID	Contaminant	CAS No.	Molecular Weight	Emission Factor ($kg/10^6 dscm_{CH4}$)[1]	Total Emission Rate (g/s)
Flare 1	S1	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- [2]	1.07E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	7783-06-04	34.08	--[3][4]	3.19E-04
		Vinyl chloride	75-01-4	62.50	--[3][4]	1.19E-04
		Chloroform	67-66-3	119.39	--[3][4]	9.32E-07
Flare 2	S2	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- [2]	1.07E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	7783-06-04	34.08	--[3][4]	3.19E-04
		Vinyl chloride	75-01-4	62.50	--[3][4]	1.19E-04
		Chloroform	67-66-3	119.39	--[3][4]	9.32E-07
Flare 3	S3a	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- [2]	1.07E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	2148878	34.08	--[3][4]	3.19E-04
		Vinyl chloride	75-01-4	62.50	--[3][4]	1.19E-04
		Chloroform	67-66-3	119.39	--[3][4]	9.32E-07
Flare 4	S3b	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- [2]	1.07E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	2148878	34.08	--[3][4]	3.19E-04
		Vinyl chloride	75-01-4	62.50	--[3][4]	1.19E-04
		Chloroform	67-66-3	119.39	--[3][4]	9.32E-07
Flare 5	S3c	Nitrogen Oxides	10102-44-0	44.01	631	4.36E-01
		Sulphur Dioxide	7446-09-05	66.01	-- [2]	1.35E-01
		Carbon Monoxide	630-08-0	28.01	737	5.10E-01
		Particulate Matter	N/A - TSP	--	238	1.65E-01
		Hydrogen sulphide	2148878	34.08	--[3][4]	4.03E-04
		Vinyl chloride	75-01-4	62.50	--[3][4]	1.50E-04
		Chloroform	67-66-3	119.39	--[3][4]	1.18E-06

Notes:

(1) Emission factors obtained from US EPA AP-42 Chapter 2.4 Table 2.4-4 "Emission Factors for Secondary Compounds Existing Control Devices" for a flare.
(2) Emission estimates obtained from US EPA AP-42 Chapter 2.4 equations 3, 4, 7, and 8.

(3) Emission estimates obtained from landfill gas collection efficiency, flare efficiency, and LandGEM generated emissions. The total emission rates for these estimates are split across all flares.
(4) Flare parameters:

Landfill Gas Flare 1 Flow[5]	1.0	m^3/s
Landfill Gas Flare 2 Flow[5]	1.0	m^3/s
Landfill Gas Flare 3 Flow[8]	1.0	m^3/s
Landfill Gas Flare 4 Flow[8]	1.0	m^3/s
Landfill Gas Flare 5 Flow[8]	1.25	m^3/s
Methane Content[6]	55.3	%
Destruction Efficiency[7]	98	%

(5) Taken from Technical Memorandum "Ridge Landfill Expansion EA - Old landfill design optimization and information for visual, air and noise impact assessment of the preferred landfill expansion alternative" by Golder dated January 31, 2019.
(6) Landfill gas methane concentration taken from "Ontario Regulation 127, NPRI and Greenhouse Gas Emissions Reporting Year - 2017" by RWDI dated May 28, 2018.
(7) Manufacturer guarantee.
(8) Estimated.

Table 3-3
Estimated Landfill Footprint Emissions - Scenario 2

Landfill	LandGEM Contaminant	Source ID	Fugitive Emissions (kg/year)	Fugitive Emissions (m^3/hr)	Odour Concentration (OU/m^3)(1)	Contaminant	CAS No.	Total Emission Rate (OU/s or g/s)
Old Landfill	Total Landfill Gas	S9	--	1,481	10,000	Odour	N/A - Odour	4.11E+03
	Hydrogen Sulphide		662	--		Hydrogen Sulphide	7783-06-04	2.10E-02
	Vinyl Chloride		246	--		Vinyl Chloride	75-01-4	7.81E-03
	Chloroform		1.9	--		Chloroform	67-66-3	6.13E-05
West Landfill	Total Landfill Gas	S10	--	1,352	10,000	Odour	N/A - Odour	3.76E+03
	Hydrogen Sulphide		605	--		Hydrogen Sulphide	7783-06-04	1.92E-02
	Vinyl Chloride		225	--		Vinyl Chloride	75-01-4	7.13E-03
	Chloroform		1.8	--		Chloroform	67-66-3	5.60E-05
South Landfill	Total Landfill Gas	S11	--	790	10,000	Odour	N/A - Odour	2.19E+03
	Hydrogen Sulphide		353	--		Hydrogen Sulphide	7783-06-04	1.12E-02
	Vinyl Chloride		131	--		Vinyl Chloride	75-01-4	4.16E-03
	Chloroform		1.0	--		Chloroform	67-66-3	3.27E-05
South Landfill Expansion	Total Landfill Gas	S12	--	240	10,000	Odour	N/A - Odour	6.67E+02
	Hydrogen Sulphide		107	--		Hydrogen Sulphide	7783-06-04	3.41E-03
	Vinyl Chloride		40	--		Vinyl Chloride	75-01-4	1.27E-03
	Chloroform		0.3	--		Chloroform	67-66-3	9.94E-06

Notes:
(1) Screening level taken from Interim Guide to Estimate and Assess Landfill Air Impacts (MECP, 1992).

Table 3-4
Vehicle Activity - Scenario 2

Road Segment	Activity	Description	Movements per Hour (inbound/outbound)	Percentage Equipment Operating in a Given Hour	Non-Road Vehicle Daily Operating Time per Equipment (hour)
Paved Road Segment 0-1	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	Public Waste Drop off	Light Vehicles	6	--	--
	LCS Unloading Clear Stone	Tri-Axle Truck	10	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 1-2	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	LCS Unloading Clear Stone	Tri-Axle Truck	10	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 2-3	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	LCS Unloading Clear Stone	Tri-Axle Truck	10	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 2-RF	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 3-WF	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Hauling Soil	Tri-Axle Truck	4	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Working Face (WF) (including cell excavation, storage pile 1, and cell excavation)	Lift Waste Trailer to unload Waste	Landfill tipper	1	0.17	10
	Push and Spread Waste	CAT D8T Dozer	3	0.75	10
	Compact Waste	CAT 836K Landfill compactor	3	0.75	10
	Soil excavation	CAT 345 Hydraulic Excavator	1	0.75	5
	Cell excavation	CAT 336 Hydraulic Excavator	1	1.00	10
	Cell excavation	CAT 345 Hydraulic Excavator	1	1.00	9
	LCS unloading clear stone	CAT D8T Dozer	1	1.00	8
Concrete Crushing (CC) (including wood grinding)	Feed the crusher	Cat 336 Hydraulic Excavator	1	1.00	6
	Push the material	Cat D8T Dozer	1	1.00	6
	Create stockpiles	Conveyor/Stacker	1	1.00	10
	Crusher	Crusher	1	1.00	10
	Wood Grinder	Wood Grinder	1	1.00	6
	Moving material	John Deere 644K Front End Loader	1	1.00	10

Table 3-5
Paved Roads - Scenario 2

Source	Source ID	Distance Travelled (m)	Vehicle Type	Vehicle Numbers (#/hour)(1)	Truck Weight (tons)	Contaminant	CAS No.	Emission Factor (g/VKT)(2)(3)(4)	Total 24-hr Emission Rate (g/s)(5)(6)
Paved Road	S7	735	Tri-Axle Truck	53	40	TSP	N/A - TSP	6.93E+02	1.08E+00
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.33E+02	2.07E-01
			Light Vehicles	6	2.5	PM2.5	N/A - PM2.5	3.22E+01	5.01E-02

Notes:

(1) Water wagon vehicle numbers have been removed from dust generation vehicle numbers due to water flushing.
(2) Emission factors obtained from US EPA AP-42 Chapter 13.2.1 "Paved Roads" equation (2).
(3) Emission factor parameters:

Road surface silt loading (sL)	7.4	g/m^2 (taken from US EPA AP-42 Chapter 13.2.1. Table 13.2.1-3 for municipal solid waste landfill).
Mean Vehicle Weight (W)	36	tons
Precipitation days (P)	137	days (at least 0.2 mm [0.01 in] of precipitation per year taken from the Environment Canada Climate Nortmals - Chatham WPCP, 1981 to 2010
Averaging period	365	days

(4) Particle size multipliers (k) from US EPA AP-42 Table 13.2.1-1:

< 30 um	3.23	g/VKT
< 10 um	0.62	g/VKT
< 2.5 um	0.15	g/VKT

(5) A 70% reduction has been applied to the total emission rate due to dust mitigation techniques.
(6) Based on 10 hours of operation per day.

