DILLON CONSULTING

CITY OF SAULT STE. MARIE

Sault Ste. Marie Municipal Landfill Design and Operations Report

March 2017 – 06-6988

Note to Reader:

The attached Report (the "Report") has been prepared by Dillon Consulting Limited. This report was prepared specifically for the City of Sault Ste. Marie Solid Waste Environmental Assessment.

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1.0 Introduction

1.1 Purpose and Scope

The purpose of this report is to support the Environmental Assessment for expansion of the Sault Ste. Marie Municipal Landfill (herein referred as Landfill) and future environmental approvals. The existing Landfill is located at 402 Fifth Line East in Sault Ste. Marie, Ontario and is owned and operated by the City of Sault Ste. Marie under Environmental Compliance Approval (ECA) No. A560102.

It is proposed to expand the existing waste footprint laterally (west and north) and vertically. There will be no changes to the approved service area, i.e. it will remain as the City of Sault Ste. Marie, the Township of Prince and the Batchewana First Nation's Rankin Reserve. The proposed expansion will add 4.2 million cubic metres (m^3) of waste and daily/intermediate cover capacity. The location of the Landfill is shown on *Figure 1* and *Drawing 1*.

This Design and Operations (D&O) Report provides a detailed description of the Landfill design and operations for the proposed expansion. The D&O Report addresses a number of relevant matters such as:

- Regulatory and approval requirements;
- Design approach, including volumes, site boundaries and limit of fill;
- Base and final contours;
- Surface water management;
- Leachate management;
- Landfill gas management;
- Site development plan and operations;
- Environmental control measures;
- On-going monitoring and maintenance needs; and
- Contingency plans.

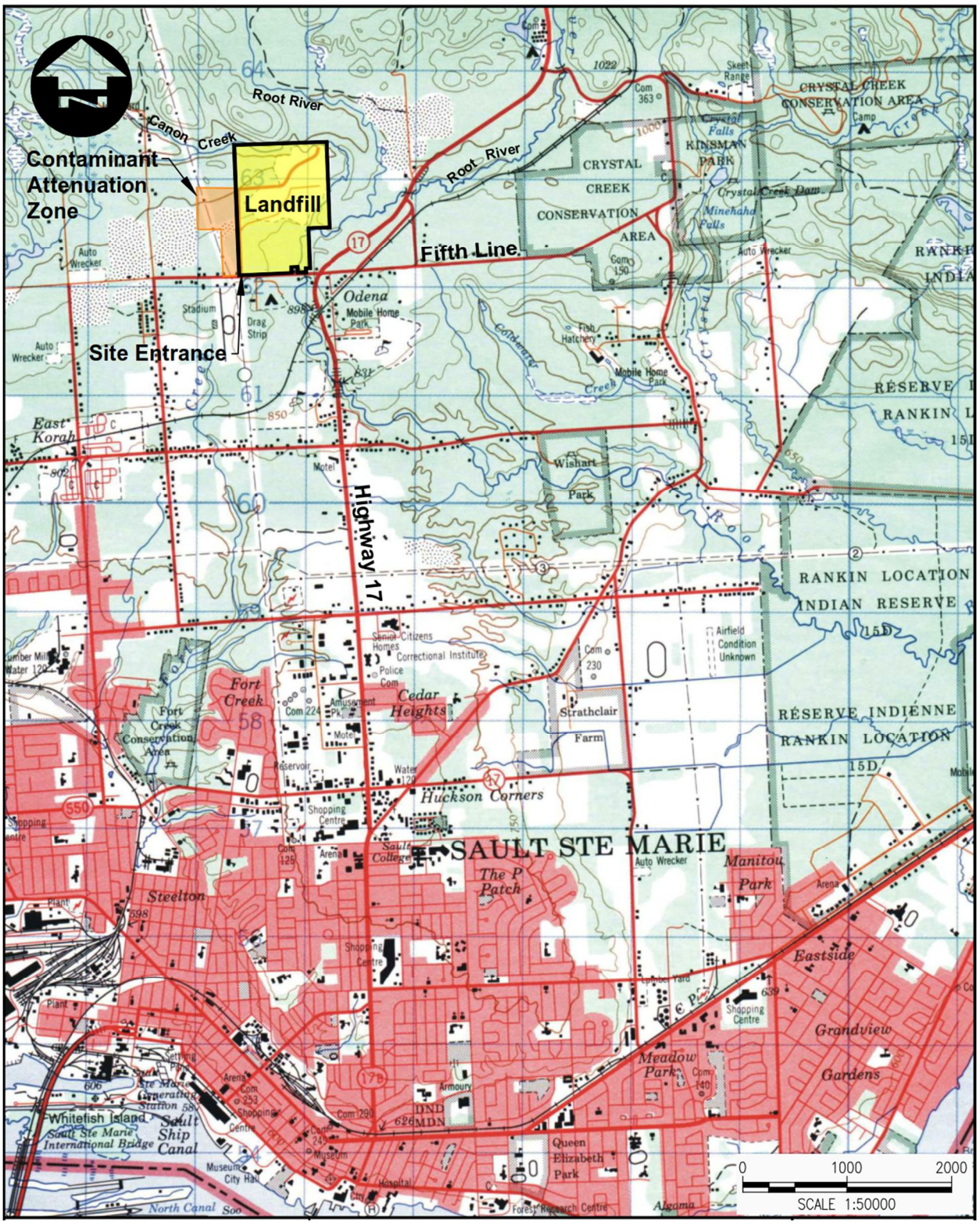

Figure 1-1: Site Location

1.2 Regulatory Requirements

The Landfill is currently operated under ECA No. A560102. The City is seeking to expand the capacity of the Landfill. The key Landfill expansion approvals are summarized below.

1.2.1 Environmental Assessment Act (EAA)

The EAA provides for the protection, conservation and wise management of the environment through sound planning and informed decision making in the selection and establishment of major undertakings, including landfills. The planning requirements are extensive and include evaluation of alternatives and the preparation of a number of technical studies in support of the EAA application. The Environmental Assessment Report and the following technical appendices address the requirements of the EAA:

- Biology (terrestrial and aquatic)
- Geotechnical
- Hydrogeology
- Air Quality and Odour
- Noise
- Surface Water
- Visual
- Traffic
- Archaeology
- Planned Land Use
- Design and Operations
- Socio-Economic

The conclusions and recommendations of the above reports have been considered in the preparation of this Design and Operations Report.

1.2.2 Environmental Protection Act (EPA)

Landfill sites and other waste management activities are subject to Part V of the *Environmental Protection Act* (EPA). Section 27 of the EPA requires that an ECA be obtained from the Director of Ministry of the Environment and Climate Change (MOECC) for the establishment, operation, alteration or enlargement of a landfill site.

Although the legislative framework for waste management is provided in Part V of the EPA, regulatory requirements for the design and operation of a landfill site are detailed in the following:

Ontario Regulation 347, which defines waste management terms and classes of waste and which provides standards for the location, maintenance and operation of existing landfilling sites; and Ontario Regulation 232/98, under Part V of the EPA, which defines regulatory requirements for design and operation of new or expanding landfilling sites greater than 40,000 m^3 in volume.

As the expansion of the Sault Ste. Marie Municipal Landfill is for additional landfill capacity of about 4.2 million cubic metres, the design and operations of the Site fall under Ontario Regulation 232/98.

1.2.3 Ontario Regulation 232/98 – Landfill Standards

Ontario Regulation 232/98 contains detailed requirements for the design, operation, closure and post-closure care of municipal waste landfills. The document entitled *"Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfilling Sites"* (MOECC, January 2012) provides guidance to application of the Regulation 232/98. *Table 1-1* summarizes the design requirements under Ontario Regulation 232/98.

1.2.4 Ontario Water Resources Act (OWRA)

The purpose of the OWRA is for the protection and conservation of the surface water and groundwater resources in the Province of Ontario. Any system that discharges to a surface water body requires approval under the OWRA. The Landfill will require approval for the storm water management facilities under Section 53 – Sewage Works.

1.2.5 Planning Act

The *Planning Act* describes the ground rules for land use planning in Ontario and establishes how land uses may be controlled.

The on-site study area is designated Rural Area in the City's Official Plan (which includes approved landfill sites), and zoned Rural Area (RA) and Rural Aggregate Extraction (REX) in the City's Zoning By-Law.

Special Exception 23 – Sanitary Landfill Site of the City's Zoning By-Law allows sanitary landfill use, where "sanitary landfill site" shall mean a place where waste is deposited under controlled conditions including proper compaction and regular covering with an approved cover material. It also may include ancillary operations associated with the landfill site such as, but not limited to, leachate collection, site access, storage and maintenance of heavy equipment, weigh scales and monitoring wells.

The current zoning by-law was approved in 1995 and since that time, the City has acquired additional properties adjoining the landfill site which has resulted in an expansion of the overall landfill site boundaries. As a result of the more recent acquisitions and the proposed landfill expansion, Special Exception 23 boundaries are currently being approved at municipal level (*refer to Drawing 1*). A Zoning By-Law amendment will be required to incorporate the full extent of the site under Special Exception 23.

1.3 Description of the Undertaking

The Landfill currently has an approved waste footprint of 44.6 hectares and disposal capacity of 2,260,000 m^3 for waste and daily/intermediate cover. This undertaking proposes to expand the site capacity by 4,200,000 m^3 for a total capacity (existing and proposed) of 6,460,000 m^3. The proposed expansion would allow for the disposal of an estimated 2,352,000 tonnes of solid residential, industrial, commercial and institutional (IC&I), construction and demolition (C&D) wastes and biosolids, assuming

an apparent density of 0.56 t/m^3. The actual tonnage of waste disposed of will depend on the type and density of waste received, the density of waste in place, and the quantity of cover material employed.

It is anticipated that the Site will accept up to 73,200 tonnes per year of waste for disposal.

The existing site has a well-established network of monitoring wells with a significant level of historical monitoring data. The existing monitoring data indicates the site is generally in compliance with reasonable use criteria.

The preferred expansion option consists of lateral expansion (expand the approved limits of the waste footprint to the north and west), vertical expansion (increase the height of the approved contours) and landfill mining (excavate existing disposed waste and cover material, recover recyclables, earthen material or "fines" and return the waste to the disposal area).

Table 1-2 summarizes the key details of the proposed undertaking.

Table 1.1: Summary of Ontario Regulation 232/98 Design Report Requirements

INFORMATION REQUIREMENTS OF DESIGN REPORT	REPORT REFERENCES	SUPPORTING TECHNICAL ASSESSMENT
Legal survey of site	· Drawing 1 – Existing Site Conditions · Section 2.1 Site Location and Property Limits	· Property limits shown on Drawing 1
Plan and description of site and surrounding area within 500 m	· Drawing 1 – Existing Site Conditions · Section 7.6 Land Use Review	· *Land Use Impact Assessment Report, AECOM* · *Socio-Economic Impact Assessment, AECOM*
Plans of waste fill area, base contours, final contours	· Drawing 1 – Existing Site Conditions · Drawing 2 – Proposed Site Plan and Final Contours · Drawing 3 – Base Contours And Leachate Collection System · Section 5.2 Limits of Landfilling · Section 5.3 Base Contours · Section 5.4 Final Contours	· *Hydrogeological Impact Assessment*, Dillon
Total waste disposal volume	· Section 5.6 Landfill Capacity Calculations	
Soil balance	· Section 5.7 Soil Balance	
Hydrogeological assessment of the suitability of the site for landfilling that considers geologic and hydrogeological conditions of the site; design of the site; monitoring and contingency plans.	· Section 2.4 Hydrology · Section 2.5 Hydrogeology · Section 7.3 Groundwater Assessment	· *Hydrogeological Impact Assessment*, Dillon
Geotechnical assessment of the suitability of the site for landfilling that considers bearing capacity, differential settlement and slope stability that addresses potential effects on any liner or leachate collection system Description of the expected quality and quantity of leachate	· Section 5.5 Geotechnical Considerations · Section 4.7 Base Contours · Section 4.8 Final Contours · Section 10.4 Leachate Collection System · Section 10 Leachate Management	· *Landfill Expansion - Geotechnical Report*, AECOM
Detailed plans, specifications and descriptions of the liner system	· Drawing 5 – Landfill Cross Sections · Drawing 6 – Sections and Details · Section 4.7 Base Contours	· *Hydrogeological Impact Assessment*, Dillon

INFORMATION REQUIREMENTS OF DESIGN REPORT	REPORT REFERENCES	SUPPORTING TECHNICAL ASSESSMENT
	· Section 4.8 Final Contours · Section 10.4 Leachate Collection System	
Detailed plans, specifications and descriptions of the leachate collection, treatment and disposal system	· Drawing 3 – Base Contours And Leachate Collection System · Drawing 5 – Landfill Cross Sections · Drawing 6 – Sections and Details · Section 10 Leachate Management	
Assessment of potential for subsurface migration of landfill gas at the site and of any control system necessary for monitoring or controlling the migration	· Drawing 9 – Groundwater Monitoring Plan · Section 11.4 Assessment of Need for Control of Subsurface Migration of Landfill Gas · Section 14.2.3 Landfill Gas Monitoring	
Detailed plans, specifications and descriptions of any system necessary for controlling landfill gas by venting it or by collecting and burning or using it	· Drawing 7 – Landfill Gas Collection System · Drawing 8 – Landfill Gas Collection System Details · Section 11.3 Assessment of Need for Collection of Landfill Gas · Section 14.2.3 Landfill Gas Monitoring	
Assessment of potential impacts on surface water features that may be caused by the site or operations at the site.	· Section 7.2 Surface Water Assessment	· *Surface Water Impact Assessment and Mitigation, AECOM*

INFORMATION REQUIREMENTS OF DESIGN REPORT	REPORT REFERENCES	SUPPORTING TECHNICAL ASSESSMENT
Detailed plans, specifications and descriptions of the system for collecting, directing and discharging surface water, including details of any sediment control	· Drawing 2 – Proposed Site Plan and Final Contours · Drawing 5 – Landfill Cross Sections · Section 9.0 Surface Water Management · Section 14.2.2 Surface Water Monitoring	· Surface *Water Impact Assessment and Mitigation, AECOM*
Detailed plans, specifications and descriptions of monitoring facilities for leachate, groundwater, surface water and, where appropriate, landfill gas	· Drawing 9 – Groundwater Monitoring Plan · Drawing 10 – Surface Water Monitoring Plan · Section 14 Monitoring and Reporting · Section 15.1 Landfill Gas Monitoring	· Hydrogeological Impact Assessment, Dillon · Surface Water Impact Assessment and Mitigation, AECOM
Assessment of potential noise impacts due to operations at the site and to local trucking related to operations at the site, including an evaluation of any proposed noise control measures	· Section 7.8 Noise Assessment · Section 13.6 Noise Control ·	· Noise Impact Assessment, Dillon
Assessment of potential visual impacts on nearby properties due to the site and site operations	· Section 2.3 Topography · Section 7.7 Visual Impact Assessment ·	· Visual Impact Assessment, AECOM
Detailed plans, specifications and descriptions of the buffer area and ancillary facilities, including screening, landscaping, fencing, weigh scales, buildings, structures, roads, holding areas for cover or rejected waste or materials for recycling, etc.	· Drawings 2 – Proposed Site Plan and Final Contours · Section 5.2 Limits of Landfilling · Section 7.3 Land Use Review · Section 5 Landfill Expansion Design · Section 8 Site Features · Section 10.0 Landfill Operations	
Detailed plans and descriptions of the contaminant attenuation zone	· Drawing 1 · Section 2.2 Site History · Section 7.3 Groundwater Assessment · Section 10.1 Existing Leachate Management System	· Hydrogeological *Impact Assessment*, Dillon
Estimate of the contaminating life span of the site with respect to contaminants involved in the subsurface migration of landfill gas and an	· Section 11 Landfill Gas Management ·	

INFORMATION REQUIREMENTS OF DESIGN REPORT	REPORT REFERENCES	SUPPORTING TECHNICAL ASSESSMENT
estimate of the service life of any engineered facilities associated with subsurface migration of landfill gas		
Estimate of the contaminating life span of the site with respect to contaminants in leachate	· Section 7.3 Groundwater Assessment · Section 10.3 Leachate Generation	· *Hydrogeological Impact Assessment,* Dillon
Estimate of the service life of every engineered facility associated with leachate	· Section 7.3 Groundwater Assessment	· *Hydrogeological Impact Assessment,* Dillon
Details of any facilities intended to control or change the contaminating life span of the landfilling site	· Section 10.4 Leachate Collection System	· *Hydrogeological Impact Assessment,* Dillon
Contingency plans to be implemented to control leachate produced in a quantity greater than expected or quality worse than expected	· Section 16.0 Contingency Plans	· *Hydrogeological Impact Assessment,* Dillon
Contingency plans to be implemented to control landfill gas migrating in a quantity greater than expected or quality worse than expected	· Section 16.0 Contingency Plans	
Description of the source, nature and quality of daily cover, including, with respect to material not normally used for daily cover, a discussion of its benefits and limitations, a description of quality assurance and quality control procedures for daily cover and a description of application rates and application procedures for daily cover, including the frequency and timing of application of daily cover if other than at the end of each working day Description of the nature, quality and quantity of final cover	· Section 5.1 Landfill Design Criteria · Section 5.7 Soil Balance · Section 12.6 Daily Operations · · Section 5.1 Landfill Design Criteria · Section 5.7 Soil Balance · Section 12.7 Final Cover ·	
Site closure plan, including details of the proposed end use of the site, the appearance of the site after closure, revegetation, landscaping,	· Drawing 2 – Proposed Site Plan and Final Contours · Drawing 5 – Landfill Cross Sections	· Visual Impact Assessment, AECOM

INFORMATION REQUIREMENTS OF DESIGN REPORT	REPORT REFERENCES	SUPPORTING TECHNICAL ASSESSMENT
the construction of new facilities and the removal of existing facilities to facilitate closure, post-closure care and site end use	· Section 15 Site Closure	
Summary of the main characteristics of the landfilling site, including the maximum daily quantity of waste that will be accepted for disposal, the estimated annual average quantity of waste that will be accepted for disposal, the area of the landfilling site, the area of the waste fill area, the total waste disposal volume, the estimated waste disposal capacity in tonnes, any subcategories of municipal waste that are not expected to be received or that will not be accepted for disposal, and the estimated date of site closure	· Drawing 2 – Proposed Site Plan and Final Contours · Section 1.3 Description of the Undertaking · Table 1-2 Summary of the Proposed Undertaking · Section 3 Waste Quantities and Characteristics · Section 5 Landfill Expansion Design · Section 8 Site Features	

Table 1.2: Summary of the Proposed Undertaking

PARAMETER	DESCRIPTION
Municipal Address	402 Fifth Line East, Sault Ste. Marie, Ontario
Service Area	City of Sault Ste. Marie, Prince Township and Rankin Reserve
Waste Type	Solid residential, industrial, commercial and institutional (IC&I), construction and demolition (C&D) wastes and biosolids
Maximum Rate of Fill	78,500 tonnes/year
Total Site Area	Original approval: 83.6 ha Current: 145.4 ha
Fill Area	Existing Fill Area as per 1990 D & O Report Drawings: 25.8 ha Proposed Expansion Fill Area Addition: 17.8 ha Existing Fill Area plus Proposed Expansion Fill Area Addition: 43.6 ha Proposed Mining Area (included in the Existing Fill Area): 3.4 ha
Total Waste Disposal Volume (Waste and Daily/Intermediate Cover)	Currently Approved as per 1990 D & O Report: 2,260,000 m^3 excluding the original Cherokee Landfill capacity Proposed Expansion: 4,200,000 m^3 Currently Approved plus Expansion: 6,460,000 m^3
Apparent Waste Density*	0.56 t/m^3 (based on experience with the existing site)
Estimated Disposal Capacity**	2,352,000 t for the proposed expansion 3,617,600 t for the existing and proposed expansion combined
Maximum Top of Final Cover	309 m above sea level (m ALS) – existing approval 314.3 m ALS - proposed
Minimum Bottom of Excavation	274 m ASL - proposed
Groundwater Protection	1. Existing landfill Horizontal leachate collection system located south and east of the existing landfill and nine purge wells west of the existing waste footprint. The horizontal collection and purge wells intercept groundwater flow between the landfill and the south and west property boundary, respectively. The leachate management system is connected by forcemain to the City's sanitary sewer system 2. Proposed expansion: underdrain liner and leachate collection system. Key design elements: · Geosynthetic clay liner · 1.5 mm thick HDPE geomembrane

PARAMETER	DESCRIPTION
	· Stone drainage blanket · Sand protective layer
Surface Water Protection	Ditches draining to storm water management ponds
Site Facilities	Access roads, scales, scale house, admin./maintenance building, recycling centre, public waste drop-off area, leaf and yard waste composting area, pumping stations, landfill gas collection and flare
Closure Plan	Capped and vegetated
End Use	To be determined

*Apparent waste density is defined as the weight (tonnes) of waste divided by the volume of waste and daily/intermediate cover.