Table 3-6
Unpaved Roads - Scenario 2

Source	Source ID	Distance Travelled (m)	Vehicle Type	Vehicle Numbers (#/hour)	Truck Weight (tons)	Contaminant	CAS No.	Emission Factor (lb/VMT)(1)(2)(3)	Total 24-hr Emission Rate (g/s)(4)(5)
Unpaved Segment 1	$S8_{1-2}$	770	Tri-Axle Truck	53	40	TSP	N/A - TSP	6.27E+00	2.60E+00
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	7.02E-01
			Mean Vehicle Weight (W)		39.3	PM2.5	N/A - PM2.5	1.69E-01	7.02E-02
Unpaved Segment 2	$S8_{2-3}$	814	Tri-Axle Truck	53	40	TSP	N/A - TSP	6.27E+00	2.75E+00
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	7.42E-01
			Mean Vehicle Weight (W)		39.3	PM2.5	N/A - PM2.5	1.69E-01	7.42E-02
Unpaved Segment 3	$S8_{2-RF}$	1050	Tri-Axle Truck	2	40	TSP	N/A - TSP	5.56E+00	2.28E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.50E+00	6.17E-02
			Mean Vehicle Weight (W)		30.0	PM2.5	N/A - PM2.5	1.50E-01	6.17E-03
Unpaved Segment 4	$S8_{3-WF}$	245	Tri-Axle Truck	44	40	TSP	N/A - TSP	6.26E+00	6.91E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	1.87E-01
			Mean Vehicle Weight (W)		39.1	PM2.5	N/A - PM2.5	1.69E-01	1.87E-02

Notes:

(1) Emission factors obtained from US EPA AP-42 Chapter 13.2.2 "Unpaved Roads" equations (1a) and (2).
(2) Emission factor parameters:

Road surface silt loading (sL)	6.4	g/m^2 (taken from US EPA AP-42 Chapter 13.2.2. Table 13.2.2-1 for municipal solid waste landfill - disposal routes).
Precipitation days (P)	137	days (at least 0.2 mm [0.01 in] of precipitation per year taken from the Environment Canada Climate Nortmals - Chatham WPCP, 1981 to 2010
Averaging period	365	days

(3) Constants for equation (1a) from US EPA AP-42 Table 13.2.2-2:

Particle Size	Particle multiplier (k)		Constant (a)	Constant (b)
< 30 um	4.9	lb/VMT	0.7	0.45
< 10 um	1.5	lb/VMT	0.9	0.45
< 2.5 um	0.15	lb/VMT	0.9	0.45

(4) A 70% reduction has been applied to the total emission rate due to dust mitigation techniques.
(5) Based on 10 hours of operation per day.

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Table 3-7
Non-Road Vehicles Emission Factors - Scenario 2

Vehicle Type	Power Rating (hp)	Tier	Contaminant	CAS No.	Emission Factor[1] (g/hp-hr)
CAT 430 Backhoe	94	2	Nitrogen oxides	10102-44-0	4.7
			Sulphur dioxide	7446-09-05	0.0038
			Carbon monoxide	630-08-0	2.3655
			Particulate matter[4]	N/A - TSP	0.24
CAT 735 Water Wagon	434	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT D8T Dozer	354	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 836K Landfill compactor	562	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 336 Hydraulic Excavator	314	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 345 Hydraulic Excavator[2]	314	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
John Deere 644K Front End Loader	232	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.075
			Particulate matter	N/A - TSP	0.0092
Landfill tipper	173 (3)	1 (3)	Nitrogen oxides	10102-44-0	5.7
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.87
			Particulate matter[4]	N/A - TSP	0.28
Conveyor/Stacker	90	3	Nitrogen oxides	10102-44-0	3.0
			Sulphur dioxide	7446-09-05	0.0038
			Carbon monoxide	630-08-0	2.4
			Particulate matter[4]	N/A - TSP	0.2
Crusher	440	3	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.8
			Particulate matter[4]	N/A - TSP	0.2
Wood Grinder	580	3 (3)	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.8
			Particulate matter[4]	N/A - TSP	0.2

Notes

(1) Emission factors taken from the US EPA document "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition NR-009d", July, 2010.
(2) Estimated to be similar to the CAT 336 ydraulic Excavator.
(3) Estimated due to lack of available information.
(4) Emission factors are not available for PM10 and PM2.5, it was conservatively estimated that all TSP emitted from these sources are in the PM2.5 size fraction.

Table 3-8
Non-Road Vehicles - Scenario 2

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate[(1)(2)] (g/s)	Total 24-hr Emission Rate[(1)(2)] (g/s)
Paved Road	S7	735	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	2.49E-02	1.25E-02
								Sulphur dioxide	7446-09-05	2.02E-05	1.01E-05
								Carbon monoxide	630-08-0	1.25E-02	6.27E-03
								Particulate matter	N/A - TSP	--	6.36E-04
								PM10	N/A - PM10	--	6.36E-04
								PM2.5	N/A - PM2.5	--	6.36E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	3.06E-02	1.02E-02
								Sulphur dioxide	7446-09-05	4.21E-05	1.40E-05
								Carbon monoxide	630-08-0	1.03E-03	3.43E-04
								Particulate matter	N/A - TSP	--	3.76E-05
								PM10	N/A - PM10	--	3.76E-05
								PM2.5	N/A - PM2.5	--	3.76E-05
Unpaved Segment 1	$S8_{1-2}$	770	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	2.61E-02	1.31E-02
								Sulphur dioxide	7446-09-05	2.12E-05	1.06E-05
								Carbon monoxide	630-08-0	1.31E-02	6.57E-03
								Particulate matter	N/A - TSP	--	6.67E-04
								PM10	N/A - PM10	--	6.67E-04
								PM2.5	N/A - PM2.5	--	6.67E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	3.21E-02	1.07E-02
								Sulphur dioxide	7446-09-05	4.41E-05	1.47E-05
								Carbon monoxide	630-08-0	1.08E-03	3.60E-04
								Particulate matter	N/A - TSP	--	3.94E-05
								PM10	N/A - PM10	--	3.94E-05
								PM2.5	N/A - PM2.5	--	3.94E-05
Unpaved Segment 2	$S8_{2-3}$	814	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	2.76E-02	1.38E-02
								Sulphur dioxide	7446-09-05	2.24E-05	1.12E-05
								Carbon monoxide	630-08-0	1.39E-02	6.95E-03
								Particulate matter	N/A - TSP	--	7.05E-04
								PM10	N/A - PM10	--	7.05E-04
								PM2.5	N/A - PM2.5	--	7.05E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	3.39E-02	1.13E-02
								Sulphur dioxide	7446-09-05	4.66E-05	1.55E-05
								Carbon monoxide	630-08-0	1.14E-03	3.80E-04
								Particulate matter	N/A - TSP	--	4.16E-05
								PM10	N/A - PM10	--	4.16E-05
								PM2.5	N/A - PM2.5	--	4.16E-05
Unpaved Segment 3	$S8_{2-RF}$	1050	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	3.56E-02	1.78E-02
								Sulphur dioxide	7446-09-05	2.89E-05	1.44E-05
								Carbon monoxide	630-08-0	1.79E-02	8.96E-03
								Particulate matter	N/A - TSP	--	9.09E-04
								PM10	N/A - PM10	--	9.09E-04
								PM2.5	N/A - PM2.5	--	9.09E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	4.38E-02	1.46E-02
								Sulphur dioxide	7446-09-05	6.02E-05	2.01E-05
								Carbon monoxide	630-08-0	1.47E-03	4.90E-04
								Particulate matter	N/A - TSP	--	5.37E-05
								PM10	N/A - PM10	--	5.37E-05
								PM2.5	N/A - PM2.5	--	5.37E-05
Unpaved Segment 4	$S8_{3-WF}$	245	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	8.31E-03	4.16E-03
								Sulphur dioxide	7446-09-05	6.75E-06	3.37E-06
								Carbon monoxide	630-08-0	4.18E-03	2.09E-03