** Tonnes of waste only (i.e. cover material not included).

2.0 Site Description

2.1 Site Location and Property Limits

The existing landfill is located at 402 Fifth Line East in the City of Sault Ste. Marie. The Site is less than a kilometre from the Trans-Canada Highway (Highway 17). The location of the Site is shown on *Figure 1* and the Site property limits are shown on *Drawing 1*.

2.2 Site History

The existing Landfill was originally owned, developed and operated by Cherokee Disposals and Construction Ltd. in the 1960s. An Environmental Assessment (EA) was undertaken by the City of Sault Ste. Marie (City) in 1983 and 1984 to evaluate alternative means of providing long-term waste disposal capacity for the City, the Township of Prince and the Rankin First Nation Reserve. The recommended undertaking was the acquisition and expansion of the Cherokee Landfill Site. The environmental assessment was approved without hearing and Environmental Compliance Approval (ECA) No. A560102 was issued March 2, 1989 "for the use and operation of 44.6 hectare waste disposal site (landfilling) within a total site area of 83.6 hectares". The City purchased the Landfill in 1989 and has been operating the site since March 1989.

The site currently has the following existing features:

- Access roads.
- Inbound and outbound weigh scales and scale house.
- Administration building.
- Maintenance garage.
- Public drop off areas for wood waste, tires, shingles, construction and demolition waste, batteries, propane tanks, and recyclables.
- Hazard Household Waste (HHW) depot.
- Leaf and yard waste composting area.
- Surplus materials stockpiles.
- Leachate control system (south gravity leachate collector supplemented by nine purge wells adjacent to the west boundary).
- Forcemains and leachate pump station.
- A 23.2 ha contaminant attenuation zone west of the existing waste limit, approved in July 2009 by an ECA amendment.
- Storm water management pond.
- Active landfill gas collection and flaring system.
- Monitoring wells.
- Utilities.

2.3 Topography

The existing conditions at the Site are shown on *Drawing 1* and are based on aerial photography conducted in September 29, 2012. The topography generally slopes to the southeast. The ground elevation ranges from approximately 310 m ASL on the northwestern portion of the Site to approximately 268 m ASL on the southeastern portion of the Site.

2.4 Hydrology

The landfill site lies within the watershed of the Root River which drains south to the St. Marys River. The Canon Creek drains south and is a major tributary of the Root River. The Canon Creek joins the Root River approximately 400 m north of the southern property boundary of the existing landfill site. Downstream of the confluence of Canon Creek and Root River south of the existing disposal area, is an old meander area that is frequently inundated with water during high flow periods (refer to *Drawing 10*).

2.5 Hydrogeology

Three hydrostratigraphic units have been identified beneath the Site. These include a shallow sand and gravel unit, a less permeable intermediate sand and silty sand unit, and a deeper till unit.
The groundwater table was reported to be within 267 to 274 m ASL range in the proposed west expansion area, with groundwater flow direction from northeast to southwest (2015 Monitoring Report prepared by Dillon in April 2016).

There is a groundwater divide located along the western portion of the existing fill area. Groundwater flows both southeast and southwest from this divide. The lateral direction of shallow groundwater flow, beneath the central and eastern portion of the landfill fill area, is south-southeastward with discharge to Canon Creek and the meander area. Intermediate flow, at approximately 10 m in depth in the area of the meander loop, continues southward with ultimate discharge estimated to be into the Root River south of the property boundary.

The till units of the meander area, and east of Canon Creek and the Root River have lower permeability than the sand. This causes preferential lateral flow in the overlying sands and gravels.

3.0 Waste Quantities and Characteristics

3.1 Service Area

The service area will remain unchanged, i.e. the City of Sault Ste. Marie, the Township of Prince and the Batchewana First Nation's Rankin Reserve.

3.2 Waste Characteristics

The Landfill is approved to accept solid non-hazardous residential, industrial, commercial and institutional (IC&I), and construction and demolition (C&D) waste, and biosolids. This includes waste generated by the City's operations. No changes to the types of waste are proposed.

3.3 Waste Quantities

It is forecasted that waste will be landfilled at a rate of approximately 62,500 tonnes to 73,200 tonnes per year.

4.0 Overview of Proposed Landfill Expansion and Waste Mining

4.1 Landfill Expansion Overview

It is proposed to expand the existing landfill by an additional disposal capacity of 4.2 million m³ of waste and daily/intermediate cover (including disposal capacity associated with mining as described below). The proposed expansion will comprise of north and west horizontal expansions and a moderate vertical expansion.

The existing site has an existing fill area of 25.8 hectares as per 1990 D & O Report Drawings. The horizontal expansion will add a waste footprint of 17.8 hectares, for a total footprint of 43.6 hectares.

The proposed modest vertical expansion will increase the landfill height by approximately 4 metres (from elevation 310 mALS to 314.3 mALS).

As part of the landfill expansion, landfill mining is also proposed as described below.

4.2 Landfill Mining Overview

Landfill mining (or landfill reclamation) has been used in Ontario to mitigate impacts to groundwater and/or create additional landfill capacity.

Landfill mining is proposed as part of the landfill expansion. The main driver behind mining for the proposed expansion is to improve groundwater conditions in the western portions of the existing waste footprint. Other benefits of the waste mining are the increase of available airspace through increased compaction of screened waste, recovery of recyclables and re-use of the finer material as daily cover.

Once the proposed landfill mining is completed down to original base grades, a new cell will be constructed including liner and leachate collection system following the same design as the proposed west and north expansion.

An area of approximately 3.4 hectares is proposed to be mined within Cell 1A (refer to *Drawing 4*), which will generate a disposal capacity for waste and daily/intermediate cover of 160,000 m^3. This assumes that 320,000 m^3 of waste and cover materials will be excavated, with 50% either recovered or compacted at a greater rate and the residual 50% will be re-landfilled as per operational practices described in this report.

For a detailed description of the proposed landfill mining operations, including process description, design considerations, health and safety, mitigation of anticipated potential impacts, inspections and monitoring, refer to Section 6 of this report.

5.0 Landfill Expansion Design

5.1 Landfill Design Criteria

Ontario Regulation 347, made under Part V of the *Environmental Protection Act*, defines landfilling as:

"The disposal of waste by deposit, under controlled conditions, on land or on land covered by water, and includes compaction of the waste into a cell and covering the waste with cover materials at regular intervals."

The *Landfill Standards: A Guideline on the Regulatory and Approval Requirements for New or Expanding Landfill Sites (MOECC, 2012)* gives directions on the appropriate methods and approaches for landfill design, operation, closure and post-closure maintenance. The *Guide to Applying for an Environmental Compliance Approval* (*MOECC, 2012*) is also relevant to this application.

The conceptual design of the landfill expansion has been prepared in accordance with the MOECC regulations, policies and guidelines. The following parameters were used in the expansion design:

- A volumetric capacity for waste and daily/intermediate cover of 4,200,000 m^3 to manage 2,352,000 tonnes of waste assuming an apparent density of 0.56 t/m^3, including capacity generated by mining operations.
- Maximum 4 horizontal to 1 vertical (4:1) above-ground side slopes up to 10 m high.
- Maximum 6:1 above-ground side slopes above 10 m high.
- Minimum 20:1 for top slopes.
- Maximum 3:1 excavation side slopes.
- Apparent density of 560 kg/m^3.
- Waste to daily cover ratio of 4:1.
- Final cover depth of 1 m.
- Minimum 30 m setback distance from the property boundary.
- Minimum base of excavation grade of 0.5%;
- A composite liner consisting of a geosynthetic clay liner overlaid by a 1.5 mm thick HDPE geomembrane for new landfill cells, including the mined cell.
- A full underdrain leachate collection system consisting of clear stone with thickness varying between 0.3 and 0.8 m and sand protective layer with 0.2 m thickness.
- Transmission of leachate to the sanitary sewer system at Fifth Line/Old Goulais Bay Road.
- Active landfill gas management system.

Other criteria, specific to various features, were established in the conceptual design process and are discussed in the report sections below that follow.

5.2 Limits of Landfilling

The waste limit is the outermost boundary of waste landfilling and was generally established based on site topography, groundwater and surface water divides and buffers and setbacks from property limits. The waste fill area is proposed to increase from 25.8 hectares to 43.6 hectares for a net increase of 17.8 hectares. The proposed mining area of 3.4 hectares is included in the existing 25.8 hectares of waste fill. The landfill limits for the existing landfill and the landfill expansion are shown on *Drawing 2*.

The proposed waste fill area will maintain the current setback along the east boundaries, slightly reduce the existing setback along the south boundary and establish a 30 m buffer along the west boundary against the hydro corridor and a 100 m setback along Canon Creek, located north of the Site.

5.3 Base Contours and Liner

The base of the proposed landfill expansion area was designed with a minimum 3 m vertical separation from historical groundwater elevation. Borehole logs and available monitoring data were used to establish the highest recorded water table elevation at applicable monitoring wells. The type of soil recorded in borehole logs was also reviewed. The proposed base grades of the west expansion were influenced by existing site topography. The base grades of the north expansion were influenced by landfill geometry, considering constructability, leachate drainage and operations.

Drawing 3 shows the proposed base contours that were developed based on the criteria noted above. The base of the proposed west expansion area generally slopes towards the southeast corner. The base of the proposed north expansion has a high point that divides the base slopes to the east and west. Two sumps will collect leachate from the north and west expansion areas as part of the leachate management system. The west expansion will have 2.9% longitudinal base slopes (from north to south). The north expansion will have 2.8% and 3% at east and west valleys, respectively. The excavation depth below existing ground for the proposed expansion will range from approximately 5 to 13 m.

The existing landfill has an approved fill area of 25.8 hectares as per 1990 D & O Report Drawings. The proposed expansion has 17.8 ha of additional waste fill area.

The proposed overall fill area will be 43.6 ha (25.8 ha existing plus 17.8 proposed fill area).

The proposing mining operations has an area of 3.4 hectares, which is included in the existing fill area of 25.8 hectares. Mining is described in more detail in Section 6.

The proposed composite liner and leachate collection system for the expansion and mining areas will consist of, from bottom to top:

- Cushion geotextile.

- Geosynthetic clay liner.
- 1.5 mm thick high density polyethylene (HDPE) geomembrane.
- Cushion geotextile.
- 0.3 to 0.8 m thick stone drainage layer.
- Separator geotextile.
- 0.2 m thick sand protective layer.
-

An approximately 1 m high berm will be constructed at the toe of the existing fill areas that are being expanded or mined to separate the lined area from the unlined area. The berm will anchor the liner and geotextiles, provide leachate containment, assist in directing surface water from the unlined areas away from the lined areas and control sediments from entering the lined area. Refer to *Drawing 5* for more details.

5.4 Final Contours

The final contours were designed in accordance to Regulation 232/98 which requires maximum 4:1 and minimum 20:1(5%) side slopes. Side slopes higher than 10 m were designed with 6:1 slopes as recommended by the geotechnical report.

The maximum elevation of the entire waste fill is 314.3 m ASL, including 1 m thick final cover, which is a 4.3 m vertical increase compared to the approved final contours at 310 m ASL maximum elevation for the existing site. The approved and proposed final contours including final cover are shown on *Drawing 3*.

5.5 Geotechnical Considerations

The *2013 Landfill Expansion – Geotechnical Report*, prepared by AECOM for the proposed landfill expansion, presents the results of the geotechnical investigations and provides design recommendations which were considered in preparation of this Design and Operations Report.
Groundwater depths were measured in the field and assumed at elevations 280 m ASL for the north expansion and northern portion of the west expansion and 265 to 272 m ASL at the southern portion of the west expansion.

The geotechnical report recommends the following:

- Sand berms and roadway embankments up to 5 m high can be constructed with maximum 3:1 slopes. Sand berms and roadway embankments higher than 5 m should be constructed with 4:1 slopes.
- Excavation side slopes shall not be steeper than 3H:1V.
- Landfill slopes less than 10 m high can be constructed at side slopes of 4H:1V. Flatter slopes 5H:1V shall be used for fill height between 10 and 15m. For fill heights greater than 15 m side

slope at 6H:1V or flatter is recommended. The AECOM geotechnical engineer confirmed on March 11, 2016 that the side slopes can be 4:1 up to 10 m height and 6:1 above 10 m height.

- The piezometric condition associated with groundwater and leachate within the existing waste fill has a significant impact on the stability and should be monitored. The analyses were completed to investigate the maximum groundwater and leachate levels at which the design objective Factor of Safety (FS) = 1.5 would be maintained. In this regard, the groundwater level should be controlled at or below elevation 280 m ASL for all cells; leachate levels should be controlled at or below elevation 290 m ASL on cells 1A, 3, 4 and 6 and at or below elevations 292 to 294 m ASL on Cells 1, 2, 5 and 7. Groundwater level variation in the order of 1 m could impact the calculated FS. Monitoring is recommended during and post cell development to observe and protect against development of higher groundwater/leachate levels.

  Generally, groundwater elevation in the lower sand has a limited impact on the stability analysis as the modelled groundwater level is relatively deep and below theoretical slip surfaces.
- Perimeter berms up to 3 m high and 6 m crest wide can be constructed at 3H:1V side slopes.

5.6 Landfill Capacity Calculations

The volume between the top of final cover contours and base (excavation) contours of the landfill represents the volume available for the construction of a leachate collection system, the landfilling of waste, and the application of daily, intermediate, and final cover. Various CAD files/Civil 3D surfaces prepared for the landfill design were used to calculate the expansion capacity as summarized in *Table 5.1*.

Table 5.1: Landfill Capacity

DESCRIPTION	QUANTITY
Disposal capacity generated by expanded waste limit for waste and daily/intermediate cover, estimated from the top of the leachate collection system to the underside of the final cover, excluding mining volumes*	4,040,000 m^3
Excavated waste volume generated by mining operations	320,000 m^3
Minus volume of mining residual waste that will be re-landfilled (assumed 50%)	-160,000 m^3
Total volume of waste plus daily/intermediate cover	4,200,000 m^3

*It includes disposal capacity of 115,000 m^3 generated by final cover stripping of the existing site that overlaps with the proposed expansion (153,000 m^2 final cover area x 0.75 m final cover thickness).

5.7 Soil Balance

Table 5.2 summarizes the soil balance for the proposed expansion, including mining (reclamation) operations. Soil excavation volume and road fill requirement were calculated with AutoCAD software.

Table 5.2: Soil Balance

DESCRIPTION	QUANTITY
1. Excavation volume	990,000 m^3
2. Fines generated by the reclamation process (assumed 50% of 320,000 m^3)	160,000 m^3
3. Soil generated by final cover stripping assuming 50% recovery rate (153,000 m^2 final cover area x 0.75 m final cover thickness x 50%)	58,000 m^3
4. Road fill requirement	-4,000 m^3
5. Daily/intermediate cover requirement (assume 4:1 waste to daily/int. soil ratio, i.e. 20% of 4,200,000 m3)	- 840,000 m^3
6. Final cover requirement	-358,000 m^3
7. Surplus available	6,000 m^3

The soil surplus will be used to construct the noise attenuation berm and landscape/visual screening berms.

6.0 Detailed Description of Landfill Mining

Landfill mining operations are proposed to be performed in the Cell 1A area indicated on *Drawing 4*.

6.1 Process Description

The contractor selected by the City will choose the means and methods, including equipment, sequence and personnel to complete the mining work based on tender specifications to be prepared by a qualified engineer. The mining process should, in general, be completed according to the following sequence (for a process flow diagram, refer to *Figure 2*):

- *Mobilization* - Contractor mobilization, submission and review of health & safety plan, odour mitigation plan, dust and erosion and sedimentation control plans.
- *Site preparation* - Existing soil cover stripping within the area of Cell 1A to be mined. Soil will be stockpiled for future cover use.
- *Waste excavation and pre-separation* - The waste excavation will be completed in lifts of approximately 3 m thick by an excavator and/or dozer. Materials that can be reused or recycled will be pre-separated. During waste excavations, large size materials (e.g. tires, metals, concrete, etc.) are to be pre-separated and stockpiled or stored for reuse or recycling, which may include on-site or off-site mechanical processing such as shredding, grinding or crushing.
- *Waste screening* - Excavated waste materials that are not pre-separated will be loaded by an excavator into screening equipment (e.g. trommel screen). The screening process will mechanically separate fine parts (mainly soil), from the residual materials typically referred to as waste overs.
- *Fines* - The fines fraction will be hauled to the working face of the active cell to be stockpiled and either used as daily/intermediate cover or re-landfilled. Other uses of fines within the approved waste footprint may be allowed, such as berms or road fill. Pre-approval of the resident inspector will be required for uses other than cover.
- *Waste overs* - The waste overs will be hauled to the working face of the active cell and immediately re-landfilled along with the regular incoming solid waste materials.
- *Compaction and cover* - Mined waste that will be re-landfilled will be treated as regular waste and will be compacted and/or mixed with other waste and will be covered with approved daily cover at the end of each operating day.

6.2 List of Mining Equipment

The following equipment is anticipated to complete mining operations:

- Dozer(s).
- Excavator(s), possibly with a thumb.
- Trommel screen(s).
- Loader.
- Articulated trucks.
- Top loading trucks to haul waste.
- Conveyors/Stackers equipment (optional).
- Water truck for dust control.
- Odour misting system.

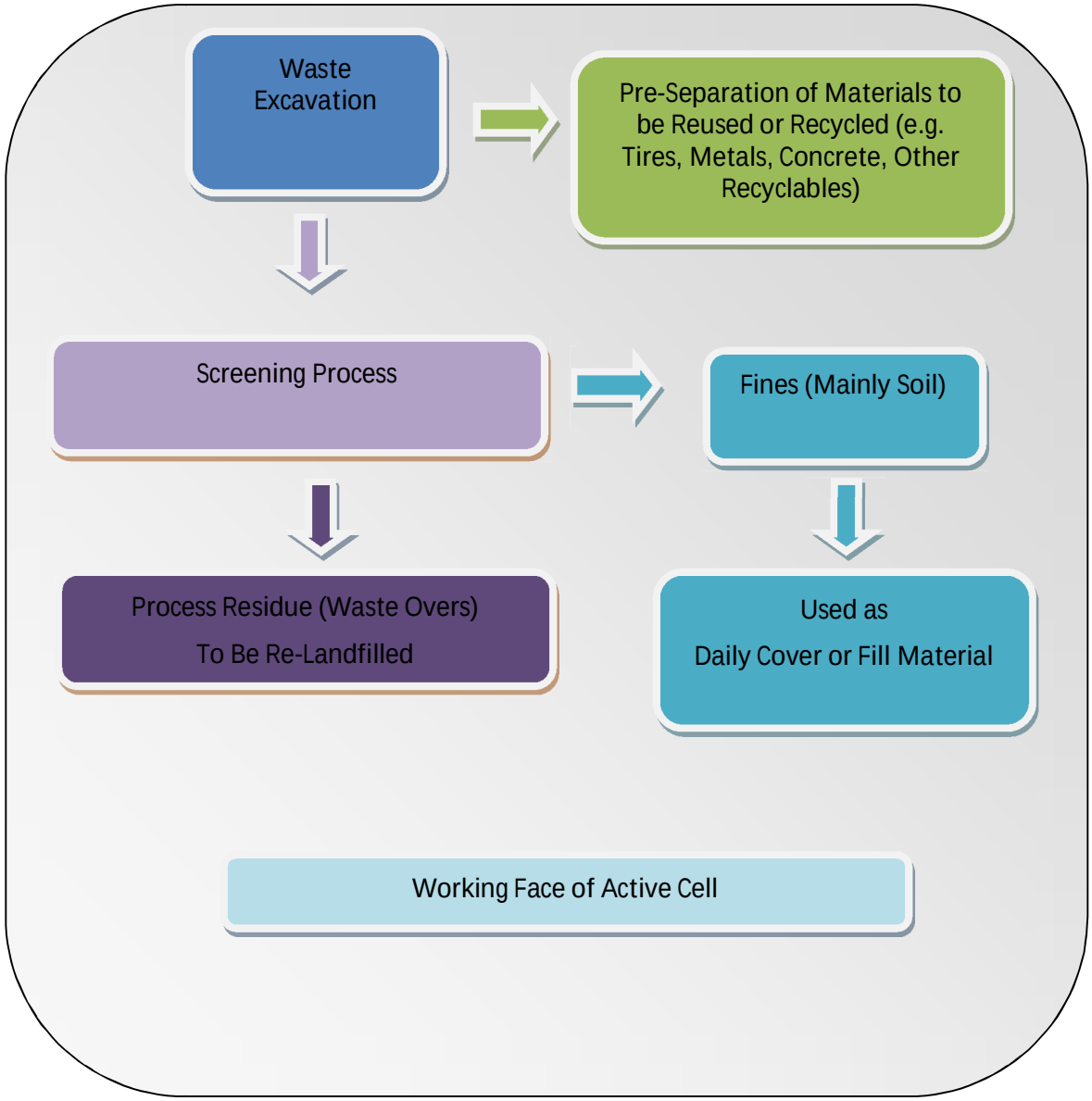

Figure 6-1: Mining Process Flow Diagram

6.3 Fines Management

Based on analytical data available for landfill mining sites in Ontario (e.g. City of Barrie, Northumberland County, Simcoe County and City of Blue Mountains), fines generated from mining operations (primarily soil) either meet or marginally exceed MOECC Tables 1 or 2 criteria. MOECC Tables 1 and 2 criteria used to assess maximum acceptable level of contaminants under the Soil, Ground Water and Sediment Standards for Use Under Part XV.1 of the Environmental Protection Act issued by MOECC.

In general, fines will be assumed to be non-hazardous solid waste and will be used within the approved waste fill limit as daily cover, intermediate cover, road fill or temporary berming.

If fines are being considered for on-site use outside the approved waste limits, site specific testing should be conducted to characterize and assess consistency in the chemical quality and should meet applicable MOECC criteria. Furthermore, any fines to be used for road fill shall require approval of the City's on-site representative.

6.4 Design Considerations

Excavated waste at Cell 1A should be maintained with a stable slope expected to be no flatter that 4:1, with typical waste slopes ranging from 2:1 to 3:1.

A composite liner and leachate collection system consistent with the design for the proposed expansion is proposed for the base of the excavated waste (Cell 1A) for groundwater protection. Leachate will be collected at the base of the lined Cell 1A by a drainage blanket and perforated pipes and conveyed by gravity to the proposed sump located on Cell 3.

A 1 m high berm will be constructed at the toe of the excavated waste to separate the lined area from the unlined area (existing landfill). The berm will anchor the geosynthetic materials (GCL, geomembrane and geotextiles), provide leachate containment, assist in directing surface water from the unlined areas away from the lined area and control sediments from entering the lined area. Refer to *Drawing 5* for cross-sections showing the proposed separation berm.

6.5 Health and Safety Considerations

A site-specific health and safety plan will be prepared prior to commencement of mining operations and will be implemented during mining operations.

The health and safety plan will consider various applicable hazards associated with mining operations and should be in compliance with the City of Sault Ste. Marie policies and procedures and Ministry of Labour regulations. Physical, chemical and biological hazards such as gases (methane, hydrogen sulphide), sharps, wastewater biosolids, asbestos and equipment traffic will be identified and mitigated. The health and safety plan will include specific operating procedures to address air quality, dust monitoring, airborne contaminant management, personal protective equipment (PPE), decontamination procedures and emergency procedures.

The health and safety plan will include procedures to manage anticipated or confirmed hazardous materials. Any hazardous waste that may be encountered will be properly managed at a licensed facility for proper disposal or processing.

The health and safety plan will also address the potential presence of any material of concern and include material-specific procedures.

The health and safety plan will include procedures to operate heavy equipment, processing equipment and tools. Heavy equipment and processing equipment should be provided with engineering controls. Tools should be of adequate design and include engineering controls to provide a safe environment to the site personnel.

6.6 Odour Management

A preliminary odour management plan (OMP) was developed as part of this EA and will be further developed and finalized as the landfill mining program evolves and information on contractor's procedures, means and methods are available. A waste mining pilot project will be completed prior to full-scale waste mining activities to further develop and refine the OMP based on actual Site conditions. The final OMP will be specific to the site and proposed equipment means and methods and will be prepared by a consultant retained by the mining contractor (or by the City directly) documenting procedures for odour management. The OMP will be based on the MOECC's recommended FIDOL (frequency, intensity, duration, offensiveness and location) approach.

Environmental parameters such as temperature, humidity, wind direction and speed will be monitored as part of the OMP. Odour mitigation measures to be contemplated include operational and administrative controls such as: adjust work areas to reduce the amount of exposed waste; place cover material close to the work areas so exposed waste can be covered quickly; transport of waste to occur under optimal temperature and wind speed conditions; and use of odour suppressant foam and misters where appropriate.

Additional details on nuisance management are covered under Sections 13 and 14 of this report.

6.7 Dust and Airborne Contaminant Management

Mining operations have the potential to generate dust during dry periods (usually in the summer when the ground is dried up by higher temperatures). Dust can be generated by typical mining operations such as cover stripping, waste and soil excavation, screening and heavy equipment and truck traffic.

Dust is a concern because it may reduce visibility, generate airborne contaminants and potentially may become a nuisance to off-site receptors if not controlled at the source. Airborne contaminants should be controlled because they represent a safety hazard to site personnel and should be addressed in the health and safety plan.

A dust and airborne contaminant management plan should be prepared and implemented by the mining contractor and approved by the City and the contract administrator retained by the City. The dust and

airborne contaminant management plan should include equipment used to control dust and describe the liquid and rate that will be applied. Monitoring procedures should also be included in the dust and airborne contaminant management plan.

6.8 Erosion and Sediment Control Plan

An erosion and sediment control plan should be submitted and implemented by the mining contractor and approved and monitored by the City or a contract administrator retained by the City. Refer to Section 9.7 of this report for the proposed erosion and sediment control plan.

7.0 Assessment of Potential Impacts

7.1 Terrestrial and Aquatic Environment

A natural heritage assessment was conducted at the site to identify potential impacts to the natural environment and respective mitigation measures associated with the proposed landfill expansion.

7.1.1 Potential Effects on Terrestrial and Aquatic Environment

The potential direct impacts associated with the proposed landfill expansion that were identified are:

- Woodland and meadow vegetation removal and loss of wildlife habitat.
- Incidental wildlife mortality.
- Erosion and sedimentation effects.

There are also indirect impacts that have the potential to manifest in the areas adjacent to the site development. The indirect impacts of the proposed landfill expansion include:

- Operational disturbance to wildlife and ecological linkages.
- Operational aquatic effects.
- Colonization of exotic invasive species.

The recommended mitigation measures during site preparation, construction and operational phases of the landfill are summarized in the following subsections. For specific details refer to the Natural Heritage Impact Assessment Report prepared by Dillon.

The recommended mitigation measures applicable to construction should be added to the contract documents of each landfill development phase that will disturb the existing vegetation.

7.1.2 Mitigation Measures – Woodland Edge Management

- Remove any waste and debris within the proposed vegetation removal.
- Manage select fell logs, trees, shrubs, ground vegetation, heavy machinery traffic and soil cut/fill as recommended by the Natural Heritage Impact Assessment Report.
- Provide ongoing monitoring and maintenance during construction.
- A qualified arborist should assess the new woodland edges 12 months following completion of each stage of the landfill expansion.

7.1.3 Mitigation Measures – Wildlife Impact Mitigation during Construction

- Remove vegetation before May 9 or after August 8, unless cleared by a biologist.
- Where appropriate, retain non-hazardous wildlife habitat trees adjacent to development limits that contain nest, den, or roost cavities.
- Avoid construction lay-down and staging within the boundary of a natural feature scheduled for preservation.
- Where possible, maximize the distance of construction equipment used from the woodland edge to avoid disturbing wildlife.
- Limit the use of lighting where possible. Avoid light effects entering the vicinity of the woodland (eliminate light trespass) where possible.
- Advise contractor and construction staff through drawing specifications and awareness training to visually monitor wildlife species and report encounters.

7.1.4 Mitigation Measures – Erosion and Sediment Control

- An erosion and sediment control plan should be submitted and implemented by the landfill expansion construction contractor and approved and monitored by the contract administrator retained by the City.
- Provide general measures for erosion and sediment control during construction as necessary.
- Provide monitoring and maintenance.

7.1.5 Stormwater Management and the Leachate Collection System

Stormwater and leachate will be managed as indicated in this D & O Report.

To mitigate any potential water quality impacts along Canon Creek and Root River and groundwater features, surface water and leachate management plans have been developed for the site and are described in more detail in Sections 9 and 10 of this report.

7.2 Surface Water Assessment

The purpose of surface water quantity management is to mitigate potential flooding impacts for downstream users. The purpose of surface water quality management is to not degrade the water quality beyond Provincial Water Quality Objectives, and to maintain or enhance it where possible.

Regulation 232/98 under the EPA includes the following objectives for drainage at waste disposal sites:

- Drainage onto or leaving the site should not adversely affect site operations, on-site surface water, or surface water in the vicinity of the site.
- Where there is potential for on-site surface water to become contaminated, measures should be taken to collect, test, and if necessary, treat the collected drainage.
- Ensure that peak flows either upstream or downstream of the site are not affected.

The drainage control objectives for the proposed expansion will be to comply with the applicable regulations, guidelines and procedures. The diversion of clean surface water from the fill area will be maximized, thereby minimizing leachate generation and maximizing clean surface water available to assist with natural attenuation of former unlined fill areas.

In order to quantitatively estimate runoff flows and volumes and to assess the effects of changes within a drainage area (land use and drainage patterns) a hydrologic model is required. For the evaluation of hydrologic impacts associated with the proposed landfill expansion, a Visual OTTHYMO (VO2) hydrology model was developed to determine the peak flow estimations at key locations within the study area. For details on the hydrologic modelling prepared for the proposed expansion, refer to the Surface Water Impact Assessment and Mitigation Report prepared by AECOM. A summary of key findings and recommendations is included in the following subsections.

The estimation of flows in larger watersheds is typically achieved by the statistical analysis of long term flow records. For Canon Creek and the Root River, the WSC gauge 02CA002–Root River at Sault Ste. Marie on the Root River provides a convenient source of long term flow record with forty three (43) years of observed flow data (1971-2013).

7.2.1 Potential Effects on Surface Water

From a water quality perspective, potential for impact to surface water is due to accidental leachate seeps to the surface and/or increases in Total Suspended Solids (TSS) concentration associated with runoff from site development activities, internal operations along the access roadways or site erosion. As well, there is a potential for thermal impact from the permanent pool (dead storage) of the SWMPs and the coldwater fisheries status of the Root River.

From a water quantity perspective, there are negligible impacts since peak flows from the site are significantly smaller than those of the receiving watercourse and the peaks from the site do not coincide with peak flows in the receiving watercourses.

7.2.2 Mitigation, Compensation and/or Contingency Measures

Surface water quality impacts would be mitigated by a single stage Stormwater Management Pond (SWMP) to reduce TSS loading and provide for emergency leachate/spill containment. SWMP outflow would be through an open channel to the nearest receiving watercourse. The outflow structure design would have bottom draw characteristics and landscaping to encourage shading of the SWMPs thereby minimizing thermal impacts. Conceptual Stormwater Management Plans are provided in Appendix A of the Surface Water Impact Assessment and Mitigation Report prepared by AECOM.

There is no mitigation proposed for water quantity as the impact is not significant (i.e., there will be no increase in peak flows in the receiving watercourses).

7.3 Groundwater Assessment

Groundwater quality protection was carefully considered in the development of the landfill expansion conceptual design. The conceptual landfill design not only addressed mitigation of potential groundwater impacts from the expansion fill area, but also mitigates impacts from the western portion of the existing fill area that are currently being mitigated by the purge well system and the Contaminant Attenuation Zone (CAZ). Groundwater impact control is well established and effective on the south and east sides of the existing fill area through horizontal collection systems which will continue to be maintained throughout the contaminating lifespan of the site and can be easily replaced if necessary. The impact mitigation that currently occurs on the western portion of the site (purge wells and the CAZ) will be removed. The chief groundwater protection component for mitigation of impacts to the southwest from the existing site is landfill mining of a significant area of the western portion of the fill area and the construction of engineered landfill cells with a full underdrain leachate collection system and a composite liner system.

Contaminant transport modelling was completed to estimate groundwater quality impacts resulting from the proposed site, including the mining scenario. The computer program POLLUTE was used to predict the groundwater quality in time and space as contaminants migrate from the landfill into the groundwater environment. The simulations incorporate the performance of the leachate control system and the hydrogeologic setting. The impact of the landfill on groundwater quality was assessed by comparing the predicted impact to the Ontario Drinking Water Objectives and the Reasonable Use Guideline. The contaminating lifespan of the landfill is approximately 92 years for a leachate generation rate of 0.15 $m^3/year/m^2$ and 55 years for a leachate generation rate of 0.20 $m^3/year/m^2$. For modelling methodology and additional results, refer to the Hydrogeological Assessment Report prepared by Dillon.

Based on the leachate generation for the site, and the results of the contaminant transport model, the site is predicted to meet appropriate criteria and have minimal impacts during the service life of the engineered systems that have been incorporated into the design of the proposed expansion. The minimum service lives established by the MOECC for these systems are 100 years for the leachate collection system and 150 years for the geomembrane liner. The service lives of these systems means that potential impacts from the Expansion Site will not occur for many years (150 years plus) and the leachate strength at that time will be significantly diminished. Refer to *Drawing 6* for liner and leachate collection system cross-sections.

In summary, the impacts from the portion of the existing landfill that will not be mined will continue to be mitigated to the south and east through the use of the existing horizontal collection system which can be maintained and replaced if necessary throughout the contaminating lifespan of the existing landfill.