Table 3-8
Non-Road Vehicles - Scenario 2

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate(1)(2) (g/s)	Total 24-hr Emission Rate(1)(2) (g/s)
								Particulate matter	N/A - TSP	--	2.12E-04
								PM10	N/A - PM10	--	2.12E-04
								PM2.5	N/A - PM2.5	--	2.12E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	1.02E-02	3.41E-03
								Sulphur dioxide	7446-09-05	1.40E-05	4.68E-06
								Carbon monoxide	630-08-0	3.44E-04	1.15E-04
								Particulate matter	N/A - TSP	--	1.25E-05
								PM10	N/A - PM10	--	1.25E-05
								PM2.5	N/A - PM2.5	--	1.25E-05
Working Face Leachate collection system construction Storage pile 1 Cell excavation	S4	--	Landfill tipper	Lift Waste Trailer to unload Waste	1	0.17	10	Nitrogen oxides	10102-44-0	4.53E-02	1.13E-01
								Sulphur dioxide	7446-09-05	2.75E-05	6.87E-05
								Carbon monoxide	630-08-0	6.94E-03	1.74E-02
								Particulate matter	N/A - TSP	--	5.60E-03
								PM10	N/A - PM10	--	5.60E-03
								PM2.5	N/A - PM2.5	--	5.60E-03
			CAT D8T Dozer	Push and Spread Waste	3	0.75	10	Nitrogen oxides	10102-44-0	7.99E-01	3.89E-01
				LCS unloading clear stone	1	1.00	8	Sulphur dioxide	7446-09-05	1.10E-03	5.35E-04
								Carbon monoxide	630-08-0	2.68E-02	1.31E-02
								Particulate matter	N/A - TSP	--	1.43E-03
								PM10	N/A - PM10	--	1.43E-03
								PM2.5	N/A - PM2.5	--	1.43E-03
			CAT 836K Landfill compactor	Compact Waste	1	1.00	8	Nitrogen oxides	10102-44-0	3.90E-01	1.30E-01
								Sulphur dioxide	7446-09-05	5.36E-04	1.79E-04
								Carbon monoxide	630-08-0	1.31E-02	4.37E-03
								Particulate matter	N/A - TSP	--	4.79E-04
								PM10	N/A - PM10	--	4.79E-04
								PM2.5	N/A - PM2.5	--	4.79E-04
			Cat 336 Hydraulic Excavator	Cell excavation	1	1.00	10	Nitrogen oxides	10102-44-0	2.18E-01	9.09E-02
								Sulphur dioxide	7446-09-05	3.00E-04	1.25E-04
								Carbon monoxide	630-08-0	7.33E-03	3.05E-03
								Particulate matter	N/A - TSP	--	3.34E-04
								PM10	N/A - PM10	--	3.34E-04
								PM2.5	N/A - PM2.5	--	3.34E-04
			CAT 345 Hydraulic Excavator	Soil excavation	1	0.75	5	Nitrogen oxides	10102-44-0	3.82E-01	1.27E-01
				Cell excavation	1	1.00	9	Sulphur dioxide	7446-09-05	5.24E-04	1.75E-04
								Carbon monoxide	630-08-0	1.28E-02	4.27E-03
								Particulate matter	N/A - TSP	--	4.68E-04
								PM10	N/A - PM10	--	4.68E-04
								PM2.5	N/A - PM2.5	--	4.68E-04
Concrete Crushing Wood Grinding	S6	--	Cat 336 Hydraulic Excavator	Feed the crusher	1	1.00	6	Nitrogen oxides	10102-44-0	2.18E-01	5.45E-02
								Sulphur dioxide	7446-09-05	3.00E-04	7.49E-05
								Carbon monoxide	630-08-0	7.33E-03	1.83E-03
								Particulate matter	N/A - TSP	--	2.01E-04
								PM10	N/A - PM10	--	2.01E-04
								PM2.5	N/A - PM2.5	--	2.01E-04
			Cat D8T Dozer	Push the material	1	1.00	6	Nitrogen oxides	10102-44-0	2.46E-01	6.15E-02
								Sulphur dioxide	7446-09-05	3.38E-04	8.44E-05
								Carbon monoxide	630-08-0	8.26E-03	2.07E-03
								Particulate matter	N/A - TSP	--	2.26E-04
								PM10	N/A - PM10	--	2.26E-04
								PM2.5	N/A - PM2.5	--	2.26E-04

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Table 3-8
Non-Road Vehicles - Scenario 2

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate(1)(2) (g/s)	Total 24-hr Emission Rate(1)(2) (g/s)
			Conveyor/Stacker	Create stockpiles	1	1.00	10	Nitrogen oxides	10102-44-0	7.50E-02	3.13E-02
								Sulphur dioxide	7446-09-05	9.55E-05	3.98E-05
								Carbon monoxide	630-08-0	5.91E-02	2.46E-02
								Particulate matter	N/A - TSP	--	2.08E-03
								PM10	N/A - PM10	--	2.08E-03
								PM2.5	N/A - PM2.5	--	2.08E-03
			Crushing	Crushing	1	1.00	10	Nitrogen oxides	10102-44-0	3.06E-01	1.27E-01
								Sulphur dioxide	7446-09-05	4.20E-04	1.75E-04
								Carbon monoxide	630-08-0	1.03E-01	4.29E-02
								Particulate matter	N/A - TSP	--	7.64E-03
								PM10	N/A - PM10	--	7.64E-03
								PM2.5	N/A - PM2.5	--	7.64E-03
			Wood Grinder	Wood Grinder	1	1.00	6	Nitrogen oxides	10102-44-0	4.03E-01	1.01E-01
								Sulphur dioxide	7446-09-05	5.53E-04	1.38E-04
								Carbon monoxide	630-08-0	1.36E-01	3.39E-02
								Particulate matter	N/A - TSP	--	6.04E-03
								PM10	N/A - PM10	--	6.04E-03
								PM2.5	N/A - PM2.5	--	6.04E-03
			John Deere 644K Front End Loader	Moving material	1	1.00	10	Nitrogen oxides	10102-44-0	1.61E-01	6.71E-02
								Sulphur dioxide	7446-09-05	2.21E-04	9.22E-05
								Carbon monoxide	630-08-0	4.83E-03	2.01E-03
								Particulate matter	N/A - TSP	--	2.47E-04
								PM10	N/A - PM10	--	2.47E-04
								PM2.5	N/A - PM2.5	--	2.47E-04

Notes

(1) Emission factors taken from the US EPA document "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition NR-009d", July, 2010.
(2) Emissions from the site maintenance vehicle (CAT 430 Backhoe) have been distributed based on the segment lengths.

Table 3-9a
Onroad Vehicles - Scenario 2

Source	Source ID	Vehicle Type	Segment Length (m)	Number of Trips per hour (Inbound and Outbound)	Hourly Vehicle Distance Travelled (VKT)	Daily Vehicle Distance Travelled (VKT)(1)	Contaminant	CAS No.	Emission Factor(2) (g/VKT)	Total 1-hr Emission Rate (g/s)	Total 24-hr Emission Rate (g/s)
Paved Road	S7	Refuse Truck	735	41	30	301	Nitrogen oxides	10102-44-0	1.50E+00	1.26E-02	5.25E-03
							Sulphur dioxide	7446-09-05	1.40E-02	1.17E-04	4.88E-05
							Carbon monoxide	630-08-0	4.35E-01	3.64E-03	1.52E-03
							Particulate matter(3)	N/A - TSP	7.29E-01	--	2.54E-03
							PM10	N/A - PM10	7.29E-01	--	2.54E-03
							PM2.5	N/A - PM2.5	1.44E-01	--	5.02E-04
		Light Vehicles	735	6	4	44	Nitrogen oxides	10102-44-0	3.27E-02	4.01E-05	1.67E-05
							Sulphur dioxide	7446-09-05	2.47E-03	3.02E-06	1.26E-06
							Carbon monoxide	630-08-0	1.08E+00	1.32E-03	5.50E-04
							Particulate matter(3)	N/A - TSP	7.67E-02	--	3.91E-05
							PM10	N/A - PM10	7.67E-02	--	3.91E-05
							PM2.5	N/A - PM2.5	1.17E-02	--	5.94E-06
Unpaved Segment 1	$S8_{1-2}$	Refuse Truck	770	41	32	316	Nitrogen oxides	10102-44-0	1.50E+00	1.32E-02	5.50E-03
							Sulphur dioxide	7446-09-05	1.40E-02	1.23E-04	5.12E-05
							Carbon monoxide	630-08-0	4.35E-01	3.82E-03	1.59E-03
							Particulate matter(3)	N/A - TSP	7.29E-01	--	2.66E-03
							PM10	N/A - PM10	7.29E-01	--	2.66E-03
							PM2.5	N/A - PM2.5	1.44E-01	--	5.27E-04
Unpaved Segment 2	$S8_{2-3}$	Refuse Truck	814	8	6.5	65	Nitrogen oxides	10102-44-0	1.50E+00	2.72E-03	1.13E-03
							Sulphur dioxide	7446-09-05	1.40E-02	2.53E-05	1.06E-05
							Carbon monoxide	630-08-0	4.35E-01	7.88E-04	3.28E-04
							Particulate matter(3)	N/A - TSP	7.29E-01	--	5.49E-04
							PM10	N/A - PM10	7.29E-01	--	5.49E-04
							PM2.5	N/A - PM2.5	1.44E-01	--	1.09E-04
Unpaved Segment 3	$S8_{2-RF}$	Refuse Truck	1050	2	2	21	Nitrogen oxides	10102-44-0	1.50E+00	8.78E-04	3.66E-04
							Sulphur dioxide	7446-09-05	1.40E-02	8.17E-06	3.41E-06
							Carbon monoxide	630-08-0	4.35E-01	2.54E-04	1.06E-04
							Particulate matter(3)	N/A - TSP	7.29E-01	--	1.77E-04
							PM10	N/A - PM10	7.29E-01	--	1.77E-04
							PM2.5	N/A - PM2.5	1.44E-01	--	3.50E-05
Unpaved Segment 4	$S8_{3-WF}$	Refuse Truck	245	44	11	108	Nitrogen oxides	10102-44-0	1.50E+00	4.51E-03	1.88E-03
							Sulphur dioxide	7446-09-05	1.40E-02	4.20E-05	1.75E-05
							Carbon monoxide	630-08-0	4.35E-01	1.31E-03	5.44E-04
							Particulate matter(3)	N/A - TSP	7.29E-01	--	9.10E-04
							PM10	N/A - PM10	7.29E-01	--	9.10E-04
							PM2.5	N/A - PM2.5	1.44E-01	--	1.80E-04

Notes

(1) Based on the site operating 10 hrs/day.
(2) Emission factors generated from US EPA MOVES.
(3) It was estimated that all total particulate matter emitted from this source was in the PM10 size fraction or smaller.