Waste impacts from the expansion area (which will include a significant portion of the existing western fill area which will be removed ("mined") and incorporated into the expansion area) will not occur for

some time (more than 150 years and well after the contaminating lifespan of the expansion area landfill) and will be much less than those that are presently occurring within the CAZ caused by the existing landfill. In addition to landfill mining in the west, the expansion design allows for the installation of a new horizontal groundwater collector along the western edge of the new fill area (refer to *Drawing 3* and Section 3 of *Drawing 5*) or replacement of purge wells as and if needed to mitigate remnant impacts from the existing site (if any) and provide a contingency protection measure for the expansion fill area. As a north-south collection system would be underneath or adjacent to the proposed expansion Cells 6 and 7, the City will assess the need for it and the appropriate construction approach prior to construction of Cells 6 and 7. It is anticipated that Cell 6 would be constructed approximately 25 years into the life of the expansion at which time ground water monitoring should reflect the improvement expected as a result of landfill mining.

The proposed expansion, inclusive of the proposed landfill mining and the placement of a composite liner and underdrain collection system, significantly enhances groundwater protection at the site in comparison to the current landfill.

7.4 Archaeology Assessment

The Archaeology Assessment Report prepared by Woodland Heritage Services Limited describes a Stage 1 and 2 site investigation and concluded that no archaeological sites were found and no further assessment is required.

Although no specific mitigating measures were identified in the Archaeology Assessment Report, the construction contract specifications should include provisions to stop work should any heritage resources be discovered during excavation activities.

7.5 Social-Economic Assessment

AECOM prepared the Socio-Economic Impact Assessment Report for the proposed landfill expansion. The area surrounding the landfill site is primarily a mixture of larger rural residential lots with large areas of open space, outdoor recreation areas and industrial sites (contractor's yards, gravel and aggregate pits). Within 1 km there are approximately 177 homes, the majority of which are located on large plots and have been there for some time. The quiet, rural nature of the area was identified as a valuable asset by the people living in the community. The residents' survey showed that almost all local residents are satisfied with living in the community. The survey noted some landfill related issues in the community – notably odour, noise, bears and garbage on the roads and heavy vehicle traffic.

The nuisance effects associated with traffic, noise, odour, vermin and litter identified in the Socio-Economic Impact Assessment Report are not anticipated to be significant or above acceptable standards. Those nuisances are identified and mitigated as described in the various sections of this D & O Report. In addition, the following additional general mitigation measures are also proposed:

- Construction of a biosolids management and processing facility to eliminate direct disposal of biosolids which can be a significant contributor to odour issues.
- Ongoing engagement with the public to continue with the City's process of continual improvement.

7.6 Land Use Review

AECOM prepared the Land Use Impact Assessment Report for the proposed landfill expansion. The existing land uses within the on-site study area (existing disposal footprint and expansion areas) consist of existing waste disposal activities (existing disposal footprint), organics processing (i.e. leaf and yard waste composting in open windrows, curing and screening compost and storage of the final product) and wooded area.

The on-site study area is designated Rural Area in the City's Official and zoned Rural Area (RA) and Rural Aggregate Extraction (REX) in the City's Zoning By-Law.

Special Exception 23 – Sanitary Landfill Site of the City's Zoning By-Law allows sanitary landfill use, where "sanitary landfill site" shall mean a place where waste is deposited under controlled conditions including proper compaction and regular covering with an approved cover material. It also may include ancillary operations associated with the landfill site such as, but not limited to, leachate collection, site access, storage and maintenance of heavy equipment, weigh scales and monitoring wells.

The current zoning by-law was approved in 2005 and since that time the City has acquired additional properties adjoining the landfill site which has resulted in an expansion of the landfill property boundaries. As a result of the latest land acquisitions and the proposed landfill expansion, a municipal zoning by-law amendment is required to adjust the "Sanitary Landfill Site" boundary defined by Special Exception 23 Schedule to coincide with the expanded property boundaries. Refer to *Drawing 1* for the currently property and Special Exception 23 boundaries.

Furthermore, neither the existing landfill nor the proposed expansion is identified to be within a municipal wellhead protection area in the City's Official Plan schedules. The landfill site is located within the Groundwater Recharge Protection Area. This area has been recognized as being important in the Source Water Protection Plan (SWPP) and the plan encourages protection of this area through appropriate Official Plan policies. The protection measures related to fuel handling and storage, chemical storage and handling, vehicle maintenance, repair and storage, spill response and stormwater management stated in the Official Plan are addressed in this Design and Operations Report.

It is acknowledged in the Land Use Report that there are sensitive uses located within the existing and expanded are of influence, defined to be within 500 m of the existing and expanded disposal fill area. A

series of impact assessment reports were completed to address potential impacts of the expansion on adjacent sensitive uses. Those reports identify potential impacts and proposed mitigation measures.

7.7 Visual Impact Assessment

A Visual Impact Assessment Report was prepared by AECOM to support the proposed landfill expansion approval. The report identified minor potential effects and mitigation measures. The landfill expansion is anticipated to be visible from small sections of Fifth Line East at the Hydro Easement crossover and existing residential property located adjacent to the southwest edge of the site.

The Visual Impact Assessment Report recommends the preparation of an Environmental Management Plan (EMP) following approval by the MOECC and prior to construction. The intent of the EMP is to enhance visual screening and to compensate for loss of existing woodlot and will include a description of mitigation measures, commitments and monitoring to be carried out as part of the construction, operation, and maintenance of the proposed landfill.

Conceptual design for screening berms and vegetation areas included in the Visual Impact Assessment Report was added to *Drawing 2* of the D & O Report.

7.8 Noise Assessment

A Noise Impact Assessment was prepared by Dillon for the proposed landfill expansion. The purpose of this study is the assessment of potential noise impacts at nearby receptors associated with the proposed landfill expansion.

Noise emissions for the proposed landfill expansion were modelled to estimate the impact on nearby receptors as a result of various anticipated site activities, such as regular landfill operations, mining, landfill cell construction and leaf & yard waste composing operations, for 8 different scenarios, including the worst case scenario.

The noise modelling results indicate that only one receptor (i.e. the closest residence located west of the Hydro Corridor) exceeds the MOECC daytime criterion of 50 dBA for landfills.

The recommended mitigation measure for this exceedance is the construction of a 2.5 m high, 150 m long soil berm to mitigate noise from the proposed leaf and yard waste composting facility. The proposed noise mitigation berm should be constructed before the operations of the proposed leaf and yard waste composting facility starts. *Drawing 2* of the D & O Report shows the noise mitigation berm location.

For details on how noise control will be incorporated into the operations, refer to Section 13.6 – Noise Control of this D & O Report.

7.9 Air Quality and Odour Assessment

Dillon prepared the Air Quality and Odour Impact Assessment Report for the proposed landfill expansion. No exceedances of relevant air quality criteria were predicted. The odour impact assessment was completed for regular landfill waste disposal operations and concurrent landfill waste mining operations. The odour impact assessment was completed based on the MOECC's recommended FIDOL criteria (frequency, intensity, duration, offensiveness and location) approach. For each criterion, management practices were recommended to mitigate potential odour impacts.

The odour impact assessment report indicates that the current landfill operations are not expected to cause odour impacts greater than the historical impacts that have been observed and managed on site. The City will continue to implement the current odours measures (refer to Section 13.4.1 – Odour Control During Regular Landfill Operations of the D & O Report for mitigation details). Odour mitigation measures to be implemented include operational and administrative controls such as: minimize the area of the active working face to reduce the amount of exposed waste; place cover material close to the work areas so exposed waste can be covered quickly; transportation of waste to occur under optimal temperature and wind speed conditions; and use of odour suppressant foam and misters where appropriate.

Once mining operations are introduced, new odour impacts are expected to be managed by a mining-specific odour management plan (OMP).

A preliminary OMP was prepared and includes operational and administrative controls for regular landfill waste disposal operations and landfill waste mining operations. To mitigate the potential for odour impacts during waste mining operations, a detailed OMP specific to the site and proposed equipment means and methods will be prepared by a consultant retained by the mining contractor (or by the City directly) documenting procedures for odour management. The OMP should be based on the MOECC's recommended FIDOL (frequency, intensity, duration, offensiveness and location) approach. Environmental parameters such as temperature, humidity, wind direction and speed should be monitored as part of the OMP.

The effects, mitigation and monitoring recommendations of the Air Quality and Odour Impact Assessment Report have been considered in this D & O Report. Refer to Section 13.4.1 – Odour Control During Regular Landfill Operations and 13.4.2 - Odour Control During Mining Operations of the D & O Report for mitigation details).

7.10 Traffic Assessment

A Traffic Impact Study Report was prepared by AECOM for the proposed landfill expansion. In addition to the landfill site, Fifth Line also services area residents along Fifth Line and Old Goulais Bay Road,

several local businesses, and KOA campground. It is an important truck route for Contractor's yards and aggregate extraction operations in the Fifth Line/Old Goulais Bay Road area.

No significant increase in traffic is anticipated with land development in the vicinity of the site. The City has developed mapping illustrating potential residential and Industrial, Commercial & Institutional (IC&I) growth areas over the next 20 years and no potential development sites have been identified in the vicinity of the landfill site.

The City has also recently completed an update to their Transportation Master Plan. There are no references to any significant changes in traffic patterns/volumes in the site vicinity study area nor are there any specific upgrades or improvements referenced for the Fifth Line corridor within the site vicinity study area.

Future increases in traffic on Fifth Line associated with the proposed landfill expansion will generally be limited to additional site visits by individual residents as the City's population increases very modestly over time and construction related traffic associated with future site development activities.

Although the proposed landfill expansion is not expected to have any significant impacts on the transportation infrastructure/networks, a mitigation plan and a monitoring plan is recommended in the Traffic Impact Study Report. The following mitigation measures have either been implemented or are proposed to further mitigate the less than desirable sight distance at the Highway 17/Fifth Line intersection:

- Complete clearing within the right-of-way to the full extent possible to maximize sight lines.
- Remove or relocate signage that may obstruct sight lines.
- Maintain the existing flashing amber lights (triggered by vehicles at the Fifth Line stop blocks) and the reduce speed signage on the north and south approaches to the Highway 17/Fifth Line intersection.
- Maintain existing truck and bus prohibited straight through and left turn movements from the Fifth Line approaches.
- Complete a detailed review of the intersection to assess the existing mitigation and identify possible signage enhancements prior to initiating the expansion construction.

In addition to the foregoing, the City will also consider improvements to geometrics on the north and south approaches to this intersection in conjunction with the next capital improvement project along this stretch of Highway.

8.0 Site Features

Various existing facilities shown on Drawing 1 will be replaced/relocated in the future as shown on Drawing 2. It should be noted that the proposed site features shown on *Drawing 2* are the final build-out, which will be constructed in phases.

Most of the replacement site infrastructure/facilities will have to be established prior to initiating development activities in Cell 3. Application(s) for amendment(s) to the site ECA will be submitted to the MOECC prior to initiating construction of the replacement site infrastructure.

The following general development sequence is suggested for the landfill expansion and proposed facilities, subject to revisions as new options are identified:

- Build the proposed northeast surface water management pond.
- Decommission the existing northeast stormwater management pond.
- Relocate the compost pad before construction of Cell 1.
- Build the proposed southwest surface water management pond as part of the compost pad relocation.
- Build the proposed perimeter road to serve Cell 1.
- Build Cell 1.
- Implement the initial phase of the landscape plan per Environmental Management Plan that will be prepared following EA approval. Other phases of the landscape plan will be implemented as per Environmental Management Plan that will be prepared following EA approval.
- Build proposed pump station to serve Cell 1 and associated forcemain. Connect forcemain to the existing pump station.
- Build the east and south perimeter ditches for the existing site and the southeast surface water management pond.
- Build Cell 2.
- Complete a pilot program for Cell 1A mining.
- Proceed and complete full-scale mining operation at Cell 1A.
- Build the liner and leachate collection system for Cell 1A.
- Decommission purge wells within the footprint of Cell 3. Replace purge wells as and if needed (depending on remaining groundwater impacts, if any, after landfill mining is completed).
- Relocate existing Public Drop-Off, Maintenance Garage, Scale House/Administration Building and Scales.
- Build the new entrance/exits.
- Build the Recycling Centre.
- Build the HHW Depot.
- Build the South surface water management pond.

- Build roads to serve the relocated facilities.
- Decommission and remove or repurpose (where not in conflict with future site development) the existing site infrastructure (i.e. Public Drop-Off, Maintenance Garage/Administration Building and Scales/Scale house, HHW Depot).
- Build Cell 3.
- Build proposed pump station to serve Cell 3 and associated forcemain. Connect forcemain to the existing pump station.
- Decommission remaining purge wells. Replace purge wells as and if needed (depending on remaining groundwater impacts, if any, after landfill mining is completed).
- Build Cell 4.
- Build Cell 5.
- Build the horizontal leachate collector (based on a need assessment prior to construction of Cells 6 and 7, as per contingency plan).
- Build Cell 6.
- Build Cell 7.

8.1 Site Entrance and On-Site Roads

The site entrance will continue to be provided from Fifth Line. The site entrance will, however, be relocated further east relative to the existing entrance and a separate exit only gate will be provided at the location of the existing entrance. The relocated entrance gate will provide access to both the landfill and the Recycling Centre.

The access roadway to the landfill provides access to the scales and eventually to the public waste drop-off area and the landfill perimeter road.

The hard-surfaced perimeter road will be 7.2 m wide with a two-lane cross section. Drainage ditches, where necessary, will be constructed adjacent to the road. *Drawing 6* shows the site perimeter road in cross section.

Access to the landfill working face will be provided via several haul roads departing from the perimeter road. Waste materials, such as wood chips or fines generated by mining operations may be used as an alternative building material for these haul roads. Consideration will be given to the finished surface of the haul roads to reduce dust emissions from waste haul truck traffic.

8.2 Scales and Scale House

A weigh scale will be located to the south as shown on *Drawings 1 or 2* and will have a set back from the entrance to allow for vehicle queuing on site. The distance from the Fifth Line entrance to the scale will provide adequate queuing length. A scale house equipped with a methane detection system will be provided for the scale attendant.

8.3 Landfill Gas Management Facility

The LFG management facility for the existing and expansion consists of two major components:

- The gas collection system (vertical extraction wells, related lateral and header pipes, and condensate management facilities); and
- The flare station.

The flare station is shown on *Drawing 1* and is located south of the existing scale house.

8.4 Administration/Maintenance Building

The existing Administration Building and Maintenance Garage shown on *Drawing* 1 will be replaced in the future by the Administration and Maintenance Building shown on *Drawing 2*. The Administration and Maintenance Building will be equipped with a methane detection system.

8.5 Stockpiles

Stockpiles will be located in designated areas or adjacent to the active working face. Soil for daily cover will be located near the active working face. Stockpiles shall be sized and managed to minimize the potential for off-site dust nuisance.

8.6 Drop-Off Area

The site plan has been developed to separate waste diversion activities from disposal activities. The main entrance to the site will facilitate access to both the waste diversion drop-off area and the weigh scales which are located upstream of the waste disposal drop off-area.

Customers are able to enter the waste diversion drop-off area without passing over the weigh scales. This approach encourages customers to properly manage diversion items as they can be tipped at no charge. The waste diversion drop-off area is configured to facilitate traffic flow in a counter clockwise direction with various diversion stations located along the periphery of the traffic loop. The following diversion stations have been included:

- Metals including appliances and propane tanks;
- Tires;
- Typical blue box recyclables (i.e. fibres and containers);
- Waste electrical and electronic equipment; and
- Household special waste.

Customers can then proceed to the weigh scales and the waste drop-off area once diversion items are discarded. Customers that do not have diversion items may also proceed directly to the weigh scales.

Once passing over the weigh scales customers proceed in a counter clockwise direction through the waste disposal drop-off area. Separate stations have been established for normal household waste, construction and demolition waste and clean wood waste including brush. Typical blue box material recyclable containers are also accessible from the waste disposal drop off area.

Once customers have tipped their waste they will proceed over the outbound weigh scale and pay appropriate charges before exiting the site.

9.0 Surface Water Management

9.1 Drainage Design Objectives

The overall objective of the surface water management plan is to ensure that any drainage leaving the site does not adversely affect surface water in the vicinity of the site, in compliance with environmental regulations. As such, the site has been designed to keep uncontaminated surface water out of the disposal footprint. Currently, the majority of surface water infiltrates and becomes groundwater due to the permeable nature of the native soils, and the absence of on-site watercourses.

A further objective is to maintain the existing drainage conditions under which the majority of surface water infiltrates to groundwater.

9.2 Plan Components

The surface water management plan consists of several components, which collectively will achieve the objectives.

9.3 Separation of Surface Drainage System from Leachate

Clean surface water, originating from areas separate from landfill operations (i.e., outside the landfill perimeter road and perimeter ditches) will not be managed and will continue to drain unaltered.

Non-contaminated storm water, originating from non-operating areas of the landfill (i.e., undeveloped areas or areas completed with final cover) will be collected in a ditch inside the perimeter road and conveyed to one of the three (3) SWM Ponds that will serve the existing and proposed landfill. The internal ditching will be designed to accommodate the peak flow generated from the 25-year design storm. Berms or ditching will be used to divert any non-contaminated storm water away from landfill excavations where it may cause operational problems and from operating areas where it may come in contact with waste. Considerations of the potential impacts of climate change (e.g. more frequent or severe events) will be incorporated into detailed design as appropriate.

Potentially contaminated storm water, such as that originating from operating areas where drainage may come in contact with waste or leachate, will not be discharged to the surface drainage system. This isolation of drainage from operating areas will be accomplished by grading of waste and daily/intermediate cover surfaces (i.e. interim separation berms, slopes and diversion ditches will be constructed as part of the landfill operations). All drainage from operating areas that may come in contact with waste or leachate will be collected and managed as leachate, i.e. allow infiltration within the active waste filling areas.

The leachate collection system is entirely separate from the surface drainage system. Leachate will be collected from the existing and proposed fill areas and sent through a forcemain to the municipal sewage treatment plant for treatment. No leachate will be discharged to the surface drainage system.

9.4 Infiltration of Surface Water

To compensate (to the extent possible) for surface water overland flow loss and groundwater recharge loss that will occur over the lined area of the landfill, infiltration of surface water will be encouraged at the landfill site. Non-contaminated storm water from non-operating areas will be conveyed to the proposed storm water management ponds and subsequently discharged to Root River/Canon Creek. The storm water management ponds will remove suspended solids before discharging the surface water.

9.5 Internal Drainage Ditches

The existing and proposed waste fill area will be drained by ditches adjacent to the perimeter roads. Refer to *Drawing 6* of the D & O Report for a typical ditch design.

9.6 Stormwater Management Ponds

Four (4) stormwater management (SWM) Ponds are proposed, to mitigate runoff impacts, as shown on *Drawing 2*. Three (3) SWM Ponds will serve the landfill. The South SWM Pond will serve the public drop-off, administration building, recycling centre, and adjacent paved areas.