Table 3-9b
Onroad Vehicles - Scenario 2

	MOVES Emission Factors	
	Refuse Trucks	Light Trucks
Compound	(g/VMT)	(g/VMT)
Nox	2.42E+00	5.27E-02
SO2	2.26E-02	3.97E-03
CO	7.01E-01	1.73E+00
PM10 total	1.06E-01	3.87E-03
PM10 Brakewear	1.01E+00	1.05E-01
PM10 Tirewear	5.45E-02	1.50E-02
PM2.5 total	9.73E-02	3.43E-03
PM 2.5 brakewear	1.27E-01	1.31E-02
PM2.5 tirewear	8.18E-03	2.25E-03
Carbon dioxide	2.69E+03	5.97E+02
Methane	7.81E-02	1.52E-03
Nitrous oxide	8.28E-03	5.16E-03

Table 3-10
Material Transfer - Scenario 2

Source	Source ID	Hourly Tranfer (tonnes/hour)	Contaminant	CAS No.	Emission Factor (kg_{PM}/tonne)(2)(3)(4)	Total Emission Rate (24-hr average)(5) (g/s)
Active Working Face	S4	610	TSP	N/A - TSP	1.39E-04	9.81E-03
			PM10	N/A - PM10	6.58E-05	4.64E-03
			PM2.5	N/A - PM2.5	9.96E-06	7.03E-04
Storage Pile 1	S5	72	TSP	N/A - TSP	1.39E-04	1.16E-03
			PM10	N/A - PM10	6.58E-05	5.50E-04
			PM2.5	N/A - PM2.5	9.96E-06	8.33E-05
Storage Pile 2	S6	7	TSP	N/A - TSP	1.39E-04	1.17E-04
			PM10	N/A - PM10	6.58E-05	5.51E-05
			PM2.5	N/A - PM2.5	9.96E-06	8.35E-06

Notes:

(1) Material handled taken from Ride Landfill's 2017 NPRI Report. It was estimated that the sand, clay, cover, and misc. fill was split between the active working face and aggregate storage pile.
(2) Emission factors obtained from US EPA AP-42 Chapter 13.2.4 "Aggregate Handling and Storage Piles" equation 13.2.4. (1).
(3) Material parameters:

Mean wind speed (U)	3.4	m/s (taken from the MECP pre-processed 2018 hourly weather data from the ECCC's RidgeTown Station)
Moisture content (M)	14	% (taken from Table 13.2.4-1 for clay/dirt mix at municipal solid waste landfills)

(4) Particle size multipliers (k):

< 30 um	0.74
< 10 um	0.35
< 2.5 um	0.053

(5) Based on the site operations of 264 days/year, 10 hours/day.

Table 3-11
Material Crushing - Scenario 2

Source	Source ID	Source Description	Hourly Material Tranfer[1] (tonnes/hour)	Contaminant	CAS No.	Emission Factor (kg_{PM}/tonne)[2][3]	Total Emission Rate (24-hr average)[4] (g/s)
Concrete Crushing	S6	Crushing	500	TSP	N/A - TSP	2.70E-03	1.56E-01
				PM10	N/A - PM10	1.20E-03	6.94E-02
				PM2.5	N/A - PM2.5	5.00E-05 (5)	2.89E-03
Concrete Crushing	S6	Conveyor/Stacker	500	TSP	N/A - TSP	1.50E-03	8.68E-02
				PM10	N/A - PM10	5.50E-04	3.18E-02
				PM2.5	N/A - PM2.5	6.50E-06 (5)	3.76E-04

Notes:

(1) Taken from general equipment specifications production capacity.
(2) Emissions from the crusher are based on the US EPA AP-42 Chapter 11.19.2-1 Crushed Stone Processing and Pulverized Mineral Processing emission factor for uncontrolled tertiary crushing.
(3) Emissions from the conveyor/stacker are based on the US EPA AP-42 Chapter 11.19.2-1 Crushed Stone Processing and Pulverized Mineral Processing emission factor for uncontrolled conveyor transfer point emissions.
(4) Based on the site operations of 264 days/year, 10 hours/day.
(5) Due to lack of data for PM2.5 emission factors for uncontrolled emissions, the controlled emission factor was used for completeness.

Appendix D3A-4

Preferred Alternative Scenario 3 Calculation Summary

Table 4-1
LandGEM Results - Scenario 3

Old Landfill - Operating Year 2039 (Closure 2027)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(2)
Total landfill gas	5.36E+07	4.18E+07	1.07E+07
Methane	1.53E+07	2.30E+07	3.07E+06
Carbon disulfide - HAP/VOC	7.67E+01	2.42E+01	1.53E+01
Carbon monoxide	6.81E+03	5.85E+03	1.36E+03
Carbonyl sulfide - HAP/VOC	5.11E+01	2.05E+01	1.02E+01
Chloroform - HAP/VOC	6.22E+00	1.25E+00	1.24E+00
Dimethyl sulfide (methyl sulfide) - VOC	8.42E+02	3.26E+02	1.68E+02
Ethyl mercaptan (ethanethiol) - VOC	2.48E+02	9.61E+01	4.97E+01
Hydrogen sulfide	2.13E+03	1.50E+03	4.26E+02
Methyl mercaptan - VOC	2.09E+02	1.04E+02	4.18E+01
Vinyl chloride - HAP/VOC	7.93E+02	3.05E+02	1.59E+02

West Landfill - Operating Year 2039 (Closure 2017)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(1)
Total landfill gas	4.90E+07	3.82E+07	9.80E+06
Methane	1.41E+07	2.11E+07	2.82E+06
Carbon disulfide - HAP/VOC	7.01E+01	2.21E+01	1.40E+01
Carbon monoxide	6.22E+03	5.34E+03	1.24E+03
Carbonyl sulfide - HAP/VOC	4.67E+01	1.87E+01	9.34E+00
Chloroform - HAP/VOC	5.68E+00	1.14E+00	1.14E+00
Dimethyl sulfide (methyl sulfide) - VOC	7.69E+02	2.98E+02	1.54E+02
Ethyl mercaptan (ethanethiol) - VOC	2.27E+02	8.77E+01	4.54E+01
Hydrogen sulfide	1.95E+03	1.37E+03	3.89E+02
Methyl mercaptan - VOC	1.91E+02	9.54E+01	3.82E+01
Vinyl chloride - HAP/VOC	7.24E+02	2.79E+02	1.45E+02

South Landfill - Operating Year 2039 (Closure 2021)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(1)
Total landfill gas	2.86E+07	2.23E+07	5.72E+06
Methane	8.22E+06	1.23E+07	1.64E+06
Carbon disulfide - HAP/VOC	4.09E+01	1.29E+01	8.18E+00
Carbon monoxide	3.63E+03	3.12E+03	7.27E+02
Carbonyl sulfide - HAP/VOC	2.73E+01	1.09E+01	5.45E+00
Chloroform - HAP/VOC	3.32E+00	6.68E-01	6.64E-01
Dimethyl sulfide (methyl sulfide) - VOC	4.49E+02	1.74E+02	8.98E+01
Ethyl mercaptan (ethanethiol) - VOC	1.32E+02	5.12E+01	2.65E+01
Hydrogen sulfide	1.14E+03	8.02E+02	2.27E+02
Methyl mercaptan - VOC	1.11E+02	5.57E+01	2.23E+01
Vinyl chloride - HAP/VOC	4.23E+02	1.63E+02	8.45E+01

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Table 4-1
LandGEM Results - Scenario 3

South Landfill Expansion - Operating Year 2039 (Closure 2032)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(2)
Total landfill gas	4.91E+07	3.83E+07	9.83E+06
Methane	1.41E+07	2.12E+07	2.82E+06
Carbon disulfide - HAP/VOC	7.03E+01	2.22E+01	1.41E+01
Carbon monoxide	6.24E+03	5.36E+03	1.25E+03
Carbonyl sulfide - HAP/VOC	4.69E+01	1.88E+01	9.37E+00
Chloroform - HAP/VOC	5.70E+00	1.15E+00	1.14E+00
Dimethyl sulfide (methyl sulfide) - VOC	7.71E+02	2.99E+02	1.54E+02
Ethyl mercaptan (ethanethiol) - VOC	2.27E+02	8.80E+01	4.55E+01
Hydrogen sulfide	1.95E+03	1.38E+03	3.91E+02
Methyl mercaptan - VOC	1.91E+02	9.57E+01	3.83E+01
Vinyl chloride - HAP/VOC	7.26E+02	2.79E+02	1.45E+02

West Landfill Expansion - Operating Year 2039 (Closure 2041)

Contaminant	Landfill Gas Generated from LandGEM (kg/year)	Landfill Gas Generated from LandGEM (m^3/year)	Landfill Gas Not Collected (kg/year)(2)
Total landfill gas	7.35E+07	5.73E+07	1.47E+07
Methane	2.11E+07	3.17E+07	4.23E+06
Carbon disulfide - HAP/VOC	1.05E+02	3.32E+01	2.10E+01
Carbon monoxide	9.34E+03	8.02E+03	1.87E+03
Carbonyl sulfide - HAP/VOC	7.01E+01	2.81E+01	1.40E+01
Chloroform - HAP/VOC	8.53E+00	1.72E+00	1.71E+00
Dimethyl sulfide (methyl sulfide) - VOC	1.15E+03	4.47E+02	2.31E+02
Ethyl mercaptan (ethanethiol) - VOC	3.40E+02	1.32E+02	6.81E+01
Hydrogen sulfide	2.92E+03	2.06E+03	5.84E+02
Methyl mercaptan - VOC	2.86E+02	1.43E+02	5.73E+01
Vinyl chloride - HAP/VOC	1.09E+03	4.18E+02	2.17E+02

Landfill Gas Flare Flow Rate (m^3/year)(1)	Estimated Landfill Gas Collection Efficiency (%)(2)	Methane Concentration in Landfill Gas(3) (%)	Methane Gas Produced from LandGEM (m^3/year)	Methane Gas Flare Flow Rate (m^3/year)
158,191,663	80.0%	55.3%	109,224,661	87,479,990

Sulphur Compounds	Molecular Weight	Volume (m^3/year)	Concentration (ppm)	Concentration of Sulphur Compounds (ppm)
Carbonyl Sulphide	60.07	9.69E+01	0.49	4.90E-01
Carbon Disulphide	76.14	1.15E+02	0.58	1.16E+00
Dimethyl Sulphide	62.13	1.54E+03	7.80	7.80E+00
Ethyl Mercaptan	62.13	4.55E+02	2.30	2.30E+00
Hydrogen Sulphide	34.08	7.12E+03	36.00	3.60E+01
Methyl Mercaptan	48.11	4.94E+02	2.50	2.50E+00
	Total	9.82E+03	Total	5.03E+01

Notes:

(1) The 2039 emission inventory year of each landfill footprint was taken to provide an analysis of landfill gas generation emissions for scenario 3.

(2) Landfill gas collection efficiency taken from Technical Memorandum "Ridge Landfill Expansion EA - Old landfill design optimization and information for visual, air and noise impact assessment of the preferred landfill expansion alternative" by Golder dated January 31, 2019.

(3) Landfill gas methane concentration taken from "Ontario Regulation 127, NPRI and Greenhouse Gas Emissions Reporting Year - 2017" by RWDI dated May 28, 2018.

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Table 4-2
Flare Emission Estimates - Scenario 3

Source	Source ID	Contaminant	CAS No.	Molecular Weight	Emission Factor $(kg/10^6 dscm_{CH4})$(1)	Total Emission Rate (g/s)
Flare 1	S1	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- (2)	1.25E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	7783-06-04	34.08	--(3)(4)	2.06E-04
		Vinyl chloride	75-01-4	62.50	--(3)(4)	7.64E-05
		Chloroform	67-66-3	119.39	--(3)(4)	6.00E-07
Flare 2	S2	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- (2)	1.25E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	7783-06-04	34.08	--(3)(4)	2.06E-04
		Vinyl chloride	75-01-4	62.50	--(3)(4)	7.64E-05
		Chloroform	67-66-3	119.39	--(3)(4)	6.00E-07
Flare 3	S3a	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- (2)	1.25E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	2148878	34.08	--(3)(4)	2.06E-04
		Vinyl chloride	75-01-4	62.50	--(3)(4)	7.64E-05
		Chloroform	67-66-3	119.39	--(3)(4)	6.00E-07
Flare 4	S3b	Nitrogen Oxides	10102-44-0	44.01	631	3.46E-01
		Sulphur Dioxide	7446-09-05	66.01	-- (2)	1.25E-01
		Carbon Monoxide	630-08-0	28.01	737	4.04E-01
		Particulate Matter	N/A - TSP	--	238	1.30E-01
		Hydrogen sulphide	2148878	34.08	--(3)(4)	2.06E-04
		Vinyl chloride	75-01-4	62.50	--(3)(4)	7.64E-05
		Chloroform	67-66-3	119.39	--(3)(4)	6.00E-07
Flare 5	S3c	Nitrogen Oxides	10102-44-0	44.01	631	4.36E-01
		Sulphur Dioxide	7446-09-05	66.01	-- (2)	1.58E-01
		Carbon Monoxide	630-08-0	28.01	737	5.10E-01
		Particulate Matter	N/A - TSP	--	238	1.65E-01
		Hydrogen sulphide	2148878	34.08	--(3)(4)	2.59E-04
		Vinyl chloride	75-01-4	62.50	--(3)(4)	9.65E-05
		Chloroform	67-66-3	119.39	--(3)(4)	7.57E-07

Notes:

(1) Emission factors obtained from US EPA AP-42 Chapter 2.4 Table 2.4-4 "Emission Factors for Secondary Compounds Existing Control Devices" for a flare.
(2) Emission estimates obtained from US EPA AP-42 Chapter 2.4 equations 3, 4, 7, and 8.

(3) Emission estimates obtained from landfill gas collection efficiency, flare efficiency, and LandGEM generated emissions. The total emission rates for these estimates are split across all flares.
(4) Flare parameters:

Landfill Gas Flare 1 Flow(5)	1.0	m^3/s
Landfill Gas Flare 2 Flow(5)	1.0	m^3/s
Landfill Gas Flare 3 Flow(8)	1.0	m^3/s
Landfill Gas Flare 4 Flow(8)	1.0	m^3/s
Landfill Gas Flare 5 Flow(8)	1.25	m^3/s
Methane Content(6)	55.3	%
Destruction Efficiency(7)	98	%

(5) Taken from Technical Memorandum "Ridge Landfill Expansion EA - Old landfill design optimization and information for visual, air and noise impact assessment of the preferred landfill expansion alternative" by Golder dated January 31, 2019.
(6) Landfill gas methane concentration taken from "Ontario Regulation 127, NPRI and Greenhouse Gas Emissions Reporting Year - 2017" by RWDI dated May 28, 2018.
(7) Manufacturer guarantee.
(8) Estimated.

Table 4-3
Estimated Landfill Footprint Emissions - Scenario 3

Landfill	LandGEM Contaminant	Source ID	Fugitive Emissions (kg/year)	Fugitive Emissions (m^3/hr)	Odour Concentration (OU/m^3)(1)	Contaminant	CAS No.	Total Emission Rate (OU/s or g/s)
Old Landfill	Total Landfill Gas	S9	--	954	10,000	Odour	N/A - Odour	2.65E+03
	Hydrogen Sulphide		426	--		Hydrogen Sulphide	7783-06-04	1.35E-02
	Vinyl Chloride		159	--		Vinyl Chloride	75-01-4	5.03E-03
	Chloroform		1.2	--		Chloroform	67-66-3	3.95E-05
West Landfill	Total Landfill Gas	S10	--	871	10,000	Odour	N/A - Odour	2.42E+03
	Hydrogen Sulphide		389	--		Hydrogen Sulphide	7783-06-04	1.23E-02
	Vinyl Chloride		145	--		Vinyl Chloride	75-01-4	4.59E-03
	Chloroform		1.1	--		Chloroform	67-66-3	3.60E-05
South Landfill	Total Landfill Gas	S11	--	509	10,000	Odour	N/A - Odour	1.41E+03
	Hydrogen Sulphide		227	--		Hydrogen Sulphide	7783-06-04	7.21E-03
	Vinyl Chloride		85	--		Vinyl Chloride	75-01-4	2.68E-03
	Chloroform		0.7	--		Chloroform	67-66-3	2.10E-05
South Landfill Expansion	Total Landfill Gas	S12	--	874	10,000	Odour	N/A - Odour	2.43E+03
	Hydrogen Sulphide		391	--		Hydrogen Sulphide	7783-06-04	1.24E-02
	Vinyl Chloride		145	--		Vinyl Chloride	75-01-4	4.61E-03
	Chloroform		1.1	--		Chloroform	67-66-3	3.62E-05
West Landfill Expansion	Total Landfill Gas	S13	--	1,307	10,000	Odour	N/A - Odour	3.63E+03
	Hydrogen Sulphide		584	--		Hydrogen Sulphide	7783-06-04	1.85E-02
	Vinyl Chloride		217	--		Vinyl Chloride	75-01-4	6.89E-03
	Chloroform		1.7	--		Chloroform	67-66-3	5.41E-05

Notes:
(1) Screening level taken from Interim Guide to Estimate and Assess Landfill Air Impacts (MECP, 1992).

Table 4-4
Vehicle Activity - Scenario 3

Road Segment	Activity	Description	Movements per Hour (inbound/outbound)	Percentage Equipment Operating in a Given Hour	Non-Road Vehicle Daily Operating Time per Equipment (hour)
Paved Road Segment 0-1	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	Public Waste Drop off	Light Vehicles	6	--	--
	LCS unloading of clear stone	Tri-Axle Truck	10	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 1-2	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	LCS unloading of clear stone	Tri-Axle Truck	10	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 2-3	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 2-RF	Public Recycling (one way)	Tri-Axle Truck	2	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 3-WF	Waste (non-IC&I/C&D)	Tri-Axle Truck	8	--	--
	Waste (IC&I/C&D Waste)	Tri-Axle Truck	32	--	--
	Hauling Soil	Tri-Axle Truck	4	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Unpaved Road Segment 3-CC	Hauling Soil	Tri-Axle Truck	4	--	--
	Concrete Crushing	Tri-Axle Truck	1	--	--
	Water Wagon	CAT 735 Water Wagon	1	0.50	4
	Site Maintenance	CAT 430 Backhoe	2	0.50	6
Working Face (WF) (including LCS construction and cell excavation)	Lift Waste Trailer to unload Waste	Landfill tipper	1	0.17	10
	Push and Spread Waste	CAT D8T Dozer	3	0.75	10
	Compact Waste	CAT 836K Landfill compactor	3	0.75	10
	Cell excavation	CAT 345 Hydraulic Excavator	1	1.00	9
	LCS unloading clear stone	CAT D8T Dozer	1	1.00	10
Concrete Crushing (CC) (including storage pile 1 and wood grinding)	Feed the crusher	Cat 336 Hydraulic Excavator	1	1.00	6
	Push the material	Cat D8T Dozer	1	1.00	6
	Create stockpiles	Conveyor/Stacker	1	1.00	10
	Crusher	Crusher	1	1.00	10
	Soil excavation	CAT 345 Hydraulic Excavator	1	0.75	5
	Wood Grinder	Wood Grinder	1	1.00	6
	Moving material	John Deere 644K Front End Loader	1	1.00	10