The SWM Ponds serving the landfill will have sufficient storage capacity to accommodate runoff from the 1:100 year storm event for operation under emergency leachate spill conditions. Such emergency control is not required for the South SWM Pond.

The proposed SWM Ponds will have no quantity control function, i.e. they will be operated with the valves in normally open position and water quality monitored. In case the water quality exceeds the trigger parameters (e.g. Oil and Grease, Conductivity, pH and TDS) at two successive sampling events, the valve at the respective SWM Pond that exceed the trigger parameters should be closed and operated in contingency (batch) mode. The contaminated runoff will either be treated and discharged to the receiving watercourse or pumped or hauled for treatment. The valve can be operated in normally open condition again once the water quality meets the trigger parameters after two consecutive sampling events.

All four (4) SWM Ponds will be designed to operate as water quality control facilities as identified in the City's SWM Guidelines (RV Anderson 2014) and will achieve MOECC Level 1 criteria (80% TSS removal). The SWM Ponds will be lined as a contingency in the event that the water quality exceeds the trigger parameters.

The proposed SWM Pond characteristics are described in more detail in Appendix B of the Surface Water Impact Assessment and Mitigation report prepared by AECOM.

9.7 Erosion and Sediment Control Plan (Landfill Construction, Mining and Operational Period)

During the construction and operation of the landfill site, large volumes of soil will be moved and/or exposed during excavation and preparation of the landfill area. During this period, non-vegetated areas are particularly vulnerable to soil erosion. The following control measures are proposed to prevent off-site effects. The following measures will also be applicable to mining operations.

9.7.1 Seeding and Mulching

Stockpiles and the fill area will be the main areas susceptible to wind and rill erosion. Permanent stockpiles, road embankments and berms will be stabilized using seeding and/or mulch.

Permanent seeding of grass will also be used to stabilize the final face of the landfill mound.

9.7.2 Additional Erosion Control Measures

Alternative stabilization may be necessary at times during the construction period where immediate erosion control is needed. This may include erosion control blankets, rip-rap, rock protection or sodding, to be applied on ditches, road embankments, or buffer strips adjacent to drainage ditches.

9.7.3 Silt Fencing

Silt fencing will be installed at strategic locations upstream of receiving water bodies during the construction phase of each cell or during mining operations. The silt fencing will reduce the quantity of sediment entering receiving watercourses. Regular maintenance of the fencing will be undertaken.

9.7.4 Ditch Erosion

Temporary and permanent drainage systems will need to be established during the construction, operational and post-closure phases. To control erosion and sedimentation within the drainage system, the following mitigation measures will be incorporated, as appropriate, into the design:

- Streambank stabilization (grading, seed and sodding, rip-rap placement);
- Geotextiles (erosion mats and blankets, filter fabrics).
- Check dams (constructed of stone, rock or rip-rap).
- Inlet/outlet protection (rip-rap placement, wingwalls and headwalls).

The drainage channels/swales will be vegetated (sodding or seeding as required) and stabilized immediately upon completion to protect against erosive velocities.

9.7.5 Check Dams

Temporary rock check dams will be constructed along the drainage ditches during the construction and operational periods of the landfill site, as necessary, to decrease the flow velocity. The rock check dams will be effective in reducing erosion and gullying and will also allow sediments to settle out, hence reducing loading rates to the stormwater retention ponds.

10.0 Leachate Management

10.1 Existing Leachate Management System

The monitoring program identified groundwater impacts in the meander area in the late 1980's resulting from the waste fill located in the eastern portion of the existing site (the existing site was generally developed from east to west). To address these groundwater impacts, a horizontal west-to-east collection system was installed in 1992 south of the existing site. The collection system intercepts leachate impacted groundwater moving south from the waste area and protects groundwater quality in the downgradient meander area. The collection system has been in continuous operation since November 1992. Initially collected water was recirculated back to the waste fill areas but in 1998 the collection system was connected by forcemain to the City's sanitary sewer system. The leachate impacted groundwater is now treated at the City's west end wastewater treatment facility.

As landfilling progressed to the western portion of the existing site, groundwater quality impacts were identified in downgradient monitoring wells located west of the waste fill area. Additional monitoring wells were installed to further characterize hydrogeological conditions in the western portion of the property. The water table is located at a significant depth (~20 m) in this western portion of the site and the geology of this area of the site was confirmed to be fine-to medium grained beach sand.

In response to the identified deterioration in groundwater quality in the western portion of the site, a purge well system was designed to intercept impacted groundwater moving west and southwest from the existing site.
West of the site is an area of remnant groundwater quality impacts downgradient of the purge well system. A Contaminant Attenuation Zone (CAZ) was established in this area to manage impacts within City owned property. Currently, the existing site is in compliance with the MOECC Reasonable Use Policy although a relatively thin groundwater plume has been identified southwest of the fill area near the downgradient boundary of the CAZ.
The historical development of the leachate management system is summarized below.

- Leachate collector constructed adjacent to the southern boundary in 1992. The collected leachate was pumped back into the disposal footprint until March, 1998 (refer to forth bullet).
- Three purge wells (PW-2, PW-3 and PW-4) were installed in 1996 adjacent to the west boundary of the landfill to intercept ground water flow between the landfill and the west property boundary.
- Installation of purge wells was included in the contingency plan prescribed by the Design and Operations Report (Dillon, 1990) to supplement leachate control by the leachate collection system. The discharge lines from the purge wells are connected to an on-site sewer system that ties into the leachate collector.

- In 1998, a forcemain was constructed from the landfill pump station to the sanitary sewer system at Fifth Line/Old Goulais Bay Road. Since then, leachate collected at the leachate collector and purge wells has been pumped to the City's waste water collection system and treatment plant in lieu of being re-circulated into the disposal footprint.
- Four additional purge wells (PW-5, PW-6, PW-7, PW-8) were installed and commissioned in January, 1997. The leachate sewer along the west side of the landfill was extended north from existing MH 6 to convey ground water from the purge wells to the leachate collection system. The new purge wells were installed based on ground water monitoring evidence of the development of a new plume further north along the west side (refer to Monitoring Report 2000 and Monitoring Report 2001).
- Back-up purge wells PW-9 and PW-10 were installed in April 2003 and became operational in mid-December, 2003. PW-2 and PW-3 were retired in mid-December 2003 to serve as back-up wells for PW-9 and PW-10. A pump was installed in PW-5 in mid-December 2003 and made operational.
- In 2006 a portion of Canon Creek was relocated and the leachate collection pipe extended within the former creek bed.
- Currently, nine purge wells are operational 24/7, with the exceptions of shutdowns required for maintenance of the system.

10.2 Leachate Management Objectives

Provisions for the protection and enhancement of ambient surface water quality are outlined in Procedure B-1-1, *Water Management Policies, Guidelines and Provincial Water Quality Objectives of the Ministry of Environment and Energy*, dated July 1994 (reprinted February 1999) and also referred to as the "Blue Book" (MOEE, 1994b). The procedure contains the Provincial Water Quality Objectives, which are a set of narrative and numerical criteria designed for the protection of aquatic life and recreation in and on the water. The objectives represent a desirable level of water quality that the Ministry strives to maintain in surface water in the province.

The policy concerning groundwater is described in Guideline B-7, *The Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities* (MOEE, 1994a). The guideline describes the basis for limiting contaminant concentrations in groundwater on properties adjacent to landfills. Meeting the "Reasonable Use Guideline" requires the proponent to determine the reasonable use of groundwater on the adjacent property and then design the landfill such that the maximum concentration of a particular contaminant is predicted to be in compliance with Guideline B-7 at the property boundary.

As a minimum, the leachate management objectives for the design of the Sault Ste. Marie Municipal Landfill will be to comply with the requirements of the "Blue Book" for surface water, and with the requirements of the "Reasonable Use Guideline" for groundwater.

10.3 Leachate Generation

The leachate generation rate is a function of meteorological and landfill cover design factors. The Hydrologic Evaluation of Landfill Performance (HELP) Model (version 3.03) (Schroeder et al., 1994) was used as the basis for this evaluation. HELP is an internationally accepted U.S. EPA model used to determine the amount of evapotranspiration, runoff and percolation through the landfill cover (i.e., a water balance).

Simulations were completed for cover thicknesses of 0.75 m and 1.0 m to allow for comparison and for two hydraulic conductivities (10^{-7} m/s and 10^{-8} m/s). The amount of runoff calculated by the HELP model is based on the USDA Soil Conservation Service (SCS) Curve Number method. Simulations were completed for a curve number of 75.

Contaminant transport modelling was completed to estimate groundwater quality impacts resulting from the proposed Expansion Site. The computer program POLLUTE was used to predict the groundwater quality in time and space as contaminants migrate from the landfill into the groundwater environment. The simulations incorporate the performance of the leachate control system and the hydrogeologic setting. The impact of the landfill on groundwater quality was assessed by comparing the predicted impact to the Ontario Drinking Water Objectives and the Reasonable Use Guideline (RUG). The contaminating lifespan is based on the amount of time it takes for leachate source concentrations to decrease to a level where their release to the environment is no longer a concern from a compliance perspective. The two critical factors in predicting leachate concentrations with time are the leachate generation rate and the mass loading (tonnes of waste per hectare of footprint area). The contaminating lifespan of the landfill is approximately 92 years for a leachate generation rate of 0.15 m^3/year/m^2 and 55 years for a leachate generation rate of 0.20 m^3/year/m^2.

Overall, it is concluded that the engineered systems incorporated in the design of the Expansion Site will prevent the RUG criteria from being exceeded immediately below the landfill base. The predicted performance of the landfill is better than that of the Ministry's Generic Design since there is more rapid removal of contaminant mass because the leachate generation rate is predicted to be higher than the minimum 0.15 $m^3/m^2/a$ required by the Generic Design.

10.4 Leachate Collection System and Liner System

The leachate collection system was designed on the basis of field investigations and groundwater flow modelling. As requested in the ECA, an assessment of the performance of the leachate management facilities and an estimate of the quality and quantity of leachate pumped is addressed in the Annual Monitoring reports.

The proposed leachate collection system (LCS) was designed to remove leachate accumulated on the geomembrane.

The proposed composite liner and leachate collection system for the expansion and mining areas will consist of, from bottom to top:

- Cushion geotextile.
- Geosynthetic clay liner.
- 1.5 mm thick high density polyethylene (HDPE) geomembrane.
- Cushion geotextile.
- 0.3 to 0.8 m thick stone drainage layer.
- Separator geotextile.
- 0.2 m thick sand protective layer.

An approximately 1 m high berm will be constructed at the toe of the existing fill areas that are being expanded or mined to separate the lined area from the unlined area. The berm will anchor the liner and geotextiles, provide leachate containment, assist in directing surface water from the unlined areas away from the lined areas and control sediments from entering the lined area. Refer to *Drawing 5* for more details.

The proposed LCS consists of the following key components (on top of the liner system): drainage blanket, lateral collection pipes, header pipes, sand protective layer, cleanouts, two (2) sumps and pumping stations and connection to existing forcemain.

The drainage blanket will be a continuous layer of 19 mm – 38 mm clear stone with thickness ranging from 0.3 m to 0.8 m over the low permeability base liner. The lateral collection pipes are 200 mm inside diameter perforated HDPE pipes. The LCS lateral pipes will be installed at valleys and will run in a north-south orientation within the proposed west landfill expansion area and from a high point divide to the west and east within the proposed north landfill expansion area.

Since the base contours are designed to be sloped towards the lateral collection pipes, leachate from the blanket will be drained to the header pipes which are 200 mm inside diameter perforated HDPE pipes with the same perforation pattern as the lateral pipes. A geotextile filter will surround the clear stone to prevent migration of soil fines into the perforated collection pipes.

Leachate will drain by gravity to the leachate sumps and pump stations located south and east of the landfill footprint. The overall layout of the LCS is illustrated on *Drawing 3* and a typical cross section of the leachate collection drainage layer and details of the perforated leachate collection pipe are shown on *Drawing 7.*

Collected leachate will be pumped from the sump using submersible stainless steel pumps equipped with all necessary piping, valves, controls, power supply, and flow meters.

The current forcemain is a HDPE pipe designed to handle the peak flow which is estimated to be in the order of 33 L/s. Five flushing stations and an air release valve are installed along the forcemain between the pumping station and Fifth Line to remove accumulated solids within the pipe. Regular flushing of the forcemain has improved the overall performance of the pump station.

Leachate from the forcemain discharges to the sanitary sewer system and is conveyed to the City's wastewater treatment plant facility.

The capacity of the existing pumping station, forcemain and receiving sewage treatment plant shall be assessed prior to the submission of an ECA application.

11.0 Landfill Gas Management

11.1 Landfill Gas Management Objectives

Landfill gas is generated during the decomposition of organic material under anaerobic conditions. The rate of landfill gas production depends on the interrelationship of many factors of which, waste composition and age, temperature, moisture content, pH, and quantity and quality of nutrients and microbial populations are the principal factors.

Landfill gas is composed of a variety of chemical compounds, which reflect the type of waste that is placed at the landfill site. In general, landfill gas is composed of approximately 50-55 percent methane by volume, 40-45 percent carbon dioxide by volume, and less than 1 percent other gases such as sulfur species and volatile organic compounds. The concerns with landfill gas are associated with:

- Explosive gases. The methane gas creates an explosive hazard under certain conditions (between 5-15 percent by volume in air) that can reduce or replace the percentage of the natural atmosphere in enclosed structures;
- Health concerns (depending on the level of oxygen and trace gas compounds and levels);
- Climate change; and
- Odours.

The generated landfill gas has two methods of emanating from the landfill site. These two methods are emission of the landfill gas to the atmosphere either under controlled release conditions (designed venting and/or collection structures) or uncontrolled conditions (venting through the landfill cover), and/or the migration of the landfill gas within the surrounding subsurface until a venting location is encountered.

Gas migration in the subsurface soil is governed by the same principles as groundwater flow. The migration of landfill gas is dependent on the soil conditions at the landfill site, the landfill gas generation rate, the landfill site design, and weather conditions throughout the year. The migration of landfill gas will occur in the higher permeable soil stratigraphic units that are present around the landfill site. The landfill gas generation rate will govern the amount of gas available to migrate and impact the landfill gas migration, since landfill gas will usually rise. A perched water table or frost layer will impact the distance of landfill gas migration, since the boundary layer will create a reduced exfiltration area for the gas.

Ontario Regulation 232/98 defines standards for new or expanding landfill sites within the Province with a total volumetric capacity of more than 40,000 m^3. The following summarizes some of the key components of Regulation 232/98 that apply to landfill gas management:

- Implement gas controls for sites with a total waste volume of 1.5 million m^3 or more unless air impacts are not expected to result;
- Assess and, if necessary, control subsurface migration of landfill gas;
- Provide specific information regarding any landfill gas controls that may be necessary;
- Provide specific information regarding landfill gas monitoring that may be necessary;
- Ensure the concentration of methane in the subsurface at the site boundary is less than 2.5% by volume;
- Ensure the concentration of methane in any on-site enclosed structure or within/near the foundation of any on-site enclosed structure is less than 1.0 % by volume; and,
- Ensure the concentration of methane from the site in any off-site enclosed structure or within/near the foundation of any off-site enclosed structure is less than 0.05 % by volume.

Section 33 of Regulation 419/05 under the *Environmental Protection Act* states that:

No person shall cause or permit to be caused the emission of any air contaminant to such extent or degree as may,

a) cause discomfort to persons;
b) cause loss of enjoyment of normal use of property;
c) interfere with normal conduct of business; or
d) cause damage to property.

The objectives of the landfill gas (LFG) management system at the Site are:

- Minimize subsurface migration of LFG from the fill areas;
- Minimize atmospheric LFG emissions (including odourous compounds); and
- Incorporate flexibility to accommodate future LFG utilization if this is shown to be feasible.

The LFG system described in the following sections includes collection and control components to achieve the above objectives.

11.2 Landfill Gas Collection System

The current landfill gas collection system is governed by ECA (Air) No. 4306-7ZHPR3 which includes 150 m PVC pipe vertical extraction wells, 200 mm HDPE LFG header pipes, 100 mm HDPE LFG lateral pipes and one enclosed flare equipped with temperature control system and landfill gas burner. The proposed LFG collection system layout is shown on *Drawing 7* and details are included on *Drawing 8*.

The landfill gas collection system will be progressively expanded as the landfill reaches approved final contours.

There are 41 existing active vertical LFG extraction wells installed at the landfill which are equipped with valves to permit the adjustment of the well flow rates and monitoring ports designed to allow the measurement of gas composition. The extraction wells are located throughout the western portion of the existing waste footprint using the design criteria to cover the areas of the landfill filled to or near final grade.

Condensate is drained from the low points along the main LFG header through a trap to the nearest leachate manhole. Condensate collected at the low points on sub-headers within the landfill drain by gravity via a self-draining trap back into the landfill.

The existing enclosed flare is designed to handle a LFG flow of 770 standard cubic feet per minute (scfm) which is equivalent to 0.36 m^3/s. The flare is equipped with a centrifugal blower which provides the flexibility of adjusting flow rates.

11.3 Assessment of Need for Collection of Landfill Gas

The LFG Management System Design Report prepared in June 2009 for the existing site, estimated the gas recovery rate from the landfill using the Landfill Gas Emission Model (LandGEM) developed by U.S. EPA.

The LandGEM is a simplistic, first order, single stage model with only two input parameters other than waste receipts and LFG composition. It assumes that the gas generation rate is at its peak following a short lag time in which anaerobic conditions are established at the landfill upon initial waste placement. The gas generation rate is then assumed to decrease exponentially (i.e., first order decay) as the organic fraction of the landfill refuse decreases.

The LFG projections for the existing landfill combined with the proposed expansion predict a potential maximum recovery landfill gas flow of 717 scfm.

The air quality impact assessment for the landfill expansion predicts that the maximum air quality concentrations are below the Ministry's and Canadian Council Ministers of the Environment (CCME) air quality criteria.

Therefore, the proposed LFG collection system layout as shown on *Drawing 7* and the existing flare and blower are likely adequate to satisfy the landfill gas management requirements for the existing and expansion areas. The need for future flare upgrades will be monitored.

At present, collected landfill gas is flared only. As landfills represent a source of greenhouse gas emissions, the City of Sault Ste. Marie has and will continue to look at opportunities to utilize this gas to create energy. The decision to move forward with energy production will be based in part on the business case.