Table 4-5
Paved Roads - Scenario 3

Source	Source ID	Distance Travelled (m)	Vehicle Type	Vehicle Numbers (#/hour)[1]	Truck Weight (tons)	Contaminant	CAS No.	Emission Factor (g/VKT)[2][3][4]	Total 24-hr Emission Rate (g/s)[5][6]
Paved Road	S7	735	Tri-Axle Truck	53	40	TSP	N/A - TSP	6.93E+02	1.08E+00
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.33E+02	2.07E-01
			Light Vehicles	6	2.5	PM2.5	N/A - PM2.5	3.22E+01	5.01E-02

Notes:

(1) Water wagon vehicle numbers have been removed from dust generation vehicle numbers due to water flushing.
(2) Emission factors obtained from US EPA AP-42 Chapter 13.2.1 "Paved Roads" equation (2).
(3) Emission factor parameters:

Road surface silt loading (sL)	7.4	g/m^2 (taken from US EPA AP-42 Chapter 13.2.1. Table 13.2.1-3 for municipal solid waste landfill).
Mean Vehicle Weight (W)	36	tons
Precipitation days (P)	137	days (at least 0.2 mm [0.01 in] of precipitation per year taken from the Environment Canada Climate Nortmals - Chatham WPCP, 1981 to 2010
Averaging period	365	days

(4) Particle size multipliers (k) from US EPA AP-42 Table 13.2.1-1:

< 30 um	3.23	g/VKT
< 10 um	0.62	g/VKT
< 2.5 um	0.15	g/VKT

(5) A 70% reduction has been applied to the total emission rate due to dust mitigation techniques.
(6) Based on 10 hours of operation per day.

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Table 4-6
Unpaved Roads - Scenario 3

Source	Source ID	Distance Travelled (m)	Vehicle Type	Vehicle Numbers (#/hour)	Truck Weight (tons)	Contaminant	CAS No.	Emission Factor (lb/VMT)(1)(2)(3)	Total 24-hr Emission Rate (g/s)(4)(5)
Unpaved Segment 1	$S8_{1-2}$	770	Tri-Axle Truck	53	40	TSP	N/A - TSP	6.27E+00	2.60E+00
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	7.02E-01
			Mean Vehicle Weight (W)		39.3	PM2.5	N/A - PM2.5	1.69E-01	7.02E-02
Unpaved Segment 2	$S8_{2-3}$	814	Tri-Axle Truck	41	40	TSP	N/A - TSP	6.26E+00	2.14E+00
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	5.79E-01
			Mean Vehicle Weight (W)		39.1	PM2.5	N/A - PM2.5	1.69E-01	5.79E-02
Unpaved Segment 3	$S8_{2-RF}$	1050	Tri-Axle Truck	2	40	TSP	N/A - TSP	5.56E+00	2.28E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.50E+00	6.17E-02
			Mean Vehicle Weight (W)		30.0	PM2.5	N/A - PM2.5	1.50E-01	6.17E-03
Unpaved Segment 4	$S8_{3-WF}$	201	Tri-Axle Truck	44	40	TSP	N/A - TSP	6.26E+00	5.66E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.69E+00	1.53E-01
			Mean Vehicle Weight (W)		39.1	PM2.5	N/A - PM2.5	1.69E-01	1.53E-02
Unpaved Segment 5	$S8_{3-CC}$	1386	Tri-Axle Truck	5	40	TSP	N/A - TSP	5.90E+00	5.60E-01
			CAT (or equivalent)	2	20	PM10	N/A - PM10	1.59E+00	1.51E-01
			Mean Vehicle Weight (W)		34.3	PM2.5	N/A - PM2.5	1.59E-01	1.51E-02

Notes:

(1) Emission factors obtained from US EPA AP-42 Chapter 13.2.2 "Unpaved Roads" equations (1a) and (2).
(2) Emission factor parameters:

Road surface silt loading (sL)	6.4	g/m^2 (taken from US EPA AP-42 Chapter 13.2.2. Table 13.2.2-1 for municipal solid waste landfill - disposal routes).
Precipitation days (P)	137	days (at least 0.2 mm [0.01 in] of precipitation per year taken from the Environment Canada Climate Nortmals - Chatham WPCP, 1981 to 2010
Averaging period	365	days

(3) Constants for equation (1a) from US EPA AP-42 Table 13.2.2-2:

Particle Size	Particle multiplier (k)		Constant (a)	Constant (b)
< 30 um	4.9	lb/VMT	0.7	0.45
< 10 um	1.5	lb/VMT	0.9	0.45
< 2.5 um	0.15	lb/VMT	0.9	0.45

(4) A 70% reduction has been applied to the total emission rate due to dust mitigation techniques.
(4) A control efficiency of 55% was applied to the unpaved road surface as detailed in the "Road dust emissions from unpaved surfaces: guide to reporting", Environment Canada, 2017.
(5) Based on 10 hours of operation per day.

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Table 4-7
Non-Road Vehicles Emission Factors - Scenario 3

Vehicle Type	Power Rating (hp)	Tier	Contaminant	CAS No.	Emission Factor[1] (g/hp-hr)
CAT 430 Backhoe	94	2	Nitrogen oxides	10102-44-0	4.7
			Sulphur dioxide	7446-09-05	0.0038
			Carbon monoxide	630-08-0	2.3655
			Particulate matter[4]	N/A - TSP	0.24
CAT 735 Water Wagon	434	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT D8T Dozer	354	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 836K Landfill compactor	562	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 336 Hydraulic Excavator	314	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
CAT 345 Hydraulic Excavator[2]	314	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.084
			Particulate matter[4]	N/A - TSP	0.0092
John Deere 644K Front End Loader	232	4	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.075
			Particulate matter	N/A - TSP	0.0092
Landfill tipper	173 (3)	1 (3)	Nitrogen oxides	10102-44-0	5.7
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.87
			Particulate matter[4]	N/A - TSP	0.28
Conveyor/Stacker	90	3	Nitrogen oxides	10102-44-0	3.0
			Sulphur dioxide	7446-09-05	0.0038
			Carbon monoxide	630-08-0	2.4
			Particulate matter[4]	N/A - TSP	0.2
Crusher	440	3	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.8
			Particulate matter[4]	N/A - TSP	0.2
Wood Grinder	580	3 (3)	Nitrogen oxides	10102-44-0	2.5
			Sulphur dioxide	7446-09-05	0.0034
			Carbon monoxide	630-08-0	0.8
			Particulate matter[4]	N/A - TSP	0.2

Notes

(1) Emission factors taken from the US EPA document "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition NR-009d", July, 2010.
(2) Estimated to be similar to the CAT 336 ydraulic Excavator.
(3) Estimated due to lack of available information.
(4) Emission factors are not available for PM10 and PM2.5, it was conservatively estimated that all TSP emitted from these sources are in the PM2.5 size fraction.

Table 4-8
Non-Road Vehicles - Scenario 3

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate[(1)(2)] (g/s)	Total 24-hr Emission Rate[(1)(2)] (g/s)
Paved Road	S7	735	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	1.82E-02	9.08E-03
								Sulphur dioxide	7446-09-05	1.47E-05	7.37E-06
								Carbon monoxide	630-08-0	9.14E-03	4.57E-03
								Particulate matter	N/A - TSP	--	4.64E-04
								PM10	N/A - PM10	--	4.64E-04
								PM2.5	N/A - PM2.5	--	4.64E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	2.23E-02	7.45E-03
								Sulphur dioxide	7446-09-05	3.07E-05	1.02E-05
								Carbon monoxide	630-08-0	7.51E-04	2.50E-04
								Particulate matter	N/A - TSP	--	2.74E-05
								PM10	N/A - PM10	--	2.74E-05
								PM2.5	N/A - PM2.5	--	2.74E-05
Unpaved Segment 1	$S8_{1-2}$	770	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	1.90E-02	9.52E-03
								Sulphur dioxide	7446-09-05	1.55E-05	7.73E-06
								Carbon monoxide	630-08-0	9.59E-03	4.79E-03
								Particulate matter	N/A - TSP	--	4.86E-04
								PM10	N/A - PM10	--	4.86E-04
								PM2.5	N/A - PM2.5	--	4.86E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	2.34E-02	7.81E-03
								Sulphur dioxide	7446-09-05	3.22E-05	1.07E-05
								Carbon monoxide	630-08-0	7.87E-04	2.62E-04
								Particulate matter	N/A - TSP	--	2.87E-05
								PM10	N/A - PM10	--	2.87E-05
								PM2.5	N/A - PM2.5	--	2.87E-05
Unpaved Segment 2	$S8_{2-3}$	814	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	2.01E-02	1.01E-02
								Sulphur dioxide	7446-09-05	1.63E-05	8.17E-06
								Carbon monoxide	630-08-0	1.01E-02	5.07E-03
								Particulate matter	N/A - TSP	--	5.14E-04
								PM10	N/A - PM10	--	5.14E-04
								PM2.5	N/A - PM2.5	--	5.14E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	2.48E-02	8.25E-03
								Sulphur dioxide	7446-09-05	3.40E-05	1.13E-05
								Carbon monoxide	630-08-0	8.32E-04	2.77E-04
								Particulate matter	N/A - TSP	--	3.04E-05
								PM10	N/A - PM10	--	3.04E-05
								PM2.5	N/A - PM2.5	--	3.04E-05
Unpaved Segment 3	$S8_{2-RF}$	1050	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	2.60E-02	1.30E-02
								Sulphur dioxide	7446-09-05	2.11E-05	1.05E-05
								Carbon monoxide	630-08-0	1.31E-02	6.53E-03
								Particulate matter	N/A - TSP	--	6.63E-04
								PM10	N/A - PM10	--	6.63E-04
								PM2.5	N/A - PM2.5	--	6.63E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	3.19E-02	1.06E-02
								Sulphur dioxide	7446-09-05	4.39E-05	1.46E-05
								Carbon monoxide	630-08-0	1.07E-03	3.58E-04
								Particulate matter	N/A - TSP	--	3.92E-05
								PM10	N/A - PM10	--	3.92E-05
								PM2.5	N/A - PM2.5	--	3.92E-05
Unpaved Segment 4	$S8_{3-WF}$	201	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	4.97E-03	2.48E-03
								Sulphur dioxide	7446-09-05	4.03E-06	2.01E-06
								Carbon monoxide	630-08-0	2.50E-03	1.25E-03