11.4 Assessment of Need for Control of Subsurface Migration of Landfill Gas

Subsurface migration of landfill gas is regulated by Ontario Regulation 232/98 and must meet the following conditions:

- Less than 2.5% methane by volume in the subsurface at the property boundary;
- Less than 1.0% methane by volume in any on-site building, and in the area immediately outside the foundation if the building or structure is accessible to any person or contains electrical equipment or a potential source of ignition; and
- Less than 0.05% methane in any off-site building, and in the area immediately outside the foundation if the building or structure is accessible to any person or contains electrical equipment or a potential source of ignition.

The water table is known to be an effective natural barrier for methane gas (since methane gas is relatively insoluble in water). Therefore, the Canon Creek will effectively retard the lateral migration of methane gas along the north and east boundaries of the fill area. Southern migration of gas will be limited by the high water table in the meander area. Subsurface migration of methane gas should be monitored as described below.

Measures have been implemented to protect on-site buildings against landfill gas which include a methane monitoring systems in the Scale House and Administration Building and in the Maintenance Garage. Future buildings should also be equipped with a methane monitoring system.

Landfill gas generation is likely to decline upon landfill closure when no more waste is added and upon application of the low-permeability cap over the landfill when moisture supply is significantly reduced. However, landfill gas generation may continue for decades and there will be potential for subsurface migration of landfill gas over this time frame. As such, it will be necessary to monitor subsurface migration of landfill gas by installation of landfill gas monitoring wells between the existing landfill and the property boundary and between the existing landfill and existing site buildings. The landfill gas monitoring is described in Section 14 and contingency measures are described in Section 16.

11.5 Climate Change Considerations

The current landfill has a gas collection and flaring system. The gas collection system for the proposed expansion will be expanded to provide full coverage as explained above. This system reduces a significant amount of greenhouse gases.

A landfill gas to energy feasibility study was completed in October 2011 for the site. Electricity generation and sale to the grid was recommended if long-term revenue incentives are secured. The City will consider the installation and operation of a landfill gas powered power plant in the future.

12.0 Landfill Development and Operation

12.1 Initial Site Preparation

Before wastes are received at the expanded landfill, the following activities will be undertaken:

- Relocate the existing compost pad and earth borrow area located north of the existing Landfill;
- Implement sediment control plan;
- Clear and grub the initial areas of construction (Cell 1);
- Strip topsoil from Cell 1 and other initial construction areas that will be regraded;
- Strip existing final cover for the overlap areas;
- Excavate and grade Cell 1 to proposed base contours;
- Construct berms to divert any surface water from the cell excavation area, and away from the lined area of Cell 1;
- Construct the liner and leachate collection system for Cell 1;
- Construct a new stormwater management pond and perimeter ditches;
- Construct the leachate pump station and leachate forcemain extension and connection;
- Construct initial perimeter road extension;
- Begin waste reclamation activities on Cell 1A (note: this may be deferred with commencement of Cells 1, 2 or 3); and
- Establish new groundwater and gas monitoring stations.

The City will ensure all the nuisance control measures are in place to minimize any environmental impacts during landfill construction, mining and operation activities.

12.2 Development Sequence

The proposed landfill expansion consists of seven cell areas (Cells 1 to Cell 7) and one landfill mining area (Cell 1A) as shown on *Drawing 4*.

The Cell Development Staging shown on *Drawing 4* assumes that each Cell will be constructed from Cell 1 to 7. Waste reclamation activities will be completed in Cell 1A following completion of Cell 1, 2 or 3.

The typical development of a cell is described below in general terms:

- Each cell will be excavated to proposed base grades as shown on *Drawing 3*. Dewatering and temporary stormwater control berms and ditches will be completed as needed to facilitate construction. Each new cell will have a base liner and leachate collection system installed as shown on *Drawings 3 and 6*.
- Landfilling will begin in each constructed cell;

- Landfill reclamation (mining) operations will be completed at Cell 1A. Once the Cell 1A reclamation operations are completed, a liner and LCS will be constructed in this area up to the maximum footprint shown on *Drawing 4*.
- A progressive filling/closure plan will be utilized throughout development of the Site in order to minimize leachate generation.

The City will continue to work within the existing waste disposal footprint and approved final contours until necessary approvals for the modified footprint are received from the MOECC.

Development of the north expansion areas will require the relocation/reconstruction of the compost pad, earth borrow areas and stormwater management pond. Development of the west expansion area will require relocation/reconstruction of the public drop off, maintenance garage, scale house and administration building prior to the development of Cells 3 and 6.

Access roads, drainage ditches and stormwater management ponds will be constructed progressively as needed during the development of the landfill.

An erosion and sediment control plan should be implemented during construction, mining and operations as per outlined in Section 9.3 of this report.

12.2.1 Development of Mining Cell 1A

In addition to the development sequence described above, the following is also applicable to the proposed landfill mining.

Access to the landfill mining area is available using existing roads. To accommodate processing equipment, working pads may be required.

Before waste excavation can commence, the following activities must be completed:

- Conduct landfill mining trial or pilot to assist in defining best practices for operations and odour management.
- Delineate areas to be mined, areas dedicated to the processing equipment, stockpiles and hazardous or suspect waste storage areas, and provide signs as necessary.
- Develop the Odour Management Plan.
- Implement erosion and sediment control measures.
- Excavate interim/final cover from the area to be mined and stockpile.
- If perched leachate is encountered, collect and dispose of leachate in accordance to the leachate management plan, prior to further excavation.

Existing site drainage should be maintained and modified as necessary to prevent run-on or run-off from the area being mined. In general, mining operations should be confined to designated areas. Additional swales, ditches or berms should be constructed as needed to control surface water drainage.
Mining operations should be monitored and documented to assess the performance of the equipment employed, evaluate the quantity and quality of the various material fractions and to recommend modifications or improvements to the operation. To the extent practical, the initial lift of waste placed over the LCS (where applicable) will consist of select waste, primarily consisting of domestic waste having a minimum of fines and soil. The initial lift of waste will provide a relatively high permeability waste layer directly over the LCS. This placement methodology will help prevent fines (soil particulates) from migrating into the LCS, contributing to the premature clogging of the LCS.

12.3 Hours of Operation (AECOM)

The maximum proposed hours of operation for the expanded landfill are Monday to Saturday, 7:30 am to 5pm, except for statutory holidays. The landfill management may decide to increase or decrease the hours of operations anytime within the maximum proposed hours of operation.

Landfill equipment may start internal operations one hour earlier or later to prepare or close the daily operations respectively.

12.4 Site Equipment

Basic functions to be performed by landfill equipment are:

- Waste grading and compaction; and
- Excavating and placing of daily and intermediate cover.

Typically, these functions will be performed by a landfill compactor and a dozer. A rock truck will be used to haul soil to the active area.

Other functions requiring equipment are landfill cell preparation, final cover construction, delivery of drop-off bin wastes to the working face, road maintenance, snow removal, and dust control. Some of these functions may be performed with on-site equipment, but others may require equipment to be leased or a contractor to be hired.

Routine maintenance and cleaning will be performed as necessary to keep on-site equipment in good operating order.

The following equipment is proposed for site management and disposal operations:

- 1 Landfill compactor;
- 1 D6 dozer;
- 1 Front end loader;

- 1 Rock truck;
- 1 Roll-off truck;
- 1 bobcat toolcat tractor with various attachments (snowblower, broom, bucket and forks);
- 4 pickup trucks;
- 1 Industrial tow-behind vacuum for litter pick-up;
- 1 Portable odour control turbine; and
- 1 Kubota 4 wheel drive used to monitor gas wells and the landfill gas collection system.

The following equipment is used to facilitate site composting operations:

- 1 Trommel screen;
- 1 Windrow turner;
- 1 Front end loader – borrowed from PW&T for summer use only;
- 1 Farm tractor – borrowed from PW&T for summer use only; and
- 1 Water truck – sourced from PW&T or a local Contractor on an as-needed basis to maintain adequate moisture content in the windrowed feedstock.

The following equipment is also proposed for the mining operations:

- 2 Trommel screeners;
- 1 Hydraulic stacker (stacking conveyor);
- 1 Grinder;
- 2 excavators fitted with hydraulic "thumbs";
- 1 bulldozer Cat D7; and
- 2 articulated trucks Cat 735.

12.5 Landfill Staff

Operations will be undertaken by City staff but may be contracted to a third party in the future. All employees working at the landfill will be properly trained for the jobs that they will be expected to perform. The following gives a brief description of the staff at the landfill.

Landfill Site Management

The Landfill Management staff are responsible for the operation of the Landfill. They oversee and co-ordinate day-to-day operations at the site.

Equipment Operators and Labourers

Under the direction of Landfill Management staff, the Equipment Operators and Labourers are responsible for operating and maintaining mobile equipment used for waste handling and disposal operations, site maintenance and housekeeping and other assigned work tasks.

Administrative Personnel
Administrative personnel will be employed at the landfill to conduct work as directed by Management staff.

Continuing on-the-job training will be provided for all employees. The training will emphasize the safe and environmentally sound operation of the landfill. All employees will be given safety training covering all equipment and systems with which they will be expected to interact on a daily basis.

12.6 Daily Operations

Waste will be placed utilizing the area method in which the waste will be placed and compacted on previously filled areas or the prepared base, where applicable, and covered with daily cover soil at the end of each working day.

Daily cover should be applied at the end of each operating day and will consist of a 0.15 metre thick layer of soil, fines generated from mining operations or an alternative cover material. Cover material will be obtained through progressive excavation of adjacent cells, import of soil from construction projects, disassembly of soil berms, street sweeping, non-hazardous contaminated soils, and snow. Any potential deficiencies may be accommodated by alternative cover material.

Intermediate cover will consist of a 0.3 metre thick layer of soil, fines generated from mining operations or alternative cover material and will be placed on disposal areas which remain inactive for long periods of time, after which landfilling will resume until final contours are reached. Intermediate cover will be stripped or scarified prior to the resumption of landfilling, in order to promote hydraulic connection between waste lifts.

Interim stormwater berms will be constructed as required in each stage to divert clean surface runoff from the disposal footprint and thus reducing the leachate quantity.

12.7 Final Cover

A progressive final cover placement program will be utilized throughout development of the site in order to maximize surface water runoff, thereby reducing the amount of infiltration into the landfill area and consequently minimizing leachate generation. Final cover will be progressively placed over all areas of the landfill that have reached final contours. The final cover will be constructed with a 0.85 m soil layer overlain by a 0.15 m layer of soil capable of sustaining vegetation.

12.8 Environmental Monitoring (Public Liaison) Committee

An Environmental Monitoring Committee (Public Liaison) exists for the existing Sault Ste. Marie Landfill. This committee has been kept aware of the proposed expansion throughout the EA process. It is anticipated that the committee will continue to be active into the future and will serve as the focal point

for dissemination, review and exchange of information and monitoring results relevant to the Site. Any changes to committee membership will follow an open transparent application process.

13.0 Site Maintenance and Control Measures

13.1 Access and On-Site Traffic Control

Access to the site is provided from Fifth Line and controlled by a gate which is locked during non-operating hours. Security cameras are also mounted on poles adjacent to the scale house to monitor activity during non-operating hours.

The Site will be supervised during operating hours. This will ensure that vehicles will be directed to an appropriate area (i.e., public drop-off, working face or waste diversion facilities). Traffic control is provided by traffic signals mounted at each end of each weigh scale. Traffic signals are semi-automated and controlled by the weigh scale attendants.

The weigh scale attendants will also be responsible for vetting customers to confirm they reside within the approved service area. This may include questioning customers on the inbound weigh scale or asking them to provide identification to confirm their residency.

13.2 Waste Control

Vehicles delivering waste are required to stop at the weigh scale to confirm waste types and vehicle weight with the scale house attendant. If a load is considered "unacceptable," (i.e., waste type or materials not identified on the ECA), the attendant will have the authority to reject the load.

Another opportunity for waste control is at the working area and drop-off areas. Equipment operators and other staff will be trained to recognize non-permitted wastes. If "unacceptable" waste is identified when a vehicle is unloading, it will be reloaded back into the source vehicle for removal. If the source vehicle has left the site, the unacceptable waste will be segregated and the hauler/generator will be contacted and asked to remove the waste promptly. The rejection and action will be recorded and kept with the site operating records.

If a waste is suspected to be hazardous, it will be segregated and assessed. The hauler will be informed of the receipt of the waste, its storage and any testing that is required to confirm the nature of the waste. Each event will be reported to MOECC. If the waste is confirmed to be hazardous, the operator will obtain an Emergency Generator Number and waste number from the MOECC, and arrange to have the waste removed for proper disposal at an approved hazardous waste site. The costs of testing and handling of all suspect waste will be charged to the hauler.

If the waste is proven to be non-hazardous and “acceptable”, results of testing will be provided to the hauler and generator (via the hauler) and the MOECC. The waste will be sent back to the working area for disposal.

13.3 Litter Control

Security of loads is a matter of public safety and is mandated through the Ontario Highway Traffic Act. Regulation 363/04 "Security of Loads" adopts Canada's *National Safety Code* 10 Cargo Securement published by the Canadian Council of Motor Transport Administrators (CCMTA). The standard is based on consultations with all provinces, territories and Transport Canada. Motor vehicle operators must ensure loads do not fall or become dislodged from their vehicle.

Given the nature of landfilling operations, as well as waste mining activities, litter control is however needed within and adjacent to the site. Several measures can be taken to minimize the amount of wind-blown debris leaving the active disposal area of the Landfill. Control measures can be divided into two groups: preventative measures to limit the generation of litter and regular maintenance measures to collect and prevent litter from leaving the site. Litter inspections will be carried out around the perimeter of the Site on a monthly basis.

The following preventative actions will be taken to control and minimize the amount of litter generated at the Site:

- All vehicular traffic transporting waste to and around the Site will have loads secured to prevent waste from becoming dislodged or blowing out of the vehicle;
- Daily cover soils will be placed over the working face of the landfill in order to minimize the blowing of debris;
- Waste will be compacted to reduce blowing litter;
- The active face of the landfill and waste reclamation areas will be kept to a minimum, especially on windy days. This may be accomplished by placing daily cover soils over a portions of the active face, should windy conditions warrant this action; and
- Portable litter control fences will be utilized at the active face of the landfill, if required, to prevent wind-blown litter from leaving the active disposal area. Temporary (i.e., snow fences) or permanent litter control fences may also be used around the perimeter of the landfill, if required.

Under normal operating conditions and with the implementation of the above control measures it is still expected that some litter will be blown from the active landfill area. The landfill operator will carry out monthly inspections around the perimeter of the site. Any wind-blown litter observed during the inspections will be collected through both manual and mechanical methods and returned to the active landfill area.

13.4 Odour Control

Landfill odours may originate from the waste (at the working face), landfill gas, leachate or waste reclamation (mining) activities. The following odour control program is consistent with the Air Quality

and Odour Impact Assessment Report prepared for the landfill expansion EA and should be implemented.

As practical as possible, operations activities that can potentially generate high levels of odours should be completed during favourable meteorological conditions. When possible, avoid performing activities with high potential to generate odour when the wind is blowing in the direction of the sensitive receptors.

Odour complaints should be immediately investigated and remedial actions implemented as soon as possible.

13.4.1 Odour Control during Regular Landfill Operations

Waste odour is typically generated by recently disposed waste and is controllable by various mitigation measures. Wastes with very strong odours will be placed at the toe of the working face and will be immediately covered with other waste or daily cover. The size of the working should be minimized to reduce exposed waste and odour potential. The proper application of cover material at the close of the day will aid in controlling odour. If required, odour suppressing agents applied directly at the working face or at the site perimeter will be used as an additional measure to control waste odours.

Landfill gas odour is generated during the anaerobic decomposition of organic waste material. Landfill gas may be released at cracks or fissures in the cover soils long after landfilling has taken place. Depending on weather conditions, these may create an odour problem if landfill gases are being released in sufficient quantities. Regular inspections can identify cracks or fissures that must be repaired by filling with cover soil. The existing landfill gas management system helps to reduce landfill gas odours by extracting the gas and burning in a flare.

If landfill gas odours become problematic, a number of measures can be taken, including the following:

- Identification and elimination of any potential source of odour;
- Placement of additional cover material;
- Repair fissures in the final cover;
- Application of de-odourizers; and
- Expand the landfill gas collection system. The gas management system shall be systematically expanded as cells are filled to capacity (final contours).

Odour problems from leachate can occur where it is exposed to the atmosphere in manholes and pump stations. Leachate may also be exposed to the atmosphere if leachate seeps develop. Leachate will be collected and discharged to the sanitary sewer system by means of a forcemain. Any leachate seeps will be promptly repaired. The leachate collection system should be properly operated and maintained to minimize the build-up of potentially odourous leachate.

13.4.2 Odour Control during Mining Operations

Once mining operations are introduced, new odour impacts should be managed. A preliminary odour management plan (OMP) was prepared as part of the EA. The odour mitigation measures to be implemented during mining operations are categorized into operational and administrative actions and are summarized below.

Table 13.1: Summary of Proposed Operational Odour Control Measures for Waste Mining

Operational Control	Description
Minimize the area of active excavation	· The area of active excavation would be minimized to one day's production wherever possible, and would be covered as soon as possible with soil · This would minimize exposing freshly excavated waste to the air, which could cause significant odour emissions · All reasonable precautions would be taken to prevent the movement of adjacent material when waste is being mined
Increase the slope of excavation	· The slopes of exposed waste are expected to be between 4V:1H and 2H:1V. A steeper slope will expose less waste and will minimize odours. Considerations should be given to slope stability. · The waste slopes should be inspected before the start of each working day.
By-pass screening of waste where highly odourous waste may be excavated	· Some types or ages of waste may have higher odour generation potential than others. For example, older waste typically generates fewer odours than newer waste · Site operators should by-pass screening of waste with known high potential for odour generation
Avoid mining in areas of known or suspected to have perched leachate	· Encountering perched leachate during mining could cause odour emissions · Leachate impacted water encountered during mining would be pumped using tanker trucks or other methods and disposed of appropriately as soon as possible · Drain the leachate from area to allow mining if practical.
Manage operations based on meteorological conditions	· As with typical landfill operations, site operators should consider meteorological conditions to mitigate potential off-property odour emissions · Examples include avoiding mining on hot days, mining during wet days wherever possible, and avoiding mining when winds are blowing strongly in the direction of residences or other sensitive odour receptors · Observations documented during similar waste mining projects completed by others indicated reduced odour generation by conducting waste mining activities during the colder months of the year
Use chemical and/or biological	· The City has experience using odour neutralizing agents and an

Operational Control	Description
treatment to reduce the significance of odour	odour fogging machine at the landfill and should continue this practice · The waste mining process would include the use of this existing equipment at the location of the mining where feasible, and use of additional chemical odour controls as required

The administrative controls presented in *Table 13.2* will be implemented at the Site, to support the operational mitigation measures to control odour impacts from waste mining.

Table 13.2: Summary of Proposed Administrative Odour Control Measures for Waste Mining

Administrative Control	Description
Process-specific employee training	· Landfill employees associated with the waste mining process should receive training in the operational controls and related Standard Operating Procedures (SOPs)
Contractor selection	· A contractor for the project will be selected that demonstrates adequate experience with similar waste mining projects, and knowledge of how to effectively manage odours · The contract for the project will incorporate requirements to strictly comply with the SOPs
Monitoring program	· The construction contract will include a requirement for the periodic collection and analysis of air samples
Routine inspections	· Daily inspections will be completed of the active waste mining area(s) to document Site conditions, adherence to the control measures and SOPs, and potential odour impacts

To effectively mitigate the potential for odour impacts during waste mining operations, an OMP specific to the site and proposed equipment means and methods will be prepared by a consultant retained by the mining contractor (or by the City directly) documenting procedures for odour management. The plan will be based on the MOECC's recommended FIDOL (frequency, intensity, duration, offensiveness and location) approach. Environmental parameters such as temperature, humidity, wind direction and speed will be monitored as part of the OMP.

13.5 Dust Control

Dust generation is common at most landfill sites due to the handling of soils and the movement of vehicles along gravel and dirt roads. Dust impacts result from: landfill site traffic, landfill operation, waste excavation and screening, soil borrow operation, and wind erosion. Dust in the vicinity of a landfill site should not be problematic under normal conditions and is usually controllable.

To ensure dust does not become a problem at the site during normal or extremely dry and windy conditions, the following control measures will be implemented:

- The extent of the waste reclamation area and soil handling operations will be minimized during high wind conditions;
- Vegetation will be established on inactive areas, if required, to minimize wind erosion; and
- If dry conditions warrant, a dust suppressant will be applied to the on-site roadways, soil borrow areas, and active disposal area.

13.5.1 Dust Control during Mining Operations

Mining operations have the potential to generate dust during dry periods (usually in the summer when the ground is dried up by higher temperatures). Dust can be generated by typical mining operations such as cover stripping, waste and soil excavation, screening and heavy equipment and truck traffic.

Dust is a concern because it may reduce visibility, generate airborne contaminants and potentially may become a nuisance to off-site receptors if not controlled at the source. Airborne contaminants should be controlled because they represent a safety hazard to site personnel and should be addressed in the health and safety plan.

A dust and airborne contaminant management plan should be prepared and implemented by the mining contractor and approved by the City and the contract administrator retained by the City. The dust and airborne contaminant management plan should include equipment used to control dust and describe the liquid and rate that will be applied. Monitoring procedures should also be included in the dust and airborne contaminant management plan.

13.6 Noise Control

Potential noise impacts from the site may result from operation of the landfill equipment and/or waste reclamation operation equipment. The operation of this equipment will be conducted in such a manner as to minimize noise impacts, whenever possible. In order to reduce the noise impacts to surrounding residents, operation of landfill equipment will not be undertaken prior to 1 hour before and no later than 2 hours after the approved hours of operation.

All operation equipment used during landfill construction, landfill operation and waste reclamation activities will comply with the noise level limits outlined in the *"Noise Guidelines for Landfill Sites"* (MOE, 1997). In addition, a landfill equipment maintenance program will be implemented at the site with particular attention to maintaining and where feasible, improving the noise muffling systems on landfill equipment.

The Noise Impact Assessment prepared by Dillon for the proposed expansion recommends the construction of a 2.5 m high, 150 m long soil berm to mitigate noise from the proposed leaf and yard

waste composting facility. The proposed noise mitigation berm should be constructed before the operations of the proposed leaf and yard waste composting facility starts. *Drawing 2* of the Design and Operations Report shows the noise mitigation berm location.

13.7 Vector Management Plan

The terms vector and vermin refer to objectionable insects, rodents, birds and wildlife that may establish a habitat at a landfill. Common landfill vector and vermin include flies, rats, gulls and bears. The presence of animals at landfill sites is of concern because they represent potential pathways for the dissemination of disease to humans and domestic animals. Animals that can harbour or carry pathogens that may cause disease are collectively known as vectors. Disease may be transmitted by vectors through direct or indirect contact with humans.

Animals may be attracted to a landfill because site features offer suitable foraging habitat. Consequently, they may move onto the landfill temporarily or permanently. Secondly, animals may arrive at a landfill by chance as part of refuse delivered to the site. Because the working face is compacted and covered daily, rodents and insects do not survive and do not typically create problems.

Bears are expected to be present on Site. Daily, intermediate and final cover should minimize the attraction to bears. If bears become problematic, an electrical fence may be installed around the active working face and energized during the active bear season.

The following control measures will be undertaken should other vector and vermin become problematic:

- Flies are a common occurrence at any type of waste disposal operation. The flies breed and maggots develop in particular within food wastes. The application of daily cover will ensure that the matured flies are unable to escape the waste material, thus controlling the fly population.
- The occurrence of rodents is reduced by the application of daily cover. These creatures are attracted to landfill operations by the odour of the waste, particularly food wastes. By applying daily cover and continually advancing the working face, the attraction is eliminated. Should rodents be noted to extensively inhabit the Site, then extermination will be conducted by a licensed exterminator, on an as-required basis.
- The bird species most commonly present at a landfill site is the gull which is attracted by food wastes. The application of daily cover will help minimize the attractiveness. Should the presence of gulls at the Site become problematic, then more aggressive measures should be undertaken to control and discourage them. Several methods are available that aid in discouraging the presence of gulls including hawking and erection of an overhead mesh.

13.8 Fire Control

Accidental fires at landfills are rare. They are caused by two processes. The more common is a surface fire caused by undetected hot loads that are landfilled. Hot loads (i.e., loads that are smoking or visibly burning) may arrive at the site. Staff will monitor all vehicle arrivals for signs of a hot load. In the event that a hot load arrives on-site, the driver will be directed to an isolated area of the landfill to prevent a fire at the working face. The vehicle will then be unloaded and the fire smothered with soil.

Much less common is a subsurface fire resulting from the spontaneous combustion of wastes, usually caused by inappropriate operation of a landfill gas collection system drawing air into the landfill.

A fire plan has been developed by the City and staff will be trained regarding its contents. The following measures are in place at the landfill to either reduce the potential for fires, or to react to fires in the event they occur:

- No smoking is permitted in the landfill;
- A stockpile of clean fill material is maintained adjacent to the working face for smothering any accidental fire;
- Burning of waste is prohibited at the site; and
- Suitable fire extinguishers are kept and maintained in working order in all structures and landfill vehicles and equipment.

Site staff will be trained in the prevention and detection of fires along with the procedures to be followed in case of fires. Fire Services will be called to investigate and respond to fires other than small incidental fires brought under control by the landfill staff.

13.9 Site Inspection and Maintenance

13.9.1 Inspections

Regular Site inspections will be conducted by landfill personnel to verify that nuisance factors associated with housekeeping procedures, such as dust, litter, and odour, are under control, thereby, preventing routine operational nuisances from developing into more serious environmental problems. Inspections should be conducted at the frequency indicated below. Written records should be maintained of site inspections, including the following information:

- Time and date of the inspection;
- Name of the personnel conducting the inspection; and
- Recommendations for any remedial actions to correct the deficiencies and the date when the remedial actions were completed.

Daily Inspections - The following items shall be inspected on a daily basis:

- Weather, date, operators, wind direction;
- Hauler non-compliances (e.g. not following site rules);
- Adequacy of daily cover material;
- Evidence of unacceptable wastes and illegal dumping;
- Need for dust control on working areas and access roads;
- Unacceptable levels of odours; and
- Evidence of leachate discharge to surface in the immediate vicinity of the working face.

Weekly Inspections - An inspection of the entire Site and all equipment active and in use at the Site shall be conducted each week to ensure that the Site is secure, that the operation of the Site is not causing any adverse effects on the environment and that the Site is being operated in compliance with its ECA. Any deficiencies discovered as a result of the inspection shall be remedied immediately, including temporarily ceasing operations at the Site, if needed.

The areas to be inspected shall include, but not be limited to the following:

- Condition of the active disposal area;
- Condition of the surface water drainage works (on-site ditches and stormwater management ponds);
- Presence of any ponded water at the site;
- Condition of the on-site roads for evidence of excessive erosion, mud and/or waste and fugitive dust emissions;
- Condition of any soil stockpiles for evidence of excessive erosion;
- Presence of litter at the site's perimeter and litter fences;
- Condition of the intermediate cover and of the final cover;
- Presence of vector, vermin, scavenging birds and other animals (e.g. bears);
- Condition of the on-site facilities, the gate and its lock and the signs required by the ECA;
- Amount of cover material to ensure that sufficient daily cover is available at all times that the site is in operation;
- Waste handling practices; and
- Evidence of leachate seeps over the entire landfill area.

Monthly Inspections - The areas to be inspected on a monthly basis shall include, but not be limited to the following:

- Landfill final cover for evidence of vegetative stress; and
- Side slopes of the landfill.

The drainage ditches shall be inspected on a semi-annual basis during spring and fall to identify any clean-out requirements. If clean-out is required, it will be completed promptly. Weed removal on the ditch network shall be conducted as required.

Mining operations will be monitored and documented to assess the performance of the equipment employed, evaluate the quantity and quality of the various material fractions and to recommend modifications or improvements to the operation.

13.9.2 Routine Maintenance

A routine maintenance program shall be employed at the site to keep the site clean and in working order. The following activities will be included in the routine maintenance schedule:

- Entrance areas, gates, and signs will be maintained to provide safe access to the site;
- The site access perimeter roads will be maintained as required to address pot holes or other surface deficiencies. This will ensure good all-weather access throughout the site;
- All buildings will be kept in a clean, tidy appearance, and repaired as required;
- All equipment and machinery will be checked and tuned. Repairs will be undertaken, if necessary;
- All ditches and the stormwater quality ponds will be re-excavated and graded and all culverts cleaned, as necessary, to keep them clear of silt, debris, and weeds;
- Areas where landfilling will not be carried out for extended periods and where erosion has resulted will be re-graded and, if required, will receive additional earth cover;
- Finished areas will be routinely checked for erosion and will be re-graded and vegetated, as necessary; and
- The leachate collection system will be video inspected annually for the first five years after placement of waste overtop each pipe and then at a frequency indicated to be necessary by the video inspection. Any necessary cleaning will be based on the results of the initial and continuing video inspections.

13.10 Additional Controls for Landfill Mining

Given the proposed landfill mining of Cell 1A, additional controls may be required. As part of research conducted on the potential key hazards associated with landfill mining, odour impacts and exposure to asbestos and other hazardous materials were identified. Based on the research of mining projects in Ontario and the United States, the following are potential measures to mitigate odour impacts and exposure to asbestos and other hazardous materials.

Approaches to Manage Odour Emissions

- Conduct landfill mining during winter months and potentially night operations;
- Efficient operation of landfill gas collection systems and progressive expansion as the expansion areas reach final contours;
- Use of odour suppressants applied to the working area;
- Use of a small excavation area;
- Development of site-specific operations and odour management plan that may include:
    - Triggers (e.g., measured concentrations of gases, meteorological conditions) for stopping operations;
    - Odour monitoring and daily inspection program;
    - Remedial actions to be taken in the event of elevated concentrations being measured; and
    - Odour complaint and response program.

· Conduct an initial pilot program to fine tune odour mitigation strategies.

Approaches to Manage Potential Exposure to Asbestos and Other Hazardous Materials

- Develop a site-specific health and safety plan for asbestos/hazardous material, with plan requirements pre-identified by the City.
- Develop protocols to deal with asbestos and other hazardous materials if exposed.
- Do not screen/process potentially hazardous materials.
- Deal with likely or known asbestos containing areas during favourable weather conditions.

13.11 Spills Procedure

The Spills and Hazardous Materials Procedure issued by the City should be followed in case of spills of oil and other hazardous materials with in the site (refer to *Appendix A*).

14.0 Monitoring and Reporting

Development and operation monitoring is undertaken to ensure proper construction, operation, and maintenance of the site. Environmental monitoring is concerned with observing and recording changes in the environment to forecast and manage impacts off site.

The following sections describe the proposed inspection, monitoring, and reporting programs for the landfill expansion.

14.1 Development and Operation Monitoring

Landfill development will be monitored and documented annually. Landfill operation will be monitored and documented monthly. Inspection records will be maintained, detailing the installation of all site facilities and any remedial activities carried out. Site development will be discussed in the annual reports.

14.1.1 Development Monitoring

Landfill development will be monitored and recorded to assess the progress of site development and to compare with waste capacity, soil excavation, and leachate generation calculations performed during landfill design. The type of records that will be maintained by the landfill operator include the following:

- Volumes of soil excavated on site;
- Volumes of any clean or non-hazardous contaminated fill brought to the site from off-site sources;
- Volumes of excavated soil (cover materials) stockpiled;
- Estimates of combined quantities of daily, intermediate and final cover used;
- Volume of leachate collected and pumped for treatment off-site; and
- Volume of waste mined, separated out and re-landfilled.

Cover soil records will be used to assess the current cover needs and forecast future requirements.

The data obtained through development monitoring will be summarized in the annual development and operations reports.

14.1.2 Incoming Waste Records

Every waste vehicle entering the site will stop at the inbound and outbound weigh scales, where the driver will check in with the weigh scale attendant. With each vehicle passing over the weigh scale, the attendant will note the following information:

- Incoming weight of vehicle;

- Origin of waste by municipality or name of operator and haulage business;
- Vehicle identification (truck number or driver name);
- Nature of waste being disposed (residential, IC&I, C&D, biosolids);
- Type of material (recyclables, waste);
- Type of vehicle (packer, roll-off, dump truck, private vehicle, etc.); and
- Outgoing weight of vehicle.

Every vehicle entering the site will be recorded by the weigh scale attendant. Frequent users will be logged against existing business accounts or municipal contacts.

The scale house attendant will ensure that all material entering the site is recorded including waste type, source, and quantity/weight of each load. Corresponding records for recyclable/reusable materials received at and removed from the site will also be maintained. All records mentioned above will be maintained and retained at the legal address of the owner, for a minimum of three (3) years, and made available for review upon request of the MOECC. The amount and type of wastes received at the site will be summarized and presented in the annual operation reports.

14.2 Environmental Monitoring

The following monitoring programs are proposed for the Sault Ste. Marie Municipal Landfill expansion and are consistent with the existing monitoring program which involves:

- groundwater water monitoring for levels and chemistry,
- pump station monitoring,
- surface water monitoring,
- methane gas monitoring, and
- data interpretation and reporting.

14.2.1 Groundwater and Leachate Monitoring

The groundwater monitoring program for the proposed expansion will utilize existing monitoring wells. Additional replacement monitoring wells will be required as existing wells will be required to be decommissioned as a part of the construction of the landfill expansion. The locations of the groundwater monitoring wells that are available as well as proposed monitoring well locations are shown on *Drawing 9*. Groundwater monitoring wells are selected to provide sufficient chemical information to evaluate the impact of the landfill site on ground water quality.

The sampling frequency associated with the expansion will remain the same for the groundwater program (three times per year - Spring, Summer and Fall).

Ground water elevations for all accessible monitoring wells on-site will be obtained in conjunction with ground water sampling events. Categories of chemical parameters included in the analyses undertaken are general chemistry, major and minor ions, trace metals and volatile organic parameters. The target parameter list is based on that recommended in Schedule 5 of O.Reg. 232/98.

Currently, there are 38 ground water monitoring wells in the existing sampling program that were chosen for their strategic locations and potential to detect changes in ground water chemistry as a result of leachate generation in the refuse pile. *Table 14.1* summarizes the function of each monitoring well used.

Table 14.1: Monitoring Wells Used as Indicators of Contaminant Plume Movement

Background Ground Water Quality	23-IV, 72
Western Groundwater Monitoring	29-II (New), 52-I*, 53-I*, 56-I*, 57-I*, 58-I (New), 58-II (New), 61-I, 61-II, 62-I, 62-II, 63-I*, 63-II*, 64-I, 65-I, 65-I (New), 66-I, 67-I, 68-I, 69-I, 70*, 71*, 73, 74, 75, 76, 77, 78
Eastern Groundwater Monitoring	39-IV (New)
Southern Groundwater Monitoring	31-I, 31-IV, 32-I, 35-III
Source Characterization	51-I, A5-I

*some wells will be decommissioned and replaced as the landfill expansion is developed.

The environmental monitoring program will be discussed in the annual reports.

14.2.2 Surface Water Monitoring

Surface water quality samples are obtained and analysed to provide a general assessment of the surface water quality conditions near the Sault Ste. Marie Municipal Landfill site. The existing surface water monitoring program includes the collection of water samples at sampling points along Canon Creek and the Root River. No new monitoring locations are required for surface water monitoring at the site since the landfill expansion will not result in proximity to any new surface water that is not already part of the existing surface water monitoring program.

The existing landfill monitoring program has taken surface water quality samples at five locations, stations S-1B, S-2, S-3, S-4 and S-5. These locations and others are described below and shown on Drawing 10.

Station	Description
S-IB	Canon Creek upstream
S-2	Root River upstream
S-3	Canon Creek adjacent to the landfill site
S-4	Meander area
S-5	Root River downstream
S-8	Root River at Highway 17
S-9	Root River at Fourth Line
S-10	West Branch of Root River at confluence with East Branch.

The samples collected are analysed for general parameters, nutrients, mercury and trace constituents (metals and phenols). The target surface water parameter list is based on that recommended in Schedule 5 of O.Reg. 232/98.

14.2.3 Landfill Gas Monitoring

The monitoring program currently consists of monthly measurements of gas in five gas monitors (M3, M4, M5, M6 and M7). The need to install new gas monitors will be assessed as new facilities are built or existing facilities are relocated and the monitoring program evolves.

The landfill gas monitors will be monitored using a portable gas analyzer to measure gas composition. An electronic water level meter will be used to monitor for water presence within the gas monitors on a quarterly frequency, and if so the depth of water in the monitor will be recorded.