Table 4-8
Non-Road Vehicles - Scenario 3

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate(1)(2) (g/s)	Total 24-hr Emission Rate(1)(2) (g/s)
								Particulate matter	N/A - TSP	--	1.27E-04
								PM10	N/A - PM10	--	1.27E-04
								PM2.5	N/A - PM2.5	--	1.27E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	6.11E-03	2.04E-03
								Sulphur dioxide	7446-09-05	8.39E-06	2.80E-06
								Carbon monoxide	630-08-0	2.05E-04	6.84E-05
								Particulate matter	N/A - TSP	--	7.49E-06
								PM10	N/A - PM10	--	7.49E-06
								PM2.5	N/A - PM2.5	--	7.49E-06
Unpaved Segment 5	$S8_{3\text{-}CC}$	1386	CAT 430 Backhoe	Site Maintenance	2	0.50	6	Nitrogen oxides	10102-44-0	3.43E-02	1.71E-02
								Sulphur dioxide	7446-09-05	2.78E-05	1.39E-05
								Carbon monoxide	630-08-0	1.73E-02	8.63E-03
								Particulate matter	N/A - TSP	--	8.75E-04
								PM10	N/A - PM10	--	8.75E-04
								PM2.5	N/A - PM2.5	--	8.75E-04
			CAT 735 Water Wagon	Water Wagon	1	0.50	4	Nitrogen oxides	10102-44-0	4.21E-02	1.40E-02
								Sulphur dioxide	7446-09-05	5.79E-05	1.93E-05
								Carbon monoxide	630-08-0	1.42E-03	4.72E-04
								Particulate matter	N/A - TSP	--	5.17E-05
								PM10	N/A - PM10	--	5.17E-05
								PM2.5	N/A - PM2.5	--	5.17E-05
Working Face LCS construction Cell excavation	S4	--	Landfill tipper	Lift Waste Trailer to unload Waste	1	0.17	10	Nitrogen oxides	10102-44-0	4.53E-02	1.13E-01
								Sulphur dioxide	7446-09-05	2.75E-05	6.87E-05
								Carbon monoxide	630-08-0	6.94E-03	1.74E-02
								Particulate matter	N/A - TSP	--	5.60E-03
								PM10	N/A - PM10	--	5.60E-03
								PM2.5	N/A - PM2.5	--	5.60E-03
			CAT D8T Dozer	Push and Spread Waste	3	0.75	10	Nitrogen oxides	10102-44-0	7.99E-01	4.10E-01
				LCS unloading clear stone	1	1.00	10	Sulphur dioxide	7446-09-05	1.10E-03	5.63E-04
								Carbon monoxide	630-08-0	2.68E-02	1.38E-02
								Particulate matter	N/A - TSP	--	1.51E-03
								PM10	N/A - PM10	--	1.51E-03
								PM2.5	N/A - PM2.5	--	1.51E-03
			CAT 836K Landfill compactor	Compact Waste	1	1.00	10	Nitrogen oxides	10102-44-0	3.90E-01	1.63E-01
								Sulphur dioxide	7446-09-05	5.36E-04	2.23E-04
								Carbon monoxide	630-08-0	1.31E-02	5.46E-03
								Particulate matter	N/A - TSP	--	5.98E-04
								PM10	N/A - PM10	--	5.98E-04
								PM2.5	N/A - PM2.5	--	5.98E-04
			CAT 345 Hydraulic Excavator	Cell excavation	1	1.00	9	Nitrogen oxides	10102-44-0	2.18E-01	8.18E-02
								Sulphur dioxide	7446-09-05	3.00E-04	1.12E-04
								Carbon monoxide	630-08-0	7.33E-03	2.75E-03
								Particulate matter	N/A - TSP	--	3.01E-04
								PM10	N/A - PM10	--	3.01E-04
								PM2.5	N/A - PM2.5	--	3.01E-04
Concrete Crushing Storage pile 1 Wood grinding	S6	--	Cat 336 Hydraulic Excavator	Feed the crusher	1	1.00	6	Nitrogen oxides	10102-44-0	2.18E-01	5.45E-02
								Sulphur dioxide	7446-09-05	3.00E-04	7.49E-05
								Carbon monoxide	630-08-0	7.33E-03	1.83E-03
								Particulate matter	N/A - TSP	--	2.01E-04
								PM10	N/A - PM10	--	2.01E-04
								PM2.5	N/A - PM2.5	--	2.01E-04

Table 4-8
Non-Road Vehicles - Scenario 3

Source	Source ID	Segment Length (m)	Vehicle Type	Description	Number of Equipment	Percentage of Equipment Operating Per Hour	Hours of Operation per Equipment (hrs)	Contaminant	CAS No.	Total 1-hr Emission Rate(1)(2) (g/s)	Total 24-hr Emission Rate(1)(2) (g/s)
			CAT 345 Hydraulic Excavator	Soil excavation	1	0.75	5	Nitrogen oxides	10102-44-0	1.64E-01	4.54E-02
								Sulphur dioxide	7446-09-05	2.25E-04	6.24E-05
								Carbon monoxide	630-08-0	5.50E-03	1.53E-03
								Particulate matter	N/A - TSP	--	1.67E-04
								PM10	N/A - PM10	--	1.67E-04
								PM2.5	N/A - PM2.5	--	1.67E-04
			Cat D8T Dozer	Push the material	1	1.00	6	Nitrogen oxides	10102-44-0	2.46E-01	6.15E-02
								Sulphur dioxide	7446-09-05	3.38E-04	8.44E-05
								Carbon monoxide	630-08-0	8.26E-03	2.07E-03
								Particulate matter	N/A - TSP	--	2.26E-04
								PM10	N/A - PM10	--	2.26E-04
								PM2.5	N/A - PM2.5	--	2.26E-04
			Conveyor/Stacker	Create stockpiles	1	1.00	10	Nitrogen oxides	10102-44-0	7.50E-02	3.13E-02
								Sulphur dioxide	7446-09-05	9.55E-05	3.98E-05
								Carbon monoxide	630-08-0	5.91E-02	2.46E-02
								Particulate matter	N/A - TSP	--	2.08E-03
								PM10	N/A - PM10	--	2.08E-03
								PM2.5	N/A - PM2.5	--	2.08E-03
			Crushing	Crushing	1	1.00	10	Nitrogen oxides	10102-44-0	3.06E-01	1.27E-01
								Sulphur dioxide	7446-09-05	4.20E-04	1.75E-04
								Carbon monoxide	630-08-0	1.03E-01	4.29E-02
								Particulate matter	N/A - TSP	--	7.64E-03
								PM10	N/A - PM10	--	7.64E-03
								PM2.5	N/A - PM2.5	--	7.64E-03
			Wood Grinder	Wood Grinder	1	1.00	6	Nitrogen oxides	10102-44-0	4.03E-01	1.01E-01
								Sulphur dioxide	7446-09-05	5.53E-04	1.38E-04
								Carbon monoxide	630-08-0	1.36E-01	3.39E-02
								Particulate matter	N/A - TSP	--	6.04E-03
								PM10	N/A - PM10	--	6.04E-03
								PM2.5	N/A - PM2.5	--	6.04E-03
			John Deere 644K Front End Loader	Moving material	1	1.00	10	Nitrogen oxides	10102-44-0	1.61E-01	6.71E-02
								Sulphur dioxide	7446-09-05	2.21E-04	9.22E-05
								Carbon monoxide	630-08-0	4.83E-03	2.01E-03
								Particulate matter	N/A - TSP	--	2.47E-04
								PM10	N/A - PM10	--	2.47E-04
								PM2.5	N/A - PM2.5	--	2.47E-04

Notes

(1) Emission factors taken from the US EPA document "Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition NR-009d", July, 2010.
(2) Emissions from the site maintenance vehicle (CAT 430 Backhoe) have been distributed based on the segment lengths.

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Table 4-9a
Onroad Vehicles - Scenario 3

Source	Source ID	Vehicle Type	Segment Length (m)	Number of Trips per hour (Inbound and Outbound)	Hourly Vehicle Distance Travelled (VKT)	Daily Vehicle Distance Travelled (VKT)[1]	Contaminant	CAS No.	Emission Factor[2] (g/VKT)	Total 1-hr Emission Rate (g/s)	Total 24-hr Emission Rate (g/s)
Paved Road	S7	Refuse Truck	735	41	30	301	Nitrogen oxides	10102-44-0	8.61E-01	7.21E-03	3.00E-03
							Sulphur dioxide	7446-09-05	1.36E-02	1.14E-04	4.75E-05
							Carbon monoxide	630-08-0	2.41E-01	2.02E-03	8.42E-04
							Particulate matter[3]	N/A - TSP	6.84E-01	--	2.38E-03
							PM10	N/A - PM10	6.84E-01	--	2.38E-03
							PM2.5	N/A - PM2.5	1.03E-01	--	3.58E-04
		Light Vehicles	735	6	4	44	Nitrogen oxides	10102-44-0	8.12E-03	9.95E-06	4.14E-06
							Sulphur dioxide	7446-09-05	1.95E-03	2.39E-06	9.95E-07
							Carbon monoxide	630-08-0	4.92E-01	6.03E-04	2.51E-04
							Particulate matter[3]	N/A - TSP	7.59E-02	--	3.87E-05
							PM10	N/A - PM10	7.59E-02	--	3.87E-05
							PM2.5	N/A - PM2.5	1.09E-02	--	5.58E-06
Unpaved Segment 1	$S8_{1-2}$	Refuse Truck	770	41	32	316	Nitrogen oxides	10102-44-0	8.61E-01	7.56E-03	3.15E-03
							Sulphur dioxide	7446-09-05	1.36E-02	1.20E-04	4.98E-05
							Carbon monoxide	630-08-0	2.41E-01	2.12E-03	8.83E-04
							Particulate matter[3]	N/A - TSP	6.84E-01	--	2.50E-03
							PM10	N/A - PM10	6.84E-01	--	2.50E-03
							PM2.5	N/A - PM2.5	1.03E-01	--	3.75E-04
Unpaved Segment 2	$S8_{2-3}$	Refuse Truck	814	40	33	326	Nitrogen oxides	10102-44-0	8.61E-01	7.79E-03	3.25E-03
							Sulphur dioxide	7446-09-05	1.36E-02	1.23E-04	5.14E-05
							Carbon monoxide	630-08-0	2.41E-01	2.18E-03	9.10E-04
							Particulate matter[3]	N/A - TSP	6.84E-01	--	2.58E-03
							PM10	N/A - PM10	6.84E-01	--	2.58E-03
							PM2.5	N/A - PM2.5	1.03E-01	--	3.87E-04
Unpaved Segment 3	$S8_{2-RF}$	Refuse Truck	1050	2	2	21	Nitrogen oxides	10102-44-0	8.61E-01	5.02E-04	2.09E-04
							Sulphur dioxide	7446-09-05	1.36E-02	7.95E-06	3.31E-06
							Carbon monoxide	630-08-0	2.41E-01	1.41E-04	5.87E-05
							Particulate matter[3]	N/A - TSP	6.84E-01	--	1.66E-04
							PM10	N/A - PM10	6.84E-01	--	1.66E-04
							PM2.5	N/A - PM2.5	1.03E-01	--	2.49E-05
Unpaved Segment 4	$S8_{3-WF}$	Refuse Truck	201	44	9	88	Nitrogen oxides	10102-44-0	8.61E-01	2.11E-03	8.81E-04
							Sulphur dioxide	7446-09-05	1.36E-02	3.35E-05	1.39E-05
							Carbon monoxide	630-08-0	2.41E-01	5.93E-04	2.47E-04
							Particulate matter[3]	N/A - TSP	6.84E-01	--	6.99E-04
							PM10	N/A - PM10	6.84E-01	--	6.99E-04
							PM2.5	N/A - PM2.5	1.03E-01	--	1.05E-04
Unpaved Segment 5	$S8_{3-CC}$	Refuse Truck	1386	2	2.8	28	Nitrogen oxides	10102-44-0	8.61E-01	6.63E-04	2.76E-04
							Sulphur dioxide	7446-09-05	1.36E-02	1.05E-05	4.37E-06
							Carbon monoxide	630-08-0	2.41E-01	1.86E-04	7.75E-05
							Particulate matter[3]	N/A - TSP	6.84E-01	--	2.19E-04
							PM10	N/A - PM10	6.84E-01	--	2.19E-04
							PM2.5	N/A - PM2.5	1.03E-01	--	3.29E-05

Notes

(1) Based on the site operating 10 hrs/day.
(2) Emission factors generated from US EPA MOVES.
(3) It was estimated that all total particulate matter emitted from this source was in the PM10 size fraction or smaller.

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Table 4-9b
Onroad Vehicles - Scenario 3

	MOVES Emission Factors	
	Refuse Trucks	Light Trucks
Compound	(g/VMT)	(g/VMT)
Nox	1.39E+00	1.31E-02
SO2	2.19E-02	3.14E-03
CO	3.89E-01	7.92E-01
PM10 total	3.30E-02	2.56E-03
PM10 Brakewear	1.01E+00	1.05E-01
PM10 Tirewear	5.46E-02	1.50E-02
PM2.5 total	3.03E-02	2.26E-03
PM 2.5 brakewear	1.27E-01	1.31E-02
PM2.5 tirewear	8.19E-03	2.25E-03
Carbon dioxide	2.63E+03	4.72E+02
Methane	8.14E-02	7.21E-04
Nitrous oxide	8.28E-03	4.59E-03

Table 4-10
Material Transfer - Scenario 3

Source	Source ID	Hourly Tranfer (tonnes/hour)	Contaminant	CAS No.	Emission Factor (kg_{PM}/tonne)(2)(3)(4)	Total Emission Rate (24-hr average)(5) (g/s)
Active Working Face	S4	610	TSP	N/A - TSP	1.39E-04	9.81E-03
			PM10	N/A - PM10	6.58E-05	4.64E-03
			PM2.5	N/A - PM2.5	9.96E-06	7.03E-04
Storage Pile 1	S6	72	TSP	N/A - TSP	1.39E-04	1.16E-03
			PM10	N/A - PM10	6.58E-05	5.50E-04
			PM2.5	N/A - PM2.5	9.96E-06	8.33E-05
Storage Pile 2	S4	7	TSP	N/A - TSP	1.39E-04	1.17E-04
			PM10	N/A - PM10	6.58E-05	5.51E-05
			PM2.5	N/A - PM2.5	9.96E-06	8.35E-06

Notes:

(1) Material handled taken from Ride Landfill's 2017 NPRI Report. It was estimated that the sand, clay, cover, and misc. fill was split between the active working face and aggregate storage pile.
(2) Emission factors obtained from US EPA AP-42 Chapter 13.2.4 "Aggregate Handling and Storage Piles" equation 13.2.4. (1).
(3) Material parameters:

Mean wind speed (U)	3.4	m/s (taken from the MECP pre-processed 2018 hourly weather data from the ECCC's RidgeTown Station)
Moisture content (M)	14	% (taken from Table 13.2.4-1 for clay/dirt mix at municipal solid waste landfills)

(4) Particle size multipliers (k):

< 30 um	0.74
< 10 um	0.35
< 2.5 um	0.053

(5) Based on the site operations of 264 days/year, 10 hours/day.

Table 4-11
Material Crushing - Scenario 3

Source	Source ID	Source Description	Hourly Material Tranfer[(1)] (tonnes/hour)	Contaminant	CAS No.	Emission Factor (kg_{PM}/tonne)[(2)(3)]	Total Emission Rate (24-hr average)[(4)] (g/s)
Concrete Crushing and Wood Grinding	S6	Crushing	500	TSP PM10 PM2.5	N/A - TSP N/A - PM10 N/A - PM2.5	2.70E-03 1.20E-03 5.00E-05 (5)	1.56E-01 6.94E-02 2.89E-03
Concrete Crushing and Wood Grinding	S6	Conveyor/Stacker	500	TSP PM10 PM2.5	N/A - TSP N/A - PM10 N/A - PM2.5	1.50E-03 5.50E-04 6.50E-06 (5)	8.68E-02 3.18E-02 3.76E-04

Notes:

(1) Taken from general equipment specifications production capacity.
(2) Emissions from the crusher are based on the US EPA AP-42 Chapter 11.19.2-1 Crushed Stone Processing and Pulverized Mineral Processing emission factor for uncontrolled tertiary crushing.
(3) Emissions from the conveyor/stacker are based on the US EPA AP-42 Chapter 11.19.2-1 Crushed Stone Processing and Pulverized Mineral Processing emission factor for uncontrolled conveyor transfer point emissions.
(4) Based on the site operations of 264 days/year, 10 hours/day.
(5) Due to lack of data for PM2.5 emission factors for uncontrolled emissions, the controlled emission factor was used for completeness.

Appendix D3A-5

Air Dispersion Modelling Files (Electronic)

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Modeling files can be provided upon request. They have been included with our digital submission.