14.2.4 Leachate Collection System Monitoring Program

Leachate collection system samples will be collected from the pump station on four occasions during the sampling year. The target leachate parameter list is based on that recommended in Schedule 5 of O.Reg. 232/98.

14.2.5 Residential Water Well Monitoring

A residential water well monitoring program will be implemented as part of the landfill expansion. It is recommended that residences along the Fifth Line from Highway 17 to Old Goulais Bay Road should be included in the residential water well monitoring program.

Water samples from the residential wells included in the monitoring program will be taken on an annual basis. Where possible, samples will be taken from the wells prior to any treatment systems such as water softeners. Water samples will be analyzed for the parameters included in the indicator and

comprehensive list of Schedule 5, of the Landfill Standards (the same target parameter list for on-site monitoring wells).

14.3 Maintenance of Monitoring System

The network of groundwater monitoring wells and gas monitors will be inspected annually and changes in the physical condition of all monitoring facilities will be noted. Minor repairs will be completed, as necessary. Monitoring wells damaged beyond repair, or whose integrity is judged to be in doubt for continuous monitoring, will be abandoned in accordance with standard abandonment procedures (O.Reg. 903) and, if necessary, will be replaced by a licensed driller.

14.4 Complaint Response Procedure

During the operation of any landfill, complaints regarding litter, dust, traffic, odour, noise, vectors and bears may occur. A complaint of any nature will be recorded by landfill staff and resolved as soon as possible after notification. This will assist in maintaining good community relations. The telephone number for complaints will be made available for the public on the City's website and will be posted on a sign at the site entrance.

Complaint forms will be completed when a verbal complaint is received. This form will be kept on file, along with copies of any correspondence or other records of discussions with the complainant. The form will indicate the following information:

- Date and time of day that the complaint was received;
- Date and time of day the complaint incident occurred;
- Complainant's name, address, telephone number, and the location of the incident relative to the site;
- Nature of the complaint (noise, dust, odour, etc.);
- Receipt of complaint (by phone, or site visit, and staff which received the complaint);
- Nature and result of any investigation or follow-up; and
- Weather conditions and meteorological measurements at the time of the complaint.

Weather conditions at the time of a complaint will be noted. In some instances, this information could be used to validate the complaint (e.g., wind speed and direction).

A summary of complaints will be provided in the annual report.

14.5 Annual Reports

To assist in the tracking of site progress and performance, a site development and operations report and an environmental monitoring report will be prepared annually and will cover a twelve-month period. Both reports will be submitted to the MOECC and the Environmental Monitoring Committee.

14.5.1 Development and Operations Report

Generally, a condition in the ECA requires the preparation and submission of an annual site development and operations report. A yearly audit of the operation provides a forum for communication with the MOECC and the public. The report would include:

- An update of the site development showing the areas of excavation and landfilling;
- Any deviations from the operating plan and the reasons for the deviations;
- A summary of the volume of waste and waste types received over the reporting period;
- An estimate of the amount of cover material used in the operations;
- An estimation of the remaining capacity and expected site life of the site;
- An overall assessment of the landfill operation;
- A description of major construction works undertaken in the past year;
- A summary of complaints received during the past year; and
- A description of any significant environmental problems and mitigation measures implemented.

14.5.2 Environmental Monitoring Report

The results of the monitoring program will be summarized in an annual monitoring report. This report will consist of a presentation of the results of the monitoring data, and an assessment via comparison to both historical data and applicable criteria. Recommendations will be made, as necessary, for changes to the monitoring programs. As additional data are acquired, and the understanding of the significance of changes to monitoring results is enhanced, the frequency of reporting may be modified with the concurrence of the MOECC.

An annual monitoring report will be produced. This annual monitoring report will contain the following information:

- A review of the contingency plans;
- A characterization of the site hydrogeology, including up-to-date groundwater levels and flow directions;
- Groundwater sampling and groundwater level measurement protocols;
- Groundwater quality data collected during the current year and previous years;
- An analysis of the groundwater quality data in which trends will be identified;
- An analysis in which the concentration levels will be compared to “Reasonable Use Guideline” criteria;

- Surface water quality monitoring, analysis of trends and comparisons to PWQO criteria;
- Results of measurements of subsurface landfill gas (methane) concentrations and comparison to concentration limits;
- Results of leachate monitoring; and
- Results of residential wells monitoring.

15.0 Site Closure

15.1 Site Closure Works and Closure Plan

During landfill development, final cover and seeding will be applied progressively to portions of the fill area that are completed. Consequently, site closure will involve reaching final waste elevations over the last remaining area of the landfill followed by the application and seeding of final cover in that area. The entrance gate will be retained to control access.

Long-term maintenance will be concerned primarily with maintenance of the final cover and leachate management systems. Erosion, ponding from settlement, and leachate seeps will be corrected, as required. Typically, regular inspection and monitoring takes place for a period of two years after site closure, after which a long-term monitoring and care program is established.

A Closure Plan will be submitted to the Regional Director of the MOECC for approval when the landfill site is five years from its projected closure. A closure plan appropriate for this site would include:

- Final site contours and stormwater management plan;
- Operation plan up to site closure;
- Details on final grading, cover system, and the source of cover materials;
- Details on vegetation, landscaping, and end use of the property;
- Proposed maintenance and long-term care schedule, including the on-site leachate management system and gas management system;
- A long-term monitoring plan for gas, leachate, groundwater and surface water; and
- A contingency plan for gas and groundwater and surface water quality protection.

15.2 Post-Closure Care

Long-term maintenance will be concerned primarily with maintenance of the final cover, leachate management system and gas management system. Erosion, ponding from settlement, and leachate seeps will be corrected, if and as required. Typically, regular closure inspection and monitoring takes place for a period of two years after site closure, after which a long-term monitoring and care program is established.

15.3 End Use

An end use will be developed when the site is approaching closure.

16.0 Contingency Plans

A contingency plan is a response to a recognized but unexpected failure event. A contingency plan is required by O.Reg. 232/98 which is defined as "an organized set of procedures for identifying and reacting to an unexpected, but possible occurrence" (MOECC, 2012). The contingency plan consists of a predictive monitoring program (see above), establishing trigger levels for investigation and response and a description of potential contingency measures.

16.1 Groundwater Contingency Plans

The new landfill system is predicted to have maximum impacts well below allowable RUG concentrations immediately below the landfill.

A typical contingency measure for a landfill would be to establish a CAZ to mitigate impacts and prevent off-site impacts. While there is an existing CAZ established for the existing landfill, the landfill expansion will occupy a significant portion of it. Current down gradient land use west of the site consists of a hydroelectric transmission corridor with an aggregate extraction pit down gradient of the transmission line. Both of these land uses are conducive to the establishing of a CAZ in the unlikely event that such a contingency is required.

Contingency measures for the south portion of the existing site consist of the maintenance and replacement, if necessary, of the existing horizontal collection system. The horizontal collection system is located beyond the fill area and can be maintained or replaced if necessary throughout the contaminating lifespan of the existing fill area.

Municipal water is available to current residences along Fifth Line to the west of the site.

Residents south and east of the site remain on private wells. Impacts are not presently occurring to the south and east of the landfill based on the monitoring program data. Extension of the municipal water system to residents south and east of the site could be completed as a contingency measure if monitoring data indicates the potential for water quality impacts in this area.

Additional groundwater protection contingency measures include a north-south horizontal collector system installed within the expansion area or a new purge well system installed west of the existing area to provide groundwater protection to the area west and southwest of the new and existing fill areas.

16.2 Surface Water Contingency Plan

The water quality in the SWM Ponds will be monitored regularly to ensure that it meets surface water quality objectives (refer to Section 14.2.2). Water quality monitoring, coupled with routine site inspections, will prompt maintenance or changes in operational practices to minimize surface water impacts.

If surface water quality objectives are exceeded in any of the SWM Ponds, the impacted water will be directed to the leachate collection system. Alternative measures include recirculation of contaminated surface water back into the landfill, or removal by tanker truck to the municipal wastewater treatment plant.

When operating with valves in closed position (after two consecutive water sampling events indicate exceedances to the trigger parameters), the SWM Ponds will be operated in batch mode. Before releasing of water from a SWM Pond, samples will be taken and tested for contamination. Therefore, there will be no discharge to off-site watercourses until water quality has been confirmed.

In a contingency situation, the SWM ponds have sufficient storage such that discharge of water from the site would be retained by leaving the outlet closed for rainfall events. This would allow for immediate testing of pond water quality and identification of the source of contamination.

Uncontrolled leachate breakouts or accidental spills detected by site inspections may also trigger the contingency plan. In such a case, early detection can minimize or effectively eliminate impacts to surface water, particularly if containment of the contamination and repair of the landfill cover is undertaken promptly.

In case of a sudden acute release of fuel or other hazardous material (spill), the procedures outlined in the Spills and Hazardous Materials Procedure issued by the City should be followed (refer to *Appendix A*).

The potential for impact on surface water as a result of the discharge of contaminated groundwater to surface water is low. The proposed groundwater monitoring program will identify potential groundwater contamination before it can be discharged to surface waters. In the event that groundwater contamination is identified, contingency measures as described in Section 16.1 will be implemented as appropriate, resulting in the protection of both groundwater and surface water resources.

16.3 Landfill Gas Contingency Plan

In the event that monitoring of subsurface LFG migration reveals that unacceptable levels of landfill gas are occurring in the subsurface, the first response will be to ensure there is no imminent hazard (e.g., explosion hazard at on-site building). Next, an investigation will be conducted to confirm whether the landfill is the source by the installation and monitoring of additional gas probes. If the source is confirmed to be the landfill, several solutions will be evaluated to reduce subsurface migration:

- Modification of the design or operation of the LFG collection system; and
- Installation of a low permeability barrier (i.e., cut-off wall).

Based on the evaluation, the appropriate contingency measure will be implemented.

SUPPORTING DOCUMENT LIST

- Ontario Ministry of Environment and Energy (MOEE), 1993. *Guidance Manual for Landfill Sites Receiving Municipal Waste*. November 1993.
- Ontario Ministry of Environment and Energy (MOEE), 1994a. *Incorporation of the Reasonable Use Concept into MOEE Groundwater Management Activities*. Guideline B-7. Revised April 1994.
- Ontario Ministry of Environment and Energy (MOEE), 1994b. *Engineered Facilities at Landfills that Receive Municipal and/or Non-Hazardous Wastes*. Guideline C-13. Revised April 1994.
- Ontario Ministry of Environment and Energy (MOEE), 1994c. *Water Management - Policies, Guidelines and Provincial Water Quality Objectives of the Ministry of Environment and Energy.* Procedure B-1-1. July 1994.
- Ontario Ministry of Natural Resources (MNR), 1990. *Environmental Guidelines for Access Roads and Water Crossings*. Queen's Printer for Ontario. 1990.
- Ontario Ministry of the Environment (MOE), January 2012. *Landfill Standards, A Guideline on The Regulatory and Approval Requirements for New or Expanding Landfilling Sites.*
- Ontario Ministry of the Environment (MOE) Version 1, December 2012. *Guide to Applying for an Environmental Compliance Approval*.

Drawings

(Under Separate Cover)

DRAWING 1	Existing Conditions
DRAWING 2	Proposed Site Plan and Final Contours
DRAWING 3	Base Contours and Leachate Collection System
DRAWING 4	Cell Development Sequence
DRAWING 5	Landfill Cross Sections
DRAWING 6	Sections and Details
DRAWING 7	Landfill Gas Collection System
DRAWING 8	Landfill Gas Collection System Details
DRAWING 9	Groundwater Monitoring Plan
DRAWING 10	Surface Water Monitoring Plan

Appendix A

Spills and Hazardous Materials Procedure

PUBLIC WORKS & TRANSPORTATION POLICIES AND PROCEDURES		
Subject:	**SPILLS AND HAZARDOUS MATERIALS**	
File in Section:	1.21.6	
Effective Date:		Page 1 of 4
ALL REVISIONS ARE MARKED BY AN ASTERISK (*)		Revision Date:
Approved By:		

PURPOSE:

The best method of avoiding spill incidents is by prevention. This plan provides a response mechanism for spills of oil and other hazardous materials on the premise of the Sackville Works Centre and Municipal Landfill Site.

Spills on any other locations are to be handled as outlined in the City Emergency Measures Plan.

IMMEDIATE RESPONSE

This plan is applicable to incidents involving accidental spills and discharge of hazardous gaseous, liquid or solid substances. The severity of the spill, which in itself can be controlled by nature and quantity of pollutant in the locality, will determine the level of response required. It is imperative that all spills and discharges of hazardous materials be immediately reported to the Fire Department. The Fire Department will call the agencies listed below as required.

Fire Department	949-3335
Emergency	9-1-1
Ministry of Environment (Spills Action Reporting)	1-800-268-6060
Emergency Measures	

ASSESSMENT OF SPILL MAGNITUDE

Before any effective action can be taken to remedy the effects of any kind of spill, it is necessary to make an assessment of the type of containment and the magnitude of the spill.

When a spill is reported, the Fire Department will be notified immediately and they will be responsible for notifying the appropriate officials. All reported spills will be investigated by responsible City and/or Ministry authorities as soon as it is practical to do so.

PHASES

There are three (3) phases to a spill response:

- Phase 1 Discovery and Notification
- Phase 2 Containment and Countermeasures
- Phase 3 Clean up and Disposal

PHASE 1 - DISCOVERY & NOTIFICATION

The notification of a spill could be received from many sources. The message will immediately be reported to the Fire Department. The Fire Department staff member receiving the report will solicit all the information possible.

The Fire Department staff member receiving the report will at once have the incident investigated by the Fire Department or appropriate authority depending on the circumstances.

PHASE 1 - DISCOVERY & NOTIFICATION - Cont'd

The Fire Department of Sault Ste. Marie is the local agency, which has equipment to respond to hazardous material spill, and every effort shall be made to contact that Department first before taking any action!

Note: Person means "individual, official, passerby, crew, etc.".

The person, upon arriving at the scene and appraising the situation, will report to the Fire Department, who in turn will report to the appropriate officials. This report should fall into one of the following categories:

Report	Action To Be Taken
1. No evidence of a spill	Note in report and inform all concerned
2. Minor problem; no further action to be taken	Note in report and inform all concerned
3. Action to be taken to contain or clean up with the following results:	
1. Satisfactory	Note in report and inform Fire Department
2. Unsatisfactory	In conjunction with the Ministry of the Environment and Fire Department, take the necessary action to ensure spill is cleaned up
3. Spill with No Action Taken	Implement Spill Contingency Plan as outlined in the Emergency Measures Plan for the City to contain and control the spill if the magnitude so warrants

Haz Mat'l Response Plan.

Response

The person calling in will give a verbal report. The Fire Department, having been notified by the receiver on duty and having arrived on site, will institute action procedures as required.

PHASE 2 - CONTAINMENT AND COUNTERMEASURES

a) Action to be taken during this phase will depend entirely on the type and extent of the problems encountered. The spill might be minor enough to be contained and cleaned up by personnel on site. It might be of major proportion necessitating the implementation of the City of Sault Ste. Marie Contingency Plan for Spills and other Hazardous Materials, or moderate enough to require something less than a full response by the City.

b) Fire Department personnel on the scene must, after assessing the situation, decide on the necessary countermeasures to be taken and see that these countermeasures are put in effect.

PHASE 2 - CONTAINMENT AND COUNTERMEASURES - Cont'd

c) UNDER NO CIRCUMSTANCES will the Department of Public Works and Transportation personnel employ chemical spill treating agents without the express authorization of the Ministry of the Environment, the Fire Chief, Deputy Chief or senior Fire Officer present, who are the only authorized authority for the deployment of such agents.

PHASE 3 - CLEAN UP AND DISPOSAL

This will normally be the responsibility of the Department of Public Works and Transportation under the direction of the Ministry of the Environment. The Fie Department may participate through direct arrangements with the Ministry of the Environment. If deemed necessary by the Fire Chief or his designate, the Fire Department will remain at the scene to provide whatever protection is required.

DISPOSAL METHODS

The method of disposal of contaminated absorbents such as earth, sandbags, bales of hay, etc., will be decided by the Ministry of the Environment in consultation with the Department of Public Works and Transportation.

SUMMARY

The response to a spill of any kind of hazardous material will be a joint effort of the Department of Public Works and Transportation, the Ministry of the Environment and the Fire Department. The Fire Department personnel first on the scene will make an assessment of the situation and take all necessary steps to ensure containment and eventual disposal of containment and clean up products is properly handled. Speed in making decisions is vital. City and Ministry personnel will work together as a team, both at the site and in the Emergency Operations Centre, if required. Additional support will be called in as necessary and the City's Emergency Plan will be put into effect if conditions warrant it.

The Emergency Operations Centre will be located at a site to be determined by the Fire Department or as stipulated in the Emergency Measures Plan for the City.

DEFINITION

Minor Spills

A minor spill is a discharge of oil or other hazardous materials.

Minor Spills - Cont'd

1. Of such magnitude in which the Department of Public Works and Transportation can utilize their own resources or the resources available to take the necessary measures to control, contain and clean up the material spilled.
2. Of such magnitude as to have no significant effects on fish, wildlife, plant or other living things.
3. Not likely to significantly effect or interfere with any private municipal, industrial, institutional or other water supply.
4. Of such a nature as not to generate public concern.

Moderate Spill

A moderate spill is a discharge of oil or other hazardous material.

1. Of such magnitude that it requires the resources under the City contingency plan to effectively contain and clean up the material.
2. Of a volume or type likely to present a significant hazard to fish, wildlife, plants or other living things.
3. Of such a nature that is likely to result in adverse effects or interferes with any private, municipal, industrial, institutional or other water supply within the immediate vicinity of the spill site.
4. Of such a nature as to generate public concern in the vicinity of the spill site.

Major Spill

A major spill is a discharge of oil or other hazardous material.

1. Of a magnitude requiring resources in addition to those available under the City contingency plan, or a spill, which gets out of control when action is being taken under the City Contingency Plan.
2. Which adversely effects or interferes with, or will adversely interfere or affect private, municipal, industrial, institutional or other water supply systems beyond the spill site.
3. Of such a nature as to present a hazard to human health.
4. Of such a nature as to have or most likely to have a serious effect on fish, wildlife, plants or other living things.
5. Of such a nature as to generate considerable public concern.

SCOPE

All employees of the Department of Public Works and Transportation.